The selection of artificial anterior teeth appropriate for the age and gender of the complete denture wearer.
A study into the variation of choices made by general dental practitioners, final year dental students and fine art students.

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ABSTRACT

An historical overview of the methods used to aid artificial tooth selection was undertaken. This showed that no universally reliable method has been found for determining tooth form. It also revealed that the aesthetic outcome of complete denture construction has received little attention in the dental literature, although some surveys have focused on the perception of aesthetic dentistry in relation to dentures (Brisman, 1980; McCord et al., 1994; Hyde et al., 1999).

Sellen et al. (2001, 2002) carried out two studies to assess the ability of dental undergraduates and dental school staff to choose appropriate artificial teeth when prescribing complete dentures. From these studies it was concluded that there was a need for improved training and guidance on artificial tooth selection and arrangement.

The studies of Sellen et al. (2001, 2002) have been the springboard for this particular study to assess the variation of choice made by general dental practitioners, final year dental students and fine art students when it comes to choosing appropriate artificial teeth for the age and gender of the denture wearer.

Aims and objectives

Central to the study was to determine if any significant differences, in choices made, exist between the three groups of participants. It was also important to determine if any significant preferences exist when different moulds and arrangements of teeth were considered for different age groups and genders of individuals. Finally, determining if an obvious need for improved training and guidance, in this area of dentistry, was needed.

Methods and materials

Photographs of six subjects representing youth, middle age and old age for both genders were produced for the study along with two three-dimensional aesthetic guides. Using the guides, 40 general dental practitioners, 40 final year dental

students and 40 fine art students were each asked to select the teeth that they would use to construct a denture for the subjects detailed in the photographs.

Results

Data analysis showed that there were no relevant, significant differences in tooth or arrangement choice between the three groups.

Similar trends in tooth and arrangement choice were shown when testing for significance within the individual groups. There was a highly significant association for all three groups between the subject and tooth size, with a tendency to choose large teeth for males and smaller teeth for females. There was also a highly significant association for all three groups between the age of the subjects and the age arrangement, with a tendency to choose arrangements indicative of youth for young subjects and arrangements indicative of old age for old subjects.

No significant associations were found within the groups surveyed when choosing a tooth shape or gender arrangement.

Discussion

Certain trends within all three groups of participants, with regards tooth size and age arrangement, may suggest that an obvious training need does not exist.

Inconsistent choices with regards gender arrangement and tooth shape may be as a result of factors which are too subtle to perceive and not necessarily because of inadequate training. Subsequently, it may be argued that, tooth shape and gender arrangement are less important than other aesthetic factors.

The idea that a reliable method of selecting artificial anterior teeth exists has lessened as this study has progressed and with it the idea of providing specific training in this area of dentistry.

Making assumptions about what may exist in the natural dentition and rigidly trying to impose this in a clinical setting may increase the likelihood of failure. Attempting to instil a strong perception of an individualised approach to denture

construction may make the process more difficult if patient perceptions are generally different.

Building an understanding of the methods used for tooth selection over the years can help provide dentists with a starting point and allow them to develop their own selection methods in combination with patients' preferences.

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DECLARATION

All data presented in this thesis is the original work of the author.

I declare that no portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification of this or any other University or other institute of learning.

Marc Bingham

INTRODUCTION

A commitment to improve the appearance of complete dentures provided in general dental practice has led to the following research.

The privileged position of being able to significantly change an individual's dentofacial appearance, through the provision of dental prostheses, is a strong motivational factor in striving to achieve high clinical standards.

In order to gain a full understanding of the advances that have been made in prosthetic dentistry over the years, a study of our predecessors' work is essential. This work aims to undertake an historical overview of the methods used to aid anterior tooth selection for complete dentures and to trace the efforts made to achieve a more realistic appearance.

In recent years, patient awareness of the importance of dentofacial appearance has dramatically increased, resulting in more demanding requests for improved treatment outcomes (Sheets, 1987).

An acceptable cosmetic effect in any dental restoration has always been regarded as important to good dentistry and it is likely that a well-made prosthesis will fail, in the eyes of the patient, if it is deficient in this respect (Van Victor, 1963).

An important objective in selecting and arranging artificial teeth is to produce a prosthesis that defies detection. This can be difficult to achieve when there are no natural teeth remaining and no pre-extraction records, however a choice of artificial teeth which reflect the age and gender of a patient may be helpful in achieving this aim (Sellen et al., 1999, 2001, 2002).

The research reported in this thesis will especially focus on recent studies into undergraduate and postgraduate dentists' abilities to choose artificial teeth appropriate for the age and gender of the denture wearer.

CHAPTER 1

LITERATURE REVIEW

1.1 Introduction

As will be seen throughout this review, there are many factors to consider when an individual's dentofacial appearance is observed.

The shape of the face is a factor which can be subject to great changes throughout life. For example, ill health, age, weight loss or obesity can have dramatic effects on the outline form of the face and this may influence decisions on how a dental prosthesis is to be constructed (Sellen et al., 1999; Wright, 1942).

With regard to the teeth themselves, the colour, form, size, arrangement and how the teeth are framed, are all factors which can affect dentofacial appearance (Pound, 1962).

Of the articles reviewed, several tend to have focused attention on the maxillary central incisor. Owing to their prominent size, position and shape in the natural dentition, maxillary central incisors may significantly influence facial appearance, and those that harmonise with the patient's features are considered by some to be of primary importance in successful aesthetics (Berry, 1905; Williams, 1914 a-f; Wright, 1942; Mavroskoufis, 1980; Goose, 1956; Brodbelt, 1984). Lateral incisors and canines are considered by some to perform a subordinate role from an aesthetic viewpoint but remain fundamental components in achieving optimum dentofacial appearance (Sellen et al., 1999).

1.2 Pre-tooth selection systems

As was highlighted by Woodforde's 1968, 'The Strange Story of False Teeth' early replacements for missing teeth were fabricated from wood, bone or ivory and attached to the remaining natural dentition with ligatures or fixed to a metal plate which was held in the mouth. Natural teeth themselves were also

incorporated into early dentures. Etruscan examples date back to 700 BC and such tooth replacements were by not unusual throughout the Roman Empire.

The first known European complete set of dentures date back to the 15th century and resembled a hinge device with upper and lower teeth being carved from one piece of material rather than having individual teeth (Woodforde, 1968).

In Britain, at least until the end of the 17th century, progress in this field appears to be negligible and the wearing of false teeth was reserved for the wealthy. Woodforde refers to Elizabeth I wearing a device to improve her appearance after losing her front teeth (Woodforde, 1968).

John Watts was the founder of a famous firm which specialised in false teeth and Thomas Beardmore who joined the firm in 1760 was appointed to look after the teeth of George III. His book on teeth and gums (1768), with a long section on false teeth, remained for years the only British textbook on dentistry (Woodforde, 1968).

The use of porcelain for denture construction first appeared in the 18th century when attempts were made to construct full dentures as one complete piece (Woodforde, 1968). Girdwood's 1918 publication 'Tube teeth and porcelain rods' refers to the production of individual porcelain teeth dating from 1788. A reference dating individual porcelain teeth to 1838 is also made in Lowery's 1920 article on the selection of artificial teeth for prosthetic restorations (Lowery, 1920).

1.3 Temperamental Theory

In the 5th century BC, Hippocrates conceived the temperamental theory of health classification, based on the dominance of bodily fluids. His theory was used, by the medical profession to help diagnose and treat patients until the late 19th century when it began to give way to demonstrable science.

Blood, phlegm, yellow bile and black bile were translated into mental, physical and functional characteristics. Susceptibility or immunity to various conditions was perceived to determine an individual's temperament classification.

The four fundamental classifications were;

- Sanguine
- Phlegmatic
- Choleric
- Melancholic

Twelve combinations of mixed temperaments, in which one dominates another, were also identified, making a total of sixteen varieties.

In 1884, the use of the temperamental theory was proposed in dentistry to aid tooth selection and improve aesthetics (White, 1884). Temperamental forms of teeth were produced as ‘named sets’ and appeared to make tooth selection temporarily easier. Teeth were selected according to the individual’s body size, body form, colour of eyes and hair, disposition and character.

Before this point in time, dentists chose from hundreds of moulds that had been carved as copies of pleasing natural teeth. These were carved by skilled artisans, most of whom were not dentists, with a resulting outline form and labial surface that looked mechanically un-lifelike. They reflected light and colour in unnatural and unpleasing ways, with each mould standing alone, unrelated in form or size to any other, or any form of face (Clapp, 1955).

There was no clearly understandable theory of face form, tooth form harmony to guide selection. Dentists were left to hunt through many individual teeth and attempt to create pleasing prostheses for patients.

Although the idea of ‘named sets’ appeared to make selection easier, this theory had not been defined or illustrated in an authoratative way and it was highlighted that dentists had great difficulty trying to decide into which category each patient should go. When they did decide, each manufacturer tended to have a different form of tooth for that particular class. In time dentists found the system unworkable (Clapp, 1955; French, 1951; Lowery, 1920).

Lowery refers to the work of Berry (1905) who highlighted a need for better harmony between face form and tooth form and called attention to how inharmonious, in regard to outline, artificial teeth were (Lowery, 1920).

1.4 Correlation between aesthetic factors

1.4.1 Relationship between face-form and tooth-form

Around the turn of the 20th century Williams had become unhappy over the unnatural appearance of his denture restorations and realised that there could be no lifelike restorations until he could get lifelike artificial teeth.

Williams believed the temperamental theory to be a fallacy and proceeded to analyse tooth form in great depth (Williams, 1914 a-e).

In 1914 Williams presented a theory of tooth form and selection to the dental profession in a series of publications. Here, natural teeth were examined to discover features that provided a key to determining anterior tooth form and desirable aesthetics (Williams, 1914 f).

In his geometric theory he described three ‘typal’ or ‘basic’ forms of teeth, square, tapering and ovoid, as well as some intermediate and composite forms. Williams’ theory appears to be remarkably similar to that presented by Madame Schimmelpennick in 1815. Schimmelpennick, an English authoress, had issued work on the ‘Science of beauty’, in which she classified faces into three fundamental forms, square, triangular and circular (Lowery, 1920). This valuable idea would not be related to dentistry until Williams started his extensive anthropological studies and campaign for better tooth forms. Williams preferred to use the term ‘ovoid’ rather than ‘circular’, and ‘tapered’ rather than ‘triangular’.

This classification of tooth forms would represent a very significant contribution to dental aesthetics.

Williams also believed that a relationship existed between the face form and the form of the maxillary central incisor, in most people, and that this relationship

should be taken into account in the tooth selection procedure. The most pleasing appearance would be one in which the outline form of the individual's face, turned upside down, and the outline of the maxillary incisor are identical.

Williams produced sixteen photographs of faces to correspond with the sixteen tooth forms that made up his new system for tooth selection. Faces were also classified as square, tapering and ovoid and the manufacturers produced teeth with blends to conform to facial blends.

The pictures were used with the intention of shortening the time taken for tooth selection. When a dentist had chosen a photo to fit the face he could then use the corresponding tooth form for that particular photo. This system seemed quite simple and comparatively easy to apply. It would become widely accepted by the profession, taught in dental schools and incorporated into prosthetic textbooks.

Clapp's 1955 article fully supported Williams' ideas with the following statement;

> *'The photographs establish the first factual proof of the exactness of the harmony of face forms and tooth forms in nature's finest handiwork. There had long been a strong belief in the existence of this harmony, and many expressions of the belief. But there had been no indisputable proof. Here was the proof.'*

Clapp treats Williams' work as though a secret law of nature has been discovered.

Hermann tested the various methods of tooth selection as predictors of natural tooth forms in dentate subjects. He believed that facial form was a more reliable predictor of natural tooth form than constitutional type (Marunick et al., 1983).

Although this method of harmonising the face with the teeth has been popular for most of the 20th century, many authors have questioned its validity.

Krajicek stated,

> *'There is much evidence to indicate that the harmony between tooth form and face form is a rare exception and not the rule. This simple system of classifying faces as square, tapering and ovoid and then applying manufacturer's teeth classified in this manner to the individual patient may be easy to use, but it has no scientific basis. Nature does not conform to comfortable and convenient rules of standardisation.'* (Krajicek, 1969).

Brisman observed;

> *'Williams' method of harmonising the face with the teeth has been popular for more than 60 years. This is remarkable because the outline forms of the face and the maxillary central incisors coincide in only a small percentage of cases, and it has never been proved that this occurrence results in an ideal esthetic appearance.'* (Brisman, 1980).

Wright highlighted the increasing criticism of a method of selecting teeth which was based on the assumption that tooth form and face form should be identical. His 1942 study involved the recording of face form and the form of the upper central incisor teeth in students at the Pittsburgh School of Dentistry. The type and form of the face were determined both by visual observation and the use of the Wavrin Truetype tooth guide as recommended by one of the manufacturers of the time. The study included 632 young adults, of whom 600 presented data on both face and tooth form.

Results showed 13% of subjects to have an identical match with regard face form and tooth form outlines, 39% were similar and 60.7% were dissimilar. Wright concluded that, correlation, if present, exists with regard to dissimilar face forms and tooth forms (Wright, 1942).

Mavrokoufis and Ritchie (1980) carried out a similar study in which 70 dental students were investigated to assess the validity of Williams' method of face form-tooth form harmony for the selection of maxillary central incisor teeth.

Two photographs of each student were made, one full face and the other an intraoral view of the two maxillary central incisors. Slides of the faces were projected onto a white screen and the outline forms drawn onto white paper. Tooth forms were then projected onto the paper so that the margins of the tooth were made to coincide as closely as possible with the outline form of the

face. Tooth form outlines were drawn onto the diagrammatic representations of the face forms for comparison.

Results showed 5.7% of subjects to have an identical match with regard face form and tooth form outline, 25.7% were similar and 68.7% were dissimilar. Mavroskoufis and Ritchie (1980) concluded that Williams' face form-tooth form hypothesis had no validity.

According to typal classification, changes in facial outline caused by ill health, age, weight loss and obesity would require changes in tooth form to maintain dentofacial harmony. This may contradict nature, were tooth form remains fairly constant throughout life regardless of the changes in facial appearance. The only changes that may occur relate to the loss of mammelons/incisal wear or changes cervically due to gingival recession.

In 1936 Stein challenged the geometric theory of tooth selection on the grounds that it had no scientific basis. He said that Williams himself was the first one to demonstrate conclusions that there was no harmony between face form and tooth form and referred to his 1914 paper where Williams recorded results of an extensive investigation on this subject in which he demonstrated wide teeth in narrow skulls, narrow teeth in wide skulls, long teeth in short skulls, short teeth in long skulls, dissimilar teeth in similar skulls and similar teeth in dissimilar skulls.

With the following quotes, Stein emphasised the point that in nature, harmony of tooth form and face form is the rare exception and not the rule,

> *'Upper anterior teeth are like fingerprints; there are no two alike. They vary from one individual to another.'*
>
> *'Like faces and fingerprints, they are inherited from parent to offspring. They obey the same laws of heredity as any other part of the body. There are dominant family traits in teeth just as in faces. The selection of teeth for an edentulous patient is a problem in biology and not in geometry. A patient's blood relative is a better clue to the form of his missing teeth than the outline form of his face. The dentist's most scientific approach is the realisation that no one has yet written a foolproof formula for the solution of this biological problem.'* (cited in French, 1951).

In a heterogenous population with an inheritance of numerous racial characteristics, it appears logical that similarity between tooth form and face form would occur infrequently because of the multiple sets of genes which control these characteristics.

Despite these invalidations Williams' developments in artificial teeth have been extremely beneficial to the dental profession. It has elevated the practice of prosthodontics by introducing new forms and graduated sizes of teeth with which to render a more effective service to the public. It has tended to increase public opinion for the field of prosthetic dentistry which, in the past, tended to be dreaded because of the unnatural appearance generally resulting from prosthetic restorations.

Wright also brought another important point to our attention when he observed that the lack of harmony between face form and tooth form outline does not necessarily appear incongruous or result in a poor appearance (Vig, 1961). As several studies have shown (Marunick, 1983; Krajicek, 1969; Brisman, 1980; Wright, 1942; Mavroskoufis, 1980), most individuals with a natural dentition possess dissimilarities between tooth form and face form and this does not necessarily take away from a natural look. Their teeth are lifelike because they are natural and not because of any similarity with facial outline.

Although Wright encouraged artistic sense and judgement to select teeth that appear correct for the patient, he did not rule out the use of a system which harmonised face and tooth form along side these adjuncts.

As well as Williams' face form-tooth form theory, many other studies of aesthetic factors have examined the possible correlation between various aspects of the head and anterior tooth size and position.

Sears suggested that the total width of the maxillary incisors can be determined by dividing the bizygomatic breadth by 3.3 (Sears, 1960). However this was disputed by Kern (1967) in a study to analyse the relationship between the skull and tooth size. Out of 6000 skulls examined, 509 were deemed suitable for the study. These skulls had full dentitions and little evidence of attrition.

The results showed 92 (18%) to have a bizygomatic width to maxillary central incisor width ratio of 14:1, 216 (42%) a ratio of 15:1, 157 (31%) a ratio of 16:1 and 42 (8%) a ratio of 17:1. He concluded that the correlation between the width of the maxillary central incisor and the bizygomatic width were not consistent (Kern, 1967).

Berry reported that the upper central incisor was approximately a sixteenth the width of the face (Berry, 1905), and this was supported by House who suggested a method of tooth selection based on average tooth sizes (House, 1939).

It has also been suggested that nasal width may be a more reliable guide for selecting anterior teeth than bizygomatic width (Kern 1967). However this was disputed by Smith who used a radiographic method to measure the interalar width of the nose in 80 subjects. He concluded that there was no significant relationship between the intercanine distance and the interalar width of the nose and therefore the width of the nose would not be a reliable guide for the selecting artificial teeth (Smith, 1975).

1.4.2 Relationship of facial contour to tooth contour

Sears considered the forms of the anterior teeth from three viewpoints, labially, proximally and incisally. He believed that the visible outlines should be harmonious from the standpoint of convexity. If one is decidedly convex, all three should possess this characteristic.

The decision of how much curvature to introduce into the outline would be made on the basis of the curves of the face. The curvature of the teeth should be harmonious with the curvature of the face. This concept was not to be confused with that of typal theory (Sears, 1938).

1.4.3 Relationship between facial profile and tooth arrangement

Facial profile has been suggested as a guide to the inclination of the maxillary incisors (Hughes, 1951).

Hughes' studies were based on the photographic and cepahlometric records of 105 students at the University of California. The primary objective of the study was to determine whether or not arrangement of anterior teeth might follow definite patterns peculiar to the various facial types. He used the Simon classification of facial profile to classify each subject and found this to be of greater value than the simple three group classification of straight, convex and concave. The Simon classification consists of five groups with protractions and retractions being horizontal deviations from the norm, attractions and abstractions being vertical deviations from the norm and the fifth group being normal itself.

From his analysis he felt that there was sufficient evidence to indicate typical harmonious arrangement of teeth for the major facial types. He believed that anterior teeth arranged with protractive or retractive tendencies present in nature will provide continuity and an improved dentofacial appearance.

1.4.4 Arch form, palatal contour and alignment form

Arch form has been proposed as a guide to the arrangement of anterior teeth (Lowery, 1920).

With reference to the three typal forms, Lowery refers to their corresponding palatal contours and how natural tooth arrangements should be simulated to improve dentofacial appearance.

For square, the palate is usually broad and shallow. The six anterior teeth in the upper arch should be arranged in the segment of a larger circle, approaching more nearly a straight line. The inclination of the labial surfaces are almost vertical and inter-dental spaces are short and narrow.

For tapered, the palate is high and an inverted v-shape. The upper anterior teeth are arrangement v-shaped with incisal edges well forward of the cervical region. The inter-dental spaces are broad and v-shaped.

For ovoid, the palate is medium high and rounding. The upper anterior teeth are arranged in the segment of a smaller circle than that of the square type. Central

incisors are slightly prominent and the laterals depressed cervically, leaving the mesial portion of the cuspid prominent. Spaces between anterior teeth are not uncommon.

Nelson also observed three classes of arches and described their corresponding palatal contours and tooth arrangement similarly. From his five year study of natural dentitions, he concluded that there was a distinct relationship between face form, the form of the maxillary arch and the alignment form of the upper anterior teeth and stated that we could get a clue from the arch form as to what the alignment of the natural teeth had been. It should be the unchanging form of the central portion of the palatal vault that will help decide the original form of the arch and not the general outline of the arch which tends to changeover time. (Nelson, 1925 a,b; Krajicek, 1969).

Others have observed consistency between face and arch form in a high percentage of edentulous cases (Schlosser, 1953). A continuous line drawn along the alveolar crest as far as the tuberosities and just prior to the junction of the hard and soft palate, when inverted and superimposed onto the face, was found to correspond with the chin margin, jaw lines, cheek lines, and eyebrows. Artificial teeth selected to arch form, and therefore face form would appear to improve dentofacial harmony.

French acts on the work of Nelson, reporting that alignment form is more important than the outline form of the teeth (French, 1951).

French’s study involved the setting up of three arrangements of teeth, one for each alignment form. Although an identical mould was used, they are described as looking like three entirely different sets of teeth. The teeth in the square alignment looked square, the teeth in the tapered alignment looked tapered and those in the ovoid alignment looked ovoid.

According to French it was quite clear that, as a tooth was rotated or its inclination changed from vertical, a different outline was presented to the eye. Therefore despite thinking that a favourable choice of tooth has been made initially, the final result could potentially appear quite different.

Young also cited alignment as an essential factor in denture aesthetics (Young, 1956).

1.4.5 Influence of tooth form modification

Recontouring of incisal edges has been suggested to contribute more to appearance than the selection of tooth moulds (Seluk, 1987).

Seluk carried out a study to consider whether the perceived shape of the tooth mould could be significantly modified by the contour of the artificial gingival. Six patients were selected, 3 male and 3 female and three sets of dentures were fabricated using uniform moulds representing square, tapered and ovoid teeth. Comparing set and unset teeth revealed no significant difference in the incisal halves of the teeth, however there was a highly significant difference ($P< 0.001$) when the cervical halves of the teeth were compared. Seluk concludes that this difference was probably attributable to gingival contouring and he referred to the afore-mentioned work of French who stated that one tooth can appear square, tapered or ovoid depending on the way it is set.

1.4.6 Cranial landmarks

It is very difficult to accurately compare irregular forms such as teeth and faces, however Cozza stated that comparisons of separate descriptions such as height, width, surface area, or angle of taper may be carried out.

Cozza devised a method of comparing the measured angle of taper of the maxillary central incisors, the maxillary dental arch and the skull. Four points were defined on each of the three forms which would be most reasonably analogous in relation to maximum and minimum widths. Thirty patients and employees of a hospital in Houston, Texas were subjects in the study.

Measurements were taken from photographs for the maxillary central incisors, a posterior-anterior cephalogram for the skull and a stone cast for the maxillary dental arch. Of the 30 subjects, the average angle of taper for the maxillary central incisors was 21.54 degrees. For the P-A cephalograms, the average angle

of taper was 23.87 degrees. The maxillary dental arch casts had an average angle of taper of 48.43 degrees.

Cozza concluded that no correlation could be found between the angles of taper of any set of tooth, skull and dental arch (Cozza, 1970).

Another study took lateral cephalometric roentgenograms of 50 subjects who had all of their natural anterior teeth and most of their posterior teeth remaining. Tracings of various cranial landmarks were made on acetate paper and compared to the position of the incisor teeth. The variations in measurements confirmed that each patient is an individual with anatomic relationships characteristic only to himself or herself. However the most consistent measurements were made from the incisive papilla and, within this study, this would appear to be a useful guide in the preliminary placement of anterior teeth (Ellinger, 1968).

1.5 Dentogenics

The concept of dentogenics was introduced by Frush and Fisher in the mid nineteen fifties (Frush and Fisher 1955,1956 a & b ,1957 a & b,1958,1959). It was seen as a major advance in denture aesthetics and could be viewed, in a way, as a variation of the temperament theory. Tooth morphology was altered by incorporating dominant ridges, irregular surface details, and smooth gentle curves to develop very distinctive forms that reflected different personalities. Factors influencing dentogenic restorations were sex (male or female), personality (vigorous, moderate or delicate), and age (young, middle aged or elderly). These factors, combined, would be influential in enhancing personal character and appearance. Collectively they were called the SPA (sex-personality-age) factor.

The term ‘dentogenic’ is meant to convey, in relation to prosthetic dentistry, the same meaning as the suffix –genic imports to photograph in the word photogenic. Photogenic meaning, suitable for production or reproduction (Frush and Fisher 1955). By inventing the concept of dentogenics, a new artistic approach to aesthetic dentistry could be taken. Results, unthought-of before, could now be achieved and this subject would hopefully move forward.

Frush and Fisher (1955) believed that roundness, smoothness and softness, as feminine, should be reflected in dentures for women, just as masculine, vigor and boldness should be reflected in dentures for men. They also believed that the patients' personalities could be incorporated into their dentures by selecting a delicate, medium pleasing, or vigorous arrangement of denture teeth.

Selective removal of superficial tooth material from the mesial aspect of the centrals gave the illusion of depth, improving feminine realism. Tooth arrangements enhanced feminine tendencies by rotation of lateral incisors to expose the mesial surface or to create slight overlapping of the central incisors. Reduction of the canine eminences provided a less aggressive appearance. Conversely, representative tooth moulds for men would be created with sharp, angular features adjusted by deep grinding of the central incisor's mesial surface to produce a harder masculine form. Arranging the canine eminence in prominent positions highlighted masculine attributes in establishing an individual appearance. These considerations generally agree with other studies (Sears, 1938; Nelson, 1925 b; Wright 1936; Lowery 1921).

The age factor was accomplished by using lighter shades for younger patients and darker shades for older patients, incorporating wear into the artificial dentition and using more diastemas for older patients to simulate that which occurs naturally. A need to incorporate factors that convey an appearance commensurate with age has been supported (Sears, 1941; Pound 1952).

In reference to the concept, Brisman wrote,

> *'Developing this idea to its natural conclusion, we must assume that the old patients prefer old and defective teeth to match their age and physical condition, and unpleasant patients are to be given unpleasant teeth to match their unpleasant personality. Attempts to create an individualised dental composition for each patient conflicts with the hypothesis that there are standard concepts of beauty in society that develop from, social, cultural and psychological considerations and that each person wants teeth that conform to these concepts.'* (Brisman, 1980).

Here Brisman believes the concept as a whole may take dental aesthetics, in some cases, to extremes, although one of his studies did highlight a preference

for patients and dentists to choose square teeth for male patients (Brisman, 1980). This would support the dentogenic concept.

A study involving photographs of three male and three female patients, with square, tapering and ovoid facial outlines, evaluated the tooth form preferences of the general public (Marunick, 1983). Three complete dentures constructed for each patient incorporated either square, tapering, or ovoid teeth. Photographs of each prosthesis, *in situ,* with patients displaying the teeth through an open smile, were shown to 110 subjects for appraisal. The results showed that most individuals did not focus on the teeth as a dominant characteristic of the photograph until their attention was directed to the shapes of the teeth. This suggested that tooth shape or typal matching may be of negligible importance in aesthetic dentistry, in comparison to other factors such as tooth size, colour and arrangement. In the same study a preference for square and ovoid teeth over tapering teeth agreed with Brisman's 1980 study. Marunick also found that a preference for square teeth in males and ovoid teeth in females supported the dentogenic concept.

Another study indicated that it is difficult to correctly determine age and sex by using anterior teeth as a guide. The study found that neither dentists, dental laboratory technicians, nor dental auxiliaries proved to have an advantage in determining age and sex (Burchett, 1988).

Burchett stated,

> *'The difficulty in estimating age and sex in dental patients is that they do not always fall into set patterns. Teeth do darken with age but this is not always true. Older patients sometimes show minimal wear and some younger dentitions can show moderate to excessive wear. The position of the maxillary lateral incisors does not always enhance male and female characteristics.'* (Burchett, 1988).

This clearly disputes the dentogenic concept, or at least realises its limitations.

With regard to limitations, Krajicek wrote,

> *'…each patient presents specific and individualised problems of appearance that cannot be solved by any standardised laboratory*

> *method. Patient's problems cannot be solving by relying on a system of averages.'* (Krajicek, 1963).

Although the concept of dentogenics has been put in place to make the creation of more individualised denture possible, it looks to some as just another standardised system, all be it with a bit more sophistication.

1.6 Summary of observational methods

Although the science and mechanics of prosthodontics had moved forward in the first half of the 20th century, the appearance of prosthodontic restorations had not. Since Williams' first simple rules of aesthetic dentistry, very little had been done to elaborate upon these, and to combat the mass production and stylized mechanics of artificial teeth.

Great strides had been taken to bring greater patient comfort as far as function was concerned, however dental aesthetics lagged behind. Attempting to follow a concept of idealism and symmetry, combined with a standardised process of tooth selection according to the face form hypothesis, would do much to curb dentists' initiative in the artistic phases of prosthetic dentistry and ultimately lead to monotonous uniformity. This look would become know as, 'The denture look' (Frush and Fisher, 1955; Vig, 1961).

Arranging teeth in a classic manner may produce a pleasing aesthetic result for young individuals, however complete dentures more times than not will be made for older groups. Any consistent pattern tends to make all patients look alike.

Krajicek stated,

> *'Any standard followed too closely destroys the individuality of the denture and reduces the procedure to a mechanical routine of mass production.'* (Krajicek, 1963).

In the second half of the 20th century Pound, Frush and Fisher, and others attempted to sway dentists away from the classic concepts that dominated aesthetic dentistry and to encourage the production of more individualised denture prostheses (Frush and Fisher, 1955-59; Pound, 1962; Vig, 1961).

1.7 Other methods used to determine the selection of artificial teeth

An attempt to move away from simple observational methods of tooth selection led others to develop new techniques.

1.7.1 Measuring devices

Devices for selecting tooth form and size were developed to help take the indecision out of the process.

The Truebite Teleform Gauge consisted of one flat bar and two rulers pivoted together to form three sides of a square. Placing the gauge on the patient's head, the two rulers were brought into contact with the sides of the face. Facial classification was determined via a pointer located on top of one ruler and a scale on the horizontal bar above the head. Face length, and then tooth length, was arrived at by taking readings from the rulers on each side (Dalbey, 1918).

A similar device to that of the Truebite gauge was the Tooth Selector. This comprised of three aluminium rulers resembling three sides of a rectangle. The longest ruler incorporated a 1:16 and a 1:17 scale. The 1:16 scale was intended for general use, the 1:17 scale specifically for female patients. One of the shorter rulers remained fixed to one end of the longest ruler, while the other short ruler could be adjusted along a slot in the longest ruler. Measurement of facial length and width taken from the longest ruler (in millimetres) was then translated into tooth forms analogous with face forms. Tooth form was identified by taking a measurement from hairline to symphysis across the zygomas. These measurements were converted into millimetres and combined with face form. From this, anterior teeth of a suitable size and shape could then be selected (Kaufman, 1982).

1.7.2 Combination theory

The idea of combination theory was to take the best perceived features of previously established methods and combine them together. It was thought that

by pooling a selection of techniques, the fabrication of dental compositions that complement an individual's appearance would be more achievable (Esposito, 1980).

An amalgam of the typal theory and dentogenics recognised face form and tooth form as fundamental prerequisites in facial harmonisation, whilst also including the sex factor to convey improved realism. Emphasis was placed on manipulation of the denture base to correlate with a patient's age, in particular the evolution of dental papillae as a patients gets older (Picard, 1958).

1.7.3 Mould guide casts

A technique for the use of mould guide casts to assist in the selection of artificial anterior teeth has been described (Van Victor, 1963). These guides each consisted of six maxillary anterior teeth and were constructed from impressions of natural teeth. It was thought that this method allowed a more accurate evaluation of size, form, rotation and inclination (Van Victor, 1963). A selection of these guides could be tried in patients' mouths until a satisfactory appearance was achieved. The desired mould could then be duplicated and incorporated into the denture base.

Van Victor (1963) believed that the most important factor in the selection of denture teeth was their arrangement. Observing a cast of natural teeth in the mouth would simplify this procedure. He made reference to the accumulation of a library of natural tooth moulds and arrangements that should reduce the time taken to develop arrangements and provide laboratory technicians with a pattern they can copy. Using mould guide casts was Van Victor's attempt to reduce the amount of rules and formulae necessary for the selection and placement of artificial teeth.

1.7.4 Computers and formulae

The use of computer technology and formulae can be used to determine the precise degree of correlation between aesthetic factors associated with the teeth and face. This method involves taking readings from anatomical landmarks, digitising these shapes and using computer programs to derive shape

plots. A computer-generated study of the correlation between selected aesthetic factors that influence dental appearance has been described (Sellen, 1998). This study evaluated the relationships between five aesthetic factors; face form, tooth form, arch form, maxillary tooth arrangement and palatal contour. An assessment was made to determine if the correlation was sufficient to recommend use of these factors as a reliable aid for selecting artificial teeth for edentulous patients. It was found that a high incidence of correlation between anterior tooth arrangement and arch form may be valuable as an aesthetic aid.

1.8 Concluding remarks

So far the review of literature has shown that no universally reliable method has been found for determining tooth form. The numerous studies and methods proposed, along with the many conflicting opinions show how subjective this issue is. In a sense, with the exception of extremes (Sears, 1941), there is no right or wrong.

1.9 The genetic basis of tooth morphology

The past two decades have seen advances in our understanding of the genetic control of embryonic development and the discovery of the homeobox genes has provided the springboard for these advances (Duboule, 1994).

Homeobox genes are involved in the genetic control of many different developmental processes and many are expressed in the developing orofacial region and during tooth development. Although current knowledge of mechanisms controlling tooth shape development is limited, it is believed that homeobox genes may have a role (Teaford et al., 2000)

Tooth shape is not the same as tooth family (incisor, canine, premolar or molar) which is defined by relative position. The actual determination of tooth shape during development is probably a downstream process from the specification of tooth family.

The importance of differentiated transient epithelial structures, enamel knots, has recently gained significance (MacKenzie et al 1992). The primary enamel knot is considered as one candidate for the control of actual tooth shape and appreciation of the secondary enamel knots may mark the actual process of crown shape development. In order for the correct tooth shape to form, development has to be initiated in the right place at the right time. Enamel knots are probably mediators of this process however the exact mechanisms as to how the formation of the enamel knot is controlled, as well as the regulation of the other aspects of tooth shape, such as crown height are still uncertain (Teaford et al., 2000).

With so many research articles relying on anecdotal evidence and the opinion of the author, it is not surprising that no universally reliable method for tooth selection has been found. A genetic basis for tooth morphology provides a more scientific approach to this subject and may help to dispel the idea that a universally reliable method can exist.

1.10 Science and Art

Throughout this review, on the methods of selection of artificial anterior teeth for complete dentures, it became apparent that the number of articles related to the topic have dwindled in the second half of the 20th century. Very little new material has appeared and that which does appear tends to concentrate on past theories. This reduction may be the result of an overall reduction in the number of articles devoted to complete denture prosthodontics. Morrow et al. (1995) observed that the ‘journal space’ for complete denture prosthodontics had fallen from 1971-1991.

McCord (2003) highlighted that, at undergraduate and graduate levels, the importance of this subject may no longer enjoy the leading position it once did. With the addition of new disciplines to the profession over the years, the emphasis on complete dentures has lessened.

It is also interesting to note that articles published more than 50 years ago tend to be more philosophical in their approach and inclusive of a wider breadth of knowledge. As well as dentistry and science, the idea of art is an integral part of

the text. This may reflect a more classical approach to education in the past and a less scientific approach to the methods of artificial tooth selection.

In more recent times, McCord stated, '*Successful provision of complete dentures is a paradigm of science and art.*' McCord believed that clinicians may be aware of how little evidence based science there is for complete denture prosthodontics but less aware of the artistic aspects to the subject (McCord, 2003).

He also argued that, in recent times, younger clinicians may be less well equipped to diagnose and treat edentulous patients. This may be because of many factors including, the reduced time devoted to the teaching of this topic, compared with in the past, and the fact that many clinicians may just dislike denture prosthodontics.

The use of the word art in conjunction with denture prosthodontics may do much to curb the interest or reduce the confidence of many clinicians when faced with the complex process of providing dentures to edentulous patients.

In relation to art, Sears wrote,

> '*To some persons, art is a vague and mysterious thing, the perception and production of which depends entirely on the spark and flare of genious in the artist's soul. This belief misses the point that all of us have some artistic ability awaiting development. If art is the production of significant form, every normal child is an artist. Our attempts are quite naturally crude in the beginning, but thought, practise and systematic attack can make artists of us all.*' (Sears, 1938).

This shows a positive attitude in an area of dentistry that can often appear very grey.

Clapp (1955) highlighted the fact that aesthetic dentistry does not involve the construction of something new, but instead involves replacing a lost or missing part. This part should conform to standard concepts of beauty within society. Clapp tends to extract most of the art away from denture prosthetics and reminds us that this field shouldn't necessarily be something unknown and vague, but something where clinicians with ordinary artistic perception and no

artistic training should be able to create restorations for edentulous patients that don't lead to disappointment.

1.11 Harmony and Nature

Aesthetic is another word that appears frequently in the literature, and according to Van Victor, included, '*…the appreciation and response to the beautiful in art and nature.*' (Van Victor, 1963).

In relation to the word aesthetic, Young stated, '*It is apparent that beauty, harmony, naturalness and individuality are major qualities.*' (Young, 1956).

Since the late 19th century great advances have been made to improve the appearance of denture prostheses, and a great deal of time has been spent attempting to achieve, what has been referred to as, 'dentofacial harmony'. The first widely accepted ideas of dentofacial harmony were through the work of Williams who, as mentioned previously, believed that the only way to achieve this harmony was to select a form of tooth similar to the form of the face. Dissimilarity would result in an inharmonious and displeasing result. Statements from the teeth manufacturers of Williams' system read, '*Nature harmonises tooth form with facial outline*', and '*…forms in the face and teeth are noticeably unlike and produce a displeasing harmony.*' (Wright, 1942).

Lowery described how the harmony obtained by this system can occur in different degrees of perfection. Firstly, a lack of harmony, or inharmony. Secondly, approximate harmony or simple harmony (also explaining that higher degrees can be obtained through clinical experience). And lastly, there is perfect harmony or ideal harmony (Lowery, 1920).

Many conflicting opinions exist, however few authors have questioned if a match between tooth form and face form actually equates to something beautiful or harmonious.

Most authors have been more interested in discovering the percentage of cases where similarity exists and not if dentures made with William's theory in mind have actually been successful. How can so many people accept such sweeping

statements and not decide for themselves what form harmony may take? Who is to decide what is beautiful and what is not?

Of the few authors who have briefly raised these questions, Brisman, in reference to face form tooth form theory, stated, '*…it has never been proved that this occurrence results in an ideal esthetic appearance*.' (Brisman, 1980). And Wright explained, '*…this dissimilarity between tooth and face form does not make such combinations inharmonious*.' Wright observed that the lack of similarity doesn't necessarily appear incongruous or unaesthetic, and speculated that quite often nature can obtain pleasing effects by contrast, more frequently than similarity.

With reference to art, Wright wrote,

> '*A study of art will reveal that contrast is one of the most important rules for obtaining harmony in architecture and painting.*' (Wright, 1942).

The pursuit of harmony and beauty has been translated from art to dentistry through the concept of the golden ratio (1:1.618). The use of this mathematical proportion has been advocated for the development of specific pleasing dental relationships (Ricketts, 1982 a,b; Levin, 1978; Shoemaker, 1987), and some parallels can be drawn with the findings of Williams.

The ratio has its origins in antiquity and has been used by mathematicians and artist for centuries. It is also referred to as 'The Divine Proportion'.

Levin advocated its use for establishing tooth size and stated that the width of the maxillary central incisor was in golden proportion to the width of the maxillary lateral incisor. He also believed the maxillary lateral incisor to be in golden proportion to the width of the maxillary canine (Levin 1978). It must be noted that the proportion was derived from the apparent size, as viewed directly from the anterior.

Shoemaker (1987 a, b) stated that the maxillary central incisor was in golden proportion to the mandibular central incisor.

Levin (1978) devised a grid, with the spaces of the golden proportion, to help develop the harmonious proportion of the anterior teeth, whilst Shoemaker (1987 a,b) devised a calliper for similar purposes.

Preston challenged these claims in a study which concluded that such ratios did not exist in the average natural dentition and described the measuring techniques of Levin and Shoemaker as inaccurate (Preston, 1993).

It is tempting to seek mathematical or mechanical assistance in developing aesthetic dentistry, and the existence of valid relationships to support such theories would be helpful. However, whether the golden ratio exists in the natural dentition or not it still presents a viable approach that has the potential to provide a pleasing outcome.

An initial focus on harmony, idealism and the creation of perfectly positioned sets of symmetrical teeth, eventually gives way to a more naturalised and individualised approach to tooth selection and arrangement. A need for the provision of dentures with a 'natural' look, incorporating a reflection of age, gender and character, is cited by several authors (Krajicek, 1963,1969; Frush and Fisher 1958; Watt and MacGregor 1986; Pound, 1960; Maritato, 1964; Ali and McClean 1999; Besford, 1984).

In this age of aesthetic dentistry clinicians should be striving to produce dentures which look as natural as possible. However it appears that current denture production does not take place with the appearance of the patients' teeth in mind (McCord et al., 1994). Despite the expectations of patients rising and many denture wearers requesting better aesthetic dentistry (Besford, 1984; Rosthenthal et al., 1964), the vast majority of dentures being prescribed fail to look natural and individualised (Ali and McClean 1999). Instead dentures conform to the 'denture look' or 'British standard' as described by Besford. These include a 'text-book' idealised set up, lack of gingival contour and shiny pink tissue filling the embrasure (Besford, 1984).

It may be that the majority of dentists and technicians prefer to provide this set up on the presumption that this is what the patients prefer, however it may also be due to the willingness of patients to choose the standard option in an attempt

to comply with perceived accepted norms (Brisman, 1980; Rosthenthal et al., 1964).

Carlsson et al (1998) highlighted that in spite of increasing interest in aesthetic dentistry, little or no attention has been given to the psychologic and social aspects of dental appearance.

Carlsson and his fellow workers asked the following question, '*Who should be the judge of dental aesthetics, the patient or the dentist?*' (Carlsson et al 1998).

Differing attitudes towards dental appearance supports the view that dentists should consult their patients before selecting a particular shape or arrangement of teeth. In the survey of Carlsson et al concluded that there was a substantial difference among dentists, technicians and non-dental subjects in their beliefs and perceptions relating to dental appearance. He also observed that non-dental subjects preferred teeth light in colour.

A greater emphasis should be placed on the provision of complete dentures that are aesthetically pleasing. Besford suggested that when prescribing dentures, options should be explained to the patient as a kind of aesthetic menu. Patients can be educated on what makes teeth look natural and then decide whether an individualised denture would be more advantageous (Besford, 1984).

1.12 The perception of aesthetic dentistry

Although the aesthetic outcome of complete dentures has received little attention in the dental literature, some relatively recent surveys have begun to focus on the perception of aesthetic dentistry.

With an increasing aesthetic awareness within the dental profession and the description of many methods and aids for tooth selection having been written about over the years, it might be safe to think that the ability to fabricate a prosthesis to reflect an individual patient could be quite high. However, work by Hyde concluded that dental experts were unable to identify the gender of a subject from casts of the anterior upper teeth (Hyde et al., 1999).

A study by McCord et al. (1994) asked two hundred participants, including dental staff, dental students and patients from two different teaching schools, to assess photographs of five sets of dentures for age, gender and personality.

The results indicated that there would appear to be little perceived personalisation of complete dentures. No one school's choice were determined to be better than the other, and in some instances teachers quite clearly stated that they were unable to determine age and gender from the information supplied (McCord et al. 1994).

It could be argued that, on one hand the literature is anticipating the possibility of highly individualised denture construction, with the reality being that dentists are unable to clearly differentiate between age and gender when asked to observe the anterior dentition. The reasons for this may be due to a lack of knowledge and training or it could simply be that differentiation of such factors is a difficult and subjective task.

The literature shows very few studies concentrating on the assessment of knowledge when it comes to the selection of artificial teeth.

After a review of methods used to select anterior teeth for the edentulous patient (Sellen et al., 1999), Sellen et al. carried out a survey to assess the ability of dental undergraduates, at a single dental school, to choose artificial anterior teeth when prescribing complete dentures (Sellen et al., 2001).

One hundred and fifty dental undergraduates aged 18-25 were asked to complete a questionnaire to assess their attitudes towards artificial tooth selection. They were also asked to correctly identify six arrangements according to sex and age. The results showed that a large percentage of students experienced difficulty in selecting artificial teeth which are appropriate. Only 8% of students categorised all arrangements correctly.

Sellen and his colleagues also carried out a further study to assess the variability in choice made by dental staff, at a single dental school, to select teeth appropriate to the age and sex of the individual with the aid of a series of three dimensional guides. Fifty dentists took part (Sellen et al, 2002).

Dental staff were asked to choose one shade, one mould and one arrangement that they thought appropriate for each of three male subjects detailed in photographs. These subjects represented youth, middle age and old age. Positive results were based on the participants choosing the exact shade, mould or arrangement present in each of the subjects' natural dentitions.

From this study it was concluded that there was little consistency in the selection of shade, mould and arrangement of the anterior teeth, appropriate for the age and sex of the individual, by qualified dental staff.

From these two studies it was concluded that there was a need for improved training and guidance on artificial tooth selection and arrangement, and that the development of a proforma, to guide dentists and patients through the tooth selection process, would be helpful.

Although these studies have no reflection on how dentists in other dental schools would perform, it none the less highlights the difficult nature of tooth selection and arrangement, and the possible need for improved training methods.

1.13 Summary

Throughout this literature review most articles have only been able to provide anecdotal evidence with regards the selection of artificial anterior teeth and it may be argued that a genetic basis for determining tooth shape and size would provide a more scientific approach.

From the above it was decided to carry out a study into the variation of choices made by dentists, dental students and fine art students, with regards the selection of artificial anterior teeth. The objective was to determine if any significant differences or similarities exist between the groups and therefore analyse whether anecdotal evidence may continue to be of use in the process of tooth selection.

CHAPTER 2

AIMS AND OBJECTIVES

The general aims and objectives of this thesis may be summarised below:

2.1 Aims

This study aims to analyse the variation in choice of general dental practitioners, dental students and fine art students, in relation to selecting artificial anterior teeth for complete dentures. It will particularly focus on the choices made when the age and gender of an individual are taken into account.

2.2 Objectives

- To carry out an historical overview of literature relating to the methods used to aid anterior tooth selection for complete dentures, and to review articles focusing on the perception of aesthetic dentistry.

- To investigate, via photographs, 3-dimensional tooth guides and a questionnaire, the choices of artificial anterior teeth that general dental practitioners, dental students and fine art students feel are appropriate for different age groups and genders of individuals.

- To determine if any significant differences, in the choices made, exist between the three groups of participants (general dental practitioners, final year dental students and fine art students).

- To determine if any significant preferences exist when different moulds and arrangements of teeth are considered for different age groups and genders of individuals e.g. Do participants tend to choose smaller teeth for female patients than they would for male patients?

- To determine if there is a need for improved training and guidance on artificial tooth selection and arrangement.

The following Null Hypotheses were proposed:

- There are no significant differences between general dental practitioners, dental students and art students when choices, in relation to selecting artificial anterior teeth for complete dentures, are analysed.

- There are no significant differences, within the groups surveyed, when choosing a tooth size for the subjects detailed in the photographs.

- There are no significant differences, within the groups surveyed, when choosing a shape of tooth for the subjects detailed in the photographs.

- There are no significant differences, within the groups surveyed, when choosing a masculine or feminine arrangement for the subjects detailed in the photographs.

- There are no significant differences, within the groups surveyed, when choosing a young, middle aged or old aged arrangement for the subjects detailed in the photographs.

CHAPTER 3

METHODS AND MATERIALS

3.1 Introduction

To analyse the variation in the choice of dentists, dental students and art students, in relation to selecting artificial anterior teeth, it was necessary to design a data collection sheet/questionnaire to collect the required information. Appendix 1 shows the initial draft of the questionnaire.

Three 3-dimensional guides were produced for the study. These are shown in Figures 1, 2 and 3.

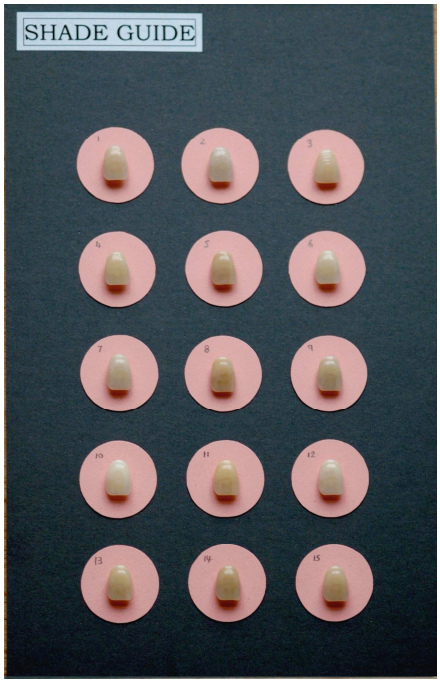

Figure 1 Shade guide

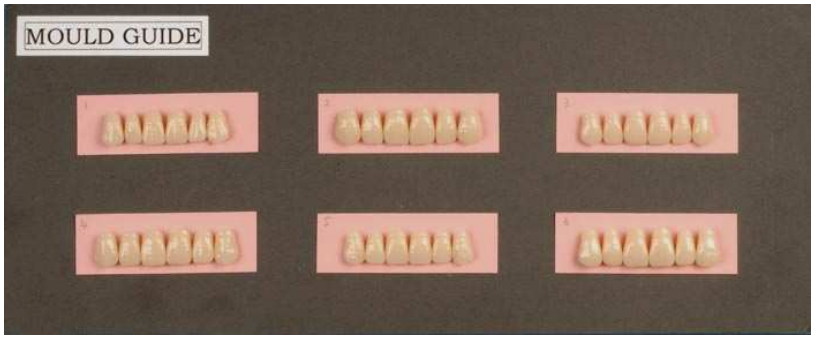

Figure 2 Mould guide

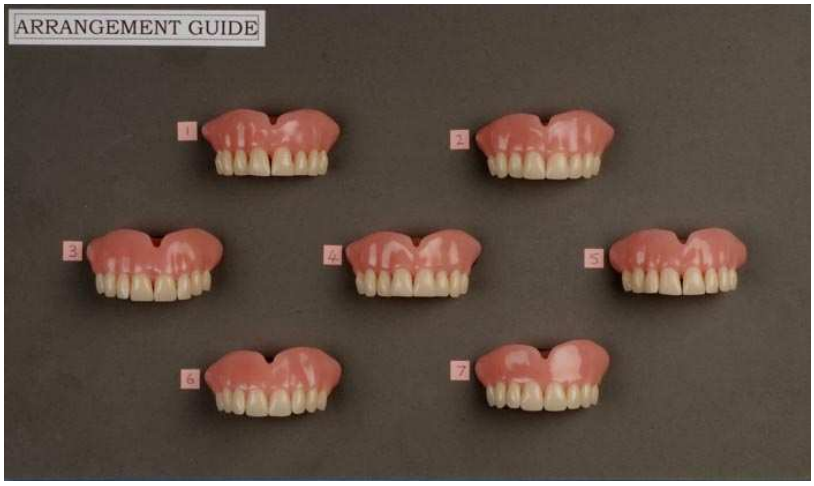

Figure 3 Arrangement guide

Six photographs of three dentate males and three dentate females were also produced for the study. These are shown in Figure 4.

The questionnaire along with the photographs and 3-dimensional guides were circulated among six dentists to test their suitability.

The dentists' feedback showed that, for the following reasons, they had had difficulty choosing a shade,

- Inconsistency in the colour of the photographs
- Variation in the lighting depending on the environment where shades were being chosen.
- Shades were randomly ordered and difficult to differentiate.

For these reasons it was decided to exclude the shade guide from the study and revise the questionnaire accordingly. Black and white photographs were used for consistency (Figure 4).

Appendix 2 shows a copy of the final draft of the questionnaire.

3.2 Description of the questionnaire

The first part of the questionnaire introduced the purpose of the research project (Appendix 2), then participants were asked to record general information regarding their own age and gender.

In the second part of the questionnaire, participants were asked to select, from the two 3-dimensional tooth guides, the teeth that they would use to construct a denture for the people detailed in the six photographs.

Taking age and gender into consideration, they were asked to select one mould from a choice of six and one arrangement from a choice of seven, that they thought most appropriate for each subject.

3.3 Description of the photographs

Six black and white photographs of three dentate males and three dentate females with closed smiles, representing youth, middle age and old age (approximately 20, 50 and 80 years) for both genders, were taken using a Nikon D70 camera. The photographs were fixed to grey cardboard and labelled A-F. These are shown in Figure 4.

The subjects were positioned to achieve a facial orientation perpendicular to the camera in order to provide respondents with the same view of each individual. All six individuals were friends or colleagues who had volunteered. The eyes in each photograph were blacked out as this detail was not deemed essential for the purposes of the study.

Figure 4 Photographs of three dentate males and three dentate females representing youth, middle age and old age.

3.4 Description of the 3-dimensional guides

The first tooth guide comprised of six different moulds, each with six maxillary anterior teeth (right canine to left canine). Three small moulds and three larger moulds were used. Each size included three different shapes of teeth (square, ovoid and tapering). All teeth were shade A3.

Each mould was mounted on a rectangular pink cardboard tab, placed on a neutral grey board and numbered 1-6 (Figures 2). Individual moulds are shown in Figures 5-10.

Figure 5 Small, tapered mould

Figure 6 Large, ovoid mould

Figure 7 Small, ovoid mould

Figure 8 Large, square mould

Figure 9 Small, square mould

Figure 10 Large, tapered mould

The second guide consisted of seven different arrangements each with eight maxillary anterior teeth (right first premolar to left first premolar). All teeth were the same mould and all teeth were shade A3.

Six of the set ups were arranged and customised to concur with some aesthetic principles, described by Frush and Fisher 1955, to reflect youth, middle age and old age for both males and females. One straight-forward set up was also included to represent an example of the ‘denture look’ (see page 28). This had no tooth imbrication, no tooth wear and no alterations to the denture base. As this straight-forward set up incorporated no tooth wear or gingival recession it was included in the results along with figure 12 (young male) and figure 16 (young female) as an arrangement indicative of youth (see Tables 21-26, 37-39).

The set ups were examined at the wax stage by prosthodontic specialists and senior prosthodontic technicians. Each agreed that the set ups accurately reflected the aesthetic principles previously mentioned. The seven maxillary tooth arrangements were then fabricated in a heat-cured PMMA acrylic resin, mounted on a neutral grey board and numbered 1-7. These are shown in Figures 11-17.

Figure 11 Old male

Figure 12 Young male

Figure 13 Middle aged female

Figure 14 Middle aged male

Figure 15 Old female

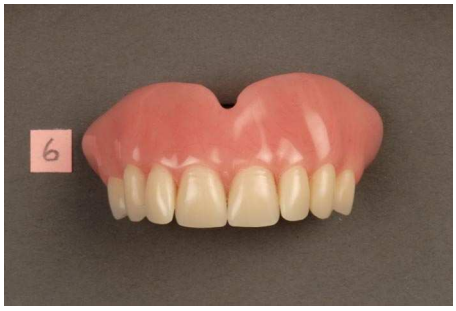

Figure 16 Young female

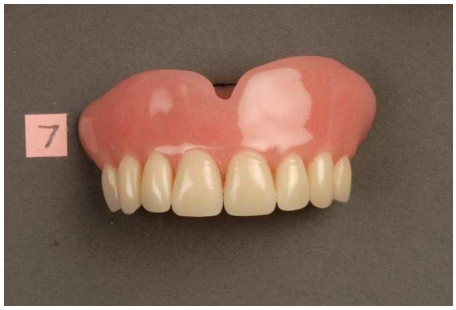

Figure 17 Straight-forward set up

3.5 Description of the study

Three groups of people were asked to complete the questionnaire (Appendix 2) designed to assess the variability in selection of anterior teeth appropriate for the age and gender of the individual. These groups included general dental practitioners, final year dental students and fine art students. An average time of 5 minutes was taken to complete the questionnaire.

General dental practitioners were accessed from a stand at the 2009 British Dental Association (BDA) conference and also by visiting independent practices in the Dumfries and Galloway region. 8 salaried general dental practitioners were accessed through a peer review meeting in Dumfries and Galloway.

Final year dental students were accessed through Glasgow Dental School and associated dental outreach clinics.

Fine art students were accessed through the Newcastle University's Fine Art Department.

The researcher was in the vicinity while questionnaires were being completed. This meant that any participant queries or misunderstandings could be addressed. It also gave an opportunity to check questionnaires before participants left to make sure that no errors had been made and all relevant areas had been completed.

3.6 Statistical methods

With the help of a statistician a target of 40 participants for each group was set. This was deemed to give the study sufficient power and at the same time would allow data to be collected within a realistic timescale.

The data collected was analysed using the SPSS statistical package (version 16.0 SPSS Inc, 1999) and Minitab software.

CHAPTER 4

RESULTS

4.1 Description of population

By the end of the survey, 40 general practitioners, 40 final year dental students and 40 fine art students had participated.

An attempt was made to achieve an equal spread of male and female participants within each group. Out of 40 dentists 18 (45%) were male and 22 (55%) were female. The dental student group consisted of 16 (40%) males and 24 (60%) females, and the art student group consisted of 17 (42.5%) males and 23 (57.5%) females.

For age range, dentists had 3 (7.5%) in the <25 year age group, 26 (65%) in the 25-50 year age group and 11 (27.5%) in the >50 age group. Fine art students had 36 (90%) in the <25 year age group, 1 (2.5%) in the 25-50 year age group and 3 (7.5%) in the >50 year age group. All 40 dental students fell into the <25 year age group.

The above results are shown in Tables 1 and 2 (see page 50).

		RATER		
		DENTIST	DENTAL STUDENT	ART STUDENT
MALE	count	18	16	17
	% within rater	45.0%	40.0%	42.5%
FEMALE	count	22	24	23
	% within rater	55.0%	60.0%	57.5%
TOTAL		40	40	40

Table 1 Numbers of male and female participants within the surveyed groups

		RATER		
		DENTIST	DENTAL STUDENT	ART STUDENT
<25 yrs	count	3	40	36
	% within rater	7.5%	100.0%	90%
25-50 yrs	count	26	0	1
	% within rater	65.0%	0.0%	2.5%
>50 yrs	count	11	0	3
	% within rater	27.5%	0.0%	7.5%
TOTAL		40	40	40

Table 2 Age range of participants within the surveyed groups

4.2 Testing for significance between individual groups

A Chi square test was applied to test the Null Hypothesis of ‘no significant differences between the groups surveyed, in relation to the selection of artificial anterior teeth for complete dentures’. The significance level was set to $p < 0.05$.

4.2.1 Tooth size

One significant difference was detected for tooth size. There was a statistically significant association for photograph B between rater and tooth size. 90.0% (36/40) of dentists and 85% (34/40) of dental students chose a large tooth size compared to 67.5% (27/40) of art students ($P = 0.027$). See Table 4.

Although a significant difference was shown, in relation to choice of tooth size, the results for each group still follow a similar pattern in that the majority of participants chose a larger tooth mould for the subject in photograph B.

The remaining results for tooth size showed no significant differences between the raters. These are illustrated in Tables 3, 5, 6, 7 and 8 (see page 52 and 53).

	RATER		
	DENTIST	DENTAL STUDENT	ART STUDENT
SMALL count	3	6	8
% within rater	7.5%	15.0%	20.0%
LARGE count	37	34	32
% within rater	92.5%	85%	80%
TOTAL	40	40	40
Pearson Chi-Square	p-value 0.272		

Table 3 Tooth size choices for photograph A (young male) + p-value

	RATER		
	DENTIST	DENTAL STUDENT	ART STUDENT
SMALL count	4	6	13
% within rater	10.0%	15.0%	32.5%
LARGE count	36	34	27
% within rater	90.0%	85%	67.5%
TOTAL	40	40	40
Pearson Chi-Square	p-value 0.027		

Table 4 Tooth size choices for photograph B (middle aged male) + p-value

	RATER		
	DENTIST	DENTAL STUDENT	ART STUDENT
SMALL count	10	9	15
% within rater	25.0%	22.5%	37.5%
LARGE count	30	31	25
% within rater	75%	77.5%	62.5%
TOTAL	40	40	40
Pearson Chi-Square	p-value 0.280		

Table 5 Tooth size choices for photograph C (old aged male) + p-value

	RATER		
	DENTIST	DENTAL STUDENT	ART STUDENT
SMALL count	30	35	31
% within rater	75.0%	87.5%	77.5%
LARGE count	10	5	9
% within rater	25.0%	12.5%	22.5%
TOTAL	40	40	40
Pearson Chi-Square	p-value 0.335		

Table 6 Tooth size choices for photograph D (young female) + p-value

	RATER		
	DENTIST	DENTAL STUDENT	ART STUDENT
SMALL count	27	23	23
% within rater	67.5%	57.5%	57.5%
LARGE count	13	17	17
% within rater	32.5%	42.5%	42.5%
TOTAL	40	40	40
Pearson Chi-Square	p-value 0.571		

Table 7 Tooth size choices for photograph E (middle aged female) + p-value

	RATER		
	DENTIST	DENTAL STUDENT	ART STUDENT
SMALL count	28	30	30
% within rater	70%	75.0%	75.0%
LARGE count	12	10	10
% within rater	30%	25.0%	25.0%
TOTAL	40	40	40
Pearson Chi-Square	p-value 0.843		

Table 8 Tooth size choices for photograph F (old aged female) + p-value

4.2.2 Tooth shape

Two significant differences were detected for tooth shape.

The first was a statistically significant association for photograph B between rater and tooth shape. 27.5% (11/40) of dental students and 22.5% (9/40) of art

students chose a square mould compared with 50% (20/40) of dentists (p = 0.034). See Table 10.

The second was a statistically significant association for photograph C between rater and tooth shape. 40% (16/40) of dental students and art students chose a square mould compared to 12.5% of dentists (p = 0.045). See Table 11.

The remaining results for tooth shape showed no significant differences between the raters. These are illustrated in Tables 9, 12, 13 and 14.

	RATER		
	DENTIST	**DENTAL STUDENT**	**ART STUDENT**
SQUARE count	**22**	**16**	**14**
% within rater	**55.0%**	**40.0%**	**35.0%**
OVOID count	**16**	**14**	**16**
% within rater	**40.0%**	**35.0%**	**40.0%**
TAPERED count	**2**	**10**	**10**
% within rater	**5.0%**	**25.0%**	**25.0%**
TOTAL	**40**	**40**	**40**
Pearson Chi-Square	**p-value 0.092**		

Table 9 Tooth shape choices for photograph A (young male) + p-value

	RATER		
	DENTIST	**DENTAL STUDENT**	**ART STUDENT**
SQUARE count	**20**	**11**	**9**
% within rater	**50.0%**	**27.5%**	**22.5%**
OVOID count	**17**	**18**	**22**
% within rater	**42.5%**	**45.0%**	**55.0%**
TAPERED count	**3**	**11**	**9**
% within rater	**7.5%**	**27.5%**	**22.5%**
TOTAL	**40**	**40**	**40**
Pearson Chi-Square	**p-value 0.034**		

Table 10 Tooth shape choices for photograph B (middle aged male) + p-value

	RATER		
	DENTIST	DENTAL STUDENT	ART STUDENT
SQUARE count	5	16	16
% within rater	12.5%	40.0%	40.0%
OVOID count	11	7	6
% within rater	27.5%	17.5%	15.0%
TAPERED count	24	17	18
% within rater	60.0%	42.5%	45.0%
TOTAL	40	40	40
Pearson Chi-Square	p-value 0.045		

Table 11 Tooth shape choices for photograph C (old aged male) + p-value

	RATER		
	DENTIST	DENTAL STUDENT	ART STUDENT
SQUARE count	16	9	14
% within rater	40.0%	22.5%	35.0%
OVOID count	14	14	15
% within rater	35.0%	35.0%	37.5%
TAPERED count	10	17	11
% within rater	25.0%	42.5%	27.5%
TOTAL	40	40	40
Pearson Chi-Square	p-value 0.366		

Table 12 Tooth shape choices for photograph D (young female) + p-value

	RATER		
	DENTIST	DENTAL STUDENT	ART STUDENT
SQUARE count	16	16	12
% within rater	40.0%	40.0%	30.0%
OVOID count	16	13	18
% within rater	40.0%	32.5%	45.0%
TAPERED count	8	11	10
% within rater	20.0%	27.5%	25.0%
TOTAL	40	40	40
Pearson Chi-Square	p-value 0.732		

Table 13 Tooth shape choices for photograph E (middle aged female) + p-value

	RATER		
	DENTIST	**DENTAL STUDENT**	**ART STUDENT**
SQUARE count	**15**	**13**	**16**
% within rater	**37.5%**	**32.5%**	**40.0%**
OVOID count	**11**	**13**	**8**
% within rater	**27.5%**	**32.5%**	**20.0%**
TAPERED count	**14**	**14**	**16**
% within rater	**35.0%**	**35.0%**	**40.0%**
TOTAL	**40**	**40**	**40**
Pearson Chi-Square	**p-value 0.793**		

Table 14 Tooth shape choices for photograph F (old aged female) + p-value

4.2.3 Gender arrangement

The results for gender arrangement showed no significant differences between the raters. These results are illustrated in Tables 15-20.

	RATER		
	DENTIST	**DENTAL STUDENT**	**ART STUDENT**
STRAIGHT FORWARD count	**10**	**11**	**9**
% within rater	**25.0%**	**27.5%**	**22.5%**
MASCULINE count	**16**	**13**	**10**
% within rater	**40%**	**32.5%**	**25.0%**
FEMININE count	**14**	**16**	**21**
% within rater	**35.0%**	**40.0%**	**52.5%**
TOTAL	**40**	**40**	**40**
Pearson Chi-Square	**p-value 0.539**		

Table 15 Gender arrangement choices for photograph A (young male) + p-value

	RATER		
	DENTIST	**DENTAL STUDENT**	**ART STUDENT**
STRAIGHT FORWARD count	**4**	**7**	**5**
% within rater	**10.0%**	**17.5%**	**12.5%**
MASCULINE count	**21**	**17**	**19**
% within rater	**52.5%**	**42.5%**	**47.5%**
FEMININE count	**15**	**16**	**16**
% within rater	**37.5%**	**40.0%**	**40.0%**
TOTAL	**40**	**40**	**40**
Pearson Chi-Square	**p-value 0.855**		

Table 16 Gender arrangement choices for photograph B (middle aged male) + p-value

	RATER		
	DENTIST	**DENTAL STUDENT**	**ART STUDENT**
STRAIGHT FORWARD count	**3**	**2**	**5**
% within rater	**7.5%**	**5.0%**	**12.5%**
MASCULINE count	**23**	**23**	**13**
% within rater	**57.5%**	**57.5%**	**32.5%**
FEMININE count	**14**	**15**	**22**
% within rater	**35.0%**	**37.5%**	**55.0%**
TOTAL	**40**	**40**	**40**
Pearson Chi-Square	**p-value 0.135**		

Table 17 Gender arrangement choices for photograph C (old aged male) + p-value

	RATER		
	DENTIST	**DENTAL STUDENT**	**ART STUDENT**
STRAIGHT FORWARD count	**17**	**10**	**12**
% within rater	**42.5%**	**25.0%**	**30.0%**
MASCULINE count	**13**	**9**	**10**
% within rater	**32.5%**	**22.5%**	**25.0%**
FEMININE count	**10**	**21**	**18**
% within rater	**25.0%**	**52.5%**	**45.0%**
TOTAL	**40**	**40**	**40**
Pearson Chi-Square	**p-value 0.148**		

Table 18 Gender arrangement choices for photograph D (young female) + p-value

	RATER		
	DENTIST	**DENTAL STUDENT**	**ART STUDENT**
STRAIGHT FORWARD count	**9**	**11**	**7**
% within rater	**22.5%**	**27.5%**	**17.5%**
MASCULINE count	**13**	**20**	**16**
% within rater	**32.5%**	**50.0%**	**40.0%**
FEMININE count	**18**	**9**	**17**
% within rater	**45.0%**	**22.5%**	**42.5%**
TOTAL	**40**	**40**	**40**
Pearson Chi-Square	**p-value 0.221**		

Table 19 Gender arrangement choices for photograph E (middle aged female) + p-value

	RATER		
	DENTIST	**DENTAL STUDENT**	**ART STUDENT**
STRAIGHT FORWARD count	**5**	**1**	**1**
% within rater	**12.5%**	**2.5%**	**2.5%**
MASCULINE count	**19**	**20**	**25**
% within rater	**47.5%**	**50.0%**	**62.5%**
FEMININE count	**16**	**19**	**14**
% within rater	**40.%**	**47.5%**	**35.0%**
TOTAL	**40**	**40**	**40**
Pearson Chi-Square	**p-value 0.177**		

Table 20 Gender arrangement choices for photograph F (old aged female) + p-value

4.2.4 Age arrangement

The results for age arrangement showed no significant differences between the raters. These results are illustrated in tables 21-26.

	RATER		
	DENTIST	**DENTAL STUDENT**	**ART STUDENT**
YOUNG count	**29**	**29**	**24**
% within rater	**72.5%**	**72.5%**	**60.0%**
MIDDLE count	**8**	**9**	**11**
% within rater	**20.0%**	**22.5%**	**27.5%**
OLD count	**3**	**2**	**5**
% within rater	**7.5%**	**5.0%**	**12.5%**
TOTAL	**40**	**40**	**40**
Pearson Chi-Square	**p-value 0.643**		

Table 21 Age arrangement choices for photograph A (young male) + p-value

	RATER		
	DENTIST	DENTAL STUDENT	ART STUDENT
YOUNG count	15	16	16
% within rater	37.5%	40.0%	40.0%
MIDDLE count	16	17	12
% within rater	40.0%	42.5%	30.0%
OLD count	9	7	12
% within rater	22.5%	17.5%	30.0%
TOTAL	40	40	40
Pearson Chi-Square	p-value 0.675		

Table 22 Age arrangement choices for photograph B (middle aged male) + p-value

	RATER		
	DENTIST	DENTAL STUDENT	ART STUDENT
YOUNG count	5	7	10
% within rater	12.5%	17.5%	25.0%
MIDDLE count	10	11	13
% within rater	25.0%	27.5%	32.5%
OLD count	25	22	17
% within rater	62.5%	55.0%	42.5%
TOTAL	40	40	40
Pearson Chi-Square	p-value 0.452		

Table 23 Age arrangement choices for photograph C (old aged male) + p-value

	RATER		
	DENTIST	DENTAL STUDENT	ART STUDENT
YOUNG count	33	36	30
% within rater	82.5%	90.0%	75.0%
MIDDLE count	6	1	8
% within rater	15.0%	2.5%	20.0%
OLD count	1	3	2
% within rater	2.5%	7.5%	5.0%
TOTAL	40	40	40
Pearson Chi-Square	p-value 0.150		

Table 24 Age arrangement choices for photograph D (young female) + p-value

	RATER		
	DENTIST	DENTAL STUDENT	ART STUDENT
YOUNG count	30	27	19
% within rater	75.0%	67.5%	47.5%
MIDDLE count	7	10	15
% within rater	17.5%	25.0%	37.5%
OLD count	3	3	6
% within rater	7.5%	7.5%	15.0%
TOTAL	40	40	40
Pearson Chi-Square	p-value 0.130		

Table 25 Age arrangement choices for photograph E (middle aged female) + p-value

	RATER		
	DENTIST	DENTAL STUDENT	ART STUDENT
YOUNG count	12	6	9
% within rater	30.0%	15.0%	22.5%
MIDDLE count	5	13	11
% within rater	12.5%	32.5%	27.5%
OLD count	23	21	20
% within rater	57.5%	52.5%	50.0%
TOTAL	40	40	40
Pearson Chi-Square	p-value 0.214		

Table 26 Age arrangement choices for photograph F (old aged female) + p-value

4.3 Testing for significance within individual groups

4.3.1 Tooth size

A Chi-Square test was applied to test the Null hypothesis of 'no significant difference, within the groups surveyed, when choosing a tooth size for the subjects detailed in the photographs'.

There was a highly significant association for all three groups, between the gender of the subjects and tooth size.

When 40 dentists were asked to select tooth moulds for male subjects, 103 out of 120 choices (85.8%) were for large tooth moulds compared with selections for female subjects where 35 out of 120 choices (29.2%) were for large moulds. (p-value = < 0.001) see Table 27.

When 40 dental students were asked to select tooth moulds for male subjects, 99 out of 120 choices (82.5%) were for large tooth moulds compared with selections for female subjects where 32 out of 120 choices (26.7%) were for large moulds. (p-value = < 0.001) see Table 28.

When 40 art students were asked to select tooth moulds for male subjects, 84 out of 120 choices (70%) were for large tooth moulds compared with selections for female subjects where 36 out of 120 choices (30%) were for large moulds. (p-value = < 0.001) see Table 29.

	MALE (Photographs A,B&C)	**FEMALE (Photographs D,E&F)**
SMALL	**17**	**85**
LARGE	**103**	**35**
TOTAL	**120**	**120**
Chi-Square	**p-value = < 0.001**	

Table 27 Dentists' tooth size choices for male and female subjects

	MALE (Photographs A,B&C)	**FEMALE (Photographs D,E&F)**
SMALL	**21**	**88**
LARGE	**99**	**32**
TOTAL	**120**	**120**
Chi-Square	**p-value = < 0.001**	

Table 28 Dental students' tooth size choices for male and female subjects

	MALE (Photographs A,B&C)	**FEMALE (Photographs D,E&F)**
SMALL	**36**	**84**
LARGE	**84**	**36**
TOTAL	**120**	**120**
Chi- Square	**p-value = < 0.001**	

Table 29 Art students' tooth size choices for male and female subjects

4.3.2 Tooth shape

A Chi-Square test was applied to test the Null hypothesis of 'no significant difference, within the groups surveyed, when choosing a tooth shape for the subjects detailed in the photographs'.

The results of the statistical test demonstrated no significant differences within the groups, in relation to tooth shape, and the Null hypothesis was not rejected ($p > 0.05$).

	MALE (Photographs A,B&C)	FEMALE (Photographs D,E&F)
SQUARE	47	47
OVOID	44	41
TAPERED	29	32
TOTAL	120	120
Chi-Square	p-value = 0.881	

Table 30 Dentists' tooth shape choices for male and female subjects

	MALE (Photographs A,B&C)	FEMALE (Photographs D,E&F)
SQUARE	43	38
OVOID	39	40
TAPERED	38	42
TOTAL	120	120
Chi-Square	p-value = 0.771	

Table 31 Dental students' tooth shape choices for male and female subjects

	MALE (Photographs A,B&C)	FEMALE (Photographs D,E&F)
SQUARE	39	42
OVOID	44	41
TAPERED	37	37
TOTAL	120	120
Chi-Square	p-value = 0.897	

Table 32 Art students' tooth shape choices for male and female subjects

	MALE (Photographs A,B&C)	FEMALE (Photographs D,E&F)
SQUARE	129	127
OVOID	127	122
TAPERED	104	111
TOTAL	360	360

Table 33 Dentists', Dental students' and Art students' tooth shape choices combined for male and female subjects.

4.3.3 Gender arrangement

A Chi-Square test was applied to test the Null hypothesis of 'no significant differences, within the groups surveyed, when choosing a masculine or feminine arrangement for the subjects detailed in the photographs'.

The results of the statistical test showed no significant differences within the groups, in relation to gender arrangement, and the Null hypothesis was not rejected ($p > 0.05$).

	MALE (Photographs A,B&C)	FEMALE (Photographs D,E&F)
MASCULINE ARRANGEMENT	60	45
FEMININE ARRANGEMENT	43	44
TOTAL	103	89
Chi-Square	p-value = 0.286	

Table 34 Dentists' gender arrangement choices for male and female subjects

	MALE (Photographs A,B&C)	FEMALE (Photographs D,E&F)
MASCULINE ARRANGEMENT	53	49
FEMININE ARRANGEMENT	47	49
TOTAL	100	98
Chi-Square	p-value = 0.673	

Table 35 Dental students' gender arrangement choices for male and female subjects

	MALE (Photographs A,B&C)	FEMALE (Photographs D,E&F)
MASCULINE ARRANGEMENT	42	51
FEMININE ARRANGEMENT	59	49
TOTAL	101	100
Chi-Square	p-value = 0.181	

Table 36 Art students' gender arrangement choices for male and female subjects

4.3.4 Age arrangement

A Chi-Square test was applied to test the Null hypothesis of 'no significant differences, within the groups surveyed, when choosing a young, middle aged or old aged arrangement for the subjects detailed in the photographs'. There was a highly significant association for all three groups, between the age of the subjects and the age arrangement.

When 40 dentists were asked to choose an arrangement for young subjects, 62 out of 80 choices (77.5%) were for arrangements indicative of youth, 14 out of 80 choices (17.5%) were for arrangements indicative of middle age and 4 out of 80 choices (5.0%) were for arrangements indicative of old age. When 40 dentists were asked to choose an arrangement for old subjects, 48 out of 80 choices (60%) were for arrangements indicative of old age, 15 out of 80 choices (18.75%) were for arrangements indicative of middle age and 17 out of 80 choices (21.2%) were for arrangements indicative of youth.(p-value = < 0.001) see Table 37.

When 40 dental students were asked to choose an arrangement for young subjects, 65 out of 80 choices (81.25%) were for arrangements indicative of youth, 10 out of 80 choices (12.5%) were for arrangements indicative of middle age and 5 out of 80 choices (6.25%) were for arrangements indicative of old age. When 40 dental students were asked to choose and arrangement for old subjects, 43 out of 80 choices (53.75%) were for arrangements indicative of old age, 24 out of 80 choices (30%) were for arrangements indicative of middle age and 13 out of 80 choices (16.25%) were for arrangements indicative of youth. (p-value = < 0.001) see Table 38.

When 40 art students were asked to choose an arrangement for young subjects, 54 out of 80 choices (67.5%) were for arrangements indicative of youth, 19 out of

80 choices (23.75%) were for arrangements indicative of middle age and 7 out of 80 choices (9.75%) were for arrangements indicative of old age.

When 40 art students were asked to choose an arrangement for old subjects 37 out of 80 choices (46.25%) were for arrangements indicative of old age, 24 out of 80 choices (30%) were for arrangements indicative of middle age and 19 out of 80 choices (23.75%) were for arrangements indicative of youth.

(p-value = < 0.001) see Table 39.

	YOUNG AGED (Photographs A&D)	MIDDLE AGED (Photographs B&E)	OLD AGED (Photographs C&F)
YOUNG ARRANGEMENT	62	45	17
MIDDLE AGED ARRANGEMENT	14	23	15
OLD AGED ARRANGEMENT	4	12	48
TOTAL	80	80	80
Chi-square	p-value = < 0.001		

Table 37 Dentists' age arrangement choices for young, middle aged and old aged subjects

	YOUNG (Photographs A&D)	MIDDLE AGED (Photographs B&E)	OLD AGED (Photographs C&F)
YOUNG ARRANGEMENT	65	43	13
MIDDLE AGED ARRANGEMENT	10	27	24
OLD AGED ARRANGEMENT	5	10	43
TOTAL	80	80	80
Chi-Square	p-value = < 0.001		

Table 38 Dental students' age arrangement choices for young, middle aged and old aged subjects

	YOUNG (Photographs A&D)	MIDDLE AGED (Photographs B&E)	OLD AGED (Photographs C&F)
YOUNG ARRANGEMENT	54	35	19
MIDDLE AGED ARRANGEMENT	19	27	24
OLD AGED ARRANGEMENT	7	18	37
TOTAL	80	80	80
Chi-Square	p-value = < 0.001		

Table 39 Art students' age arrangement choices for young, middle aged and old aged subjects

CHAPTER 5

DISCUSSION

5.1 Introduction

An ideal study would provide a randomised sample that represented general dental practitioners, final year dental students and fine art students in the UK. Within the resources available it was not possible to conduct a study on such a large scale.

Initially a postal questionnaire was considered for the study, however the inherent problems with gaining a good response rate are well known and it was felt that approaching potential participants directly would be more reliable (Cohen and Sheiham 1989). This would also allow closer inspection of the 3 dimensional guides compared to photographs of the guides sent through the post.

Owing to the time consuming nature of a direct approach, it was decided to seek out opportunities where an audience could be captured. Initial attempts to visit high street dental practices proved unsuccessful as dentists were either not interested in participating or could not spare the time.

30 general dental practitioners were accessed via a stand at the 2009 BDA conference in Glasgow. 8 salaried general dental practitioners were accessed through a peer review group organised by Dumfries and Galloway Health Board. 2 general dental practitioners were accessed individually at their practices.

40 final year dental students were accessed through the University of Glasgow dental school and associated outreach centres.

40 fine art students were accessed through the University of Newcastle-upon-Tyne fine art department.

5.2 Three groups of participants

As previous studies on the perception of denture aesthetics had concentrated on staff and students within the dental schools (Sellen et al. 2001, 2002; McCord 1994) it was decided, within this study, to include participants from outside this environment. These would take the form of general dental practitioners and fine art students. As well as this, a group of final year dental students was asked to participate.

It was believed that comparisons could potentially point out differences between general dental practitioners and final year dental students, with regards to the choice of artificial teeth for complete dentures when age and gender are taken into consideration.

When investigating the variation in choice of artificial anterior teeth for complete dentures, Sellen et al. (2001, 2002) concluded that there was a need for improved training and guidance for qualified dentists as well as students in Bristol Dental School.

The research presented in this study was interested in carrying out a similar study to that of Sellen et al. (2002) but at the same time incorporating non dental school based dental participants (general dental practitioners) and non dental participants (fine art students).

Final year dental students were chosen over those in lower year groups as it was believed that by this stage in their undergraduate course they would be more likely to have received some form of training in complete denture construction.

Fine art students were chosen to represent a group of lay people. Here it was believed that comparisons could potentially point out differences between dental and non dental participants, with regards to the choice of artificial teeth for complete dentures when age and gender are taken into consideration. It was thought that choosing fine art students would help aid data collection. A single art school providing a captured audience, alongside the students' aesthetic interests may increase the likelihood of participation. This proved to be the case, with fine art students being the most obliging group of participants.

5.3 Test of suitability

Before the main body of data could be collected it was important to test the suitability of the survey. To do this, the questionnaire along with photographs and 3 dimensional guides was circulated among six dentists. Each dentist studied the components of the survey separately.

The main criticism from the dentists involved the component of the study which involved choosing a shade. The following points were raised;

- Inconsistency in the colour of the photographs made it difficult to appreciate the subjects complexion and therefore difficult to choose a shade.

- Variation in lighting of the environment where shades are chosen could be problematic.

- Random arrangement of tooth shades on guide made differentiation more difficult.

For the reasons mentioned above it was decided to exclude the shade guide from the study and focus on mould and arrangement only. This helped to simplify the questionnaire and lessen completion time for participants.

As it was only necessary for the photographs to portray the age and gender of the subjects it was decided to use black and white photographs for consistency.

One dentist also highlighted the importance of the patient's input to the process of tooth selection and it was felt that they couldn't make a choice without this information. It was acknowledged that the patient's input was an essential and integral part of the denture construction process, however for this study the focus was solely to be based on general dental practitioners', dental students' and fine art students' perceptions.

The questionnaire followed a simple design and all six dentists agreed that it was straight forward and easy to complete.

It was agreed, for the mould guide, that three typal forms could be identified and the difference between large and small moulds were easy recognised.

As was mentioned previously (Chapter 3), with regards to the arrangement guide, six set ups were arranged and customised to concur with some aesthetic principles described (Frush and Fisher, 1955) to reflect youth, middle age and old age for both males and females.

Arrangements indicative of a youthful appearance had thinner gingiva contoured on the cervical margin, tooth to tooth contact and no incisal wear. The feminine arrangements demonstrated overlapping of the lateral incisors onto the central incisors and a more rounded arch form. The masculine arrangements demonstrated depression of the lateral incisors resulting in a more palatal position compared with the central incisors. A squarer arch form was used.

Arrangements indicative of middle age followed the tooth relationships outlined above for male and female, respectively, but had slightly thickened gingiva with a little recession, some small diastemas and visible incisal wear.

In comparison, arrangements indicative of old age demonstrated similar tooth arrangement, moderately sized diastemas and heavier incisal wear. The gingival appearance thickened together with significantly more recession.

One straight-forward set up was also included. This had no tooth imbrication, no tooth wear and no alterations to the denture base.

Several attempts were required to achieve sufficient consistency with male and female arrangements and with age group arrangements. With each gender arrangement representing the same dentition at different stages of life (20 yrs, 50 yrs, 80 yrs) it was important to recreate similar tooth positions.

The guides were scrutinised by three experts in the field of prosthodontics and it was agreed that the completed arrangements were indicative of the aesthetic principles that had been followed.

No other problems were highlighted by the test group.

5.4 Discussion of similar studies and how research method was defined and modified

A study into the variation of choice among dental staff, with regards to the selection of appropriate artificial teeth for complete dentures, concluded that there was very little consistency in the answers of respondents (Sellen et al., 2002). Dental staff were asked to choose one shade, one mould and one arrangement that they thought appropriate for each of three male subjects detailed in photographs. These subjects represented youth, middle age and old age. Choices were made from a variety of aesthetic guides and responses were compared to the shade, mould and arrangement of the subject's actual natural dentition. Although Sellen et al. (2002) concluded that there was little consistency in dental staffs' responses, it appears that this is not necessarily true.

Positive results were based on participants choosing the exact shade, mould or arrangement present in each of the subject's natural dentition. A very low success rate reflected the difficult nature of this task.

If an approach was taken where general answers were sought instead of specific answers, the results showed that as the subjects got older dental staff tended to choose darker shades. This would appear to be in keeping with the idea of appropriate tooth selection if we assume that teeth naturally darken as we get older. Overall, according to Sellen et al. (2002), only 4% of dental staff chose what the researchers considered to be the correct shades, however when these results were analysed more closely it was shown that darker shades were consistently chosen for older subjects. If anything, their attempt to select appropriate shades was exaggerated.

It is interesting to note that Sellen and his co-workers' (2002) choice of male subjects showed the male representing middle age had a brighter tooth shade than that representing youth. This not only highlights the sometimes random nature of the natural dentition and the fact that not all patients will fall into generalised categories, but also appears to contradict the thinking behind the study which followed the idea that whiter shades of teeth for older individuals

are inappropriate and may draw attention to the prosthesis rather than improve facial character and appearance.

Although Sellen and his colleagues' studies (2001; 2002) have been influential, as far as this research thesis is concerned, it was decided to take a more general approach where answers did not need to be specific, to be classified as appropriate. Details of the subject's natural dentitions were not recorded. It was believed that more reliable conclusions could be drawn using this approach.

Another example of this specificity can be seen in the work of Sellen et al. (2001) which concluded that dental students at one dental school had difficulty selecting artificial anterior teeth which were appropriate for the age and gender of the denture wearer. Here dental students were asked to correctly identify six artificial tooth arrangements according to age and gender. As the study did not analyse age and gender separately students were not credited, for example, for choosing a young set up for a young subject or an older set up for an older subject. Instead correct results relied heavily on the ability of students to recognise subtle differences associated with gender according to dentogenic concepts (Frush and Fisher, 1955). The results showed that only 8% of students categorised all arrangements correctly. This success rate may reflect the difficult nature of this task.

For the above reason it was decided that, for the research in this thesis, aesthetic components being assessed would be analysed separately with the belief that a more realistic reflection could be given for any potential training needs.

It was also decided that in order to provide more balance to the study, photographs of three males and three females would be used. When using only male subjects it can only be assumed how participants perceive tooth selection for female subjects. By using both genders any assumptions should be lessened.

5.5 Discussion of the size of tooth selected

Only one significant difference was detected for tooth size when statistical tests were carried out between the groups. This difference related to selections for the middle aged male in photograph B (p-value = 0.027).

However, when counts were observed this difference appeared less significant with 36/40 dentists and 34/40 dental students choosing a large tooth mould compared to 27/40 art students choosing a large tooth mould. It was clear that although significance was found between the groups, each group had followed a similar pattern, with the majority of participants choosing large tooth moulds for this male subject.

When the groups were analysed individually a highly significant association was found for all three groups between the gender of the subjects and tooth size (P-value = < 0.001). The majority of participants chose large tooth moulds for all male photographs (A, B and C) and small tooth moulds for all female photographs (D, E and F).

The literature review in this study did not identify any comparable studies describing dentists' perceptions of tooth size for male and female subjects.

It is interesting to note that most participants associated larger teeth for male subjects as an appropriate choice when no evidence can be identified to suggest that the natural dentitions of males tend to have larger anterior teeth than females. It is also interesting to note that fine art students had a similar perception to that of dental participants.

5.6 Discussion of the shape of tooth selected

Two significant differences were found between the groups when tooth shape selections were statistically tested.

The first difference was associated with photograph B (middle aged male) where 11/40 dental students and 9/40 art students chose a square mould compared with 20/40 dentists.

The second difference was associated with photo C (old aged male) where 16/40 dental students and 16/40 art students chose a square mould compared with 5/40 dentists.

Although the results for individual photographs showed significant differences, it could be seen that tooth shape selections were inconsistent when photographs were compared. For example, 20/40 dentists chose a square mould for the male in photo B, but only 5/40 chose a square mould for the male in photo C. With this in mind, it was believed that looking for significance within each group and at the combined results for both male and female photographs, for each group, would provide a better reflection of selection patterns.

When statistical tests were applied within individual groups, no significant differences in relation to tooth shape were found.

Combined results showed dentists' selections of tooth shape to be similar for both genders; square being the most popular choice, followed by ovoid, with tapered being the least popular choice (see Table 30).

Combined results showed that dental students selected square moulds as the most popular for male subjects, followed by ovoid, with tapered the least popular. For female subjects, tapered was the most popular choice, followed by ovoid, with square being the least popular choice (see Table 31).

Combined results for art students showed ovoid to be the most popular choice for male subjects, followed by square, with tapered being the least popular choice. For female subjects, square was the most popular choice, followed by ovoid, with tapered being the least popular choice (see Table 32).

These results show a large variation in tooth shape selection for male and female subjects. This supports the inconsistent findings of Sellen et al., (2002) with regard tooth shape.

When tooth shape results for male and female subjects were totalled for all the groups it revealed a similar pattern for both genders. Square teeth were the

most popular choice, followed closely by ovoid, with tapered being the least popular choice (See Table 33).

Brisman's 1980 study into perceptions of denture aesthetics, found a preference for patients and dentists to choose square teeth for male patients, thus supporting the dentogenic concept. The findings in this research thesis, in relation to tooth shape, do not support the dentogenic concept.

In addition to this Brisman (1980) found tapered moulds to be the least popular choice of tooth shape. This finding is supported by the work in this thesis.

It may be argued that the lack of consistency in the selection of tooth shape may suggest that subtle differences in shape can be quite difficult to perceive. In Marunick's 1983 study, participants' attention had to be drawn to tooth shape before any realisation of differences could be made. Marunick (1983) remarked that tooth shape or typal matching may be of negligible importance compared to other aesthetic factors concerned with dentofacial appearance.

5.7 Discussion of the gender arrangements selected

No significant differences were found, in relation to gender arrangement, between the groups or within individual groups.

Dentists chose masculine arrangements as the most popular choice for both male and female subjects. Dental students chose masculine arrangements as the most popular for male subjects and equal counts of masculine and feminine arrangements were recorded for female subjects. Art students chose feminine arrangements as the most popular choice for male subjects and masculine arrangements as the most popular choice for female subjects.

It is interesting to note that the straight-forward set up was chosen quite regularly by all three groups. Overall dentists chose this option 20% of the time, dental students chose it 17.9% of the time and art students chose it 16.25% of the time. This may highlight a lack of attention paid, by the participants, to gingival contouring and imbrication details. It may also be argued that there was a preference for a straighter alignment of teeth for certain subjects. This set up

may also have been seen to be more youthful in appearance compared to arrangements indicative of older subjects as no wear or exaggerated recession had been incorporated.

The inconsistencies highlighted in this research thesis, in relation to gender arrangement selection, are in agreement with the findings of Hyde et al. (1999), where experts were unable to distinguish gender by visual assessment. They also support the findings of McCord (1994) who concluded that there was little perceived personalisation of complete dentures.

Although Sellen et al. (2001, 2002) found similar inconsistencies; his conclusions suggested that participants had an inability to choose arrangements appropriately, leading to a perceived need for training.

If a true sexual dimorphia exists in the natural dentition its subtleties may be very difficult for the human eye to perceive. It can therefore be argued that the decision to use these aesthetic principles or not should be down to a matter of personal preference. These aspects of the study may be too subjective to be used as a judge as to what is an appropriate tooth selection.

5.8 Discussion of age arrangements selected

As no significant differences were shown between the groups, when statistical tests were applied, it may be assumed that all groups followed a similar pattern of selection, in relation to age arrangement.

When a Chi-Square test was applied to the individual groups, it was found that all three groups showed a highly significant association between the age of the subjects and age arrangement. The majority of participants selected arrangements indicative of youth for young subjects and arrangements indicative of old age for old subjects.

The work of Sellen et al. (2002) is in agreement with a previous study which reported that clinicians more frequently select suitable anterior arrangements for old patients than for other age groups (Matthais et al., 1993).

Although the findings in this research thesis were highly significant with regard to clinicians choosing arrangements indicative of old age for old subjects, clinicians more frequently selected arrangements indicative of youth for young subjects (see Tables 37-39). This does not support the findings of Sellen et al. (2002) and Matthais et al. (1993).

It appears that from the limited research carried out, with regard the perception of denture aesthetics, there is a strong awareness of how the oral tissues are likely to change as a person gets older. This raises the question of why more dentures are not produced with a more individualised approach (Ali, 1999).

5.9 Patients' perceptions of denture aesthetics and the idea of appropriateness

The aesthetic outcome of complete denture treatment receives little attention in the dental literature (McCord 1994), and this is supported by the findings in this research thesis.

Although studies by Sellen et al. (2001, 2002) and the research in this thesis did not focus on patient perceptions of denture aesthetics, it is an essential aspect of denture construction that must not be overlooked.

Amongst the limited studies that do focus on patient perceptions of denture aesthetics (Brisman,1980; Marunick, 1983; McCord, 1994), Brisman speculated that dentists may develop concepts of an aesthetic appearance that differ from that of patients, this may lead to communication problems and unanticipated treatment difficulties.

The idea of patients being given dental compositions that conform to their own concept of aesthetic appearance may increase the likelihood of a successful outcome with regards appearance. With this in mind, dentists should be aware of patients' opinions on denture appearance and their need for a more positive body image. Using techniques which have the potential to increase self esteem and social confidence should be encouraged. This may or may not mean

following the dentogenic concept, depending on which patient is receiving the treatment.

According to the dentogenic concept; to help restore the facial profile of edentulous patients, appropriately prescribed denture teeth should reflect the age of a patient and their general arrangement should impart appropriate character and gender (Grant 1992).

It could be argued that the word ‘appropriate’ implies that a right or wrong answer exists when it comes to selecting artificial teeth. Sellen et al. (2001, 2002) analysed their results based on the expectation that participants chose the exact shade, mould or arrangement of the subject’s natural dentition. This would appear to be an impossible task for the most experienced prosthodontist and any correct answers, it could be argued, may be down to luck.

If an approach is taken where a clinician follows the concept of how oral tissues change as a person ages i.e. teeth generally darken, wear and the gingival tissue recedes, it could be argued that, although still subjective, an appropriate choice of teeth for a particular individual should exist. However, the idea of imparting character and gender is much more subjective, and the idea of what is appropriate may be more a case of personal preference.

It must be remembered that the dentogenic concept, although providing a useful aid to the process of tooth selection and opening up clinicians’ minds to what may be achievable, is just an idea invented by a limited number of people. Beauty, being in the eye of the beholder, means that patients’ perceptions can not be ignored if successful treatment outcomes are to be attained. No matter how much effort a clinician has made to achieve what he or she thinks is an appropriate dentofacial appearance, it will be the patient who will wear the prosthesis and the patient who will decide whether it is a success or not.

A similarity in the pattern of non-dental participants’ tooth selections compared to dental participants’ tooth selections may suggest that most people have a general perception of what happens to oral tissues as a person ages. However, as this study was only concerned with what teeth participants selected for other

individuals, it can not be assumed that the same patterns would be followed if participants had to select teeth for themselves.

The interest and pressure for people to look younger as they age may influence people's choice of teeth and at the same time redefine what is appropriate. When anterior teeth are lost as a result of neglect or trauma, this presents an opportunity to improve dentofacial appearance with an artificial replacement. Being able to choose straighter, whiter and a less worn dentition may have the potential to create a more attractive appearance than that which existed previously. For this reason, providing a construction that appears to be in keeping with the age and gender of the patient and incorporates a more 'natural' and less ideal arrangement, may not necessarily appeal to most patients. This may explain why denture wearers have been reported to possess a more positive body image of themselves when compared with non denture wearers (Alvi et al., 1984).

For the individual who is keen to achieve a natural appearance there is much that can be done to reproduce features once present in the natural dentition. Therefore, it is essential to establish good communication with the patient in order to assess their aesthetic requirements based on individual preferences (Neumann 1989).

5.10 Weaknesses in the study/future research

It was noted that the difference in tooth mould shape may have been quite difficult to perceive and, following a similar approach to Brisman (1980), who used drawn shapes to represent typal forms, may have provided a more accurate reflection of participant's preferences.

It was also noted that all groups chose the large tapered mould as the most popular choice for the old aged male. On reflection it could be seen that this mould looked longer than the other moulds, and may have been perceived as a tooth with more recession, thus being chosen for an older aged subject.

Using drawn tooth shapes, as mentioned previously, or waxed moulds instead of unwaxed moulds may have presented tooth shapes with more definition of typal form.

Achieving consistency with the tooth arrangements was challenging, and although great efforts were made to ensure accuracy, it could still be argued that inconsistencies may have affected participants' choices.

This particular study may be looked upon as a pilot study, with the potential for a further more extensive study into dentists', dental students' and lay peoples' perceptions of denture aesthetics. A study of patients' perceptions of dental attractiveness would also provide a very interesting area of research.

5.11 General summary

Much has been done to develop rules and formulae which hope to establish a system for the optimum selection and placement of artificial anterior teeth for complete dentures.

Some studies (Sellen et al., 2001, 2002) have suggested that a need for improved training exists among qualified dentists and dental students, with regard to tooth selection for complete dentures. Within this research thesis, it has been found that dentists and dental students consistently chose arrangements that were indicative of a subject's age category. They also consistently chose larger teeth for male subjects and smaller, more delicate teeth for female subjects. As far as providing a denture which follows a dentogenic concept is concerned, these two findings support this concept and suggest that a training need does not exist.

It is interesting to note the similarity in the pattern of choices made by art students. This may suggest that the general public hold a certain concept of how oral tissues change as a person ages and that dental training may not be the main reason for dentists' and dental students' choices.

Inconsistent choices with regards gender arrangement and tooth shape, in this research thesis, were in keeping with the studies of Sellen et al. (2001, 2002).

This may highlight a specific training need or it may be argued that these inconsistencies are as a result of factors which are too subtle to perceive and subsequently less important than other aesthetic factors.

It is interesting to note the similar inconsistencies in art students' choices. This may suggest that any inconsistencies are more likely to be due to the subjective and subtle nature of gender arrangement and tooth shape, rather than inadequate training.

If one concludes that a training need exists for these particular aspects of artificial tooth selection, it is difficult to know what form this training should take.

The idea that a reliable method for selecting artificial teeth exists has lessened as this study has progressed and with it the idea of providing specific training in this area of dentistry.

To a certain extent the idea of naturalness and the general idea of what happens to the oral tissues as one ages should be discussed, however each denture making situation is unique and it could be argued that it is impossible to teach the judgement of the subtleties of denture aesthetics. This can only come with experience (trial and error) and a genuine interest in this area of dentistry. It could also be argued that artistic ability and good powers of observation may increase the chances of a good aesthetic result.

Building an understanding of the methods used for tooth selection over the years can provide dentists with a starting point and help them develop their own tooth selection preferences, however making assumptions about what may exist in the natural dentition and rigidly trying to impose this in the clinical setting may increase the likelihood of failure. Attempting to instil a strong perception of an individualised approach to denture construction may make the process more difficult if patient perceptions are generally different.

With less time being devoted to complete denture training compared to the past (McCord, 2003), it may be said that mastering the basic aspects of denture construction is more important than spending time on the fine details. Van

Victor (1963) observed that the appearance of each individual tooth is not as important as the overall arrangement and the positioning of the teeth as a whole. Making sure a denture is functional and that the basic size and positioning of the teeth are acceptable may be viewed as the most important aspects of denture construction. Colour could possibly accommodate the next level of importance, with imbrication, denture base details and tooth shape being the least important aesthetic factors.

CHAPTER 6

CONCLUSIONS

- No universally reliable method was found for determining tooth selection when an extensive literature review was undertaken.

- No relevant significant differences were found between general dental practitioners, final year dental students and fine art students, in relation to the selection of artificial teeth appropriate for the age and gender of the complete denture wearer.

- There was a highly significant association, within all three groups of participants (general dental practitioners, final year dental students and fine art students), between the gender of the denture wearer and the tooth size selected.

- No significant differences were found, within the three groups of participants (general dental practitioners, final year dental students and fine art students), in relation to the tooth shape selected.

- No significant differences were found, within the three groups of participants (general dental practitioners, final year dental students and fine art students), in relation to the gender arrangement selected.

- There was a highly significant association, within all three groups of participants (general dental practitioners, final year dental students and fine art students), between the age of the denture wearer and the age arrangement selected.

- There was no positive evidence to suggest a definite need for improved training for general dental practitioners or final year dental students, in relation to selecting artificial teeth appropriate for the age and gender of the denture wearer.

APPENDICES

APPENDIX 1

SELECTING ARTIFICIAL ANTERIOR TEETH FOR COMPLETE DENTURES

SELECT THE TEETH THAT YOU WOULD USE TO CONSTRUCT A DENTURE FOR THE PEOPLE IN THE PHOTOGRAPHS.
TAKING AGE AND GENDER INTO CONSIDERATION USE THE TOOTH GUIDES TO SELECT ONE SHADE, ONE MOULD (SHAPE/SIZE) AND ONE ARRANGEMENT FOR EACH PERSON.

MALE/FEMALE AGE: < 25yrs / 25-50yrs / > 50yrs

PHOTO A

Shade	1-15	☐
Mould	1-6	☐
Arrangement	1-7	☐

PHOTO B

Shade	1-15	☐
Mould	1-6	☐
Arrangement	1-7	☐

PHOTO C

Shade	1-15	☐
Mould	1-6	☐
Arrangement	1-7	☐

PHOTO D

Shade	1-15	☐
Mould	1-6	☐
Arrangement	1-7	☐

PHOTO E

Shade	1-15	☐
Mould	1-6	☐
Arrangement	1-7	☐

PHOTO F

Shade	1-15	☐
Mould	1-6	☐
Arrangement	1-7	☐

APPENDIX 2

SELECTING ARTIFICIAL ANTERIOR TEETH FOR COMPLETE DENTURES

SELECT THE TEETH THAT YOU WOULD USE TO CONSTRUCT A DENTURE FOR THE PEOPLE IN THE PHOTOGRAPHS.
TAKING AGE AND GENDER INTO CONSIDERATION USE THE TOOTH GUIDES TO SELECT ONE MOULD (SHAPE/SIZE) AND ONE ARRANGEMENT FOR EACH PERSON.

MALE/FEMALE AGE: < 25yrs / 25-50yrs / > 50yrs

PHOTO A

Mould 1-6 ☐

Arrangement 1-7 ☐

PHOTO B

Mould 1-6 ☐

Arrangement 1-7 ☐

PHOTO C

Mould 1-6 ☐

Arrangement 1-7 ☐

PHOTO D

Mould 1-6 ☐

Arrangement 1-7 ☐

PHOTO E

Mould 1-6 ☐

Arrangement 1-7 ☐

PHOTO F

Mould 1-6 ☐

Arrangement 1-7 ☐

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