DUPUYTREN'S DISEASE:

ANATOMY AND SURGICAL TREATMENT

VOLUME 1

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NOTRE DAME L'EVÊCHÉ ET LE CLOITRE

(1850)

PL. III.

Annexe de l'Hôtel Dieu — Pont au Double — Hôtel Dieu — Pont de l'Archevêché — Quai des Tournelles — Archevêché — Notre Dame — Jardin de l'Archevêché — Quai Napoléon — Pont de la Cité

NOTRE-DAME L'ÉVÊCHÉ ET LE CLOÎTRE

1830

From a lithograph purchased by the author in Paris 1985. The dating of 1830 has been validated from the architectural detail of Notre-Dame and the Quai des Tournelles. The Hôtel-Dieu is situated to the left of the Cathedral and connected to its Annexe by a bridge with a copper-roofed canopy.

Dupuytren described "Permanent Rétraction of the Fingers" in a surgical lecture at the Hôtel-Dieu in 1831. [Lithograph by Firmin Didot et Cie, Editeurs, Paris].

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To those whose advice in discussion has moulded my views. Professor Thomas Gibson did much to start this inquiry by disagreeing with my original hypotheses, now considerably modified, but encouraged me to continue to examine the distal palm. Dr. Robert McFarlane has provided constant stimulation to continue researching in this area of knowledge. Ideas on anatomy and treatment have been moulded by discussions with Mr. Douglas Lamb, Dr. Graham Lister, Prof. Dr. Dieter Buck-Gramcko, Prof. Hano Millesi, Mr. Graham Stack, Mr. Nicholas Barton and Mr. R. Guy Pulvertaft. All have provided encouragement for my anatomical studies.

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To the workers who will follow and modify these views.

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To my patients. To those whose treatment provided experience and to those who waited in the wings.

To the silent cohort who volunteered their last bequests to their fellow men.

I express my sincere gratitude.

DECLARATION

An account of the anatomy of the palmar fascial ligaments, (Chapter 10) was awarded The Pulvertaft Prize of the British Society for Surgery of the Hand and was published as "The Microanatomy of Dupuytren's Disease" in the Hand, 1982. This work has been republished in the monograph on "Dupuytren's Disease", edited by J. T. Hueston and R. Tubiana, and in the French edition "Maladie de Dupuytren". Dupuytren's Disease in the Thumb, (appendix 1), was a contribution by this author to "The Thumb" by D. Campbell Reid and D. A. McGrouther, published by Butterworths, London, 1986. Material from Chapter 7 was included in "Methods and Concepts in Hand Surgery", edited by R. Smith and N. Watson, and from Chapters 15 and 16 in "Principles of Hand Surgery", edited by F. D. Burke, D. A. McGrouther, P. Smith, Churchill Livingstone (in print). Further sections from Chapter 1, 4, 16, 17 and 18 are in preparation for "Dupuytren's Disease", a volume in "The Hand and Upper Limb" series published by Churchill Livingstone, the volume being jointly edited with R. M. McFarlane and M. Flint. All this material has been rewritten to ensure the continuity of scientific argument in this thesis.

Some of the clinical findings have been observed by the author in the patients of other surgeons (see acknowledgements).

The dissection of detailed areas on the dorsum of the pip joint has been performed by Dr. Penelope Law and reviewed and analysed jointly with this author. Detailed dissections of Cleland's ligaments have been undertaken jointly with Dr. Benita Walton who has also collected and analysed the operative records of this author's patients. Mr. David Elliot has unearthed numerous accounts from the 19th century and before.

All references have been personally consulted by the author, except where indicated in abstract form or where a historical record is attributed to a later author. The extensive and obscure nature of the historical accounts in English, French and German merits a separate indepth study which is being undertaken by David Elliot.

SUMMARY

The principal aim of this written account is to describe the evolution of a surgical approach to the treatment of Dupuytren's Disease based on current knowledge of pathogenesis and precise description of the anatomy.

The historical record of the life and works of Baron Guillaume Dupuytren, together with those of his contemporaries, pupils and critics have been reviewed to clarify the understanding of the condition at that time and to uncover wisdom which has been forgotten.

The disease process is considered by analysis of studies of incidence, aetiological factors, pathology and related fibromatous lesions.

Series of dissections of the palm and digits in fresh and preserved cadaveric hands have been performed to establish a new perspective on the micro-anatomy of the normal ligamentous components of the hand. The lesions of Dupuytren's Disease - palmar nodules, pits and cords, distortion of palmar creases and knuckle changes - have been examined by observations of clinical signs and operative dissections. New clinical signs - the "blanching" sign in the palm, and knuckle changes - have been described.

A new classification of operative interventions is described according to the approach to a) the skin, b) the fascia and c) the joints.

The operative experience and long term results, using an evolution of techniques, have been reviewed in a series of 100 patients.

Dupuytren's Disease is viewed as a process akin to wound healing which involves not only the palmar fascia, as described by Dupuytren, but many of the connective tissues of the hand including the dermis of the skin. The distribution of the pathological tissue is not random, but dictated by lines of tension or stress concentrations transmitted through certain anatomical pathways. Movement of the hand may be the stimulus to the propagation of the contracture once it has commenced. Treatment has been found to be generally not curative, but affording only temporary release. A less extensive and more precise operative approach has been developed. The values of minimal surgery and maximal rehabilitation are stressed.

Abbreviations

DC	Dupuytren's Contracture
DD	Dupuytren's Disease
mp	metacarpophalangeal joint
pip	proximal interphalangeal joint
dip	distal interphalangeal joint

INTRODUCTION

On 5th December 1831, Baron Guillaume Dupuytren, Chirurgien-en-chef at the Hotel-Dieu in Paris, delivered a lecture on the subject of "La Rétraction des Doigts". His attribution of this clinical phenomenon to an "affection" of the palmar fascia and his excellent description of the condition in clinical and post-mortem study has been rewarded by the adoption of his Eponym. Rarely in the history of surgical teaching has a single presentation received so much attention and given rise to such discussion and controversy.

Minor variations in the reporting of Dupuytren's leçon orale and in subsequent translations have caused much confusion in the historical record and have added to the uncertainty and mystery which surrounds the aetiology. Dupuytren's own impressions will be reviewed in this thesis.

The cause of this curious condition remains unknown, but there has been considerable progress in the past decade towards an understanding of aetiological factors. Epidemiological evidence is presently being expanded and the relationship to diseases occurring in association, such as diabetes or epilepsy, is being clarified. The basic cellular processes are under intense investigation in relation to the cells, collagen fibres and ground substance of the normal palmar fascia and of "Dupuytren's tissue". This literature will be reviewed.

It is the superimposition of the 'disease' process on the delicate, anatomical mechanisms of the palmar fascial ligamentous systems which disturbs the biomechanical function of the hand and leads to contracture. This thesis seeks to rationalise and expand the knowledge of anatomy of palmar and digital fascial structures both in relation to static morphology and dynamic function.

A new description of the palmar fascial ligamentous systems allows the lesions of Dupuytren's disease (nodules, pits, distortion of palmar creases, joint contractures) to be explained in mechanical terms. The criteria for diagnosing the condition and the clinical signs have been critically reviewed and expanded.

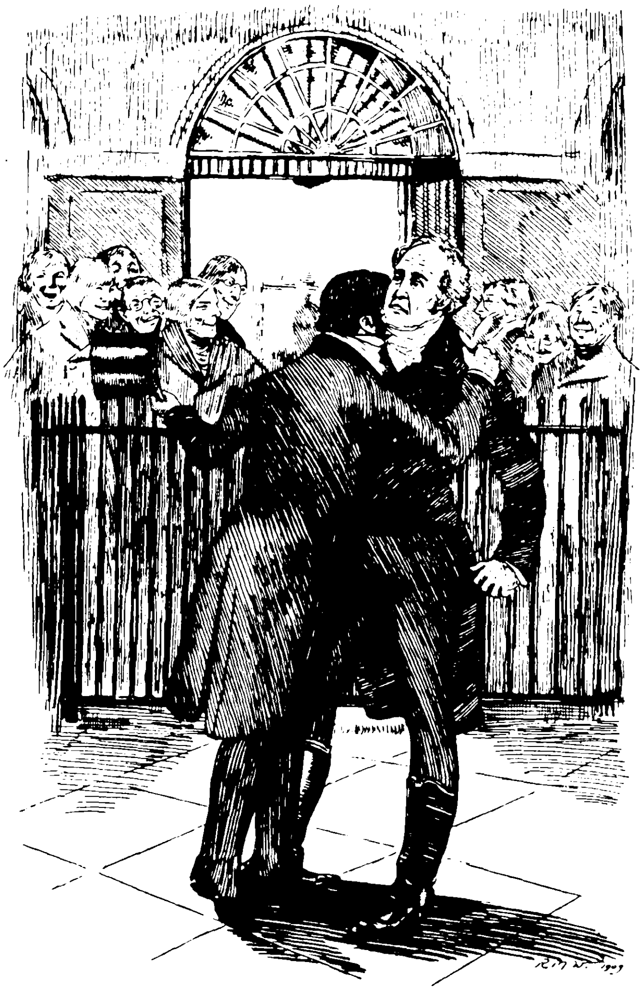
A better understanding of the nature and microanatomy of the disease allows an analysis of the widely varying surgical treatments available. The role of surgery in release, excision of fibroblastic foci or prophylaxis can be understood. Dupuytren's attribution of the cause of the contracture to the palmar fascia has, regrettably, focussed the major therapeutic attention on this layer. The lesions, however, involve not only the connective tissues of the hand, but also the skin and even the joints. The surgical treatments available have been classified according to their roles in tackling these 3 areas. A limited surgical approach to the treatment of Dupuytren's Disease has been derived by the author. The roles of rehabilitation and splintage have been analysed and modified.

La maladie de Dupuytren came to be known in English literature, (Lancet, 1834), as Dupuytren's Contracture. More recently it has been recognized that certain features of the condition (for example, palmar nodules may exist in the absence of finger contracture and the term "Dupuytren's Disease" has been adopted. There is no definite evidence, however, of a distinct disease process. Many of the phenomena can be explained on the basis of biological processes akin to wound healing. There is no specific test or unequivocal histological appearance and the diagnosis is therefore based on clinical features. Contractures of the palmar fascial ligamentous bands may represent the final common pathway of many different conditions.

For the purpose of analysis of epidemiological data and for a conformity of approach with the literature, the term Dupuytren's Disease will be used in this thesis.

I HISTORY

316 GUY'S HOSPITAL GAZETTE. AUGUST 7, 1909.



Episode for a Guy's Pageant.

"Sir Astley's fame was European, so that distinguished foreign surgeons never failed to visit him at the Hospital. We read of Dupuytren going round the wards with him . . . . . When he took leave he saluted the worthy baronet on each cheek. The manner in which Sir Astley submitted to the ceremony afforded no small amusement to the pupils standing round."—WILKS AND BETTANY'S HISTORY.

Fig 1.1 Visit of Baron Dupuytren at Guy's Hospital 1825. The cartoon published in 1909 omits the remainder of the Lancet (1826) description:- which was brightened by his observing "Well I am even with the Baron, for I saluted his daughter yesterday, when he was out of the way".

CHAPTER 1

THE LIFE AND TIMES OF BARON DUPUYTREN

"Regarding surgery in the true sense, we hesitate not to place the late Baron Dupuytren at the head of European surgery". Thus read a Lancet obituary (1835). The pre-eminence of Dupuytren's position and the power of his personality were such that much has been written on his life. Regrettably, many commentaries have been opinionated, critical or inaccurate by reason of their brevity.

A recent biography by Hannah K. Barsky (1984) has done much to weigh the balance of previous evidence. This thoroughly researched work cites many accounts from Dupuytren's times until the present day and contains an excellent bibliography. It is said of Mrs. Barsky (about the author, unattributed, p295) that "even a cursory investigation (of Baron Dupuytren) revealed a personality so complex and a life so richly varied that only a book would do justice to the man and the surgeon!". This commentary adequately portrays the difficulty of summing-up Dupuytren in a concise manner.

It is appropriate to summarise Mrs. Barsky's view of the life and times of Dupuytren to give a perspective to his report on contracture of the hand.

From a factual point of view, Guillaume Dupuytren was born and baptised on October 5th, 1777 - even this record is uncertain; he may have been born on October 4th, (Barsky, 1984) or October 3rd (Goldwyn, 1968). His birthplace was the family home, which still stands at Pierre-Buffière, 20Km South East of Limoges, in the departement of Haute-Vienne, part of the Limousin area which forms the Western buttress of the Massif Central.

Pronunciation of the disease which bears his name is today a source of confusion to patients internationally, but even in France the surname was unusual and presented difficulty to his own patients. His birth certificate bears the form Guilliaume Dupuytrein and a marginal note states that this was changed by court order in 1821 to the more familiar Guillaume Dupuytren.

The family origins lay in a hamlet west of Pierre-Buffière then called Le Puytrem, later Le Puytrein then Le Puytren. Puy denotes a crag, the site being on a height between two arms of the Aixette river.

Hannah Barsky discounts notions of Dupuytren's relatively humble origins (as suggested by Hueston, 1985a). He was descended from what she terms "solid bourgeois stock", a professional and property owning middle class. His father was a lawyer and barrister, his maternal grandfather a "squire", Lord of the Manor of Tranchepie, West of Pierre-Buffière. There was a family tradition of surgery and a paternal grandfather had served at the Hôtel-Dieu in Paris in 1743 where Guillaume was later to be Chirurgien-en-Chef.

The political upheaval of France in that historical era is expressed; "The acute want of his early student years was the consequence not of family destitution, but of social and political chaos: revolution at home, war abroad, blockaded ports, all brought desperate shortages and a shattering inflation". During the time that Dupuytren was a boarding school student in Paris at the Collège de la Marche, the revolution saw on August 10th, 1792, the storming of the Tuileries (Royal Residence); September 22nd, 1792, became the first day of the first year of the new Republic; on January 21st, 1793, the execution of King LouisXVI, and on September 15th, 1793, of Queen Marie Antoinette by the guillotine.

The turbulent Paris of the 1790's and the ensuing Napoleonic era provided a milieu for great change in Medicine and Surgery. This was a golden age when philosophy and practice took a great leap forward; many of the Paris school of that time have made lasting contributions.

It is interesting to speculate on the ingredients which brought together by circumstances will interact so dramatically as to produce a surge of advance across a broad front of knowledge. Such a change has happened in the Paris of Dupuytren, the Vienna of Bilroth and the Britain of Sir Harold Gillies. The patients needs are ever present, but are more dramatically expressed when drawn together in large numbers in time of plague, war, or revolution. Younger men must develop new philosophies from clinical, anatomical and laboratory experience and implant these on the "old order". The stimulation of competition, the drive to teach, to publish, and to inform must contribute. Such circumstances are evidence in Paris at the dawn of the 19th century.

Not long before Dupuytren's birth, Voltaire in 1768 wrote "You have in Paris a Hôtel-Dieu where external contagion reigns, where patients piled on top of each other bring one another pestilence and death". This enormous hospital on the Ile de la Cité had 1,110 beds, but a patient count of 3,418 was noted on one occasion. These terrible circumstances were greatly improved by an insistence on hygiene far in advance of an understanding of infection by Pierre Joseph Desault (1744-95), Chirurgien-en-Chef, and in his time the greatest surgeon and clinical teacher in France. A second great influence on medical practice at that time was Corvisart, who published in 1808 "Nouvelle méthode pour reconnaître les maladies internes de la poitrine par la percussion de cette cavité". (The diagnostic value of percussion of the chest: a new method). Reliance was on the laying on of hands as the stethoscope was not invented until 1819 by Laennec, a pupil of Dupuytren and Corvisart. This was an age of observation and documentation in the absence of investigative help, or even such simple ancillary aids as a clinical thermometer.

The third strong influence on Paris medical practice was Philippe Pinel (1745-1826), philosopher, theoretician and founder of the modern humane treatment of the insane. He transformed conditions at the infamous Salpetrière and the Bicêtre from "prisons" to mental hospitals. This triumvirate set the scene for medical practice in Paris. A fourth giant who influenced Dupuytren's career was Baron Cuvier, renowned comparative anatomist.

Notable amongst Dupuytren's teachers were Alexis Boyer, anatomist and surgeon, who was, in 1805, appointed official surgeon to the Emperor Napoleon and made a Baron. Boyer was Dupuytren's patron and he lived at the Boyer home for two years. Raphael Bienvenu Sabatier published "De la médecine opératoire" in 1796 (the distinction between medicine and surgery and physicians and surgeons was not clear at that time), and this publication was later revised in 1822-24 'sous les yeux de M. le Baron Dupuytren". Other teachers were Pierre Lassus, pathology; M. Lallement, surgery; Nicolas Louis Vauquelin, chemistry and the scientific methods of meticulous observation and recording; Edmé Jean Baptiste Bouillon-Lugrange, chemistry; Claude Berthélemy Jean Leclerc, physiology; François Chaussier, experimental physiology; M. Fourcroy, animal chemistry; Antoine Portal, internal pathology.

Dupuytren served as assistant to various professors; Vauquelin, Bouillon-Lagrange, Leclerc, Corvisart.

Dupuytren's most formidable rival was Marie François Xavier Bichat (1771-1802), who has been equated to John Hunter as a creative genius of the eighteenth century. His talents of invention and inspiration were applied to histology and physiology. He bridged a gap between the philosophies of Morgagni who held that diseases were located in individual organs (this was the generally held view at that time), and the later view of Virchow who located diseases in the cells. Bichat published a Traité des Membranes and located diseases in cell layers or membranes. He died young after a fall downstairs at the Hôtel-Dieu.

During the period 1802-1806, Dupuytren's work at the Hôtel-Dieu was primarily research and instruction; cadaveric dissections and animal experimentation. In 1806, he was appointed Chirurgien de Deuxième Classe and in 1808 Chirurgien Adjoint gradually assuming more of the clinical duties and operating from his senior Dr. Philippe Joseph Pelletan. In 1815, following the departure of Pelletan, he was appointed Chirurgien-en-Chef at just 38 years of age.

During his ascendancy, contemporaries, sometimes rivals, were Roux, Bayle, Laennec and Delpech. Those who knew him in his work for many years included Cruveilhier, Bourdon, Pariset, Vidal de Cassis or many who held internships or externships under him; Ménière, Bouillard, Royer-Collard. Marjolin was his adjunct surgeon. Breschet and Sanson were assistants.

The areas in which Dupuytren made contributions were many and varied. In 1826, he described congenital as distinct from accidental dislocations of the hip. He described fractures of the lower end of the fibula and devised a splint. He was the first to describe a distortion of the wrist which is now called Madelung's deformity. He performed the first resection of the lower jaw and the patient survived to attend Dupuytren's funeral some 20 years later. He was concerned with cerebral cases and psychiatric problems and gave a vivid account of the progressive symptomatic alterations in a case of fracture of the skull. He considered post-traumatic shock, and in 1832, produced a classification of burns into six categories by depth. He noted gastrointerstinal ulceration in burns ten years before Curling. He even entered into the field of dentistry with an 1833 Academy report on new instruments for tooth extraction. He made the observation that a round puncture wound becomes elongated to produce a slit-like wound in the skin and attributed this to the direction of the skin fibres. This original observation was acknowledged by Karl Langer who developed from this the lines for elective skin incision. Langer gave full credit to Dupuytren for the observation (Langer translated by T. Gibson, 1978). Of particular relevance to this thesis, he described the condition of "Permanent Retraction of the Digits".

Dupuytren lived and worked at a period of history where the modalities of surgical treatment were limited by lack of adequate anaesthesia, blood transfusion, or control of infection or shock. The pathology of disease was not understood. The Hall Mark of the scientific doctor of his era was the ability to carefully observe and record clinical signs and to correlate these with pathological anatomy to derive theories of pathogenesis. Communications were difficult, travel rare. Surgical textbooks were often written in Latin. New methods of distribution of information were developing with the foundation of scientific medical journals, the publication of new textbooks. It is perhaps Dupuytren's successful harnessing of the medical media that gave such a wide prominence to his views on contracture of the hand; his Leçons Orales were published in the first volume of a new journal. The Lancet article (1834) assured international dissemination of his views on this subject and the stamping of his mark on this condition.

He received many honours in his lifetime. Following an incident in 1820, when he attended the Duc de Berry, (son of the Duc d'Artois later to become King Charles X), stabbed in an assassination attempt. Louis XVIII conferred on Dupuytren the hereditary title of Baron in 1825.

Baron Alexander Von Humboldt (1769-1859), explorer, botanist and cartographer, campaigned successfully for Dupuytren's membership of the Institut de France. Dupuytren submitted theses on aneurysms complicating fractures and fire-arm wounds, ligature of the carotid artery and colostomy.

Fig 1.2 A Royal visit to the Hotel Dieu

Dupuytren presents to King Charles X a patient whom he has cured of cataract.

Musee Carnavalet, Paris.

Fig 1.3 Dupuytren one year before his death.

Faculte de Medicine, Paris.

Dupuytren's departure from the surgical scene was premature. On November 15th, 1833, when crossing the Pont Neuf, (walking to the Hôtel-Dieu), he was overcome by a momentary vertigo. Later that day he developed a facial weakness from what appears to have been a cerebral vascular accident. He requested three months leave of absence, during which time he visited Italy. His health deteriorated until he died on February 8th, 1835, after a lingering period of ill-health from empyema and renal calculi. He bequeathed his body to M.M. Broussais and Cruveilhier for post-mortem dissection.

Dupuytren's greatest talents were as a clear observer and thinker. He was not simply carried by a wave of advance, he was a major part of it. The writings of Malgaigne (1854 and 1856) have contributed greatly to a critical view of Dupuytren, particularly in relationships with Pelletan. Barsky visualises the relationship as a confrontation of two generations with Pelletan looking back towards out-moded pathological concepts, Dupuytren looking forward towards scientific observation.

Dupuytren made provision in his will for the erection of a bronze fountain in honour of his daughter Adeline at his birthplace Pierre-Buffière. Unfortunately, it was confiscated during the German occupation of the second World War. There is currently an international movement to replace this fountain, which is a measure of the respected position which Dupuytren holds even today.

CHAPTER 2

VARIOUS ACCOUNTS OF THE LECTURE AND OPERATIONS OF DUPUYTREN

There are numerous accounts attributed to Dupuytren which describe his lecture on contraction of the fingers (1831, 1832 (a) and (b) 1834). Of these, the most immediate account is that reported in Journal Universel et Hebdomadaire de Médecine et de Chirurgie Pratiques et des Institutions Medicales, in 1831; entitled "De la rétraction des doigts par suite d'une affection de l'aponévrose palmaire - Description de la maladie - Opération chirurgicale qui convient dans de Cas". This article is reported by MM les Docteurs Alexandre Paillard and Mardochée (Adolphe) Marx. Thus prepared by two of Dupuytren's most loyal assistants, this account is full of enthusiastic praise and admiration for Dupuytren. There is a warmth of personality and enjoyment of the treatise implicit in the style of reporting. This contrasts with the 1832 (a) report (Leçons Orales); entitled "Rétraction Permanente des Doigts. Par suite d'une affection de l'aponévrose palmaire". The term "permanente" seems to have been introduced between 1831 and 1832. This latter account portrays Dupuytren in a more formal and somewhat critical light.

The 1831 account describes a lecture in the surgical clinic on 5th December 1831. The lecture is described by the authors as "Un veritable Mémoire" and "un sujet entierement neuf". They describe a disease, or maladie, generally regarded as incurable and present their report _in the words of Professor Dupuytren_. It does appear to be the most immediate reporting of the lecture and is therefore likely to be the most accurate account. It is significant that the Leçons Orales" account of 1832 is shorter and the order of presentation of information is quite different from the 1831 article. In addition, Leçons Orales makes no mention of its authors. This latter account commences with a fairly factual reporting. It is significant that Boyer is mentioned in the first paragraph with a description of "Crispatura tendinum" (Tendinous contracture). There may be political significance in the introduction of Boyer's account at such an early stage in the article.

Boyer (1826) had in fact ascribed the term crispatura tendinum to others; "quelques auteurs". He made other interesting observations. The condition was a disease of old age, never found in young subjects. The digits became flexed little by little and he believed the flexor tendons raised the skin in transverse folds. He stated "On a donné le nom de _contracture_". Boyer's account therefore pre-dated Dupuytren by five years and perhaps influenced the changes between Dupuytren's 1831 and 1832 reports.

The introduction (1831) to Dupuytren's speech has been much quoted:-
"Je ne vous parlerai aujourd'hui que d'un seul malade et d'une seule maladie" (I shall speak to you today of a single patient and a single disease). The coachman Demarteau was only 40 years of age (described as cocher de fiacre, hackney carriage) and yet he had a three finger retraction of both hands of several years duration; this suggests a very severe Dupuytren's Contracture. The fingers were noted to make a right angle with the palm of the hand. There are references to illustrations, but these are not available in any of the accounts. Dupuytren stated that he had seen 30 or 40 retractions of this type in 20 years. He made a reference to previous literature as follows:-
"du moins, je les ai vainement cherchés dans les auteurs qui ont écrit sur les maladies de la main. Il est vrai que ma vie, presque toute employée à agir, ne m'a, peut-être, pas permis de faire sur ce sujet, des recherches assex approfondies; loin d'être affligé qu'on pût trouver dans les écrits de ceux qui nous ont précédés, quelques indications de ce que je vais dire, je m'en réjouirai, au contraire, car ces indications seraient une utile confirmation de ce que j'ai observé".
(I have searched in vain amongst authors who have

written on diseases of the hand. It is true that my life, being almost completely devoted to hard labour has perhaps not allowed me to make sufficiently profound searches on this subject; for from being distressed that one might find in the writings of those who preceeded us some indications of that which I am about to recount, I would rejoice, on the contrary, as such indications would be useful confirmation of what I have observed).

This polite, apologetic recognition of previous literature contrasts with the account in Lecons Orales:- "Peut-être, dit M. Dupuytren", en faisant des recherches, en trouvera-on quelques descriptions dans les auteurs; mais ma vie, entièrement consacrée à agir, ne m'a paspermis de les faire toutes, et je serai heureux d'apprendre que ceux qui m'ont devance, et qui ont écrit sur cette maladie, ont trouvé la cause et les moyens à employer pour la guérir". (Perhaps in making searches one would find a description in the literature, but my life, being entirely devoted to work, does not allow me to do so, and I would be happy to learn that those who preceeded me and who have written on this disease have found the cause and the means of treatment). This latter account gives the impression of Baron Dupuytren being rather more supercilious and there is the impression that the reporter did not have the greatest of respect for the Baron.

To return to the 1831 account this continues - He believed the contracture to be the result of no preceding disease. He believed occupational trauma to be of importance. He described "un appui sur sa paume", (pressure on his palm), in relation to the coachman Demarteau. He suggested use of his whip "pour hater la lenteur de deux mauvais chevaux" (to speed two poor horses). The Leçons Orales account reports this as "de faire jouer sas cesse son fouet sur le dos de ses haridelles" (to play his whip ceaselessly on the backs of his jaded horses!!!). Dupuytren describes le marchand de vin, on whom he had operated, "le manche de ce poincon contondait fortement la paume de la main" (Lecons Orales, "de percer des barriques"). These forms of pressure were considered significant. Dupuytren also reports "un homme de cabninet - pressait tres fortement" on the palm of the hand. He had also noticed the disease in stonemasons and: "autre personnes obligees de soulever depesants fardeaux" (those required to lift heavy weights). The 1832 account also mentions "les cultivateurs". In summary, Dupuytren considered "des contusions plus ou moins fortes et repetees" to be significant.

He described the presentation. The ring finger is generally involved. There is a gradual loss of extension and a cord develops, which is apparent on extension, but relaxed on digital flexion. Digital flexion is not inhibited. He described the terminations of the cord and the way in which the skin forms folds (plicatures). He noted that the joints had no trace of ankylosis and that the fingers could not be straightened by traction on the digit by a heavy weight of even 150 livres (pounds). The 1831 article suggests the contracture to be painless, but pain on gripping is described in 1832.

"Quel est le siege, et quelle est la cause de cette singuliere affection? Cela est important a determiner pour asseoir son traitement sur des bases solides". Thus Dupuytren understood that rational treatment would require an understanding of the aetiology. He felt that the skin was not the primary cause of the disease. He discussed the supposed aetiologies of flexor tendon spasm, tendon contractures or joint disease, a gouty affliction, an inflammation or adherence of the "cellular tissue".

The Lecons Orales account described use of the machine of Lacroix. This may be a reporting error for Delacroix, 1808) in an attempt to treat the finger conservatively. Dupuytren believed Crispatura tendinum (literally, tendon shrivelling or contracture) to be nearer the truth than any other, if one transferred the pathology of "la Crispature" to parts other than the tendons.

He described a hand which he dissected. The extent of the contracture was very similar to that of the coachman, "j'ai fait representer, couche par couche, une main affectee de retraction, depuis la peau jusqu'aux os". On dissection, the elevated skin became soft and supple. The skin "n'etaient pour rien", "je commencai a soupconner que l'aponevrose palmaire pouvait etre pour quelque chose dans cette maladie". On cutting the flexor tendons the contracture persisted. He concluded that the palmar aponeurosis was the sole cause of retraction. Dupuytren reported that this maladie was generally considered to be incurable. He described the many remedies which had been used. He described two patients in whom he had undertaken division of the flexor tendons. In one, there was a life-threatening infection and in the other no amelioration of contracture. A M. Bennati brought to him a patient who had previously consulted Mr. Astley Cooper. The 1832 account misspells Astley Cooper and also presents a different spelling of the patient's name Ferari. M. Ferari is reported in 1831 as a "maitre de piano" and "la retraction l'avait force a cesser l'exercice de sa profession". In summary, he concluded that the retraction was due to "la crispation de l'aponevrose palmaire". He suggested as a solution to cut transversely the "brides" or fascial bundles. The occasion to do this presented itself. He recounts Dr. Mailly's account of an operation which he performed in June 1831.

There followed an account of the operation on M.L..... which Dr. Mailly had taken care to reproduce. It seems that the Baron was reading from a clinical document, possible a ledger, as all operation notes were preserved in this form at the Hôtel Dieu.

The "marchand de vins en gros" (Wholesale Wine Merchant) had described an incident in 1811 when in trying to lift a barrel, he placed his left hand under the rim and felt a crack and a slight pain within the palm. For some time following he felt discomfort and stiffness in the same hand. Later he realised that the ring finger was beginning to contract. This condition progressed until he presented in 1831 with contractures of the ring and little fingers. M. Boyer had then advised the patient to put himself entirely in the hands of M. Dupuytren.

An operation was arranged for the 12th June. Dupuytren was assisted by M. Mailly and M. Marx. The following translation has been made by David Gault. "The patient's hand was firmly fixed and a transverse incision was made at the level of the metacarpal joint of the ring finger. The scalpel divided first the skin then the palmar aponeurosis with an audible snap. Hardly had the incision been made than the ring finger had straightened out and could be extended almost as easily as in the normal state. To avoid the pain of a second incision M. Dupuytren tried to extend the division of the aponeurosis by sliding the lancet transversely under the skin toward the ulnar side of the hand in an attempt to free the little finger, but this was in vain. He could only partially divide the aponeurosis and the little finger was not improved. Consequently he decided to make a fresh transverse incision at the level of the pip joint of the little finger, and in this way the tip of the finger was released from the palm of the hand, but the rest was still firmly stuck down towards the palm. Then a second divided the skin and aponeurosis at the level of the corresponding metacarpophalangeal joint. A little freeing of the finger was obtained, but the result was incomplete. Finally, a third incision was made transversely at the level of the proximal phalanx itself and straight away the little finger could be extended with the greatest ease: one could think that this last incision was made at the point of insertion of the branch of the aponeurosis. A trickle of blood, little considering, came from the incisions. The wound was dressed with dry gauze; the little and ring fingers were secured in extension with the help of an appropriate apparatus fixed to the back of the hand".

The initial post-operative splint was tight and uncomfortable and replaced by "one more skilfully constructed by Lacroix" on the 14th, i.e. second post-operative day. Swelling, presumably due to infection, increased and the hand was sprayed with a solution of lead acetate in cold water. Pain, swelling and tenderness persisted for a few days. "The wounds scarred over slowly, really because the forced extension maintained the wound edges apart deliberately. The healing was complete in all wounds by the 2nd July (20 post-operative days)". "The wounds closed successively. First to heal was that of the pip joint of the ring finger. Second that which was made over the proximal phalanx, thirdly that related to the mcp joint of the little finger and finally that related to the mcp joint of the ring finger - the incision that was made first".

The patient used the splint for almost a month: "at this time the patient could easily flex his fingers when the apparatus was removed". Thereafter he wore the splint at night. "The disease presents in many forms". 'If one examines the anatomy of the involved tissues, it is apparent that the skin blends intimately with the palmar aponeurosis bonded by dense cellular tissue that is both fibrous and tight and in which there is little fat. The skin folds are formed when the aponeurosis retracts. The four bundles of aponeurosis extend in to the palmar surface of the proximal phalanges and insert into the deep transverse metacarpal ligament after forking in to allow the flexor tendons to pass beneath. This is the tissue that must be cut to restore free movement to the fingers. However, in this region the vessels and nerves which travel to the fingers are found and they must not be cut. Fortunately, when the fingers retract these small tongues of fibrous tissue form a type of bridge beneath which the vessels and nerves pass. These leave enough room to permit the incisions required without risk".

Thereafter M. Dupuytren proceeded to operate on the coachman's right hand only. A transverse crease incision was made. "Another transverse incision was made one and a quarter thumb widths from the first deeper in the palm" (? distal) "to divide the digital prolongations. Straight after this the ring and little fingers returned to take-up, almost entirely, their resting position". He concluded with the comment that the retraction was due to the palmar aponeurosis and especially the prolongations that are sent to the base of the fingers. "I call these observations in all sincerity '<u>tiny paths</u>' to be subject to scrutiny, because it is my sincere wish to benefit humanity to which I pledge my attention and power". M. Dupuytren concluded by stating that should the situation arise, he would speak on retraction of the plantar fascia.

The Lecons Orales account of the first operation of M. Dupuytren varies little from the above.

There is a reference to an anatomical thesis by Alex Paillard - Traite des aponevroses, suivi de considerations chirurugicales, Paris, 1807, indicating that one of Dupuytren's assistants had written on this subject. The four distal slips of the palmar aponeurosis are described. It is emphasized that these slips bifurcate to insert into the sides of the phalanges. The palmar aponeurosis is reported to be well developed in birds.

The near correspondence of the two accounts in relation to the first operation may be attributable to both being derived from M. Mailly's written account. In the account of the operation on the coachman Lecons Orales points out that the operation was performed with the patient seated on a chair. Dupuytren took his right hand and moved the subject's digit passively demonstrating the tension in the aponeurosis. Then with a curved knife he made the incisions previously described. "Le malade s'etant trouve tres faible, M. Dupuytren a remis a un autre jour l'operation de la main gauche".

These accounts together illustrate many common features and indicates Dupuytren's profound awareness of aetiology, case selection, treatment and aftercare. In particular, he appreciated the difficulty in releasing the pip joint, especially in the little finger, and the need for multiple releases. It has not been previously appreciated that Dupuytren made one incision to release the Wine Merchant's ring finger, but three to release the little finger. His meticulous dressing and splintage technique has often been neglected as a vital part of the treatment programme.

It is interesting that he maintained a splint in position except apparently for exercise periods until his 'open palm' wounds had healed. Thereafter he used a night splint for a prolonged period of at least a month - a regime which is currently coming back into vogue. He seems to have been aware also of the benefit of active mobilisation. It is his attribution of the contracture to the palmar fascia which is often held to be his major contribution to knowledge on this subject. He was well aware of the intimate relationship to the overlying skin however and of the distal prolongation of the palmar fascia to the digits and much too simplistic a view of his understanding of the condition has often been taken.

CHAPTER 3

SURGICAL TREATMENT IN THE 19TH CENTURY

Nineteenth century treatment must be reviewed against the background of the knowledge and facilities of that time. Only a patient with much to gain would consider treatment. The patient Ferari seen by Baron Dupuytren was described as a maître de piano who was unable to perform his profession - the fact that this Italian musician had consulted both Sir Astley Cooper and Baron Dupuytren reflects his strong desire to try to obtain release.

In the early part of the century, operations were performed without anaesthesia or tourniquet and only the most limited dissection was possible. With no precise haemostasis and without an appreciation of the seeds of infection much reliance was placed on operative speed and dressings technique. By contrast, post-operative splintage was ingenious and highly developed. Dupuytren refers to an extension splint of Lacrois. It has not been possible to find a record of this, but almost certainly a publication by Delacroix (1808) refers to a similar instrument (see Fig. 3.1).

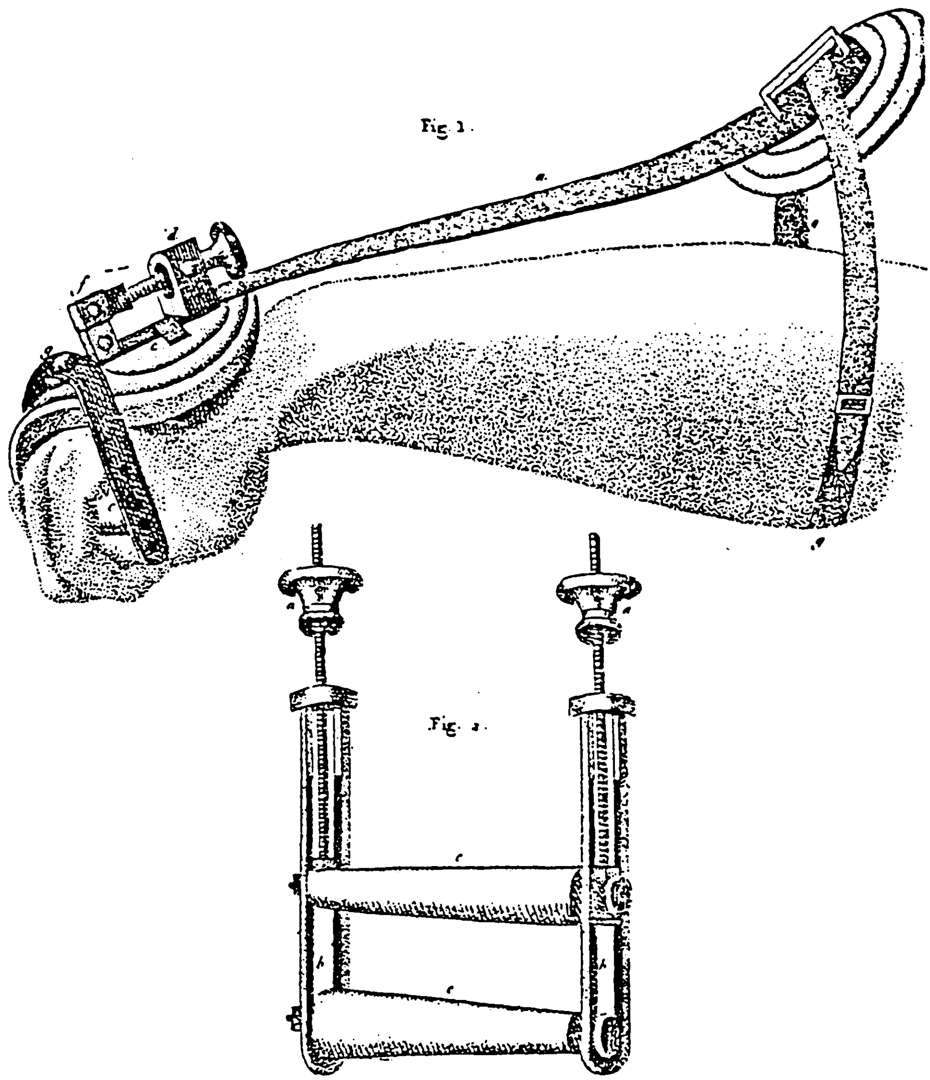


Fig. 3.1 Splint of Delacroix (1808).

Used for application to a flexion contracture (?Radial Nerve Palsy). The splint used for DC was probably similar.

Baron Dupuytren (1831) alluded to the belief current in his time that the disease was incurable. It is of very great significance that he appreciated the need for case selection prior to operation, of operative technique and of a specific post-operative rehabilitation programme. This wisdom has been forgotten many times in the past 150 years as surgeons have come to place too much emphasis on the operative technique alone.

Dupuytren was unaware that Henry Cline, Senior, had conceived a similar operation in the year of his birth 1777, (Cline, 1777 = Elliot, unpublished information) and that Henry Cline, Junior, had performed such procedures around 1807 (Lecture 1808, described by Windsor, 1834).

Astley Cooper described release of contracted fingers and toes in his book of 1822: "fingers are sometimes contracted in a similar manner by a chronic inflammation of the thecae and aponeurosis of the palm of the hand from excessive action of the hand in the use of the hammer, the oar, plowing etc. When the thecae are contracted nothing should be attempted for the patient's relief, as no operation or other means will succeed; but when the aponeurosis is the cause of the contraction, and the contracted band is narrow, it may with advantage be divided by a pointed bistoury introduced through a very small wound in the integument. The finger is then extended, and a splint is applied to preserve it in the straight position". It seems therefore that Cooper used fasciotomy in selected cases.

Very little more has been said of hammer toes as an associated condition since that time.

Goyrand (1833 & 1835) suggested longitudinal incisions over the fascial bands (abnormal fibrous fasciculi) which he then divided transversely. The wound was closed and extension applied.

Caesar Hawkins published in 1835 a case of Dupuytren's Contracture affecting the little and ring fingers of the left hand in a man of 30 years of age admitted into St. George's Hospital. This was treated by the open wound technique of Dupuytren. He considered subcutaneous operation in 1844, but decided against this as he wanted "no confinement of matter". He used a post-operative extension technique to separate the ends "while the united substance is still soft".

Dr. Otto W. Madelung (1875) has reported an account of Dupuytren's Contracture treated in the surgical hospital at Bonn by Professor Busch. A distally based triangular flap is elevated and the contracted fascia divided. "The healing of the wound, accelerated perhaps by skin grafting, is accomplished in three or four weeks". Adams (1874) tried this method and, "not withstanding the use of Lister's antiseptic treatment", (his techniques were certainly up-to-date!), suppuration with sloughing of the flexor tendon took place. The author would anticipate a high rate of skin necrosis with a flap of this design.

A view of management in the U.S.A. at that time is provided by Adams (1979). Dr. Alfred C. Post of New York operated by the open wound technique and William Adams visited him in 1876. Adams describes discussion of the treatment of this condition with Professor Post. "That portion of the cord at which close adhesions of the skin exist, being thus isolated and freed from tension, undergoes a gradual process of atrophy and absorption, just as all the knotty cutaneous thickenings do after the subcutaneous division of the fascial bands". This spontaneous resolution of contracted tissue left in situ is a most important observation.

Sir William Fergusson (1862) alluded to the operation by open wound as "likely to obviate the disposition to recontraction". "I should be inclined to dissect a portion of it out at once". it seems that William Fergusson was an early advocate of fasciectomy.

A magnificent scientific account of observations on contraction of the fingers was published by William Adams (1879) (also 1878, 1884, 1890) surgeon to the Great Northern Hospital in London. The breadth and depth of his knowledge on this subject, and his style of prose, are so modern that it is difficult to believe that this publication is more than one century old. It is an indictment of those who followed him that so much of this knowledge has been neglected for more than one century. Adams presented an extensive review of previous surgical experience and then reported his own operative approach (Fig. 3.2). He condemned all operations by open wound as "unnecessarily severe - involving a long and tedious reparative process, with the risk of suppurative inflammation, and also a liability to failure, in which event the condition of the patient would be worse than before the operation, contraction from cicatrix being one of the most difficult conditions to relieve. The great advantage of subcutaneous operations was the supposed immunity from inflammation. John Hunter, in 1794 in his treatise on the blood, inflammation and gunshot wounds, had described the difference in the healing of wounds depending in the exposure or non exposure to air. Adams advised multiple subcutaneous division of the fascia and its digital prolongations and attributed the technique to Jules Guerin (1841 - a report published in 1842 has

Figs. 21 and 22.—Right and left hand of a medical man about 50 years of age, showing in the right hand a severe degree of contraction in the little finger, from which a prominent fascial cord passed towards the palm of the hand, the skin of which was puckered and thickened, and its cavity appeared to be deepened by some contraction of the other fingers, as well as the thumb, which was drawn towards the palm.

In the left hand the contraction was chiefly limited to the ring-finger, but extended in a moderate degree to the middle finger, the little finger not being at all involved. The skin in the palm of the hand was thrown into thick puckered folds, and the thumb was in some degree drawn towards the palm of the hand. This gentleman is of gouty diathesis, and the contraction, which had existed for many years, was steadily increasing. I commenced the treatment of this case by operating on the little finger of the right hand, but he was obliged to leave London for the North of England, where he resides, on the day of the operation, and as the immediate extension principle could not be fully carried out, the extension had to be made gradually by the instrument represented in Fig. 10. Although the treatment could not be carried out in this case in consequence of the pressure of professional engagements, there can be no doubt that the case, although one of great severity, is one admitting of further improvement. Drawings taken from photographs.

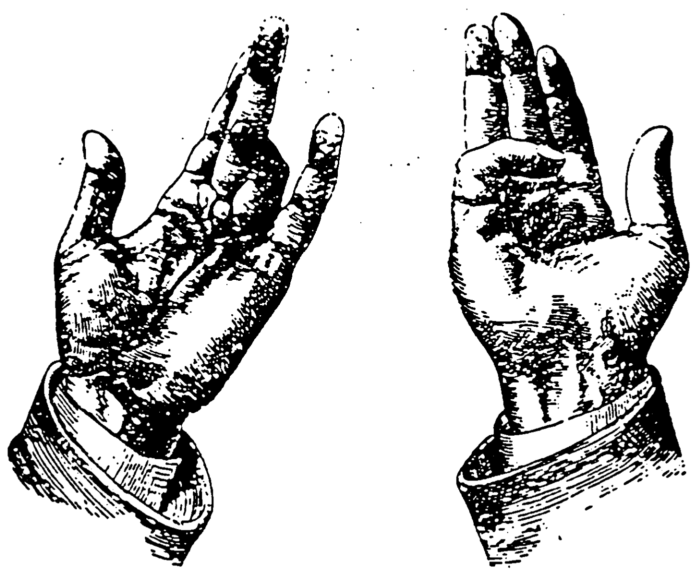


Fig. 3.2 Adams (1879) appreciated the need for patient compliance with the post-operative splintage regime.

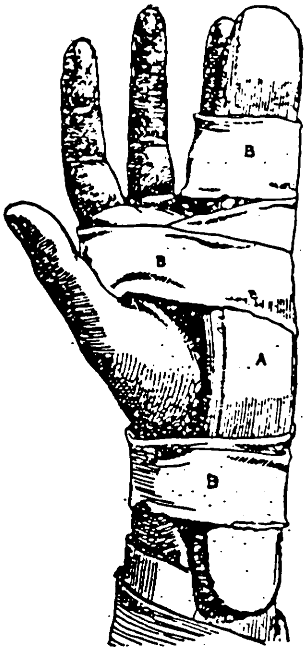


Fig. 6.—A. Retentive metal splint, softly padded, to which fingers and hand are bandaged B, immediately after operation.

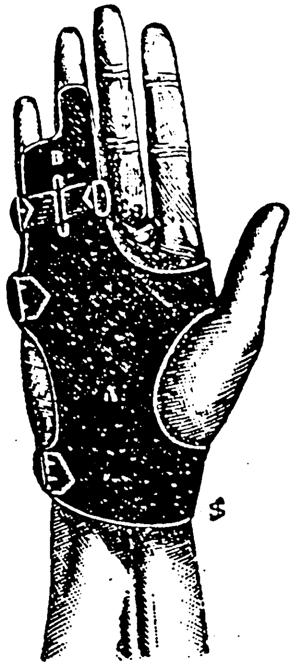


Fig. 7.—A. Retentive metal splint, applied on palmar surface of hand and fingers, B, which are fastened to it by straps. To be applied fourth day after operation.
Fig. 8.—A. Retentive metal splint, applied along back of hand and fingers, B, which are fastened to it by straps; sometimes preferred to splint applied on palmar aspect of hand, Fig. 7. To be applied fourth day after operation.

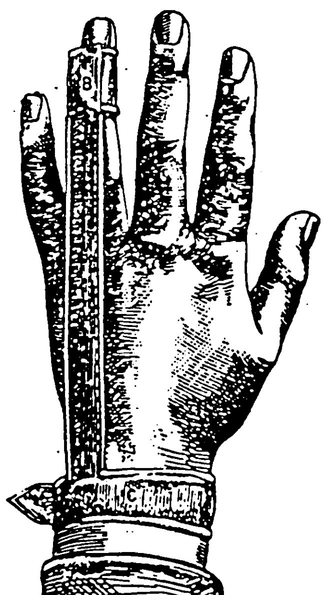


Fig. 9.—A. Another simple form of retentive metal splint, applied on dorsal aspect of hand and finger, the tip of which is received into leather ring B., fastened round the wrist C. Useful in some cases, and easily applied at night.

Fig. 3.3 Splints. Adams (1879).

been found). He thought it advisable to confine the operation to one or two fingers. He made the first puncture "at the greatest distance from the finger in the palm of the hand between the transverse crease and the annular ligament". The second puncture was made "between the transverse crease and the web of the fingers". The third and fourth punctures were made at the bifurcation of the cutaneous web between the fingers. As the fascia knife was withdrawn, pressure with the fourth finger of the other hand was placed on the wound to arrest haemorrhage. The hand was bandaged in the extended position. Adams had previously used a policy of gradual extension, but later reverted to immediate extension at the time of operation, the object being to "widen, as quickly as possible, the gaps made by the incisions in the fascia with the view of preventing union of the divided fascia, or to have the union as feeble as possible". Immediate extension, however, could not always be carried out, more especially in those cases in which "the second phalanx was sharply flexed upon the first". He used a variety of post-operative splints applied to the palmar or dorsal surfaces of the hand (Fig. 3.3). His patients were advised to wear the splint for a considerable time at night and continuously for three weeks after operation. He states that "the finger or fingers will appear to be perfectly straight at the end of the first week, when the immediate extension principle is successful, but unless the extension be maintained during the reparative process so as to keep the divided extremities of the fascia as far apart as possible, they might re-unite and the finger again become drawn down". Where immediate extension was not possible, he used a rack and pinion type of splint. Perhaps one of his greatest contributions is the discussion of the type of anaesthetics - he valued ether general anaesthesia - as the operation must necessarily be done slowly and very carefully. He did, however, use local ether spray when operating on colleagues. Relapse of the contracture was, he believed, guarded against by the plan of dividing all the contracted bands. These insights into the condition were far ahead of his time.

It seems therefore that the 19th century literature extensively described various approaches to the disease, Dupuytren advocating an open fasciotomy, Cooper and Adams a closed fasciotomy and Goyrand and Fergusson the desirability of fasciectomy.

Many of todays arguments have been fought for much longer than the present generation of surgeons appreciate.

More will be said on individual reports on Discussion of Operative Treatment (Chapter 16 & 17).

II DUPUYTREN'S DISEASE

CHAPTER 4

EPIDEMIOLOGY: OBSERVATIONS ON CLINICAL DIAGNOSIS

Despite his enormous clinical commitment, Dupuytren (1831) had observed only 30 or 40 contractures of the hand suggesting a relatively uncommon occurrence. To establish the true incidence of this condition population studies rather than surgeons impressions are necessary. Mikkelsen (1976) has emphasized that those patients who present for surgery are a highly selected group; of the patients in his study who had contractions of such an extent that surgery was advisable, less than one in four had been operated upon. This is in keeping with the authors experience of seeing many patients in the community with severe Dupuytren's Contractures who have not sought medical advice.

The recognition of DD has generally been taken for granted; it is much more difficult than it may appear. There is little confusion in the well developed case, at the stage when the patient frequently presents for treatment; in epidemiological surveys however the minor signs are difficult to distinguish from the normal hand with thick skin or prominent fascia. These minor signs challenge even the most experienced observer to establish with certainty just what exactly does constitute DD. It is of little help to the examiner that in the epidemiology of this "Maladie" the diagnosis must be made on clinical signs alone, there being no ancillary tests available.

From the experience of practice in an area where DD is endemic, there is found to be a spectrum of clinical appearances in the hands of the local population from "normal" through minor and equivocal signs to frank joint contracture. It can readily be appreciated that the precise point at which a positive diagnosis of DD is made in a study group will alter considerably the reported incidence. It is therefore important to consider how the early or minimal signs may be recognized, quantitated and recorded.

Lund (1941) divided the disease into different degrees and recognized as the earliest stage a "simple nodular or banded thickening of fascia". Skoog (1948) considered there to be "generally no difficulty" in making the diagnosis of DD which was based on a "pathognomonic nodular thickening and retraction of the palmar aponeurosis". Early (1962) also found the diagnosis to be readily made on inspection and palpation of the palm and fingers; the earliest stage being the presence of a nodule without finger contracture (stage 0). The "nodule" had come to acquire an identity.

The emphasis on the nodule was no doubt reinforced by the work of Luck (1959) who visualised this as the "powerhouse" of the contracture. Hueston (1963) defined the accepted sign of DD as "A thickening in the palm fixed to the palmar fascia, either localised as a nodule or extending as a plaque or band to the fingers". He believed that this definition served to widen the scope of the diagnosis and to increase the incidence in comparison with previous reports which had concentrated on contracture. He specifically excluded paralysed hands where he considered that atrophy of fat and intrinsic muscles had rendered prominent the bands of the aponeurosis and additionally considered hands in which passive extension rendered the fascia palpable to be a variant of normal. Ling (1963) in examining the families of Dupuytren's patients reported that"Although it might be felt that the diagnosis of DD presents no difficulty, in fact, in a number of relatives it was hard to be certain whether or not it was present". He took the decision not to include cases with a doubtful diagnosis but despite excluding patients with bands alone - nodules fixed to the palmar fascia with or without dimpling were regarded as essential for the diagnosis - he found 68% of patients to have affected relatives. This incidence may have been higher with wider criteria of diagnosis. By contrast he accepted significant knuckle pads, even in the absence of palmar signs, as a sign of DD and many authors would disagree

(Mikkelsen, 1972). In the largest and most authoritative study available of a general population group, Mikkelsen has based his diagnosis on the nodule, and considered it distinguishable from "ordinary occupational indurations". Bands and contractures have served to provide "further confirmation". He recognized the diagnostic problem of an extremely small nodule and excluded a few doubtful cases.

There has been a gradual evolution of perception of this curious malady and even a change of name from Dupuytren's Contracture to Dupuytren's Disease. Parallel with this has been a recognition of earlier manifestations. Noble, Heathcote and Cohen (1984) have included "tethering" or a pretendinous band as definite indicators, in addition to the more usually accepted features; nodule or digital contracture. In a pilot study of diabetic patients an 18% incidence of DD was noted on examination by a physician but this rose to 42% when the same hands were examined by an orthopaedic surgeon. It seems therefore that incidence depends very much on diagnostic criteria, and how widely one chooses to cast the net.

A discussion of the individual diagnostic features is appropriate to establish their relevance in hand contracture in general. Firstly, however, we must characterise and define what is the contracture of Dupuytren?

The Baron used the term "Retraction des doigts" (literally, retraction of fingers) which was rapidly translated in the Lancet (1834) as "Contracture", a term which is somewhat ambiguous, being capable of describing the posture of the digit or the state of the fascia. The more imprecise terms Dupuytren's Disease, Maladie de Dupuytren and Morbus Dupuytren have become more popular. The underlying pathological process however appears to involve a fibrous contracture of the fascial skeleton of the hand resulting in retraction of any of its attachments. Clinical examination should therefore be aimed at eliciting signs which detect any evidence of contracture within the fibrous tissues of the hand. At operation the surface signs frequently underestimate the extent of the pathological changes.

A potential difficulty in making the diagnosis in epidemiological studies is that the diagnosis is made at one point in time. More information is needed on the natural history of DD.

The individual clinical signs found in DD are summarised in Table I and will be discussed in order; nodules, skin changes, signs detectable in the subcutaneous fascia and fat, joint changes, and signs related to involvement of other anatomical structures within the hand. Associated fibromatous conditions outwith the hand - plantar fasciitis or Peyronie's disease - lend strong support to the diagnosis. The descriptive term "ectopic" for these conditions has been avoided since it mistakenly implies that DD is a fibromatosis properly confined to the palm whereas it should be considered as a much more generalised condition.

The Nodule

The nodule has been hailed as the essential lesion, pathognomonic of DD (Meyerding et al, 1936; Luck, 1959; Hueston, 1963; Skoog, 1963). The pathogenesis of the clinical nodule must be appreciated (Chapter 10 and Fig. 4.1) reflecting either a bunching up of skin or possibly the deposition of new cellular masses outside the confines of the original fascial ligamentous framework and either displacing or replacing fat.

The examining finger, although possessing the skill of tactile gnosis, does not have "histological gnosis" and any palpable change in texture of the tissues will be interpreted as a nodule. It should be appreciated that the nodule is a less well defined clinical entity than we have come to believe.

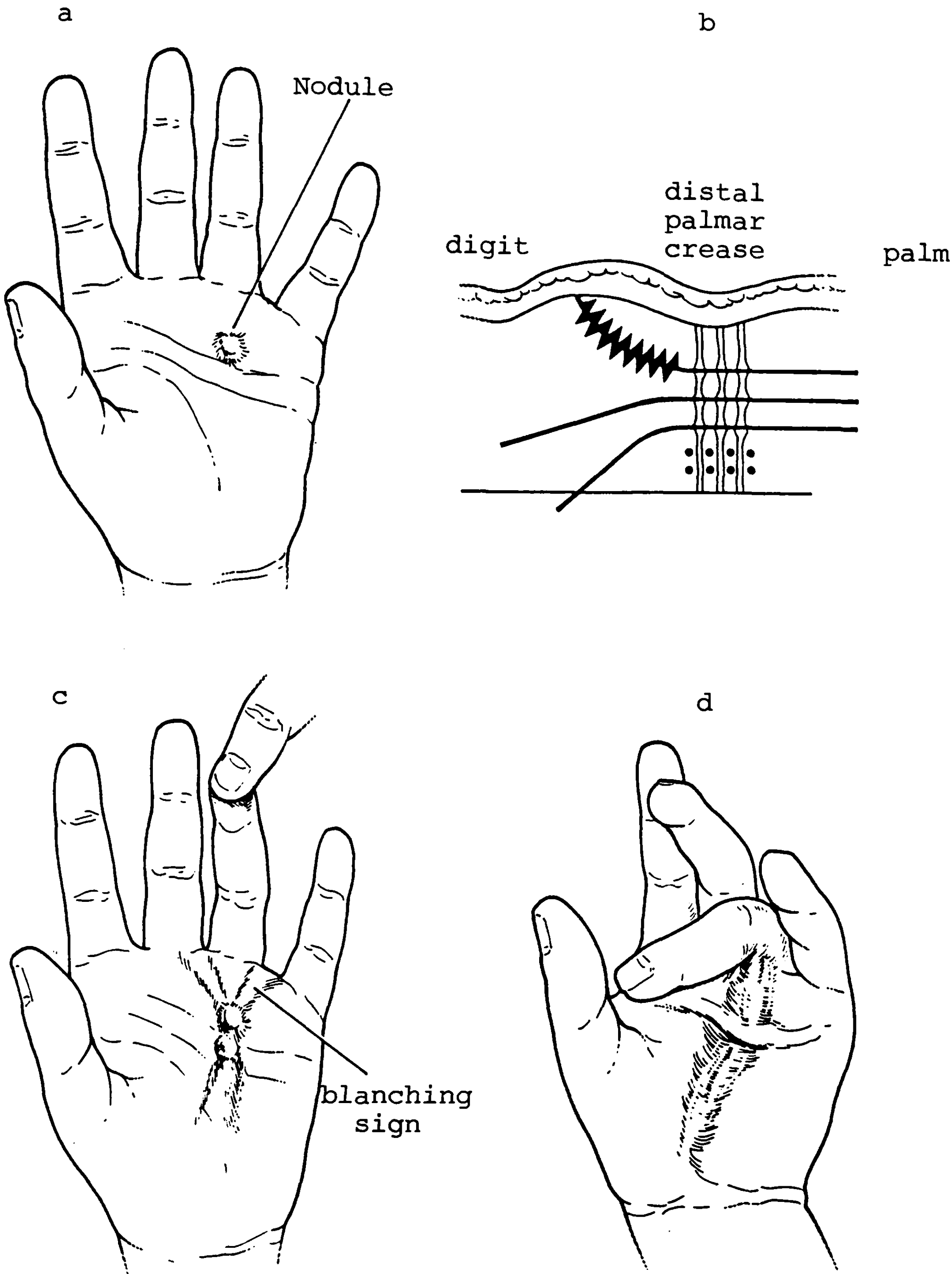


Fig. 4.1 Early clinical sign of DD.

a) Typical site of Dupuytren's nodule.
b) Cross section at distal palmar crease showing area of contracture which bunches the skin to produce a nodule (see also Chapter 10).
c) On digital extension the palmar skin blanches distal to the nodule.
d) Joint contracture is a later stage in the disease.

Clinical nodule formation must not be confused with the pathologists description of a "Nodule" which is not palpable; a histological feature of much smaller dimensions, representing a fibroblastic focus.

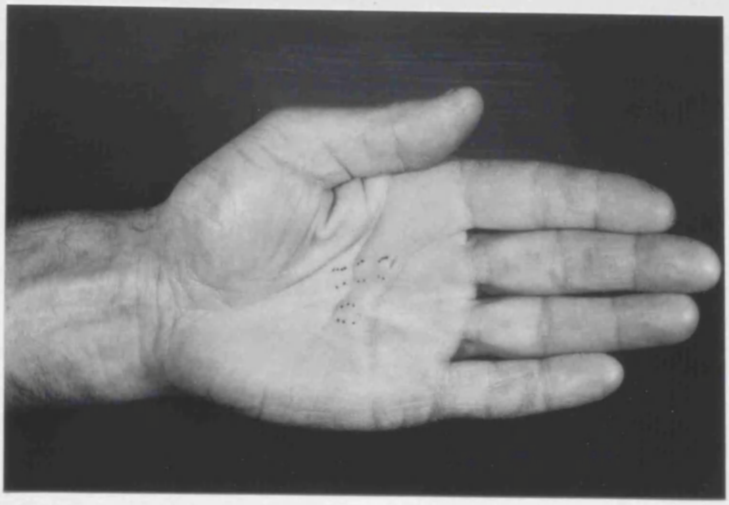
Is the clinically apparent nodule a certain sign of DD? Confusion may arise with other specific lumps in the hand - cysts, fibromata, neurofibromata, lipomata, rheumatoid nodules, ganglions, nodules related to the tendons or sheaths, foreign bodies, and other swellings of infective, traumatic or neoplastic origin - but distinction between these conditions and DD is generally not difficult as Dupuytren's nodules have defined positioning on top of the pretendinous bands or natatory ligaments or the proximal segment of the finger.

A major source of confusion arises in the swollen hand where oedematous fat bulges between the inelastic fibrous fascial components of the hand, with exaggeration of the normal monticuli in the distal palm. Although there is generally no shortening of the fibrous tissue skeleton, the oedematous fatty tissue appears to be producing nodules. This lumpy thickening is typical of reflex sympathetic dystrophy and generally resolves but it may progress to true DD in a few cases (perhaps those with the appropriate inheritance) indicating that contracture of the fascial skeleton has become superimposed. Stewart et al (1985) reported 16 cases of thickened fascia, all mild, after Colles fracture in 235 patients - only two developed finger contractures.

With these exceptions it is generally agreed that palpable nodules are diagnostic of DD. Some authors have made the diagnosis in their absence, perhaps because of a difference of opinion as to what constitutes a nodule. Luck (1959) considered that the nodules disappear in the late residual phase. Nodules have been reported to appear and then disappear spontaneously without contracture (Campbell Reid, personal communication) or they may disappear after the release of tension by fasciotomy (Adams, 1879). An early nodule may appear but 'never' progress. Corlette (1944) noted nodules in his own hands over a 25 year period (Fig.4.2).

There appear to be two schools of thought. Nodules may be considered a frequent but not invariable phase in the course of contracture. Alternatively, if the nodule is considered as an invariable accompaniment of DD, then the nodular cases are DD and those without nodules are some other as yet undefined process. The difference between these views may be merely a question of definition.

a



b

Fig 4.2 Early signs of Dupuytren's Disease

a) This patient (40 years) presented with carpal tunnel syndrome and nodules and skin crease distortion were noted as an incidental finding. There is also a pit in the middle finger ray.

b) No significant progression was seen over a 3 year period.

Fig 4.3 Early signs of DD. This print of the right hand of Gen. Sir Redvers Buller, V.C. from a text on palmistry, Cheiro's Language of the Hand, 1986, shows indentations in the palmar skin just proximal to the ring and little fingers with slight flexion of these digits. These changes could be interpreted as borderline signs of DD.

Fig 4.4

a

Early manifestations of DD. Indentations of palm at attachment of longitudinal bands midway between distal palmar crease and base of digits.

b

Early sign of DD. Tight longitudinal bands run from palm to digits making the monticuli between the bands more prominent.

Further epidemiological evidence is needed to ascertain whether or not these signs indicate progressive DD.

Fig. 4.4 C.1 Changes of DD more extensive on dissection.

C1

Post mortem dissection of a hand with DD. Ring finger nodules and palmar crease distortion are apparent.

C2

Pointer indicates deep contracture tissue in the index/middle web space not apparent on external examination.

C3

Longitudinal fibres insertion into skin of the little finger has been defined, as have the transverse natatory fibres at the distal margin of the web. A spiral cord of Gosset is indicated by the pointer in the ring finger ray.

Skin Changes

Various of the signs of DD are due to retraction or involvement of the skin (Chapter 10). Tethering has been used alone as a sign of DD by Noble et al (1984) although this evidence must be subject to considerable observer interpretation as to what skin anchorage is normal and what is exaggerated. A loss of the normal mobility of fascial ligamentous systems upon one another results in distortion of the palmar creases which may be vertical or horizontal. The former is a persistence of the flexed appearance of the palmar creases even on full digital extension; the reader can observe from his own palm that the normal creases become flat linear marks on extension. Horizontal distortion may result in the creases becoming concave or convex depending on the direction of tethering. The creases may also become broader as described by Hugh Johnson in his own hand (Johnson, 1980). A particular result of tethering is the "blanching sign" (Fig. 4.1) (McGrouther, 1982) apparent in the skin distal to the insertion of the longitudinal pretendinous fibres; increased tension in the dermis on full extension results in an area of tight ischaemic skin. Pits or dimples are a form of tethering which arises where the contracting cords insert into the dermis. Skin involvement is the thickening of the skin at the base of the finger which indicates that the contracture is being propagated through the dermis (Fig. 4.3). The various manifestations of skin tethering must

TABLE 4I

CLINICAL SIGNS OF A CONTRACTURE
OF THE FASCIAL SKELETON OF THE HAND

PALM OR DIGIT	Outwith the fascial ligaments	NODULE
	Within anatomical structures	SKIN Tethering Distortion of palmar creases Blanching sign Pits Skin involvement
		FASCIA AND FAT Cords Loss of fat layer
		JOINTS Contractures mp pip
		DORSAL SURFACE Knuckle changes Loss of distal wrinkles Tethering of proximal wrinkles Thickening/Lump Hyperkeratosis
		INVOLVEMENT OF OTHER STRUCTURES Tendon sheath - triggering Intrinsic tethering Vasomotor abnormalities

TABLE 4II

DIFFERENTIAL DIAGNOSIS OF JOINT CONTRACTURES IN THE HAND

	Influences outwith the hand	Causes within the hand
Congenital		Camptodactyly Windblown Hand
Acquired	C.N.S.	Trauma
	a) Organic - Strokes Paralysis b) Psychoses - Hysteria Schizophrenia	a) Post-burns contractures b) Injury of skin tendon nerve bone and joint esp. pip joint locked mp joint
	Peripheral nerves	Diseases of
	Ulnar nerve injury/disease	Skin - scleroderma etc. Tendon - trigger finger/tenosynovitis Nerve or muscle
	Volkmann's Ischaemia	Bone and joint - Rheumatoid and other arthritis
	Intrinsic muscle paralysis	Connective tissues - (Diabetes) Limited joint mobility
	Occupational contractures??	Infections - Tendon sheath Joint Deep palmar space

reflect either active contraction of the fascia, or "adaptive" shortening (see below).

<u>Changes in the Fascia (and Subcutaneous Fat)</u>

The term "cord" has been suggested for the contracted fibres of DD whereas "band" should be reserved for the anatomical fascial structures. This convention is not however strictly adhered to. <u>Cords</u> are therefore contracted bands and contraction may occur with or without obvious surrounding masses of nodular tissue. They may be palpable within the palm or digits or they may lie deeply within the tissues. a clear distinction between a cord and a nodule is not possible clinically. At operation tendon-like cords are apparent which may be more extensive than had been suspected.

Bands are often found around the thumb which may simply represent well defined anatomy and there appears to be a gradation between the anatomical band and the pathological cord. Luck has suggested that in the late residual phase there may be cords without nodules. It seems that adaptive shortening of the bands may occur from a long standing position of flexion. Skoog (1948) has suggested this possibility in the senile hand. Ledderhose (1897) noted palmar bands in the hands of rheumatoid arthritis sufferers possibly from a prolonged posture of flexion or ulnar deviation. The palmar contractures which accompany strokes and schizophrenia may be examples of adaptive shortening. This mechanism may therefore be either the prime cause or a significant contribution to the development of DD, especially in the inactive senile hand.

Cords may be seen in the hand in contractures from other aetiologies - deep burns and following open wounds.

Further evidence which may be apparent is thinning of the fat layer between the bands/cords and the overlying dermis such that the two fuse or are separated only by a loose areolar layer. This is not a sign which always indicates DD, as thinning of the fat layer appears to occur with ageing (Flint, 1985).

Joint Contractures

Although the hand surgeon, as has been mentioned, will readily make up his mind whether or not an established contracture is DD, the general physician may all too readily seek refuge in this diagnosis when the fingers are flexed from any cause, especially in parts of the world where the condition is frequent. The possibility of confusion is emphasized by the use of the term Violinist's Hand Syndrome by Dias (1976) who has likened the hand posture of DC to that of a violinist.

In general terms a contracture of a joint may be defined as a loss of part of its range of motion. This may either occur from tethering outside the joint, as in the case of DD, or by contraction of the joint capsule or soft tissue components - this appears to occur in DD as a secondary phenomenon. The differential diagnosis of hand contractures is noted in Table II.

Of these the conditions most likely to give rise to confusion in diagnosis are as follows:-

Camptodactyly Although this congenital pip flexion deformity, often associated with mp hyperextension, is often present in childhood, it may either become apparent for the first time during the teenage years or appear to become progressive at that stage. When contracture first develops at this time it may be difficult to distinguish between a tendon imbalance with adaptive shortening of the skin and fascia, or if there is a primary fascial contracture pulling the finger down. There is often a history of trauma which serves to increase confusion. A family history of either DD or camptodactyly may give some clue as to which diagnosis is more likely. In the teenage years the diagnosis of DD is very unlikely. In adult life bilateral contractures of both little fingers are seen in the absence of any other signs to indicate DD. Not only is precise diagnosis difficult but the results of surgical correction in the experience of the author are disappointing.

The Windblown Hand is an unusual anomaly in which there appears to be a congenital contracture of the palmar tissues. The palmar creases are absent in the most severe cases and the digits may be ulnar deviated at the mp joint as well as flexed.

Prolonged flexion is the common feature in patients who develop contracture secondary to the hand being habitually held closed (Fig. 4.5). This posture may be adopted after organic disease of the C.N.S.; strokes or spastic disorders, or in Psychoses, such as schizophrenia. The pattern of contracture is however different in that although the longitudinal pretendinous bands may be quite apparent on passively extending the digit, they are never as thickly hypertrophied as to develop typical cords. True nodules are not seen but distortion of palmar creases and shallow pits are found from adaptive shortening of the fascia. Fixed contracture of mp or pip may occur.

Trauma Contractures may follow all types of injuries to the hand. The injured hand assumes a posture of pip flexion and mp extension which may rapidly become fixed due to oedema and fibrosis. The

a

Fig 4.5 Habitual flexion or Dupuytren's Disease?

a) Flexion contracture in an elderly man of more than 20 years duration with minimal contracture of longitudinal bands of palmar fascia.

Treated by fasciectomy b, c.

b

c

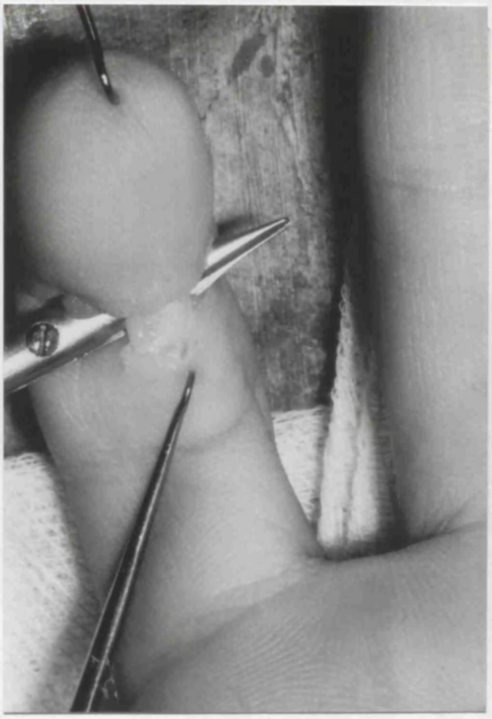
d

e

d) Early result after static splintage.
e) Relapse in to pre-operative posture.

Diagnosis uncertain. Possibly Dupuytren's Contracture and/or habitual postural deformity.

Fig. 4.6



a

b

Can trauma precipitate DD?

Progressive dip joint contracture following some years after a hyperextension injury in a 19 year old (Father has DD).

a) Isolation of a mid line cord.
b) After division of the cord a full thickness graft was applied.

pip joint in particular readily loses the extremes of its extension range, and if neglected can progressively become stiff. Distinction between DD and trauma depends mainly on the history, but the question remains - can trauma precipitate DD in some individuals? This difficult question will be tackled below.

Contractures of healed burns scars may produce a posture like DC but the diagnosis is immediately apparent on examination of the palm. This is also true where a bridle scar develops in a longitudinally orientated skin wound. Injuries to tendons and their sheaths due to open wounds are also obvious but a closed profundus avulsion may not be immediately obvious as a late presentation of a stiff flexed digit. Malunited fractures and the prolonged swelling of the pip joint which follows dislocation or volar plate injury may lead to a progressive flexion deformity. A locked mp joint, usually due to a sharp osteophyte catching the retinacular ligament is a rare but possible source of confusion.

<u>Diseases of skin</u> often are associated with some digital flexion but the diagnosis is usually obvious. Scleroderma involves many connective tissues in addition and is often associated with severe pip flexion.

Diseases of tendons Rheumatoid tenosynovitis may flex the digit and a locked trigger finger can mimic DD. There is an increased incidence of trigger finger in association with DD and a mild contracture may appear to deteriorate suddenly due to locking. The result of surgery can be equally dramatic as simple release of the A1 pulley may relieve almost all of the finger flexion necessitating little extra dissection of the Dupuytren's tissue.

Interosseous paralysis due to injury of the ulnar nerve or diseases too numerous to discuss here (see below) may result in a claw deformity, especially involving the ulnar digits. The similarity of distribution of these deformities has led many to speculate on a cause and effect relationship. Eulenberg (1864) felt that DD was due to an irritative lesion of the ulnar nerve. Bauer et al (1985) have presented an excellent review of this subject. Certainly a fixed claw deformity from interosseous paralysis can readily be mistaken for DD. Even in the presence of normal innervated muscle fibres, the muscle's function will be lost if the tendon becomes adherent losing its excursion. More will be said of this in considering mechanisms of contracture.

Disease of bone and joint All manner of bone and joint diseases may present as a loss of digital extension, and some may even produce a lump. Rheumatoid arthritis may present with loss of extension due to joint or tendon synovitis, joint subluxation, tendon rupture, or the pain may cause habitual flexion. There is rarely confusion as the overall picture of the disease is quite different. However, the diagnosis of RA is almost as difficult to establish in the mild case as DD!

Diseases of connective tissues Scleroderma and Rheumatoid arthritis have already been discussed and other less common connective tissue diseases can on occasion be associated with flexed digits. The fascinating condition of Limited Joint Mobility has only recently been described (Rosenbloom, 1974). Ceruso et al (1987) have discussed this condition and its treatment at the third congress of the IFSSH at Tokyo. LJM (synonyms - diabetic hand syndrome, diabetic cheiroarthropathy) occurs in approximately 30% of juvenile insulin dependent diabetics. It is characterised by flexion contractures of the fingers, mainly affecting pip and dip joints. It is associated with a higher risk of microangiopathic complications. A simple screening test is the "prayer sign"; the palmar surfaces of the digits can not be approximated. The aetiology of the contracture is not entirely clear but flexor tendon adhesive synovitis may be a significant factor. It has also been suggested as a general disturbance of collagen metabolism affecting all collagenous structures.

Infections of deep spaces - tendon sheath, joint or palmar spaces complete the list. These for Dupuytren were important differentials. Currently these are less frequent, and more easily neglected.

Involvement of Other Structures

It is curious how little effect these masses of new tissue have on surrounding structures. It seems that only the skin is "invaded", or rather the dermis is one of the pathways of contracture. Are there clinical signs to reflect pressure effects or displacement or tethering of normal structures? The association with trigger finger has already been mentioned - this may be a pressure effect from contracture around the tendon sheath at the A1 pulley. The possibility of a nodular mass obstructing the tendon of an interosseous muscle has been mentioned by Iselin (1985). More will be said on this subject in considering recurrence.

It is difficult to demonstrate clinical dysfunction of nerve or vascular supply. Many authors have commented on the sweating "vasomotor" hands seen in some. Bauer et al (1985) have reviewed extensively this subject. No consistent abnormality of nerve conduction has been found - it is curious that the large increase in Paccinian corpuscles (Millesi, 1985) can not be detected transcutaneously. Circulatory abnormalities, although not definable clinically are reflected by sophisticated testing, such as the response to cooling (Bauer, 1985).

CHAPTER 5

EPIDEMIOLOGY: REVIEW OF STUDIES OF INCIDENCE

Age

There is general agreement that the incidence increases with age. This has been shown by Early (1962) who reviewed different population groups in the North West of England; the employees of Crewe Locomotive Works, the residents of an old people's home, a cross section of the population of Leigh, a Lancashire industrial and mining town, and the patients of an epileptic colony. The age distribution of Dupuytren's Contracture in his overall group is summarised in Figure 5.1. His figures may be compared with a control group cited by Arafa, Steingold and Noble (1984), drawn from nearby Manchester. It seems likely that the difference in incidence reflects different criteria of diagnosis rather than an increase in incidence of the contracture in the interval between the two studies. Hueston's (1963) (see also Hueston 1960) figures are also shown for comparison and correspond more nearly with those of Arafa et al. It therefore seems that comparisons made by one observer or team are likely to be meaningful, but comparisons between series must be made with caution.

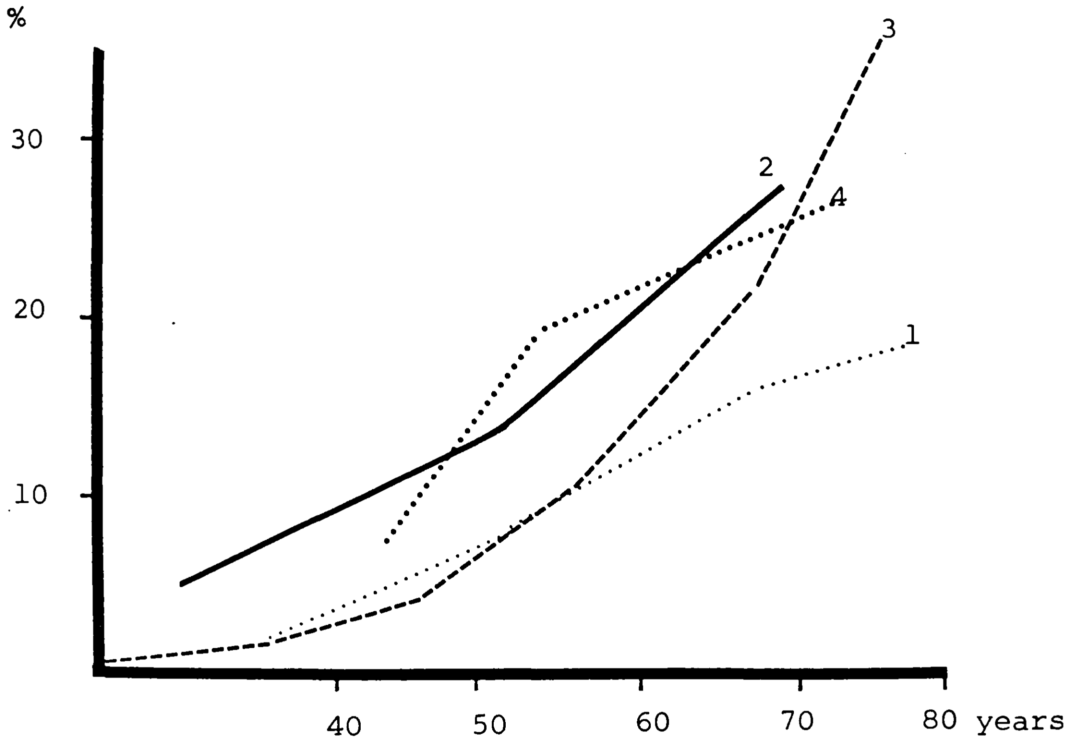


Fig. 5.1. Prevalence of D.D./D.C. and age.

1. Early (1962), D.C.
2. Hueston (1963)
3. Mikkelsen (1972)
4. Arafa et al (1984), D.D.

At the lower end of the age range contracture is rare before the age of twenty years, although a condition of palmar fasciitis exists in children (Stout, 1954). (The author has not observed this condition).

Mikkelsen's (1972) routine examination of the residents of Haugesund, Norway, remains the only comprehensive population study. In the course of population screening for pulmonary tuberculosis he examined the hands of 15,950 persons; 901 were found to have Dupuytren's Disease. In about 50% of the men, the disease started between 40 and 59 years of age (women 40-69). In men, the contracture increased rather constantly during the first 20 years followed by a stationary phase from about 20 to 35 years of duration whereafter it appeared to decrease. The tendency to develop more severe contractures suggested by other authors when the disease starts in younger ages was not supported by this study.

Sex

In the early nineteenth century the condition was believed not to occur in females until reported by Adams (1882). Mikkelsen (1972) found DD in 9.4% of the men and 2.8% of women.

The distribution of the contracture within the palmar fascia is somewhat different. Fewer women present for surgery and it has been suggested that the results are poorer (Wallace, 1964) (Hueston, 1985).

Kipikasa and Gregorova (1970) have suggested that DD is associated with a disturbance of balance between the individual components in androgens especially in the "climacterium".

Distribution of Digital Involvement

Mikkelsen (1976) found that the frequency of contracted digits, counted from the total number of affected hands, was for men (women) thumb 3% (0.6%), index finger 1.2% (1.7%), middle finger 28.3% (27.9%), ring finger 85.1% (92.3%), and little finger 45.4% (39.5%). At corresponding ages, the contractures were more severe in men than in women, and more severe in the right than in the left hand. From the history, Mikkelsen (1977), nodules in the ulnar part of the palm had been the first symptom in 90%, although the disease usually started in the right hand. In 10% of the cases with bilateral disease it started simultaneously in both hands.

Geography

There seem to be widely differing incidences from country to country and this has been suggested to be principally due to racial differences, although sociological factors, such as longevity, and the incidence of associated conditions, may to some extent explain apparent regional variations. The disease is commonly seen in all Northern European countries, in Scandinavia and in Russia. Hueston (1982 and 1985) has suggested a relation to Celtic or Viking racial groups who arose from Northern Europe and Scandinavia, but the evidence for this is indirect. (Delaney, 1986, has outlined the geographic spread of the Celts). Early (1962) suggested that the disease tended to be more prevalent in countries with smaller populations, suggesting that the condition may have arisen in one particular racial group. The disease has even been suggested to be "The Curse of the Clan McCrimmon" - a flexion deformity found in this famous piping family, preventing play (MacNeill, 1986).

There seems to be little other evidence to support the hypothesis that the geographic distribution is tied to racial migrations as the disease was not clearly recorded before the eighteenth century. Certainly the inhabitants of the new world who have migrated from Northern Europe do have a high incidence of the condition (Hueston, 1982). It is common in Australia, the United States of America and Canada. The condition is uncommon in Japan (Hori et al, 1978; Ushijima et al, 1984), although more common than previously believed (Egawa et al, 1985), and very rare in China (Chow et al, 1984) or South East Asia (Maes, 1974). Within India the condition is rarely seen in the South (Srinivasan, personal communication), but may occur infrequently in Northern India (personal communications B. B. Joshi, Bombay; A. Govila, Chandigar).

In negroes the condition is so rare as to justify single case reports (Zaworski and Mann, 1979; Haeseker, 1981). Bocanegra et al (1981) have compared black and caucasoid groups for Dupuytren's contracture and found that despite the presence in black patients of such associated diseases as diabetes mellitus, epilepsy, and alcoholism, Dupuytren's contracture is extremely rare. When it occurs, it has been attributed to genetic admixture, but Plasse (1979) and Furnas (1979) have suggested a small, but definite, incidence in blacks. Mennen (1974 and 1985) has described a number of cases and by genotyping has excluded Caucasian genes. Although these tests are not quite specific they are highly suggestive of pure negro ancestry. The incidence in the Middle East is low (Fahmi, personal communication).

In the Mediterranean area Hueston (1985) has made the statement that in Italy "Dupuytren's Disease does not occur south of Rome!". The author has observed that in Malta Dupuytren's Disease is extremely uncommon. Only a few cases are operated on each year in a population of 300,000. This population is largely Italian, but with a considerable admixture of British genes from a long term British military and naval presence. It is surprising that the incidence is not higher, as Malta has one of the world's highest incidences of diabetes.

It must be considered whether environmental temperature contributes to the geographic distribution. The hand's circulation is particularly vulnerable to change in environmental temperature. The hands of patients in warm climates look plumper, fuller and softer. This may, of course, be genetic, but long term environmental exposure may have a significant effect on hand structure in addition. This factor has received surprisingly little attention. Skoog quotes a report by Schlack (1942) suggesting that chronic trauma in conjunction with cold may have contributed to the increase of this disease in military working parties during the cold winters of the second world war. Other factors may, however, have accounted for an increased notification of Dupuytren's Contracture.

It must be emphasized however, that much of the evidence of geographical distribution is based on anecdotal accounts of the practices of hand surgeons in these areas rather than on true scientific population study. There are also differences in the suppleness of connective tissues in peoples who have different racial backgrounds and there are certainly differences in wound healing and scar forming properties. Dupuytren's Disease is rare in the racial groups prone to keloid scars. Basic knowledge on collagen metabolism in different racial groups is however lacking.

CHAPTER 6

AETIOLOGY

HEREDITY

Inheritance plays a strong part in the aetiology of Dupuytren's Disease. James (1985) has reported that 10% of the Dupuytren's patients in the Edinburgh hand clinic had a positive family history of the condition and has emphasized the need for a formal study for family history to establish the role of inheritance in such a frequent anomaly. Ling (1963) visited 832 relatives of 50 patients to establish the frequency of Dupuytren's Disease. Where the changes were so slight as to make the diagnosis difficult, he chose to reject the diagnosis. He acknowledged that the younger patients may not yet have developed the condition and introduced an age weighting system. He found that whereas 8 or 16% of patients knew of other affected members of their families, on examination this figure rose to 68%. The families with a negative history tended to be those with young children and smaller families with members who could not be traced. Ling's findings suggested a single dominant genetic mode of inheritance. He suggested that the expression of the abnormal gene was delayed in women. Thieme (reported by James, 1985) confirmed the high incidence in first degree relatives. Burch (1966) has suggested a recessive inheritance. Hueston (1963) feels that a more complex genetic system may be involved. Matthews (1979) has described a family pedigree in which a strong Dupuytren's trait is manifest predominantly on the female side and it seems that the degree of penetrance of the gene is at least as important as its transmission. Nyberg et al (1982) have documented the familial transmission of Peyronie's disease as an autosomal dominant trait in 3 pedigrees. Dupuytren's Contracture occurred in 78% of affected individuals suggesting that both disorders were pleiotrophic effects of the same gene in these families. Chromosomal abnormalities have been noted in the palmar fascial fibroblasts by Bowser-Riley et al (1975) and Sergovich et al (1982), but their significance is uncertain. HLA typing (Aron, 1977) (Tait and MacKay, 1982) has suggested no difference in antigens between Dupuytren's contracture and normal subjects.

ASSOCIATED CONDITIONS

Diabetes

Certain conditions have been reported as occurring in association with Dupuytren's Disease. A relationship with diabetes seems certain (Greenwood, 1927), (Heathcote et al, 1981). Noble, Heathcote and Cohen (1984) have reviewed the literature and reported Dupuytren's Disease in 42% of adult diabetics. They noted that the disease was of benign prognosis, rarely needing operation. In a separate study, they noted that

13% of patients with Dupuytren;s Disease had a raised blood glucose level. They raised the question as to whether the biochemical disturbance causes Dupuytren's Disease or whether the pattern of inheritance predisposed to both conditions. The low incidence of Dupuytren's Contracture in Malta, where diabetes is very common, suggests that other factors also play a part. Larkin et al (1986) have noted an increase in incidence of Dupuytren's Contracture and also of Limited Joint Mobility in the digits of diabetic patients. They define limitation of joint mobility as the inability to oppose the palmar surfaces of corresponding digits when puting the hands together.

Epilepsy

Lund (1941) found a high incidence of Dupuytren's Disease among epileptic patients. Early (1962) and Critchley et al (1976) observed that epilepsy and Dupuytren's Disease were commonly associated with knuckle pads and plantar nodules. Dupuytren's Disease in epileptics also tended to be bilateral and symmetrical. James (1974 and 1985) (also review by Ritter et al, 1978) has reviewed the genetic patterns of idiopathic epilepsy and Dupuytren's Disease and found no evidence of linked inheritance. Critchley et al (1976), however, have compared the high incidence of the condition in modern series with earlier literature, and conclude that Dupuytren's disease is due to the prolonged administration of anticonvulsants, especially phenobarbitone. Noble (1985, personal communication) has noted differing incidences of Dupuytren's Disease in different epilepsy populations in the United Kingdom despite similar medication and other, as yet, undefined factors therefore appear to apply in this relationship.

Alcohol

Alcohol and Dupuytren's Disease are closely linked in the minds of medical students. This suggestion is, however, surprisingly recent. A study by Graubard (1954) in New York, brewery workers displayed a high incidence of contractures, but this may have been attributable to ethnic origin or other factors. Many of the workers were of Irish extraction. Wolfe et al (1956) have shown a relationship with alcoholism and hepatic cirrhosis, but hand contractures are not associated with Bilharzial cirrhosis. Hueston (1963) noted that in a series of 60 male alcoholics 25 had Dupuytren's Disease. The association with alcohol and cirrhosis therefore requires further clarification.

SUGGESTED AETIOLOGICAL FACTORS

Skoog, writing in 1948, has summarised beautifully a plethora of factors which have been considered at various times to be of aetiological significance.

Much of the literature of the 19th and early 20th centuries concentrated on aetiological speculation and Skoog's review of the literature is extensive. Many of these suggestions are now unfashionable and, as Skoog has reviewed the literature so extensively, only a summary will be presented with emphasis on those which have received further attention in the past 40 years.

A Neuropathy

a) Peripheral Nerve Lesions

The predominance of involvement of the ulnar side of the hand has led to speculation that the ulnar nerve is implicated. According to Skoog, Eulenberg (1864) was the first to follow this line of reasoning, but large series of ulnar nerve injuries have not substantiated this suggestion.

Current thoughts on ulnar nerve injury or irritation have been reviewed by Bauer et al (1985). Mumenthaler (1961) has suggested a lesion of the nerve of indeterminate degree which does not however lead to a paresis, but perhaps to chronic irritation of the ulnar nerve with trophic disturbances at the palmar aponeurosis leading to the formation of Dupuytren's tissue. Bauer et al (1976 and 1985) have shown by clinical testing and plethysmography that pathological conditions of the ulnar nerve are frequent in patients with Dupuytren's Disease. They have compared their results with other authors as follows:-

Patients with normal plethysmogram	37%
Patients with pathological plethysmogram	77%
Total - 35 patients	68%
Gerstendrand Millesi - 56 patients 1970	67%
Mumenthaler - 88 patients 1961	85%

Abbe (1884 a and b, and 1888) believed that slight injury to the palm caused an impression on the spinal cord which created reflex vascular and nutritive tissue disturbances. He believed that there was also a reflection of this disturbance to the opposite hand. This rather complex theory implies a suggestion of reflex sympathetic dystrophy which will be discussed later.

b) Spinal Cord Lesions

Skoog (1948) has reviewed the expression of a trophic disturbance following a primary cause in the central nervous system. He has reviewed case reports of Dupuytren's Contracture in association with syringomyelia, and cervical spine trauma and disease.

c) Cerebral Lesions

Skoog (1948) has reported cases of Dupuytren's Contracture which have improved following cerebral haemorrhage suggesting that the diagnosis was in fact a spastic contracture. Zachariae et al (1970) noted possible EEG abnormalities in patients with DC, but their controls were not adequate.

d) Disturbances of the Sympathetic Nervous System

Hypertonicity of the autonomic nervous system, irritation of the sympathetic ganglia from pulmonary or visceral disease, or coronary occlusion, are reviewed. Scleroderma or Raynaud's disease may also be associated with dysfunction of the sympathetic nervous system.

e) Neurosyphillis

Case reports of neurosyphillis in Dupuytren's Contracture were attributed by Skoog to co-incidence in individual cases and this suggestion has been substantiated with the passage of time.

B GOUT AND RHEUMATISM

Before Dupuytren, the characteristic contraction had been attributed to a rheumatismal affection or to gout. These terms were loosely applied in the early nineteenth century when diagnosis depended on symptoms and signs at a time one century in advance of x-rays and of biochemical differentiation. Gout is no longer considered to be of importance. Skoog has reviewed single case reports in which the deformity began during or following an attack of "acute rheumatism". The concepts of infection at a remote site are now held in less significance than at the time of Skoog's monograph. Fibrositis remains a mysterious concept at the present time.

Ledderhose (1897) observed changes in the palmar aponeurosis in several hundred cases with arthritis deformans of the weight bearing joints. He described this as fasciitis palmaris, this being a thickening of the fascia without nodules.

The author has noted tight longitudinal bands of palmar fascia in rheumatoid arthritis patients. These may be a form of adaptive shortening of the soft tissues in the flexed hand, but not all cases have flexion deformity. They do not seem to progress to a digital contracture.

Arafa, Steingold and Noble (1984) have reported a reduced incidence of Dupuytren's Contracture in patients with rheumatoid arthritis. This reduction was, however, in comparison with a high incidence in a control group.

C ENDOCRINOPATHY

a) Diabetes - see above.

Skoog considered diabetes of little practical importance.

b) Thyroid Deficiency

Two series were reported in which Dupuytren's Contracture was improved by thyroid replacement therapy. Such reports have been unconfirmed. There was a suggestion that parathyroid deficiency was a cause. Pituitary deficiency had been suggested, but remained unsubstantiated.

D DEVELOPMENTAL THEORIES

Reidinger (1898) reported a case with ectopic cartilage and bone, and considered this to be an atavistic phenomenon. Recently ectopic bone formation has been noted in a longstanding Dupuytren's cord. Koenig (1889) suggested congenital disposition to the formation of fibromas in the palmar aponeurosis. Krogius (1921), from Finland, on the basis of comparative anatomical studies by Kajava (1917), suggested that the atavistic remains of the flexores breves manus muscles were the cause of Dupuytren's Contracture. It was thought that there was muscular tissue within the palmar fascia which gradually underwent tendinous degeneration. This theory was widely accepted at the time and Deckner (1938) suggested that the altered aponeurosis showed a histological striation reminiscent of muscle fibres. Wang et al (1960) and Stein et al (1960) felt that the presence of muscle may account for the inheritance of DD.

E CONTRACTURES OF THE PALMARIS LONGUS MUSCLE

Smith (1884 a and b, and 1885) considered the palmaris longus to be tense and prominent, but Nichols (1899) disputed this. Boyes and James (1968) have reported DC involving the volar aspect of the wrist. A recent report by Powell, McLean and Jeffs (1986) has suggested an increased incidence of the palmaris longus in patients with Dupuytren's Contracture, but their control group is statistically unsound. Nieminen and Lehto (1986) from Finland, have recently published a paper advising resection of the palmaris longus in surgery for Dupuytren's Contracture to prevent recurrence. These authors wrongly refer to Graham Stack as stating that a typical Dupuytren's Contracture has not been observed in patients in whom the palmaris longus does not exist. They show a reduced incidence of recurrence in patients in whom the palmaris longus tendon was excised (23% compared with 43% when this was not done). There are too many variables in treatment comparison groups to draw any conclusion.

F MISCELLANEOUS

Skoog concluded his aetiological review by quoting literature with suggestions that local bacterial infection, tuberculosis (also mentioned by Gordon, 1954), axillary artery aneurysm and cervical rib had been suggested as positive factors. Three miscellaneous papers present some current interest.

1) Bahr (1895) considered the disease as a general tendency to pathological changes in the connective tissues - his patients suffered from severe arteriosclerosis. Vascular occlusion has again recently been discussed, see below.

2) Mauclaire (1913) reported that sclerosis in the palm was co-incident with sclerosis of the liver, arteries, spinal cord, penis or skin. This suggestion pre-dated the reported association with cirrhosis in 1956 (Wolfe et al). A rare case of localised sclerodema and DD has been reported by Nogueira and Belo (1968).

3) Sachs (1922) envisaged circulating fibroplastic substances in the blood. Attention has recently been drawn to fibrin and fibrinolysis and this will be discussed below.

Krinke (1935) suggested a disturbance of collagenous metabolism. The list is concluded by noting suggestions of a skin disease in association with a neoplasm or a strong grasping tendency on psycho-analysis. It seems therefore that Dupuytren's Disease has been attributed to almost every known disease process.

Since Skoog's report, Hueston (1963) has reported an increased incidence of contractures in chronic pulmonary tuberculosis. Millesi (1959) suggested auto-immunity. Rany (1962) was unable to support this. Norva et al (1977) noted raised levels of antigamma globulin factors and lack of IgG, IgA and IgM in severe forms of DD, but not in mild cases. Broadbent (1954) noted enlargement of the Paccinian corpuscles. Dupuytren's Disease has been noted in association with carpal tunnel syndrome and trigger finger. There is no increased incidence in cigarette smokers (Fraser Moodie, 1976).

G VASCULAR CHANGES

Hueston (1963) has suggested a poorer outcome from surgery in the cold moist hand. Lund (1941) measured the recovery rate of forearm skin temperature after immersion in cold water in epileptic patients. He found this to be slower in those who had Dupuytren's Contractures than those who had not.

Mammacari et al (1970) have noted changes in peripheral circulation in hands affected by DD. Wilflingseder et al (1971) and Bauer (1976 and 1985) have used finger venous occlusion plethysmography and they showed a latent vasospasm in 77% of 94 patients with Dupuytren's Disease. On cooling to below 15^{o} centigrade a significant diminution of the blood flow was observed. Normal circulation was obtained only after rewarming to 32^{o}.

A general review of aetiology has been published by Peacock (1976).

SINGLE INJURY

It is possible to interpret Plater's account of 1614 as suggesting that Dupuytren's Contracture developed in his patient after a single injury (Fig. 6.1). Dupuytren (1831) considered trauma significant (Chapter 2). Skoog (1948) weighed the balance of 14 reports of this type and considered the case not proven. Zachariae (1971) considered trauma an unlikely cause, but emphasized the need for further study. Clarkson (1961) believed that a single episode could precipitate the onset of the disease in a predisposed person. Fisk (1974 and 1985) also believes a predisposition must be present. Hueston (1963) found a convincing history of

Fig 6.1

CONTRACTION OF THE FINGERS OF THE LEFT HAND INTO THE PALM. A certain well-known master mason, on rolling a large stone, caused the tendons to the ring and little fingers in the palm of the left hand to cease to function. They contracted and in so doing were loosed from the bonds by which they are held and became raised up, as two cords forming a ridge under the skin. These two fingers will remain contracted and drawn in forever.

Plater, 1614.

injury to the hand in 11 of 220 patients and of arm injury in 6. Again in 1968 he wrote on this subject and described predisposing factors of injury and infection.

Mikkelsen (1978) addressed this question by seeking a history of definite single injury; fractures of the hand or wrist, tendon injuries, laceration, deep infections and burns leaving scars. He was able to seek a history in all patients in his Dupuytren's group, but in only a sample of the general population for comparison. Against a background level of 15.5% injuries, a history in bilateral Dupuytren's Contracture of injury was found in 27.3% - few patients, however, had had trauma to both hands. The interval between trauma and the first sign of disease is of particular interest.

In 143 men 39 of 143 (27%) developed contracture within 1 year.
21 of 143 (15%) in the period 1 - 7 years.
71 of 143 (50%) more than 7 years.
12 of 143 (8%) did not remember.

There therefore seem to be two peak intervals, one within the first year and a later one after seven years from injury. Mikkelsen, however, has not commented upon this. In the case of the early peak within one year, it seems likely that the signs more or less date from the injury. It is interesting that half of the cases are in the later group where the injury was in the remote past. This latter group is reminiscent of Dupuytren's wine merchant who attributed his contracture to a strain 20 years previously.

Palmar "nodules" are, however, not infrequent as part of the dystrophic process which may follow Colles fractures and other limb injuries (Plewes, 1956). These nodules rarely progress to a full blown contracture (Stewart et al, 1985).

OCCUPATIONAL TRAUMA

Dupuytren thought that the palmar contracture was work related (1831). He had noted the condition in stone-masons and in a cabinet maker. He believed that his wine merchant was obliged to perforate continually the casks with a gimlet, but this may have been speculation as the earliest account reports his Mr. L. as a Marchand de vins en gros or wine wholesaler who may not have performed repeated manual work. The coachman he described had severe bilateral contractions at 40 years of age and occupational trauma alone as a cause of his contractures seems unlikely. The philosophy of a relation to work was rapidly discounted in the 19th century. Hawkins (1844) and Adams (1879) considered the condition unrelated to work.

Skoog (1948) has reviewed the literature of occupational trauma in the 19th and early 20th centuries. Of particular note is the investigation of Collis and Eatock, Medical Officers of Health at Nottingham, on the prevalance of Dupuytren's contracture (13.1%) among 1360 lace machine minders or "twist hands". A departmental committee was set-up in 1912 to examine the claim. Sir Robert Jones considered the cause to be an individual predisposition with palmar irritation as the exciting cause. Collis thought the palmar stresses and strains to be the exciting causes in all cases. Black, writing in the British Medical Journal in 1915, found only 1.7% of 1329 lace minders, a much lower incidence, and attributed Collis's findings to an older age group. Skoog (1948) has emphasized the difficulty in separating the factors of age and work related trauma in many reports. He concluded that manual labour appears to increase the severity of the disease, but plays a relatively small part in its aetiology.

Herzog (1951) reported nearly equal contracture rates among steel workers, miners and clerks (1000 of each) in Rotherham, Sheffield and Manchester. In the American literature Moorhead (1953) stated emphatically that the disease was "not a traumatism" on the basis of review of published articles.

Early's studies (1962) at Crewe Locomotive Works are much quoted in this context. In comparing 427 office and 4454 manual workers at Crewe Locomotive Works, he found no difference in incidence (4% and 3.3% respectively). The groups were not strictly comparable in relation to age group, but even in the 55 -64 years decade the corresponding figures were:-

106 office workers 8.5% Dupuytren's Contracture.

820 manual workers 10% Dupuytren's Contracture.

The stage of the disease, i.e. severity of contracture, was comparable in non manual and heavy manual workers, whereas milder forms of the disease were commoner in an intermediate group of light manual workers.

Mikkelsen (1978) disagreed with Early concluding that the prevalence was higher and the contracture more severe in people doing hard manual work than in those doing light or non manual work. In analysing his figures however this difference was most marked in the upper decades, which Early did not compare, there being little apparent difference in the age ranges up to 59 years.

This analysis of Mikkelsen's results, which has not previously been made and differs from his own conclusions, is of considerable medico legal significance, as the difference between manual and non manual workers does not seem to become apparent until after an age when the industrial worker would now be expected to retire. Hand dominance did not appear to influence the side on which the contracture first presented.

Certain employments have an apocryphal reputation for being associated with Dupuytren's Disease. Bennett (1982) noted double the expected incidence in men doing a particular type of hard manual work. Roberts (1981) described two cases where transmitted hand to arm vibration may have been a contributing factor. Because of the medico legal significance of work related trauma, it is difficult to derive conclusions from individual case reports of this type. Bell and Furness (1977) have nicely expressed the opinion that some patients who have developed Dupuytren's Contracture would not have done so until later had they been engaged in a lighter occupation.

OBSERVATIONS ON DUPUYTREN'S CONTRACTURE AND SINGLE INJURY

As a general rule, mankind will readily relate the onset of disease to any one of a number of identifiable insults; the establishment of such a cause and effect relationship will bring the pathological process into the individual's sphere of comprehension thereby relieving anxiety. Contracture of the hand is no exception and injury or heavy use of the hand will frequently be blamed. There may also be a desire for compensation. The statistical problem is to separate co-incidence from causal relationship. This may be complicated in some cases by separating Dupuytren's from post traumatic or other causes of contracture.

Most single injuries of the hand, and some of the upper limb, are associated with some oedema which generally resolves leaving a soft supple hand. During the phase of palmar oedema the tethering of skin by fascial fibres may simulate early Dupuytren's Disease and there may even be apparent "nodules" or oedematous areas of the palm. Where the oedema is more prolonged as in post traumatic sympathetic dystrophy, these clinical signs become more evident and often present the dilemma "Is this or is it not Dupuytren's Disease"?. The literature suggests that most such cases resolve (Stewart et al, 1985), but a few progress. Mikkelsen (1978) described two peaks of occurrence of Dupuytren's Disease following trauma. The early peak within one year probably corresponds to the above sequence of events. It would be too simplistic a view to suggest that trauma is per se a cause of Dupuytren's Disease, but rather that trauma leads on to the poorly understood vascular disturbance of post traumatic sympathetic dystrophy associated with oedema and stiffness. The manifestations of this in the palm and digit may resolve or lead on to a progressive sequence of events which is a contracture. It is the author's view that loss of the normal mobility between palmar fascial ligamentous systems leads to stress concentrations which propagate the disease.

The late development of Dupuytren's Contracture following single injury is more indefinite. The history of injury may be a coincidence. The author has, however, seen a number of patients in whom the Dupuytren's Contracture process is continuous with the scarring of previous injury. This has been noted in a case of bilateral syndactyly in whom the Dupuytren's longitudinal pretendinous palmar cords were observed at operation to be continuous with the lateral digital scars under the skin grafts. A second case of this type has been drawn to my attention by Mr. Mahaffey and Mr. Wallace at St. Bartholomew's Hospital. A lady had a congenital syndactyly released at 56 years of age and two years later developed Dupuytren's Contracture of the same digital ray.

The author has also noted tight longitudinal palmar bands in 3 patients with distal palmar skin grafts which had been used in the treatment of burns many years previously. One of these patients developed palmar nodules and required release of a palmar cord. The appearances at operation were indistinguishable from Dupuytren's Contracture. It seems likely that these patients had a genetic predisposition to Dupuytren's Contracture. The age of onset may have been influenced by the injury, but apparently not to a great extent. The patient with the burns scar developed nodules in the other hand one year later. It seems, however, that the site of the contracture may be focused by the previous scar which tethers palmar fascial ligaments. The evidence for this is particularly strong where the contracture develops at an unusual site in the hand.

In summary, a single injury may therefore be important in two ways:-

1. An early contracture after injury. The patient must have a predisposition, but it is hard to guess at what may have happened if the injury had been avoided. Such cases should be carefully documented and a particular note taken of disease in the uninjured hand to establish whether the injury has caused contraction at a younger age than may otherwise have been the case.

2. A late contracture after injury. The scar seems to focus the site and its presence may possibly precipitate a premature onset of contracture.

OBSERVATIONS ON DUPUYTREN'S CONTRACTURE AND OCCUPATION

Rammazzini (1705) in his classical treatise on industrial disease, De Morbus Artificum, mentioned swelling of the hands of bakers from kneading dough, but he did not describe hand contractures.

Analysis of the writings of Skoog (1948), Early (1962), and Mikkelsen (1978), suggest that "occupational trauma" or heavy work seems to have little influence on the general frequency of the disease during the working years.

There has, however, been much muddled thinking on the role of work. Dupuytren (1831) made the ready association with direct pressure on the palm; he described this as a 'point d'appui'. Hueston (1963) illustrated the pressure points in the palm on gripping an ink coloured handle. Skoog (1948) felt that hyperextension trauma was important. "Partial rupture" of the fibrillar part of the aponeurosis which this writer considered to be the starting point, "had evidently greater chances of occurring among manual workers". The author's view (1982) of the biomechanics of the palm is that the longitudinal fibres are principally for resisting shearing forces, as in gripping a golf club. Occupations generating high shear forces in the palm seem to be most likely to stress the palmar fascia rather than an injury by direct blows or hyperextension. The stress received by the palmar fascia would depend to a great extent on the protection offered to it by the dermis. Nature's protective callosities and thickening of the dermis would seem likely to protect the underlying fat and fascia. The sedentary worker playing the occasional round of golf, without the protection of callosities, may be more at risk than the bricklayer. The bricklayer on promotion to foreman, lifting occasional bricks "pour encourager les autres", may have an increased risk of damaging his subcutaneous tissues.

Studies of hand involvement and hand dominance have not been illuminating. Mikkelsen (1978) noted that the disease commenced in equal frequency in either hand irrespective of the dominant side. This was true in males, but right handed women were more likely to present with right handed contractures. Hand dominance is a manipulative function. Work with the pick and shovel, the hammer and chisel, and most forms of heavy work, are bimanual activities which stress the hands in different ways.

A much more specific force analysis of certain employments is necessary to establish the contributory role of work. Should a causal relationship be found, this may result in better tool design, training of the hand to thicken the skin, and the selection of individuals who should avoid certain functional tasks.

CHAPTER 7

PATHOLOGY

The longitudinal bands of palmar fascia in the normal hand appear as discreet parallel glistening tendon-like structures with cross striations. When involved in the disease the cords macroscopically become white and opaque and even quite gelatinous in the more advanced case. Microscopically the initial change is a thickening of the bands (Millesi, 1959; Martini and Puhl, 1980; Nezelof, 1985). In the surrounding vessels there is proliferation of perivascular cells (Larsen and Posch, 1958). Kischer and Speer (1984) have described vascular occlusion within the bands and at the periphery, but this may be a later reactive change.

Aggregations of cellular tissue form subcutaneous nodules extending outwith the cords and enveloping them in such a way as to anchor them. Surrounding fat and connective tissues are displaced (Martini and Puhl, 1980) or replaced (MacCallum and Hueston, 1962). The skin may be heaped up by underlying cellular fibrous tissue or bunched up by tethering of thickened longitudinal ligamentous cords (see Anatomy section) to form clinical nodules. (McGrouther, 1982). Hueston's (1985 and 1986) view of the nodules is that these arise within the subcutaneous space on the anterior aspect of the palmar aponeurosis.

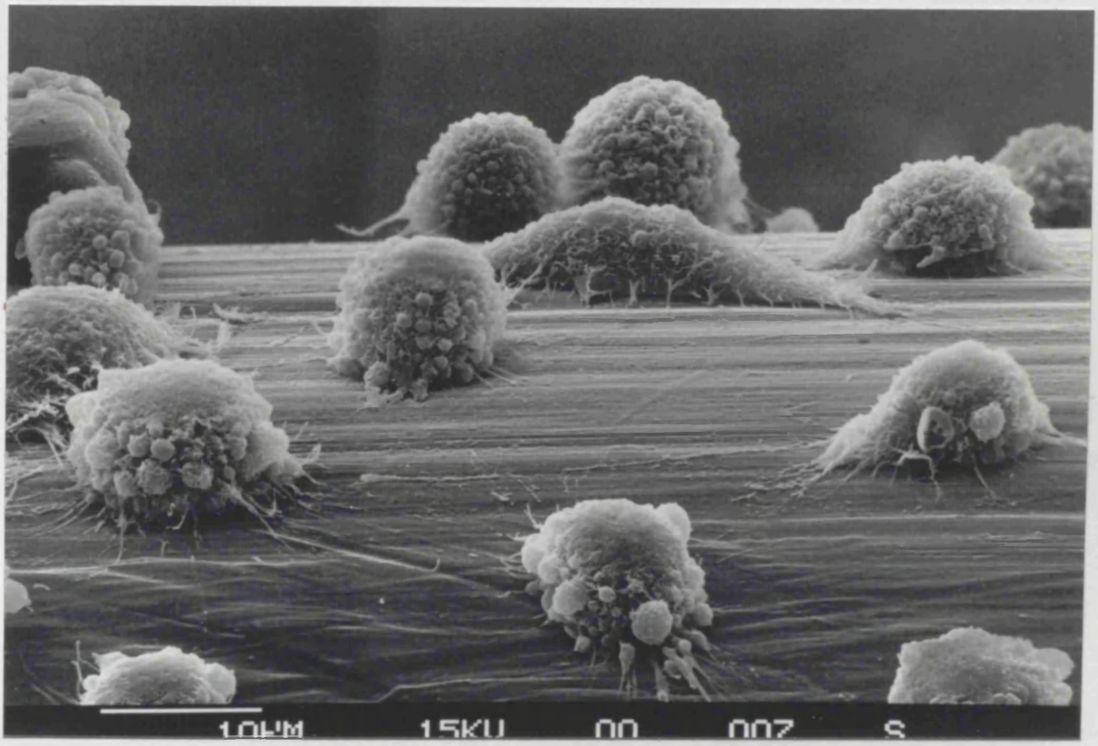


Fig 7.1 The myofibroblast

The cells shown are cultured immature mouse fibroblasts attached to a fine nylon suture. These cells have many characteristics in common with the myofibroblasts of Dupuytren's disease. In the resting state these cells are spindle shaped (centre field) and when stimulated they roll into a ball. The guy-rope like attachment mechanism may be fibronectin.

Microscopic "nodules" (different from clinical nodules) appear to arise within the bundles as areas of increased cellularity and within these areas there is a corresponding reduction of fibres and apparent fibre discontinuity. These appearances have been interpreted by Skoog (1948 and 1963) and Flint (1985) as evidence of microruptures and repair. They may, however, represent a reaction to stress without actual rupture.

Early in the disease, a prominent cell in the new fibroblastic tissue, presumably derived from the proliferation of perivascular cells, is the Myofibroblast as described by Gabbiani and Majno (1972). These cells are recognized in many pathological states, including granulation tissue (Gabbiani et al, 1970; Majno 1979; Lancet, 1978) and have morphological features akin to smooth muscle cells. A fibrillar system develops within the cytoplasm, not the few fibrils seen in normal fibroblasts, but bundles of parallel microfilaments (Gabbiani et al, 1978). Individual microfilaments measure 40-80 Å in diameter and are usually arranged parallel to the long axis of the cell. The remaining cytoplasm contains packed cisternae of rough endoplasmic reticulum typical of normal fibroblasts. The nucleus has accordian-like folds. There are several intercellular connections between myofibroblasts, the structure of which identifies them as gap junctions. There are also hemidesmosomes in areas where the cell is covered by a basal lamina. Immunological studies have shown that the cells contain the contractile proteins, actin and myosin, (Gabbiani and Montandon, 1985). It appears that myofibroblasts are at least in part responsible for the synthesis of Type III collagen. It is worth noting that Type III collagen is present in tissues that need a certain plasticity, such as embryonic skin, normal smooth muscle and granulation tissue. It is also prominent in blood vessels. Many investigators consider it to be the reticulin described by histochemical methods, although this has not been proven. The myofibroblasts present in nodules of Dupuytren's Disease do not differ morphologically from those present in granulation tissue, thus suggesting that the mechanism of tissue contraction is the same. This mechanism has been discussed by Montandon et al (1977), Azzarone et al (1983), Badalamente et al (1983). By culturing these cells on flexible substrates they have been shown to generate tension as shown by deformation of the substrate (Harris et al, 1981).

Cells from the nodule have been reported as displaying in vitro biological properties intermediate between those expressed by normal fibroblasts and sarcoma cells in culture. On the basis of this evidence, Gabbiani and Montandon (1985) believe that there is justification for the classification of Dupuytren's Disease among the benign mesenchymal tumours. In addition, culture from the apparently normal palmar aponeurosis shows some, but not all, of the abnormal growth properties of cells from nodules. It is, however, extremely difficult to grow fibroblasts in culture as they interpret the culture as a wound and tend to transform to myofibroblasts.

Gabbiani and Montandon (1985) have also mentioned myofibroblasts in Peyronie's disease. They note that some of the other fibromatoses, e.g., desmoid tumours or torticollis contain myofibroblasts, but none shows progressive retraction similar to Dupuytren's Disease. Carpal tunnel and trigger finger have also been shown to be associated with myofibroblasts and they may have a similar pathogenesis.

The means by which myofibroblast contraction is conveyed to the cellular environment is unknown. Cell to cell contact, or cell to fibrous stroma contact, through a plexus of fibres are possibilities.

Further accounts of the cell types in the different stages of DC have been presented by Nezelof and Tubiana (1958), Tyrkko and Viljanto (1975), Hueston et al (1976), Chiu and McFarlane (1978), Meister et al (1979), James and Odom (1980), Salamon and Hamori (1980, a and b), Talke and Noack (1980), Hamamoto et al (1982), Vande Berg et al (1982). Martini and Puhl (1980) considered a classification of different stages of the disease according to morphological findings impossible.

The collagen of the normal palmar fascia is Type I with a thin sheath of endotendineum around the individual bands of Type III (this type is widely present in the foetus) (Bailey et al, 1977; Menzel et al, 1979). In Dupuytren's Disease there is a marked increase in type III collagen (Bailey et al, 1977; Bazin et al, 1980; Brickley-Parsons et al, 1981) and this can be demonstrated on immunofluorescence to be scattered throughout the nodules, the collagen being disrupted into microbundles.

Hunter, Ogdon and Norris (1975) showed no primary chemical abnormality of the collagen. Brickley-Parsons et al (1981) showed an increase in collagen and hexosamine with galactosamine in the most severely involved tissue. These authors showed progressively severe changes in minimally involved fascia, longitudinal cords and nodules. Delbruck (1981) has shown no qualitative changes in enzyme activity and no increases of enzyme activity per cell (DNA).

There is multidirectional fibre orientation of the collagen fibres (Legge et al, 1981) and elastic fibres may be present in excess (Millesi, 1985; Mitz, 1977). These changes are most apparent in the nodules.

The glycosaminoglycan (GAG) macromolecules play an important role in determining the physical and functional characteristics of connective tissues. The Dupuytren's connective tissue matrix shows an increase in GAG content which is not uniformly spread amongst the three main GAG fractions (Flint et al, 1982). Chondroitin sulphate and dermatan sulphate were elevated, but Hyaluronate was not. Flint considered this to be a biological adaptation to decreased uniaxial tensional forces or to increased intermittent pressure forces. Dupuytren's cells have been grown in culture (Slack et al, 1982) and the levels of GAG were not found to be elevated, suggesting that local mechanical conditions within the palm were responsible for the elevated GAG production in vivo.

Fibronectin is an extracellular glycoprotein which is produced by fibroblasts and other cells. It appears to have two major actions. It binds cells to collagen as an attachment protein. It also has a role in tissue repair being present in high concentrations in blood and serum; it participates in a variety of reactions important to wound healing.

An excellent summary of the functions of this protein has been published by Kleinman et al (1981). Its role in Dupuytren's Disease has not yet been displayed, but it seems likely that it will participate in the biological processes.

In the late stages mature collagen bundles are seen with a gross and microscopic appearance similar to tendon (Hunter and Ogdon, 1975). These bands are not vascular. The cells are mature fibrocytes.

The question of biochemical changes in apparently uninvolved fascia is of considerable aetiological significance. Brickley-Parsons et al (1981) noted biochemical changes before cell changes. Delbruck (1985) has also shown that DNA synthesis is increased in apparently normal fascia.

Rabinowitz et al (1983) have noted changes in the lipid composition of palmar fat in DC and have suggested these may be due to mild hypoxia.

Various attempts have been made to relate pathological and biochemical features to prognosis. Tyrkko and Viljanto (1975) correlated the microscopic appearance of several active nodules with a high frequency of post-operative recurrence. Gelberman et al (1980) have related recurrence to the finding of myofibroblasts in the nodules. They showed these cells in 7 of 24 patients.

The mechanism of contracture is unknown. The myofibroblasts may play an active contractile role rather like that seen in a healing wound. Alternatively, the fibroblastic tissue may simply act to stiffen the delicate palmar fascial bands. Thereafter extension from the neutral position is prevented. Progressive contracture may be due to incremental loss of extension range (a rachet effect). Dupuytren;s Disease, like scar tissue, produces contractures on the flexion surface of the hand, as this is the concave surface in the resting position. Brickley-Parson et al (1981) have suggested resorption and remodelling of the collagen rather than coiling or crimping.

A Lancet editorial (1986) suggests that DC may be a traumatically induced fibrosis "in which the faulty regulation of collagen production is specifically associated with the particular genotype" thus drawing together many of the pieces of the jigsaw.

CHAPTER 8

RELATED FIBROMATOUS LESIONS

a Knuckle Changes

b Plantar involvement

c Peyronie's Disease

a Knuckle Changes

Archibald E. Garrod wrote in 1893 "On an unusual form of nodule upon the joints of the fingers", his observations being purely clinical; no histological examination had been performed. He described three patients:-

1. A young man aged 20, "the patient came of a gouty family. His paternal grandfather having been a martyr to that disease". His father had Dupuytren's Contracture. "Nodules of about the size of half a hazelnut" had appeared at the age of 13 and projected from the joints of several fingers. The skin could be moved over the nodules and they could be moved over the deeper structures. Two of the nodules were situated over the end joint of the thumb. The lumps were painful and there was one upon the ball of the left great toe. Two brothers had similar nodules.
2. A woman aged 59 - nodules were situated upon the first interphalangeal joints (pip joint) not centrally upon the dorsal aspect, but rather to one

side. Some had persisted for 30 years.

3. A man of 43 - these nodules were situated over the middle joints of the fingers, the end joints of the left little finger and over the mp joint of the right ring finger. There was "an induration and some puckering of the skin" of the left palm "indicating the commencement of Dupuytren's contraction".

In summary, the nodules appeared in early life, 13 to 17 years, apparently precipitated by injury in some. The nodules appeared fibrous - "originate in bursae - have become the seats of fibrous tissue growth". Garrod described the lesions as "pads" in an article in 1904. Additional names have been suggested and abandoned. Garrod's original cases therefore may have had nodules due to a number of possible aetiologies. One patient had nodules on the ip joint of the thumb, which would be very unusual in Dupuytren's disease. There is no clear reference in the literature to nodules at this site, although they may occur. Two patients did not have Dupuytren's disease.

Lund (1941) in investigating the correlation between Dupuytren's disease and epilepsy in Denmark found 29% of men and 13% of women with epilepsy to have knuckle pads. Skoog (1948) found that the incidence of knuckle pads in Dupuytren's disease was 44%. He found the nodules most pronounced in the ulnar fingers and no nodules were found in the thumb. He found no relationship however between knuckle pads and the degree of Dupuytren's contracture, nor was their occurrence confined to the contracted digits. Skoog described knuckle pads as being fairly well defined, round or somewhat irregular in shape and rarely symmetrically developed over the joint. He considered the process to be definitely connected to the extensor mechanism of the finger, since when this was stressed the nodules could no longer be shifted laterally. Mikkelsen (1977) has considered their incidence. In his large series of examinations he examined all patients with Dupuytren's contracture for knuckle pads, but only a sample of normal controls. His criteria were subcutaneous thickening over the dorsal aspect of the pip joints of the fingers, mobile over the joint capsule but adherent to the skin. His incidence was:-

		No.	Knuckle Pads	%
Men				
	Normal subjects	752	68	9
	Dupuytren's	623	303	48.7
Women				
	Normal subjects	1119	96	8.6
	Dupuytren's	246	82	33.3

Knuckle pads therefore, although occurring in the general population, were much more common in persons with Dupuytren's Disease.

During this investigation, differential diagnosis was made with Heberden's nodes at the pip joints, Bouchard's nodules, (the original report of this condition requires to be traced) and capsular swellings. Simple occupational keratoses were considered other sources of confusion. In relation to these other possibilities, he felt "none created real problems" as the knuckle pad was "situated in the mid line". Mikkelsen did not feel that his results supported the suggestion of a higher predisposition and more aggressive disease when knuckle pads accompany Dupuytren's Contracture.

Hueston (1963) described knuckle pads as part of the Dupuytren's Diathesis. He believes that knuckle pads can occur over any joint, that is pip or mp, or even ip joint of thumb. They require to be sharply dissected off the extensor apparatus. He suspected that Mikkelsen may have confused other lumps with knuckle pads. Hueston (1984 and 1985e) discussed the nature of knuckle pads, and in particular the fact that although the pads are histologically similar to palmar nodules, they do not produce contraction. He noted the anatomical situation of the knuckle pad over the joint lines and considered that the mechanical effect of ip flexion prevented longitudinal contracture. By comparison, a unique nodule occurring between the joint lines (Hueston, 1984) was associated with contracture producing a Boutonniere deformity. He believed the dermis to exert a role in the subcutaneous space in the dorsum of the digit similar to that postulated in relation to the palm. He also described depressions over the pip joint as sometimes preceding the appearance of nodules. Addison (1984) suggested knuckle pads may cause extensor tethering.

The Author's Observations

In the author's experience the exact definition of a knuckle pad is difficult. Review of published works suggest that Garrod's patients were a heterogenous group. Other authors have tended to avoid or simplify the precise definition. There is no general agreement as to whether they are attached to skin or joint capsule.

With this problem in view the author has attempted to answer the following questions:-

1. What is the normal anatomical arrangement of the wrinkle skin over the pip joint?
2. In what way does this differ from the normal in Dupuytren's Disease?

The Normal Anatomical Arrangement of the Wrinkle Skin

In the resting posture of the hand the skin over the dorsum of the pip joints lies comfortably over the joints and shows incomplete eliptical creases proximally and distally and concave towards the joint line. When the finger extends from the rest position the skin laxity becomes more apparent and curved transverse corrugations are apparent in an oval area as before. There is a lateral sagginess of redundant skin. The skin proximally and distally does not move in relation to the underlying phalanges. The arrangement of skin attachment ligaments has been fully investigated by Dr. Penelope Law and her findings are noted in full in appendix 2.

Swellings over the finger joints in association with Dupuytren's Contracture were noted by Archibald E. Garrod, Assistant Physician at St. Bartholomew's Hospital in 1893, and later described in the British Medical Journal (1904) as "pads".

Prior to the reports of Garrod (1893 and 1904), Sir James Paget, had written in the British Medical Journal (1875), "On the Minor Signs of Gout in the Hands and Feet" and described the "formation of abnormal bursae". He described the evolution of such a swelling as follows, "this soon became thickened and hardened, and almost rigid, and all the integuments over it grew thick and dense, so that a considerable nodular mass was the result; not, however, let it be observed, connected at all with a diseased articulation, but situated only in the subcutaneous tissue just beneath the integument". This curious description may today be confusing unless one appreciates the rather wider scope of the diagnosis "gout" in the nineteenth century; contracture of the palmar fascia "was often characteristic of gout".

Skoog (1948) has reviewed the literature of this condition and the origins of the terms 'Finger knochel polster', 'Coussinets des phalanges', 'symmetrischer Fibromatose', 'Helodermia', callosites dorsodigitales', 'keratomes en nappe de mains', 'keratosis supracapitularis'.

It has been suggested that knuckle pads occur in sheep shearers (Wilson, 1972) and other occupations (Hueston and Wilson 1973), but epidemiological evidence is lacking.

As previous accounts do not adequately describe the clinical signs present in the wrinkle skin, a study was undertaken to record the frequency of knuckle pads and other knuckle changes not previously described.

Clinical Study

Fifty patients attending for consultation with various stages of Dupuytren's Disease have been examined and photographic records made of the appearances of the wrinkle skin over the dorsum of the proximal interphalangeal joints with the digits in full extension, contracture permitting. Unsatisfactory photographic records were excluded and the findings in 240 digits analysed. Photographs inadequately displayed thumbs; these digits have, thus, been omitted from the report. The normal appearances were established by examination of a large number of normal hands and photographic records.

Results

The wrinkle skin, which is apparent on full extension of the digit (Fig. 1) is much less obvious when the hand is in the neutral resting position (semiflexed). There is considerable individual variation in the development of these wrinkles. The appearance of the wrinkle skin reflects the range of joint motion which is achieved; it disappears in the stiff or arthrodesed joint. In the normal hand the skin is thrown into a series of wrinkles forming a transverse oval ellipse. The skin wrinkles proximal and distal to the joint are concave towards the joint line and the centre of the wrinkle skin area.

ON AN

UNUSUAL FORM OF NODULE UPON THE JOINTS OF THE FINGERS.

BY

ARCHIBALD E. GARROD, M.D.

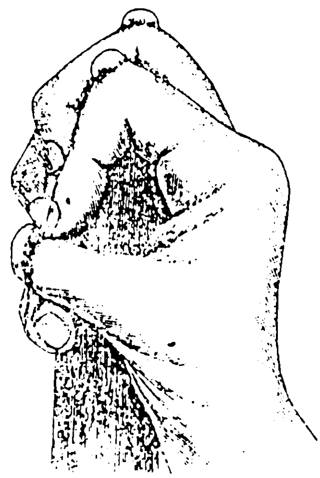


Fig. 8.1a

Fig. 8.1 Knuckle changes.

b

A knuckle "pad".

c

Hyperkeratosis most marked in the index. The middle finger shows a common pattern of loss of the distal skin wrinkles and slight tethering of the proximal wrinkles.

d

Marked skin tethering in the ring finger.

Fig. 8.1

e

A skin thickening is apparent in the index finger. In the middle and ring fingers a discrete lump is palpable.

f

The loss of wrinkles in the middle finger reflects a joint stiff in extension and is not a specific sign of DD, but changes are apparent in the other digits.

g

The arrow indicates the line of the natatory ligaments to the dorsal skin over the pip joint. Contracture of these structures may be the cause of proximal tethering.

TABLE 8.I

KNUCKLE CHANGES IN 240 DIGITS OF 50 PATIENTS

	Contracted digits	Digits not contracted	Contraction not recorded
Loss of distal wrinkles	32 (13.3%)	76 (31.6%)	8
Proximal tethering	7 (1.7%)	79 (32.9%)	4
Thickening	11 (4.6%)	71 (29.5%)	4
Lump	18 (7.5%)	39 (16.25%)	-

There was a tendency towards loss of the distal wrinkles in 83% of all digits involved. This loss was associated with skin thickening or a discrete nodule in 45% of digits. Proximal tethering of the proximal wrinkles was noted in 56% with deeper valleys between the skin wrinkles and a suggestion of tethering of the skin by a deep contracture process.

Nodules were noted in 71 digits (29.5%) and skin thickening in 70 digits (29.4%) (see Table 8.I). When grouped together, the nodules and thickening were noted in the central area in 60 digits (25%), off centre on the radial side in 21 digits (8.75%), on the ulnar side in 35 digits (14.6%), and on both sides of the mid line in 25 digits (10.4%). Nodules or thickenings without tethering were apparent in 77 digits (45%).

There was a degree of hyperkeratosis of the skin apparent on clinical examination in 91 of 240 digits, or 38%. Sequential recordings were made in 5 patients over a period of up to five years. In one, the knuckle pads appeared to develop and in another to regress. Others showed little change.

The status of these 50 patients' hands with respect to Dupuytren's Disease was as follows:-

22% of the hands were supple and soft while 44% of the hands were in a relatively quiescent stage, with obvious disease, but not needing surgery at the time. 35% of the hands needed surgery at the time of the interview.

Discussion

This study suggests that, a) knuckle pads are part of a spectrum of knuckle changes which occur in almost all Dupuytren's patients (87% digits) (at least one digit in every patient series), b) that they are not indicative of the stage of palmar disease or its severity.

One hundred and forty one (58.75%) digits had either a nodule or thickening on clinical assessment. Previous reports on knuckle pads have not clearly distinguished between these two types of skin changes which may explain the wide difference in reported incidence. Attention has not been drawn previously to changes in the skin wrinkle pattern except in a case report (Hueston, see above) in which he suggests that tethering may be a precursor of knuckle pads.

The finding of knuckle changes in 100% of this series of patients with Dupuytren's Disease suggests that palmar contracture, although being of considerable functional significance to the patient, is not an indication of the extent of pathological change. Knuckle changes are present even in non-contracted fingers (see Fig. 8.1). Dupuytren's Disease seems to be a widespread affliction of the connective tissues, although manifestations become focused on the palm of the hand.

The importance of this finding requires further clarification by epidemiological survey. The recognition of a diffuse set of knuckle changes may prove useful in recognizing the Dupuytren's-prone patients long before "Garrod's nodules" become apparent and before palmar changes develop.

<u>Summary</u>

In a series of 50 patients with Dupuytren's Disease changes in the skin overlying the (proximal interphalangeal) finger joints have been found in 83% of all digits. Each of the patients had at least one affected digit. The knuckle changes consisted of:-

1. Loss of distal skin wrinkles.
2. Tethering of proximal wrinkles.
3. Thickening or a definite lump associated with hyperkeratosis.

The frequent finding of knuckle changes and their occurrence in non-contracted digits indicates that the pathological changes of Dupuytren's Disease are widespread within the tissues of the hand and not confined to the palmar fascia.

b Plantar Manifestations

Perhaps the greatest significance of involvement of the foot is that it does not appear to be associated with contracture. Dupuytren (1831) alluded briefly to its occurrence and curiously he did associate it with a contracture, but regrettably no account has been found. Astley Cooper (1822) grouped finger retraction together with hammer toe. It has since been assumed that the conditions have no features in common, but perhaps this view requires further thought. Ledderhose (1879) wrote on the plantar manifestations and his name is often applied to this condition. He observed 50 cases in whom nodules developed after a long period of immobilisation. The entire anterior part of the foot was bent in contraction, but this may not have been due to a contracture of the aponeurosis but rather a simple equinus deformity. It is not entirely clear therefore that Ledderhose was describing the same condition. Skoog (1948) considered the anatomy of the plantar aponeurosis. This appeared well protected from external injury, but its medial part seemed exposed to considerable internal strain. The forces affecting the

TABLE 8.II

SUGGESTED FOOT DEFORMITIES

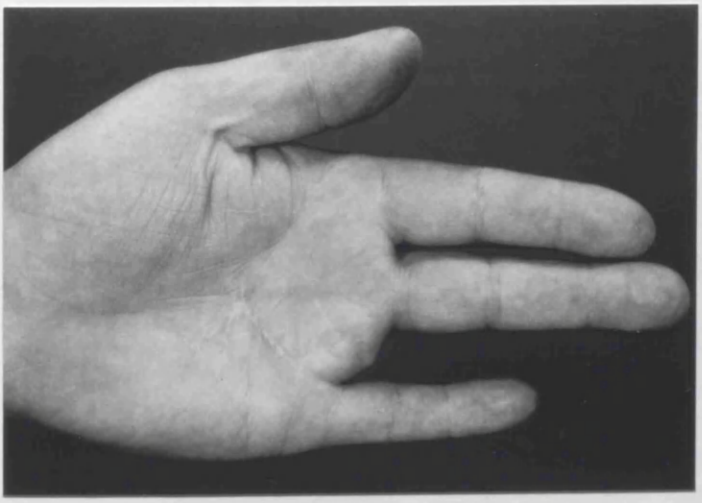
Dupuytren	-	1831	-	not specified
Cooper	-	1822	-	Hammer toe
Ledderhose	-	1897	-	Equinus?
Auvray	-	1929	-	Hallux flexed and valgus
Cokkalis	-	1926	-	Dorsiflexion of hallux
Fairbanks	-	1932	-	Pes Cavus
Powers	-	1934	-	Plantar flexion of great toe
Lund	-	1941	-	1 of 25 cases incipient contraction of toes
Skoog	-	1948	-	1 Hallux valgus 1 Hammer toe

Fig 8.2

a

Lump on sole of foot treated by local surgical excision. Referred to the author for more radical excision.

b



Patient confirmed the suspicion of DD by describing an amputation of his ring finger for Dupuytren's Contracture. Further surgery on foot avoided.

plantar aponeurosis appeared to be mainly longitudinal and its structure was predominantly orientated in this way by comparison with the complicated arrangement of fasciculi in the hand. Skoog felt that the perpetual "training" in walking kept the plantar aponeurosis in good functional condition and in fact walking counteracted shrinkage of scar tissue. Skoog reviewed the previous literature. Pickren et al (1951) reported a series of 16 cases treated by operation and found 104 additional cases in the literature. After local excision all but two of their own cases recurred. Amputation was performed in two patients, the misdiagnosis of fibrosarcoma being made in at least one. Recurrences were treated by re-excision or irradiation. More recent writings have advocated selective indications for operation, these being either pain or walking difficulty from the size of the lump (Gordon, 1964; Curtin, 1962; Hueston, 1963; Stoyle, 1964; Snyder, 1980; Tamas and Korom, 1980; Cavolo and Sherwood, 1982).

Villiger (1982) by contrast adopts a more radical approach believing surgery to prevent contracture. The tendency of the lesions to recur after surgery is well emphasized by Lettin (1964). Tamas and Korom (1980) and Gibson (1980) have advised the use of skin grafts. Snyder (1980) prefers orthoses to surgery.

In summary therefore, involvement of the foot seems uncommon (Lund, 1941). Hueston has considered it as a diathesis factor. Skoog (1948) has described the anatomy. The pathology has been clearly outlined by Pickren. Treatment seems to have a poor outcome.

Although foot deformities have been suggested in association, these do not seem to have been clearly established by dissection in most cases. The suggested deformities are outlined in the table. It is the author's view that operation should be avoided. Regrettably, the condition appears to be largely unknown to general and orthopaedic surgeons and many cases still receive multiple operations before the true nature becomes apparent (Fig. 8.2).

Wheeler and Meals (1981) reported a rare case with plantar and palmar disease and nodules in the popliteal fossa.

c Peyronie's Disease

Peyronie's disease or induratio penis plastica is an unusual condition characterised by a sclerotic plaque on the dorsum of the penis. The symptoms are of painful deflected erections. Many patients may be asymptomatic or not prepared to seek medical advice; the incidence of the condition in the population therefore is not known. A number of reports have related the condition to

Dupuytren's disease. The coincidence of the two conditions was first mentioned by Kirby (1849) and Skoog (1948) has summarised the early literature. Lund (1941) reported three cases in 100 epileptics, two of whom suffered from Dupuytren's contraction. Nyberg et al (1982) have identified an inherited from of Peyronie's disease with autosomal dominant inheritance and associated with Dupuytren's contracture and histocompatibility B7 cross reacting antigens. They documented the familial transmission of the disease in three pedigrees. Dupuytren's contracture occurred in seven of nine affected individuals. The author has undertaken treatment of the disease in two individuals by the technique of Horton and Devine in which the plaque is excised and replaced by a free dermal graft from the abdomen. The author has not specifically made enquiries about this condition. Patients are not routinely examined for it and the true incidence remains unknown.

III ANATOMY

CHAPTER 9

ANATOMY OF THE PALMAR FASCIA:

REVIEW OF THE LITERATURE

There has long been an awareness of the specialised internal fascial structures in the hand. The recognition of organized anatomy may even be considered to date back to the illustration of palmar creases in cave drawings. Graham Stack (1973) in his book the Palmar Fascia has reviewed the history of this anatomical awareness and mentioned Albinus (1734) as an early source. An even earlier account curiously printed in the English language by Bartholinus (1668) has now been uncovered by David Elliot. Bartholinus states, "to the muscles of the wrist and the hollow of the hand is the musculus palmaris referred, arising from the inner apophysis of the arm, with a round and tendinous beginning, spread almost over all the muscles of the hand, it is stretched out over the hollow of the hand, and cleaves exceeding fast to the skin: where under the skin in the hollow of the hand is a broad tendon; whence proceeds that exquisite sense which is in that part: and it ends into the first intervals between the joints of the fingers: _it seems to have been made, that the hand might take the better hold, when the skin of the palm is wrinkled_". This early account, remarkable for its clarity and clear printing, is also very far seeing in its relationships of form and function.

Albinus (1734) recognized that the palmaris longus was made up of four broad portions each of which passed to one of the fingers. At their terminations the bands became two-pronged and the prongs passed one on either side of the superficial and deep tendons. This arrangement will be described later in this account as layer two of the longitudinal fibres.

Weitbrecht (1742) collectively described the ligamentous structures of the hands under the term syndesmology (Fig. 9.1). He classified the palmar fascia as a ligamentous expansion in the palm and recognized the several planes of this fascia. Graham Stack (1973) presents the following translation, "Around the end of the digits (presumably proximal) special fibres form distinct circles and rings which hide not only the nerves and arteries which run into the fingers, but also the flexor tendons and the soft bodies of the lumbrical muscles which they surround and unite".

At that time, the loose fascial subcutaneous planes (of the hand and elsewhere) were generally referred to as the cellular membrane, as mentioned in lectures by William Hunter. This designation perhaps predicted the future importance which would be attributed to palmar fat.

Fig. 9.1 Weitbrecht (1742) described in detail the ligamentous structures within the hand. Here the deep transverse metacarpal ligaments are shown.

Detailed anatomical description therefore predated Dupuytren who also had a much greater knowledge of the anatomy of the palmar fascia than is often appreciated. He recognized the four longitudinal pre tendinous bundles each dividing to allow the passage of the flexor tendons. Each of these branches of this bifurcation became fixed to one side of a phalanx and not to the anterior surface as so many anatomists, according to Dupuytren, had previously believed. These were the slips of fascia which he considered should be divided "whenever the operation became necessary".

Goyrand (1833) considered that Dupuytren's contracture occurred in tissue "de nouvelle formation". By contrast in a discussion of his paper Sanson (1834) made the statement "that the contracted bands were only the exaggeration by fibrous tissue of the aponeurosis which existed in health". This was really the first clear statement that Dupuytren's disease follows anatomical pathways.

Bourgery (1834), writing from Paris, used the term "palmaire grêle" for the palmaris longus and found a variable number of pre tendinous bands, as many as six or eight, more than reported by later authors. He noted as many as three bands belonging to the index. He described the transverse subcutaneous (natatory) ligament and, in particular, its inferior border. In the intervals between the fingers there were two little bands beside each other which spread out to form an angle like a Gothic arch and came to cross like an X on the fibrous flexor tendon sheaths of the middle and ring fingers. Thus Bourgery described a continuity between the transverse fibres (natatory ligament) and the flexor tendon sheaths.

The work of Maslieurat-Lagémard published in the Gazette Medicale de Paris in 1839 shows the considerable interest in palmar anatomy in the Hotel Dieu at that time. Graham Stack (1973) has presented a translation of this important work and this will be discussed in a modified form after review of the original work. Maslieurat-Lagémard considered the longitudinal fibres (pre tendinous languettes) to form gutters with the concavity backwards. On the insertion of the languettes he quoted several opinions, Dupuytren, Cruveilhier, Gerdy and Blandin. Maslieurat-Lagémard classified the aponeuroses of the hand as dorsal and palmar both presenting superficial and deep layers. The palmar surface he considered more complex. The deep (palmar) layer covered the anterior surface of the interosseous muscles; the superficial part had median, thenar and hypothenar components. The median part he viewed as a triangular sheet and the fibres which constituted this part were large and distinct, longitudinal and of remarkable strength. He provides an excellent discussion of the insertion of the longitudinal fibres which reach to the level of the mp joints and insert on the deep surface of the skin giving greater thickness to the skin and combining to give the little pulpy swellings which one can see on either side of the pretendinous bands (Fig. 4.4) at the base of the fingers (monticuli). When the fingers are strongly extended one deeper fibrous band, which is continuous with the sheaths of the flexor tendons, depresses the skin at this level thereby augmenting the swellings. The pre tendinous languettes are four; one for the base of each finger. As they arrive they tend to become wider and thinner and to form a gutter which is concave posteriorly and which embraces the flexor tendons at a point where they leave the palm and plunge into the fibrous tendons sheaths on the front of each finger. At the level of the mp joint, when the fibrous band commences to hollow out into gutters to embrace the flexor tendons, it thins out and this increasing tenuousness allows easy flexion. Beneath the three fibrous languettes which adhered to the skin are found three hoops formed by circular fibres which turn and run from one finger to another. Of the lumbrical canals he said - the fibrous arcade in front and the intermetacarpal ligament behind and the corresponding metacarpal bones on either side form an almost circular opening which allows the cellular tissue at the base of the fingers to continue with that which occupies the central and subaponeurotic parts of the hand. In relation to the web folds, he attributed to Professor Gerdy a description the fibrous lamellae which augment their shapes (natatory ligaments). In discussing the termination of the languettes he quoted the opinion of others. He offered an explanation for the differing opinions. He believed that if the dissections were not done very carefully then that part of the aponeurosis found at the level of the mp joint could be lifted thus giving the appearance of two bifurcating languettes. The anterior prolongation of the languettes was seen to be continuous with the tendon sheath and to extend to the lateral borders of the proximal phalanx as Dupuytren described.

Therefore as early as 1839 Maslieurat-Lagémard had produced a clear account of the overall arrangement of the palmar fascia and had even appreciated errors which may arise in dissection. He also undertook injection studies of the synovial sheaths of the hand and it therefore seems that his work had a high degree of precision. Grapow (1887) noted the four longitudinal pretendinous bands as previously described and in every hand he considered that there was an analagous strand for the thumb. The longitudinal strands could be clearly seen as far as the web where part of the fibres was lost into the skin, but others bent towards the transverse part of the fascia. A third part ran through the natatory ligaments and continued on both sides of the fingers where the fibres then penetrated to the fatty tissue and became continuous with the periosteum and with the skin itself, particularly at the flexion creases of the fingers. These fibres may have been similar to the ones later described by Cleland. In describing the transverse fibres he noted a transverse sheet which only reached as far as the mp joint. He presented an excellent description of the natatory ligament and described four trapezoid web spaces outlined between the transverse and longitudinal fibre systems. He described this area as forming a bellows mechanism for the pumping of blood and lymph out of the fingers, suction being applied when the fingers were spread.

Legueu and Juvara (1892) presented a particularly valuable account and acknowledged the work of Maslieurat-Lagémard. This is perhaps the most comprehensive account which has been published on the anatomy of the palmar fascia and although unknown to the present author at the time of performing his dissection studies the overall plan was found to be surprisingly similar, although differing in detail. They were well aware that the fibrous fascial structures of the hand form a continuum although to facilitate description one must artificially dissociate the elements. They divided the fasciae into five distinct parts.

1. The "vertical" superficial palmar ligament now called the longitudinal pre tendinous bands (Fig. 9.2).
2. The superficial transverse ligament (the transverse fibres of the palmar aponeurosis or fibres of Skoog).
3. The interdigital ligament (the superficial transverse ligament of the palm, also called the natatory ligament, Grapow's ligament or the Schwimmband).
4. The deep transverse ligaments of the palm (the deep transverse metacarpal ligaments).
5. The fibrous sheaths of the tendons, muscles and neurovascular bundles.

They described the detail of the pre tendinous longitudinal fibres dividing into pre tendinous languettes with pre lumbrical areas between. They described the distal insertions of the longitudinal fibres to:-

a) skin of the fingers and palm.
b) fibres to the deep aponeurosis.
c) the perforating fibres.

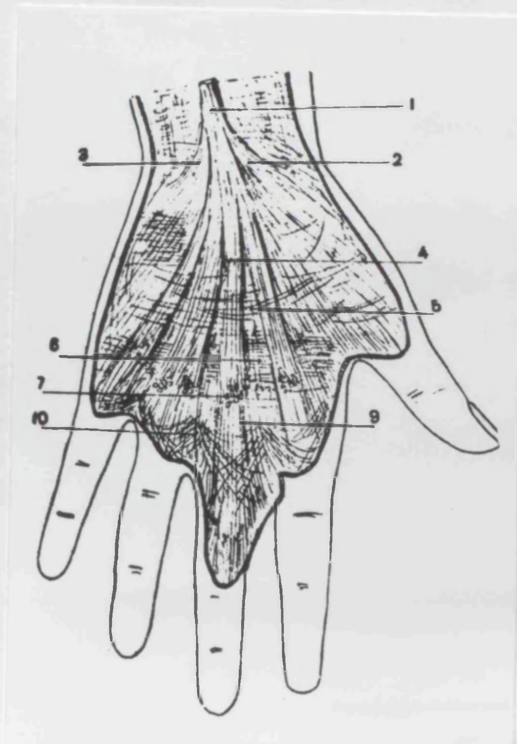


Fig. 9.2 Legueu and Juvara (1892).

4 Pretendinous longitudinal fibres.

5 Prelumbrical areas.

10 Interdigital ligament.

a) They understood the formation of skin pits in Dupuytren's contracture.

b) Where the palmar aponeurosis is detached proximally and turned downwards (Fig. 9.4) these fibres can be seen on its deep surface passing between the tendons. They form partitions on either side of the tendons (Fig. 9.3).

c) The perforating fibre (Fig. 9.5) are distal continuations of the pre tendinous fibres which pass deeply and do not end in the deep aponeurosis but traverse it and perforate it to the level of the deep transverse ligament to surround the metacarpophalangeal articulations forming a complete circle and inserting to the extensor tendon over the metacarpal head. These fibres are well shown histologically by Stack and diagramatically by Kaplan and Zancolli (Fig. 9.6).

They describe a formation of a "palmar tendinous sheath" from the pre tendinous languettes, the transverse fibres, the deep aponeurosis and continuing distally into the flexor tendon sheaths of the fingers. The diagrams presented by these authors are, however, slightly difficult to follow. In particular, the level of the cross-sections is not plain and this allows a misinterpretation in relation to the level of the perforating fibres. Many authors have considered these lie beneath the fibres of Skoog, but it is likely that

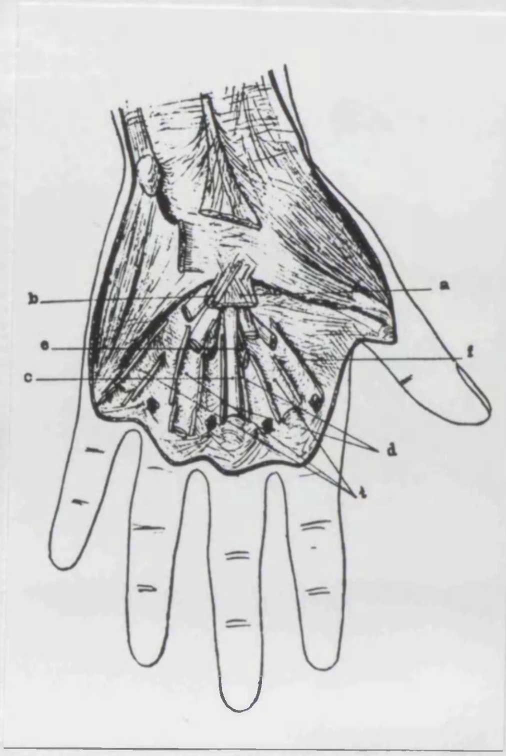


Fig. 9.3 Legueu and Juvara (1892).

f Deep attachments of palmar aponeurosis forming longitudinal paratendinous septum.

t Deep aspect of the fibrous flexor tendon sheaths formed by the pretendinous septa, flexor tendons removed.

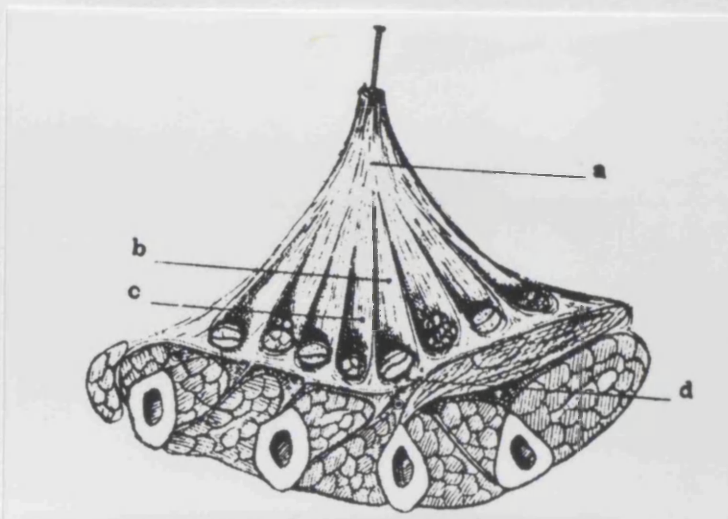


Fig. 9.4 Legueu and Juvara (1892)

Horizontal and transverse cut section of the palm at the level of the metacarpal necks.

a The superficial aponeurosis has been retracted. At b and c the pretendinous fibres can be seen detaching from the aponeurosis and forming the sheaths of which the upper openings can be seen. At d the internal and external fibres can be seen forming the deep aponeurosis under the tendons.

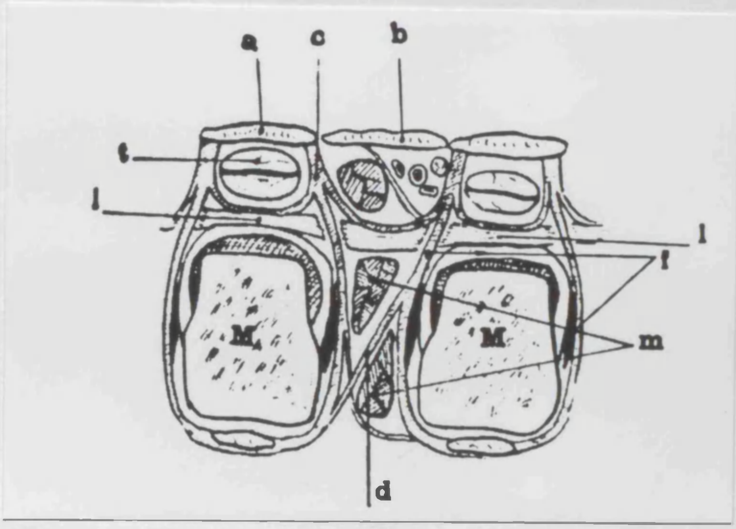


Fig. 9.5 Legueu and Juvara (1892).

Cross section of the hand at the level of the heads of the metacarpal bones (m).

a Pretendinous band.
b Prelumbrical band
(a and b together form the palmar aponeurosis).
c longitudinal septum attached to the deep palmar fascia, in this region partly penetrating the transverse metacarpal ligament (l) reaching the dorsal aspect of the hand (d and f) (m interosseous muscles) (t flexor tendons).

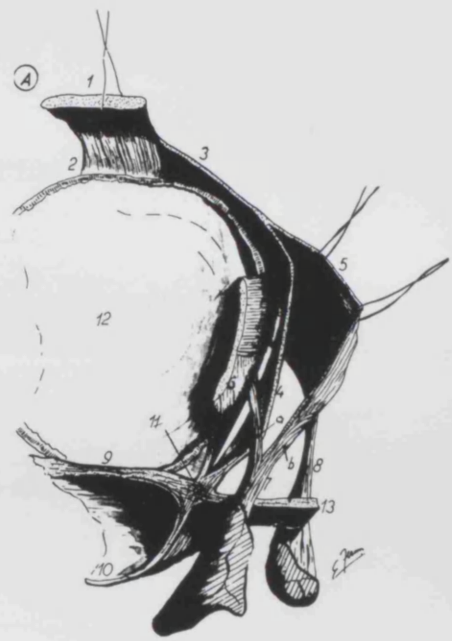


Fig. 9.6 Perforating fibres Zancolli (1979).

11 'Force nucleus' where flexor sheath and transverse metacarpal ligament meet.

12 Base of proximal phalanx.

3 and 4 Perforating fibres of Legueu and Juvara

they lie more distally between the metacarpophalangeal joints (Fig. 9.7).

In the 20th century standard reference texts have paid less and less attention to fine detail of gross anatomy where it does not seem to have surgical application. Gray's anatomy showed much greater precision in line drawings of the 19th century editions than more recently. The dawning of the age of microvascular surgery has concentrated the surgeons attention on finer structural detail and has brought surgeons back to the dissecting rooms (McGrouther, 1981). Early this century anatomical interest was focussed on the palmar spaces and potential spaces because of relevance to infection (Kanavel, 1925; Anson and Ashley 1940; Bojsen-Moller and Schmidt, 1974). A decline in infections has rendered palmar space anatomy of less interest.

Kalberg (1935) classified the palmar fascia according to the different patterns of pre tendinous fibres in an examination of 400 hands. He described the varying patterns of pre tendinous fibres to each digit. This paper emphasized the individual variation although the classification has proved of little practical value. Horwitz (1942) was unable to demonstrate the vertical fibres described by Legueu and Juvara. Skoog in his

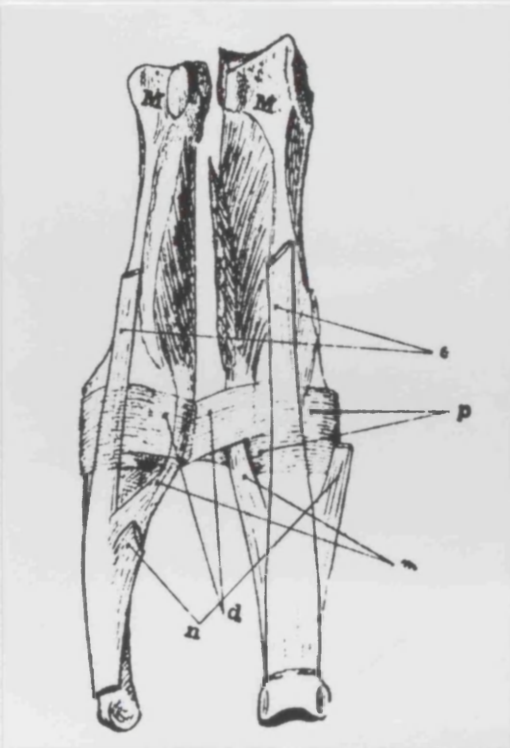


Fig. 9.7 Legueu and Juvara (1892).

p Perforating fibres.

classic monograph of 1948 reviewed the anatomy of the digits and palm. In particular, he stressed the importance of the superficial transverse palmar ligament (Fig. 9.8). Wood Jones (1949) presented an excellent monograph on the anatomy of the hand and included an illustration of the fascia which showed five pre tendinous bands running in continuity to the volar aspects of the digits (Fig. 9.9). Iselin (1955) was one of the first to describe the displacement of the digital nerves. He appreciated that some of the fibres of the pre tendinous bands passed to the skin at the level of the metacarpal heads. He described the passage way between the hand and the fingers similar to that described by Legueu and Juvara. In the fingers he noted a fine sagittal sheet separating the digital canal from the neurovascular bundle. In the passageway from the hand to the fingers he suggested that the space in the lumbrical and neurovascular canals became obliterated and the vessels and nerves come into immediate contact with the walls. In addition the fine tracts which unite the fascia to the skin of the web are affected, and finally the interosseous fascia is itself invaded and forms deep nodules which pass to the fingers. He suggests that retraction of this system might produce hyperextension of the distal phalanx and a Boutonniere deformity. Millesi (1959) discussed the fibre systems in the palmar fascia. He referred to the work of Kalberg and also noted the possibility of the

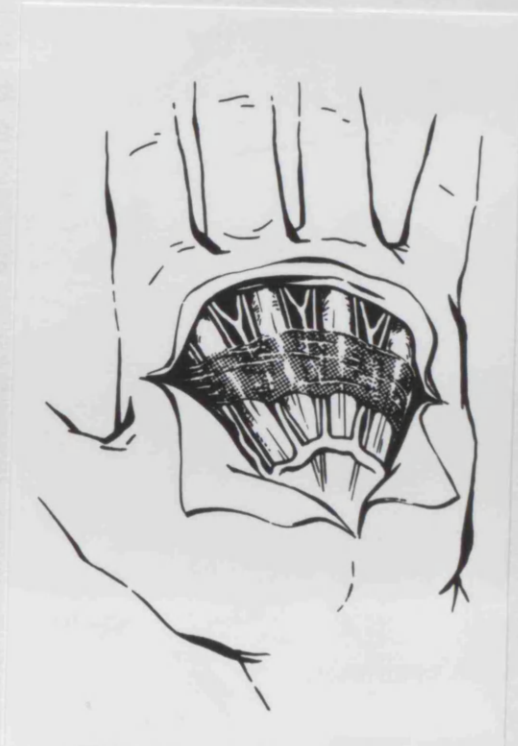


Fig. 9.8 Skoog (1967).

The transverse palmar ligament (PNA transverse fibres of the palmar aponeurosis) after removal of the longitudinal pretendinous bands. Skoog reported that this ligament is never the site of pathological lesions indicative of DD.

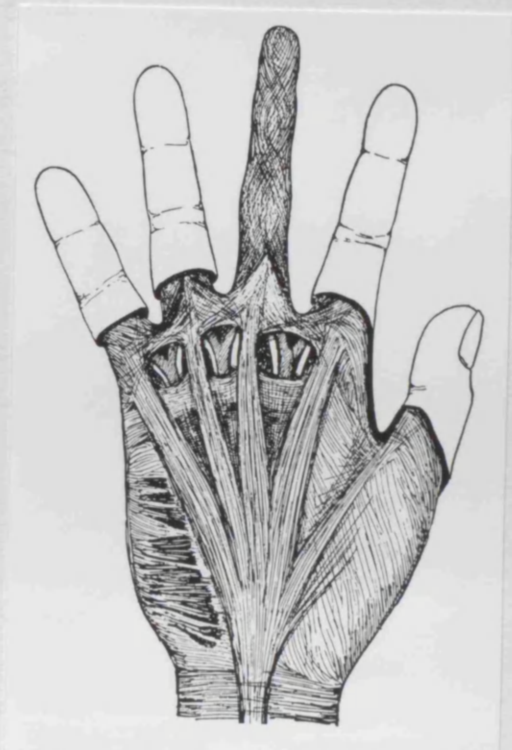


Fig. 9.9 Wood Jones (1941)

The fascias of the palm of the hand. Wood Jones shows the longitudinal pretendinous fibres of the fingers as merging with the natatory ligament, and this description is at variance with Thomine (1965), Gosset (1967), McFarlane (1974) and McGrouther (1982). Zancolli (1979) however agrees.

pretendinous fibres to the ring and little fingers arising together. He drew attention to the similarity between the architecture of the palm and the heel, with the formation of many small separate spaces containing lobules of fat. Kempf and Gonzalo-Vivar (1962) described the fibrous tissue systems surrounding the head of the metacarpals with the extensor expansion linked to the palmar plates and the deep transverse ligaments of the palm. They described this junction of the fascia as a goose's foot, the fibrous cross-roads on either side of the flexor tendon sheaths having articular capsule lamina transversa, the intermetacarpal ligament and the intertendinous partition. They remark on the importance of this junction; the whole system stabilises the flexor, extensor and interosseous muscle systems together and unites the systems with the bone. They emphasize, however, most importantly that this system surrounds the metacarpal heads, without an actual attachment to them (Fig. 9.6). They describe the perforating fibres of Legueu and Juvara, but feel that these are rare structures agreeing with Landsmeer's (1949) work.

Thomine (1964) found that in the palm all his preparations demonstrated the abrupt stopping of longitudinal fibres to the palmar aponeurosis by insertion into the skin. Gosset (1967 and 1985)

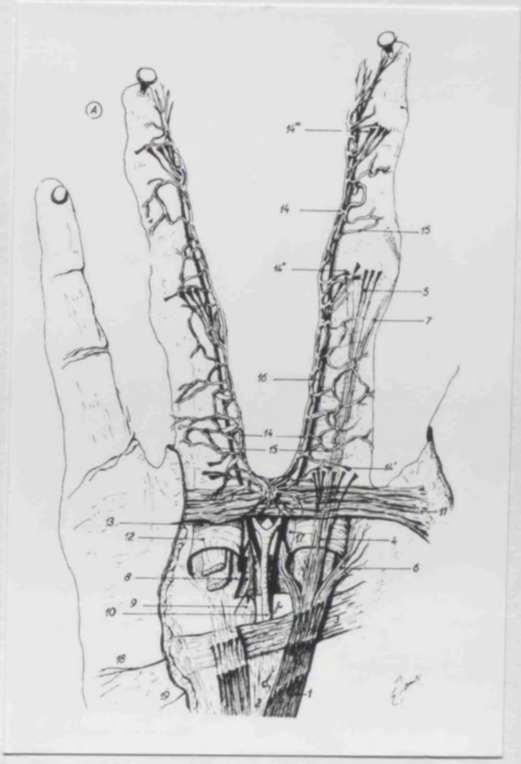
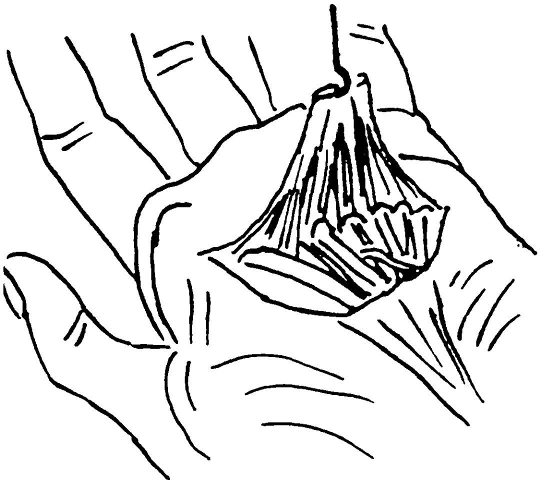
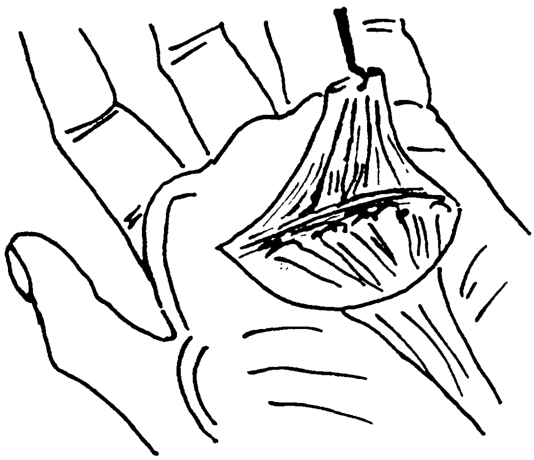


Fig. 9.10 Zancolli (1979) shows the longitudinal pretendinous fibres as having two terminations. Fibres (4) insert into the skin over the natatory ligament. The author considers the major part of this insertion to be more proximal (Chapter 10). Zancolli shows an insertion of some pretendinous fibres to the skin over the transverse fibres (at the distal palmar crease). Most authors disagree (see text).



Diagramatic representation of the arrangement suggested by Legueu and Juvara (1892) as shown in Figure 9.4.



The author has found however that the pretendinous fibres can be elevated from the transverse fibres and that the pretendinous fibres do not pass deeply until a point distal to the transverse fibres, Chapter 10, Figure 10.6.

Fig. 9.11 Reflection of the pretendinous fibres distally.

Overall Plan of Anatomy

To compare the different anatomical accounts, it is necessary to present a general plan (Fig. 9.12) and, where the descriptions of the various authors vary, to standardise the anatomical nomenclature. There is less controversy in relation to the transverse ligamentous systems. The major confusion in this area arises from confusion in terminology. In particular, the term "superficial" is applied to a number of structures lying at different levels. The two main transverse fibre systems are:-

Distal transverse fibre system - these are the fibres which span the distal palm and are situated at the palmodigital junction. These fibres have been described by Bourgery (1834) and by Gerdy, Legueu and Juvara called these the interdigital ligament. Grapow called this the Schwimmband. Standard anatomical nomenclature uses the term superficial transverse metacarpal ligament which is confusing. The best term appears to be the natatory ligament.

Proximal transverse fibre system - these are the fibres described by Skoog (1948). Legueu and Juvara called this the superficial transverse ligament, and it has been termed in the P.N.A. the transverse fibres of the palmar aponeurosis. This system has also been described by Bourgery (1834) and by many other authors. Extension

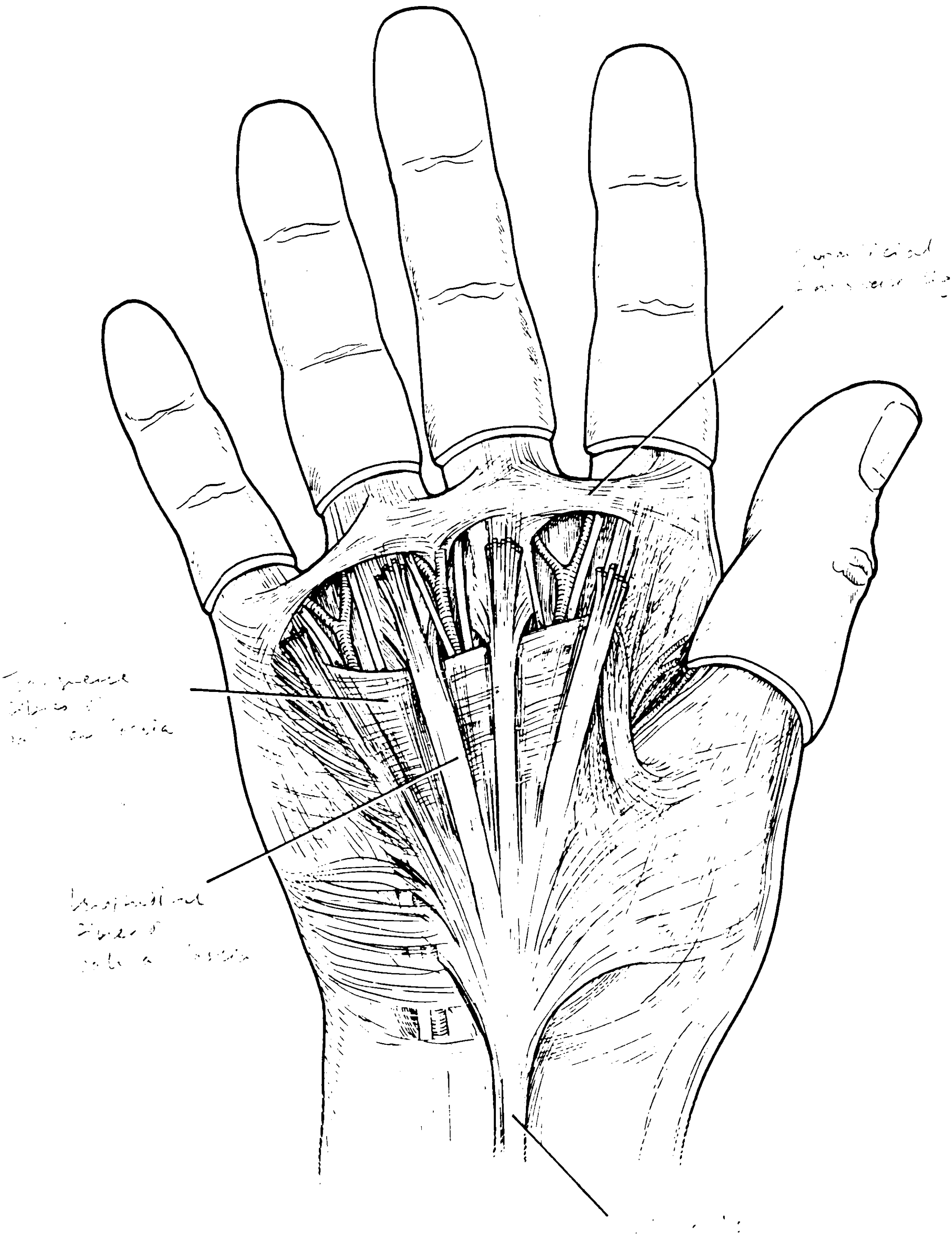


Fig. 9.12 Plan of anatomy. (Drawn by Patrick Elliott).

TABLE 9I

LONGITUDINAL FIBRE SYSTEMS

	1	2	3
Albinus 1734		4 broad portions - at their termination become two-pronged and the prongs pass one on either side of the tendons.	
Weitbrecht 1742	Form distinct circles and rings which hide not only the nerves and arteries which run into the fingers but also the flexor tendons and the soft bodies of the lumbrical muscles, which they surround and unite. - Retinacular function.		
Dupuytren 1831/2		4 fibrous bands - each divides to allow the passage of the flexor tendons - each branch becomes fixed to one side of a phalanx (not to the front as many anatomists have believed).	
Bourgery 1834	Sup. transverse ligament of the palm and transverse subcutaneous. ligament. Longitudinal fibres insert into transverse fibres.		
Maslieurat- Lagemard 1839	Interdigital Arcades = ?distal part of sup. transverse ligaments in the palm. The 'Interosseous' Fascicles corresponding to interosseous spaces insert into the dermis.	Continuous sheet which thins in its centre (rather than bifurcating). 4 pretendinous bandalettes become wider and thinner and form a gutter concave posteriorly.. seen to be continuous with the tendon sheath. Lumbrical canals allow the cellular tissue at the base of the fingers to communicate with that which occupies the central and sub-aponeurotic parts of the hand.	

TABLE 9I

LONGITUDINAL FIBRE SYSTEMS

	1	2	3
Maslieurat-Lagemard quoting -			
a) Gerdy	- Natatory fibres		
b) Dupuytren -see above			
c) Cruveilhier		Languettes bifurcate and adhere to the volar plates.	
d) Blandin		Bifurcate and terminate on the inferior transverse metacarpal ligament+.	
Madelung, Otto (1876)	Monticuli - so carefully studied by chiromancers. Implicit insertions to skin.... and tendon sheath.		
Grapow, Max (1887)	Longitudinal strands begin to lose themselves in the skin of the palm. At the webs part of the fibres are lost into the skin. A third part runs through the natatory ligament and continues on both sides of the fingers.		Some in relation with the deeper transverse layer. Others bend towards the transverse part of the fascia.
Legueu and Juvara (1892) fascia in 5 distinct parts. - The "classical" description.	Fibres to the skin of the fingers and palm, webs and sides of the fingers.	to deep aponeurosis - if reflected - seen on deep surface.	Perforating fibres - traverse the anterior interosseous fascia, perforate deep transverse ligament to surround the mp joint with a complete circle.

of these fibres to the first ray has been called the proximal commissural ligament by Tubiana et al (1982 and 1985). The term "transverse fibres of the palmar aponeurosis" is usual.

Longitudinal fibre systems - to try to clarify and co-ordinate the descriptions of various authors a table has been prepared to outline the three longitudinal pretendinous fibre systems. Layer 1 is the layer inserting into the skin of the distal palm (Table 9.1). The main area of controversy is whether or not there is a skin insertion of the longitudinal fibres in the distal palm. Gosset considered there to be none while Thomine felt that all the pretendinous fibres insert to the skin of the distal palm. Zancolli illustrated fibres running straight through to the palmar surface of the digit. Layer 2 is the pre tendinous fibres which, distal to the transverse fibres, pass down into the depth of the hand and cross to the lateral sides of the digits. Layer 3 is the deepest layer, typical of the perforating fibres of Legueu and Juvara. The description of each author has been fitted into this table to try to achieve an overall common plan.

The fascial structures on the dorsum of the hand have not been specifically reviewed in this thesis, but the following articles describe this area:- Anson et al

(1945), Landsmeer (1949)

The embryology of the palmar fascia has recently been reviewed by Dr. Caughell working with the author. Scanning electron microscopic examinations have been undertaken on six week foetal hands. Ferrarini (1935) felt that the palmaris longus was of late phylogenetic development and that the various parts of the palmar fascia were not uniform embryologically. Kaplan (1950) has described the embryological development of the tendinous apparatus of the fingers and described fascial connections between the flexor and extensor mechanisms.

CHAPTER 10

OBSERVATIONS ON ANATOMY OF THE NORMAL LIGAMENTOUS SYSTEM OF THE PALM

The fine ligamentous system of the palmar fascia lies just beneath the skin. It is cut through in almost every hand operation without being noticed. Although the transverse and longitudinal fibres have been recognised little attention has been paid to the vertical fibres in the region of the palmar creases as previous methods of study have often removed these together with the overlying skin.

A series of dissections was undertaken to chart precisely the three-dimensional relationships of this palmar ligamentous system.

MATERIALS AND METHODS

Nine fixed and thirty-one fresh cadaver hands have been examined. Careful dissection has been undertaken in more than fifty rays (each lasting up to 10 hours). This has been performed with the magnification of an operating microscope at 10 to 20 times magnification. The essentially new technique has been the preservation of the overlying skin which has been carefully reflected and removed piecemeal (Fig. 10.1) under high magnification only after definition of the fascial attachments to the skin. This technique has differed

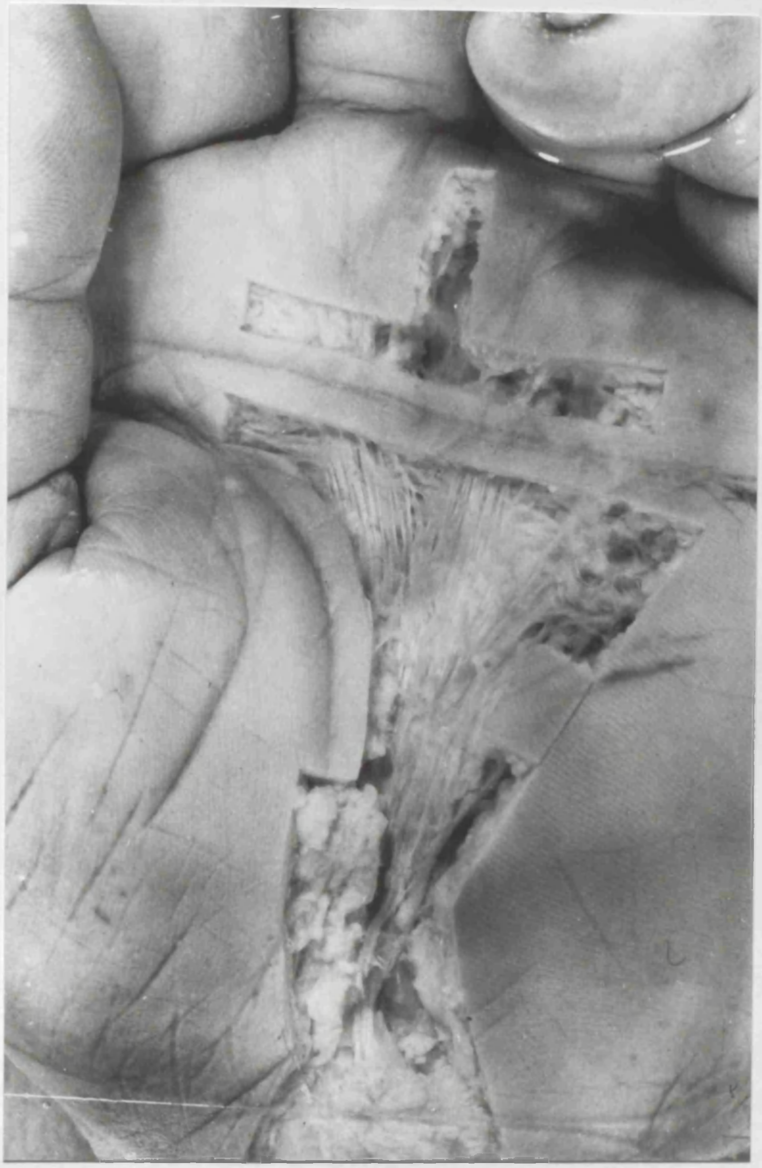


Fig. 10.1 Dissection of the palmar fascial ligaments to show the piecemeal removal of the skin. In this case there is one transverse palmar crease and the longitudinal fibres are seen passing beneath this.

from previous descriptions of the palmar aponeurosis where in general the palmar skin has been removed entirely before dissection of the palmar aponeurosis.

This examination has therefore been performed at magnifications greater than those used in normal clinical surgery, but less than those for histological study. Three-dimensional tracking of the fine ligaments has thus been possible.

Detailed areas of the anatomical findings have been confirmed by lower power scanning electron microscopy. This has been undertaken on large blocks of tissue (15mm) to facilitate orientation on a specially prepared stage.

ANATOMICAL FINDINGS

The ligamentous systems of the palm will be considered individually as Transverse, Longitudinal and Vertical fibres:-

1. Transverse fibres:

The deepest layer of the palmar fascia is the layer of transverse fibres well described by Skoog. There is some confusion about the nomenclature of these fibres, but they are generally called the transverse fibres of the palmar aponeurosis. As shown from Fig. 10.2, these are not to be confused with the superficial transverse

Fig. 10.2a Dissection of the palmar fascia. The transverse fibres are seen to lie on a deeper plane than the longitudinal fibres and the distal ends of the transverse fibres are seen to coincide with the distal palmar skin crease which has been preserved on a small tongue of skin at the right hand side. At the very top of the figure a few superficial transverse natatory fibres are seen.

Fig. 10.2b Higher power view to show the insertion of the longitudinal fibres into the skin. It is seen that the longitudinal fibres of the middle and ring finger rays insert into the skin mid-way between the distal palmar crease and the proximal finger crease. The index fibres insert more proximally. This illustration has been photographed underwater and a few fine vertical fibres are seen floating on top of the longitudinal fibres like small pieces of cotton wool.

ligamentous fibres which form part of the natatory ligament system at the base of the finger webs (Fig. 10.2; also McFarlane, 1974), or the deep transverse metacarpal fibres which lie on a much deeper plane. The fibres of Skoog run across and are fused with the anterior fibres of the flexor tendon sheaths and these pass on the radial and ulnar borders of the tendon sheaths to fasciae over the thenar and hypothenar muscles respectively. Unlike previous descriptions it has been noted that the most distal extent of these fibres underlies the distal palmar crease of the hand and this fact is of surgical significance as dissection of the longitudinal fibres proximal to the distal palmar crease in a plane superficial to the transverse fibres is safe in that nerves and vessels will not be encountered. Under magnification (Figs. 10.2a, 10.2b), the transverse fibres appear as discreet unbranching silvery glistening tendinous structures.

2. Longitudinal fibres:

On a more superficial plane are the longitudinal fibres, also silver glistening structures under the microscope. These are Wood Jones' (1941) fibres of the phylogenetically degenerated metacarpophalangeal joint flexor. All these fibres were noted to insert into structures distal to the transverse fibres. In the normal hand they do not insert into the transverse fibres or into the skin at the palmar creases.

Proximally, the longitudinal fibres run from the palmaris longus tendon or from the region of the flexor retinaculum at the wrist. Fahrer (1980) has suggested that in the absence of the palmaris longus tendon the flexor carpi ulnaris may act as a tensor of the palmar fascia by fibres which run from the flexor carpi ulnaris tendon into these longitudinal fibres. Although there are some longitudinal fibres across the whole width of the central third of the palm (triangular area), they are noted to be particularly condensed (Fig. 10.2) in the mid line of the finger rays, thereby producing four well defined longitudinal bundles to the index, middle, ring and little fingers and, in addition, there is a fifth well defined longitudinal bundle running to the thumb, although this tends to lie towards the radial side of this digital ray.

3. Vertical fibres:

By contrast, with the transverse and longitudinal fibres, the vertical fibres are thin, filmy and much weaker, as shown by the plane of separation in a palmar degloving injury (Fig. 10.3) superficial to the longitudinal fibres. Incidentally, in a palmar degloving injury it is often noted that the hand skin is avulsed proximally, but it remains attached distally where the ligamentous attachments are greater. Under the naked eye the vertical fibres appear as flimsy

Fig. 10.3 A palmar degloving injury to show the distal attachment of the skin and the plane of separation superficial to the longitudinal fibres.

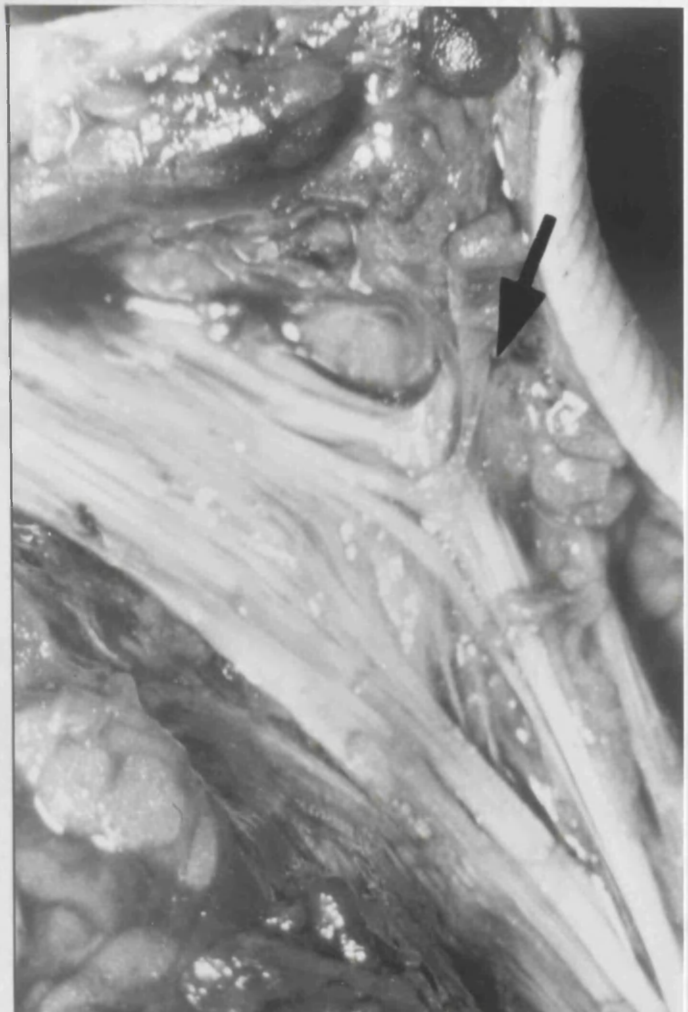
structures scattered around the palm, as shown (Fig. 10.2b), but they are particularly concentrated for a few millimetres on either side of the skin creases, i.e., they are not confined to the apex of the palmar skin creases. There are also strong condensations of vertical fibres over the thenar and hypothenar eminences of the hand. The vertical fibres run down into the hand (Fig. 10.4) from the dermis superficially and they run between the individual longitudinal fibres and between the individual transverse fibres; they then pass more deeply in the palm to the region of the flexor tendon sheaths and the metacarpal bones.

If the entire network of palmar ligaments in the distal palm is considered by reference to a cross section (Figs. 10.5 a, b), it is seen that in the depth lie the transverse fibres and then the longitudinal fibres on a more superficial plane cut transversely. The longitudinal fibres therefore appear to lie in channels with skin superficially, transverse fibres deeply and vertical fibres laterally. The channels are shown in the dissection of a Simian hand (Fig. 10.7).

If the distal attachments of the longitudinal fibres are now considered by reference to a longitudinal cross section (Fig. 10.6) from the mid-palm to beyond the proximal finger crease, it is again seen that the transverse fibres now cut transversely, terminate under

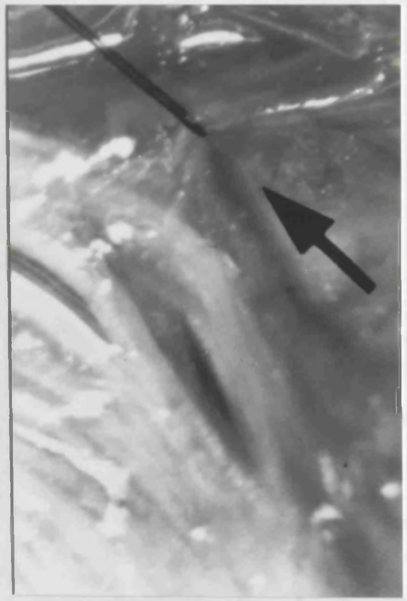
Fig. 10.4

a



b

c



d

Fig. 10.4 a The arrow indicates vertical fibres beneath the proximal palmar crease.

b A higher power view shows that the longitudinal fibres, which are passing diagonally across the illustration, are discreet from the vertical fibres which are very much finer in structure. Traction is being applied to the overlying skin and the vertical fibres seem to be 'Tenting' the longitudinal fibres.

c & d A silk suture has been wrapped around the vertical fibres and these can be pulled backwards and forwards in relation to the longitudinal fibres. The transverse fibres are not shown in this figure as they lie at a deeper level.

a

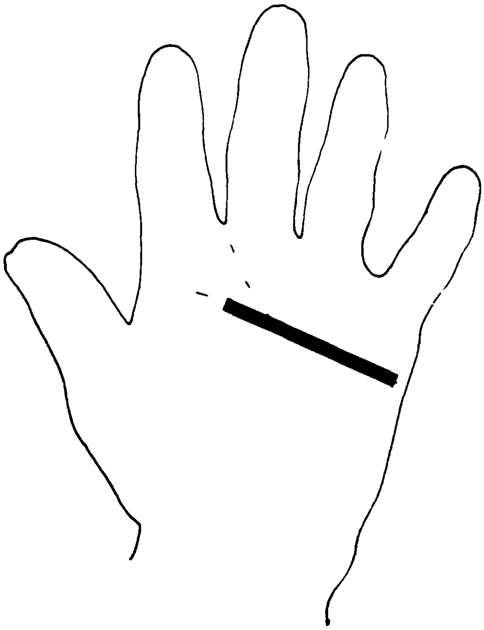
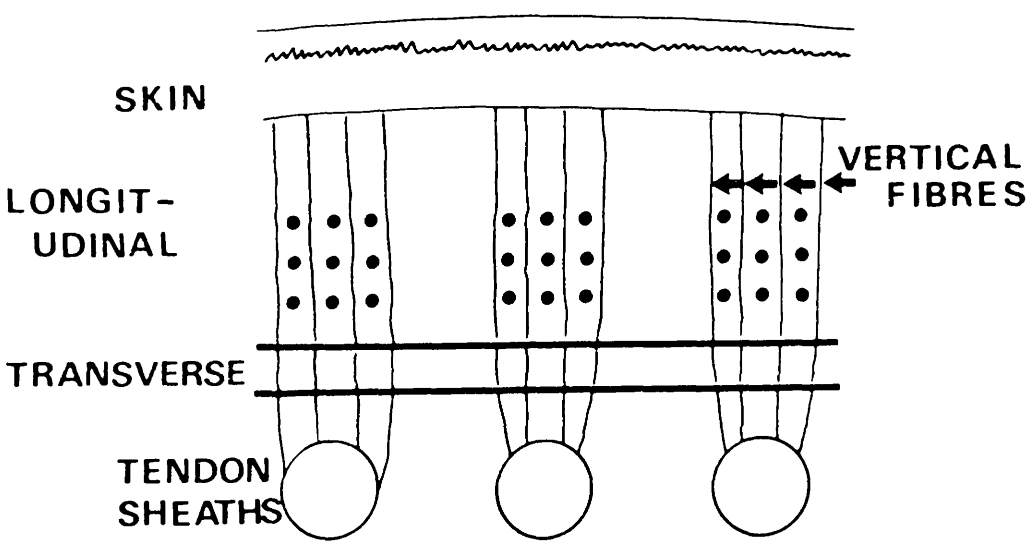


Fig. 10.5 a Cross section of the palmar fascia.

b Cross section of the palmar fascia to show the longitudinal fibres here cut in cross section, lying in channels between the skin superficially, transverse fibres deeply and vertical fibres laterally.

b



a

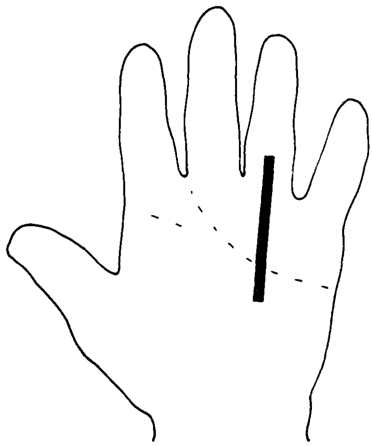


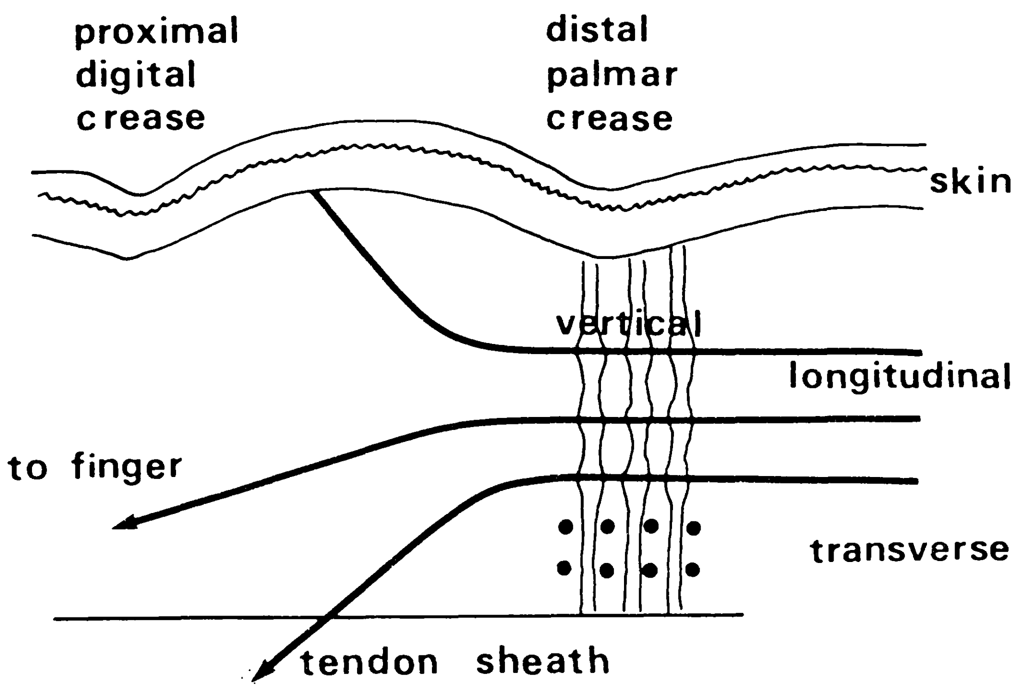
Fig. 10.6

a Longitudinal section of the palmar fascia of the ring finger.

b Longitudinal section to show the three types of insertion of the longitudinal fibres.

c Relationship of the longitudinal fibres to the neurovascular bundles.

b



c

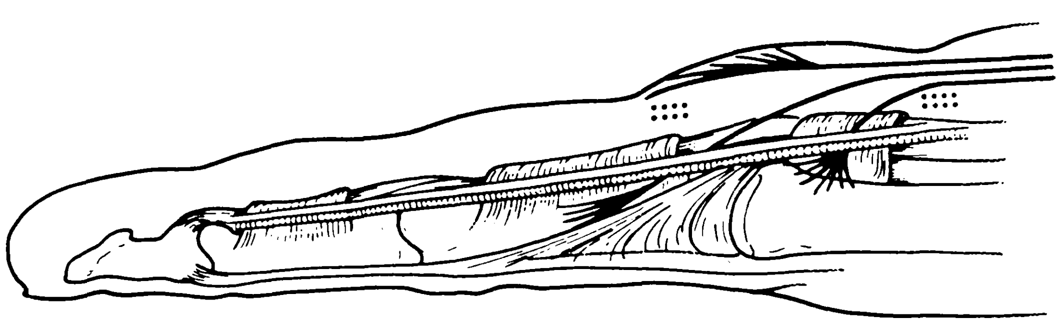


Fig. 10.7 The longitudinal fibres are here seen passing beneath the distal palmar crease. This is most apparent in the ring finger ray. In the middle finger digital ray there is a suggestion that some fibres are passing upwards into the skin in the region of the distal palmar crease, but at higher magnification these were noted to be vertical fibres. The longitudinal fibres do not insert into the skin at the palmar crease. This hand is the same dissection as Figure 10.1.

the distal palmar skin crease. The longitudinal fibres run distally through their channels between the transverse fibres and skin. This arrangement is confirmed in a normal hand by reference to a histological cross section (Fig. 10.8). The longitudinal fibres arise proximally from the palmaris longus or flexor retinaculum and there are three types of distal insertion.

The more superficial of the fibres (Fig. 10.6b) insert into the skin of the distal palm at an area roughly mid-way between the distal palmar crease and the proximal finger crease. An indentation can be seen at this point in most normal subjects on flexing the palm (Fig. 10.9).

More deeply (Fig. 10.6b) some fibres turn down into the depth of the hand distal to the transverse fibres and pass distally to the fingers to interdigitate with Cleland's ligaments and to form the lateral digital sheet as shown by McFarlane. Some of these fibres stop short of the fingers and attach to the apex of the web skin.

The deepest fibres (Fig. 10.6, 10.10, 10.11) turn down around the sides of the flexor tendon sheath at metacarpophalangeal joint level fanning out around the

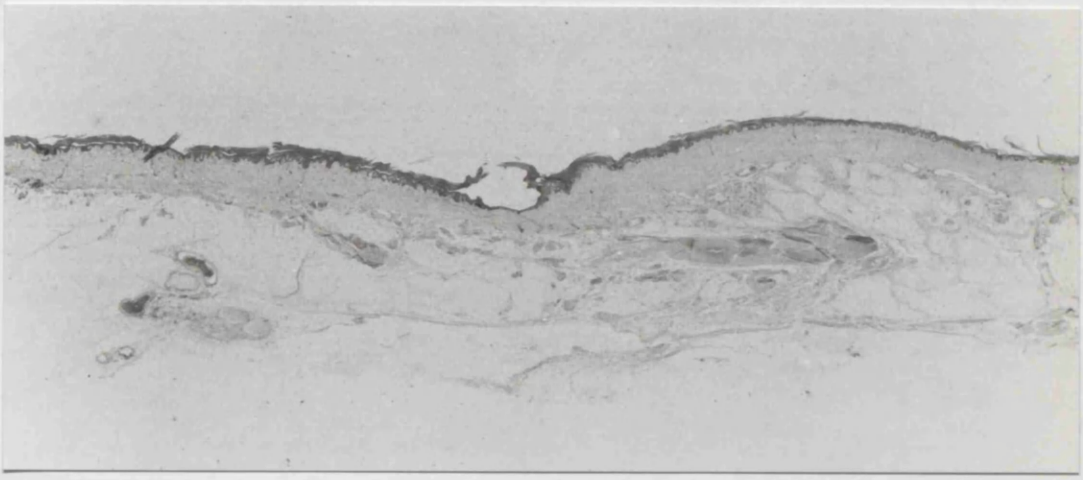


Fig. 10.8 Histological longitudinal section of normal palmar fascia beneath the distal palmar crease. The distal palmar crease lies in the middle of the illustration. The longitudinal bundle of fibres is shown inserting into the dermis on the left hand side of the picture and another part of the longitudinal fibres is seen on the right side. The transverse fibres are seen cut in cross section beneath the longitudinal fibres. These do not extend any further distally than the distal palmar crease. Fine vertical fibres are seen scattered throughout.

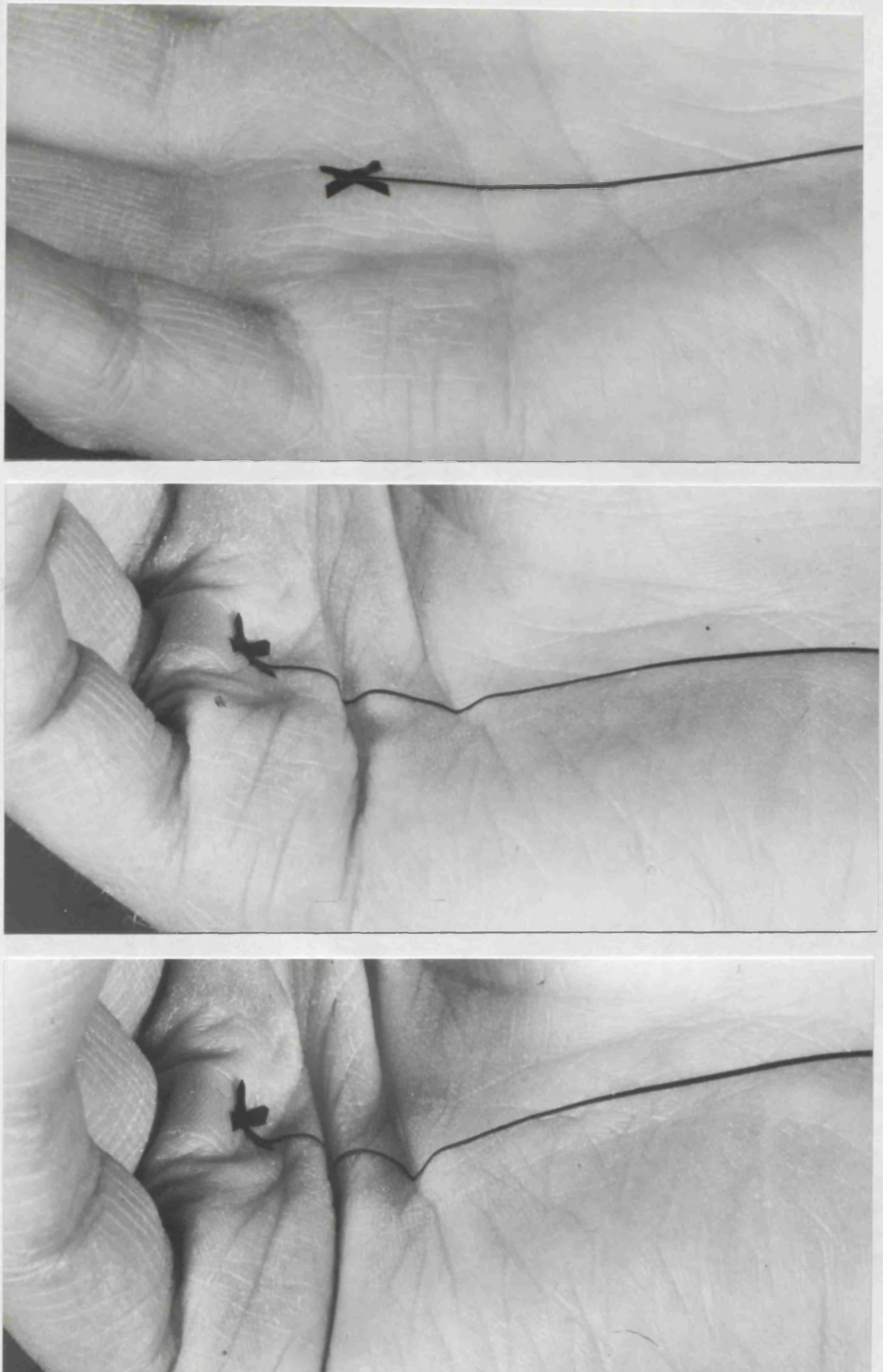


Fig. 10.9 Longitudinal fibres insert at the point marked 'X' and an indentation is seen in this area on flexing the palm.

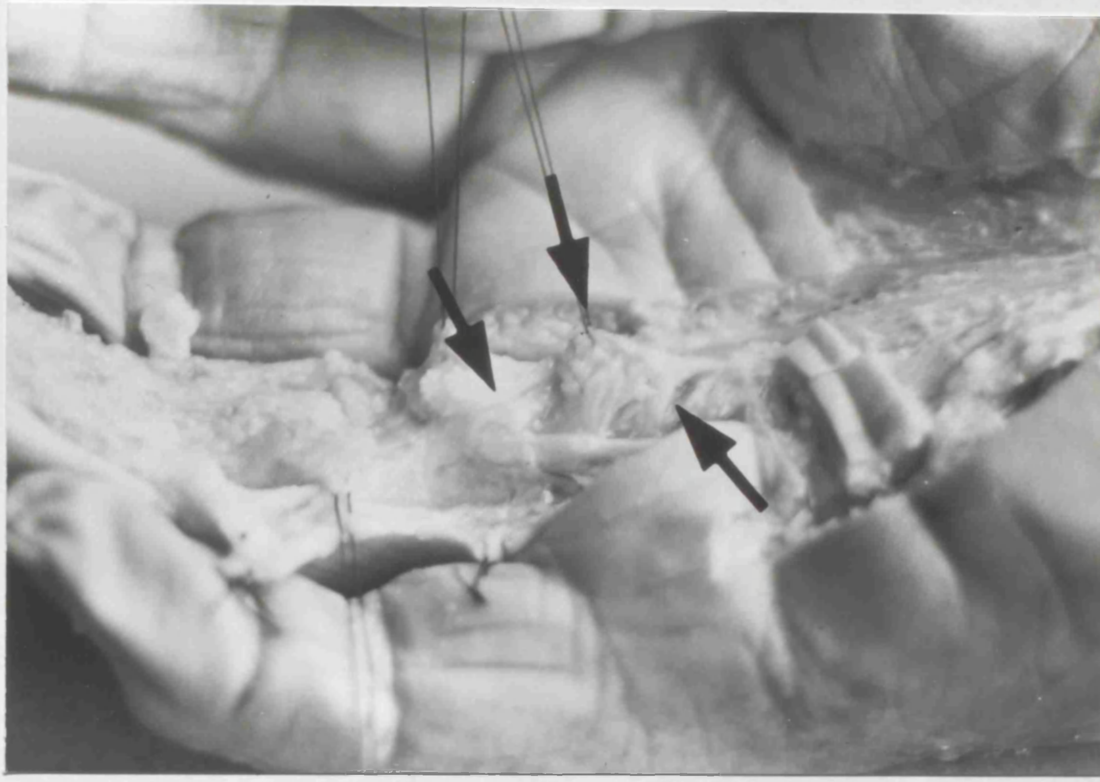


Fig. 10.10 The three distal insertions of the longitudinal fibres are shown. The middle arrow points to a piece of skin which is attached to a silk suture. The lower right hand arrow shows the deepest fibres passing downwards, around the side of the flexor tendon sheath. The distal arrow shows the fibres at intermediate depth passing distally to the finger.

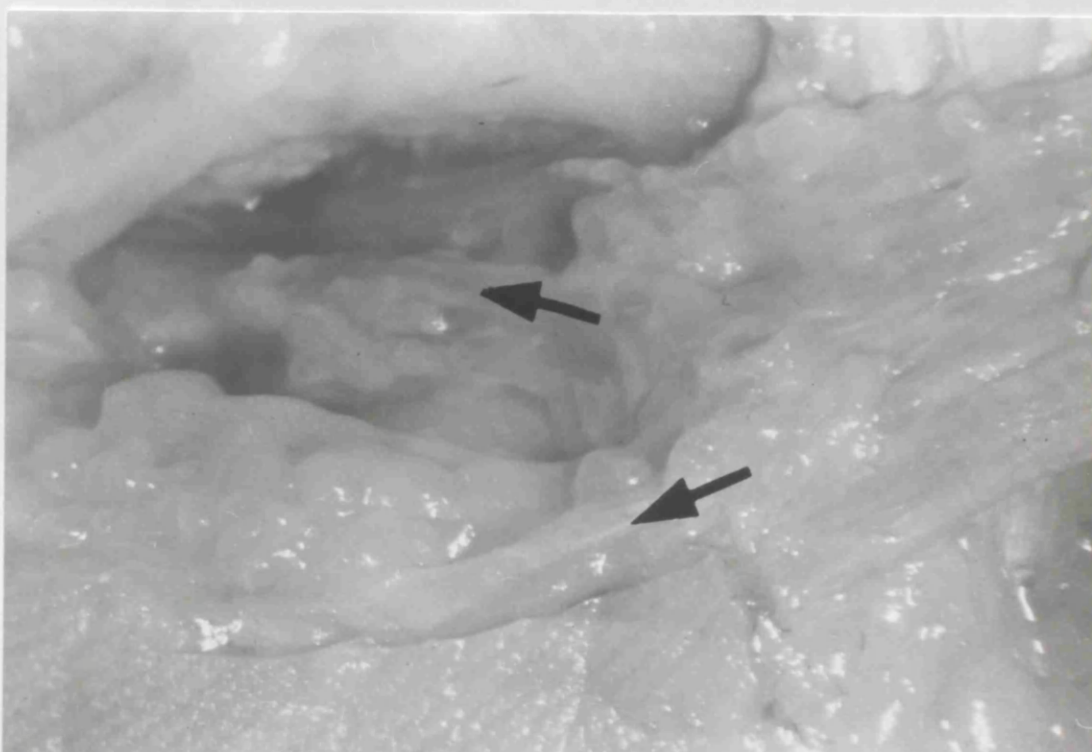


Fig. 10.11a A high power view of the distal insertion of the longitudinal fibres. Bottom right - the transverse fibres are shown on a deeper plane. At the bottom left is an island of skin and the more superficial longitudinal fibres, as shown by the lower arrow, are passing towards this skin insertion. The fibres of intermediate depth are seen by the upper hand arrow passing towards the fingers.

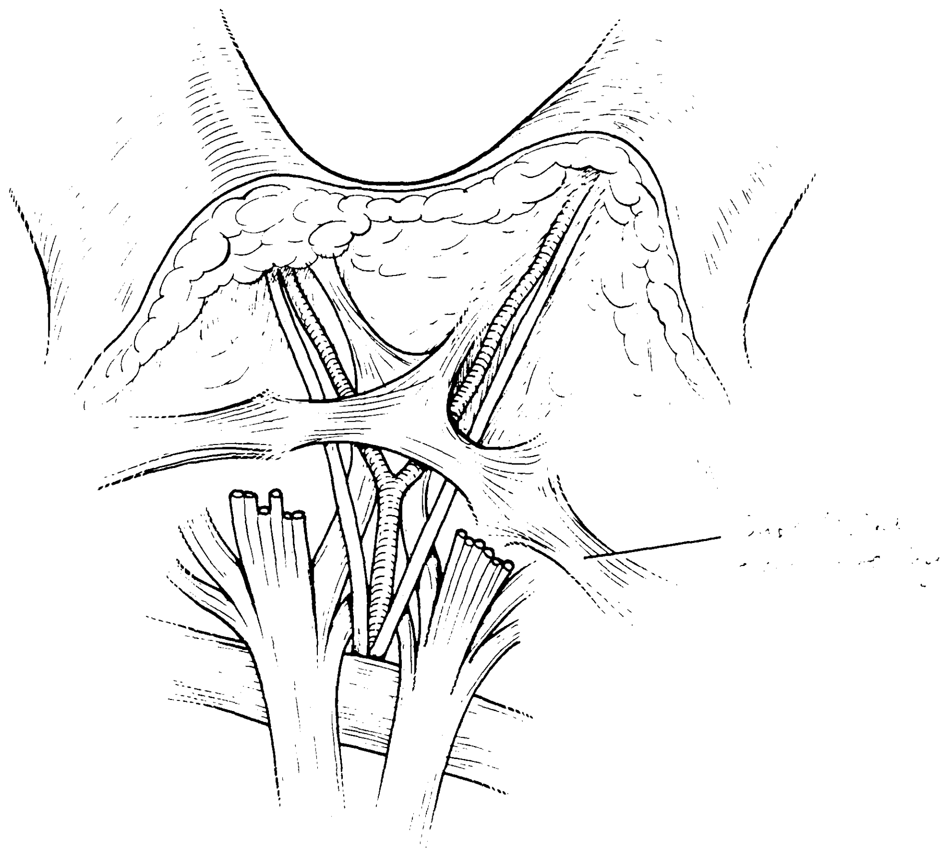


Fig. 10.11b Distal insertions of the pretendinous longitudinal fibres.

1. The most superficial fibres (cut ends illustrated) insert into the dermis.

2. Deep to the above, fibres pass deep to the neurovascular bundles and pass to the lateral digital sheet.

3. The deepest fibres pass on either side of the metacarpo-phalangeal joint.

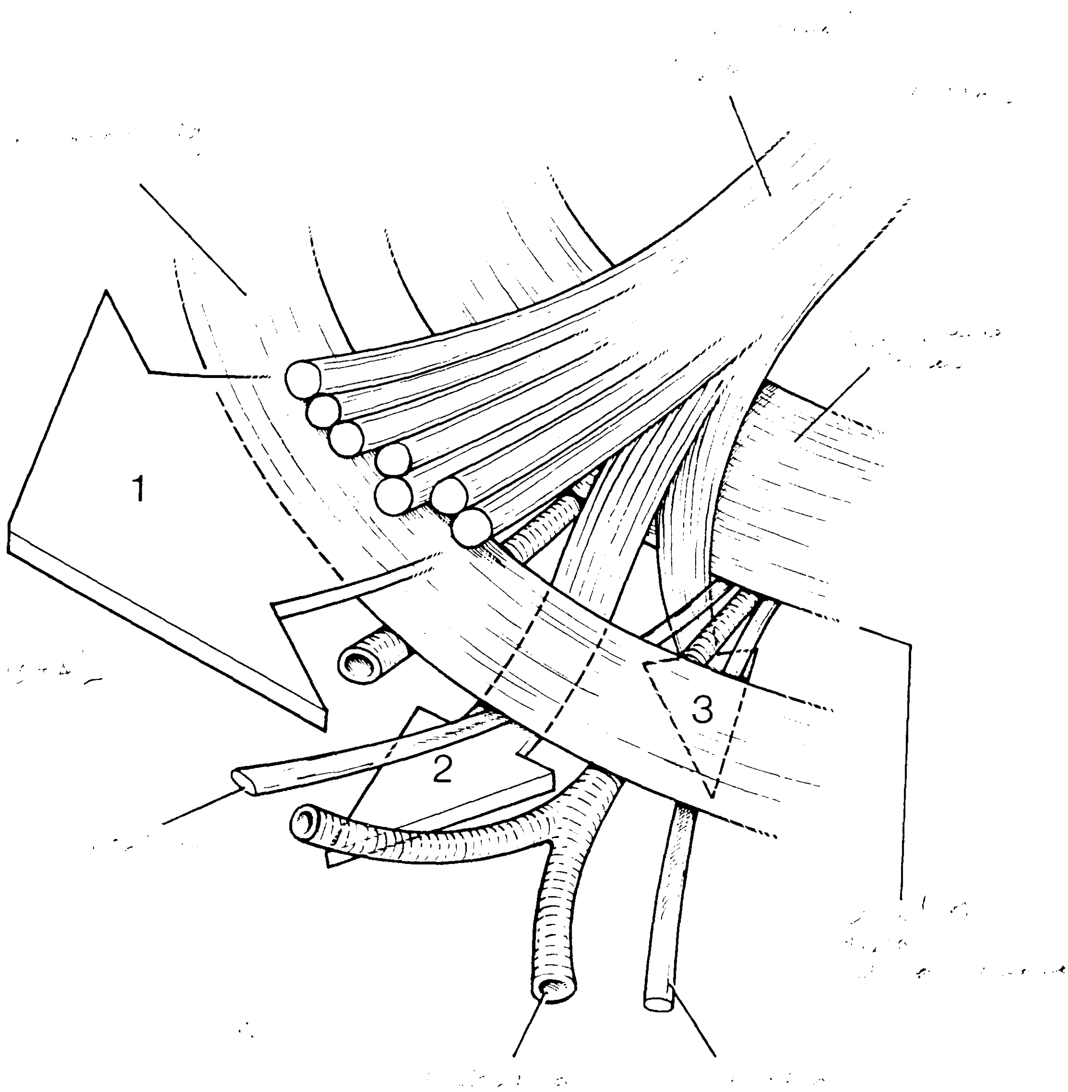


Fig. 10.11c A higher magnification view of the 3 distal insertions of the pretendinous fibres to show their relationship to the transverse fibres of the palmar aponeurosis and the transverse natatory fibres. (Illustrations 10b and c drawn by Patrick Elliott for Dupuytren's Disease, Principles of Hand Surgery).

sides of the metacarpophalangeal joint. The more proximal, therefore, lie adjacent to the metacarpal and the more distal to the base of the proximal phalanx.

The significance of this precise arrangement of fibres beneath the distal palmar crease lies in the fact that in the normal hand the longitudinal fibres can move a little in relation to the deep transverse fibres and skin. This normal relative motion between the different fibre systems has been confirmed as a constant finding in normal hands that has not been previously reported. The small amount of motion that is possible for the longitudinal fibres in the channel does not amount to an excursion similar to that which occurs between tendons and sheaths (McGrouther and Ahmed, 1981). The total range would be merely of the order of a millimeter or two and the purpose of this motion is to allow the layers of the hand, i.e., skin, longitudinal fibres, transverse fibres and deeper structures, to slide to some extent over one another in flexion of the distal palm. This necessity for one layer to slide over another in flexion is similar to the motion that occurs between the leaves of a telephone directory on folding. A similar channel exists beneath the proximal palmar crease.

The arrangement in the index is different (Fig. 10.2b) in that the longitudinal fibres insert more proximally into the palm. The channel arrangement, therefore, does not exist.

Discussion

What is the function of the Palmar Fascia? There has been much philosophical speculation on this point. Some clues can, however, be deduced by considering the function of the palm. The hand is a tool, an interface between man and his environment acted upon by all the forces generated by the forearm muscles and even body weight on occasions. It is not exempt from satisfying the Laws of natural Physics and must therefore conform to Newton's Third Law of Dynamics:- To each force there is an equal and opposite reaction. The forces acting on the palm are normal (perpendicular to the surface) and shearing (acting in the plane of the palmar skin), these being longitudinal or transverse. By the Laws of Vectors all forces can be resolved into these 3 components. To give examples of such forces, standing on one's hands would produce high normal forces, sliding down a Fireman's pole would produce high transverse shearing force, and gripping a golf club would produce high longitudinal shearing force as the club tends to rotate in the hand on striking the ball.

There must be an internal anatomical arrangement to provide the reaction balancing externally applied forces, and the development of this system will be greatest where most force must be balanced to prevent damage. Areas of the hand having high normal forces have well developed shock-absorber pads (e.g. the finger pulps), but areas requiring to resist much horizontal shear must have a horizontal structure to resist avulsion or degloving injury. The palm of the hand therefore has a longitudinal system of ligaments for this purpose.

An engineer would be hard pressed to design a system of skin anchorage effective in any degree of flexion on such a mobile frame as the skeleton of the hand. Evolution has produced a system which seems to be effective.

An added point of interest is that each skin ligament has an origin and insertion, and on tightening the ligaments, callosities (or blisters) map out the areas of skin attachment since the immobilised skin suffers shearing trauma.

THE LESIONS OF DUPUYTREN'S DISEASE AND THEIR PATHOGENESIS

The lesions of Dupuytren's Disease are nodules, skin pits, distortion of the palmar creases, cords and joint contractures. A precise morphological description has been prepared of the incidence and sites of these features.

In a series of 80 hands in 64 patients the distribution of the visible and palpable lesions have been documented and recorded photographically. One hundred and twenty four digital rays were involved and careful operation dissection has subsequently been performed in 63 rays in this patient group. These patients were mostly at an early stage, as in later stages it is difficult to recognise the lesions individually. Recurrences and extensions were excluded and the lesions in the thumbs have also been omitted.

Nodules

To facilitate description the sites of the nodules have been numbered according to Figure 10.12 as follows:-

1. Proximal to the Proximal Crease.
2. Distal to the Proximal Palmar Crease, but proximal to the Distal Crease.
3. From the Distal Palmar Crease to the Proximal Digital Crease.
4. In the proximal segment of the finger or more distally.

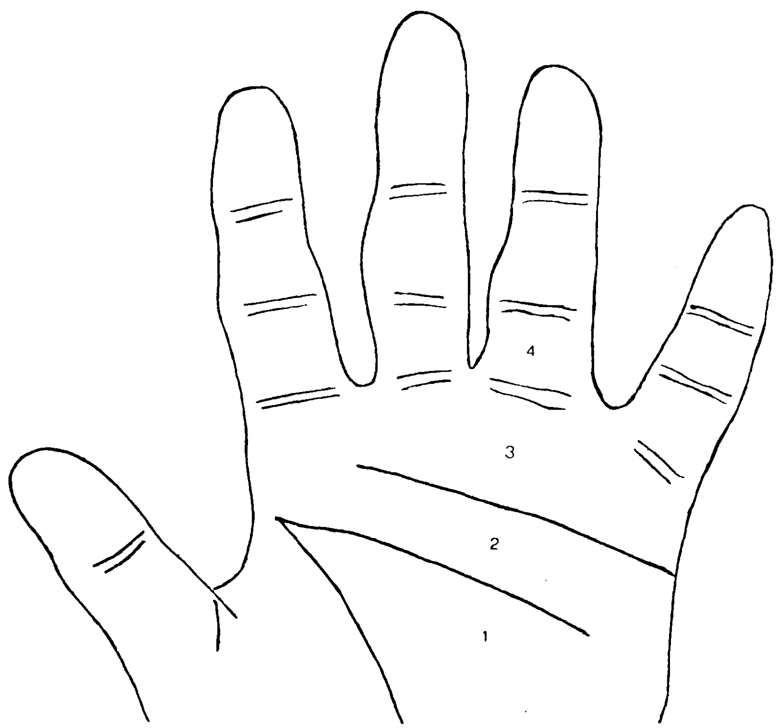


Fig. 10.12 The distribution of nodules in 64 patients. This shows the numbering system used to identify the sites of the nodules in Table 10.1.

TABLE 10.I

DISTRIBUTION OF NODULES - 64 PATIENTS

Distribution	Digit Index	Middle	Ring	Little
1, 2, 3 + /-4		1	14	14
2, 3 + /-4		4	13	3
1, 2		3	2	1
3, 4			1	5
2		6	8	2
3		1	6	1
4			2	4
None	4	8	13	8

It may be noted by reference to Figure 10.12 or the reader's own hand that the distal palmar crease runs from the ulnar border of the hand to the web between the index and middle fingers and therefore for the index the above areas for description of the nodules would be different. In this series however, no nodules were found in the palm in the line of the digital ray of the index.

The most important factor in relation to nodules is that they were found to occur along the lines of the longitudinal fibres of the palmar fascia, i.e., in the line of the finger rays, generally in the mid-line, but near the webs they were occasionally off centre, in this case on the superficial natatory ligament system.

Twenty-seven per cent had no nodules (Table 10.1). When present the commonest pattern was a line of nodules all along the longitudinal fibres from proximal to the proximal palmar crease to the finger (1, 2, 3, 4). Isolated nodules were also found between the palmar creases or distally (Fig. 10.13), but no isolated nodule proximal to the proximal palmar crease occurred in this series.

The pathogenesis of nodules was investigated by dissecting these at operation. The pattern of disease was different in each digital ray, but a constant feature in all cases of palmar involvement was a loss of the normal mobility of the longitudinal fibres over the transverse fibres. Generally the longitudinal fibres in this distal palmar area had lost their silvery tendinous appearance and become white or grey and amorphous. If the previous anatomical description is borne in mind it is possible to understand the clinical picture and pathogenesis of the nodules when each part of the longitudinal fibre system becomes involved with the disease process.

If the contracture involved the most superficial of the longitudinal fibres the distal skin attachment will be pulled proximally causing an indentation at the skin attachment site and bunching of the skin just distal to the distal palmar crease. This skin bunching is

a

b

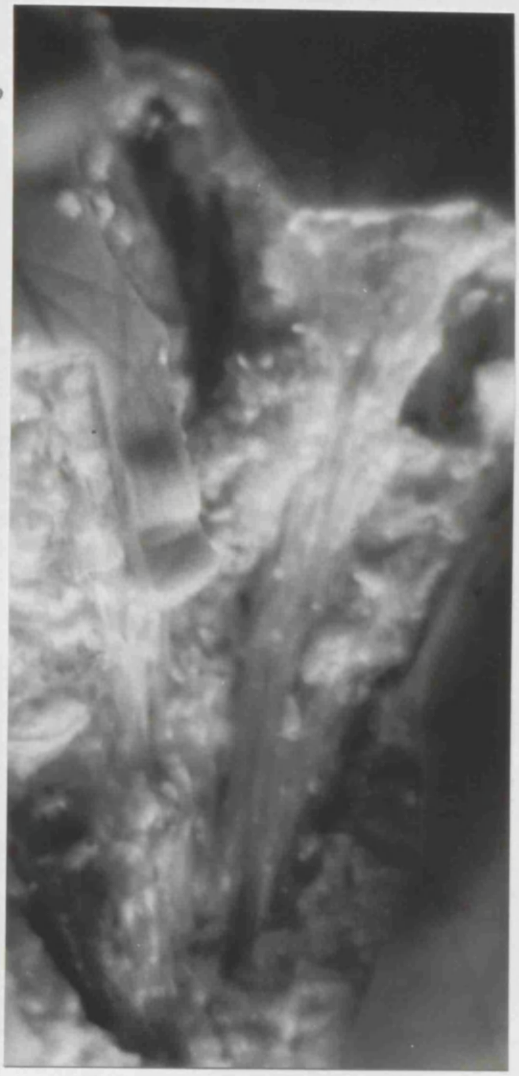


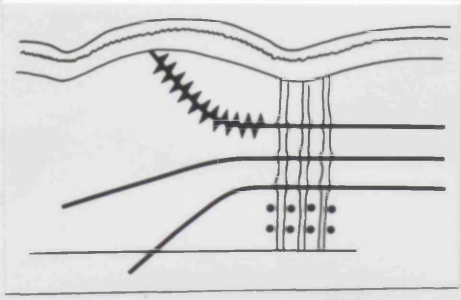
Fig. 10.13

a A nodule distal to the distal palmar crease. On attempting to forcibly extend the fingers, blanching of the skin distal to the nodule is apparent, indicating the increased tension in the skin in this area.

b Dissection of a cadaveric nodule similar to that shown in 13a. The small tongue of skin in the centre of the illustration shows the distal palmar crease with a distal bunching of the skin and an indentation distal to this.

c A diagramatic representation of the origin of a nodule in this site.

c



apparent clinically as a nodule, as shown in Figures 10.13 and 10.14c. Lagier and Rutishauser (1976) have shown histological sections.

This provides an explanation for the observation of Hueston (1976) that the nodules are superficial to the plane of the palmar fascial ligaments.

TABLE 10.II

DISTRIBUTION OF SKIN PITS - 21 PATIENTS

	Index	Middle	Ring	Little
Proximal Palmar Crease	-	2	4	2
Distal Palmar Crease	-	1	11	6
Insertion of Longitudinal Fibres	-	3	11	2
Elsewhere	3	-	3	3

Pits

Table 10.II shows the distribution of 48 pits in 21 patients and it is seen that the pits are found in certain well defined areas such as the distal palmar crease and the point of insertion of the longitudinal fibres into the dermis (Fig. 10.15).

It seems that a pit at the distal palmar crease arises when adhesions develop between the longitudinal and vertical fibres system (Figs. 10.15e and 10.15f) and Dupuytren's Disease in the more proximal palmar fascia

a

b

Fig. 10.14 a Nodule distal to the distal palmar crease with a further nodule proximally.

b Transverse fibres lying in a deeper plane. The longitudinal fibres involved in the Dupuytren's contracture are inserting into the nodule.

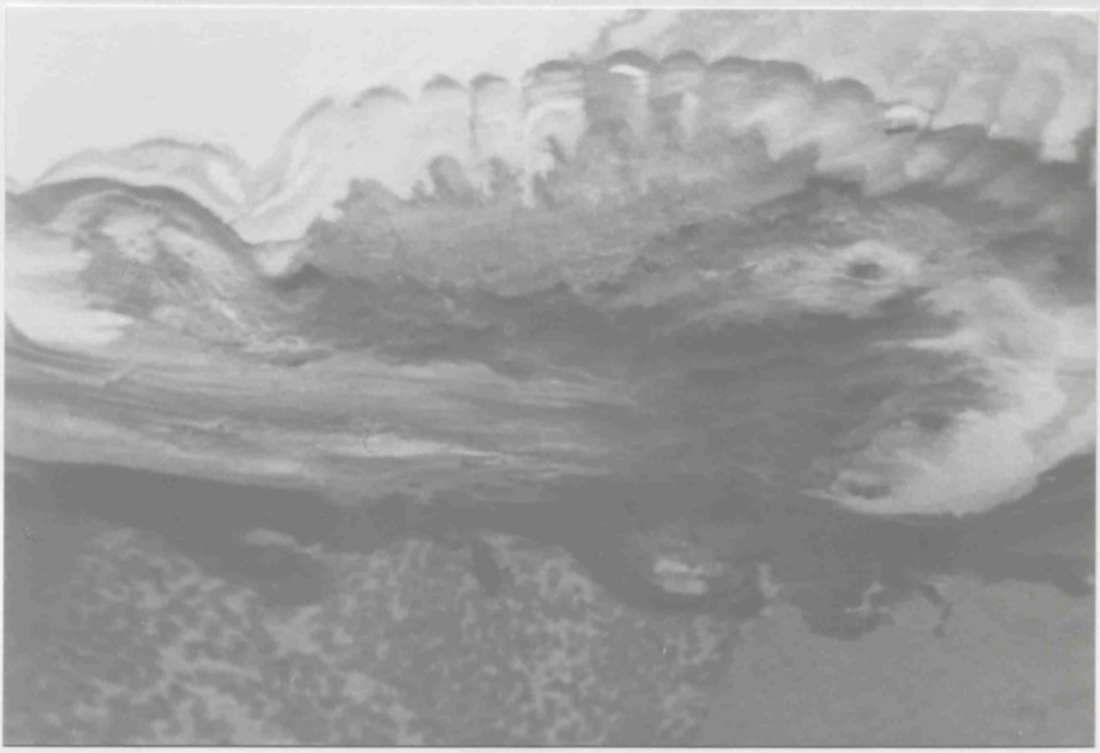


Fig. 10.14c Low power scanning electron microscope picture (x 20 magnification) showing the structure of a nodule. The longitudinal fibres are seen inserting into the dermis.

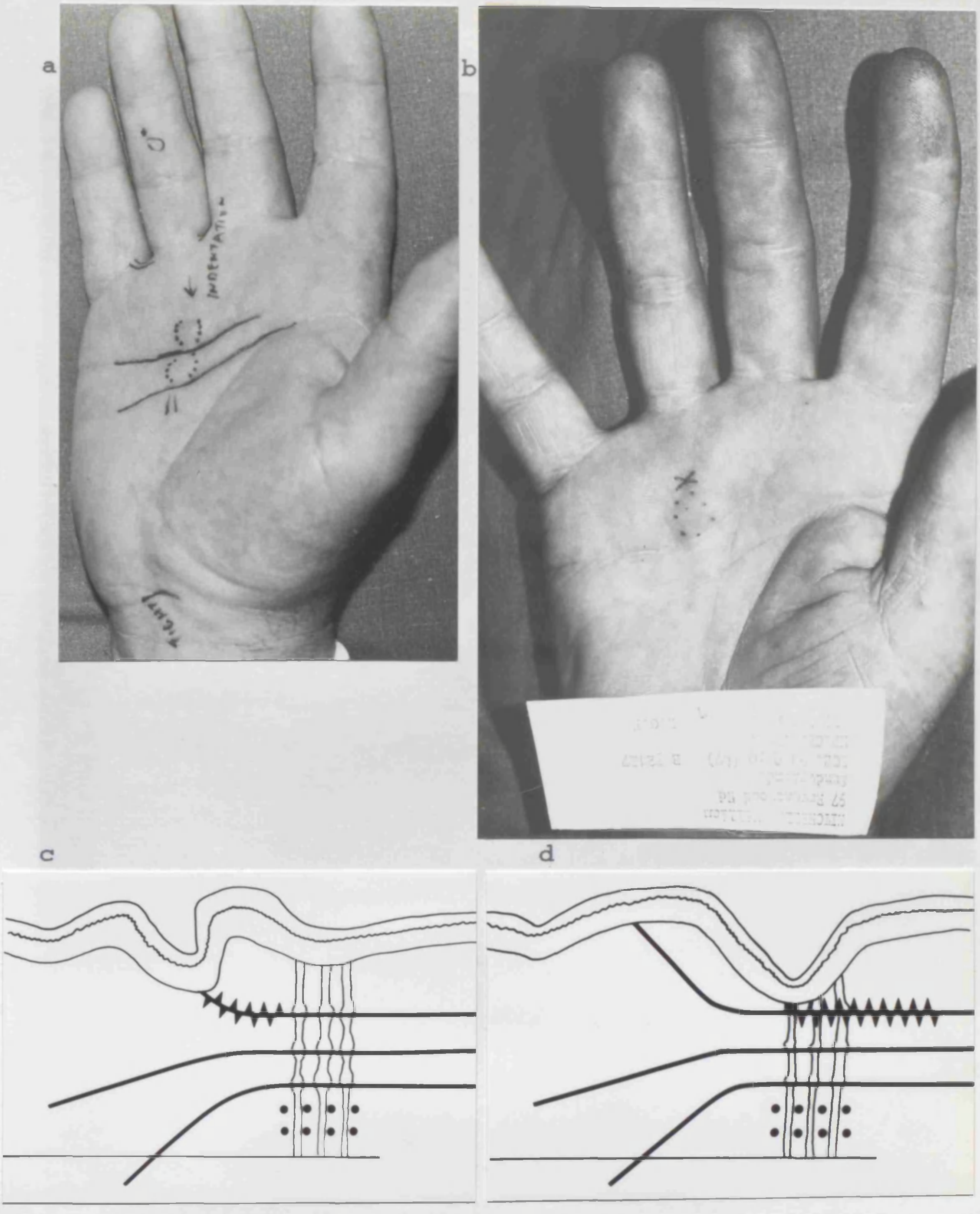


Fig. 10.15 a The origin of a skin pit. The early stage is an indentation at the skin insertion of the longitudinal fibres.

b Shallow pit has formed at the point 'X'.

c Diagrammatical representation of the origin of a skin pit at the insertion of the longitudinal fibres.

d Diagrammatic representation of the origin of a skin pit at the distal palmar crease.

e f

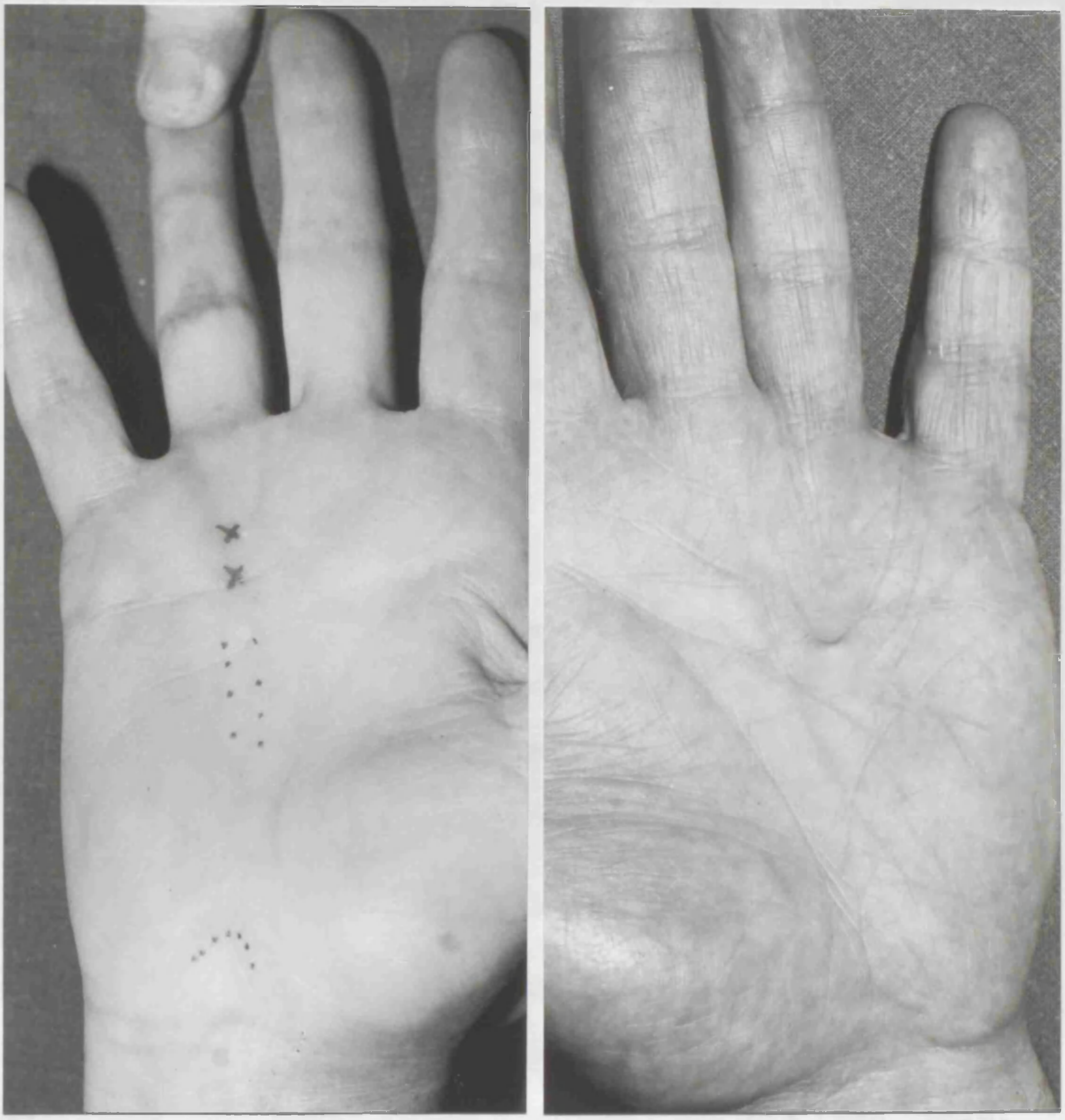


Fig. 10.15 e Shallow skin pits have developed at the skin insertion site and at the distal palmar crease. An indentation was also apparent in this case at the wrist crease.

f A skin pit at the distal palmar crease.

will pull on the pit so that its mouth faces distally.

When pits and nodules occur without joint contracture it seems that the Dupuytren's Contracture process is confined merely to the more superficial of the longitudinal fibres. A deep pit is often an indication that a contracture cord is expending its tension on the skin surface rather than producing a finger contracture.

Distortion of the Palmar Crease

One of the earliest changes is a deepening of the palmar creases. The deepened creases persist on full extension of the metacarpophalangeal joints (Fig. 10.19b) whereas in the normal hand, as the reader will note by reference to his own, the palmar creases flatten out and are simply linear marks. This deepening may be accompanied by broadening of the crease itself, as described by Hugh Johnson (1982) in his own palm. Horizontal distortion may also occur (Fig. 10.19c) and is proof that the skin is no longer mobile over the longitudinal fibres. (Again the reader can confirm the normal mobility of his palmar creases longitudinally over the longitudinal fibres by flexing the palm and pushing the skin in the region of the palmar creases proximally and distally. This ability is lost in Dupuytren's Contracture).

Hueston has attributed the direction of distortion of the palmar creases to the balance of pull between different contracting foci of the disease. This is a factor, but once the skin is adherent to the longitudinal fascial ligaments passive pulling by extension of the fingers is also important.

Horizontal distortion of palmar creases was noted in 80% of those with palmar nodules.

An indentation at the wrist crease was frequently seen (Fig. 10.15a, 10.16a, 10.19c) in both those with and those without a palmaris longus tendon. Often the indentation became more marked on passive extension of the finger, indicating fibre continuity between this point and the finger. It was assumed that some of the proximal longitudinal fibres of the fascia were attached to skin at this point, but specific dissection has not been performed here.

Cords

Cords are difficult to accurately identify by inspection and palpation except where they bowstring across a concavity or lie just beneath the skin. These generally appeared white or grey and amorphous for some distance proximal to the creases, but further proximally they were silvery and tendinous. Some mature cords, in the absence of nodules were tendinous throughout their

a

b

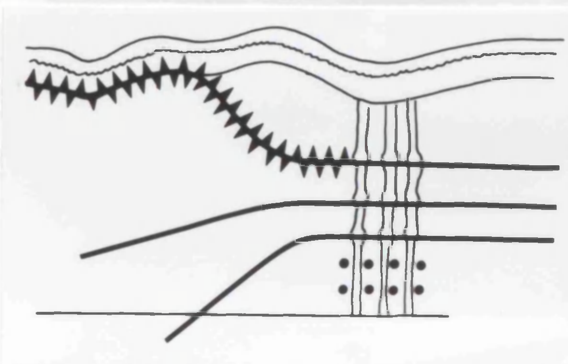


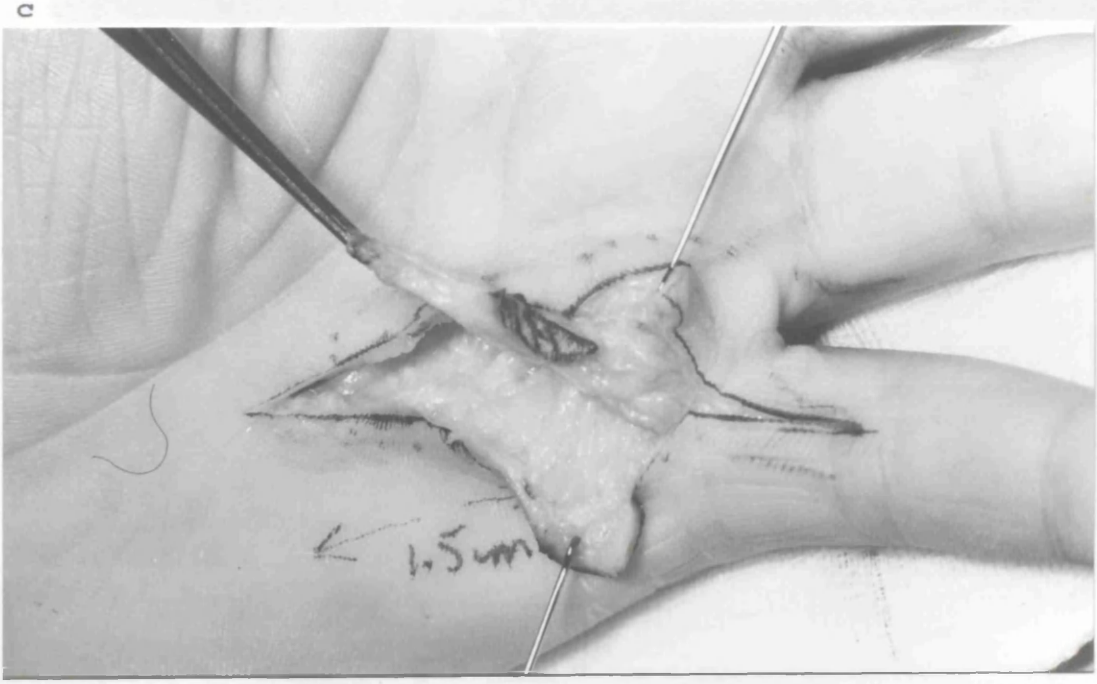
Fig. 10.16

a Skin inolvement of the little finger with an extension to the natatory fibres of the ring finger.

b Diagrammatic representation of skin involvement.

c Longitudinal fibres to the little finger have been dissected out.

c



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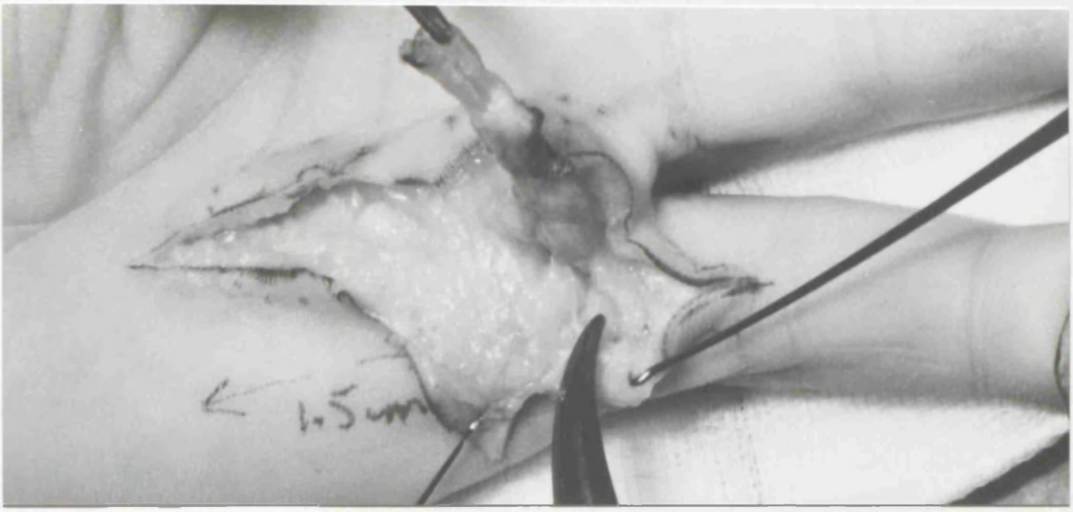

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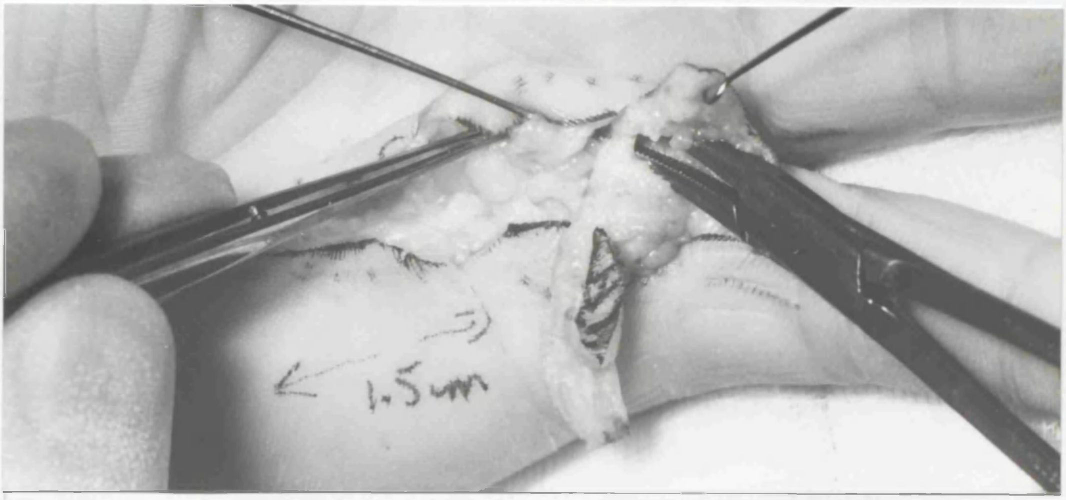

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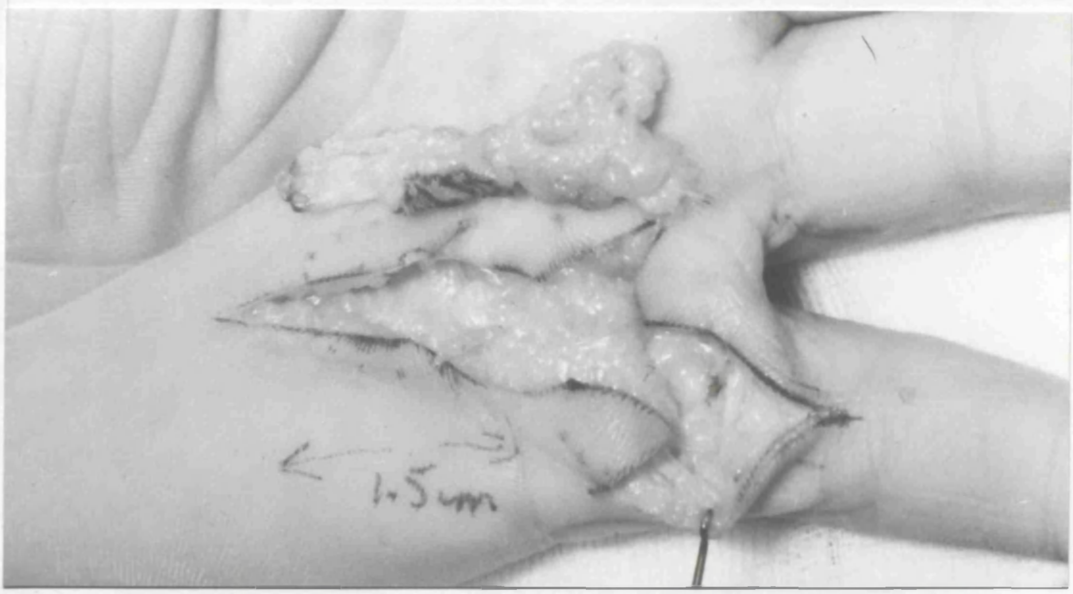


Fig. 10.16 d Distally the longitudinally fibres of the ring finger are seen to propagate through dermal or subdermal fibres and join with the lateral digital sheet on the radial side of the little finger.

e The extension to the natatory fibres of the ring finger have been isolated.

f The excised specimen. Note that a small skin island has been preserved for microscopic orientation purposes.

lengths and in these it was often difficult to say where the "diseased" tissue started and stopped. This is a general difficulty experienced by surgeons. What one surgeon will consider an excision of diseased tissue, another will consider a prophylactic excision of uninvolved tissue and others would leave this tissue alone. Many of these therapeutic judgements are based on the appearance of the fascia at the time of exploration.

Cords distal to the distal palmar crease were of three types:-

1. When the most superficial fibres of the longitudinal bundles were involved, the fibres either terminated at the skin attachment forming a pit or were propagated distally in a number of ways.

The contracture process may propagate distally perhaps through the dermis or through some fine fibres just deep to the dermis to reach the finger (Fig. 10.16). McFarlane (1974) described this as the central cord and although fibres extending distally in the mid line of the finger were well noted in Dupuytren's Contracture, there is controversy about whether or not they occur in the normal hand. Propagation of the contracture through the dermis almost certainly occurs and is clinically described as skin involvement. It is

a

b

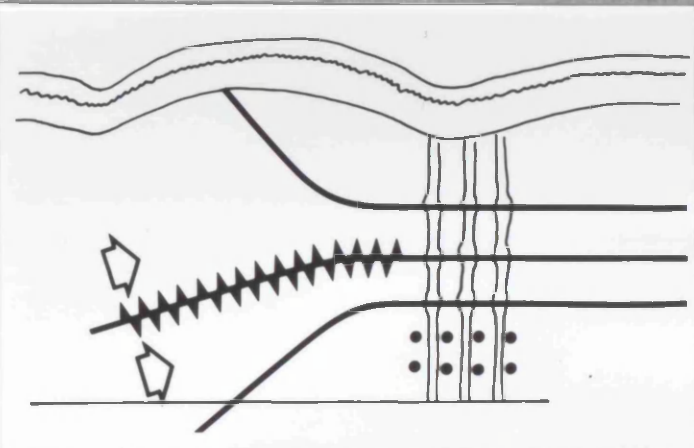


Fig. 10.17 a Involvement of the longitudinal fibres of intermediate depth, in this case producing flexion contractures of metacarophalangeal and proximal interphalangeal joints.

b Diagrammatic representation.

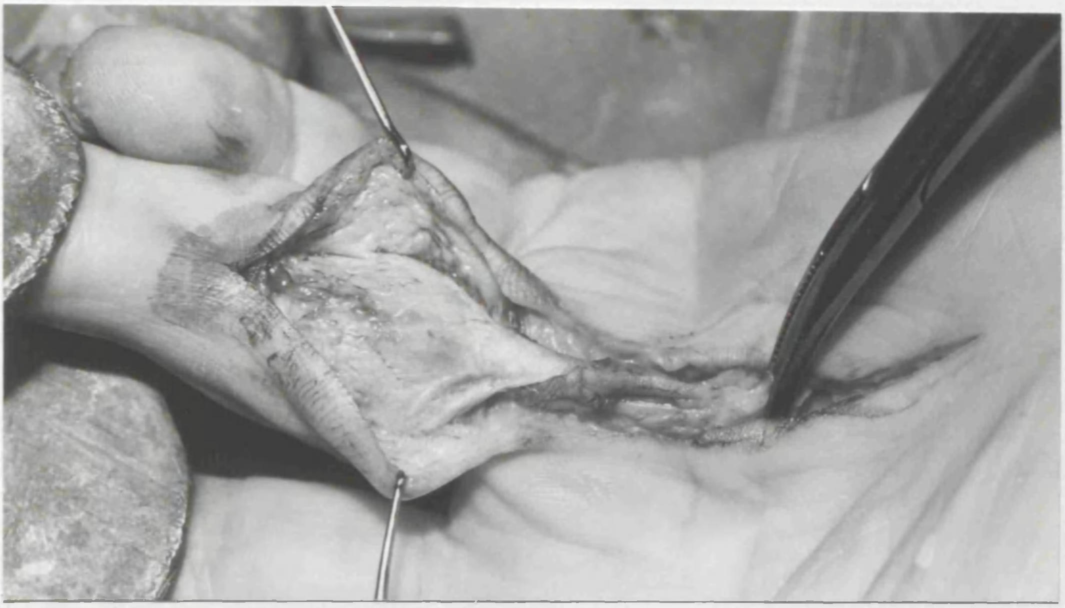
c The more superficial fibres were also involved in this case, giving a band of skin involvement as shown in 16b.

d Fibres of intermediate depth have been isolated and are seen to be passing to the lateral digital sheet on the radial side of the ring finger.

e After removal of the longitudinal fibres, the transverse fibres of Skoog are seen proximal to the excised longitudinal fibres and the transverse fibres distally are superficial natatory fibres.

Fig. 10.17

c



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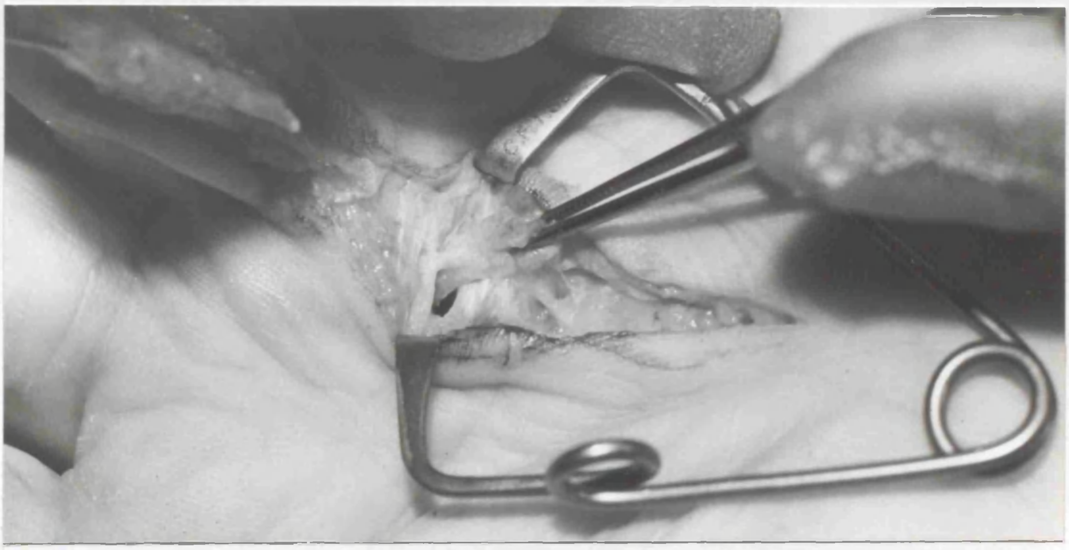

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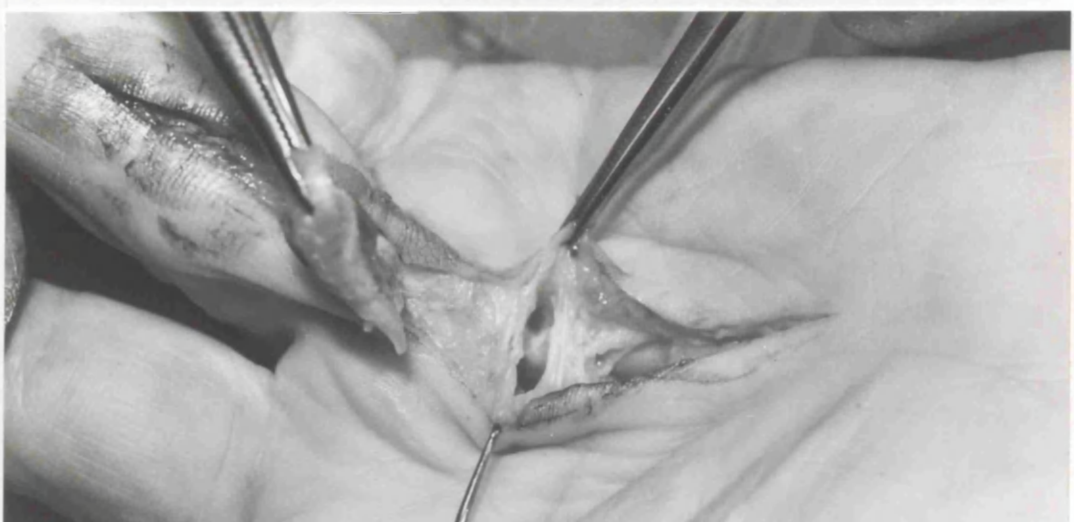

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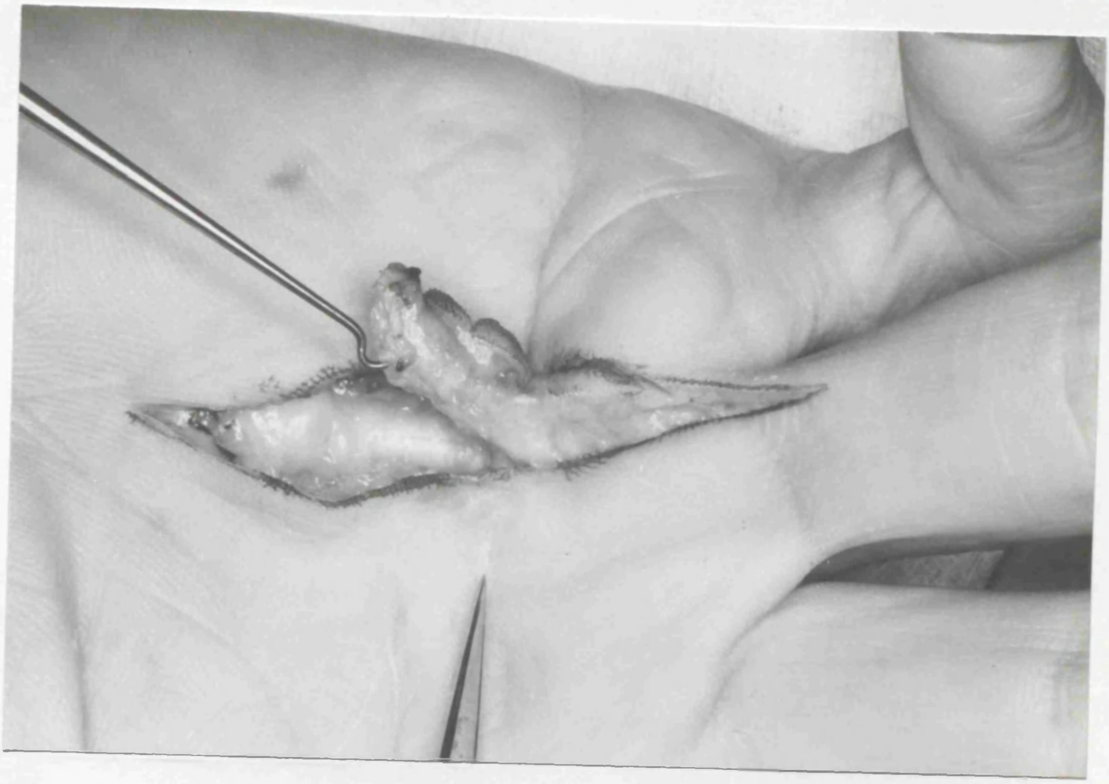

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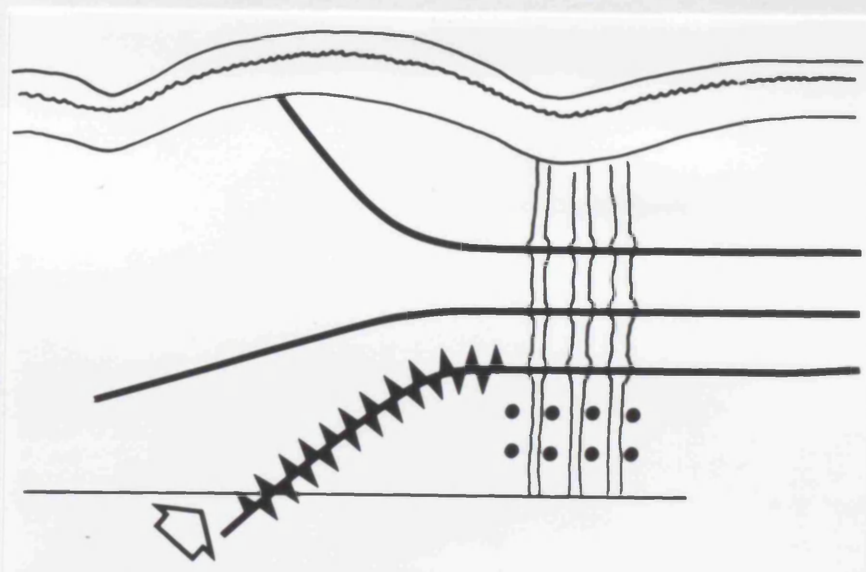
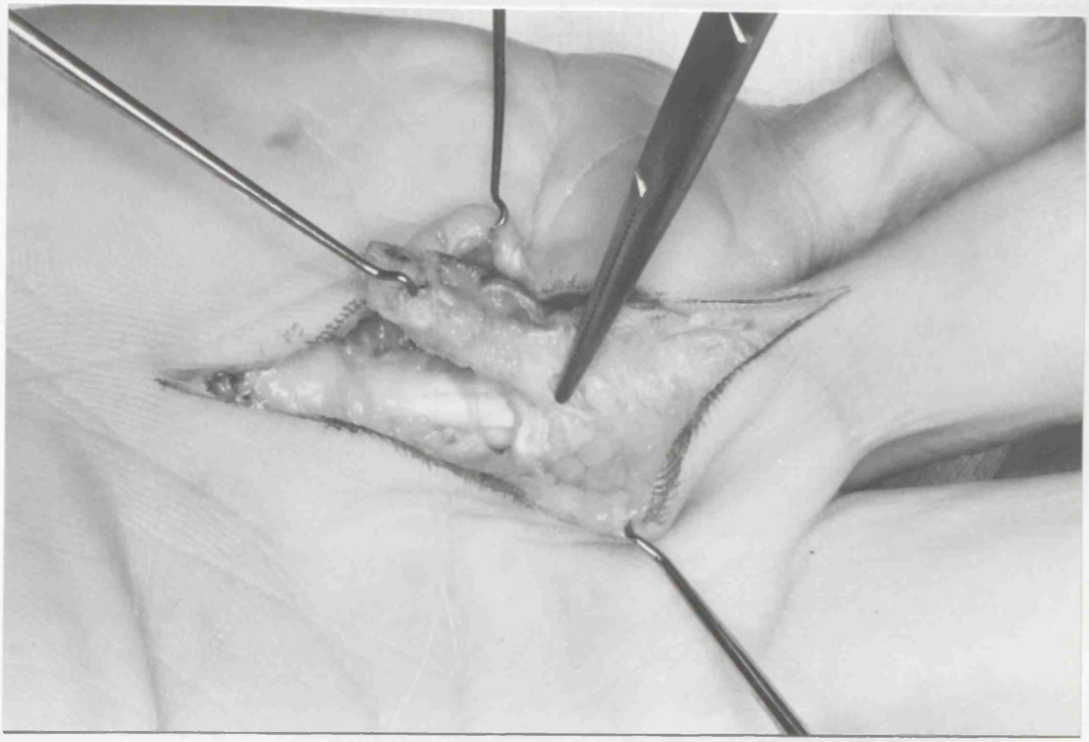


Fig. 10.18 a Involvement of the deepest longitudinal fibres.

b Diagrammatic representation of involvement of the deepest longitudinal fibres.

c



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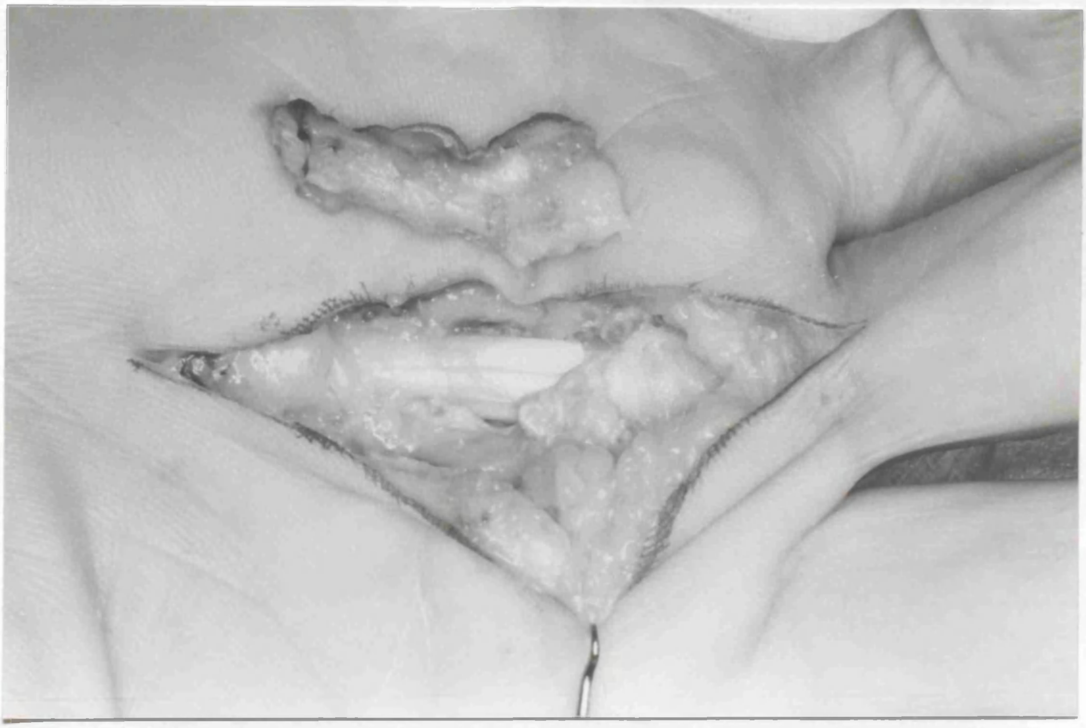


Fig. 10.18 c Deepest fibres are seen passing around the sides of the flexor tendon sheath.

d The excised specimen.

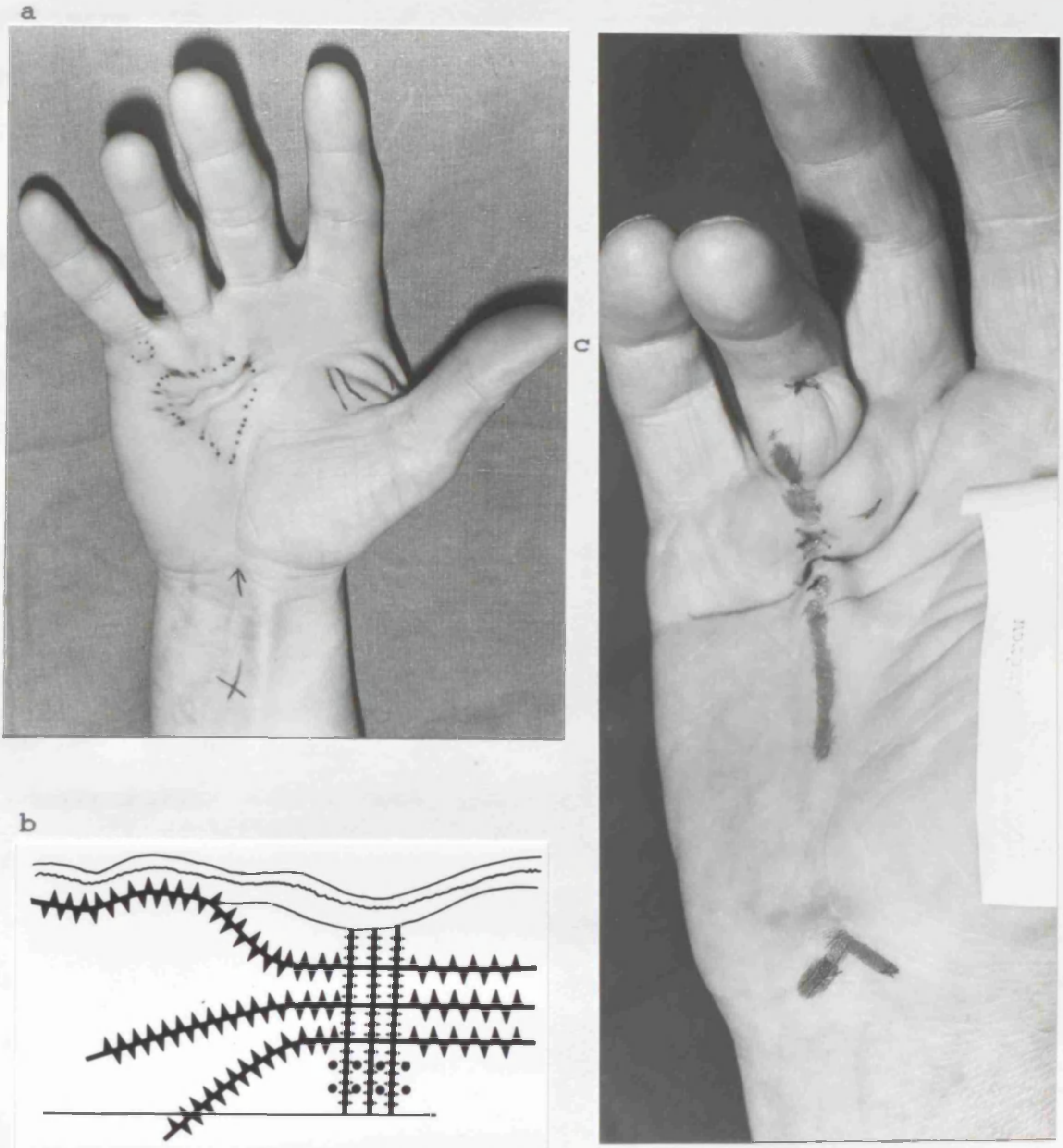


Fig. 10.19 a Clinical example of this type of involvement affecting several finger rays. There is no involvement of the index finger in this case.

b Diagrammatic representation of involvement of all the palmar fascial ligaments.

c Involvement of all of the ligamentous structures in one finger ray.

patterns that may occur have been well described by McFarlane.

If the deepest fibres are involved (Fig. 10.18) contraction of these proximal to the metacarpophalangeal joint will not produce finger retraction, but contraction of fibres distal to the metacarpophalangeal joint will produce flexion of the metacarpophalangeal joint. This type of metacarpophalangeal joint flexion contracture due to deep contracted fibres would be unlikely to be amenable to a closed fasciotomy. Another type of metacarpophalangeal joint contracture is that which occurs when the most superficial of the longitudinal fibres are involved in a contracture which propagates distally in the dermis or subdermal fibres and this type of metacarpophalangeal joint contracture is usually associated with a subcutaneous band which is amenable to fasciotomy (Fig. 10.16b).

DISCUSSION

Despite the many combinations and permutations of the individual lesions of Dupuytren's Contracture there are clearly recognisable clinical patterns of the distribution of the disease.

In its mildest form the disease may present as a line of nodules or pits in the distal palm and may never progress beyond this stage (Hueston, 1963; Gonzales, 1978 and 1985). The nodules may even regress after a time. In its most severe form Dupuytren's Contracture may cause flexion deformities of the metacarpophalangeal and proximal interphalangeal joints with widespread nodules and cords and involvement of the skin.

It must be emphasized however that the pattern of Dupuytren's Disease is not random and McFarlane has shown in the digits that the pattern appears to follow anatomical pathways and the same has been noted here in the palm.

A very much larger series of patients would be necessary to document overall the relative frequencies of distribution of the lesions. This series has been collected merely to show that there is a repetitive and predictable pattern and that this is related to the anatomy of the palmar fascial ligaments. The distribution of lesions would be expected to vary in any case with the length of history, age and other factors.

Pathologically it has been clearly shown that there are two types of tissue present; mature fibrous tissue and this is probably a mixture of normal palmar fascia, and mature cords. Surrounding these and often more superficially there is immature fibroblastic tissue. Reference to Figures 10.13 and 10.16 explains the finding of both types of tissue in a nodule. It is a daunting task for the pathologist to orientate such a specimen and microscopy has not been greatly helpful in solving the enigma as removal of the tissue from the body removes normal tension, destroying orientation, and generally the excision and examination have been performed by different individuals.

The transverse/longitudinal ligament channel system is only one of a number of critical zones in the hand where palmar fascial ligaments are crossing one another; i.e., this means that forces are being transmitted in different directions since the ligaments are a map of the forces acting. Loss of motion therefore will transfer forces from one ligament system to another at a point of crossing (critical zone) giving rise to a stress concentration; i.e., an increase in force/unit area of cross section. The anticipated outcome of such an event in an analogous inert engineering structure would be failure, leading to fracture. Biological systems rarely fail however, they hypertrophy instead. The concept of Work Hypertrophy of Luck (1959) therefore has a rational scientific basis. That ligamentous strength is in some way related to force transmitted is well known to sports trainers. One would have to postulate not only hypertrophy of the palmar fascial ligaments, but also the laying down by fibroblastic proliferation of new collagen.

SUMMARY OF PALMAR ANATOMY AND PATHOLOGY

The palmar fascial ligaments have been examined by microdissection using an operating microscope in fresh and preserved cadaveric hands. The palmar fascia is seen to be a precise three dimensional system of skin ligaments having discreet transverse, longitudinal and vertical fibre systems. In the normal hand there is relative motion between the ligament systems on movement.

The distribution of the lesions of Dupuytren's Disease has been recorded in a series of clinical cases - nodules and skin pits, which have defined positioning, distortion of the palmar creases, cords and joint contractures - and the pathogenesis of the disease is related to the anatomy of the palmar ligaments.

The disease conforms to a process of contracture along anatomical pathways.

The transverse fibres contribute to retinacular restraint for tendons, prevent bowstringing of neurovascular bundles and the most superficial limit skin tension in the webs. The longitudinal fibres act as skin anchors resisting a tendency to longitudinal slip of the skin during gripping, (i.e., they balance shearing forces). The vertical fibres anchor specific zones to the underlying base to form skin joints. The palmar skin has no elasticity and the complex anchorage and draping of the skin of the hand to allow motion are controlled by the palmar fascial ligaments. Without these ligamentous systems the skin would slide off the hand like a glove.

CHAPTER 11

ANATOMY OF THE DIGITAL FASCIAE: REVIEW OF THE LITERATURE

In 1867, John Cleland, Professor of Anatomy at the University of Glasgow, presented a report at Dundee to the British Association for the Advancement of Science of "strong ligaments, hitherto undescribed", on the lateral aspects of the digits.

Unknown to Cleland, Weitbrecht (1742), had noted these structures (Fig. 11.1) and Sevestre (Fig.11.2), in that very same year 1867, published an account of similar ligamentous structures. Regrettably, Sevestre's work and fine illustrations have been lost to the literature and only recently uncovered by David Elliot (see Acknowledgements).

John Cleland's eloquent account also lay dormant for a considerable time as structures of this delicacy were not to become of surgical relevance for almost a century. The precise anatomical description has been difficult to assimilate because of disappointing diagrammatic representation and later workers have been confused about his exact account.

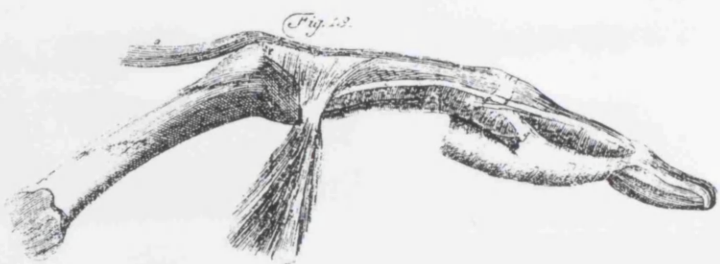


Fig. 11.1 Weitbrecht (1742) Figure 19. A cutaneous attachment ligament (ligamentum cutaneum) is shown running distally from the pip joint. A more delicate retinacular ligament running proximally is named retinaculum tendini longi. This diagram was located in the original work by David Elliot. Later it was found in Functional and Surgical Anatomy of the Hand, Kaplan (1965), Figure 26.

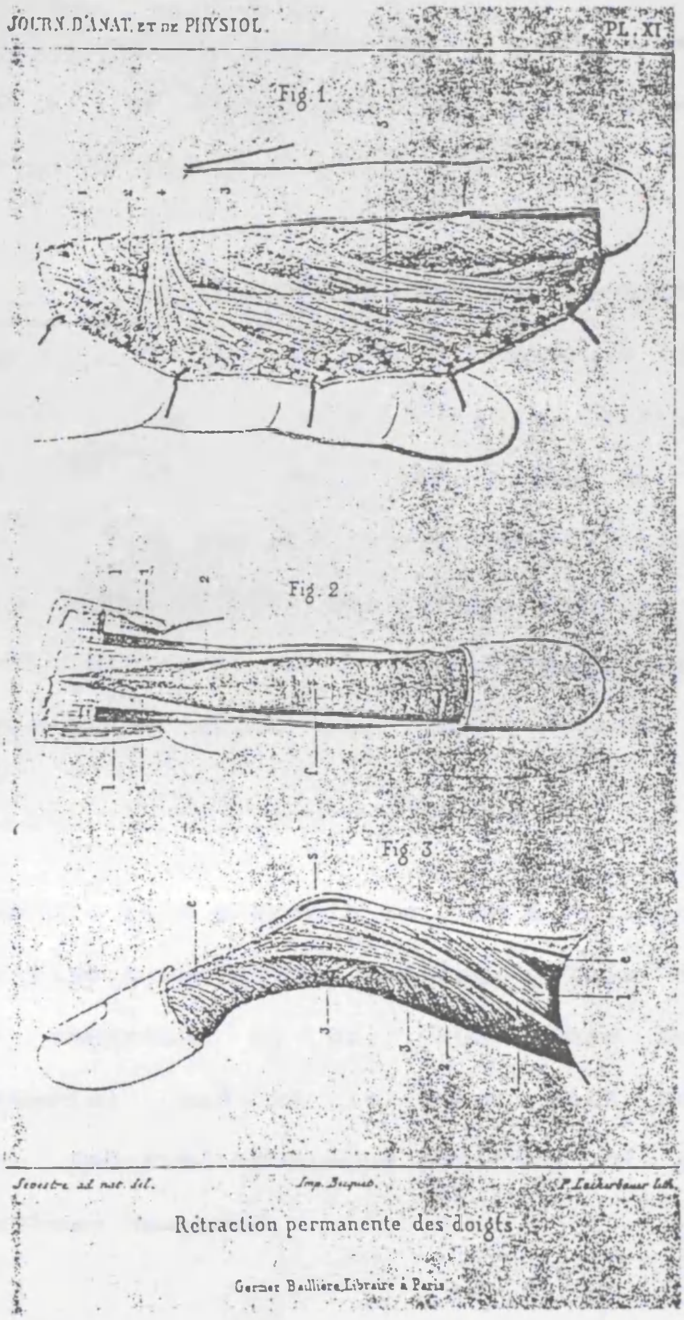


Fig. 11.2 Sevestre (1867) (from a photocopy). Figure 1 suggests the formation of a lateral digital sheet (3) deep the the natatory ligament (4).

This important work (1878) requires careful analysis, as it has often been wrongly interpreted. As it is quite succinct it will be presented here with the author's commentary following each paragraph. Interpretation is facilitated by a re-drawing of Cleland's figures by the author.

> *In the Report of the Proceedings of the British Association, at its meeting at Dundee in 1867, I have stated that "strong ligaments, hitherto undescribed, extend from the sides of the phalanges, near the phalangeal articulations, and are inserted into the skin, helping to retain the different parts of the integument in the positions which they are adapted to occupy".

It has now been possible to find a written report of the British Association Meeting. This important record was unearthed by Dr. John Shaw Dunn (see Acknowledgements) and as it dates with Sevestre's record, the deserved eponymous position of Professor Cleland has been honoured.

The functional hypothesis for these ligaments has been tested by Penelope Law (Appendix 2).

*These ligaments are very constant structures; and it is strange, seeing that they are obvious and strong, that they have not attracted attention. Those at the first interphalangeal articulations of the fingers are exceedingly well developed, as also those at the interphalangeal joint of the thumb; and an arrangement similar in kind, though less distinct, can be seen at the distal joints of the fingers, and also in the toes.

Cleland was apparently unaware of the works of Weitbrecht (1742) or Sevestre (1867).

*Describing the Ligaments opposite the first joints of the fingers from a specimen before me, I find a strong band of fibres arising from the lateral ridge of the first phalanx in the distal half of its extent, some of them within, and some of them outside, the grasp of the ligamentum vaginale binding down the flexor tendons; and joining this band are a few fibres coming from the lateral prominence of the base of the second phalanx. The strong band thus formed is directed downwards, behind the artery and nerve, and its fibres spread out somewhat on reaching the skin, those on the palmar aspect turning over towards the middle line of the finger. Decussating behind this band is one of smaller size, arising from the lateral ridge of the second phalanx, and inclining upwards by the side of the first phalanx in its course to the integument.

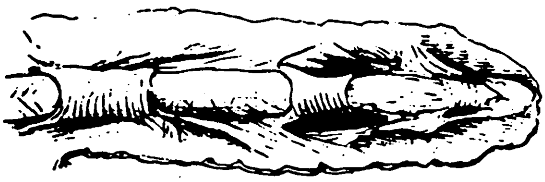
Clarification of the different ligamentous bands is possible by giving them numbers. The term upwards is taken to be proximal in the anatomical position. Milford however considered upwards as towards the palmar skin and this would be an inappropriate description in paragraph 4. The posture of the digits under study is not mentioned.

*At the last joint of the finger the principal band extends upwards from the lateral prominence of the base of the last phalanx, and is strengthened by fibres from the rough expansion of the distal extremity of the phalanx, while other fibres pass directly to the skin behind this band (Plate XVII. Fig.5 in original work and Fig. 11.3).

Fibres 2b are poorly illustrated on the plate.

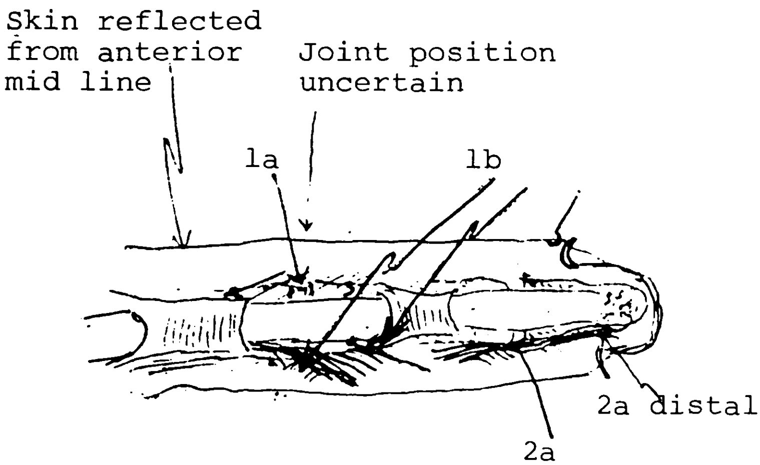
Fig. 11. 3 (a - k)

a)

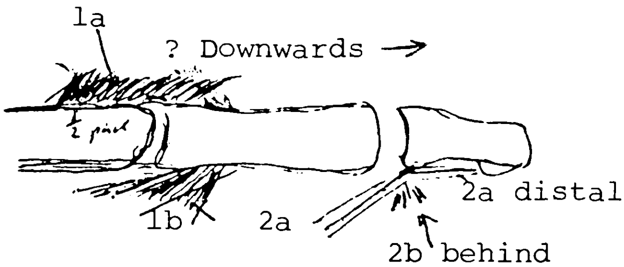


Cutaneous ligaments according to Cleland, 1878.

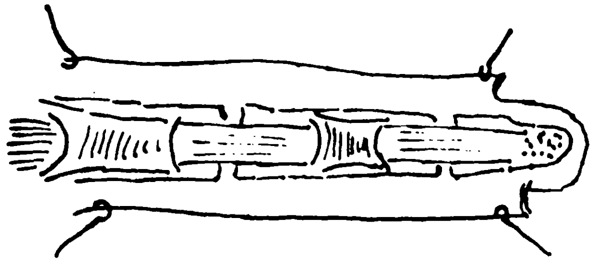
b)



c)



b) c) cutaneous ligaments redrawn by author d)



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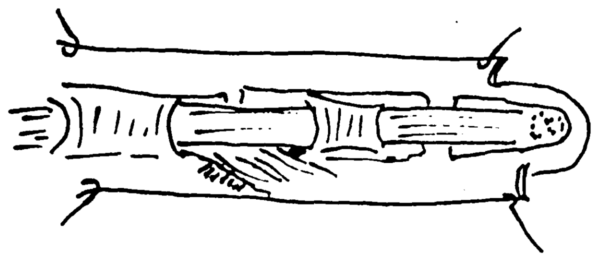

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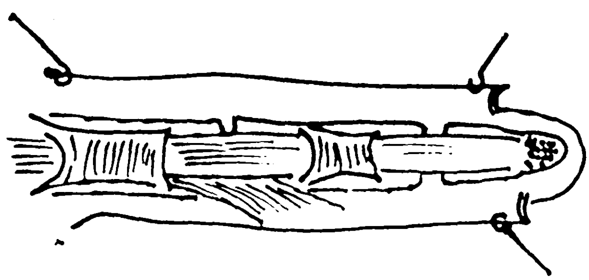

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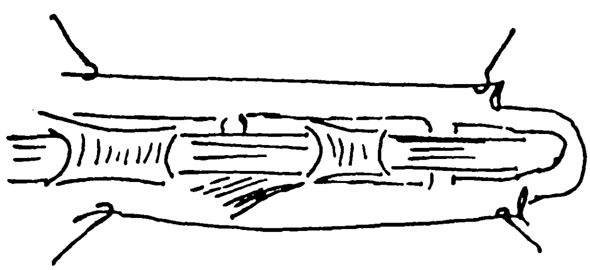
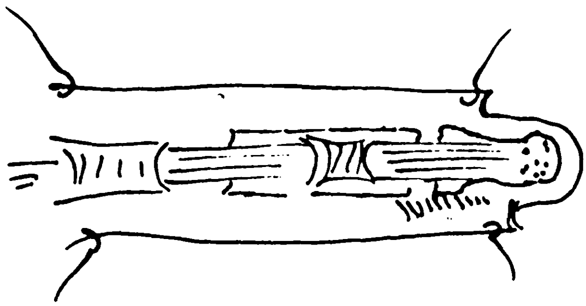


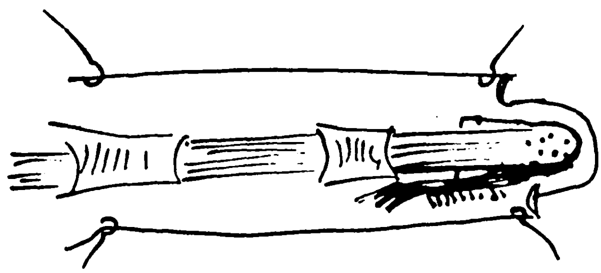
Author's interpretation.

d) Likely position of ip joints.
e) Ligaments at pip joint (la and lb)
f) Ligament la.
g) Ligament lb.

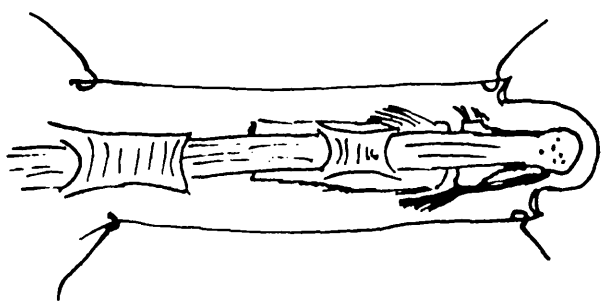
h)



j)



k)



Cleland's ligaments at dip joints.

h) 2b
j) 2a anterior to 2b
k) 2a

*The general result may be described as being the formation of a strong fibrous septum on each side of each finger, lying immediately behind the palmar digital branches of vessel and nerve.

All later authors have agreed on the essential definition of the fibres as lying behind the neurovascular bundles (Fig. 11.3).

*The main advantage of these ligaments appears to be to retain in their places the parts of the integument at the backs of the joints. Behind each joint the character of the integument is different from that on the phalanges, having thicker epithelium, and being thrown into permanent wrinkles on extension of the joint, besides being entirely free from hairs. Each of these districts of integument has within its limits ample provision for the flexion of the joint; and, indeed, the apparent redundancy of integument in extension of the joint may be considered as in some measure a consequence of its being stretched in flexion. Were the integument not retained in position, as it is at the sides of the joints, this arrangement could not exist, for the flexion of the second joint would displace the skin at the back of the first joint, and the flexion of that joint would in turn drag much more the skin over the knuckles, in the same inartistic way in which a glove is dragged; and such a displacement actually occurs to a limited extent in hands which from any cause have the integument unusually loose and baggy. But generally there is no such displacement; the skin over each phalanx retains its position accurately, and is put on the stretch when the fingers are bent.

The retention of integument at the backs of the joints is presumably indirect from anchoring of the lateral skin. The reason for retention of the dorsal wrinkle skin pattern has been described by Penelope Law (see appendix). "The inartistic dragging of a glove" is an excellent simile. It is the peculiar shape of the hand-skin-glove which is a major feature in securing the deformity of digital flexion in the oedematous hand. In this situation, the skin over the dorsum is not so much put on the stretch, but rather the wrinkles are distended with oedema.

*The ligaments in question doubtless also prevent the integument bagging to the sides of the joints in flexion. All the integument in front of their attachments is made to remain in front of them, however great the flexion of the joint, and has therefore to be accommodated in the bend of the finger, while at the back of the joint the integument is stretched laterally as well as longitudinally, and at the sides it is kept close to the bone by the ligamentous attachment. This provision against laterally prominent folds of the skin in flexion is a very necessary element in securing the perfect contact of the phalanges when the hand is used as a cup or is more closely shut, while the accumulation of integument on the flexor surface, above and below the permanent furrow, fills up the concavity of each finger, and gives firmness to the clenched fist.

The movements of the integument on digital flexion and the dynamics of Cleland's ligaments are shown diagrammatically.

In 1941, Grayson, working at the University of Manchester, confirmed that Cleland's ligaments were present in a variety of primates. In addition, he noted similar structures anterior to the neurovascular bundles. These volar retinacular structures, now called Grayson's ligaments, were found to be delicate transverse fibres arising in pairs from the flexor sheaths and running transversely to skin on the other side of the digit. Proximal members arose from the sheath over the distal one-third of the proximal phalanx and a distal pair from the sheath over the proximal one-third of the middle phalanx. These ligaments were found to pass respectively in a distal and proximal direction to be inserted into the skin over the sides of the proximal interphalangeal joint (see Fig. 11.4). The findings of Cleland and Grayson were reviewed by Milford (1968) in a comprehensive work; Retaining Ligaments of the Digits of the Hand. Quite marked differences were noted by this author in the arrangement of these ligaments, but many of these can be resolved in the following way.

Comparison between Milford (1968) and Cleland (1878)

Milford considered the ligaments of Cleland to be cone shaped rather than a fibrous septum, the skin insertion being greater in area than the deep origin, and not in one plane. A second area of disagreement was that Milford found the origin of the largest ligament (1a) to be not from the distal half of the proximal phalanx as described by Cleland, but only from the distal one-tenth. Cleland does not show the location of the proximal interphalangeal joint on his illustrations and the anatomy of his pulleys, the A2 and A4, is erroneous, according to later reports (American Society

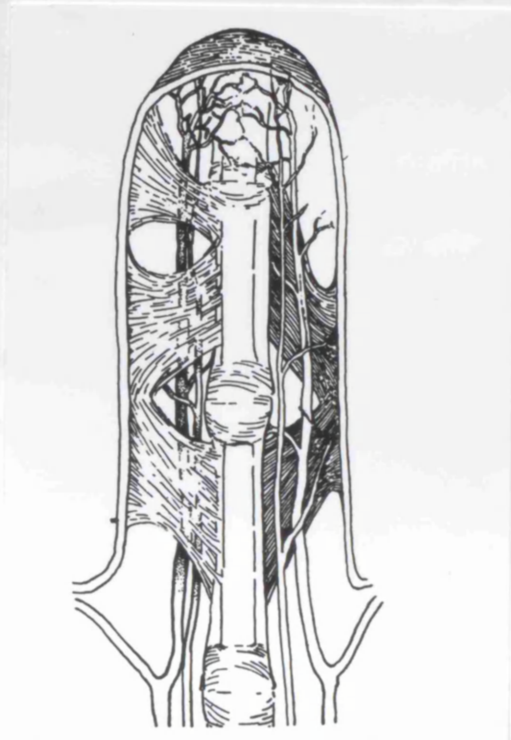


Fig. 11.4 The cutaneous ligaments of the digits according to Grayson (1940). Grayson acknowledged Professor Frederick Wood Jones for the figure which was a composite drawing made from a number of dissections. The ligaments were viewed from the volar aspect, dorsal (Cleland's) on the right, volar (Grayson's) on the left.

for Surgery of the Hand), in that they seem widely separated. The author has noted in undertaking Dupuytren surgery that it is very difficult to locate the proximal interphalangeal joint line, especially in the flexed finger, due to the rolling of the middle phalanx onto the volar surface of the head of the proximal phalanx. The author has quite frankly been lost in this area despite some anatomical experience. Perhaps Professor Cleland was also unsure of his joint line, especially in flexed cadaver digits, thereby wrongly estimating the length of proximal phalanx contributing the origin of 1a. It is of particular interest that Cleland suggested an origin of 1a within the ligamentum vaginale, presumably A2 pulley. This may correspond to the check rein ligament of Watson et al (1979). Milford did not clearly comment on this.

The third major area of inconsistency between Milford and Cleland is the orientation of the ligamentous fibres. Perhaps this can be explained by the misunderstanding of the term "upward" (see above).

The fibres of 1b are generally agreed. Milford has noted the interesting functional observation that the most dorsally situated Cleland's ligaments become taut when the proximal interphalangeal joint is flexed and the most volar taut when the joint is extended. There is general agreement about the arrangement of fibres at the distal joint. The major points of disagreement therefore hinge on the origin of 1a fibres.

Comparison of Milford (1968) and Grayson (1941)

Milford disagreed with Grayson's orientation of ligaments as shown by Figures 11.4 and 11.5. It is surprising that there should be such a marked disagreement between two careful observers. Later workers have favoured Milford's description (McFarlane, 1974) (Fig. 11.7), but Grayson's report deserves careful consideration when he attributes his diagram to such an accomplished hand anatomist as Professor Frederick Wood Jones. Some means of accommodating two views must be found. Milford also commented that Grayson's diagram of Cleland's ligaments was misleading if not erroneous. This discrepancy will be tackled first.

If we consider the illustration of Cleland's ligament by Grayson (Fig. 11.4) two structures are shown. The distal are almost certainly 2a fibres (related to the distal joint). The proximal are 1a drawn from the text of Cleland's description rather than copied from his diagram; 1b have been omitted. Mistaken interpretations have been based on the fact that these ligaments are 1a and 1b groups, as might be suggested on first inspection. The orientation of the 1a fibres are somewhat more oblique than Milfords suggesting that

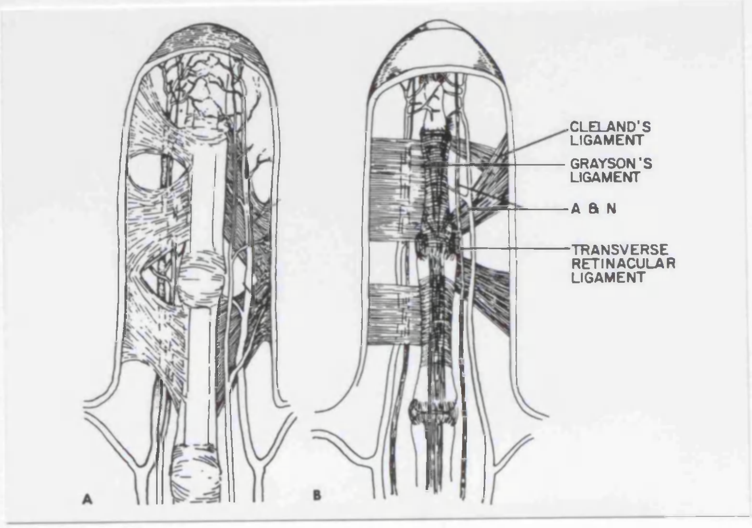


Fig. 11.5 The cutaneous ligaments according to Milford (1968). Grayson's diagram is shown on the left and Milford's findings of the orientation of the ligaments on the right, drawn in the same format.

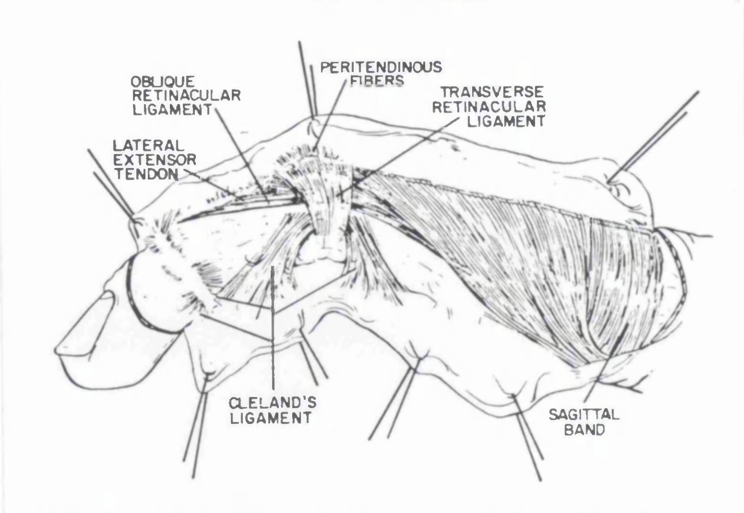


Fig. 11.6 The cutaneous ligaments according to Milford (1968).

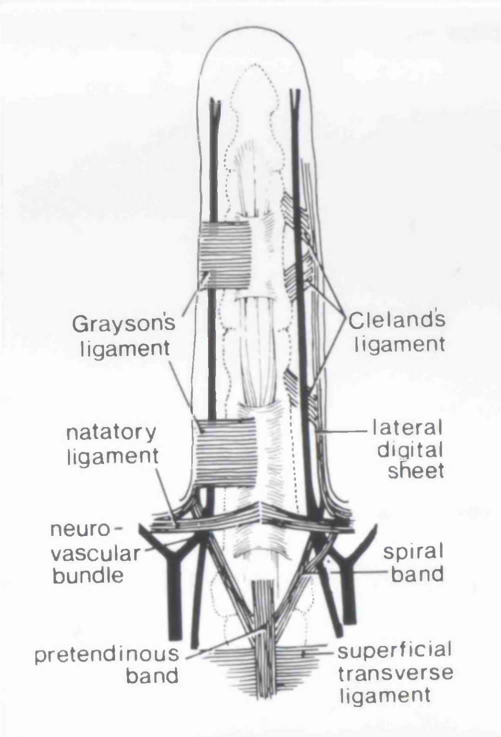
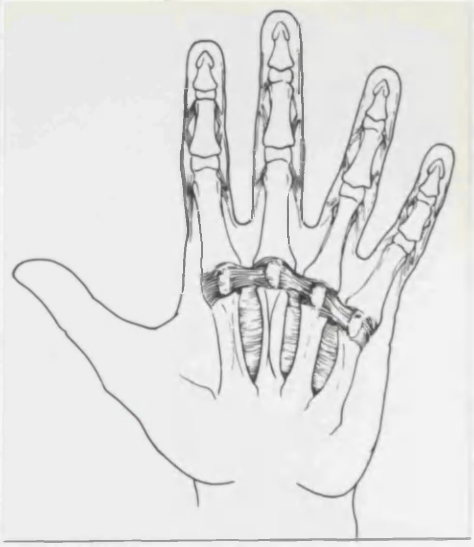
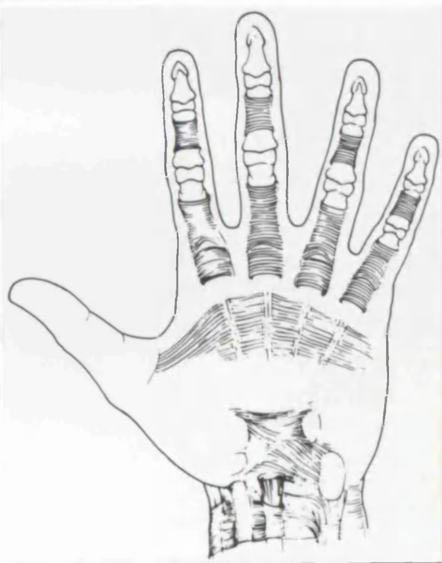


Fig. 11.7 Cutaneous ligaments according to McFarlane (1974).

a Deepest structures; intermetacarpal ligaments and Cleland's ligaments.



b Intermediate retinacular layer including flexor sheaths and transverse fibres of palmar aponeurosis.



c Superficial layer including longitudinal pretendinous fibres, natatory ligaments and Grayson's ligaments.

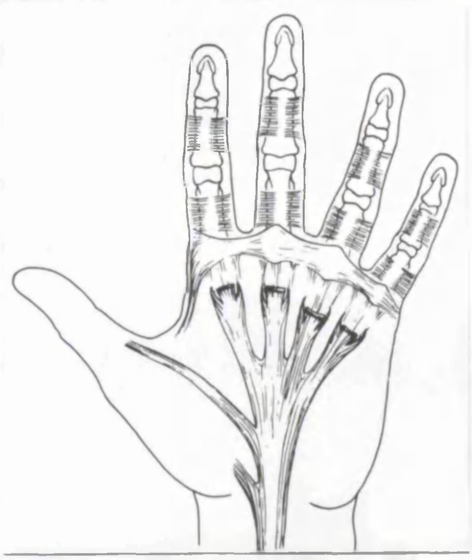


Fig. 11.8 Layers of the palmar and digital fascia according to McFarlane (1985).

Grayson, Wood Jones and Cleland were looking at fixed flexed cadaveric digits. Milford by contrast was examining fresh frozen material. This explains also the difference in description in Grayson's ligament. Grayson seems to have been looking at his study digits in flexion; Milford in extension.

This is of importance in relation to surgery for Dupuytren's Disease where exploration is generally indicated in the flexed digit. The change of orientation of the Cleland's ligaments can be shown by considering a diagramatic representation (Fig. 11.10).

Thomine (1965) based his description of the digital fascias on an elliptical sheath surrounding the neurovascular bundles (Fig. 11.9). A sheet joined these together in front of the fibrous flexor tendon sheath and there was also a sheet of fascia on the dorsum making a complete circle around the digit. He noted the disappearance of the subcutaneous fat and the fixation of the skin to the fascial covering opposite the joints. he recognized that the dorsal and palmar sheets of fascia joint together along the neutral lines of the finger at the line of union of the dorsal and palmar skin at a thickened strand which he called the digital band. He believed that his description differed from that of Cleland in that he did not find an osteocutaneous ligament with an obliquely transverse

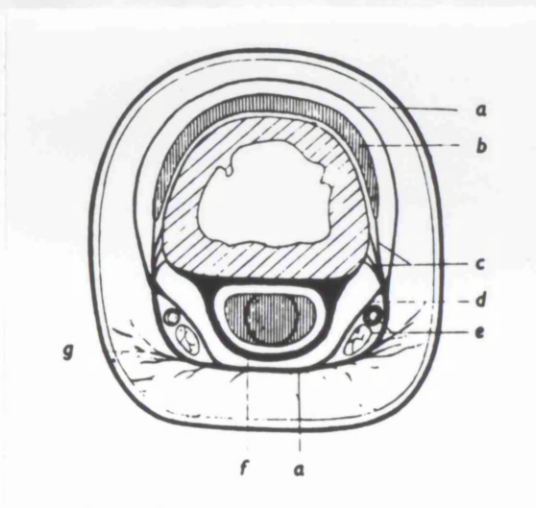


Fig. 11.9 Digital ligaments according to Skoog (1948). Thomine (1965) also described elliptical fascia around the neurovascular bundles.

a anteriorly appears to correspond to Grayson's ligament and c and e with Cleland's ligament.

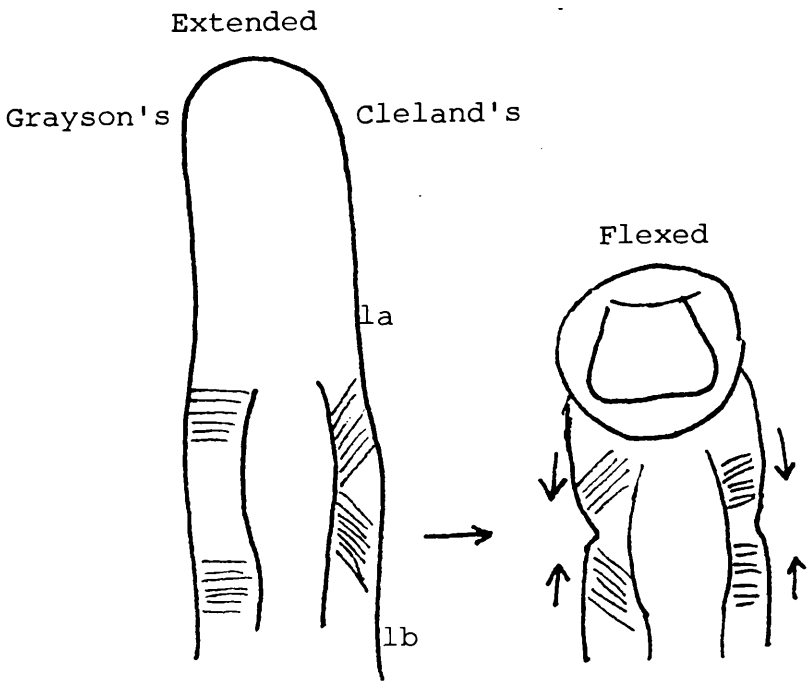


Fig. 11.10a Diagrammatic explanation of dynamic behaviour of digital ligaments.

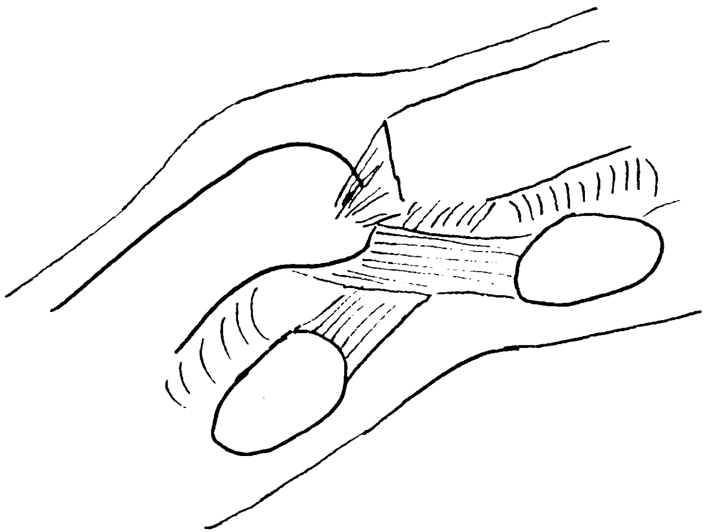


Fig. 11.10b_1

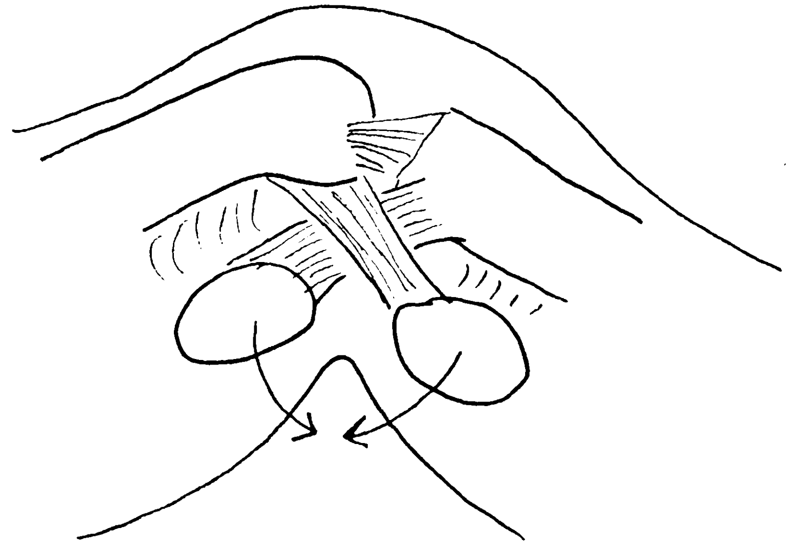


Fig. 11.10b_2

Lateral view of Cleland's ligaments to show changing orientation on digital flexion.

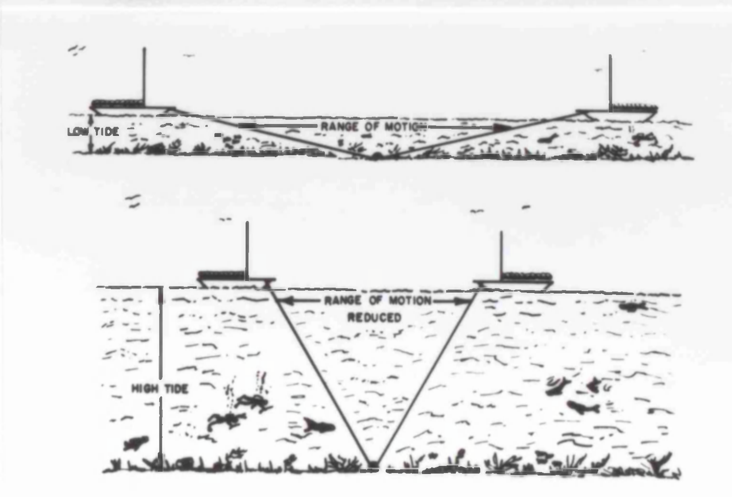


Fig. 11.10c Diagrammatic analogy of Bowers (1987) to show effect on anchoring ligaments of hand oedema (rising tide).

path, but rather a structure with a longitudinal route. He found his longitudinal band to have a bony insertion on the lateral aspect of the base of the middle phalanx.

Gosset (1967) did not agree with Thomine's description of elliptical sheets of fascia around the neurovascular bundles nor did he accept Cleland's description of the skin ligaments. Gosset based his description of the digital fascia on the lateral digital sheet which he believed to be the only really separate structure in the digit. Above there was continuity with the palmar interdigital ligaments (? natatory ligaments) at the termination of the median palmar aponeurosis. At the side of the proximal phalanx it formed a sheet with a free anterior border and a posterior border in close association with the extensor apparatus. Most of the fibres of this sheet were vertical (longitudinal) in relation to the axis of the finger. Superficially the lateral skin was fine and supple. On observing the finger from the lateral aspect the sheet hides the neurovascular bundle completely. He considers that the free anterior edge of this structure (opposite the proximal phalanx) corresponds to Thomine's description of the lateral digital band. At the level of the pip joint fibres run from the sheet to the capsule of the joint, posteriorly to the lateral ligaments, and anteriorly to cover neurovascular bundles and reach the middle of the fibrous flexor tendon sheath (Grayson's ligaments).

The Dorsum of the Digit

The arrangement of the skin retaining ligaments on the dorsum of the digit was of interest to elucidate the problem of knuckle changes and a new clinical sign of "proximal tethering" (Chapter 4).

Dr. Penelope Law has undertaken dissections in this area under the supervision of the author at the Department of Anatomy, University of Glasgow. Dr. Law's paper is presented in full in Appendix 2 (Law and McGrouther, 1984). Her dissections have been examined by the author who has confirmed a continuity between the palmar ligaments, the lateral digital sheet of ligamentous fibres and fibres passing from the lateral digital sheet to the dorsal wrinkle skin. (The eponym "Law's" ligament would be appropriate). A pathway of fascia has therefore been identified from the palm to the dorsum of the pip joint.

Relevance of digital anatomy in DD

In Dupuytren's Contracture certain definable anatomical pathways are involved. McFarlane (1974) has classified digital contractures as being due to a central (or pretendinous) cord, a spiral cord or a lateral cord.

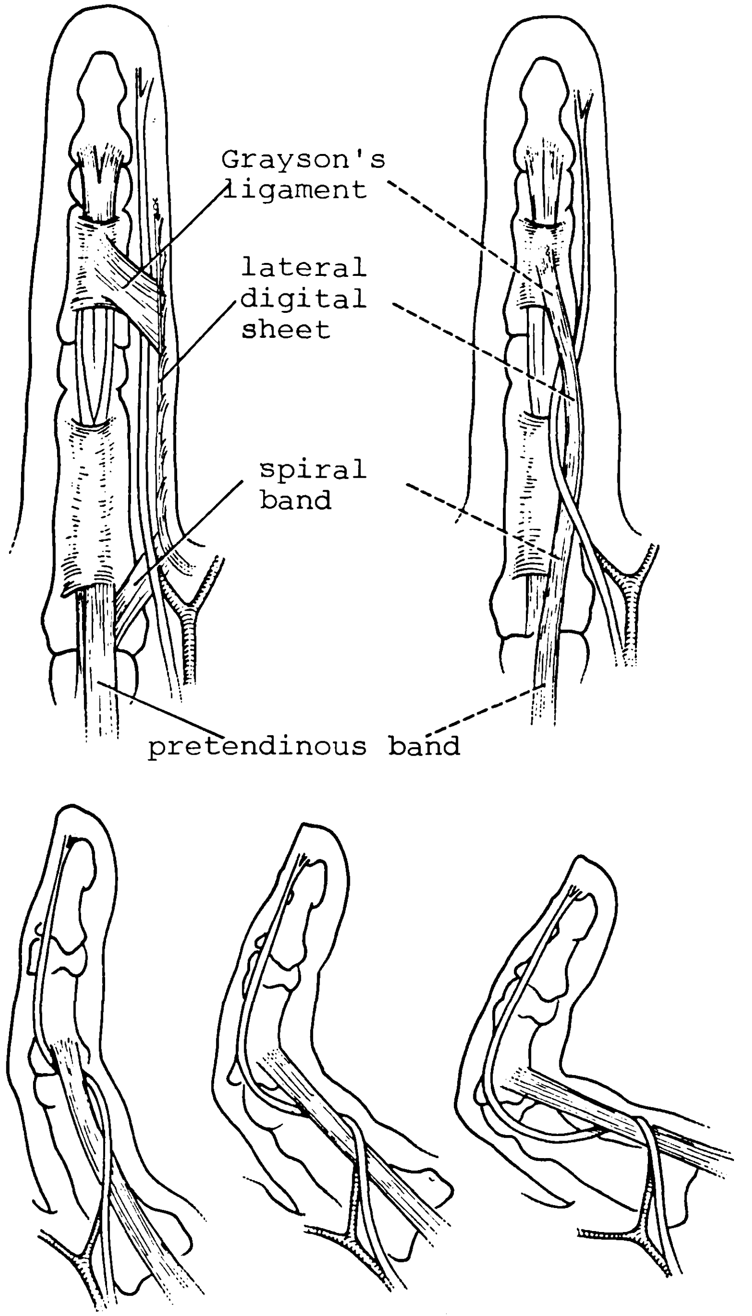
The central cord is a mid line structure which has probably no anatomical counterpart and may possibly rise from dermis. It forms in Dupuytren's Disease as a continuation of the pretendinous longitudinal fibres.

The spiral cord originates from a contracture which follows the normal pathway from the second palmar layer to the lateral digital sheet by way of the spiral band of Gosset. In the finger the contracture passes through Grayson's ligament to the tendon sheath and middle phalanx. It is this cord which is most likely to displace the neurovascular bundle.

The lateral cord follows the lateral digital sheet and neurovascular bundle displacement is less common.

Distally all finger cords may terminate in bone, tendon sheath or skin.

Strickland and Bassett (1985) have described cords which are confined to the fingers arising from the base of the proximal phalanx. These cords were either single or double running superficial to the neurovascular bundles in the proximal digit and associated with displacement of the bundles (Fig. 11.14).



As the digit becomes more flexed the neurovascular bundle comes to lie further anteriorly on top of the cord.

Fig. 11.13 Formation of spiral cord (McFarlane, 1974).

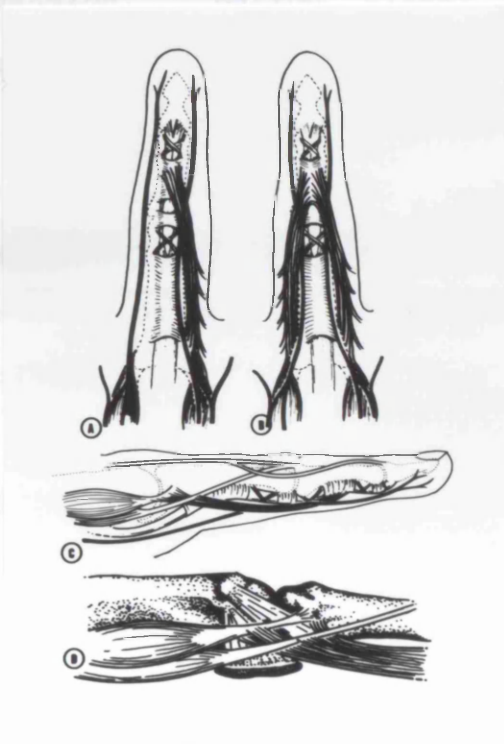


Fig. 11.14 Isolated digital cords after Strickland and Bassett (1985).

The Ulnar Side of the Hand

"The fascial structures on the ulnar side of the hand have been dissected by White (1984) (Fig.11.15). Fascial extensions of the abductor digiti minimi pass in four major directions - to the Natatory ligament, Grayson's ligaments, the lateral digital sheet and the extensor expansion. Barton (1984) has described Dupuytren's Contracture arising from the abductor digiti minimi and following these pathways. The cord originates from the muscle (well demonstrated in a dissection by Partridge, 1854) or overlying fascia and generally passes superficial to the neurovascular bundle which may be displaced.

Radial Side of the Hand

The anatomy of the palmar fascia on the radial side of the hand and its relevance to DD is discussed at length in Appendix 1.

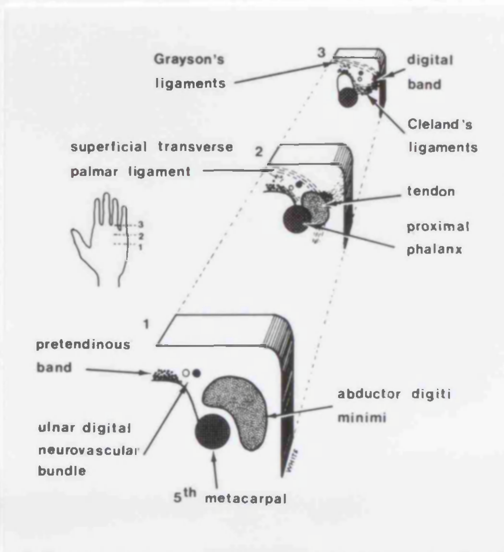


Fig. 11.15a Anatomy of fascia on the ulnar side of the hand according to White (1984).

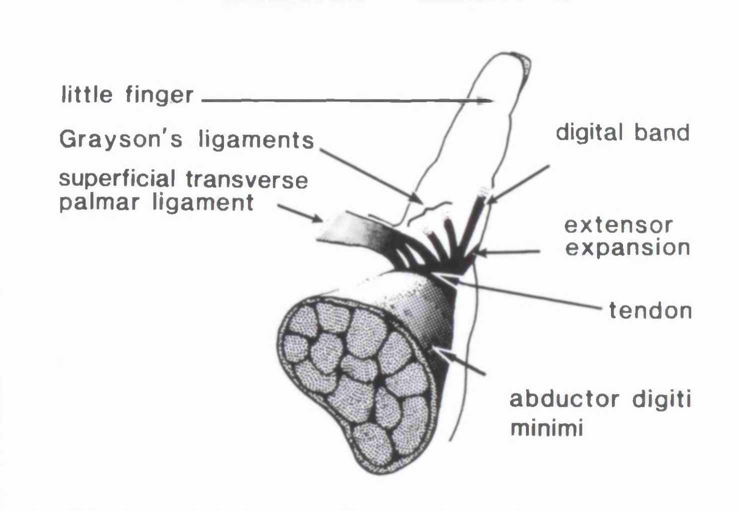


Fig. 11.15b Fascial prolongations on the ulnar side of the hand along which DC may develop.

Fig. 11.15c Diagram (J. William Littler) to show 2 types of cord in the little finger:

A pretendinous cord arising from the palm and an abductor cord from the fascia over abductor digit minimi.

Unpublished information by kind permission of Nicholas Barton (1988).

CHAPTER 12

OBSERVATIONS ON THE ANATOMY OF THE DIGITAL FASCIAE

Authors Observations

Ten fresh and 30 preserved cadaver digits were dissected. The digital ligaments were exposed in a number of ways:-

a) A mid line dorsal incision was made and the skin reflected laterally. The ligaments described by Dr. Penelope Law were divided over the dorsum of the pip joint. No further skin attachment ligaments were encountered until the skin was reflected almost as far as the neutral line of the digit (Fig. 12.1). This technique allowed exposure of the lateral ligamentous structure from the dorsal aspect.

b) A palmar mid line incision was made. The flexor tendon was generally released proximally to allow full extension of the digit. There appeared to be some attachment of the palmar skin in the region of the skin creases by vertical fibres, although these were not specifically examined. Between the skin creases there appeared to be no vertical skin attachment and by incision down to the level of the flexor tendon sheath it was possible to reflect the fascial structures laterally (Fig. 12.2). Some specimens were reflected in a plane outside the flexor tendon sheath. In others, the tendon sheath

a A condensation of fascia lateral to the extensor apparatus (Stanisavljevic and Pool)

Fig. 12.1 Skin retaining ligaments apparent on reflecting the dorsal skin. On reflecting the skin further laterally a condensation of fascia is apparent at the neutral line of the digit.

b Finger extended.

c Finger flexed.

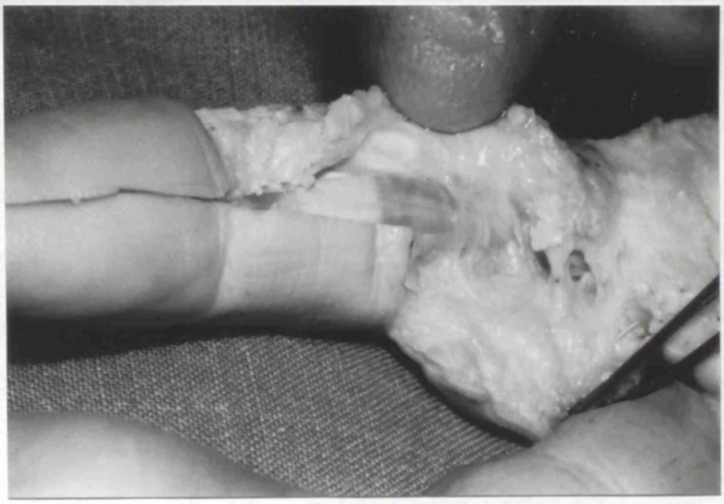


Fig. 12.2 The ligaments of Grayson (1940).

Transverse fibres crossing the flexor sheath are emphasised by applying traction to the reflected skin.

itself was divided in the anterior mid line and this was retracted laterally together with the skin and ligamentous arrangements.

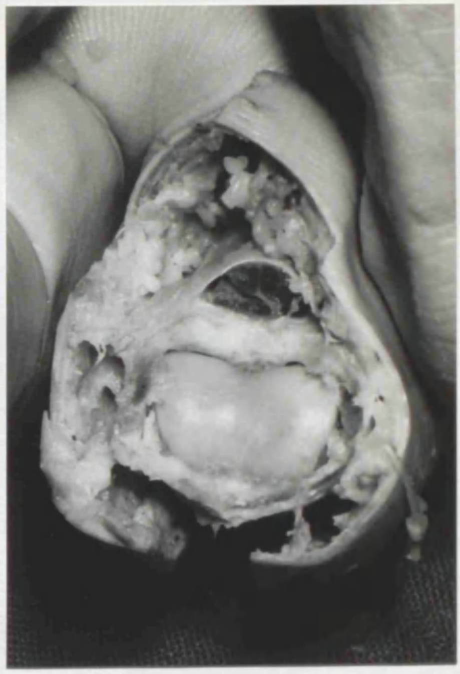
c) Some specimens were approached by transverse division at the level of the proximal interphalangeal joint. On making a transverse volar cut through the skin, flexor sheath and volar plate it was possible to separate the proximal and distal parts of the Cleland's ligament complex at the proximal interphalangeal joint (Fig. 12.3).

Findings

At the level of the proximal interphalangeal joint the most constant structure was found to be a strong ligamentous band running from the region of the lateral aspect of this joint distally to reach the lateral skin of the digit over the middle phalanx. The proximal origin of this band in the region of the proximal interphalangeal joint was quite difficult to ascertain with absolute certainty as the tissues in this area truly form a continuum and align in the direction in which tension is applied during dissection (Fig. 12.4, 5, 6). Nevertheless, there appeared to be a fairly constant origin in the region of the lateral edge of the volar plate. Review of Cleland's original description suggests this tissue arises from the fascial planes around the distal edge of the A2 pulley and from the fascia both within this pulley and outside it. This

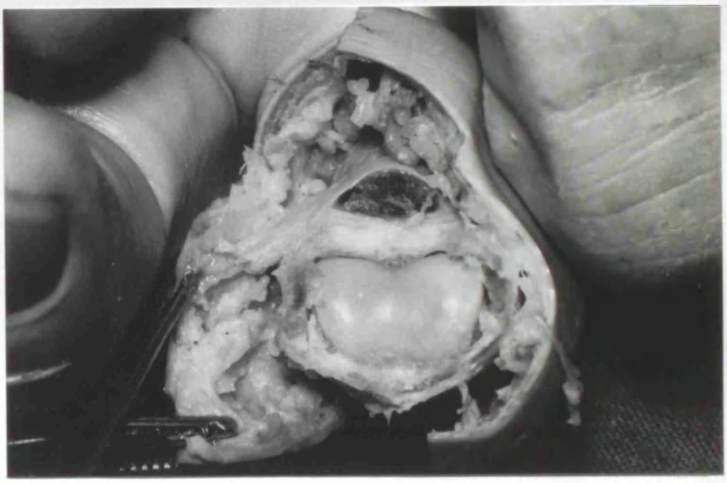
Fig. 12.3

a



Transverse section of digit at pip joint.

b



c

b, c, On reflecting the dorsal skin from the midline, a strong condensation of tissue becomes apparent running laterally from the junction of sheath and phalanx.

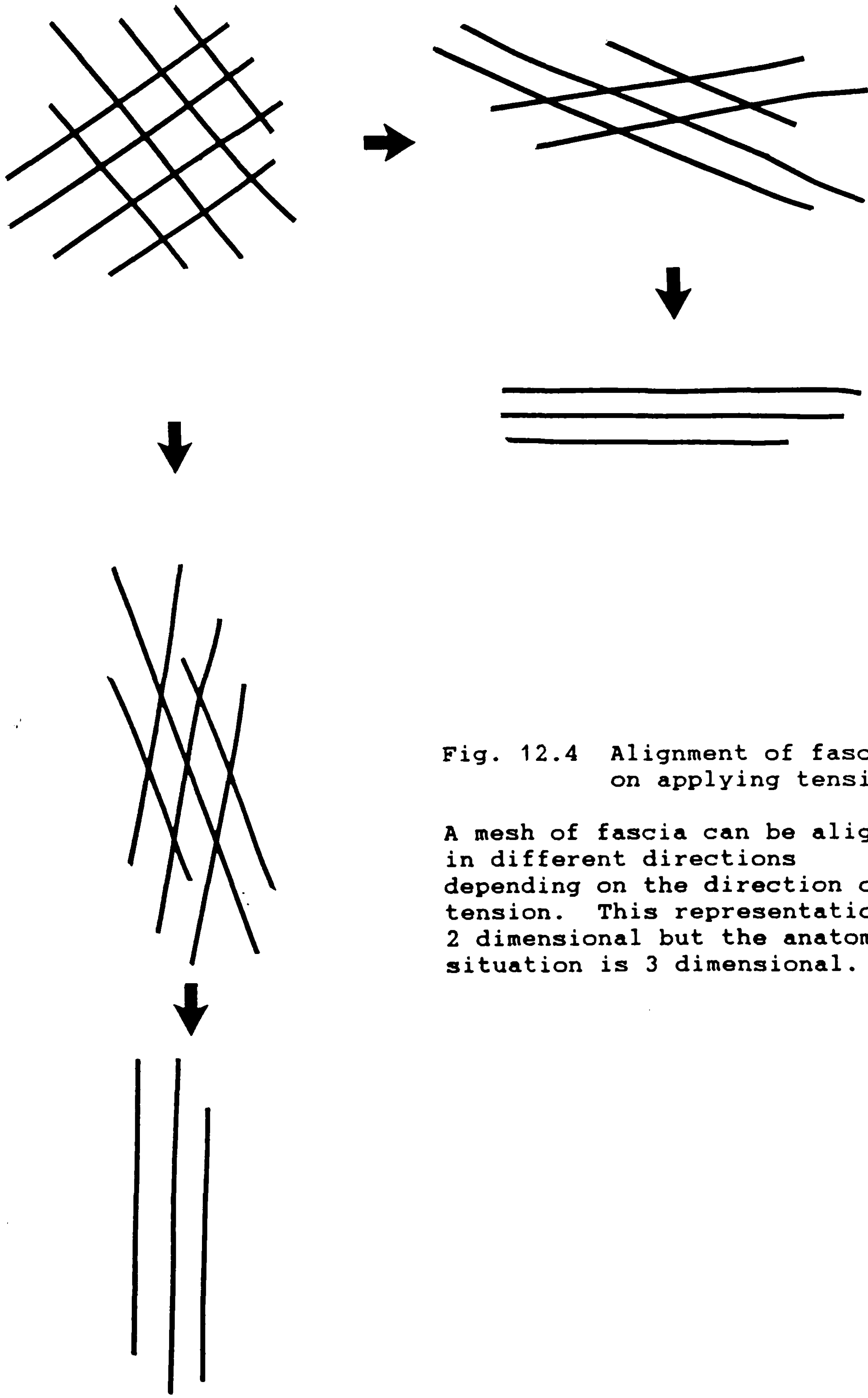
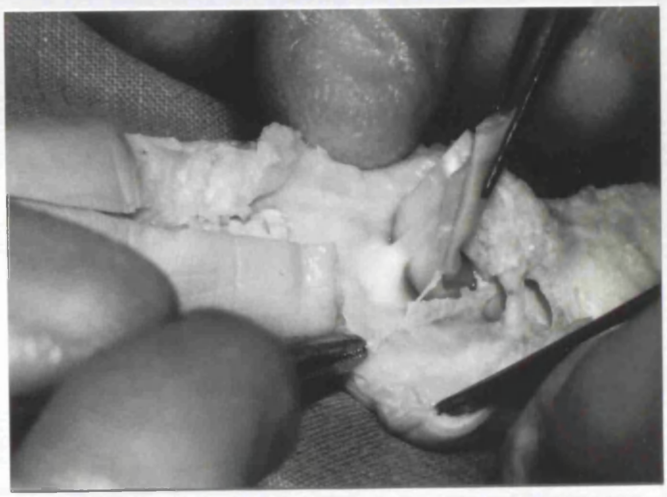


Fig. 12.4 Alignment of fascia on applying tension.

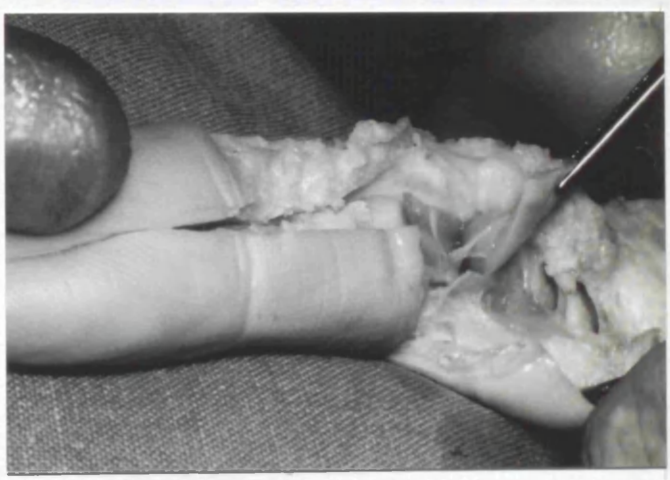
A mesh of fascia can be aligned in different directions depending on the direction of tension. This representation is 2 dimensional but the anatomical situation is 3 dimensional.

Fig. 12.5 Relationships of Cleland's ligament, A2 pulley, vinculum longum.

The long vinculum arises from the floor of the tendon sheath over the neck of the proximal phalanx.



The A2 pulley has been divided in the midline and retracted. The distal edge is gripped in an artery forcep.



The volar plate has been divided transversely. Cleland's ligament is seen streaming out from the junction of A2 pulley and bone towards the skin.

Fig. 12.6

a

Traction between 2 artery forceps shows a continuity of fibres from the vinculum to the floor of the flexor sheath to Cleland's ligament.

b

c

b, c The volar plate and collateral ligament have been cut across. The continuity of vinculum, floor of flexor sheath and Cleland's ligament is emphasised.

would certainly be one interpretation of the fascial continuum in this area. It certainly seems to arise from the lateral part of the cruciate sheath or the volar plate and also the base of the middle phalanx and to extend laterally and distally. The distal insertion of this band seems to be into a lateral fibrous tissue continuum and the lateral digital sheet description of Gosset seems an adequate depiction of the arrangement. Cleland believed this band arose from the distal 50% of the proximal phalanx whereas Milford believed this to be the distal 10%. This has been discussed, but part of these differences can be explained by differing tensions applied to the fascial continuum. It is not possible to state over how large an area the lateral fibres run into the lateral digital sheet. Milford's suggestion of a cone-shaped insertion seemed a very adequate, if somewhat over simplified, picture. In particular, the insertion appears to run behind the neurovascular bundles laterally and thereafter to fold forward towards the mid line of the digit. The posterior fibres merge imperceptibly onto the dorsal subcutaneous fibrofatty fascia (Fig. 12.3). Despite the difficulties of clearly delineating the outer margins of this fascial system it is certainly a well defined and strong fascial band.

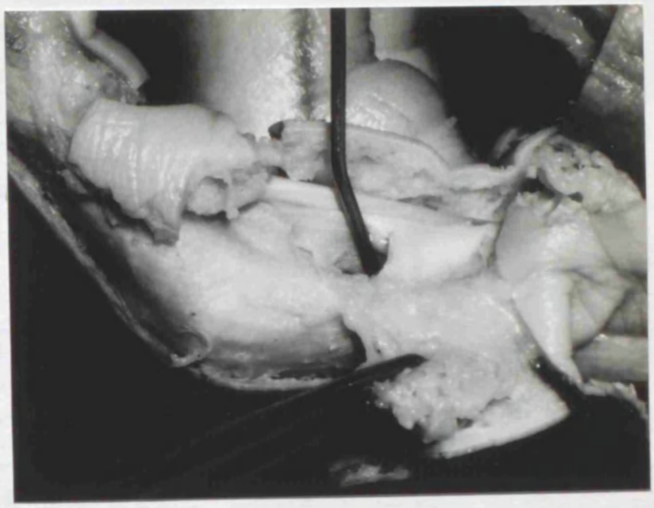
A second fibrous tissue condensation runs from the base of the middle phalanx, but is directed in a proximal direction towards the lateral digital sheet overlying the proximal phalanx of the digit. Cleland depicts the sheet as lying posterior to the ligament described above. Milford again shows this as a cone-shaped structure. The original description of Cleland suggests that this band and the one previously described cross over after leaving their points of origin on the bone and joint. Milford disagreed with this. Our findings are more in keeping with those of Milford. There are certain points in relation to this band which have not been previously described. When the band is dissected by incision of the palmar mid line skin and retraction of the digital skin the band can be placed under tension in a lateral direction, as shown in Figures 12.5 and 12.6. Cleland's ligament, although having a predominantly stout band passing laterally towards a more proximal origin on the lateral digital sheet, also has a component which is a continuous lateral sheet extending further proximally in the digit and lying posterior to the neurovascular bundle. It lies just anterior to the lateral slip of the extensor apparatus forming a septum between the extensor apparatus and the neurovascular bundle. The presence of this continual lateral sheet has been described by Stanisavljević and Pool (1962) (Fig.12.1).

On tensioning this sheet laterally (Fig. 12.6, 12.8), it is seen that the fascial continuum is continuous with the periosteum on the floor of the A2 pulley and, in particular, with the long vinculum. On dissecting normal fingers, no evidence of the check-rein ligament of Kirk Watson (Fig. 12.9) or the check ligament of Eaton (Fig. 12.10) have been found, although the attachment of the cruciate sheath to the lateral edge of the volar plate might be interpreted as a check ligament. It seems that the check-rein ligament, which is described by Kirk Watson, corresponds exactly in position to the proximal origin of the Cleland's ligament (1a). It can be readily appreciated how any fibrotic process affecting this ligament system may intimately involve the flexor tendon sheath and even the extensor apparatus. No specific dissections of the transverse retinacular fibres, as described by Milford, were performed in this series. Dissections of Cleland's ligaments at the distal joint were found to correspond in broad terms with the author's original description.

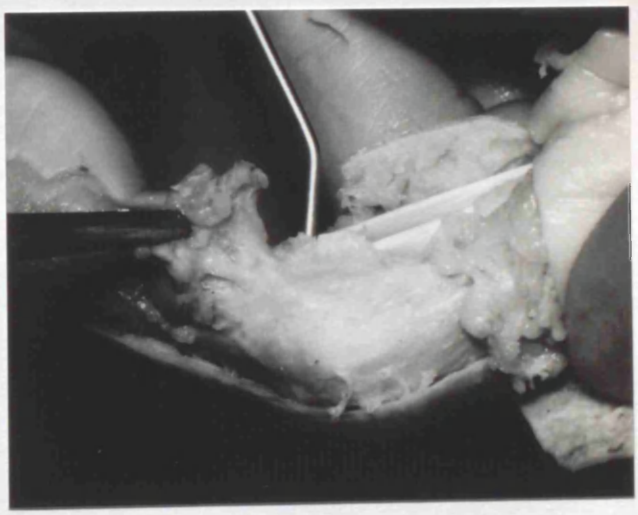
The dynamic behaviour of Cleland's ligaments was investigated. On flexion and extension there was very little difference in the positioning of the bone or joint attachments, but the skin attachments approximated in flexion. In the fully extended digit therefore the angulation between the proximal and distal Cleland's

Fig. 12.7 Lateral view.

A2 pulley divided to allow flexor tendons to bowstring. Cleland's ligament is emphasised by traction with artery forceps on subcutaneous tissue. The origin is seen to be the lateral aspect of the proximal phalanx and pip joint.



Cleland's ligament is seen to arise from the lateral aspect of the pip joint and insert into the lateral digital sheet and skin over the middle segment of the digit (gripped by pressure forceps).



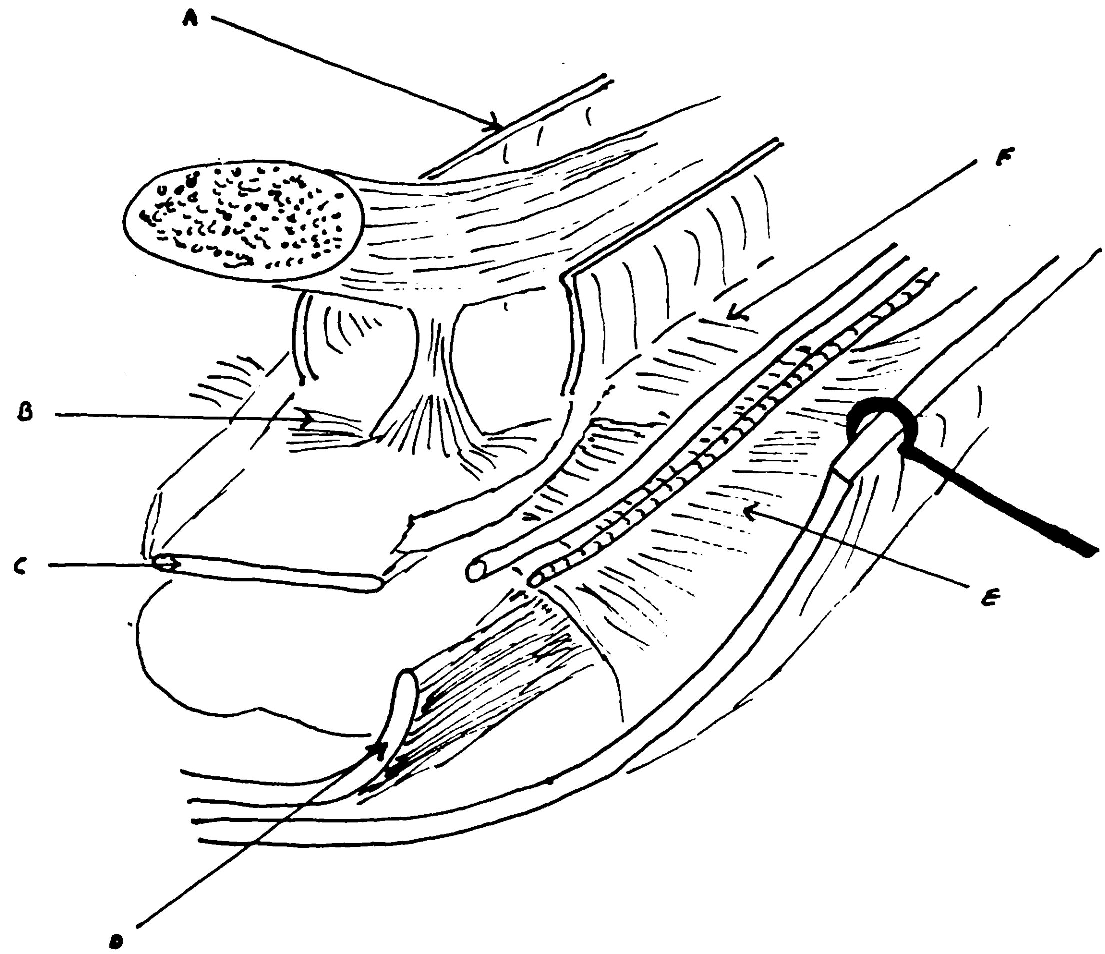


Fig. 12.8 On tensioning the skin laterally by a retractor the continuum between Cleland's ligament, flexor sheath, floor of flexor sheath and vinculum is demonstrated.

A Flexor tendon sheath opened longitudinally.
B Continuous fibrous sheet between Cleland's ligament laterally and vinculum medially.
C Volar plate.
D Extensor tendon lateral slip.
E Cleland's ligament.
F There appears to be a flat sheet between skin and skeleton behind the neurovascular bundle.

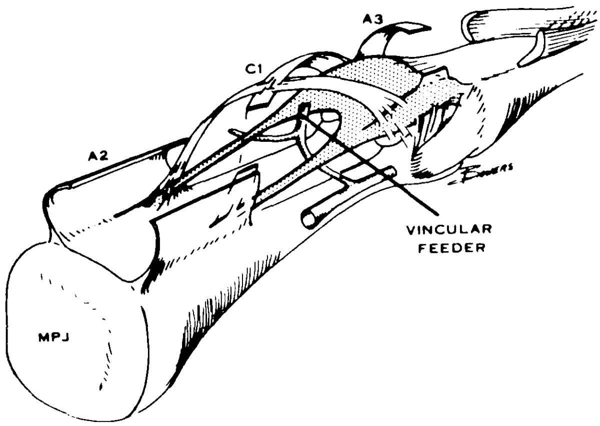


Fig. 12.9 Diagrammatic representation of check rein ligaments according to Bowers (1987). The author has not found such well defined structures.

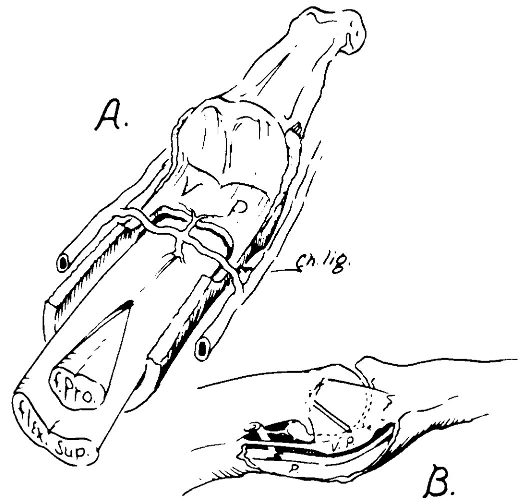


Fig. 12.10 Eaton (1971) described check ligaments tethering the proximal end of the volar plate.

ligament at the pip joint was fairly acute and as the digit flexed the skin attachment points being dorsal to the neutral line appeared to separate such that the angle became more obtuse, as shown in Figure 12.11 and Figure 11.10. Grayson's ligaments were noted in one or two specimens (Fig. 12.2). In the fully extended finger their insertions into the lateral digital sheet were roughly parallel, but as the finger flexed the lateral digital sheet insertions appeared to approach one another. This dynamic behaviour of the ligaments of Cleland and Grayson explains the reports of different authors, as described above.

Fig. 12.11 Dynamic behaviour of Cleland's ligaments.

a) Extension

b) Flexion

c) Flexion
The different orientation in flexion and extension is demonstrated. (See also Fig. 11.10)

DUPUYTREN'S DISEASE:

ANATOMY AND SURGICAL TREATMENT

VOLUME 2

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April 1988

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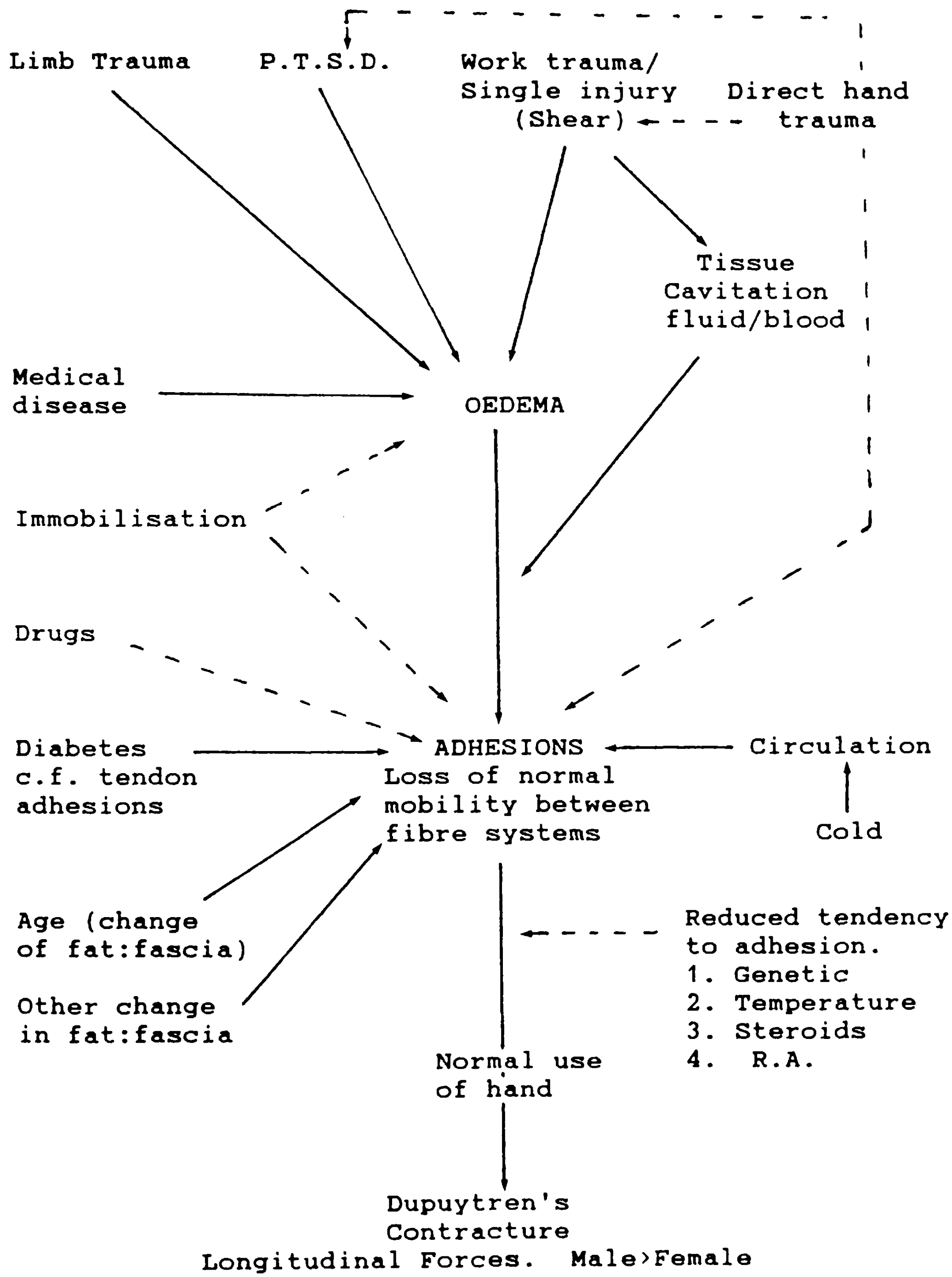
Volume 2

13.IFINAL COMMON PATHWAY OF DUPUYTREN'S DISEASE



CHAPTER 13

CONCEPTS OF AETIOLOGY

As described in the Pathology Chapter, many single factors have each been suggested as "the cause" of Dupuytren's contracture. It is, however too simplistic to suggest a single cause. There is even the possibility that DD is not a homogeneous condition, but a clinical sign (or signs) of ligamentous contracture resulting from a number of different pathological mechanisms.

At the present time, DD is considered multifactorial with a genetic diathesis and triggering factors. There is likely to be a final common pathway leading to the clinical signs (Table 13.1).

Currently there are two broad groups of aetiological views:-

A) That the disease is a neoplasm or a neoplasm-like cellular proliferation (fibromatosis).

B) That the disease has a process similar to the mechanism of wound healing.

A) D.D. - A fibromatosis?

The pathological term fibromatosis begs the question of the exact nature of the cellular process, but Kocher (1887) seems to have been first to note the proliferation of fibroblasts suggesting that the cells behave like a benign neoplasm. Warren (1953) supported this conclusion.

Luck (1959) has reported the nodules as the active foci of contracture. He considered that contraction depends on a nodule-cord unit; the nodule is the contractile element and the essential lesion of DD. He favoured the neoplastic theory, but appreciated that the dividing line between "neoplasia" and "dysplasia" was by no means sharp. Cords by contrast were not considered to contract, but to undergo functional hypertrophy. He divided the pathogenesis of DC into three stages; the proliferative stage, the involutional (contracting) stage and the residual stage.

The proliferative stage

At the outset the cells form a large proportion of the tissue and the collagen a minimal portion. The fibroblasts are not aligned with lines of stress.

The involutional stage

The fibroblasts of the nodule align themselves with the major lines of stress that pass through the nodules (longitudinal). "The unnumerable attempts to extend the metacarpophalangeal joint subject the narrow band of fascia to intermittent tension stresses". The cords undergo functional hypertrophy. Contractures take place only within the nodules. As evidence the fibrous cords are largest where these are subjected to greatest tensile stresses. The nodules are considered to go through a life cycle of stages. The rate at which the nodule involutes and therefore the rate of contracture is widely variable. New Nodules may appear in the palm at widely spaced periods. Wide variation are noted in cellular maturity and the proportion of collagen to cells.

The residual stage

The nodules disappear and the diameter of the cords is found to vary little, (i.e., they have parallel sides). The cords may later atrophy.

Luck believed that therapy should be based on the stage of the disease. In the proliferative stage, nodules should be excised. In the residual stage, subcutaneous fasciotomy would be appropriate. Subcutaneous fasciotomy should be restricted to the palm and applied where the nodules have partially or totally involuted.

Hueston has expressed an aetiological view in many articles. In 1985, he reviewed his extrinsic/intrinsic theory. The intrinsic hypothesis is that changes occur within the normal pre-existing palmar aponeurosis leading to the formation of nodules and hypertrophic bands. The extrinsic theory is that tissue overlying the anterior aspect of the palmar aponeurotic structures between the aponeurosis and the dermis produces a shortening of the aponeurosis by secondary involvement and the development of bands of work hypertrophy. Hueston therefore seems to favour the "Neoplastic" theory. He believed that the dermis exerts a control over this mechanism.

Gabbiani and Montandon (1985) has classified the cellular process as a benign mesenchymal tumour. They note that no other fibromatosis however produces such a contracture.

That there is a cellular proliferation is undisputed. Whether it is out of control, as in a neoplastic process, or under the control of factors such as those which apply to wound healing, or scar formation and maturation is uncertain.

B A Wound Healing Response

Skoog (1948) postulated and demonstrated micro-ruptures in the palmar fascial ligaments. He considered the pathological process itself to be based "on the fundamental principle of scar formation and contracture". McFarlane (1974) has shown the pathways along which contracture can occur in the digits. McGrouther (1982) has shown the pathways of contracture in the palm with an explanation for "skin involvement". If a wound healing process is to be implicated, it is necessary to postulate the reason why DC is not a "normal wound". In a normal wound, myofibroblasts are laid down and the wound contracts and matures. In the palm of the hand, however, the myofibroblasts which arise are subjected to intermittent tension which influences the orientation of scar tissue in the wound bed and produces a tight longitudinal wound with a potential to contract. If one considers the similar situation of a hand burn, a small burn will rapidly contract and heal, a large burn will however contract over a long time cycle and there will be a tendency towards digital contracture which may last for months or years until the scar tissue has matured. The myofibroblasts are, however, situated in different layers in the burned hand giving rise to a very different appearance.

Flint (1985), personal communication) has examined the fat and connective tissue continuum in normal and Dupuytren's hands and confirmed the general structural arrangement of McGrouther (1982). He has shown in addition that the relative proportions of fat and fascial ligaments change throughout life. There is thickening of the fascial structures, especially the vertical fibres and a reduction in the proportion of fat to fascia. This produces a less compliant anatomical arrangement which is less well able to absorb stresses, especially longitudinal shearing stresses. It is seen that any process altering this anatomical arrangement will affect the biomechanics of the palm. Trauma, ageing and diseases of collagen or fat may be relevant. There may be a critical level of change at which point movements of the longitudinal fibres are prevented by tethering. The stressed fibres may then undergo micro-ruptures producing further myofibroblast proliferation.

In favour of a wound healing response are the observations that DD affects areas subjected to trauma; the hand, the foot and the penis. The scar-like process is transmitted along anatomical pathways and McFarlane (1984) has emphasised that only certain anatomical pathways are involved. Against the possibility of a neoplasm is the fact that the disease never metastasises. It does not infiltrate muscle, although it does involve the dermis of skin. Perhaps the strongest evidence that the disease is not neoplastic derives from the response to fasciotomy. Cline (1808), Adams (1879), Luck (1959), Moermans (1986) have shown that simple division may result in considerable resolution of the nodular masses.

Timing of onset of DC

Given that there is a hereditary predisposition, it is interesting to speculate on the factors which determine the timing of onset of contracture. There are 4 possibilities.

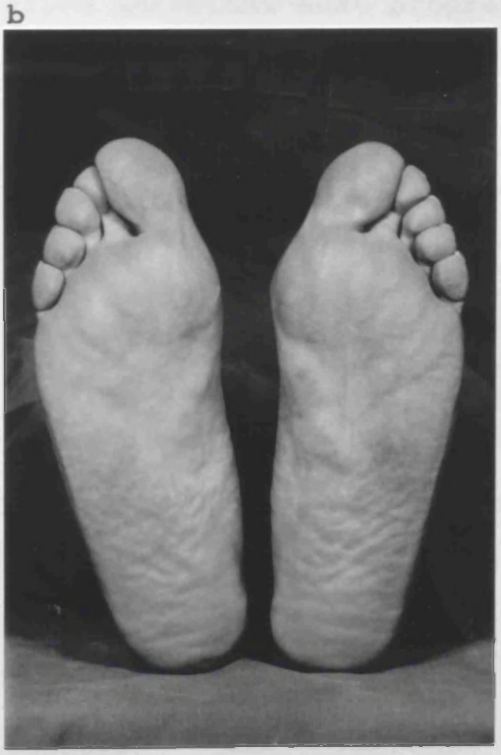
1. That the underlying genetically determined error of cellular metabolism is pre-programmed. The individual tendency to develop DC at a certain time of life would therefore be unalterable.
2. That environmental influences precipitate the onset in a person with the appropriate genes.
    a) Early post traumatic contracture would work in this way through oedema and post traumatic sympathetic dystrophy (Fig. 13.1).
    b) Late post traumatic contracture could tether fascial ligaments. The later genetic onset of contracture might focus on this scar (Fig. 13.1).
    c) Work may alter the ratio of fat to fascia and, when this reaches a critical proportion, contracture may commence. It is possible that the hypertrophy of skin and the development of

Fig 13.1

a

Dupuytren's disease occurring in continuity with old burns scar on palm.

b



Dupuytren's disease confirmed by nodules on insoles.

callosities may be protective to the palmar fascia. Constant heavy work may therefore be less traumatic than the patient who undertakes occasional stressful activity without first training the palm of the hand.

d) Climate may exert an influence in many ways. There may be an alteration in the connective tissues of the hand.

3. Intercurrent disease or drugs may precipitate D.C.
4. Changes in collagen metabolism with ageing. Skoog (1948) reported a case with mere "shrinkage" of the connective tissues.

It is easy to understand how the condition once having reached the stage of transverse to longitudinal fibre adhesions must progress to a DC. What therefore is the primary cause? Perhaps it is the adhesions themselves between fascial ligamentous systems. We know after all that conditions giving rise to stiffness can be followed by contracture, e.g. trauma,post traumatic sympathetic dystrophy, immobilisation etc. We can therefore build-up a hypothesis for the aetiology for DD. When all the known factors act through a final common pathway of adhesions between the ligamentous bands giving rise to stress concentrations. Use of the hand may do the rest by subjecting the ligamentous systems to intermittent tensile stresses. Micro-ruptures may increase the fascial ligamentous hypertrophy. Cavitation with the formation of dead space (rather like blisters filling with blood or fluid) may explain the origin of masses of cellular tissue around the normal ligamentous structures.

It seems therefore that there is a genetically susceptible population and that triggering factors may interact in a complex way. In summary, epidemiological evidence suggests that inheritance determines _if_ the patient will develop the condition. _When_ it commences may be determined by factors which are genetic or acquired, such as associated diseases, drugs, injury, or, perhaps, occupation. _Where_ the disease develops in the hand is determined by hand fascial anatomy and biomechanics. Distribution of the disease in the digits may also reflect injury and, perhaps, occupational usage. The _rate of progression_ may depend mainly on the age at first presentation, but personality seems to have some influence.

CHAPTER 14

BIOMECHANICS OF DUPUYTREN'S DISEASE

Since the tissues of the hand seem to be structurally the same throughout, there must be localising factors to explain the particular distribution of DD. McFarlane (1984) has emphasised that only certain anatomical fascial pathways are involved. The following factors require to be explained.

1. The distribution of the lesions in each digital ray. These follow fascial structures and the nodules, pits and distortion of palmar creases have a reproducible pattern (Anatomy, Chapters 9, 10, 11, 12).
2. The relative frequency of contractures of the different digits. The ring finger contracts more than the little, more than the middle, more than the index (Bruner, 1970; Mikkelsen 1976).

The progressive nature of the disease, the variable rate of progress and the normal loading to which the hand is subjected must be appreciated (Chapter 13).

1. Distribution of lesions

The distribution of lesions of DD within a digital ray is entirely explicable on the basis of the fascial anatomy. The arrangement of fascia is slightly different in each digit. On the ulnar side of the hand, the channel system beneath the distal palmar crease is particularly well developed in the ring finger, but is also present in the middle and little fingers. As the longitudinal pretendinous fibres insert into the dermis more proximally on the index finger and as the palmar crease arrangement is less obvious, the channel system is less well developed.

2. The relative frequency of digital contractures

Numerous factors apply. The extensor of the proximal interphalangeal joint is much weaker on the ulnar side of the hand (Woodburn and McGrouther, unpublished information). Also due to the resting cascade posture of the digits, the fingers on the ulnar side of the hand are held in a flexed position at rest and during sleep. Scar contractions bridle across a concavity, but do not tighten across a convexity. Contractures are therefore most likely to be noticeable across a concavity. There is also a quadrega effect in that when the ring finger is pulled down so that the metacarpal joint is at 90 degrees the middle and little fingers will follow. (The reader can observe this on his own hand).

It is frequently noted that when the proximal interphalangeal joint develops a contracture from trauma, correction is very difficult. This is due to the combined effect of joint stiffness and lack of mechanical advantage of the extensor apparatus. The combined effect of the long and short extensor tendons is likely to hyperextend the metacarpal joint, leaving the proximal interphalangeal joint flexed, rather than to fully extend both joints. DC is different in that metacarpal hyperextension is very rare and only seen in isolated digital bands. Nevertheless, the same difficulty in mobilising the pip joint post-operatively is encountered.

Bruner (1970) has considered the anatomical, mechanical and functional aspects of DD. He reports that the ring finger has the highest incidence and notes that in musicians the ring finger is the most limited digit. He attributes the quadrega effect to the common origins of the lumbrical tendons.

Stiffness of the proximal interphalangeal joint

Stiffness of the proximal interphalangeal joint in DC is not well understood. The joint is merely an abutment of two cartilage covered bone ends. When we loosely describe a joint as stiff, we have to visualise a number of faulty components.

1. Tight structures crossing the joint, e.g. fascia or sheath.
2. Tight collateral ligaments.
3. Volar plate adhesions or tight check-rein ligaments.
4. Loss of compliance of the joint capsule or skin.

The long flexor tendons appear normal, but the extensor apparatus and its intrinsic tendons may be attenuated or adherent. When we say a joint is stiff we often mean that the overlying tendons do not have a normal excursion.

Post-operative range of motion

Possible intrinsic effects must be considered. Following operation, there may be difficulty in regaining the extension range. Possible causes are:-

1. Stiffness of the proximal interphalangeal joint per se.
2. Weakness of the middle slip of the extensor apparatus (Paul Smith, personal communication).
3. Adhesions of the extensor apparatus further proximally, either at the sides of the proximal phalanx or deeply in the interosseous canals in the palm.

There may be a loss of excursion of the lateral bands or a loss of excursion of the lumbrical tendons. The intrinsic tendons may be stuck in an intrinsic minus position thereby tending to produce a claw deformity and recurrence of contracture is likely with both interphalangeal joints flexed. (A posture more often seen after recurrence than in the primary case). If the intrinsics are stuck in the intrinsic plus position, swan neck deformity will be seen. In such a hand there will be difficulty in regaining flexion and the primary problem may be adhesions of the intrinsic tendons deep in the palm of the hand, but it is likely that secondary effects will rapidly develop with adhesions of the flexor tendons, particularly if the sheath has been opened (Case 15, appendix 4).

V OPERATIONS FOR DUPUYTREN'S CONTRACTURE

15.I Operations for Dupuytren's Contracture

A. Management of the Skin

1. Incisions
   - a) Zig-Zag for exposure.
   - b) Linear followed by Z-plasty (for exposure and lengthening).
2. Skin Replacement
   - a) To replace deficiency resulting from contracture.
   - b) Prophylactically required to interrupt contracture continuity.
   - c) If excision of involved skin is necessary.
3. Open Palm

B. Management of Contracted Fascia

1. Fasciotomy

    Open

    Closed

    Fasciotomy and Z-plasty

    Fasciotomy and graft

2. Limited Fasciectomy

    Regional

    Selective

3. Radical or extensive fasciectomy

(4. Dermofasciectomy).

C. Management of Contracted Proximal Interphalangeal Joint

a) Release
   I Release of tendon sheath
   II Check-rein ligament release
   III Volar capsulectomy

b) Arthrodesis

c) Arthroplasty

d) Osteotomy

e) Accept deformity

f) Amputation

CHAPTER 15

MANAGEMENT OF THE SKIN AND SUBCUTANEOUS TISSUES

A Classification of the various operations for DC is shown in Table 15.1.

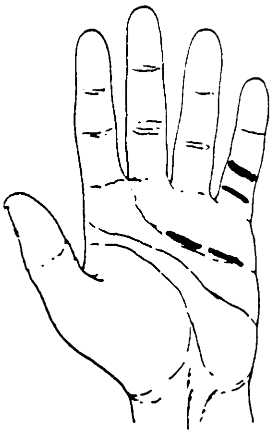
1. Incisions

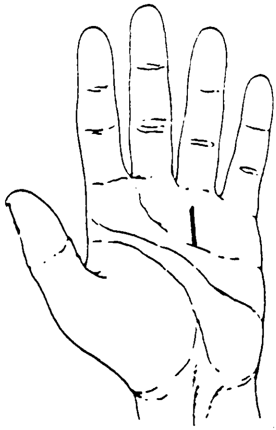
The incision made by Dupuytren (1831) was a transverse one through the skin (and fascia), subsequently to become known as the "open-wound" technique (as mentioned by Adams, 1879). Cooper (1822) by contrast advised subcutaneous fasciotomy. Goyrand (1833 and 1835) advised a short longitudinal skin incision to prevent the wound gaping. Further comment will be made on combined skin and fascia release ("fasciotomy", see below).

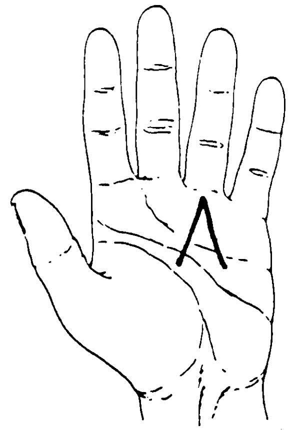
A summary of palmar and palmodigital incisions is shown in Figure 15.1. It can be seen that the simple limited incisions of the early 1800's became more complex as more sophisticated surgery became possible. The elevation of flaps to expose neighbouring fascia dated from Busch whose operation was described by Madelung in 1875. In the palm, the first priority is to avoid devitalisation of skin and the orientation of subsequent skin scar lines is probably less critical in relation to recurrence than in the fingers. The undesirability of a longitudinal mid line digital

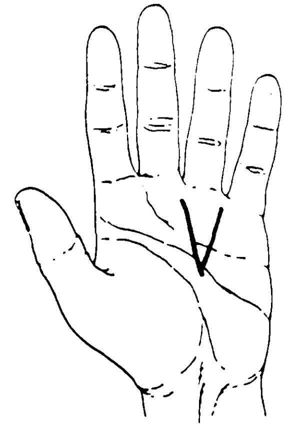
Fig. 15.1 Operative incisions for Dupuytren's Contracture.

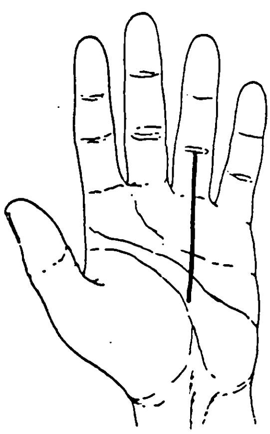
Charts of this type have been published by Einarsson (1946), Skoog (1948), Webster (1957), Parrini and Brunelli (1965) and Geldmacher (1972).

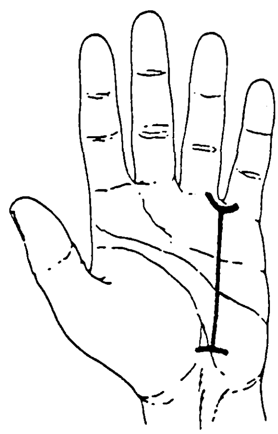

Dupuytren, 1832

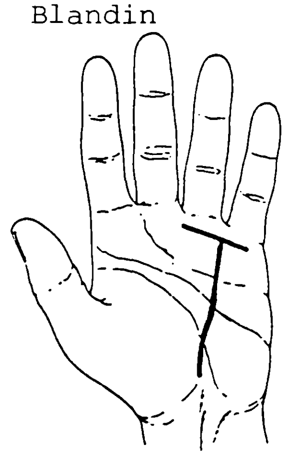

Goyrand, 1833

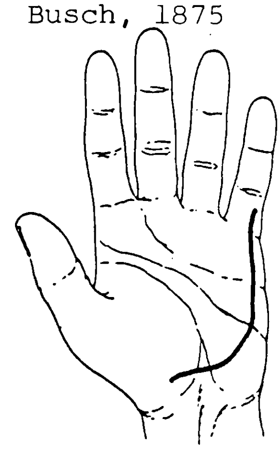

Blandin

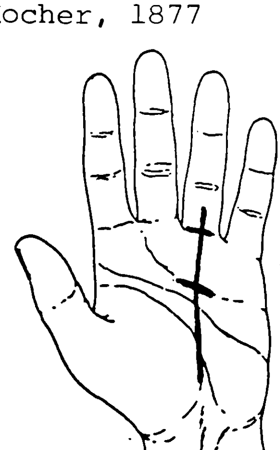

Busch, 1875

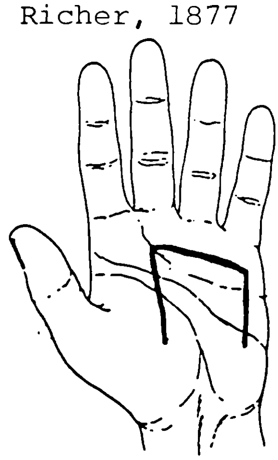

Kocher, 1877

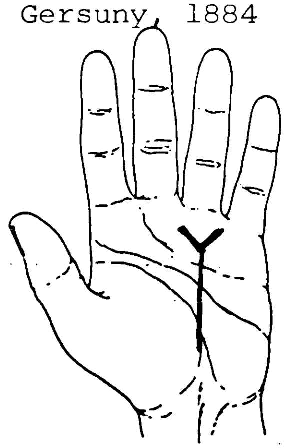

Richer, 1877

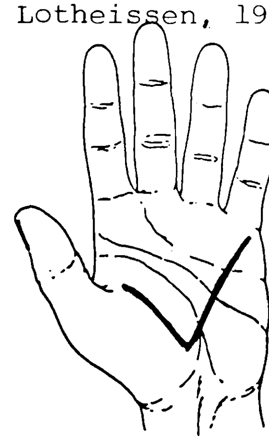

Gersuny, 1884

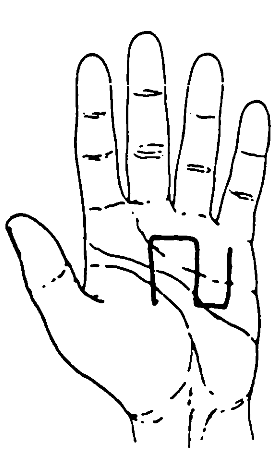

Lotheissen, 1900

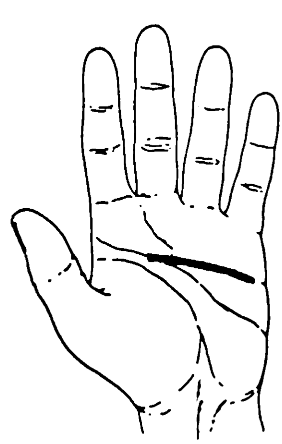

Baarnhjelm, 1905

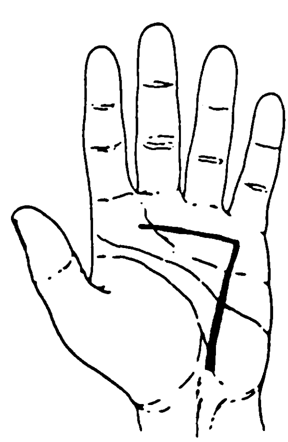

Keen, 1906

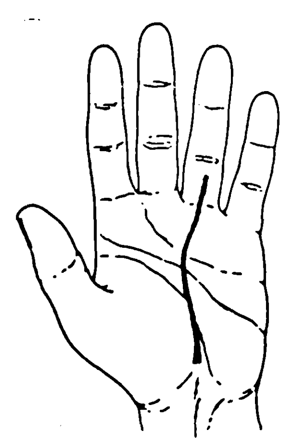

Routier, 1908

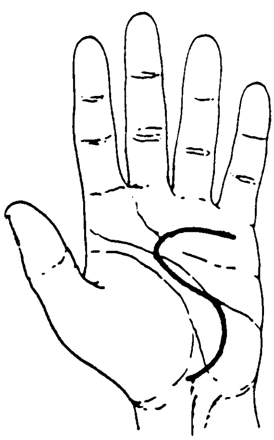

Iverson, 1909


Griffith, Davis, 1919

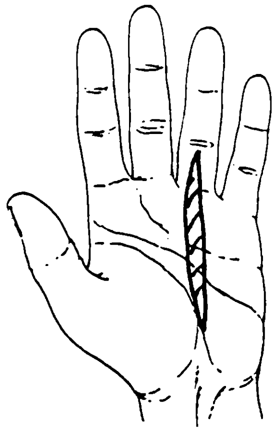

Gill, 1919


Serafini, 1927

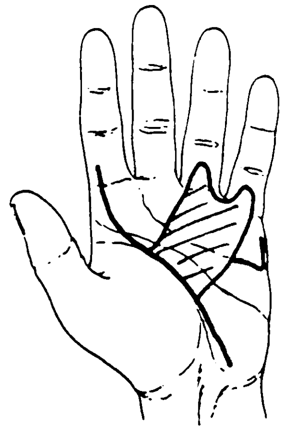

Kanavel, 1929



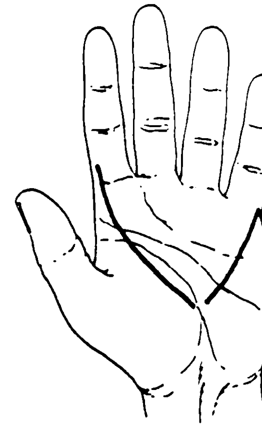
Toiasek, 1930



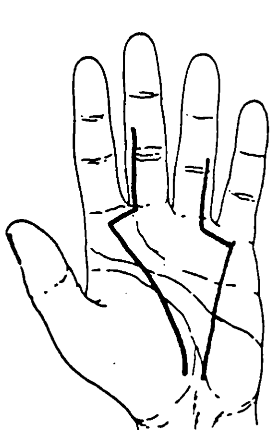
Oehlecker, 1930



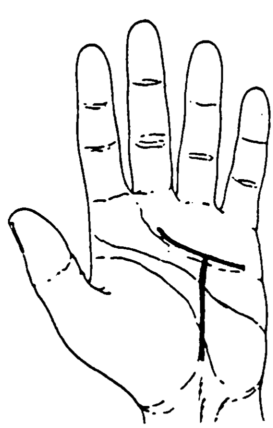
Lexer, 1931



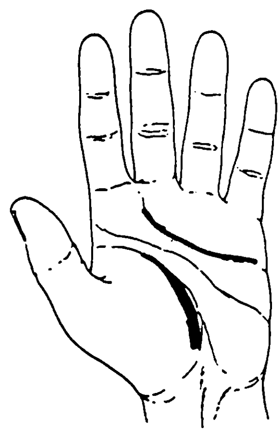
Moure, 1932



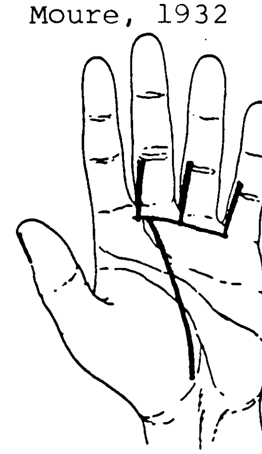
Desplas and Meillere, 1932



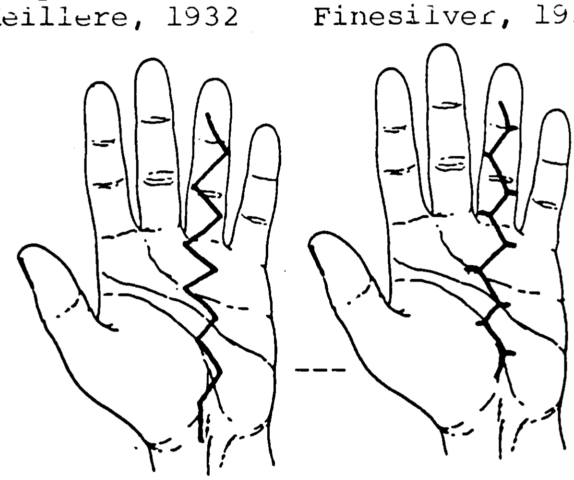
Davis and Finesilver, 1932



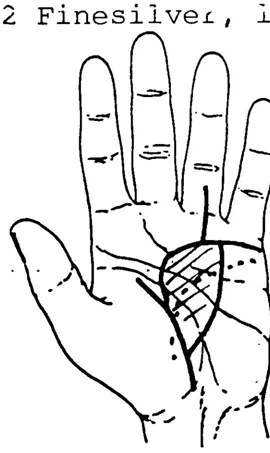
Davis and Finesilver, 1932



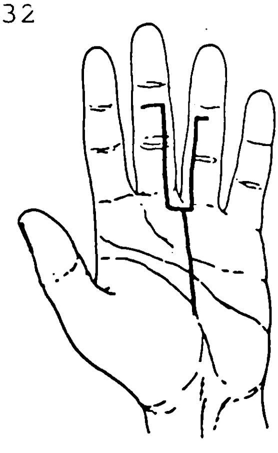
Braine, 1933



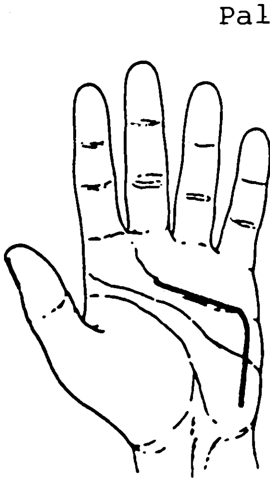
Palmen, 1932



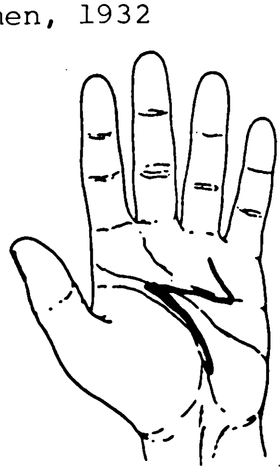
Von Seemen 1936



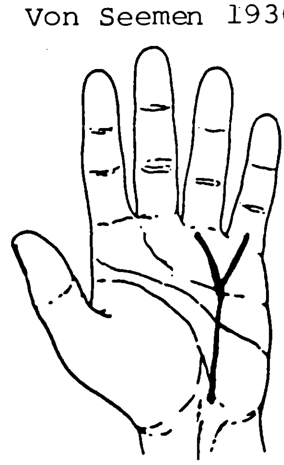
Savarese, 1935



Meyerding, 1936

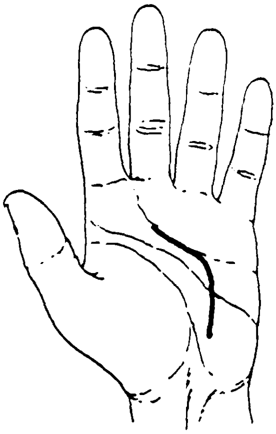


Meyerding, 1936

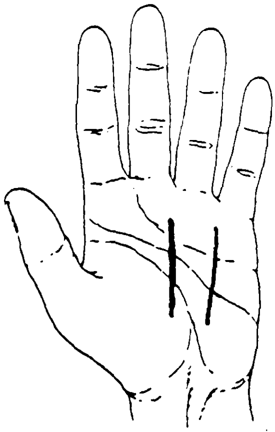


Fernandez, 1936

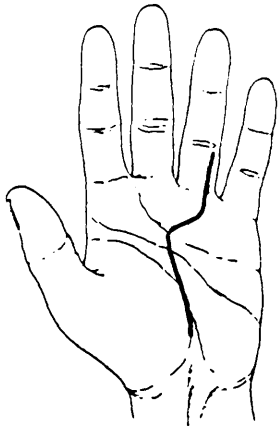
Reichl, 1937



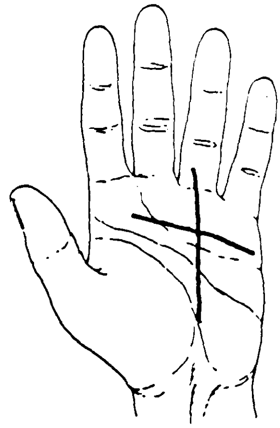
Bunnell, 1944



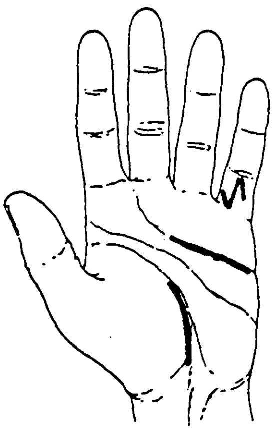
Palmer, 1945



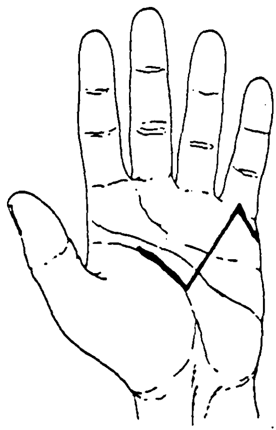
Einarsson, 1946



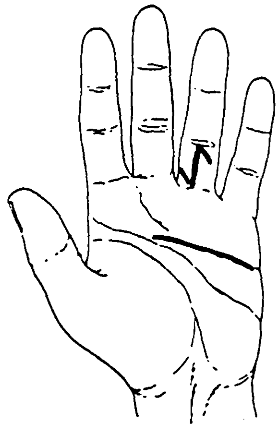
Von Stapelmohr, 194



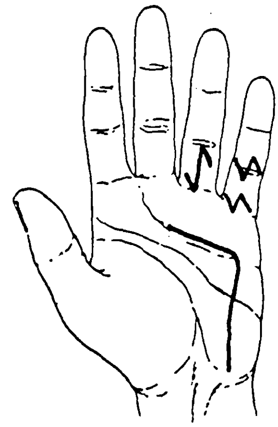
Gosset, 1948



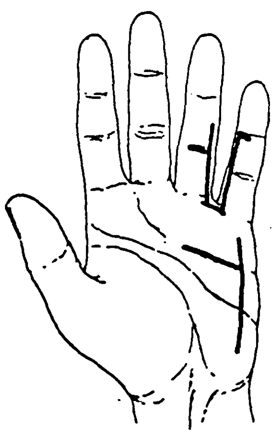
Bruner, 1949

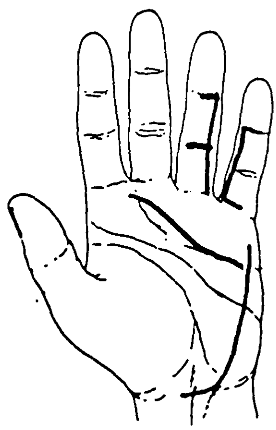


McIndoe, (1948)

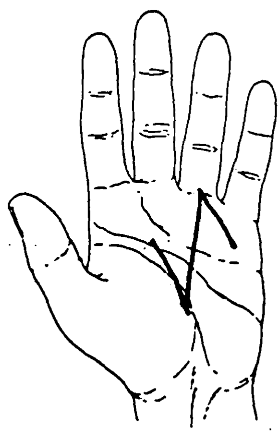


Merle d'Aubigne

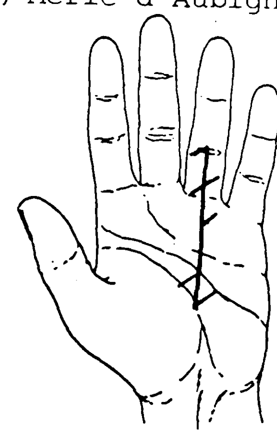




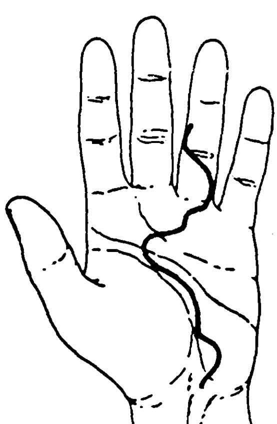
Kanavel Moure(1929)Tubiana



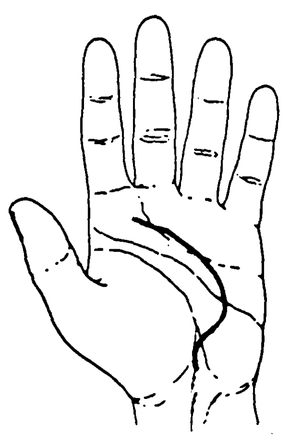
Bruner



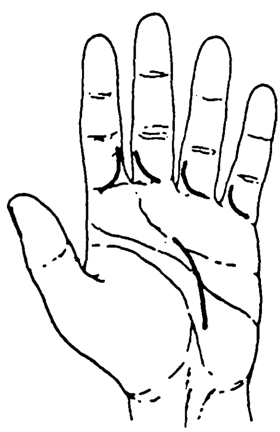
Iselin (1954)



Kaplan, 1953



Hill, 1953



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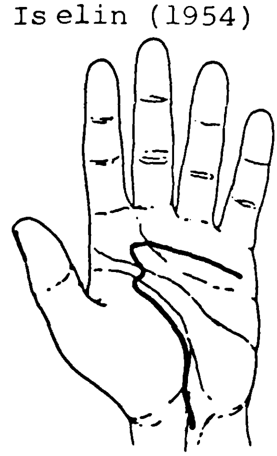

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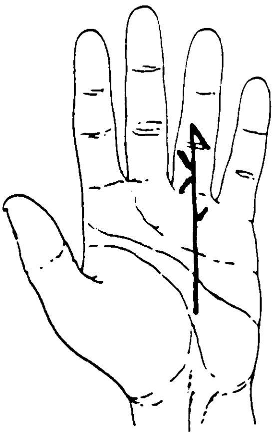
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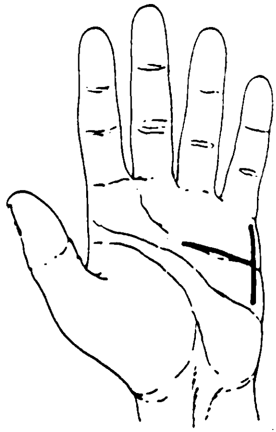
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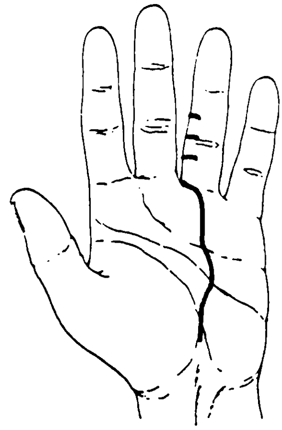
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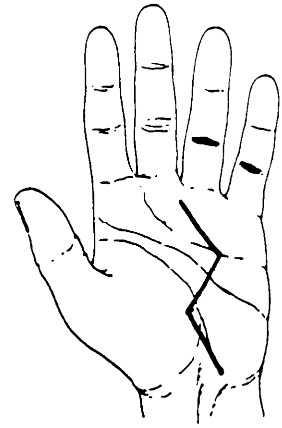
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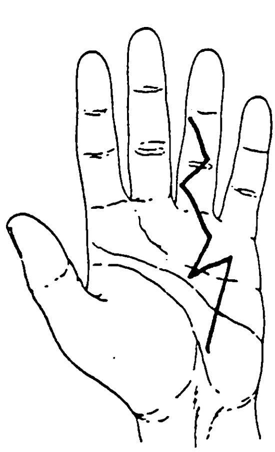
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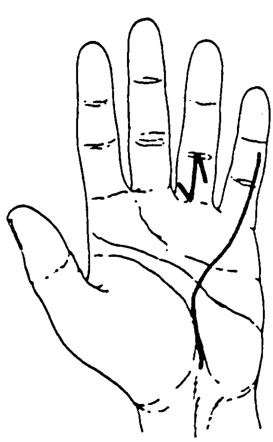
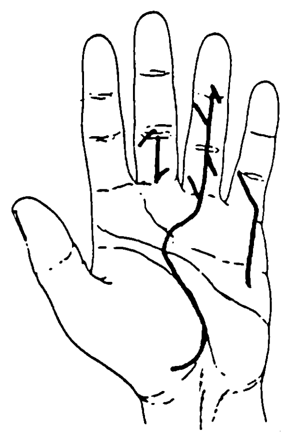
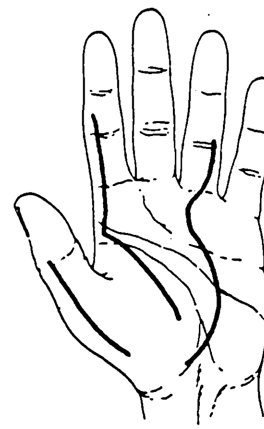

Tubiana (1964)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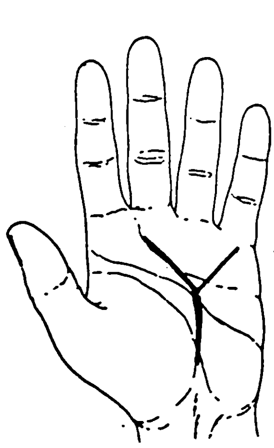
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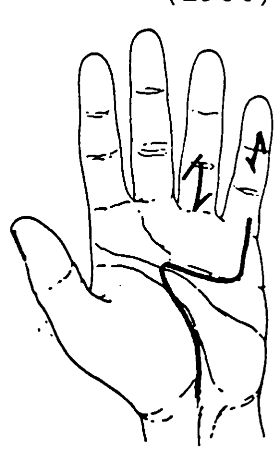
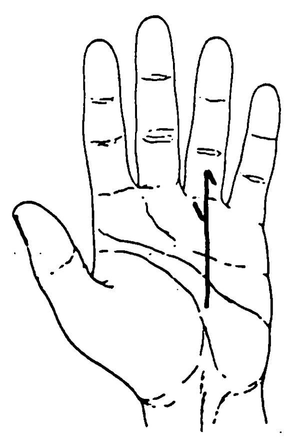

Vigliani and Rodighiero, 1965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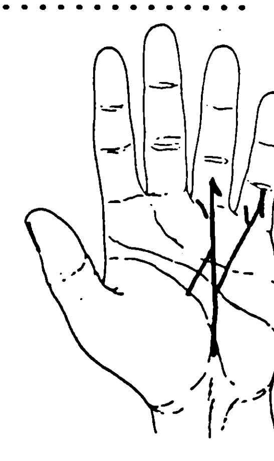
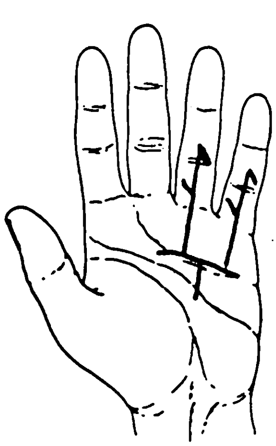
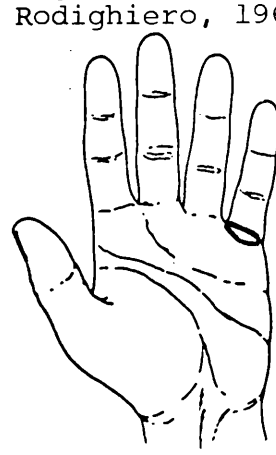
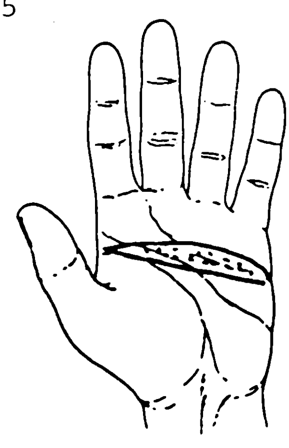
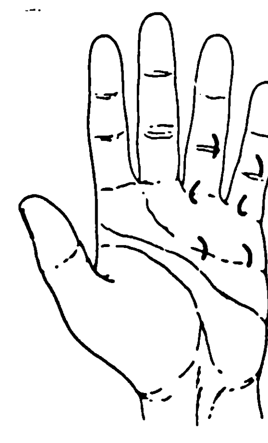

Buck-Gramcko, 1969


Skoog (1967)


Gonzales (1985)


McGregor (1985)


Moermans (1986)

incision of the type used by Kocher (1887) has long been established; Bunnell (1944) emphasised this in his classic textbook. Tom Carr (1974 and personal communication) adopted a mid lateral digital incision. Similar approaches have been used by Ashley (1953) and by Tubiana (1964) and by Jacobsen and Holst-Nielsen (1977). A variety of zig-zag patterns has been adopted to prevent volar scar contracture lines. The patterns of Bruner (1951) and Hiles (personal communication) are popular.

In addition to the protection from recurrent skin contracture afforded by a zig-zag incision, it is desirable to lengthen the volar skin if this is contracted by the Dupuytren's process. A multiple Y to V advancement has been advocated by Deming (1962), Watson, Bass and Deming (1975) and Baker and Watson (1980). This Y to V technique was however previously described by Palmen in 1932 and was widely used before the z-plasty technique. Use of the z-plasty for lengthening is a much more recent device and seems to date from the work of Sir Archibald McIndoe (Skoog, 1948; McIndoe and Beare, 1958) who used a single Z in the proximal segment of the digit. Iselin (1951) used multiple Z's in series. McGregor (personal communication) has advocated a mid line incision with multiple Z's centred on the joint creases. Robbins

(1981) has made a mid line incision and deferred the z-plasties until a later operation.

Gelberman et al (1982) have compared operative incisions. They performed longitudinally orientated incisions by the z-plasty or Bruner techniques, or alternatively transverse incisions by the technique of McCash (1964). A higher incidence of early wound complications (flap necrosis, haematoma and infection) was noted with the zig-zag and z-plasty incisions than with the transverse incisions, but this may reflect the benefits of open wound over closure rather than be related to the incision pattern per se.

The techniques of fasciectomy in continuity, or fasciotomy dictate whether skin incisions are made in continuity or in separate steps. McIndoe (Skoog, 1948) advised separate incisions for the palm and digit, but performed a fascial resection in continuity by undermining.

The various palmar incisions shown (Fig. 15.1) allow an approach to more than one fascial ray in the palm. Where more than one digit is involved a variety of approaches is possible. Skoog has described the principles of operating on more than one adjacent skin ray. He did not undertake widespread undermining, but opened each ray through separate longitudinal incisions meeting the transverse distal palmar crease incision at a right angle. A proximal extension of the incision was offset from the digital approaches to avoid a longitudinal palmar scar.

The Author's Observations

In dissecting a single digital ray, incisions with a predominantly longitudinal orientation are frequently employed for these allow the neurovascular bundles to be progressively displayed without injury. (This conforms to extensile exposure as described by A. K. Hendry (1946)). The presence of a straight longitudinal incision on the palmar surface however would leave a scar which would itself cause contracture. The scar alignment must be interrupted by use of an initial zig-zag approach, e.g., such as that used by Bruner (1951) or Hiles. Where there is skin involvement (i.e., the Dupuytren's cellular process extends into the dermis) a zig-zag incision will carry the risk of flap (tip) necrosis. In this situation a longitudinal incision is used and its alignment broken-up by z-plasties. All zig-zag scars tend to "straighten" during wound healing, perhaps due to wound contracture, but flap tip necrosis may be more frequent than generally recognised. The Y-V or z-plasty can achieve lengthening in addition to producing a zig-zag configuration. There is a redistribution of skin in the chronically flexed digit so that the volar skin may be quite short even if not apparently involved. When designing a z-plasty, it is probably better to make a linear incision and perform z-plasties at a later stage in the operation. In this way the distally placed flap can be based on the better vascularised side.

Neutral line incisions in the digit have been used (Carr (1974) and personal communication), but would seem likely to carry a risk of skin necrosis where there is skin involvement and, in addition, access is poor. The use of transverse digital incisions makes the anatomy much more difficult to visualise, but it leaves unscarred skin segments between each incision which are less likely to be a source of recurrent contracture in the skin. The guiding rule in the planning of incisions is to interrupt the line of future potential skin contracture.

Many patterns of skin incision are possible. In planning and raising the flaps, it is essential that the palmar skin must not be devitalised. Millesi and Buck-Gramcko (personal communication) have emphasised the importance of preserving small vessels. The incision should proceed as far distally as the distal end of the Dupuytren's tissue. If the distal attachment of the cord appears to be over the middle phalanx, it may be necessary to continue the incision distally to the distal interphalangeal joint crease or even to the pulp of the digit, in order to reflect flaps to achieve sufficient exposure to excise the tissue without damaging neurovascular bundles. The incision may therefore be made very extensive for safety. Once the width and length of the exposure have been planned, most surgeons adopt the discipline of marking out the necessary skin incisions with ink. For single ray involvement, a longitudinal (zig-zag) incision is adequate. Where more than one ray is involved a transverse incision at the distal palmar crease is the usual starting point. An almost endless variety of skin incision patterns is available. From this a perpendicular may be extended proximally in the mid line of the Dupuytren's tissue, thereby allowing retraction of equal flaps in radial and ulnar directions. The extent of proximal resection varies greatly between surgeons. Extending distally from the distal palmar crease, longitudinal extensions should be made to each of the involved digits. Skoog has emphasised that preservation of the subcutaneous fat pads between these longitudinal incisions will ensure that the skin of the distal palm retains a satisfactory blood supply. These rules allow planning of the width and length of the required operative field, rather than adhering to a preconceived geometric plan. If the palm alone is involved, a transverse incision may be adequate without extension.

2. Skin Grafts

Skin grafts were used by Professor Busch (described by Madelung, 1875) to "accelerate" the healing of the wound. Busch's operation of fasciotomy was performed through a distally based triangular flap which probably became necrotic on occasions. John Hueston believed that Berger (1892) was the first to use grafts. Split skin grafts were used by Baarnholm (1905) and Orbach (1934). Full thickness grafts by David (1919), Blair (1924), Lexer (1931), Frankenthal (1937), Gillies (1945), Grenabo (1946), and Langvad-Nielsen (1946).

There seem to be currently three indications for skin grafting:-

a) Skin grafts to heal a skin deficiency.

Skin deficiency may be due to chronic flexion deformity, scarring of previous operations, or necrosis following surgery. Crocket (1980) described a technique of insertion of full thickness skin gussets to augment skin shortage in the palm. The failure of revascularisation of a flap is mentioned by McFarlane and Jamieson who advised the use of a tie-over dressing where skin is thin. Should the skin not survive, skin grafting is advised.

b) Skin grafts to separate contracted fascia.

The concept of breaking-up the contracture line by a skin graft is implicit in the work of Piulachs and Mir Y Mir (1952), Gonzales (1978 and 1985) believes that skin should be inserted in addition to that required to break-up the contracture line. He believes that Dupuytren's contracture should be treated in a similar manner to post burns contracture. He uses full thickness skin. McGregor (1985) has inserted split skin grafts after adequate division of the fascia. Initially he divided the contracted fascia in the involved rays, but later undertook a more extensive release from the ulnar border of the hand to the radial border across the distal palmar crease. Additional releases were made in the digits, no fascia was excised and split skin grafts were inserted after ensuring that the contracted fascia had retracted. Hueston's (1984) Firebreak concept is similar.

c) Elective skin excision

The elective excision of skin involved in recurrent Dupuytren's disease was described by Hueston in 1962 in the belief that the dermis exerts some control on the disease process. He emphasised the need to excise the skin generally over the proximal segment of the digit from one neutral line to the other. The idea was taken up by Tubiana (1963), Gordon (1964) (who also suggested this in 1948) and Rudolph (1979). Further large series have been presented by Tonkin et al (1984) and Iselin (1985).

Piulachs and Mir Y Mir (1952) suggested that recurrence is reduced or eliminated when the local skin is replaced by skin grafting. Gordon (1957) in reporting a large series of operations mentioned that grafts had been done on 13 hands and these areas remained free of disease.

Hueston in 1962 reported the problems of secondary digital fasciectomy placing the skin in jeopardy. In 8 cases of recurrence, he deliberately excised the recurrent tissue and used a Wolfe graft replacement. When the flexor sheath was opened, he described the transposition of a local flap (tissue not stated) with supplementary Wolfe grafts. Hueston attributes to Moberg that free grafting is preferable to cross-finger flap replacement as the latter prejudices the progression of disease in the donor finger.

None of Hueston's patients developed further recurrence beneath a graft in a 2 year follow up period. In 1964, Hueston illustrated the use of a Wolfe graft as a primary procedure in a young alcoholic patient with a "strong diathesis". The technique was again described in 1969.

In 1985 (Hueston, 1985d), he stated boldly that "skin replacement prevents recurrence", but conceded that recurrence may be found proximally or distally to the graft.

Hueston summarised the use of skin grafts in 4 situations:-

a) A skin defect from correction of flexion deformity.

b) Devitalised skin. If recognised at operation full thickness skin may be used, but if only apparent later, split skin graft is usually required.

c) In recurrent Dupuytren's disease adequate dissection will render the skin ischaemic and the skin will be heavily infiltrated with Dupuytren's disease. Hueston believes that removal of the volar skin removes with it the mechanism responsible for the production of recurrence.

d) Prophylactic skin excision to prevent recurrence in selected patients with "a strong diathesis". His technique of Firebreak grafts, in association with fasciectomy, is to prevent recurrences.

The paper by Tonkin, Burke and Varian (1984) is important, as it compares the operations of fasciectomy and dermofasciectomy, although patients were not randomly allocated to the 2 groups, but selected according to criteria, such as age and diathesis. The time off work was 8.5 weeks on average in patients treated by skin grafts, compared with 5 weeks for those treated by fasciectomy alone. The rates of recurrence and extension were:-

	Male Fasciectomy	Female Fasciectomy	Male 1 W.G.	Male 2 W.G.
	74	13	15	26
Recurrence %	54	25	33	42
Extension %	28	25	40	23

Skin involvement is apparent, clinically by the strong fixation of the skin to the underlying contracted tissue. At operation, a plane can only be created artificially between involved dermis and Dupuytren's tissue by sharp dissection with a knife. The deep surface of the dermis will appear grey, there being no subcutaneous fat. The dermis is thickened and packed with myofibroblasts. This skin is liable to contract like a deep dermal burn. If such areas of skin involvement are small, it may be possible, by the design of z-plasties, to intersperse areas of involved skin with areas of normal skin, breaking-up a line of potential recurrent contracture in the dermis. Alternatively, the skin should be excised and replaced by skin grafts.

In the operation of dermofasciectomy, a wide excision of involved skin is performed, usually over the proximal segment of the finger and possibly the distal palm. the excision should extend as far laterally as the mid axial line of the digit, so that subsequent contracture along the edge of the graft will not create a flexion contracture. Skin replacement is generally by full thickness skin grafts, which are harvested from the groin crease, where the cosmetic appearance of the donor site is most satisfactory. Alternatively, the graft may be obtained from the forearm or upper arm, the donor site being closed directly or by split skin graft. The initial viability of skin grafts depends on serous exudation, traditionally called "plasmatic imbibition". a vascular link-up must be established for long term viability. The pattern of vascularity in the graft remains as at the donor site (Martin and McGrouther, 1985) favouring the theory of vascular link-up with the vessels within the graft. It seems wise to maintain the skin graft at its previous resting tension by the use of a template to facilitate the patency of the microcirculation. Full thickness grafts on the flexor aspect of the finger necessitate splintage of the finger in extension for between two and three weeks to allow the graft to stabilise. Thereafter they must be protected from shearing for a further two to three weeks. A prolonged absence from work is often necessary. However, current evidence suggests that there is continuing protection from recurrence under the graft after this procedure (but not local extension). It is the author's view that "Dupuytren's disease", i.e., nodules, pits and cords, requires the normal sandwich of fat between skin and fascial ligaments to become manifest clinically. The author has had limited numbers of full thickness grafts for review, but certainly recurrent bands of contracture may be propagated through the bed of a skin graft. Overall shrinkage of grafts is also seen with propagation of contracture around marginal scars. Thinner split thickness skin grafts are generally less satisfactory on the flexor aspect of the fingers, as they tend to contract and the resultant skin cover is less supple. Split skin grafts lack sweat glands and may develop hyperkeratosis with cracking and fissuring in this site.

3. Skin Flaps

Skin flaps may be elevated and replaced to allow access to the underlying fascia, or they may be moved to reconstruct areas of skin shortage. In the palm von Siemen (1936) used a rotation flap extending around the ulnar border to the dorsum. Bruner (1949) has also used a dorsal skin flap for covering palmar defects.

In the digits, Harrison and Morris (1975) have designed a transposition flap from the dorsal surface to lie transversely across the proximal digital crease. They have advised this particularly when the proximal interphalangeal joint is being stabilised to facilitate movement at the metacarpal joint. On review, no recurrences were noted beneath the flap.

A particular problem in the digits is the situation where release of the proximal interphalangeal joint necessitates division of the flexor tendon sheath. On extension of the digit there is a volar skin defect with exposure of the flexor tendons.

Hueston has advised care in prevention of exposure of tendons. Should it occur, he has used local transposition flaps, presumably using whatever skin is available to cover the defect in the sheath and using skin grafts for the remainder. McGregor (1985) has successfully covered exposed tendons with split skin grafts, provided that the visceral paratenon layer has not been damaged. A gliding layer is re-established. Lane (1981) has described a sliding volar flap which is elevated by making two neutral line incisions on the digits and joining these by a transverse cut over the middle phalanx. The resulting proximally based flap 'retreats' proximally on extending the digit leaving a defect over the middle phalanx which can be grafted.

Cross-finger flaps have been used. Hueston attributes to Moberg the view that cross-finger flap replacement may prejudice the progression of disease in the donor finger. He (Hueston, 1985) has therefore advised against cross-finger flaps in the young, but these may be considered in the elderly. Lueders et al (1975) have used cross finger flaps for recurrence.

Distant flaps from the chest have been used in longstanding cases by Berger (1892), Guinebault (1897), Fredet (1932). Wagner (1932) used such a technique after skin necrosis. Davis (1919) and Lexer (1931) used abdominal flaps and Oehlecker (1930) a pedicled flap from the scrotum. Clarkson (1966) used thigh flaps in the salvage of digits with severe DD. There is little local tissue available in the digit to design local flaps. The technique of Lane is made difficult by the thin skin over the proximal interphalangeal volar crease, such that the tip of the flap may be difficult to elevate with an adequate blood supply. The author has successfully used a transposition flap of subcutaneous tissue (including Dupuytren's tissue) elevated from proximal to the defect. This has been accomplished in six digits. The transposed tissue is subcutaneous fat. This technique has been reserved for elderly patients with exposed flexor tendons, or where proximal interphalangeal arthrodesis has been performed.

4. The Open Palm

The description of the open palm technique of McCash (1964, also published 1985) surprised the surgical community, but Dupuytren used a similar means of managing the skin, and open wound techniques were widely used during the 19th century (Adams, 1879).

McCash felt that poor graft take in the hand and the need to immobilise the hand after grafting were disadvantages of such techniques and that the impaired vitality of palmar skin made flaps undesirable. He described a precise technique of:-

1. Incision in the transverse skin creases. No longitudinal incisions were made.
2. By advancing the undermined skin bridges proximally and distally the whole of the skin shortage was accepted by the distal palmar crease incision "which remained wide open".
3. After a week's complete rest a night splint was worn.
4. No physiotherapy was used and the hand was dressed at weekly intervals.

Only the diseased fascia was removed. The open wound causes little discomfort when healing and McCash remarked on the freedom from haematoma or oedema during recovery. The wounds generally closed in two to five weeks. In his article, he mentioned that Mr. O. T. Mansfield of Birmingham had employed a similar method, but used z-plasties or grafts in the digits.

"McCash's" results were supported by Zachariae (1970), Salvi (1973), Briedis (1974), Connelly (1974), Ariyan and Krizek (1976), Leidi et al (1977). Noble and Harrison (1976) combined a mid lateral digital incision with a transverse palmar incision, the latter being left open. Jacobsen et al (1977) have used a similar technique.

Borden (1974) and Beltran (1976 and 1985) have used an open method in the fingers which healed to leave linear scars. Care is taken to preserve tendon sheaths intact and in some cases residual proximal interphalangeal contracture is acceptable.

Lubahn and Lister (1984) have compared series of patients treated by open and closed methods. The patients, however were not randomly allocated to different treatment groups and the difference in outcome may reflect patient selection, rehabilitation priorities and other factors.

The "open palm", which is a variation of post-operative management rather than an operative technique, was introduced by McCash in an attempt to overcome problems related to haematoma formation. Haemostasis is now more meticulous due to improved methods of vessel coagulation, and, thus, this is no longer the sole reason for this technique. An additional benefit lies in the release of extra skin which can be used to obtain digital cover at the expense of the palm which is left open. Gains can be achieved in this way without the need for importation of flap or graft cover. The transverse wound, at the distal palmar crease, is left unsutured and a non adherent dressing applied which is changed daily. Antibiotic cream in the wound facilitates this. The open wound often heals by secondary intention in 8 to 10 days, although it may take longer. Healing is by the normal processes of wound contracture leaving a transverse linear scar.

One of the claimed advantages of the technique is almost complete absence of post-operative pain. This allows immediate mobilisation, and recovery of a full range of active motion is common within the first 48 hours of surgery. The rapid post-operative mobilisation enhances collagen orientation in the healing wound leading to a soft and supple palmar scar, and is an essential part of the post-operative management.

The great merit of the technique is its safety. It is a reliable method of providing extra skin, minimising post-operative discomfort, and draining possible palmar haematoma - especially after extensive dissections. It is unnecessary where a limited dissection has been performed with good haemostasis.

The immediate disadvantage of the open palm technique is that it is unpopular with patients who are apprehensive about the appearance of the open wound. Careful counselling is always necessary. Advocates claim that the patient can return to full use of the hand immediately, despite the open wound and frequent dressings. This technique is not a substitute for good haemostasis.

Haemostasis

The underlying principle is that haematoma must not be allowed to collect in a closed dead space in the hand after fasciectomy. The exact means by which individual surgeons choose to achieve this may vary.

Possibilities are:-

1. Keeping the tourniquet up until a firm dressing is applied. Release of the bandage is always required after several hours and the circulation must always be checked post-operatively, Varian (personal

communication.

2. Letting down the tourniquet and securing bipolar haemostasis prior to wound closure. The cuff should be removed from the arm. The author advocates this technique for routine use. The bipolar coagulator should also be used throughout the operation to coagulate all small vessels which are encountered as the dissection proceeds.
3. Drains.
4. Elevation prior to wound closure.
5. Complete or partial open palm.
6. Hypotensive anaesthesia (Halliday et al, 1966).
7. Continuous suction drainage (McFarlane, 1958).

Most surgeons use a combination of approaches, but the measures must be effective. <u>Post-operative pain indicates haematoma and requires re-exploration</u>.

<u>5. Miscellaneous Operations on the Skin and Subcutaneous Fat</u>

Skinner (1941) and Palmar and Southworth (1945) have advocated placing a skin graft beneath the contracted fascia after undermining, the diseased tissue being excised at a second stage. Von Stapelmohr (1947), used a cruciate incision, trimmed the palmar skin to the thickness of Wolfe grafts and used tie-over dressings.

Madelung (1875) appreciated the importance of subcutaneous fat.

Peiser (1917), Gill (1919) and Ramstedt (1933) inserted free fat transplants beneath the skin. Spitzy (1916) recommended vegetable or swine fat, Reichl (1937) sterile paraffin, Desplas and Meillere (1932) amniotic membrane, Woolf (1920) fascia lata together with fat and Abbott (1929) fascia lata alone.

CHAPTER 16

MANAGEMENT OF THE CONTRACTED FASCIA

That simple release can result in a prolonged or permanent release of contracture has been demonstrated by the release of the contracture by trauma. The author had the opportunity of observing such a case in 1980 and having described this phenomenon at a lecture, Mr. David Grace, then Senior Registrar in Orthopaedics, drew to my attention a second case, that of Mr. Phillips in Norwich. No other such cases were found on review of recent literature, but more recently a case has been found in the writings of William Adams, in 1879, in which the contracture was relieved when a restive horse bolted. An additional case has been discovered in the notes of Henry Cline, Senior, by Mr. David Elliot, dated 1777. In this case, a heavy book fell on the hand relieving the contracture.

Fasciotomy

Henry Cline, Junior, according to the notes of Windsor, advocated cutting the fascia with a common knife. Dupuytren performed a transverse release of skin and fascia. Goyrand suggested that the skin should be opened longitudinally and the fascia divided transversely. Review of the report of his presentation to the Academy in 1833 suggests that Goyrand's technique may have been only a proposition based on anatomical dissection and he may not have actually performed this surgery. A commentary on Goyrand's paper by Sanson (1833) supports this view. The open wound technique of Dupuytren was used extensively in the mid 19th century, according to Adams.

Open wound release under aseptic conditions was performed by Hardie (1885). Richet (1873) and Abbe (1888) also used this method. Jobert and Blandin (1846) made a 'V' shaped incision pointing proximally, or distally. They cut beneath the aponeurosis elevating the triangular flap with the retracted aponeurosis left attached to skin. Lannelongue, according to Durel (1888) closed such a flap in a V to Y manner. Madelung (1875) described the technique of Busch in which a skin flap was raised before performing a fasciotomy. Vogt (1881), Koenig (1889) and Merker (1897) favoured this technique, but problems of flap necrosis were recognised by Zimmermann (1898), Lotheissen (1900) and Hutchinson (1917).

<u>Subcutaneous Methods</u>

Sir Astley Cooper (1822) advocated that when the band is narrow it could with advantage be divided with a pointed bistoury introduced through a small wound in the integument and a splint applied to maintain this finger in a straight position. William Adams (1879) reviewed the merits of the subcutaneous operation, principally the avoidance of the introduction of infection, substantiating his argument by quoting the theories of John Hunter on the introduction of air. Adams reviewed many opinions on the subcutaneous operation and described in detail the operative steps. Smith (1884, 1885) urged the need to ensure maximum separation of the severed parts to prevent re-union. In some cases, he sectioned the bands diagonally to obtain union in a lengthened position.

Annandale (1865) found that the subcutaneous methods were of less value when the skin was largely adherent to the aponeurosis. Dickson (1928) found recurrences more likely than with other methods. Macready (1890) quoted Adams (1879) estimated recurrence to be 10%. Hedges (1896) reported 9 cases with 6 recurrences. Davis (1932) described 6 hands which had remained recurrence free at 1 to 5 years. It seems therefore that the procedure may be curative in certain cases. [Fergusson (1846), Fisher (1885), Trelat (1888), Drehmann (1913), Roth (1920, 1928), Hohmann (1936) and Meyerding (1936).]

Bunnell (1944) and Snyder (1957) used subcutaneous fasciotomy in severe cases to lengthen the skin gradually before fasciectomy and Colville (1983) has supported this view. Skoog (1948) summarised the disadvantages of subcutaneous surgery. Luck (1959) revived fasciotomy as part of a treatment plan tailored to the individual patient. He advised removal of nodules and division of subcutaneous cords. A limited role for fasciotomy was therefore recognised in the individual case. Careful selection was necessary and various criteria have been described by Kelly and Clifford (1959), Hueston (1964), McFarlane and Jamieson (1966) and Howard (1959).

Colville (1983) defined the role of fasciotomy, derived from his experience of treating 137 digits in 95 patients. His indications were that the type of band must be linear and cord like. The more diffuse plaque-like lesions were a contra-indication. Bow-stringing was taken to indicate an absence of deep attachments and was a favourable indication. The overlying skin should ideally be separated from the band by normal subcutaneous fat. Extensive skin attachment is a contra-indication. Age or infirmity; Colville chose to perform fasciectomy in younger patients and to reserve fasciotomy for the older patients. No patient under 50 was accepted for this treatment.

Colville's technique is to carry out operation as an out-patient procedure, using skin infiltration anaesthesia. He uses a modified No.11 scalpel blade machined to leave only the cutting point. He employs three areas of release; proximal to the distal palmar crease, proximal to the web and proximal to the proximal interphalangeal joint crease. The blade is passed through the skin and the operation performed blindly by first separating skin from cord and then dividing the cord.

Post-operatively the hand is splinted at night for three months. The results indicate improved digital extension (102° degrees pre-operatively to 75° degrees contracture overall over three years with an average of 30° degrees contracture in the best 20 cases). Recurrence of the contracture is acceptable in exchange for such a simple operation in the selected patient group.

Luck (1959) and Tubiana (1974) have advised against fasciotomy in the digits, but Colville has "no hesitation" provided the band is well defined and bow-stringing and had no permanent damage to digital nerves. Rowley et al (1984) restricted fasciotomy to proximal to the distal palmar crease. Wilson (1962) thought there to be no place for the subcutaneous operation, preferring a local excision under vision.

Gonzales (1978 and 1985) has varied his approach to the fascia in the individual digit. He advocates fasciotomy or limited fasciectomy and the insertion of a full thickness skin graft.

McGregor (Personal communication) and Watson (1984) have broken-up the line of contracture by performing fasciotomy and z-plasty transferring flaps of the full thickness of skin and subcutaneous palmar fascial ligaments. This operation has been suggested for the early palmar contracture, or the thumb, but is less suitable in the digits, because of the difficulty of transposing the rather thick flaps.

The operation of fasciotomy and graft (McGregor, 1985) requires division of the contracted cords and the insertion of a split skin graft to separate the divided 'ends' of the fascia which are not resected. Initially, this operation was confined to one or two digital rays, but recurrence can occur around the graft margins or through the bed if the ends are not widely separated. Experience has shown that it is better to divide the palm from radial to ulnar borders and to ensure separation of fascia before inserting the graft. The technique may also be used at the proximal digital or proximal interphalangeal skin creases.

Rodrigo et al (1976) compared the long term results after fasciotomy and fascial excision. The selection criteria for the various operations are not clearly set out, but on review of 135 (of 359 treated) hands 43% of these treated by fasciotomy had deformity severe enough to warrant further surgical treatment. Excision of the involved fascia gave better results, but was associated with a higher incidence of post-operative complications (stiffness, inflammatory flare, haematoma). This series is biased by the patients presenting with further problems.

Rowley et al (1984) confirmed that the technique is more effective in relieving metacarpal rather than proximal interphalangeal contracture.

Limited fasciectomy

Sir William Fergusson (1862) was perhaps the first surgeon to advise removal of part of the palmar fascia. Goyrand has been credited with the first fasciectomy, but this may have been merely a suggestion. Gersuny (1884), Reeves (1885), Kocher (1887), Moser (1894) undermined the skin edges and excised the thickened aponeurosis.

Ritter (1930) made two incisions across the cord and excised the intervening part. Oehlecker (1930) excised a longitudinal narrow elipse of skin. Baarnhelm (1905) made two or three incisions across the skin edges and grafted the defect.

Russ (1908) performed an excision through multiple small incisions. Schmidt (1889) used the V-incision of Busch and Routier (1908) and Palmer (1933) used similar incisions. Two quadrilateral flaps were transposed in Griffith's operation, described by S. David (1919). Lotheissen made a curved incision reflecting a large skin flap. When the fingers were extended the flap moved distally leaving a raw area which may have required grafting.

Skoog's verdict of limited fasciectomy in 1948 was that the results were disappointing. The concept of partial fasciectomy became unpopular and was criticised because of the likelihood of recurrence. James and Tubiana in an extensive review in 1952 suggested an extensive approach to the ulnar 3 rays and involved digits.

The publication by Hamlin in 1952 of a report of limited fasciectomy marked a change in management philosophy with a general enthusiasm for "limited" or "partial" fasciectomy which was to last until the present day. Ten years later he presented follow up results (1962).

Hueston (1961) emphasised that the poor reputation of DC operations had largely arisen from the complications of surgery. The radical palmar clearance then in vogue was particularly responsible. He defined his operation; "Limited fasciectomy is the excision of the palpably thickened fascia with a narrow margin of normal aponeurosis". Hueston's technique has evolved such that he now uses the term regional fasciectomy, defined as excision limited to macroscopically involved retracted tissue (1982).

The basic principles of his operative technique required direct exposure of bands or nodules through individual incisions with avoidance of extensive undermining of palmar skin flaps. Z-plasties were used to prevent contracture of longitudinal scars. He preserved some fat on the skin flaps. Dissection commenced proximally with display of the superficial palmar vascular arch. The neurovascular bundles were then dissected and displayed into the fingers. For a single pretendinous band it was usual to clear over the two tendons sheaths. A Y-shaped incision gained access to a cord forking to another finger. Hueston recommends initiative in the planning of exposure rather than using a preconceived plan. Two technical advantages are stressed in the direct surgical exposure; greater safety and ready access. Advantages in terms of results are rapid wound healing and a reduced incidence of wound haematoma and an early functional recovery. The results will be discussed later.

In short, the advantages perceived by Hueston were of a relatively simpler operation than radical fasciectomy with a smoother and more rapid return to full functional recovery. No difference in the rate of recurrence or extension was found in comparison with more radical procedures.

Patrick Clarkson (1962) condemned the radical dissection at the meeting in Paris of the French and British Hand Club in 1962 showing photographs of crippled hands treated in this way. This "Trend to Conservatism" was the subject of a Hunterian Lecture by John Hueston in 1964 (Hueston, 1965).

Many other workers were moving in a similar direction. Freehafer and Strong published in 1963 a conservative procedure which they had used since 1952. Cords were exposed through short longitudinal incisions in the palm and in the digits either a mid lateral or Z incision was used. The fascia was excised in continuity; after freeing the fascia in the proximal wound, the diseased tissue is mobilised beneath the bridge of skin and pushed into the distal wound. Tubiana (1964), in an article entitled "Selective Treatment" (rather than selective fasciectomy), supported the philosophy that function was more appropriate than prophylaxis and suggested that surgery should be more extensive only when the surgeon feels that it will not impair wound healing or delay active exercises.

Davis (1965) extensively reviewed the literature of DC and concluded that surgical excision should include "only and all" of the diseased tissue.

Shaw and Eastwood (1965) recognized a role for limited fasciectomy, but defined indications for a radical or selective operation.

McFarlane and Jamieson (1966) attempted to select the correct patient for treatment and then to choose the most appropriate operation for each patient. In 100 patients, the operation performed were limited excision, radical excision or fasciotomy or amputation. They tried to see if better results would be obtained by varying the type of operation. Where limited fasciectomy was performed in the palm, this was limited not only in width but also in depth, the dissection remaining close to the thickened bands, but no attempt being made to remove dorsal septa deep to the neurovascular bundles.

Zachariae (1969) has asked the relevant question of how limited should a limited fasciectomy be.

Skoog (1967, a, b, 1970 and 1985) has introduced a limited and anatomically precise type of operation. He first recognized in 1959 that the transverse fibres (transverse palmar ligament) were not involved in the disease although they were intimately related to the contracture. He used a variety of skin incisions and made a plea that his method would not simply be attributed to a particular type of skin approach alone, but rather that the essential features were:-

a) Preservation of the transverse palmar ligament intact to act as a safeguard in protecting the delicate anatomy of the deep palmar space during dissection.
b) The neurovascular bundles were no longer isolated throughout their course, their freeing being mainly restricted to the bases of the digits. The delicate system of connective tissues was left as far as possible in place.
c) Prophylactic excision of longitudinal bands in other rays is sometimes performed, but in partial excision the adjacent bordering longitudinal fibres should

not be damaged as the healing process of severed longitudinal fibres is likely to cause re-appearance of the disease at that site.

Barclay (1972) used Skoog's operation and Borsetti and Nebiolo (1977) compared Skoog's operation with the more radical procedure of MacIndoe. They described a more rapid result. Many surgeons however have failed to appreciate the essential features of Skoog's selective approach.

Zachariae (1967) considered that there was little difference between the so called radical and the limited fasciectomy for DC and Honner (1971) supported this view. Tubiana (1964) compared and contrasted limited and radical fasciectomy and noted a large volume of recent literature moving towards the former. The limited fasciectomy method was adopted by Honner (1971), Rodrigo (1971), Orlando, Smith and Goulian (1979) whose results are reported below.

There are numerous reports of series treated by one department often using several methods. Moro (1966), Rhode and Jennings (1967), Quetglas (1972) Sakellarides (1972), Rettig and Oest (1974) Rico-Aguado et al (1976).

Radical palmar fasciectomy

Radical clearance of the palm emerged at the turn of the century when the possibilities of more extensive operative technique combined with a realisation of recurrence of contraction after operation.

Adams had certainly been aware of the possibility of recurrence in 1879 when an open-wound operation performed elsewhere on a former colleague, a physician practising obstetric medicine, returned "in an aggravated form". This was a severe proximal interphalangeal joint contracture.

Lexer (about 1900) commenced a very radical operation on the palm which was subsequently published in 1931. This method included excision of the fascia and overlying skin from the involved rays. This very radical operation was still advocated by May in 1948. Keen (1906) and Iversen (1909) performed total excision of the palmar aponeurosis by the incisions shown. Gill (1919) made his incisions in the natural skin creases. Such radical operations remained popular until the second world war. Further reports were published by Kanavel et al (1929), Wagner (1932), Desplas, Meillere (1932), Meyerding (1936), Gerritzen (1936), Einarsson (1946) and Von Stapelmohr (1947).

Einarsson believed that an indication for operation was the mild case in early life as a prophylactic procedure. He admitted, however, to 20% poor results. In common with other advocates of these extensive operations, he appreciated that a good outcome could not be guaranteed for the patient. Skoog in 1948, reporting on 50 cases of Sir Archibald McIndoe, (40 operated on by McIndoe and 10 by Skoog) favoured this great surgeon's radical approach. The technical details were enlarged on by Shaw (1952) and by McIndoe and Beare (1958). This operation comprised a single transverse palmar incision from which the skin was extensively undermined to within one inch of the wrist crease. Distal undermining extended into the finger. The transverse natatory fibres were included in the block dissection. The fingers were approached by a Z incision centred on the digital mid line. The entire palmar fascia was removed in a single block extending into the finger. Great emphasis was placed on dressings technique to prevent haematoma and oedema and Shaw (1952) recommended performing the first dressing after two weeks.

As described above the tide began to turn against the pre-eminence of radical fasciectomy in the 1950's and the report of Hamlin (1952) on limited fasciectomy was of particular significance. Iselin (1954) was aware that total removal of fascia did not preclude recurrence, as he felt that any remaining minimal strand might develop into a contracture band. He therefore advocated limited fasciectomy through Z incisions.

Larsen and Posch (1958) also reported a mixed series of total and partial fasciectomies, the limited operation being reserved for patients with one prominent band of contracture and in whom the rest of the palm was free.

The tide of extensive operations had turned and surgeons were looking for a simpler procedure with no greater recurrence rate and less complications. Hueston's article in a prominent American journal (Plastic and Reconstructive Surgery) followed by his book Dupuytren's Contracture in 1963 and a Hunterian lecture in 1964 was to establish the ground rules for the next quarter century.

The limited value in prophylaxis of extensive operations was elegantly expressed by Clarkson (1962), "The radical procedure has been supported in the view that it removes the potential sites of further recurrence. This is, of course, not so, as the nodules and bands frequently occur and recur along the proximal digits and in the first web and in the thumb - sites not included in any prophylactic radical fasciectomy".

Luck's (1959) very conservative approach, although not generally accepted, probably influenced most surgeons to become less radical.

Another change in philosophy in response to the complications of radical operations was the publication by McCash of his open palm fasciectomy in 1964. This technique has been described above, but it is relevant here to note that McCash advised removal of the diseased fascia alone.

In spite of this general trend towards more limited operations in the United Kingdom, the U.S.A., Australia and France, a number of long term reviews were to be published in the following years; Weckesser (1964), Hakstian (1966), Webb Jones (1965), Dickie and Hughes (1967). In the long term, the results reported by Hakstian of Sir Archibald McIndoe's personal cases showed 49% clear of disease which is a much more optimistic figure than Hueston's 20%. McIndoe's cases, however, showed a predominance of limited contractures and he performed 10 amputations in 24 cases with significant digital involvement, perhaps favouring the long term results by ensuring no recurrence in these digits. Dickie and Hughes (1967) operated on much more severely involved cases and reported excellent results, two-thirds of their patients being clear of recurrence or extension in 10 years. These good long term results were largely ignored as opinion had moved towards Hueston and McCash. The reason for the established change probably lies more in the results which were not published rather than those which were. Although a technically able surgeon can get a good result and avoid complications with a radical operation, it is not a safe procedure in the hands of the inexperienced or occasional operator. Perhaps more significantly the rehabilitation almost certainly requires to be more professional and intensive after such procedures. It may be said that radical fasciectomy was discredited on unscientific grounds, on anecdote rather than statistic.

Honner, Lamb and James (1971) put all previous long term results in proportion by emphasising that whereas the metacarpal joint flexion can be readily corrected with a lasting result, proximal interphalangeal joint flexion was more difficult to correct and post-operatively there was a gradual increase in contracture with the passage of years.

The argument about extent of palmar operation are therefore seen to be largely irrelevant to the main prognostic factor - flexion of the proximal interphalangeal joint.

Although extensive fasciectomy became unpopular amongst English and French speaking surgeons, a radical approach to the palm persisted in much of Europe, particularly in Germany and Austria. The German Speaking Hand Society is much more familiar with English language literature than the converse and the adherence of German surgeons to a radical palmar approach can not be attributed to lack of knowledge. It seems rather than they have not experienced the same problems with radical palmar approaches, perhaps due to better rehabilitation. Millesi (1965) used a Y shaped "Mercedesstern formige" (Mercedes-star-shaped) incision to preserve the skin blood supply. Geldmacher (1972) and Buck-Gramcko (1982, personal communication) use a similar method. Careful haemostasis and effective rehabilitation ensure good results. There has therefore been no strong motivation for change.

Other reports on treatment by radical fasciectomy are, Rukavina (1972), Nigst (1971), Klos (1967), Costa (1966), Grdovic (1951).

Digital fasciectomy

Skin incisions to obtain access to the digit have been described above, but the extent of fasciectomy in the digit and the structures actually removed have received much less attention than in the palm. Dupuytren (1831) cut across the contracted digital fascia. Goyrand (1834) described two lateral bands of new formation, but Sanson (1834) pointed out that these were simply normal fascial structures which had hypertrophied. The report of McFarlane (1974) marked a milestone in describing for the surgeon the structures which were being removed. He described three types of cords developing along the line of anatomical ligamentous structures. On observing digital fasciectomy performed by McFarlane (1985, personal communication) a radical clearance is performed to identify and remove not only involved cords, but also prophylactic removal of anatomical bands which may be the site of further disease contracture.

On reviewing the classical surgical approaches, it seems that McIndoe, Iselin, McGregor, Hueston and McCash have only removed involved fascial cords, although these surgeons have not described the specific structures removed from the digits. Hueston, in particular, has emphasised skeletalisation of the neurovascular bundles and this procedure may encourage the removal of subcutaneous fat in the proximal segment of the digit. Skoog advised preservation of connective and fatty tissues as a general rule, but does not describe in detail his approach to the digits. Baker and Watson do not comment on the extent of their fascial excision. Strickland and Bassett (1985) have described an isolated digital cord (Fig. 11.14) arising proximally from periosteum over the base of the proximal phalanx and also from the intrinsic tendons. Distally it displaces the neurovascular bundles medially and inserts in to the flexor sheath in the middle segment of the digit.

Summary

Almost all of the described procedures for managing the fascia are still performed somewhere in the world today. The question of how extensive or how conservative a resection is necessary remain to be resolved. Moermans (1986, unpublished information) has adopted a policy of removing 1 centimetre lengths of involved fascia and leaving alternating 1 centimetre lengths undisturbed - this has re-opened the debate on the whether or not it is necessary to excise all Dupuytren's tissue.

CHAPTER 17

MANAGEMENT OF THE CONTRACTED PROXIMAL INTERPHALANGEAL JOINT

Dupuytren (1832) appreciated the difficulty in straightening the pip joint and this problem lies at the heart of all contracture correction.

As described above much of the literature of DC has concentrated on the palm when the major problem is correction of pip contracture and maintenance of this correction.

Orthopaedic correction of the contracture was performed by Ombredanne (described by Nelaton, 1908) who resected the ip joint. Kosinski (1940) also performed a similar procedure and also divided the flexor tendons. Hutchinson (1917) excised the head of the proximal phalanx and shortened the extensor tendon. Eckstein (1922) removed 1 or 2 cm from the middle of the proximal phalanx.

In general the preferred operation in the early 20th century was amputation. Hakstian (1966) reported 10 primary amputations in 24 stage 3 or 4 cases.

Amputation at mp joint level may allow the use of dorsal skin flaps to resurface areas of the palm extensively scarred by Dupuytren's Disease. Tonkin et al (1985) emphasized this point. Amputation at pip joint level is also frequently performed and Christ (personal communication) has mobilised the distal pulp on two neurovascular pedicles (after the manner of Littler) to resurface the scarred proximal segment of the digit. This type of amputation maintains the width of the palm and avoids neuroma problems.

Moberg (1973) suggested three ways of avoiding amputation in advanced contractures:-

1. Arthrodesis of the proximal interphalangeal joint.
2. Dorsal wedge osteotomy of the proximal phalanx.
3. Proximal interphalangeal joint arthroplasty.

For arthrodesis Moberg used a bone peg from the ulna. Dorsal wedge osteotomy carries the theoretical chance of shifting the available arc of rotation dorsally into a more functional position, but little has been written of its results in practice.

Haimovici (1978) has used a Swanson's replacement arthroplasty at the pip joint and reports a 40 degree arc of motion in 90% of his cases, but Tonkin et al (1985) report that extension is rarely maintained post-operatively.

Soft tissue correction of pip contracture is much more recent. Curtis reported (1970) an operative capsulectomy as an alternative when amputation of the finger was being considered. He enumerated the reasons for lack of complete extension:-

1. Inadequate skin over the volar surface of the finger.
2. Contraction of the fascia within the finger.
3. Contracture of the flexor tendon sheath.
4. Contracted flexor muscles or adherent flexor tendons. There is no published evidence to indicate that flexor tendons became adherent in the primary case.
5. Contracture of the volar plate of the capsular ligament.
6. Adherence of Landsmeer's retinacular ligament to the collateral ligaments or shortening of the retinacular ligament.
7. Adherence of the accessory volar ligament to the neck and condyle of the proximal phalanx.

After adequate fasciectomy Curtis excised a section of the volar plate on either side of the flexor tendon together with a portion of the accessory volar ligament. In a few cases excision of the entire volar plate was necessary. A precise post-operative splintage and therapy programme was required.

Watson, Light and Johnson (1979) adopted a slightly less radical approach than Curtis. They recognized a contracture band, the check-rein ligament passing from the proximal edge of the volar plate to the neck of the proximal phalanx, and recommended its division. Eaton (1971) had previously described the check ligament at this site in the digit.

In the author's view the fascia in this site is less structured than suggested by Watson et al (1979) or by Bowers (1987). A rather amorphous aggregation of Dupuytren's tissue is often found at this site (Chapter 12).

The extensor apparatus is of considerable interest in Dupuytren's Disease. Haines (1951) and Stack (1962) have elegantly described and reviewed the anatomy and physiology. Smith (1986, personal communication) has recently tried to shorten the attenuated middle slip by plication. Geldmacher (1983) has emphasized the role of the cutaneous ligaments in finger contractures.

A further discussion of the pip joint is contained in Chapter 14.

The prognosis remains poor where surgery is necessary.

CHAPTER 18

AUTHOR'S PHILOSOPHY OF TREATMENT

A concept of the pathogenesis is necessary in order to establish principles of treatment. The evidence of aetiological studies (Chapter 13) suggests that the aim of surgery should be to produce a stable biological and biomechanical solution by breaking up the line of contracture with permanent release of tension rather than by a radical excisional approach, such as would be used in tumour surgery. This treatment philosophy can be compared with post burns scar contractures, where release and prevention of re-union by prolonged splintage may be effective; total excision of all burns scar tissue is not required. It seems that Dupuytren's "tissue" is behaving in a similar way to post burns contracture tissue, but being situated in different anatomical planes, it gives rise to different clinical manifestations.

Gonzales (1985) has suggested that DD should be treated like post-burns contracture. Olney (1983) has emphasized the need for prolonged splintage of electric bar-fire injuries in children, which have a similarity in behaviour to DD.

The removal of tissue per se does virtually nothing to release the contracture. It is the release which is important. However, by following the band from proximal to distally the identification of anatomical structures at risk is facilitated. Indirectly therefore removal of cords is justified on the basis of finding anatomy. Principally, however, it is done to prevent recurrence by ensuring a separation of the involved fascia.

The aim of surgery is to restore to the digits the ability to fully extend without creating the surgical complications of haematoma, wound scar contracture, damage to nerves or vessels or joint stiffness.

<u>A return to the normal anatomical arrangement is never possible</u>. The palmar tissues must however be reconstructed in such a way that tension can not subsequently be transmitted through fascial bands or the fibrosis resulting from operation. This may be achieved either by interposition of normal subcutaneous fat or by excision of involved subcutaneous tissues and application of a skin graft. However, the wound healing processes after surgery tend to promote adhesion between tissue layers producing apparent "recurrence", and this process must be modified during the rehabilitation phase.

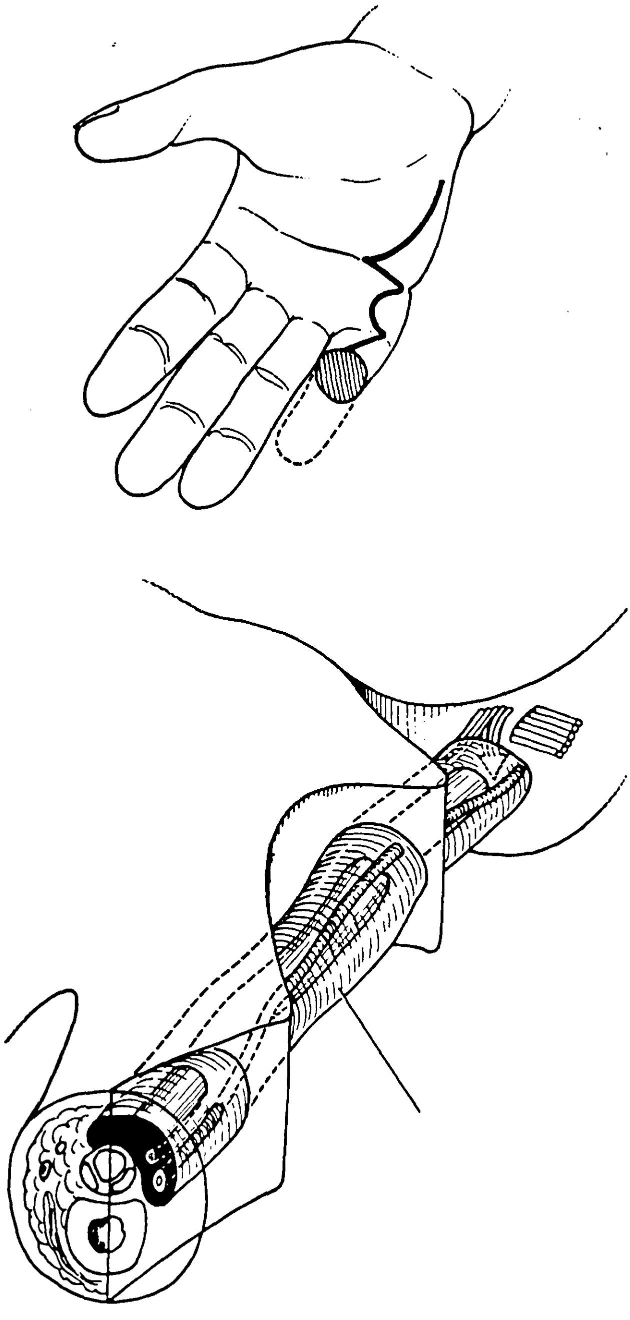


FIG. 18.1 Recurrence - a possible mechanism.

Tunnel of haematoma after limited fasciectomy predisposes to recurrence of contracture.

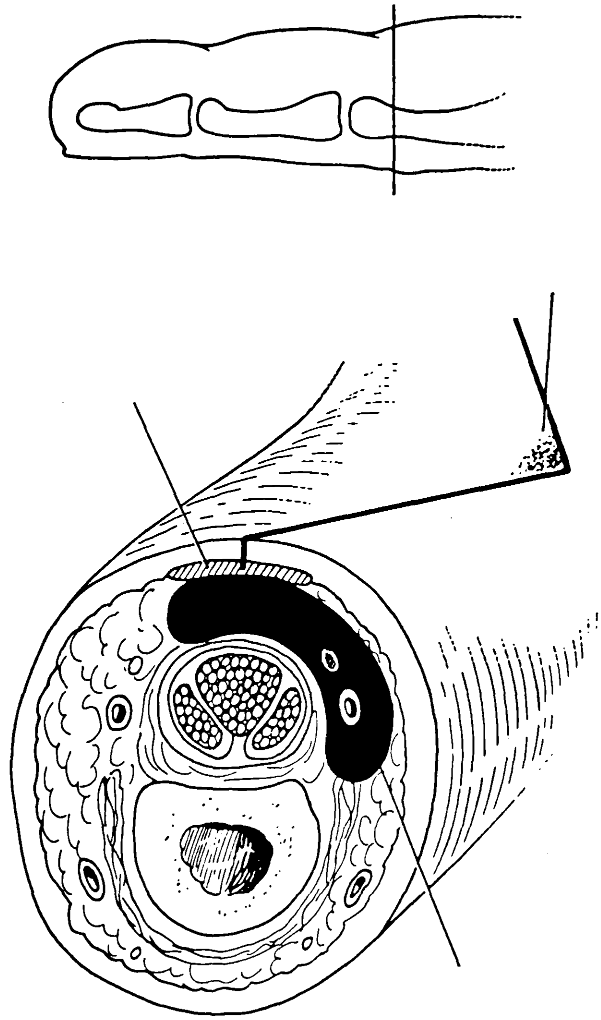


Fig. 18.2 Some causes of recurrence.

1. Skin necrosis.
2. Scarring (involvement) of the dermis.
3. Inevitable haematoma.

Surgery excises Dupuytren's "disease" myofibroblasts and replaces these by wound healing myofibroblasts. The aim of treatment must be to minimise cellular mass (and proliferation) by avoiding dead space. The wound bed is "contractile" and should be held out to length after operation until collagen maturity is established.

Factors to be Considered in Deciding on Operation

A balanced judgement must be reached contrasting the potential improvement in hand function which surgery may achieve and the probable deterioration if the hand is untreated. Not all patients should have surgery.

Timing of Operation

Once finger contracture has commenced, it seems to have a progressive course, although the rate of deterioration has considerable individual variation (Luck, 1959). <u>It is the rate of progression of contracture which is the single most important factor in determining when operation is indicated.</u> Most observers believe that the course is more rapid in the younger patient and therefore the potential for deterioration in the absence of surgery is considerable.

The ideal plan of management is that all patients should be referred to a hand surgeon early and kept under regular review to judge the rate of deterioration. The author has encouraged this practice of early referral. Postponing surgery until the digit touches the palm is disastrous (Adams appreciated this, 1879). The table top test (Hueston, 1985) is a useful guide to progression; the patient can usually accurately time the onset of the inability to place the palm of the hand flat on a table. It is also an indication when to intervene. <u>When D.C. reaches the stage that joint deformities are beginning to become fixed and no longer passively correctable, operation is indicated.</u>

Although the major indication for treatment is rapid progression of the finger contracture, the presence of a minimal contraction (which can not be passively corrected) at the proximal interphalangeal joint is an indication for surgery irrespective of the rate of progression. Metacarpophalangeal joint flexion deformity can almost always be released and there is therefore less urgency in this situation than in the case of the proximal interphalangeal joint, which once contracted, can be very difficult to release. This observation was made by Dupuytren. There seems to be a critical angle of proximal interphalangeal contraction beyond which the condition will rapidly progress, perhaps because of the poor mechanical advantage of the extensor tendon or because the patient develops a habit of flexing the digit in to the palm to keep it out of the way. The need to relieve proximal interphalangeal joint contracture at an early stage is not specific to DC, but is related to anatomical features of the joint whereby prolonged immobilisation in a flexed position is difficult to reverse. Operation is rarely indicated for palmar nodules in the absence of contracture.

Principles of All Operation for Dupuytren's Contracture

A co-ordinated surgical and rehabilitation programme is applied to achieve maximal improvement in hand function. The major role of rehabilitation has probably not received sufficient attention in recent times and this will be considered separately. There is no single operative procedure which is suitable for all patients (Luck, 1959; Meagher, 1962; Lancet Editorial, 1976; McFarlane, 1983) and the appropriate procedure must be matched to the individual problem. All patients must be advised of the likelihood of recurrence. Failure to do so is a potent cause of dissatisfaction and may lead to unnecessary litigation. The factors which should be considered in making a judgement on the choice of operation are:-

1. The patient.

   Age, motivation and general health.

2. The type of hand.
3. The contracture.

1. The Patient

Age Although there is general agreement that a limited operation is satisfactory in the elderly patient, a more radical operation in the younger patient will not necessarily give protection from recurrence. Younger patients often have a more aggressive and diffuse contracture; surgery should be undertaken early and skin replacement considered. Motivation is an important factor and should be judged by the history and attention to such factors as hand hygiene and response to previous injuries. The patient's general health should be noted, particularly in relation to systemic disease or medication. Assessment of the patient will influence a decision on whether or not day case surgery is possible (Martin, 1977).

2. The Type of Hand

The anatomy of the patient's hand is significant. The thickened workman's hand is said to be at greater risk from post-operative stiffness (Barclay, 1959), whereas long, thin digits respond more favourably. The "physiology" of the hand is difficult to quantify other than by subjective impressions. The elderly atrophic hand, which is pale and cold, has a poor prognosis as has the hand which is moved little during examination. The sweating hand is at risk of post-operative oedema and the hand which shows evidence of sympathetic dystrophy may become stiff.

3. The Contracture

The choice of operation is influenced by the speed of progression of the contracture and its severity. The slowly progressive contracture is likely to contain more mature cellular and fibrous tissue and respond favourably to a more limited surgical procedure. Luck (1959) based treatment on assessment of which of three stages was apparent (see Aetiology, Chapter 13).

Choice of operation

A lasting release of the contracted fascial tissues may sometimes be possible by performing a fasciotomy. Proximal interphalangeal joint manipulation should always be gentle if performed during Dupuytren surgery. Excessive force may provoke spasm of digital vessels or cause joint subluxation rather than true extension. If the cut fascial ends retract into fat, a lasting separation may be achieved. If this is not possible because of diffuse disease or absence of fat, then a fasciectomy is required. This is generally the case in the younger patient. Fasciectomy is principally aimed at excision of the nodules and involved cords, although some surgeons advocate prophylactic excision of apparently uninvolved tissue (see below).

The fascia which the surgeon will encounter will be of three types; visibly involved, not apparently involved but tight, or apparently normal. Most operations comprise a combination of release and excision, but it is rarely possible to remove all of the pathological tissue and the concept of excision with a margin of clearance does not apply. The first step in all fasciectomy operations is a proximal 'fasciotomy' or release of the contracted tissues whereupon by gentle manipulation there will be a considerable separation of the contracted fascial tissue. Thereafter a variable amount of fascia is removed, the wound is closed by re-application of the original skin taking steps to avoid longitudinal contracture. Alternatively, the skin may be replaced if it is grossly involved with DD.

A broad contracture consisting of a wide cord, or group of nodules, is more difficult to release. The presence of skin involvement may indicate the need for skin replacement. The distribution of the contracture in the palm will dictate whether one or more rays require dissection. The distribution in the digit will indicate the approach required for management of the skin, the contracted fascia and the proximal interphalangeal joint.

The common principle of all operations is that healthy tissue must be interposed between the two ends of the excised or divided Dupuytren's cord to prevent the re-joining of contracted fascial structures. The aim should be to preserve a layer of fat between normal skin and deep structures. However, if the fat is lost and the dermis involved, excision of the involved skin and graft replacement is preferred.

Rehabilitation

The avoidance of future problems lies more in the rehabilitation than in the amount of tissue removed. Post-operative splintage will keep the wound out to length. Early mobilisation will reduce stiffness and oedema. Together, these physical influences will determine that the fibrous components of the healing wound will not limit motion in the post-operative period. A policy of minimal surgery and maximal rehabilitation is indicated.

Non operative treatment

Radiotherapy (Finney, 1953) is now no longer popular in the United Kingdom, but was still in common use in Germany in the later seventies; the author saw many cases of post irradiation skin change while working at the Klinikum rechts der Isar in Munich.

Local injections of preteolytic enzymes (Molarinho, 1967; Hueston, 1971), cortisone (Baxter et al,) Zachariae and Zachariae (1955) and systemic administration of Vitamin e (Molarinho, 1967) cortisone (Baxter et al, 19) methyl-hydrazine (Aron, 1968) furazolidone (Skliarenko, 1982) have been reported with no consistent success.

CHAPTER 19

THE AUTHOR'S OPERATIVE EXPERIENCE

AND

LONG TERM REVIEW OF RESULTS IN 100 PATIENTS

A long term review of a sample of patients treated at Canniesburn Hospital has been undertaken to clarify the natural history and continuation of this condition after treatment and to establish whether any of the operative approaches used made a clear difference in its progression.

Patients

One hundred patients, operated on for Dupuytren's Contracture at Canniesburn Hospital during the period 1970 to 1987, were interviewed and examined. Two hundred and eleven procedures had been performed under our care and 61 hands had had previous surgery elsewhere. Many of these patients were still attending review clinics, as it is policy to keep patients under review for some years following operation. Patients with less than one year follow up were excluded. Earlier patients were located using the unit's computerized record system and contacted by letter. Many other patients could not be contacted: this was attributed to a high incidence of re-housing in inner city areas. Some older patients had died.

Each patient was interviewed to obtain demographic details. The hands were examined and the findings recorded photographically. Ranges and restriction of joint motion were recorded using a goniometer. A detailed history of the progress of disease and operations for every hand operated upon was obtained by retrospective information from the case records, confirmed and augmented at interview.

Examination of the Hand

The status of the hand with respect to Dupuytren's Disease was allocated to one of three categories as follows:-

1. A soft, supple hand. Hands in this category had skin incision line scars, but were otherwise soft and supple. Previous joint arthrodesis did not preclude a patient from classification within this group.
2. Continuing evidence of Dupuytren's Disease, as indicated by nodules, pits, or joint contractures not apparently dating from previous operation.
3. Evidence of continuing Dupuytren's Disease which had progressed to a point where further operation was indicated; the chosen criteria being metacarpal joint contractures of more than 30 degrees or proximal interphalangeal joint contractures of more than 30 degrees.

Results

a) Epidemiology. Ninety-two (92) males and eight (8) females were examined. The age range (at the time of interview) was from thirty-two to eighty-nine years. The age distribution is shown in Fig. 19.1.

Of the 200 hands examined, 7 had not been operated upon. The procedures performed at Canniesburn Hospital were as follows; 99 had had one operation, 26 two operations, 8 three operations, 9 had four operations or more. The patients past recollection of operations was poor, but 61 hands had had surgery elsewhere, although it was not possible to chart the number of procedures with compete accuracy.

The right hand was dominant in 91 cases, 5 being left hand dominant and 4 unspecified. Ninety three patients had disease bilaterally; 2 patients were only affected in the right hand, 5 only in the left.

A positive family history was recorded in 40%. The ratio of manual to non manual workers was 7 to 3. The patients eye colour was noted to be blue in 53 patients, brown in 15 and hazel in 15 patients. Six per cent suffered from diabetes, 6% from epilepsy, 13% were recorded as suffering from alcoholism or were noted to smell of alcohol at the time of examination.

Fig. 19.1 Age distribution of patients at time of review.

b Type of Operation

Various types of operation had been performed during the study period, and by a number of different surgeons. Full details of the operations performed are given in Appendix 3 and details of illustrative case histories in Appendix 4. The operations were classified as follows:-

Group 1 - limited fasciectomy

In this procedure, the digit was opened through a longitudinal incision. The Dupuytren's tissue was dissected from proximally with display of the neurovascular bundles (Case 1) (Hueston, 1961). The transverse fibres in the palm were not preserved. Z-plasties were fashioned at its conclusion (Case 1). Most patients in this group had incisions extending from the palm to involved digits.

Group 2 - fasciotomy and graft

These patients were treated by a transverse incision across the entire palm and the insertion of a split thickness graft to separate contracted fascia (McGregor, 1985). Occasional release and grafting of single rays was also performed (Case 2, Case 19).

Group 3 - highly selective fasciectomy

This operation may best be described as a more limited modification of Skoog's selective operation. (See below - author's approach).

Group 4 - fasciotomy alone

The cord was not excised, but only divided, under direct vision.

Group 5 - proximal interphalangeal joint release

This group includes check-rein ligament release (Watson et al, 1979), and Cleland's ligament releases, each along with any necessary fascial dissection (Case 14, Case 15).

Group 6 - miscellaneous

This group includes dermofasciectomies, local flaps and other techniques. Individual numbers were too small for analysis.

The Author's Operative Approach

The author has used a number of operative approaches which have evolved during the past nine years. The first operation applied may best be described as a more limited modification of Skoog's selective operation. The essential features of Skoog's approach are that incisions are made directly over the cords to avoid extensive lateral dissection and the elevation of large skin flaps. The neurovascular bundles are not completely dissected, but only uncovered at intervals to ensure their safety. This limited dissection is shown in case reports 3, 4 and 6. Dissection commenced 1.5 centimetres proximal to the distal palmar creases. The transverse fibres of the palmar aponeurosis were preserved (Case 5, Case 6). A longitudinal palmar dissection progressed to the base of the fingers (proximal digital crease). Nodules and cords in the digit without joint contractures have generally been left undisturbed. When the proximal interphalangeal joint was flexed however a more distal fascial excision was performed either in continuity or separately.

Details of dissection are illustrated in case histories (appendix 4). Case 6 illustrates a typical longitudinal dissection of a right middle finger with preservation of the transverse fibres of the palmar aponeurosis. In this case the dissection continued as far distally as the base of the middle phalanx.

Case 7 illustrates a dissection of a displaced neurovascular bundle in the digit. After definition of the neurovascular bundle the cord is generally divided proximally and resected. In this case an additional separate cord arising from the abductor digiti minimi muscle was also found. There was a general contracture lateral to the pip joint which appeared to be involving Cleland's ligaments and Watson's checkrein ligament.

Case 8 shows skin involvement and where the dermis of the skin has been found to be infiltrated with Dupuytren's Disease the skin has generally been excised and replaced by grafting. Such cases are included for analysis in group 6 above.

Case 9 illustrates an extensive dissection of the little finger and it is noted that the contracted tissue extends as far as the edge of the extensor apparatus in the depths of the wound. This may be a factor in recurrence as tethering of the extensor apparatus could result in an intrinsic minus posture.

More recently the author has undertaken an even more limited dissection. In case 10 the left hand was operated upon by the modified Skoog technique and the right hand by the simple removal of 1 centimetre of the longitudinal cord overlying the transverse fibres of the palmar aponeuorosis. This approach is rather similar to that which has been described by Dr. J. P. Moermans in 1986, but the author has used transverse incisions and has specifically tried to follow anatomical landmarks. The removal of the longitudinal cord at this specific point overlying the transverse fibres has successfully released the mp contracture in most cases.

Case 12 shows a simple release of 1 centimetre length of fascia in the distal palm and digits. This operation is intermediate between a fasciectomy and fasciotomy. These short excisions of longitudinal contracted tissue have not been included in the analysis of results presented here because of the short follow up. Further prospective work is being undertaken.

In a few cases the author has performed Gonzales' operation of transverse fasciotomy and the insertion of full thickness skin grafts (Case 11).

The common principle in all operations is, however, that a knowledge of the anatomy of the contracted fascia allows its release with the mimimum disruption of anatomical structures. The author has used night splintage for longer and longer periods and currently advises night splintage for six months.

Results - c) operations

The status of each hand was considered for five year intervals following surgery. The findings, indicated in Fig. 19.2, show that only 22% of hands were supple when examined within five years of operation, 10% within ten years and no hands were found to be soft and

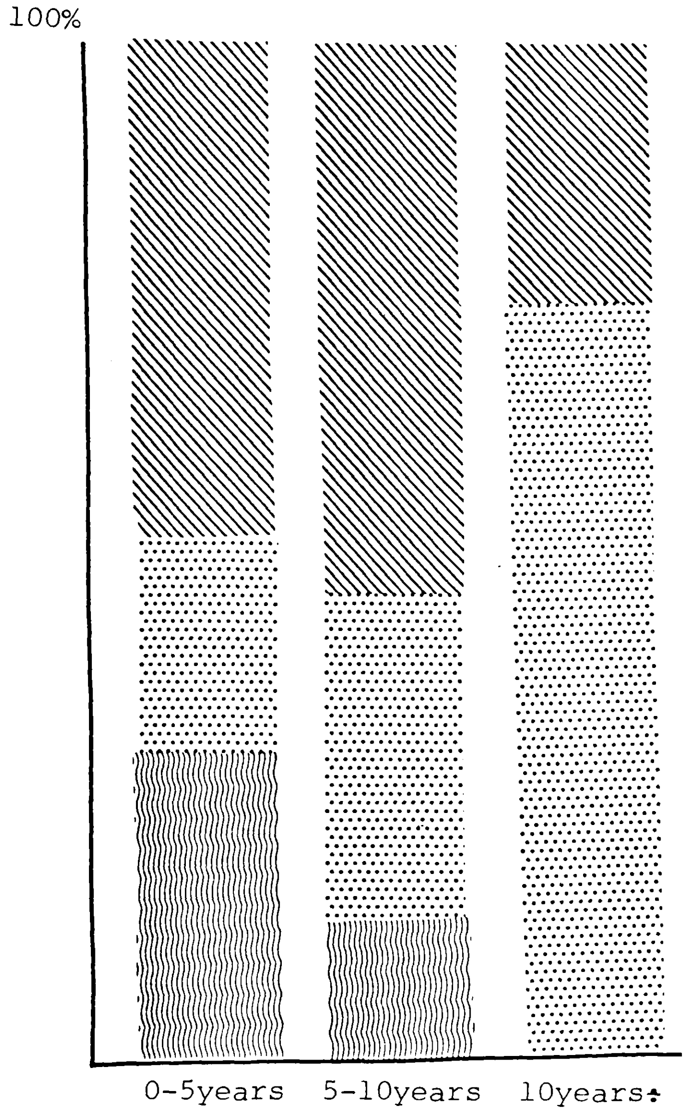
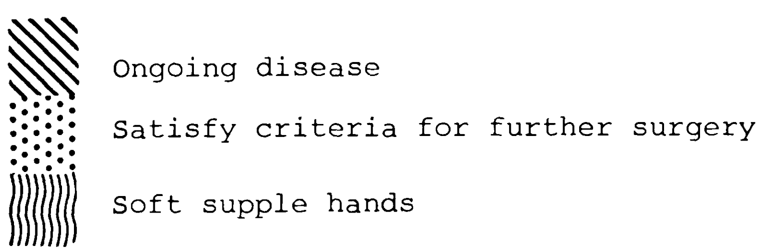


Fig. 19.2. Condition of hands at review.



supple in this series after ten years (Case 1).

Table 19.1 shows a comparison of the outcome of each operation. To compensate for the different chronological period during which the differing operations were performed, it was decided to assess the results by analysing, a) time to next operation on the same hand, or alternatively b) time to long term review if no other operations had been performed. This interval together with the condition of the hand at review gave an indication of the further progress of the disease.

It is appreciated that the selection of the criteria - time to next operation on the same hand - is unusual. Most authors have chosen the classification of recurrence and extension. Early deterioration in hand function certainly within the first year, and probably during the second, may however reflect a failure of recovery from the operation with maturation of scar tissue within the hand rather than recurrence of the disease process. Also, the distinction between recurrence and extension may be difficult as operation on one digital ray may encroach on adjacent rays precipitating the onset of the process there (Case 5). The trauma of operation may accelerate the disease process elsewhere in the hand due to oedema, immobility and reflex sympathetic dystrophy. For the patient the

TABLE 19.I Outcome of Different Operations

Operation Group	Total Number of Procedures	Number With Subsequent Operation	Years to Next Operation	Number Without Subsequent Operation	Years Follow Up
1	62	30	2.7	29	7.5
2	25	13	4	12	7.45
3	72	9	2.1	63	3.14
4	1	1	2	-	-
5	11	3	1.3	8	3.2
6	50	16	5.8	33	3.6
Total	221	72	-	145	-

real question is how long the hand may remain free of contracture as the result of the operative intervention. For this reason the time to the next operation (or to long term review) has been chosen as a measure of efficacy of surgery.

It has been seen that almost half of the "limited fasciectomy" (Group 1) procedures required a further operation after 2.7 (mean) years, whereas the more limited Group 3 operations (highly selective fasciectomy, with intensive therapy and prolonged splintage) had much fewer secondary procedures. Although the follow up time of the latter is shorter, they seem to have no poorer an outcome than the more extensive ("limited") approach.

It seems, however, that fasciectomy and grafting, i.e., division, separation of a cord, and the interposition of a skin graft may contribute to a longer period between procedures. A beneficial effect of skin grafting or skin flaps may also account for the increased time between operations in the miscellaneous group 6.

Check-rein releases (Case 15, Case 16) performed in a small number of joints were followed by a clinically stiff finger, or arthrodesis, regardless of the type of fascial release performed in addition. The arthrodeses were not followed by subsequent surgery to that digit, though the course of the disease in the rest of the hand remained progressive.

The results of selected age groups were examined to see whether the disease behaved any differently at the extremes of age and whether any specific differences in procedure type or disease course were noted. These groups were: (1) > 70 yr (2) < 46 yr). The over seventies comprised 18 patients with age ranges from 70 to 89 years. The distribution of procedures was similar to that of the whole group, with the majority of the cases in groups 1 and 2. The mean follow up was 6.6 years with a range from 2 to 19 years. The status of their hands mirrored those of the whole group at 5 to 10 years with 12% supple, 41% with ongoing disease and 47% needing an operation. The disease therefore did not appear more benign in these older patients.

There were ten patients in the under 46 group ranging from 32 to 46 years. The mean follow up was 5.7 years, two follow ups being >12 years. The most frequent procedure was group 3. The results were somewhat better than those of the group at large with 15% supple, 55% with ongoing disease and 30% needing operation. The follow up was shorter.

The supple hands were considered separately. There were 22 such hands. Of those operated upon the mean follow up was 4.9 years. Seven hands, however, had not been operated upon and one other had been arthrodesed. The most frequent operation was group 3 (highly selective fasciectomy) with 49%, groups 1 and 6 with 16% each. Their ages ranged from 42 to 77 years.

Discussion

The major conclusion of this review is that surgery is not curative in Dupuytren's Disease. It is likely that the aim of our procedures must be redirected towards simply providing a hand which is functional for greater periods than it is not. Careful study of the natural history of the disease suggests that it is progressive and ongoing in spite of our intervention... that our intervention merely delays the time course but does not arrest it. There is a high incidence of first, second, third and fourth recurrences. Many patients deteriorate after surgery, but do not wish further treatment.

Secondly, there is no evidence that a more radical operation within the range of procedures performed here will protect the patient from recurrence. It seems justifiable to perform the simplest possible operation to relieve the contracture and improve the function of the hand.

This review did not compare the operation groups in terms of morbidity. It is generally believed, however, that the more extensive dissections are more likely to produce haematomas, flap necrosis, and reflex dystrophy and oedema.

While there is the theoretical difficulty of poor visualization of a digital neurovascular bundle through a small incision, Moermans (1986) has demonstrated no marked increase in injury to the bundle. Moreover, a limited fasciectomy is less likely to entail a large amount of undermining and subsequent skin devascularization. The operations through small incisions (Group 2, 3) seem to provide as reasonable a result as the more extensive ones (Group 1), although numbers are small and duration of follow up not comparable.

The demographic details may be compared with the large epidemiological study of Mikkelsen. The incidences of diabetes, epilepsy and alcohol in these patients conform to the expected incidence. Eye colour has been discussed by Hueston (1985) who noted that Dupuytren's patients in Italy tended to have blue eyes. In Scotland, the value of eye colour as a genetic marker seems dubious.

The incidence of presence of the palmaris longus tendon has been discussed by Powell et al (1986). The incidence in this series does not lend support to their hypothesis that Dupuytren's Disease is more frequent when a palmaris longus tendon is present.

It is appreciated that this is a selected series. Firstly, there is an "unconscious" selection in the patients which reach Canniesburn Hospital, a Regional Plastic Surgery Unit. It is likely that many, apparently more simple, Dupuytren's Contractures are dealt with by other surgeons within the region. There is the possibility therefore that the more extensive cases with marked skin involvement are more frequently referred to the plastic surgical unit. Of those patients treated, it might be anticipated that patients with continuing trouble would be more likely to attend a review clinic. Nevertheless, it is surprising how many patients attending for this review were found to satisfy criteria for further surgery. It is also surprising that despite their attendance for examination and the condition of their hands they declined the offer of further treatment. One would anticipate that such patients would be more likely to default; this did not seem to be the case in our follow ups. It is possible that inclusion of the non attenders may have biased the results in either direction. Review of the records of non attenders suggest that those who were examined are fairly typical of the unit's results. Gonzales (1985) has also reviewed the Canniesburn results and drawn similar conclusions.

Comparison With Other Published Results

Other published series have generally been classified in terms of recurrence and extension (Cases 17, 18, 19). These categories are not clear-cut (see above) and it seems that a more valid comparison would be to consider the number of hands clear of disease (Table 3).

It is felt that the varying percentages of recurrence, extension and hands clear of disease simply reflect differences in the arbitrary criteria for definition of these terms.

McFarlane and Jamieson (1966) presented very tight criteria for recurrence.

Dickie and Hughes found 63% of hands to be clear of disease at 10 years but the radical operation is no longer performed in Belfast because of "frozen hands" (Colville, J. - personal communication).

The Canniesburn figures (Walton and McGrouther - to be published) offer a new perspective on DC with no hands clear of signs of disease at 10 years.

		NO.OF HANDS	FOLLOW UP YEARS	OP.	REC.	EXT.	CLEAR
GORDON	1957	120	0-21	-	18%	9%	64%
HUESTON	1961	70	5-15	LIMITED	40%	40%	20%
FREEHAFER & STRONG	1963	51	1-7	PARTIAL	2%	6%	-
McFARLANE & JAMIESON	1966	86	1-	LIMITED	2%	1%	-
HAKSTIAN	1966	73	-	McINDOE	34%	33%	49%
DICKIE & HUGHES	1967	153	10	RADICAL	27%	37%	63%
HONNER & LAMB	1971	138	1-9	RADICAL	41%	20%	-
RODRIGO ET AL	1976	65 (41	2-6	SUBTOTAL LIMITED	63% 43%)	66%	-
RANK & CHANG	1978	85	5-25	LIMITED	35%	45%	20%
TONKIN ET AL	1984	154	1-7	LIMITED GRAFT	54% 33%	28%	-
GONZALES	1985	302	5	GRAFT	<10%	-	-
WALTON & MCGROUTHER	1988	200	1-19	ALL	-	-	0%

Splintage

Dupuytren was precise in his splintage regime (Chapter 2). William Adams (1879) used a variety of sophisticated splints with routine post-operative splintage in extension and night splintage thereafter. He used a ratchet type of splint in cases of incomplete correction to augment the release achieved at operation. Although much attention has been focussed on operative technique in literature, accounts of post-operative management have been limited. McCash was an exception to this rule emphasising by illustration the importance of a post-operative night splint.

At a recent workshop held at the National Centre for Training in Prosthetics and Orthotics at Strathclyde University, it appeared that scientific evidence to support the case for post-operative night splintage was lacking and clinical practice varied widely.

The author has enjoyed the voluntary services of W. Dykes and Miss Marjorie Blanche, Orthotists from Strathclyde University, at the hand clinic. The provision of a professional orthotic service has added a new direction to the care of DC (Case 13, Case 20, 21). It now seems to the author that surgery, rehabilitation and splintage have equal importance and the results seem improved. Scientific evaluation is being embarked upon.

CHAPTER 20

GENERAL CONCLUSIONS

History

Much of our current knowledge on the management of Dupuytren's Disease has been discovered, lost and rediscovered. Modern authors have either ignored former knowledge or have oversimplified the accounts to the point of inaccuracy. Further analysis requires to be done.

Dupuytren's Disease

Almost every disease and pathological process has been suggested as an aetiological factor at one time or another. The evidence that heredity is responsible is strong, but not incontrovertible. There is no simple cause and effect relationship to trauma, but there may be a contributing role which urgently requires precise definition to clarify the unsatisfactory medico-legal situation.

The pathological process has its roots in cell biology and the responsible cell appears to be the myofibroblast.

Related fibromatous lesions in the foot and knuckle changes suggest that the abnormal cellular biology manifests itself in areas of mechanical stimulation;

shearing stresses are most likely to be the provocative trigger.

Anatomy

The contraction process is seen to follow anatomical pathways in the palm and digits. The clinical signs can be explained on an anatomical basis.

The precise anatomical arrangement of the fascial structures in the palm and digits has been reviewed and examined by dissection.

A knowledge of the anatomy of the fascial ligaments in health and disease allows a more precise approach to the surgery of Dupuytren's Disease.

Biological behaviour

Current concepts of aetiology lie between a fibromatosis and a wound healing response.

The biomechanics of the hand together with the anatomy of the palmar fascia account for the distribution of the lesions. Stiffness of the pip joint is not unique to DD, but is a consequence of the mechanics of the joint.

A philosophy of treatment based on this understanding of the disease process and of the anatomical arrangement of the fascia has been derived.

Case selection and a choice of the appropriate operation are important.

Operations

The numerous operative approaches have been classified with respect to:-

A Management of the Skin and Subcutaneous Tissues.

B Management of the Contracted Fascia.

C Management of the Contracted pip Joint.

Review of the literature and the author's experience point towards highly selective operations designed to break-up contracture lines rather than to excise all Dupuytren's Tissue.

The role of post-operative splinting is emphasized together with the need for scientific evaluation of its best means of application.

CHAPTER 21

SUGGESTIONS FOR FUTURE WORK

In reviewing a subject, the literature of which spans 156 years and beyond and in numerous European languages - the ravages of time, wars and scientific inaccuracy have all eroded the record - it has not been possible to be comprehensive. In spite of collating the largest bibliography published on this subject, many more avenues of literature need to be pursued. The author hopes to use the present bibliography as a starting point to collect and compile every article published on La Maladie. As Chairman of the Dupuytren's Disease Committee of the International Federation of Societies for Surgery of the Hand, the author intends to circulate the bibliography to committee members in the hope that each will expand the literature of his own language.

The answer to the enigma of the disease process must lie in further study. Further epidemiological surveys need to be commissioned to reconsider the factors of heredity and work in particular. It is hoped that the author's description of clinical signs will facilitate the definition of DD in such studies. The author has commenced negotiations with a major trade union to obtain funds for such a study and a second longitudinal study on the progression of knuckle changes has been embarked upon.

The nature of the pathological process requires further studies in cellular biology and the findings will illuminate allied problems of wound healing and collagen diseases. Perhaps the greatest significance of DD is not to the sufferers, but that it is a missing link in knowledge. To Charles Darwin the flying squirrel was intermediate between a bird and a mammal; la Maladie de Dupuytren lies between neoplasia and wound healing.

The author has participated in an invited workshop group of twenty Scientists and Clinicians working in this area. The first meeting in Vienna (1982) was convened by Professor Hano Millesi and the second in London, Ontario, (1985) by Dr. R. M. McFarlane. Further meetings in this series will build bridges between these disciplines and point the way to future projects. The author is currently harvesting Dupuytren's tissue for collagen analysis by Dr. A. Bailey.

Certain areas of anatomical detail remain in dispute and further dissection studies are needed, especially to look again at the perforating fibres of Legueu and Juvara and the check rein ligament of Watson. The broad brush strokes are however established and the palmar fascial ligaments have been found to have relevance to all hand surgery. (The fundamental postural deformity of oedema is partly determined by Cleland's and Grayson's ligaments.) The palmar fascia has an important role in hand stiffness.

Future work on treatment regimes, requires careful pre-operative documentation of deformity and standardisation of operation. This is difficult in the life of a 20th century surgeon which like Dupuytren's is devoted to hard labour. The future lies in better case selection, more limited surgery and much more extensive and precise rehabilitation, splintage and patient education programmes while we await a means of controlling the disordered cellular biology.

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Appendix 1

Dupuytren's disease in the thumb. McGrouther, D.A., from Surgery of the Thumb, Chapter 11, Edited by Reid, D. A. C., McGrouther, D. A. Butterworth, London

11

Dupuytren's disease in the thumb

Dupuytren's disease presents in the thumb uncommonly but is much more usually noted as an incidental finding in the course of examining or treating the condition in the ulnar three digits. Mikkelsen (1976), in an epidemiological study of 15 950 persons in a small town in Norway, found that 901 had evidence of Dupuytren's disease and this was noted in the thumb in 3 per cent of male and 0.6 per cent of female patients. The condition seems to have been of an early or 'subclinical' variety in this series, as few had sought treatment prior to the study. It is generally agreed that patients with Dupuytren's disease who present to the surgeon are a selected group and that within that group the incidence of involvement of the thumb appears to be much higher (Tubiana, 1980; Campbell Reid, personal communication; McGregor, personal communication).

There may be no disability, or there may be limitation of palmar abduction and opposition due to tightness of the web, or limitation of radial abduction due to flexion of the digit.

The clinical signs are of tightness of the web skin or of a nodule, or line of nodules, at the radial border of the thumb or just proximal to the free border of the first web space. Less commonly there may be a flexion contracture of the metacarpophalangeal joint or the interphalangeal joint. As in all cases of Dupuytren's disease there are certain types of presentation. In the younger patient with a strong diathesis there may be widespread involvement of many digital rays and knuckle pads. In the older patient the presentation is generally much more insidious.

The pathological anatomy has features in common with Dupuytren's contracture elsewhere. As described by Stack (1971), McFarlane (1974) and McGrouther (1982), the contracture follows anatomical pathways and the lesions therefore do not have a random occurrence but can be explained on the basis of the anatomical ligamentous system of the palmar fascia. Tubiana (1980) has described the anatomical ligaments on the radial side of the hand and these are well visualized on considering the surface anatomy.

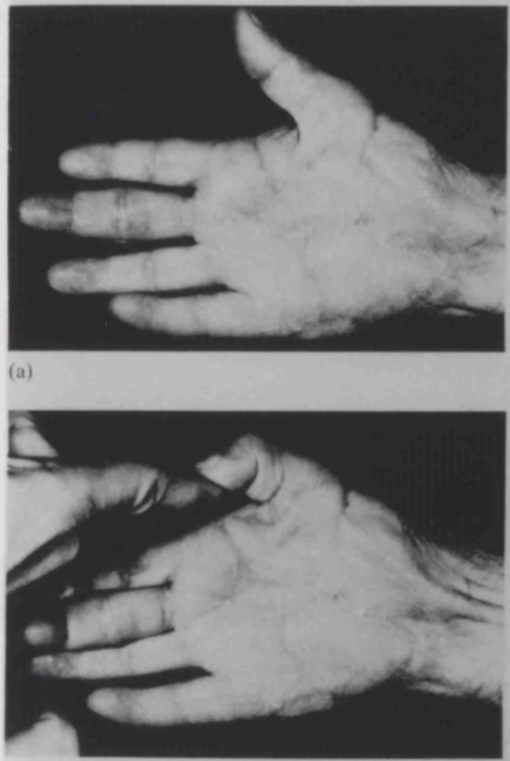
The normal fascial structures in the thumb are as follows.

Longitudinal fibres

As described by Wood Jones (1941), the longitudinal fibres of the palmar fascia arise from the palmaris longus or flexor retinaculum at the wrist and have five condensations of longitudinal fibres, one for each digital ray. Unlike the fingers, where the longitudinal fibres tend to pass anteriorly to distal insertions (McGrouther, 1982), the fibres to the thumb pass to the radial border (*Figure 11.1*). Perhaps it is this radial orientation which makes flexion contracture of the metacarpophalangeal or interphalangeal joint much less common than in the case of the digits. The midline anterior surface of the thumb is covered by thin mobile skin with loose areolar tissue and there are no obvious fascial structures in this area.

Transverse fibres

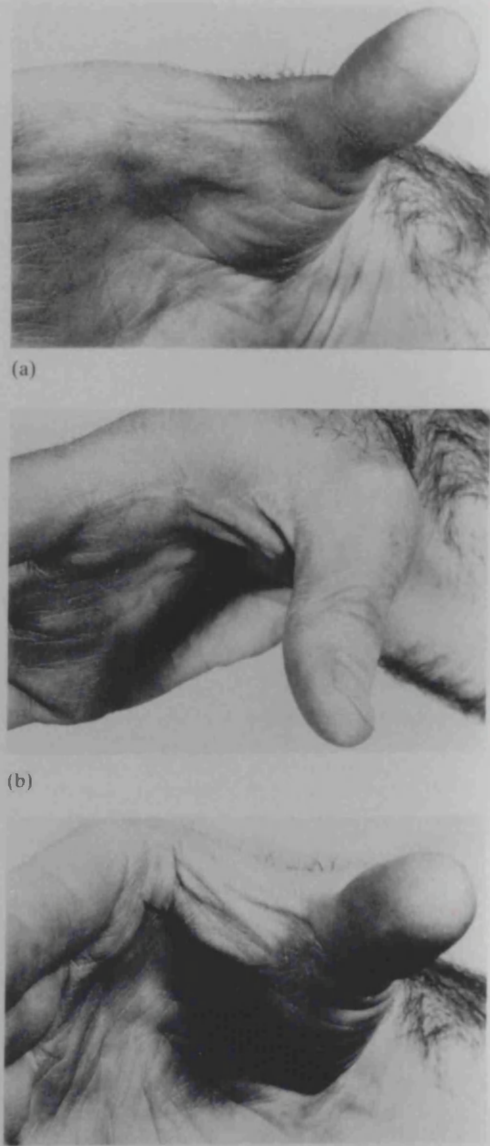
In the web, there are fibres along the free margin of the web skin, which have been variously named as part of the natatory system of web ligaments or the ligament of Grapow (1887). The draping of folds of the skin of the web is a precise and complex process which is controlled by the amount and texture of the skin available and by the underlying ligamentous attachment to the skin. The changing pattern of



(a)

(b)

Figure 11.1. (a) The normal longitudinal fascial extension of the palmaris longus tendon is well shown on this patient whose overlying soft tissues have been removed by trauma and replaced by skin graft. (b) The pull of palmaris longus through the fascial fibres is capable of exerting a weak opposition action



(a)

(b)

(c)

Figure 11.2. Surface anatomy to show the complex folding of the web skin. (a) In full radial abduction there is a single ridge of web skin. (b) As the metacarpophalangeal joint flexes, this ridge flattens and a second, more anteriorly placed, ridge appears. (c) In full palmar abduction the proximal commissural ligament is seen

folds can be seen by reference to *Figure 11.2*; as the thumb moves from radial abduction and extension towards palmar abduction and flexion, the summit of the web skin fold shifts anteriorly. The reader can confirm this by inspecting his own hand. The exact relationship of these skin folds to the underlying natatory ligaments requires clarification, but when the summit of this folding ridge system is contracted in Dupuytren's disease, this forms one common type of cord which may be called the distal commissural cord to fit in with the nomenclature of Tubiana (1980) (*see below*).

A second system of transverse fibres proximal to the above, which Tubiana (1980) has called the proximal commissural ligament, is present and may be visualized in the hands of normal subjects in palmar abduction (*Figure 11.2c*). This is not a part of the natatory system but rather a continuation of the system of transverse fibres described by Skoog (1974). The extremities of this band are a little uncertain but it seems likely that they arise in relation to the corresponding tendon sheaths of thumb and index.

Vertical fibres

Although specific dissection has not been undertaken in this region, there is clinical evidence that there are fine vertical fibres anchoring the skin, especially in the region of the 'skin joints' over the metacarpophalangeal and interphalangeal joints.

The lesions of Dupuytren's disease

The occurrence of the various clinical signs or lesions can be explained in relation to the underlying anatomy.

Nodules

Common sites for nodules are on the radial longitudinal band at the metacarpophalangeal joint (*Figure 11.3*), where there may be two or three in line. Nodules may also occur overlying the palmar or thenar end of the proximal commissural ligament (*Figure 11.4*).

Bunching of the skin creases

In association with nodules, or sometimes without any well-defined nodules, the skin folds at the base of the thumb may be distorted. There are two or three skin creases overlying the anterior and radial aspect of the metacarpophalangeal joint in the normal hand and these are often bunched together by the contracting process underneath (*Figure 11.5*). Knuckle pads of the type seen over the proximal interphalangeal joints of the fingers do not seem to have been reported in the thumb although, rarely, in longstanding contracture, a thickening of the dorsal skin may be seen over the interphalangeal or metacarpophalangeal joints (*see Figure 11.9b*).

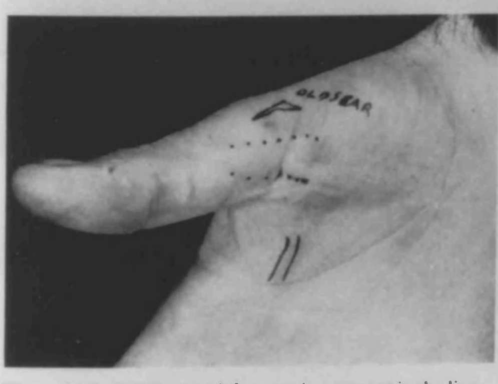


Figure 11.3. A diffuse nodular area is apparent in the line of the radial longitudinal bundle. There is also a tight proximal commissural ligament and an adjacent old scar which is coincidental

(a)

(b)

Figure 11.4. (a) An early contracture cord developing in the proximal commissural ligament, with a nodule at the palmar end. (b) The right hand of the same patient. A shorter cord is palpable, affecting the proximal commissural ligament. A second cord is apparent affecting the distal commissural ligament adjacent to the free margin of the web, with a line of nodules

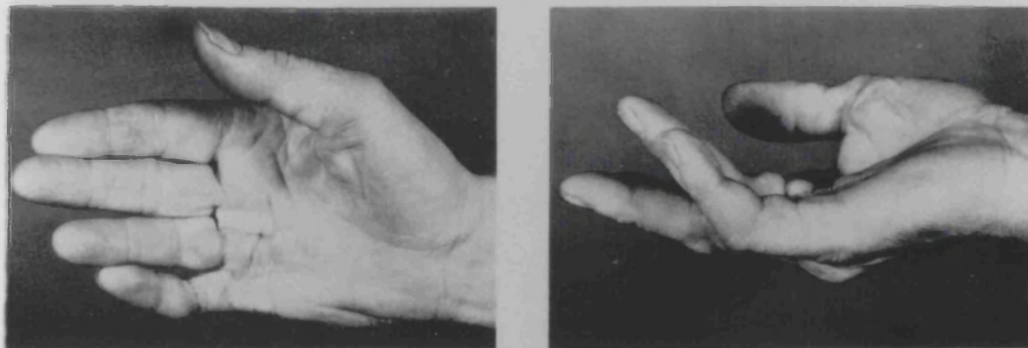
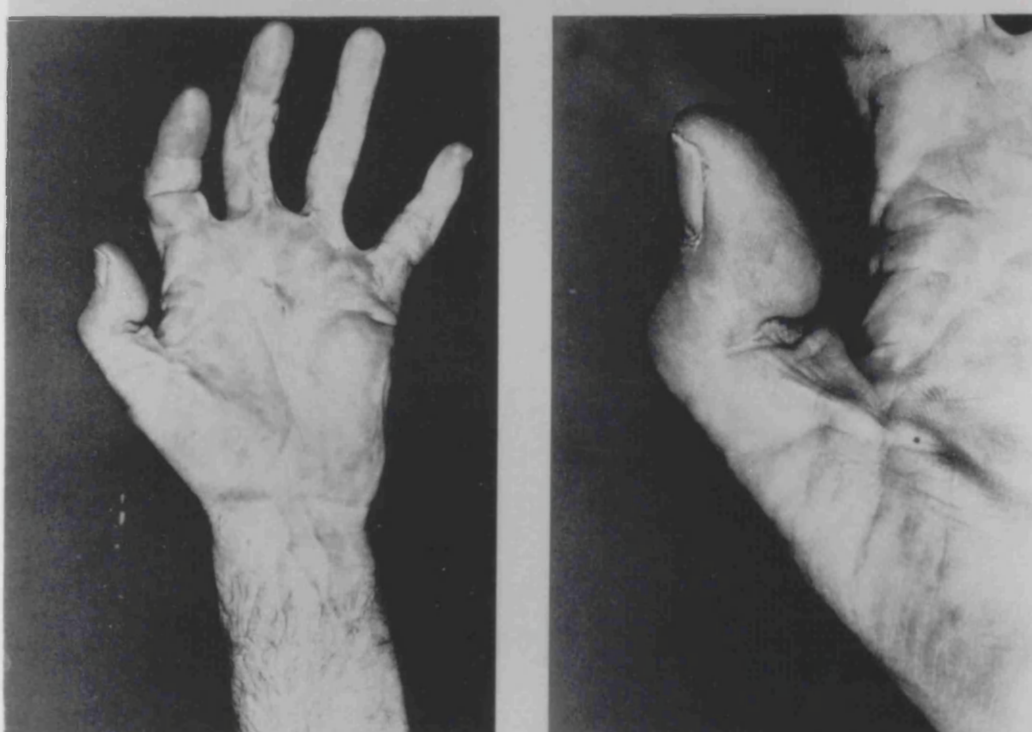


Figure 11.5. Bunching of skin due to contracture of the underlying radial longitudinal bundle



(a)   (b)

Figure 11.6. (a) Widespread Dupuytren's disease affecting all five digital rays. There is a palpable cord extending from the front of the wrist across the thenar eminence to the radial side of the thumb and there is a fixed flexion contracture of the thumb interphalangeal joint. (b) Close-up view of the contracted cord on the radial side of the metacarpophalangeal joint

Skin pits

These are rarely, if ever, seen in the thumb.

Contracture cords

A tight cord may be seen running from the wrist to the radial side of the metacarpophalangeal joint, with skin tightness distally (*Figure 11.6*). Actual cords distal to the metacarpophalangeal joint are not commonly seen but they may occur in relation to contracture of metacarpophalangeal or interphalangeal joints, which are much less common than in the fingers. A tight transverse cord may follow the proximal commissural ligament, producing an adduction contracture of the thumb (*Figure 11.4*). Less frequently, the distal commissural ligament (natatory ligament) may be involved (*Figures 11.4b* and *11.7*).

Joint contractures

Interphalangeal joint contracture does occur but is uncommon and is usually part of a generalized contracture process in the patient with severe widespread disease (*Figure 11.6*). There is no information available on the fascial pathways involved. Adduction contracture of the web is the major problem and, from this point of view, the first digital web is unique, in that the major problem is of a transverse contracture rather than the longitudinal contracture which usually occurs in Dupuytren's disease in the fingers.

Treatment

Release of adduction contracture

Treatment of contracture of the proximal commissural ligament will rarely be required on its own but may well be indicated in association with operation on the ulnar digits. The contracture can be adequately released by a Z-plasty as a rule, the central limb being centred on the band. The underlying band can be excised, i.e. the length uncovered by the elevation of the Z-plasty flaps. It is not necessary to pursue these bands to their extreme insertions, but it is sometimes necessary to use a zigzag incision for a more extensive dissection.

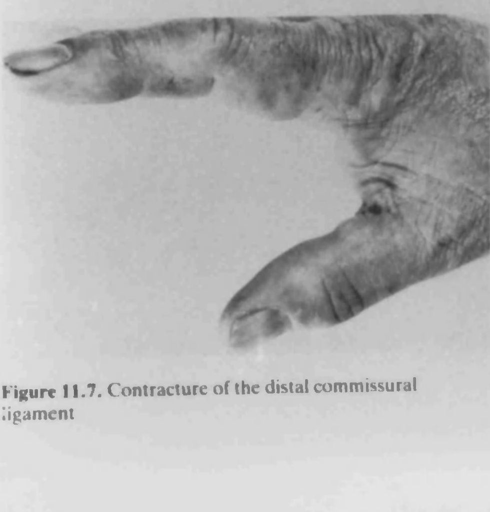
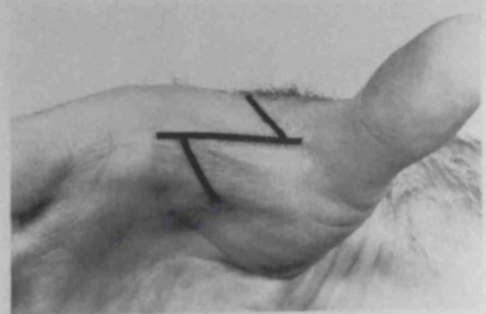


Figure 11.7. Contracture of the distal commissural ligament

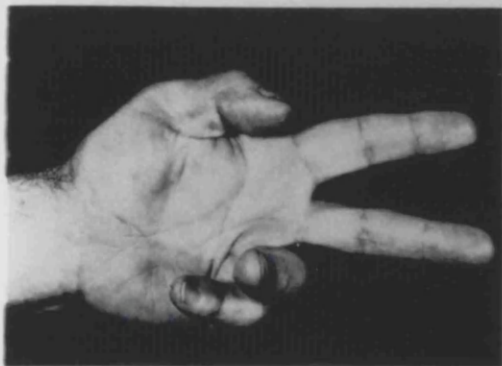
(a)



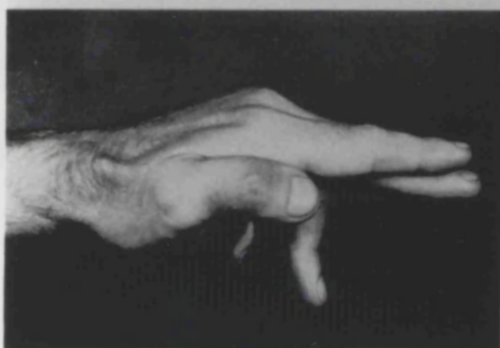
(b)

(c)

Figure 11.8. Various Z-plasty designs are shown for release of: (a) the proximal commissural ligament alone; (b) all contracted structures in the web; and (c) the radial longitudinal bundle



(a)



(b)

(c)

Figure 11.9. (a) A flexion contracture of the thumb at metacarpophalangeal and interphalangeal joints by a tight radial longitudinal cord. (b) Dorsal view to show thickening of the soft tissues over the metacarpophalangeal and interphalangeal joints. (c) After release of the cord and the wound closure, incorporating a Z-plasty, the thumb posture is improved and the adduction contracture is less, although no specific release of the web was performed. Some shortness of the palmar skin persists

McGregor (personal communication) has described an alternative of fasciotomy and Z-plasty, in which the fascial band is lifted together with the skin flap without any excision. This redirection of the fascia relieves tension and allows the band to resolve (Watson, 1984). These simple techniques can also be used for the radial longitudinal band at the same time if this seems tight (*Figure 11.8*). If the ligament along the margin of the web is short, the Z should be centred on the free margin. Using a Z-plasty of this type, it is possible to release the natatory ligament and the proximal commissural ligament with one Z-plasty. Tubiana (1980) has stressed the fact that, in a longstanding contracture, the other fascial structures in the web can become shortened in addition, including the fascial planes over the adductor muscles and even the dorsal skin. Perhaps early release of the web contracture should be considered to prevent this problem. Postoperatively, these patients are generally treated by early

(a)

(b)

Figure 11.10. (a) A flexion contracture at the metacarpophalangeal joint of the thumb. (b) After release, a full thickness skin graft has been inserted. (Mr D. A. Campbell Reid's case)

mobilization, and splintage may be necessary for some weeks or months, as in treatment of other web contractures.

Release of flexion contracture

Treatment of the interphalangeal or metacarpophalangeal flexion deformity may be possible by employing a Z-plasty, but there is little skin availability on the front of the metacarpal head and large Z-plasties will therefore not be possible. It will therefore be difficult to make up the apparent palmar skin deficiency by Z-plasties alone (*Figure 11.9*).

The technique of Gonzales (1974) of the insertion of a full thickness graft has been recommended by Tubiana (1980) (*Figure 11.10*). It is desirable to create a wide graft bed, to guard against future recurrence through the graft edges. Postoperatively, such grafts require rigid mobilization for 2–3 weeks to allow the edges to become established and they must be protected from abrasion during gripping for 6–8 weeks.

In undertaking the palmar dissection in the thumb, the usual care must be taken to avoid damage to digital nerves. The resection of the Dupuytren's tissue is undertaken as in other digits.

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Appendix 2

The Dorsal Wrinkle Ligaments of the Proximal Interphalangeal Joint.

Penelope Law and D. A. McGrouther

Journal of Hand Surgery, 9B:271-275

The Dorsal Wrinkle Ligaments of the Proximal Interphalangeal Joint

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This investigation is concerned with a precise description of the anatomy of cutaneous ligaments over the dorsum of the proximal interphalangeal joint which define the "wrinkle pattern" and their relationship to other fascial structures in the digits.
The significance of alterations of the wrinkle pattern in pathological conditions (e.g. knuckle pads) will be discussed.

In considering the attachment of digital skin, Professor John Cleland (1878) described a lateral system of cutaneous ligaments which "help to retain the different parts of the integument in the position which they are adapted to occupy". He also described how the dorsal skin of the digit over the proximal interphalangeal joint is "thrown into wrinkles on extension of the joint—to provide ample provision for flexion of the joint". However, clinical observation of the skin patterns and folds over the dorsum of the proximal interphalangeal joint suggests definite dorsal cutaneous attachments maintaining the dorsal wrinkle pattern.

Thus is raised the question of whether the dorsal wrinkle pattern of the digits is a passive phenomenon due to the redundancy of skin in extension of the joint as a consequence of its being stretched in flexion, or whether the pattern is determined by the attachment of cutaneous ligaments.

In favour of the former view, arthrodesis of the interphalangeal joints leads to the disappearance of the dorsal wrinkle pattern, possibly due to the cessation of stretching of the skin. However, the reader will note on inspection of his (or her) own hand that the pattern is exactly reproduced on every finger extension suggesting ligamentous control of the folding pattern.

Such dorsal skin attachments have previously been the subject of study by Milford (1968) and (1983) who used the term "peritendinous cutaneous fibres".

Material and Methods

Sixteen fixed and eight fresh cadaver digits were dissected at ten to twenty times magnification using either a dissecting microscope or an operating microscope.

In all dissections, the dorsal skin of the digit distal and proximal to the wrinkle pattern was reflected leaving the lateral digital skin and an "island" of the entire wrinkle

Fig. 1 Lateral aspect digit showing island of wrinkle skin retracted, lateral skin-to-skin fibres with marking thread behind these and superficial to lateral peritendinous cutaneous fibres.

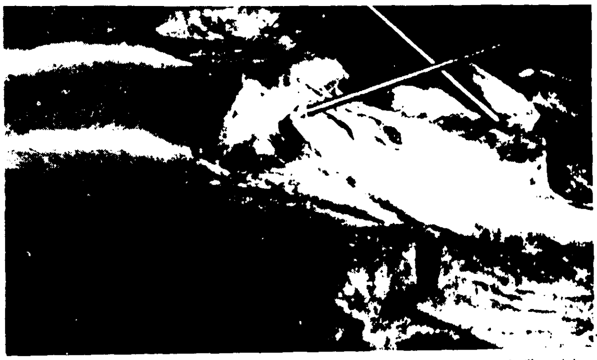

Fig. 2(a) Lateral view digit showing lateral, intermediate (defined by pin) and paramedian peritendinous cutaneous fibres.

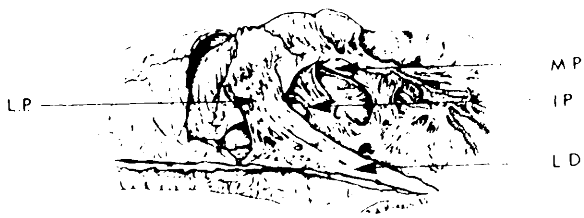

Fig. 2(b) Illustration of Fig. 2(a) with normal structures labelled.
L.P.—Lateral Peritendinous Cutaneous Fibres
I.P.—Intermediate Peritendinous Cutaneous Fibres
M.P.—Paramedian Peritendinous Cutaneous Fibres
L.D.—Lateral Digital Sheet

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skin intact (Fig. 4a). Working from a mid lateral approach the "island" of skin was then carefully dissected away from the underlying structures and any cutaneous ligamentous attachments preserved and noted.

Anatomical Findings

Anatomical findings were found to be consistent in all dissections using the above technique.

Lateral Skin to Skin Fibres. The first and most lateral structure encountered is a band of "skin to skin" fibres, approximately 4 mm wide, running between the lateral (outermost) margin of the wrinkle lines to skin over the mid lateral aspect of the proximal interphalangeal joint. These fibres may be seen at magnification in Fig. 1 in which a thread has been passed behind the fibres to indicate their independence from deeper lateral structures. The various obliquities of their insertion into the mid lateral skin is clearly shown.

Peritendinous Cutaneous Fibres

Lateral

The slightly wider band of deeper fibres which may just be distinguished deep to the thread (Fig. 1) was displayed more clearly by division of the lateral skin to skin fibres. This was found to be a strong fibrous band, running from the lateral part of the outer wrinkle line in a proximal and volar direction and is shown clearly in Fig. 2(a) and labelled as the lateral peritendinous cutaneous fibres on illustration, Fig. 2(b). This band of fibres is also seen on Fig. 3, in which a marker has been placed behind, showing the definite proximal and distal margins of the ligament. The ease with which a fine instrument could be passed deep to the ligament, as was the marker, illustrates that it is an independent and definite structure.

When these fibres were followed in a proximal direction, the outermost fibres were found to insert into adjacent skin. However, the deeper fibres became continuous with a longitudinal fascial band, which, when followed into the web space, was shown to be a part of the natatory ligament fibres which run around the web space (as reviewed by McFarlane, 1974). This continuity may be seen in Fig 4(a) and is labelled as the dorsal extremity of the lateral digital sheet (Gosset 1966) in the finger and the natatory ligament in illustration, Fig. 4(b). In this dissection a pin has been placed deep to the lateral peritendinous cutaneous fibres and the continuity is therefore noted between the lateral peritendinous cutaneous fibres, dorsal extremity of the lateral digital sheet and natatory ligament.

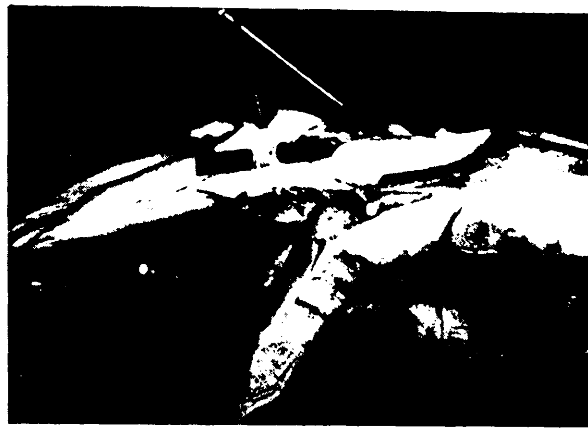

Fig. 3 Lateral view digit showing lateral peritendinous fibres with marker behind. Definite proximal and distal margins of this band are clearly seen.

Further dissection of the fibres of the natatory ligament revealed that they were continuous with the lateral digital sheet in the adjacent digit from which fibres passed in an identical fashion into the dorsal wrinkle skin over the proximal interphalangeal joint. This is shown in Fig. 5 and is further illustrated in Fig. 6, in which traction has been applied to the cutaneous insertion of the lateral peritendinous cutaneous fibres of one digit and movement of the longitudinal band in the next digit may be seen. This system of fibres may also be seen as a skin fold in the living hand on extending the metacarpophalangeal joint and simultaneously flexing the proximal interphalangeal joint, as shown in Fig. 7, in which such a pattern has been compared with the dissected specimen.

Fig. 4(a) Dissection of ring finger with pin marking L.P. Continuity of these with the lateral digital sheet (L.D.) and dorsal extent of the natatory ligament (N) is shown.

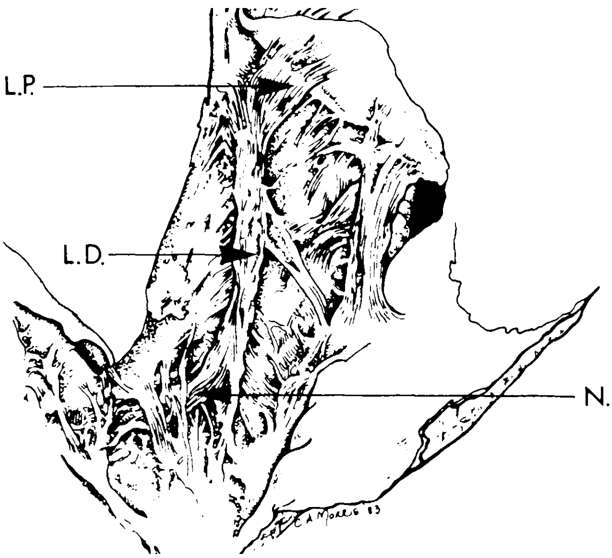

Fig. 4(b) Illustration of Fig. 4(a) with named structures labelled.
L.P.—Lateral Peritendinous Cutaneous Fibres
L.D.—Lateral Digital Sheet
N—Natatory Ligament

Intermediate

Further dissection of the digit reveals, on division of the previously described fibres, thinner, more tenuous cutaneous ligaments lying more medially in the digit. These are shown on Fig. 2(a), in which a pin has been placed deep to the fibres in order to distinguish them from surrounding tissue, and are labelled on the illustration Fig. 2(b) as the intermediate peritendinous cutaneous fibres. Fig. 8, which shows a higher magnification of the cutaneous ligaments in this region, with the wrinkle skin elevated, also illustrates the position of these intermediate fibres. The fibres may be seen to run in a proximal and volar direction towards the extensor apparatus and, under high power, were seen to merge with a filmy sheet over the extensor apparatus. It is interesting to note that the cutaneous attachment of this band was found to be along the outer wrinkle line proximal to the axis of flexion of the joint.

Paramedian

Towards the mid line of the finger, a separate band of fibres was demonstrated, made up of short, strong fibres running in various obliquities between the fascial layer over the extensor expansion and the dorsal skin, where their attachments tended to be along the wrinkle lines. These are shown in Fig. 9, in which the more lateral structures have been divided in order to demonstrate these paramedian peritendinous cutaneous fibres. Although running close to the mid line, these fibres tended to lie to either side, and indeed no cutaneous attachments were found directly in the mid line over the joint.

Fig. 5 Dissection of adjacent fingers seen from above showing continuity between the lateral fascial structures of both.

Fig. 6 Traction applied to the L.P. of one digit causing movement of the longitudinal band in the next digit (indicated by marker). There is thus a system of fibres extending from the dorsal wrinkle skin of one digit to the dorsal wrinkle skin of its neighbour.

Fig. 7 Comparison of skin fold pattern in living digit with dissected fascial structures. The loop of thread in the cadavers specimen is restricting the lateral peritendinous cutaneous fibres.

Fig. 8 Magnified view of the three types of peritendinous cutaneous ligaments with wrinkle skin elevated. The thicker band of lateral fibres is separated from lateral skin to skin fibres by a thread.

Fig. 9 Magnified view of paramedian cutaneous fibres showing the various obliquities in which these fibres run. The middle slip of the extensor apparatus indicates the mid line.

At the proximal and distal margins of the wrinkle skin however, fibrous bands were demonstrated which did attach in the mid line and ran longitudinally in a proximal and distal direction respectively, to insert at some distance from the joint. These may be seen in Figs. 2(a) and 4(a).

Discussion

This study has shown that in addition to the lateral cutaneous attachments of Cleland's ligaments there are definite and independent ligaments attached to the dorsal skin over the proximal interphalangeal joint which determine the wrinkle pattern.

The previously mentioned work of Milford describes a series of peritendinous cutaneous fibres which run from the tendinous insertions of the extensor mechanism to the dorsal skin folds over both the interphalangeal joints. Of those associated with the proximal interphalangeal joint the strongest fibres are said to be along the dorsolateral aspect of the joint and these would seem to correspond with the intermediate peritendinous cutaneous fibres shown in this study. Also described is a strong band of mid line fibres running from the extensor apparatus to the dorsal skin, and although the description of these is similar to the paramedian peritendinous fibres demonstrated they were not found in this study to lie directly in the mid line.

There does not seem to be, however, any previous mention of the lateral peritendinous cutaneous fibres demonstrated, or of their connection with other fascial structures in the digits and hand.

McFarlane (1974), in a study of fascial pathways in Dupuytren's disease, described how some of the fibres of the transverse natatory ligament pass distally from the web space longitudinally up each side of the fingers. No mention is made, however, of the continuity between these fibres and the lateral peritendinous fibres inserting into the dorsal wrinkle skin. Milford, however, does point out that the ligaments of Cleland and Grayson (1940), which attach to the lateral skin of the digit, blend with the lateral digital sheet, thus establishing continuity between the web space and the digital skin.

This continuity between palmar and digital fascia is further described by McGrouther (1982), who shows how some of the longitudinal fibres of the palmar aponeurosis pass into the lateral digital sheet.

Therefore, combination of previous studies and this work reveals a continuity in the ligamentous pathways between the lateral part of the wrinkle skin and the natatory ligament and thus with the adjacent digit and the palm of the hand.

Stack (1971) and (1973), McFarlane (1974) and McGrouther (1982) have described the way in which Dupuytren's disease follows anatomical pathways. Knuckle-pads associated often with Dupuytren's contracture certainly lie within the wrinkle area. Further work is necessary to investigate whether there is any relationship between their site and any of the structures described here.

The wrinkle pattern depends for its maintenance on the described system of vertical tethering and a skin "redundancy" in a horizontal plane. It is a useful clinical sign on examination of the hand as it provides a gauge of the motion of the proximal interphalangeal joint.

Conclusion

In this work an attempt has been made to answer the question of what determines the dorsal wrinkle pattern over the proximal interphalangeal joint. Cutaneous ligaments have been demonstrated which attach along the wrinkle lines and presumably play some part in the pattern achieved. However, the disappearance of the wrinkle pattern on immobilisation of the joint is a phenomenen that cannot be easily attributed to the findings. it may be that both the stretching of the skin on flexion of the joint and the dorsal cutaneous ligaments determine the skin folds, and that both are essential for the pattern to be maintained.

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Appendix 3

Details of 100 patients with Dupuytren's Contracture at long term review.

Hosp. # D.o.B.	Age	Name/ Occup.	Manual/ Non Man	Decade of Onset	Family History	M/F	Handedness R	L	RLB	Eye Colour	PL	Diabetes	Epilepsy Alcohol	Yr. of Op.	Hand R	L	Ray	Group of Oper.	Hand Status	Involved Rays R	L	Comments	Yrs ?	Abductor/Swan Digit/Neck
88455	53		M	30-40	?/S	M	✓		B	blue	?/ø			78	✓		palm thumb	I	3/3	I			9	
														81	✓		palm	I		II	✓			
17.11.34														85	✓		II V	III		III				
														78		✓	II, III	III		IV	✓			
														83		✓	V	III		V	✓			
														86		✓	II V	III						
54650	57		nM	30-40	+/S	M	✓		B	blue	?			72	✓		II	I	1/1	I			15	
														81	✓		IV	V		II				
17.1.28														72		✓	○	I		III				✓
																				IV	✓			✓
																				V	✓			
62522	53		M	30-40	+/SI	M	✓		B	blue	?			73	✓		palm	II	3/3	i				
														82	✓		III V	III		ii				
5.3.34														84	✓		V	III, V		III		arthrodesis		
														74		✓	○	I		IV				
														76		✓	palm	II		V				
														82		✓	II V	II, 3				L I/F fixed cx R	14	
														84		✓	III	V, III						
113563	84		nM	>50	?/S	M	✓		B	blue	?			83	✓		III IV	III, IV	3/3	I	✓	A. pulley trigger	4	
"																				II				
1.3.03																				III	✓			
"														"						IV	✓			
"																				V				
59020	53		M	30-40	?/S	M	✓	✓	B	blue	?			73	✓		palm	I	3/3	I	✓		14	
24/3/34														73 "	✓	✓	III, IV V	V		II				
"														83 "		✓	II, V I	III		III				✓
"														"						IV	✓			
"														"						V	✓			
116696	56		M	40-50	B/S	M	✓		B	blue	?			83 "	✓		III V	III		I	✓		4	
"														84 "		✓	IV V	III	3/3	II				
9/5.31														"						III				
"														"						IV	✓			
"														"						V	✓			
030933	53		M	20-30	+/S	M	✓		B	hazel	?			73 "	✓			II	3/3	I	✓		19	
"														76 "	✓			I		II				
8.4.35														79 "	✓			II		III				
"														68		✓		I		IV				
"														69		✓		I		V	✓			
"														70				•						
														74				II						
														81				II				FTSG		

Hosp. # D.O.B.	Age	Name/ Occup.	Manual/ Non Man.	Decade of Onset	Family History	M/F	Handedness R	L	RLB	Eye Colour	FL	Diabetes	Alcohol	Epilepsy	Yr. of Op.	Hand R	L	Ray	Group of Oper.	Hand Status	Involved Rays R	L	Comments	Yrs ?	Abductor/Swan Digit/Neck
108494	56		M	40-50	Ø/S	M	✓		B	blue	+/+	✓	✓		81		✓	IV V	III	3/2	I			6	
																					II				
6/5-31																					III				
																					IV	✓			
																					V				
180301	85		M	50	Ø/S	M	✓		B	hazel	+/+			✓	86	✓		IV	II	2/2	I			2	
															85		✓	IV	VII		II				
14-6-29																					III				
																					IV				
																					V	✓			
85359	66		nM	>50	+/S	F	✓		R	blue	?				83	✓		IV V	III	3/2	I			4	
															86	✓		IV V	III		II				
1-7-21																					III				
																					IV				
																					V				
111354	54		M	>50	+/S	F	✓		B	hazel	?				82		✓	IV V	III	V/1	I			5	
																					II				
8-12-21																					III				
																					IV	✓			
																					V	✓			
91693	71		nM	40-50	Ø/S	M	✓		B	blue	?				78	✓		palm	I	3/3	I			9	
															81	✓		V	VI		II		FTSt		
10-12-16															81	?			VI		III		STSt		
																					IV	✓			
																					V				
139526	53		M	40-50	Ø/S	M	✓		R	blue	?				86	✓		IV V	III	2/3	I			1	
																					II				
12-5-34																					III				
																					IV	✓			
																					V				
129475	53		M	30-40	+/S	M	✓		B	blue	+/+				84	✓		III	III		I			3	
															85		✓	III V	V	3/3	II		fusion		
26-4-35																					III	M ✓			
																					IV				
																					V	M ✓			
124155	51		M	40-50	?	M	✓		R	hazel	?				84	✓		✓	VI	2/2	I			3	
															84				V		II		fusion		
9-11-36																					III				
																					IV				
																					V				

Hosp. # D.O.B.	Age	Name/ Occup.	Manual/ Non Man	Decade of Onset	Family History	M/F	Handedness R	L	RLB	Eye Colour	PL	Diabetes	Epilepsy Alcohol	Yr. of Op.	Hand R	L	Ray	Group of Oper.	Hand Status	Involved Rays R	L	Comments	Yrs ?	Abductor/Swan Digit/Neck
117653 24.11.35	51		M	?	Ø/S	M	✓		B	Hazel	+/-	✓		83	✓		IV	III	V1	I II III IV V	✓ ✓		4	
118457 20.3.32	52		nM	40-50	+/S	F	✓		B	Hazel	+/+			84	✓		III, IV V	III	3/1	I II III IV V	✓		3	
112996 7.8.24	63		nM	30-40	Ø/S	M	✓		B	Hazel	+/+	✓		83 83	✓	✓	IV V V	III III	3/3	I II III IV V	✓		4	
112013 25.8.33	54		hm M	?	Ø/S	M	✓		B	Blue	?		✓	83	✓		III	III	3/1	I II III IV V	✓		4	✓
109338 15.4.14	73		nM	?	Ø/S	M	✓		B	Hazel	+/+	✓		81		✓	V	III	3/3	II IV	✓		6	
110785 26.1.22	65		M	?	Ø/S	M	✓		B	Blue	?			82		✓	IV V	III	V1	III V	✓ ✓		5	✓ ✓
103783 19.10.05	82		M	?	Ø/S	M	✓		B	Blue	-/+			81	✓		V	III	V1	I IV	✓ ✓		6	
95988 15.2.23	64		M	30-40	Ø/C	M	✓		B	Blue	+/+			80 86 79 83	✓ ✓	✓ ✓	palm palm V IV	I III III II	3/3	I II III IV PIP	✓ ✓ ✓	amp dermofasc.	8	

Hosp. # D.O.B.	Age	Name/ Occup.	Manual/ Non Man	Decade of Onset	Family History	M/F	Handedness R	L	RLB	Eye Colour	PL	Diabetes Alcohol	Epilepsy	Yr. of Op.	Hand R	L	Ray	Group of Oper.	Hand Status	Involved Rays R	L	Comments	Yrs ?	Abductor/Swan Digit/Neck
120990	44		M	30-40	Ø/S	M	✓		B	blue	-/+	✓	✓	83	✓		V	VI	2/1				4	
														84		✓	✓	III						
8.10.43																								
																				19				
																					✓			
108716	50		M	40-50	Ø/S	M	✓		B	blue	+/+			83		✓	V	II	3/1			dermatofibr.	+	
														84		✓	V	II						
29.4.37																				✓	✓			
																				✓				
																					✓			
109609	65		M	>50	Ø/S	M	✓		B	blue	-/-			82		✓	IV V	VI	3/1				5	
27.9.22																				✓				
																				✓	✓			
																					✓			
108496	77		M	40-50	Ø/S	M	✓		B	blue	+/+			81	✓		V	III	1/2		✓		6	
														81		✓	V IV	VI						
17.6.10																								
																					✓			
																				✓				
93190	50		M	40-50	Ø/S	M	✓		B	hazel	-/-			79	✓		V	I	2/3		✓		8	
"														80		✓	IV	I			✓			
7.1.27																								
																				✓	✓			
130710	49		M	40-50	?/S	M	✓		B	blue	?			85	✓		IV V	II	1/3		✓		2	
"																					✓			
4.2.38																				✓	✓			
"																				✓	✓			
"																				✓	✓			
114396			M	40-50	✓/S	M	✓		B	hazel	+/+			82		✓	V	III	2/3	✓		Fl. distal Clin...	5	
"														83	✓		IV V	III, VI				amp V		
"																								
"																				✓				
"																					✓			
129956			M	40-50	✓/S	M	✓		B	hazel	?			85	✓		IV	I	2/2				2	
"																								
"																								
"																				✓	✓			
"																					✓			

Hosp. & D.O.B.	Age	Name/ Occup.	Manual/ Non Man.	Decade of Onset	Family History	M/F	Handedness R	L	RLB	Eye Colour	PL	Diabetes	Epilepsy Alcohol	Yr. of Op.	Hand R	L	Ray	Group of Oper.	Hand Status	Involved Rays R	L	Comments	Yrs ?	Abductor/Swan Digit/Neck
130598	70		M	>50	Ø/5	M	✓		B	bl	-/-			85	✓		V	I	3/1	I	✓		2	
23.9.12																				II	✓			
																				III				
																				IV	✓			
																				V	✓			
93812	61		M	>50	+/5	M	✓		B	bl	+/+	✓		78		✓	IV	VII	3/2	I			9	
10.1.26														82		✓	III IV V	I		II				
														83	✓		V	III		III	✓			
														85		✓	V	II		IV	✓			
														86	✓		V	I		V	✓			
93067	57		M	>50	Ø/5	M	✓		B	bl	?	✓		79	✓		palm	III	1/1	I	✓		8	
18.9.30														79		✓	P IV V	I		II	✓			
																				III	✓			
																				IV	✓			
																				V	✓			
67598	?		M	?	Ø/5	M	✓		B	bl	+/+			74	✓		III, IV V	II	1/3	I			13	
?														80	✓		P III IV	II, I		II	✓			
														81		✓	P V	I		III	✓			
														85		✓	III IV	III		IV	✓			
																				V	✓			
113468	57		?	>50	+/5	M	✓		B	hz	-/+		✓	83	✓		V	VII	3/1	I			4	
29.1.30																				II				
																				III	✓			
																				IV	✓			
																				V	✓			
126108	49		?	?	Ø/5	M	✓		B	blue	?			86	✓		V	III	3/3	I			1	
5.3.38																				II				
																				III				
																				IV	✓			
																				V				
127346	56		?	>50	+/5	M	✓		B	bl	?			83	✓		IV		3/3	I		FTSk	4	
5.12.31														83		✓	III, IV V			II				
																				III	✓			
																				IV	✓			
																				V	✓			
44171	61		M	20-30	Ø/5	M	✓		B	bl	-/-			71	✓		IV V	VI	1/1	I	✓		17	
9.11.26														72	✓		V	VII		II				
														74 76/76	✓	✓	III	III I, VII		III		a Px		
														70		✓	IV V	I		IV	✓			
														72		✓	IV, V	I		V	✓			
														73		✓	IV, V	II						
														74		✓	I, V	I						
														83		✓	V	III				arthrodesis		
														86		✓	IV V	VI						

Hosp. # D.O.B.	Age	Name/ Occup.	Manual/ Non Man.	Decade of Onset	Family History	M/F	Handedness R	L	RLB	Eye Colour		PL	Diabetes	Alcohol	Epilepsy	Yr. of Op.	Hand R	L	Ray	Group of Oper.	Hand Status	Involved Rays R	L	Comments	Yrs ?	Abductor/Swan Digit/Neck
121963	72		nM	>50	+/S	M	✓			B	bl	+/+				83	✓		III IV V	III, V	3/3	I			4	
																84	✓		V	V		II		arthrodesis		
24.11.15																						III				
																						IV	✓			
																						V				
122751	58		nM	?	+/S	F	✓			R	hz	?				84	✓		V	III	1/3	I			3	
																						II	✓			
8/12/29																						III	✓			
																						IV	✓			
																						V	✓			
122018	57		M	30-40	?/S	M	✓			B	bl	+/-				85		✓	I II	III	3/1	I	✓	FTSG	2	
																						II	✓			
31.12.30																						III	✓			
																						IV	✓			
																						V	✓			
119704	62		M	40-50	+/S	M	✓			B	bl	+/-				83		✓	IV V	III	1/1	I			4	
																						II	✓			
9.2.25																						III	✓			
																						IV	✓			
																						V	✓			
119835	65		nM	?	+/S	F	✓			B	?	?	✓			83	✓		V	I	1/3	I			4	
																86	✓		V	III		II	✓			
6.9.22																						III	✓			
																						IV	✓			
																						V	✓			
130201	41		?	?	+/S	M	✓			B	bl	+/+		✓		85	✓		V	III	3/1	I			2	
																						II				
10.2.46																						III				
																						IV				
																						V	✓			
118535	46		nM	?	?	M	✓			R	bl	?				83	✓		IV	III	3/3	I			4	
																						II				
9.6.41																						III				
																						IV				
																						V				
121695	51			?	?/S	M	✓			B	hz	+/+				85	✓		II	III	3/2	I			2	
																88		✓	V	I		II				
3.12.36																						III				
																						IV				
																						V	✓			

Hosp. # D.O.B.	Age	Name/ Occup.	Manual/ Non Man	Decade of Onset	Family History	M/F	Handedness R	L	RLB	Eye Colour	PL	Diabetes	Epilepsy Alcohol	Yr. of Op.	Hand R	L	Ray	Group of Oper.	Hand Status	Involved Rays R	L	Comments	Yrs ?	Abductor/Swan Digit/Neck
58860	80		M	>50	ø/S	M	✓		B	bl	-/-			73	✓		III IV	I	1/1	I			14	✓ ✓
														74		✓	IV P	VII		II	✓			
24.10.07																				III	✓			
																				IV	✓			
																				V	✓			
134686	60		M	>50	ø/S	M	✓		L	bl	?			86		✓	III IV	III	2/2	I			1	
																				II				
7.8.27																				III				
																				IV				
																				V				
132451	63		M	>50	+/S	F	R		B	br	?			85	✓		IV	I	3/3	I			1	
																				II				
28.7.24																				III				
																				IV	✓			
																				✓				
62697	38		?	20	ø/S	M	R		B	br	+/+			74		✓	IV V	I	1/1	I			13	
																				II				
23.1.49																				III				
																				IV	✓			
																				V				
67298	77		?	40-50	ø/S	M	R		B	br	+/+			75	✓		IV	I	1/1	I	✓	cx R IV	12	
																				II	✓	prev. surg	62	
10.11.10																				III	✓			
																				IV	✓			
																				V	✓			
66822	66		M	>50	+/S	F	R		B	bl	+/+			75		✓	V	I	1/1	I	✓		12	✓
																				II	✓			
20.10.21														79	✓		II III IV	I		III	✓			
																				IV	✓			
																				V	✓			
63765	74		M	20	ø/S	M	R		B	br	-/-			74	✓		IV V	I	1/1	I	✓	amp R fing 8	13	
																				II	✓			
11.2.13														79	✓		IV	I		III				
																				IV	✓			
																				V	✓			
66279	55			30-40	ø/S	M	R		B	bl	+/+			73	✓			I	1/3				14	✓
														74	✓		ph	II						
2.8.32														75	✓			II						
														76	✓		ph	II						
														77		✓	ph	II						
														83		✓		II						
														85		✓		III						
														85		✓		III						
														85		✓	II	III						

Hosp. # D.o.B.	Age	Name/ Occup.	Manual/ Non Man.	Decade of Onset	Family History	M/F	Handedness R	L	RLB	Eye Colour	FL	Diabetes	Epilepsy Alcohol	Yr. of Op.	Hand R	L	Ray	Group of Oper.	Hand Status	Involved Rays R	L	Comments	Yrs ?	Abductor/Sman Digit/Neck
139665	61		M	>50	0/5	M	✓		B	bl	+/+			86		✓	III	III	1/2	I			1	
"																				II				
"																				III	✓			
17.11.23																				(IV)	✓			
"																				V	✓			
"																								
120485	42		nM	20-30	+/5	M	✓		B	hz	-/-			84	✓		V	VI	3/3	I	✓		3	
"														85	✓		III II	VI		II	✓			
19.9.45														84		✓	IV	VII		(III)	✓			
"														86		✓	II III	VI		(IV)	✓			
"																				(V)	✓			
117864	66		M	?	0/3	M		✓	B	bl	-/-			83				VII	1/3	I			4	✓
"														83				VI		(II)				
10.9.21														85	✓		II III V	VI		(III)				
"																				(IV)	✓			
"																				(V)	✓			
119747	49		?	?	0/5	M	✓		B	br	+/+		✓	83		✓	V	VII	2/2	I			4	
"																				II				
19.6.38																				III				
"																				(IV)				
"																				V	✓			
117660	59		M	?	0/5	M	✓		B	bl	?			83	✓		IV V	III	V1	I			4	✓
"																				II				
10/5/98																				III				
"																				(IV)				
"																				V	✓			
112054	?		d M	?	0/5	M	✓		L	bl	-/+			83		✓	V	VII	2/1	I			4	✓
"														84	✓		V	VII		II				
"																				III				
"																				IV				
"																				(V)	✓			
105663	58		M	40-50	?/5	M	✓		B	bl	+/+			80		✓	IV V	VII	3/1	I			2	
"														81		✓	A.L.	VII		II				
14.7.29														85		✓	V	VII		III	✓			
"														86		✓	V	VII		(IV)	✓			
"																				V	✓			
102156	58		M	>50	+/5	M	✓		B	br	?			84		✓	III	III	3/3	I	✓		3	
"																				II				
30.6.29																				(III)	✓			
																				(IV)	✓			
																				(V)				

Hosp. # D.o.B.	Age	Name/ Occup.	Manual/ Non Man.	Decade of Onset	Family History	M/F	Handedness R	L	RLB	Eye Colour	PL	Diabetes Alcohol	Epilepsy	Yr. of Op.	Hand R	L	Ray	Group of Oper.	Hand Status	Involved Rays R	L	Comments	Yrs ?	Abductor/Swan Digit/Neck
96572	74		nM	>50	✓/S	M	✓		B	blue	?			79	✓		II, I	I	3/3	I		FTSC	8	
																				(I)				
20.6.13																				(III)	✓			
																				(IV)	✓			
																				(V)	✓			
132264	62		M	40-50	?/S	M	✓		B	?	+/+			86	✓		II	I	3/1	I			1	
																				II				
5.3.25																				III				
																				(IV)	✓			
																				(V)	✓			
60591	73		M	?	ø/S	M	✓		B	blue	+/+			84	✓		I	III	2/3	I			3	
																				II				
16.7.14																				(III)				
																				IV	✓			
																				(V)				
131520	77		M	>50	+/S	M	✓		B	brown	?			85	✓		V	III, V	1/3	I			2	
																				II				
7.3.10																				III				
																				IV	✓			
																				(V)				
153357	70		M	40-50	ø/S	M	✓		B	?	+/+			85	✓		III, IV, V	III, V	1/3	(I)	✓		2	
														86		✓	III, IV, V	II		II				
14.12.17																				(III)	✓			
																				(IV)	✓			
																				(V)	✓			
129762	60		M	?	+/S	M	✓		B	?	-/-			85		✓	IV, V	III	3/2	I			2	
																				II				
7.2.27																				III				
																				(IV)	✓			
																				(V)	✓			
118909	64		nM	?	?/S	F	✓		B	b	-/+			83	✓		IV, V	III	2/2				2	
16.7.13																								
																				(IV)	✓			
																				(V)	✓			
-	66		M	?	?	M	✓		B	?	?			77	✓		I, IV, V	I	1/1	(I)			10	
														79	✓		V	I		II				
9.10.21														81	✓		V	III		III	✓			
														84		✓	IV, V	III		(IV)	✓			
																				(V)	✓			

Hosp. # D.O.B.	Age	Name/ Occup.	Manual/ Non Man	Decade of Onset	Family History	M/F	Handedness R	L	RLB	Eye Colour	PL	Diabetes Alcohol	Epilepsy	Yr. of Op.	Hand R	L	Ray	Group of Oper.	Hand Status	Involved Rays R	L	Comments	Yrs ?	Abductor/Swan Digit/Neck
123501	53		M	40-50	?/5	M	✓		B	br	+/-	✓		84	✓		IV	I	2/2	I			3	
														94		✓	III	I		II				
																				III	✓			
																				IV	✓			
																				V				
128064	64		M	>50	+/5	M	✓		B	bl	+/-	✓		84		✓	IV V	III	3/1	I	✓		3	
																				II				
7-4-23																				III	✓			
																				IV	✓			
																				V	✓			
105088	65		M	>50	?/5	M	✓		B	bl	?			82	✓		V	I	V/3	I			5	
																				II				
16.7.22																				III	✓			
																				IV	✓			
																				V	✓			
131035	53		M	40-50	?/5	M	✓		B	br	?			85		✓	III	III	2/2	I			2	
																				II				
3-5-34																				III	✓			
																				IV				
																				V				
134357	42		I	30-40	?/5	M	✓		R	bl	?			86	✓		V	VI	3/2	I		3-4f	1	
																				II				
3-4-45																				III				
																				IV				
																				V				
135602	66		I	30-40	+/5	M	✓		B	bl	?	✓ ✓		86		✓	I,III V	III	3/1	I	✓		1	
																				II				
5-1-19																				III	✓			
																				IV	✓			
																				V	✓			
"	59		M	30-40	?	M	?		B	?	?	✓		83	✓		IV V	III	3/3				4	
1-6-34																								
																				IV	✓			
																				V	–			

Hosp. # D.o.B.	Age	Name/ Occup.	Manual/ Non Man	Decade of Onset	Family History	M/F	Handedness R	L	RLB	Eye Colour	PL	Diabetes	Epilepsy Alcohol	Yr. of Op.	Hand R	L	Ray	Group of Oper.	Hand Status	Involved Rays R	L	Comments	Yrs ?	Abductor/Swan Digit/Neck
43 229	63		nM	40-50	+/S	M	✓		B	br	+/+			70	✓		I, II	I	V1	(I)	✓		17	✓
"														73	✓		II	I		(II)	✓			
5/10 20														75	✓		I, II	II		III	✓			
"														75		✓		II		(IV)	✓			
"														77		✓	II	II		(V)	✓			
"														83	✓		II	II, II						
54600	61		M	?	Ø/S	M	✓		B	bl	?			76		✓	II	VII	3/1	I			11	✓
"														80		✓	II	VII		II				
21.12.26																				III	✓			
"																				IV	✓			
"																				(V)	✓			
113201	65		y nM	30-40	+/S	M	✓		B	br	?			83	✓		IV	III	V1				4	
"														85		✓	IV V	III						
10.1.22																								
"																				(IV)	✓			
"																				(V)	✓			
122422	53		M	40-50	Ø/S	M	✓		B	?	?	✓		84		✓	IV V	III	3/3	I			3	
"																				II	✓			
28.11.34																				III				
"																				(IV)	✓			
"																				V	✓			
120663	43		el M	30-40	+/S	M	?		B	?	?	✓		85		✓	palm	III	3/3	I			2	
"																				II				
26.7.44																				III				
"																				(IV)	✓			
"																				(V)	✓			
113202	65		M	>50	?/S	M	R		?	?	?	✓		83		✓	palm V	III	V1	I			4	
"																				II				
16.12.22																				III				
"																				IV				
"																				V	✓			
166504	58		M	40-50	?	M	R		B	?	?			83	✓		P III V	VII	V1	I			4	
"																				II				
25.5.29																				(III)				
"																				(IV)				
"																				(V)	✓			
118 2??	48		M	30-40	?	M	R		B	?	?			84		✓	II	III	3/3	I			3	
"																				II				
10.6.39																				III				
																				(IV)				
																				(V)	✓			

Hosp. # D.O.B.	Age	Name/ Occup.	Manual/ Non Man.	Decade of Onset	Family History	M/F	Handedness R	L	RLB	Eye Colour	PL	Diabetes	Epilepsy Alcohol	Yr. of Op.	Hand R	L	Ray	Group of Oper.	Hand Status	Involved Rays R	L	Comments	Yrs ?	Abductor/Swan Digit/Neck
36666	57		M	30-40	+/S	M	✓		B	bl	-/-			69	✓		IV	I	1/1	I		STG	17	
														69	✓		RII	I		(II)	✓			
8.9.30														78	✓		IV V	I		(III)	✓			
														69		✓	LV	I		(IV)				
														76		✓	V	II		(V)	✓			
72016	64		M	>50	Ø/S	M	✓		B	hz	+/+	✓		75		✓	IV	II	1/1	I		SSG	12	
														81	✓		V	II		(II)	✓			
15.7.23																				(III)	✓			
																				(IV)	✓			
																				(V)	✓			
52875	45		M	20-30	Ø/S	M	✓		B	hz	+/+		✓	72	✓		I,II V	I	V/3	(I)			15	
														74		✓	III IV	I		(II)				
26.3.42														76	✓		V	I		IV	✓			
														77		✓	V	I		IV	✓			
																				(V)	✓			
44274	46			30-40	Ø/S	M	✓	✓	B	bl	+/+			70	✓		V	I	1/1	(I)			17	
														72	✓			III		II	✓	amp		
30.5.31														74	✓		IV,V	I		(III)	✓			
														76		✓	V	III		(IV)	✓			
														86	✓		III	III		(V)	✓			
														71		✓	V	III						
														86		✓	II	III						
027637	72			30-40	+/S	M	✓		B	bl	-/-			68 72	✓		palm	I I	1/1	(I)	✓		19	
														68		✓	III	II		(II)	✓			
3/5/15														78		✓		I		(III)	✓			
														80		✓		I		(IV)	✓			
														83		✓	I	I		(V)	✓			
														84		✓	II	VI						
109608	51		M	>50	Ø/S	M	✓		B	br	-/-			83		✓	IV V	III	1/1	I			4	
														84	✓		III	III		(II)	✓			
1.8.34																				II				
																				(IV)				
																				(V)	✓			
68526	67			>50	Ø/S	M	R		B	bl	+/-			78	✓		V	II	1/1	I			9	
														79	✓		V	VII		(II)		amp		
20.9.20														81		✓	II,V	VII		III				
																				(IV)	✓			
																				(V)	✓			
65392	65		?	40-50	Ø/S	M	R		B	hz	?			84	✓		P	III	2/2	I			3	
26.7.22														85		✓	P	III		(II)	✓			
																				(III)	✓			
																				IV	✓			
																				V	✓			

Hosp. # D.o.B.	Age	Name/ Occup.	Manual/ Non Man.	Decade of Onset	Family History	M/F	Handedness R	L	RLB	Eye Colour	PL	Diabetes	Epilepsy Alcohol	Yr. of Op.	Hand R	Hand L	Ray	Group of Oper.	Hand Status	Involved Rays R	Involved Rays L	Comments	Yrs ?	Abductor/Sman Digit/Neck
111879	64		M	>50	?/5	M	✓		B	?	?			82	✓		III IV V	I	3/3				5	
12.12.23																				II				
																				III	✓			
																				V	✓			
107925	59		M	40-50	?/5	M	✓		L	?	?			81		✓	III IV	III	3/3	I	✓		6	
29.5.28																				II	✓			
																				III	✓			
																				IV	✓			
																				V	✓			
124715	46		M	30-40	+/5	M	✓		L	bl	?			85		✓	V	VII	2/3	I		7 prev ops	2	
14.10.41																				II				
																				III	✓			
																				IV				
																				V	✓			
403243	32		M	20-30	0/5	M	L		L	?	?			80		−	V	VII	3/1	I			7	
3.6.55														82		−	I	II, III		II				
																				III				
																				IV				
																				V	✓			
132254	54		M	>50	?	M	L		R	?	?			85	✓		III IV	VII	3/3	I			2	
25.7.33																				II				
																				✓				
																				✓				
																				V				
116652	55		M	>50	?	M	R		B	?	?			83	✓		IV	VII	3/3	I			4	
27.5.32																				II	✓			
																				III				
																				✓				
																				V				

Appendix 4

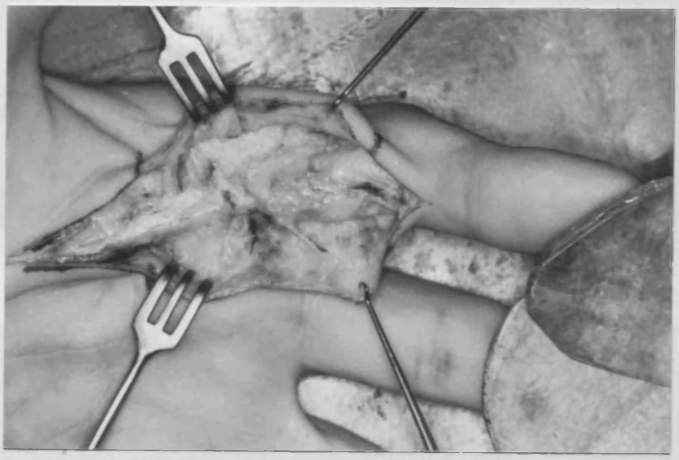
Case Histories.

Case 1 (a to g)

a

Contracture of index finger. (Traumatic amputation of little finger)

b



Longitudinal fasciectomy as advised by Hueston.

c

Fascia removed including transverse fibres down to lumbrical muscle.

d

Closure with z-plasties.

Case 1 (a to g)

e

e,f) Result after 18 years. Slight recurrence and marked progression of disease to thumb and ring finger.
[One more fasciectomy has been performed on index and ring fingers].

f

g

Right hand has severely contracted digits 12 years after fasciectomy.

a

b

c

d

Case 2 (a - g) <u>Techniques of operation</u>

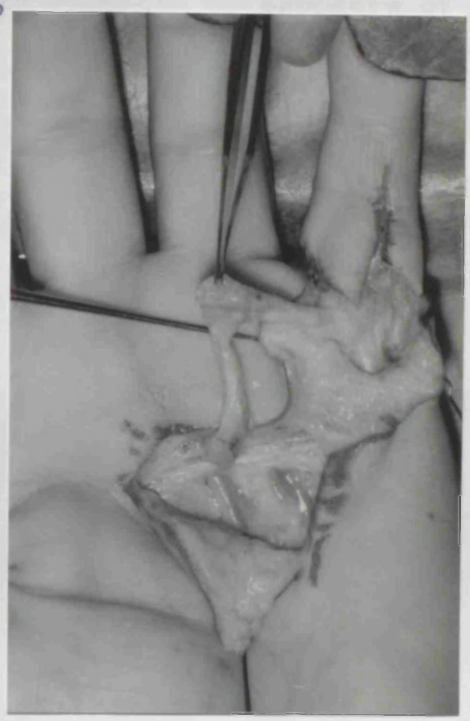
Severe contracture treated by palmar fasciotomy (and limited excision of longitudinal bands), digital fasciotomy and split skin grafts and post-operative night splintage for 6 months. This procedure was planned as a preliminary to fasciectomy.

e

f

g

Case 2 e) Early post-operative result with good correction. f, g) 3 years later, some progression of Dupuytren's disease in first web and index with recurrent contractures of ring and little fingers. No further surgery performed to date.

a  b 

Case 3 <u>Techniques of operation</u>

Limited excision of longitudinal bands.
(Modified Skoog operation).

a) Palmar incision according to Skoog.
b) Longitudinal bands to ring and little fingers excised (shown with proximal ends retracted). Transverse fibres of palmar fascia preserved.

a

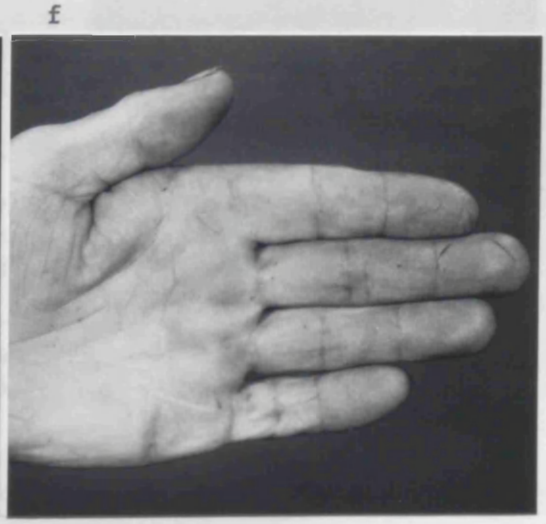
b

c

d

e

f

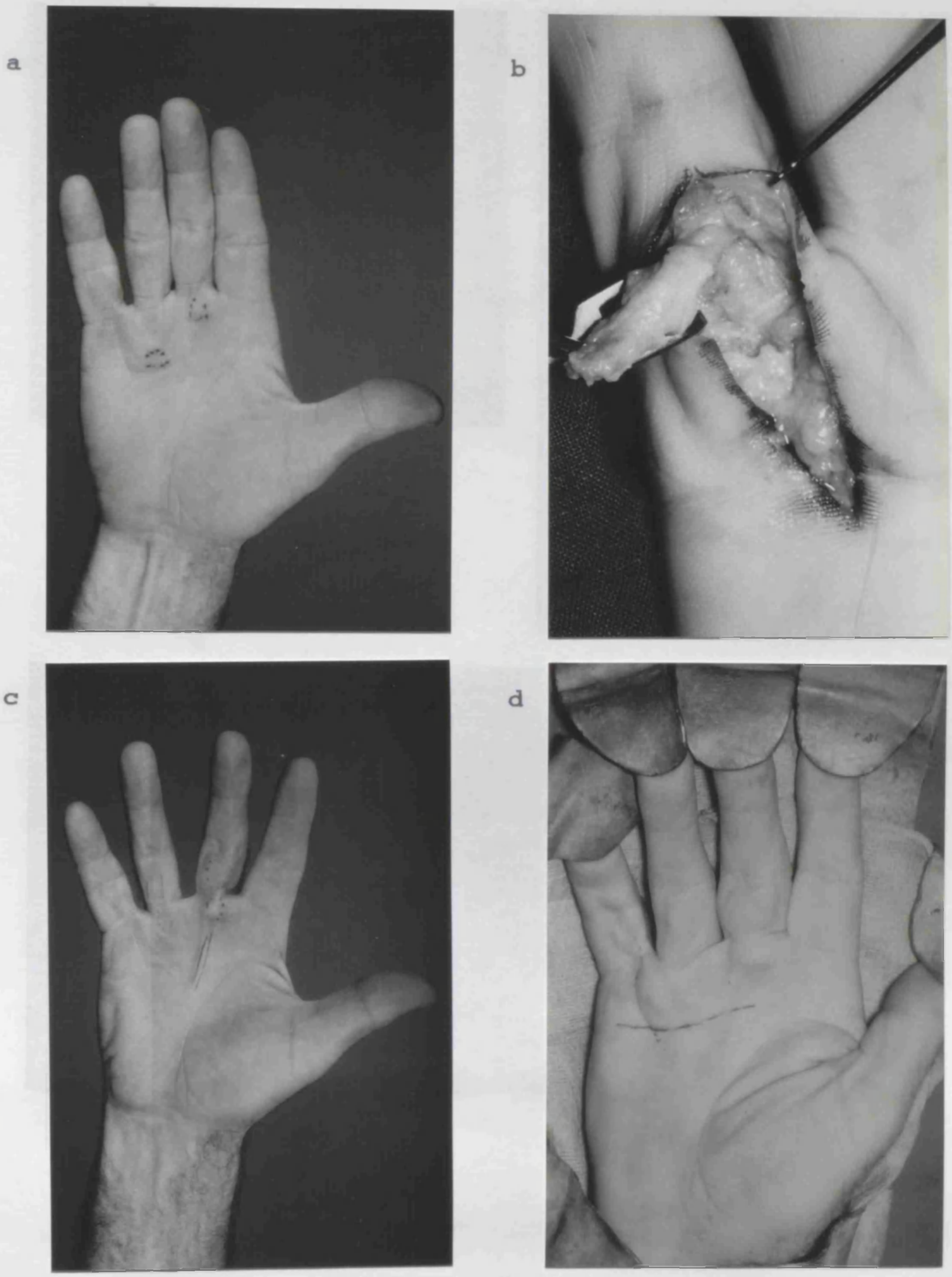


Case 4

<u>Techniques of operation</u>

Skoog's operation.

a) Incisions
b) Exposure of contracted longitudinal cords.
c) Traction on the longitudinal cord shows how the contracture develops.
d) Limited excision of longitudinal cords.
e) Result at 2 years.
f) There has been a slow progression of pip contracture in the little finger. (This area has not been operated upon).



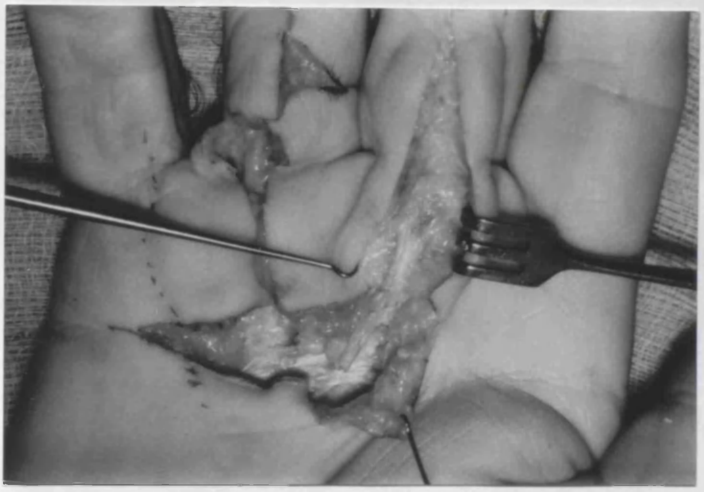
Case 5 (a - g) <u>Techniques of operation</u>

a) Early Dupuytren's disease treated by b) limited excision of longitudinal cord at palmo-digital junction of little finger. The recovery time from this minimal operation was short. c) Progression of changes in middle finger allowed the opportunity to re-explore the palm (d)

e

f

g



Case 5 e) The transverse fibres, preserved at the previous operation, remained intact and there was no recurrence of the longitudinal cord. (See operation notes). f, g) A longitudinal dissection of the middle and ring fingers was performed according to Skoog.

a

Case 6

Details of dissection

Limited longitudinal dissection of R middle finger. Longitudinal incision over longitudinal cord.

b

Fascial cord dissected from proximal end preserving transverse fibres intact.

c

Ulnar neurovascular bundle exposed.

d

Radial neurovascular bundle protected - seen to be displaced towards midline of digit.

a

Case 7

Details of Dissection

Neurovascular bundle displacement. Contracted cord of a little finger.

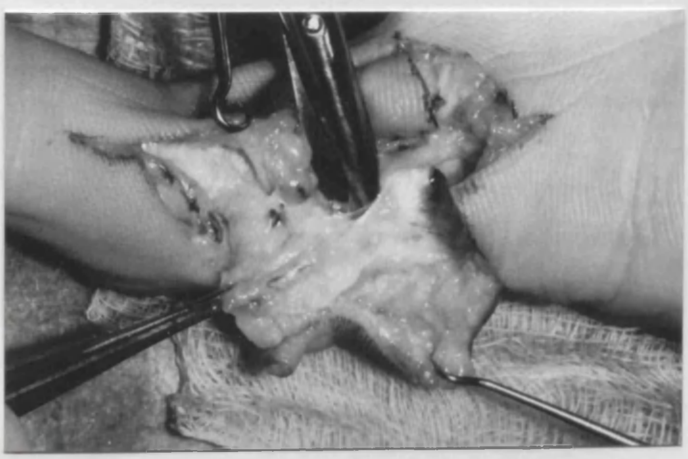
b

Ulnar digital nerve (marked by ink spots) seen to spiral around the cord.

c

Cord divided proximally and reflected.

d



Further contracted tissue. Apparently abductor band, Cleland's and check rein ligaments.

a

Case 8

Details of dissection

Skin involvement. Little finger contracture due to a contracted lateral digital sheet.

b

Involved skin (ink spots) sharply dissected off cord.

c

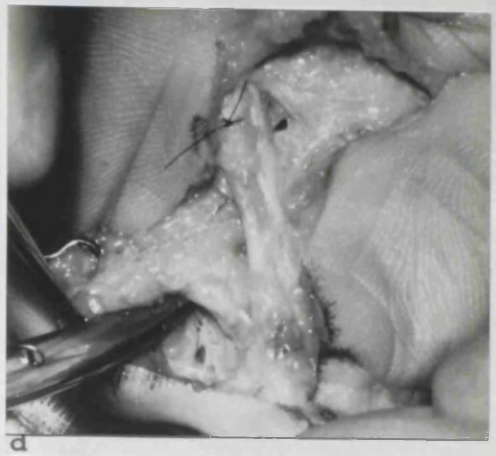
Neurovascular bundle spiralling around cord.

d

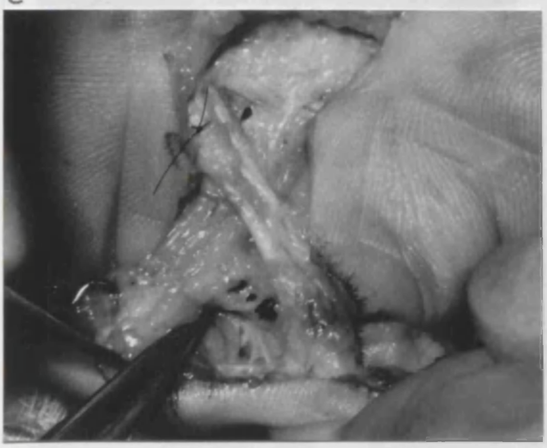
Cord isolated prior to excision.

a

b



c



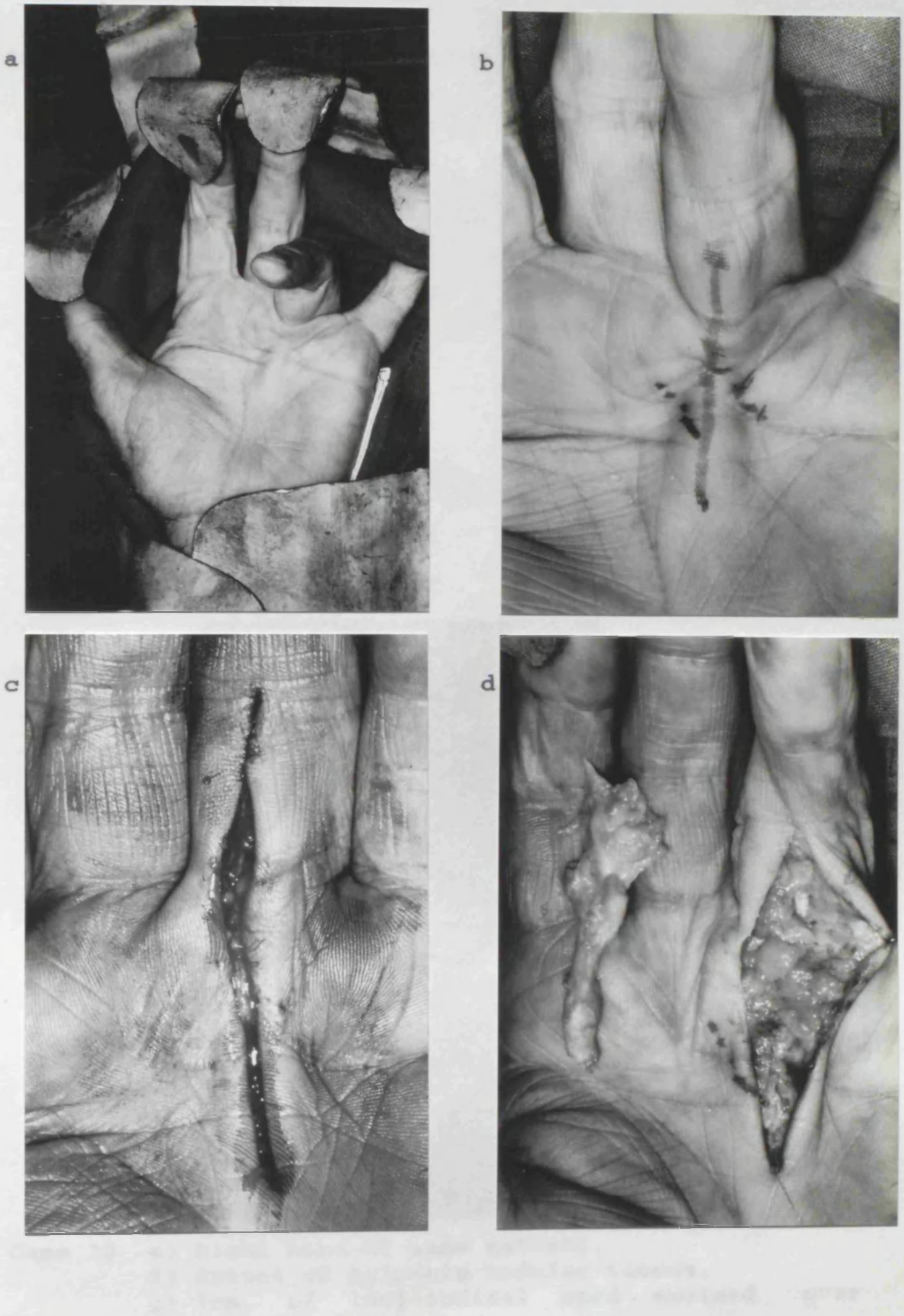
d

e

f

Case 9 <u>Details of dissection</u>

a) Longitudinal pretendinous cord of little finger.
b) Abductor cord.
c) Nerve retracted showing fascia arising from abductor digit minimi muscle.
d) Pretendinous cord giving rise to spiral cord of Gosset.
e) Abductor cord.
f) Edge of extensor apparatus seen in depths of wound.



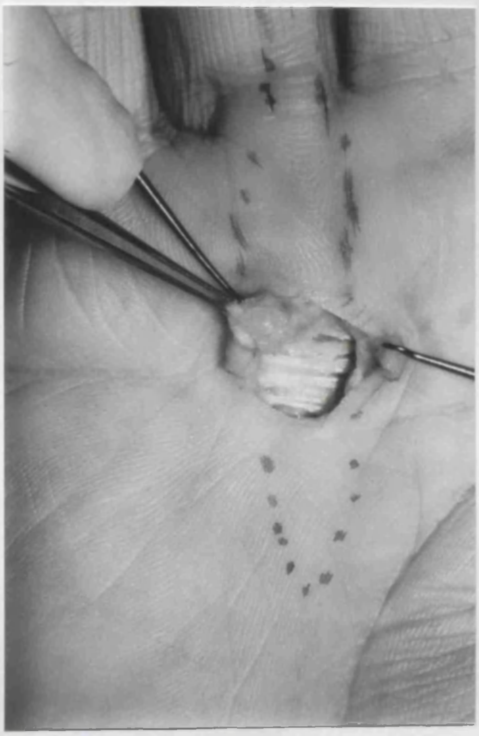
Case 10 (a - g) <u>Amount of tissue excised</u>

Comparison of longitudinal dissection and minimal release by limited excision, a, b, c, d.
Longitudinal dissection of cord from mid palm to base of middle phalanx of left hand.

e

f

g



Case 10 e) Right hand of same patient.
f) Extent of palpable nodular tissue.
g) 1cm of longitudinal cord excised over transverse fibres.

A full release was obtained in both hands (operation 1987). There was less oedema and stiffness in the right hand. The long term result will be kept under review.

Case 11

Amount of
tissue removed.

a

Gonzales
operation

Contracture of both ip joints. (Previous fasciectomy).

b

Release by transverse division, leaving intact bridge of tissue over pip joint. No fascia excised. Full thickness grafts were applied.

a

b

c

d

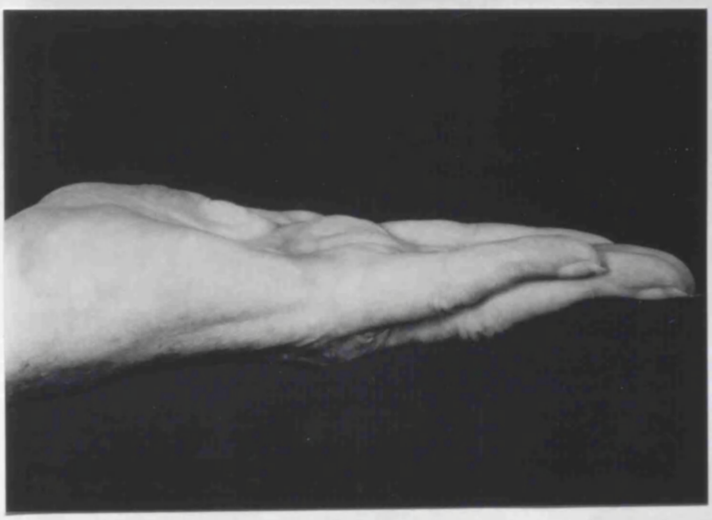
Case 12 <u>Amount of tissue removed.</u>

Release by minimal excision.

a) Widespread contractures of all digits at mp and pip level.
b) Release at multiple sites by removal of 1cm of contracted fascia at each site.
c) Amount removed.
d) Open digit treatment. The author has recently adopted this management in selected cases. The results are being assessed.

Case 13

Pre-operative flexion



Release six months after operation. (Patient wore night splint diligently).

a

b

c

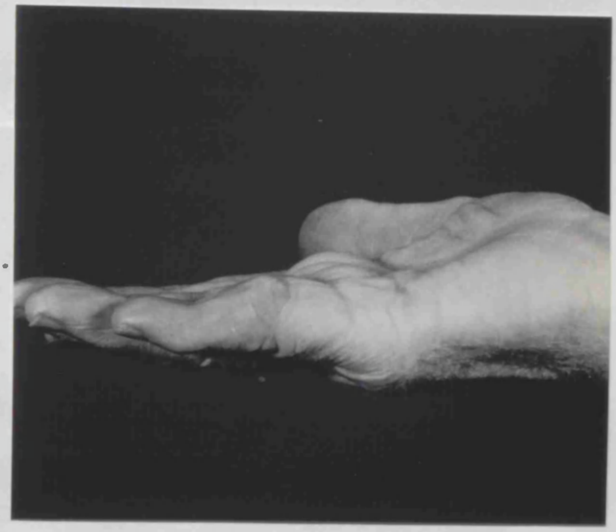
d

Case 14 <u>Pip joint contractures</u>

a) Limited excision of fascia failed to adequately relieve the contracture.
b) Check rein ligament release. Loose fascial tissue at the proximal edge of the volar plate divided.
c) Tightening of the extensor middle slip by plication.
d) Correction achieved.

Case 15 Pip joint contracture

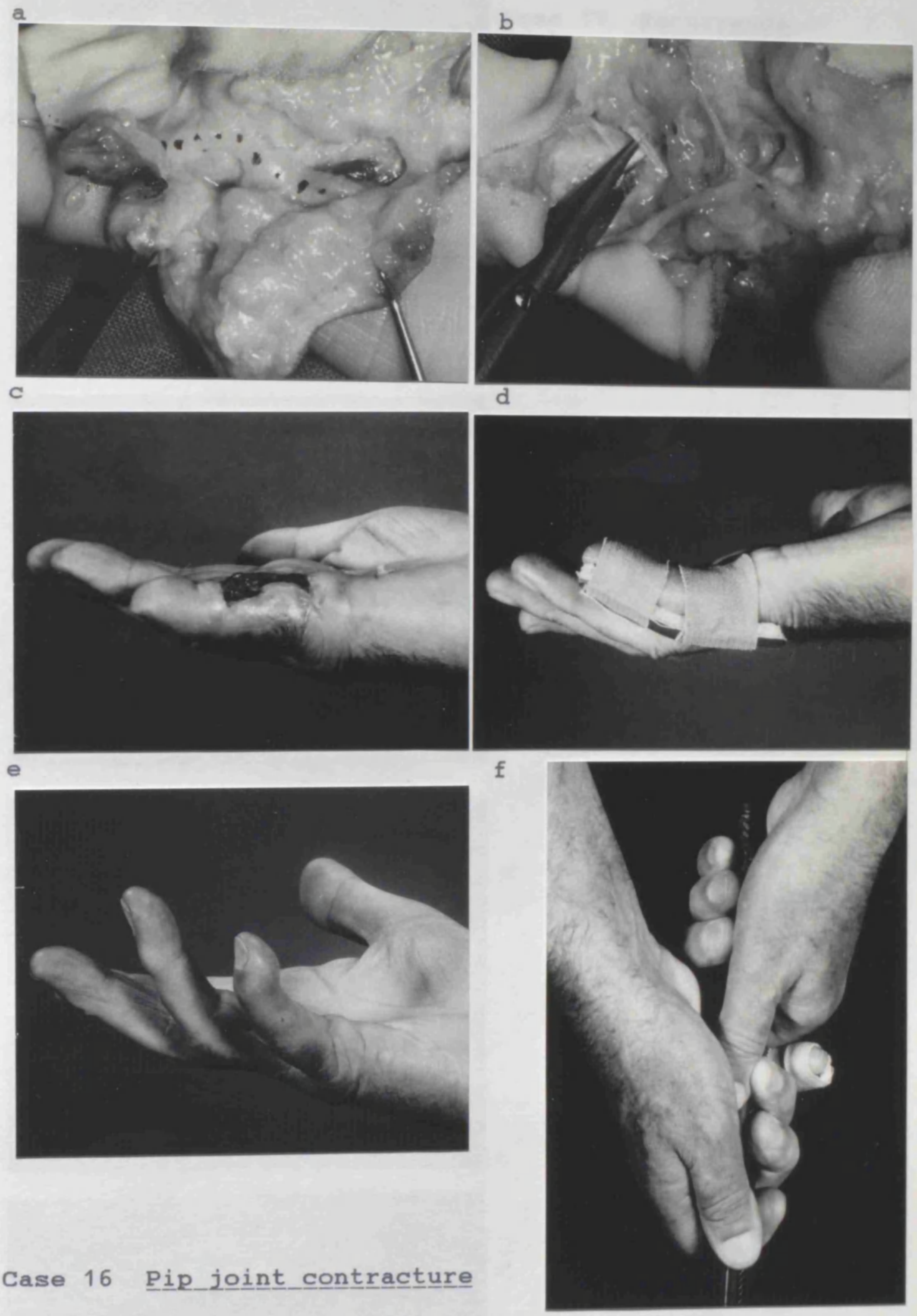
a



Contracted digit treated by fasciectomy, check rein ligament release, and skin grafting resulting in slight pip hyperextension.

b

Pip flexion considerably limited in spite of vigorous therapy. Flexion presumably limited by the stiffness of the scarred tissues around the joint.



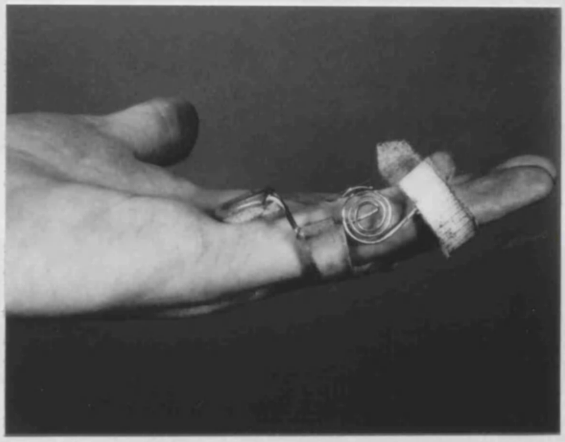
Case 16 <u>Pip joint contracture</u>

a) Contracture of little finger.
b) Check rein ligament released.
c) Post-operative cellulitis and skin necrosis.
d) Secondary pip arthrodesis performed.
e) f) Late result showing arthrodesis in a functional position.

Case 17 Recurrence

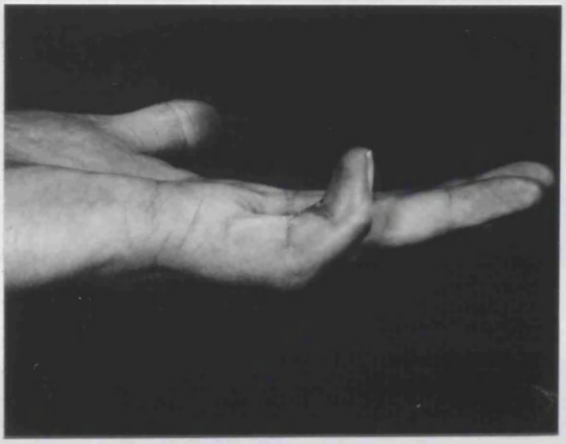
a

Lumpy skin scar following Dupuytren's release by Fasciectomy.



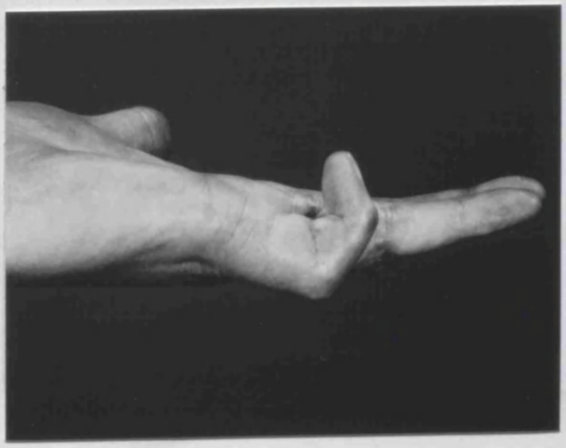
b

Full extension achieved by Capener splint.



c

Recurrence of contracture 2 years after fasciectomy.

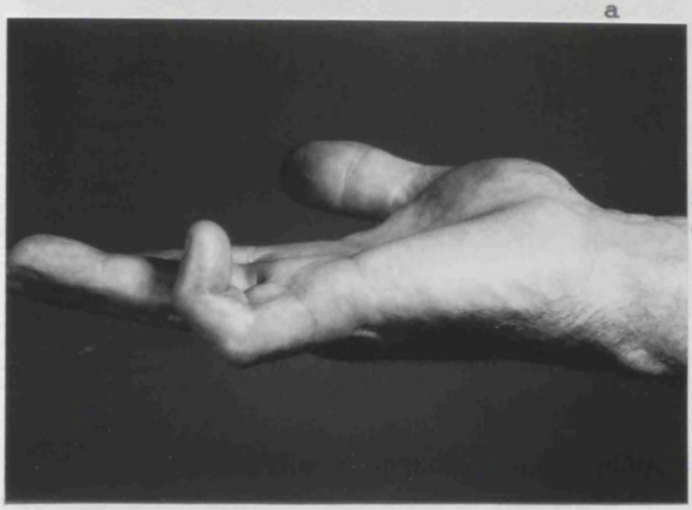


d

Relentless progression of contracture of both ip joints into "intrinsic minus" position.

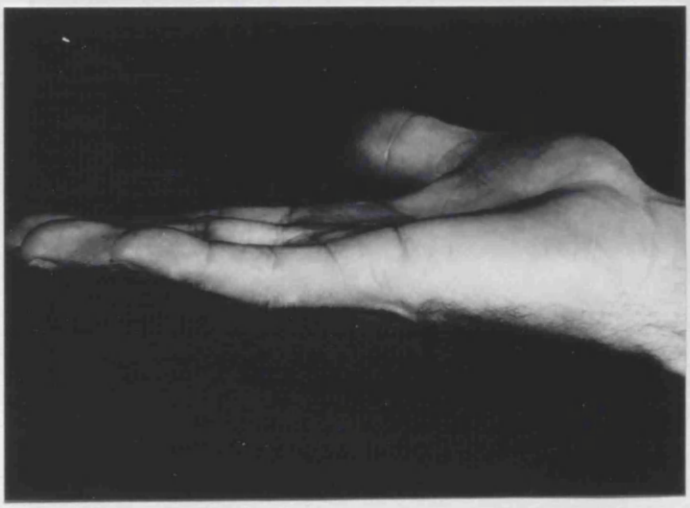
Case 18 <u>Recurrence of contracture</u>

a



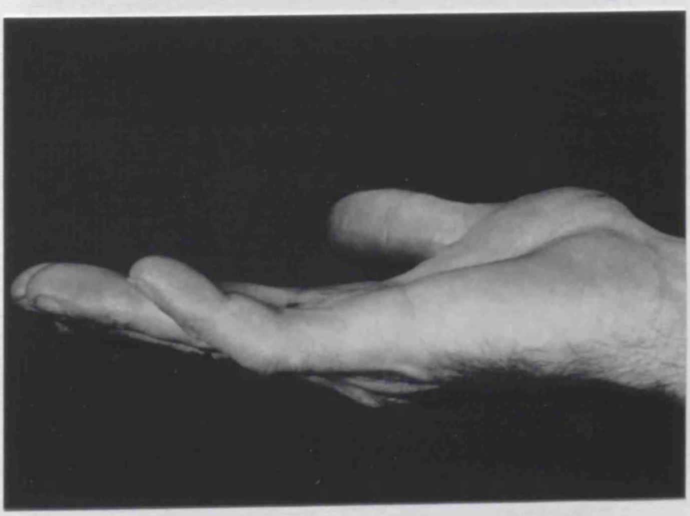
Pre-operative contracture 1984.

b



One year after operation.

c

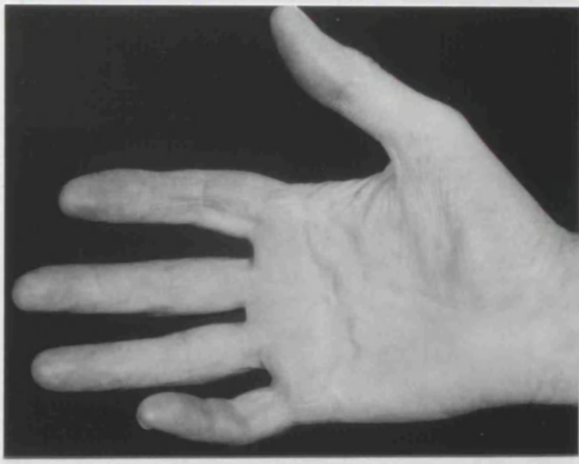


2 years after operation.

Case 19 <u>Recurrence or extension?</u>

a

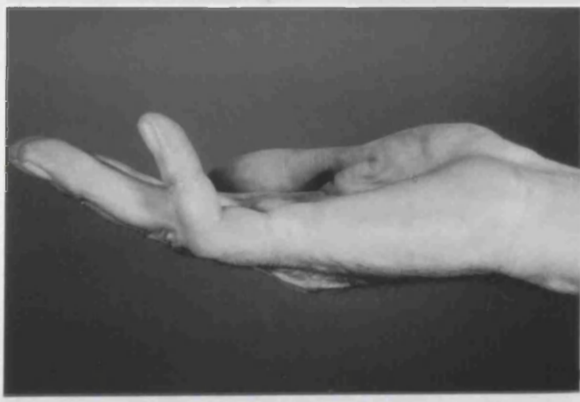
1981
Following fasciotomy and graft of (R) palm.



b

1984

c



1985

d

1987
The previous operation took place in the palm but included the ray of the little finger. Should the contracture at pip joint level be considered as a recurrence or extension?

Case 20 Splintage

a

b

c

d

Contracture controlled by long term splintage.

This patient had several previous operations on both hands prior to 1980.

Since then he has worn static night splints and a Capener splint on the right little finger by day.

No further surgery has been required and the contractures have not progressed.

Case 21 Splintage

a

b

c

d

a, b) Static night splint and
c, d) Dynamic day splints made in the clinic by
Mr. W. Dykes and Miss Majorie Blance of the
National Centre for Training and Education in
Prosthetics and Orthotics, University of
Strathclyde.