

Conventional methods for selecting form, size, and color of maxillary anterior teeth: Review of the literature

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ABSTRACT

One of the most confusing and difficult aspects of complete denture prosthodontics is the selection of appropriately maxillary anterior denture teeth when no preextraction records are available. Dental literature indicates that varied methods have been proposed for artificial tooth selection. The aim of this article is to review the conventional methods for maxillary anterior tooth selection and their reliabilities. A search of the dental literature in PubMed was completed for the years 1955–2015 with an emphasis on peer-reviewed dental journals limited to studies in the English language and using tooth selection and complete denture as keywords. The study works on three aspects of tooth selection: (1) Form, (2) size, and (3) color. This review of the literature demonstrates no universally reliable method of determining form and color for maxillary anterior denture teeth. But, interalar distance, interpupillary distance, and distance between the medialis angles of the eyes appear to be a reliable guide for selecting the size of maxillary anterior teeth. Information of racial differences may help identify esthetic modifications to treatment plans to include the multiple racial groups within modern societies.

KEY WORDS: Denture, maxillary anterior tooth, tooth selection

Introduction

The restoration of the edentulous patient by denture has an important psychological effect. Once properly restored, the patient's self-esteem and self-confidence are often improved, which is also a goal of the oral rehabilitation.^[1,2] One of the primary considerations in manufacturing a denture is the selection of the maxillary anterior artificial tooth.^[3] Biometric measurements or assumptions, usual choices made by the dentist, and the preferences of the patient are the most frequently used considerations. They are all utilized to help the dentist find a mold similar to the missing natural teeth, which may be difficult if no records of the dimensions, shape, or color of the natural teeth are available.^[4] A review of the dental literature shows that several factors have been proposed as aids for artificial tooth selection, and numerous

methods have been devised to find reliable factors in determining artificial tooth form, size, and color.^[5] Although many attempts have been made to quantify the selection of anterior teeth for complete dentures, little consensus on effective methods has been reached.^[6] The aim of this article is to review the conventional methods for maxillary anterior tooth selection and their reliabilities.

Method of Literature Search

Search of the dental literature in PubMed was performed for the years 1955–2015 with an emphasis on peer-reviewed

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dental journals limited to studies in the English language using tooth selection and complete denture as keywords. This review evaluates three aspects of tooth selection: (1) Form, (2) size, and (3) color.

Form Evaluation for Tooth Selection

Tooth form evaluation is usually made according to gender, age, and face form.

Gender and tooth form relationship

Frush and Fisher built a theory called “dentogenic theory” in the 1950s as a result of a series of articles. The theory claims that there is a relationship between the gender of a person and his or her tooth shape. It is believed that roundness, smoothness, and softness are feminine characteristics, while vigor and boldness are masculine characteristics.^[7] Other authors also corrected the correlation between the gender and tooth shape in several studies; while one of these studies shows significant dimorphism of the upper and lower canine teeth,^[8] there are also other studies that show this correlation in natural maxillary central incisor.^[9-11]

However, the literature demonstrated that positive sexual dimorphism in the natural dentition was limited.^[12-17] Berksun *et al.* carried out a study with 13 prosthodontists that evaluated male or female gender with 60 black-and-white photographs that showed the upper front teeth. The photographs that were evaluated correctly were established by the “dentogenic theory” and the photographs that were evaluated wrongly were perceived as belonging to the other gender.^[13] In a similar study completed by Wolfart *et al.*, a significant correlation could not be shown between the tooth shape and gender.^[14] Hyde *et al.* studied that size, position, and angulations of maxillary anterior teeth were evaluated regarding the sex of the patients with stone casts of natural teeth, which were assessed by experts. It was concluded that the experts could not distinguish sex by the visual assessment of maxillary anterior teeth on casts alone.^[15]

There is little consistency in the selection of the anterior teeth appropriate for the sex of the individual by the dentist.^[18] If the clinicians want to make tooth selection according to gender, they must consider the whole set of teeth instead of just focusing on one. Also, teeth form, their position, angulations, and the proportion of sizes are factors that need to be considered for suitable prosthesis for each gender.^[13,14]

Age and tooth form relation

In the dentogenic theory, artificial teeth are chosen according to the patient's age.^[7] Interproximal wear of teeth is a normal aging change and makes them appear smaller.^[19] Most of the dentists know the changes in

teeth that occur with age and they aim to create a natural appearance while selecting teeth. By studying patients with three different age groups (young, middle age, and old) having natural dentition, Sellen *et al.* asked 50 dentists to choose the correct teeth by only observing the patients' face. The results of the study reported that clinicians more frequently select suitable anterior teeth for the elderly than for other age groups.^[18] Several authors have attempted to predict patient age by reviewing denture tooth arrangements or oral photographs.^[17,18,20] These studies failed to evaluate the teeth from an extraoral perspective. Frush and Fisher noted that a restoration can only be evaluated in the mouth.^[7]

There is a little consistency in the selection of the anterior teeth appropriate for the age of the individual by the dentist. The development and implementation of an esthetic pro forma to guide the dentist and patients through the process of choosing a tooth mold based on age may be helpful.^[18]

Face form and tooth form relation

A method of selecting teeth according to the “law of harmony” is popularly used at the present time. This method is based on a relationship existing between the face form and the form of the maxillary central incisor in the most people and that this relationship should be taken into account in the tooth selection procedure. It is described as three “basic” forms of teeth shape: Tapering, ovoid, and square.^[16] Combination forms were rationalized to make selection easier, resulting in six combination forms in both square and tapering and four combination forms in ovoid. From these classifications, lateral incisors and canines that harmonized with each classification were selected.^[21]

Only a limited number of studies on this subject have been published over the past 50 years, describing a relationship between the shape of the maxillary incisor and the face form. Some studies supported that the face form was helpful to select the tooth form.^[5,22-24] Whereas others did not support the relationship between the face and tooth shape.^[12,16,25,26] Wright found identical face and tooth forms in only 13% of 600 subjects.^[27] Sellen *et al.*, Ibrahimagic *et al.*, and Wolfart *et al.* found similarities between forms in about 30% of cases.^[10,14,22] The greatest percentage of correspondence was 51.3%, found by Berksun *et al.*^[13] The similarity with the border reversing the central incisor and the face shape from the chin margin to the hairline is greater than that of the face shape from the chin margin to the eyebrow line.^[16] Another study consisting of 100 patients supported that the face shape from the chin margin to the eyebrow line produced a better match than the one from the chin to the hairline.^[28]

An important fact is that most of those studies were conducted in white population samples. Varjão *et al.* studied a total of 160 subjects (40 whites, 40 mulattos, 40 blacks,

and 40 Asians) and found that a correspondence between tooth and face forms was found in 23.75% of all cases.^[29]

Pound did not only evaluate the outline form of the face in the frontal plane, but also in the sagittal plane. This assessment then was related to the labial surfaces of the artificial teeth in the frontal and sagittal views to determine whether the patient has a convex, straight, or a concave profile.^[30]

Suggestions have been made for alternative expedient guides for anterior tooth selection, such as facial contours in different planes and anatomic landmarks.^[10,30,31]

Size Evaluation for Tooth Selection

There are some mathematical proportions for predicting the width of the maxillary anterior teeth: Nasal width, intercommissural width, interpupillary width, distance between the medialis angles of the eyes, and incisive papilla.

Nasal width and tooth size relation

Several authors stated that the distance between the outer surfaces of the alae of the nose seems to be the same as that between the tips of the canines.^[6,32-35] Kern made measurements on 509 dried skulls and found that most of his measurements of nasal width were equal to or ± 0.5 mm of his measurements of the four maxillary incisors.^[36] Mavroskoufis found that interalar nasal width is a reliable guide for selecting the mold of anterior teeth. The mesiodistal width of the set of anterior teeth (four incisors and the mesial halves of the canines) can be determined by adding 7 mm to the patient's nasal width.^[37] Hoffman *et al.* studied 340 North American subjects to investigate whether the interalar width could be used as a reliable guide for the selection of suitable anterior teeth when constructing dentures. The authors found that the mean of the distance between the tips of the maxillary canines was 3% bigger than the mean of interalar width and that the mean of the distance between the distal surfaces of the maxillary canines was 31% bigger than the mean of the interalar width.^[6] Gomes *et al.* studied 81 Brazilian people and showed that the interalar width was significantly correlated to the mesiodistal width measured on a photo, both between the tips of the maxillary canines and between the distal surfaces.^[38] In another study by the same authors, it was found that a ratio of 1.31 can be calculated when the circumferential distance between the distal surfaces of the maxillary canines was compared with the interalar width.^[35] Ellakwa *et al.*^[39] and Tripathi *et al.*^[40] showed that interalar width provided the strongest predictive relationship with anterior maxillary teeth. In 1975, Smith also studied the relationship between nasal width and intercanine distance by using a combination of clinical and radiographic methods for the recording of the interalar fold width of the nose and stone cast with modified canine cusps for the tooth measurements. No demonstrable relationship between intercanine distance and either interalar width, or

interalar fold width, or skeletal nasal aperture was found.^[41] Hasanreisoglu *et al.* studied with 100 Turkish subjects and they found that interalar width may be used as a guide for selecting maxillary anterior teeth, particularly in women.^[42] In a study by Latta *et al.*, the relationships among the width of the mouth, the interalar width, the bizygomatic width, and the interpupillary distance were evaluated. It was concluded that these relationships might be used as references if applied in combination.^[3] According to most studies, interalar width can be used as a reliable guide for maxillary anterior teeth selection.

Intercommissural width and tooth size relation

The curve distance between the corners of the mouth, which supposedly represents the curve distance between the distal surfaces of the maxillary canines, is often used as a method for selecting the maxillary anterior denture teeth.^[21,43] Sinavarat *et al.* also studied 100 Thai subjects and found a correlation between the intercommissural width to the intercanine tip width and the width of the distal surface of the canine.^[44] But, Varjão and Nogueira reported a weak correlation with the distance between the canines and the distance between the corners of the mouth in four racial groups. They reported that using the corners of the mouth for the selection of the artificial teeth width would lead to, in general, the selection of narrower teeth than the natural teeth.^[45] In addition, Latta *et al.*, Scandrett *et al.*, and Lieb *et al.* also found inadequate correlation between the intercanine width and intercommissural measurements.^[3,19,46] There is little consistency in the selection of the anterior teeth appropriate for the intercommissural width of the individual by the dentist.

Interpupillary distance and tooth size relation

Certain authors have proposed a relationship between the width of the maxillary central incisor and the interpupillary distance.^[6] The relationship between the interpupillary distance and mesiodistal width of maxillary central incisors was suggested and evaluated by Cesario and Latta's study of 100 American subjects. A ratio of 1:6.6 occurred in 95% of white and black female patients in the sample group tested. In black male patients, the ratio was 1:7.^[47] Hasanreisoglu *et al.* studied 100 Turkish subjects and found a ratio of 1:7.7 and 1:7.5 for men and women, respectively.^[42] Gomes *et al.* studied 81 Brazilian people by using dental casts and found that the highest probability correlation between the sum of mesiodistal width of the six teeth and interpupillary distance.^[38] Isa *et al.* studied 60 Malaysian subjects to investigate the relationships between some facial dimensions and widths of the maxillary anterior teeth. It has been reported that the width of the central incisors was highly correlated to the interpupillary distance, while the widths of the lateral incisors and canines were highly correlated to a combination of interpupillary distance and interalar distance.^[48] According to the studies, the interpupillary distance appears to be a reliable guide for selecting maxillary anterior teeth.

Distance between the medialis angles of the eyes and tooth size relation

Inter-canthal distance (ICD) is the distance between the medialis angles of the palpebral fissure bilaterally.^[2,38,49-51] ICD is considered normal at a dimension of 28–35 mm between 8 and 11 years and ICD of 93% growth has been achieved approximately at 5 years of age.^[52,53] No differences related to sex, race, or age have been shown in the ICD.^[52,54] This makes ICD a reliable anatomic dimension that may provide a valid approach to anterior tooth selection.^[49,51] Gomes *et al.*^[38] and Lucas *et al.*^[55] indicated that ICD showed a correlation to the distance between the tips and the apparent distal surface of the maxillary canines. Abdullah has stated that ICD, when multiplied by a decreasing function value of the geometric progression term 0.618 and divided by 2, was a reliable predictor of maxillary central incisor.^[50] According to Al Wazzan, ICD is correlated to the dental widths, the mean widths of the central incisor, and the combined widths of the six upper anterior teeth. The biometric ratios of 1:0.267 and 1:1.426 could be used to estimate the central incisor width and the combined width of the six anterior teeth, respectively.^[2] According to the studies, ICD appears to be a reliable guide for selecting maxillary anterior teeth.

Incisive papilla and tooth size relation

The incisive papilla has been used as an anatomic landmark in the positioning of maxillary anterior teeth because it is known as a reliable and relatively stable anatomic landmark.^[4,30,37] A line drawn at a right angle to the midline passing through the center of the incisive papilla passes through the tips of the maxillary canines.^[37,56-59] However, it cannot always be pronounced as a definitive method. The data obtained for a representative sample of 298 young Jordanians from measurements made on dental stone casts showed that the transversal line that connects to the cusp tips of the maxillary canines passed within 1.2 mm anterior and posterior to the midpoint of the incisive papilla in about 50% of subjects.^[60] There was also a recommendation made by Varjão *et al.* for the use of the center of the incisive papilla as a guide for the selection of the proper width of maxillary dentures in four racial groups (white, black, mixed, and Asian subjects). In all studied racial groups, there was no coincidence between the center of the incisive papilla and the canine line. The utilization of the center of the papilla would lead to the selection of wider artificial teeth.^[61]

The incisive papilla method is used as a conventional method by dentists but the relationship between natural teeth width and artificial teeth width cannot be predicted clearly by this method. Racial differences were detected when anatomic measurements were evaluated individually and more than one anatomic reference is needed to predict the width of maxillary anterior teeth.^[3,19]

Color Evaluation for Tooth Selection

Selection of an appropriate tooth color for edentulous patients is an important part of complete denture fabrication. It has been shown that proper color selection has a positive impact on the patients' perception of esthetics.^[62] In dentistry, comparison with the remaining teeth is frequently used to select the color of artificial teeth.^[63] Clinicians providing edentulous patients with complete dentures are often confronted with the problem of not knowing the patient's natural tooth color. For choosing the color of the tooth in edentulous patients, preextraction records, a photograph of patients, the idea of relatives, and reminding the patient of their own natural teeth color are beneficial.^[33] If they are not usable, some reference factors are assessed. It would be valuable to determine this from other personal features such as gender, age, eye color, hair color, and skin color.^[64]

Hassel *et al.* concluded that while some of the factors investigated, namely hair and eye color and gender were significantly associated with tooth color, facial skin complexion was not. Lighter colors were associated with lighter eye color and with female gender. More yellow/green than yellow/red values were associated with hair colors other than black and with female gender.^[64]

A supported study of African-American subjects from 21 to 69 years of age found that facial skin complexion was not significantly correlated with tooth color. It was also found that facial skin complexion did not correlate significantly with tooth color and was only a poor predictor of gingival pigmentation.^[65] Esan *et al.* indicated that there was no significant relationship between facial skin color and tooth color.^[66] Jahangiri *et al.*'s study has been conducted to assess the relationship between tooth color and skin color. Persons with medium-to-dark skin tones were more likely to have teeth with higher values (lighter), whereas individuals with lighter skin tones tended to have teeth with lower values (darker), regardless of gender or age. They showed that tooth color and skin color were inversely related for different races.^[67] Hassel *et al.* reported significant differences, with the teeth of women being slightly more yellow, lighter, and less saturated.^[64] Gozalo-Diaz *et al.* and Esan *et al.* also found that women subjects had lighter and less yellow central incisors than men.^[66,68] This result is inconsistent with the findings of Jahangiri *et al.* who reported that there was no significant relationship between tooth color and gender.^[67]

Age is highly correlated with the natural color of teeth. The color of natural teeth becomes darker, more reddish, and more yellow with increasing age because of deposition of secondary dentin, wearing a way of enamel, and external staining.^[17,33,69] Hasegawa *et al.* found that the older the subject, the darker and more yellow the color at the center

site of the natural tooth becomes. Both reddish and yellowish colors of the natural teeth tend to increase from the incisal to cervical whereas translucency decreases.^[70] Goodkind and Schwabacher found that 2,830 natural anterior teeth darkened after the age of approximately 35 years by the formation of secondary dentine.^[71] The age factor in the dentogenic theory was accomplished by using lighter colors for younger patients and darker colors for older patients.^[7] Young *et al.* indicate that the color of resin teeth selected for complete dentures tends to be relatively independent of the patient's age, although natural teeth darken with age.^[72]

The colors of teeth before extraction, when available, usually are the "color of choice" for the artificial teeth. However, the color must be selected with the tooth in its normal environment. If no such records are available, the selection of color is based primarily on the overall complexion as modified by the age of the patient.^[33]

Conclusion

One of the most confusing and difficult aspects of complete denture prosthodontics is the selection of appropriately maxillary anterior denture teeth when no preextraction records are available. This review of the literature demonstrates no universally reliable method of determining form, and color has been found for maxillary anterior denture teeth. But, interalar distance, interpupillary distance, and distance between the medialis angles of the eyes appear to be a reliable guide for selecting the size of maxillary anterior teeth. There can be racial differences in the characteristics of anterior teeth and these must be borne in mind during anterior tooth selection for various racial groups. Knowledge of racial norms may help specify certain esthetic and functional modifications to treatment plans to accommodate the multiple racial groups within modern societies.

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There are no conflicts of interest.

References

- Wolfart S, Brunzel S, Freitag S, Kern M. Assessment of dental appearance following changes in incisor angulation. *Int J Prosthodont* 2004;17:150-4.
- Al Wazzan KA. The relationship between intercanthal dimension and the widths of maxillary anterior teeth. *J Prosthet Dent* 2001;86:608-12.
- Latta GH Jr, Weaver JR, Conkin JE. The relationship between the width of the mouth, interalar width, bizygomatic width, and interpupillary distance in edentulous patients. *J Prosthet Dent* 1991;65:250-4.
- Grave AM. The frequency of various molds in a sample of natural and artificial dentitions. *J Prosthet Dent* 1987;57:194-7.
- Sellen PN, Jagger DC, Harrison A. Methods used to select artificial anterior teeth for the edentulous patient: A historical overview. *Int J Prosthodont* 1999;12:51-8.
- Hoffman W Jr, Bomberg TJ, Hatch RA. Interalar width as a guide in denture tooth selection. *J Prosthet Dent* 1986;55:219-21.
- Frush JP, Fisher RD. How dentogenic restorations interpret the sex factor. *J Prosthet Dent* 1956;6:160-72.
- Sherfudhin H, Abdullah MA, Khan N. A cross-sectional study of canine dimorphism in establishing sex identity: Comparison of two statistical methods. *J Oral Rehabil* 1996;23:627-31.
- LaVere AM, Marcroft KR, Smith RC, Sarka RJ. Denture tooth selection: An analysis of the natural maxillary central incisor compared to the length and width of the face: Part II. *J Prosthet Dent* 1992;67:810-12.
- Sellen PN, Jagger DC, Harrison A. Computer-generated study of the correlation between tooth, face, arch forms, and palatal contour. *J Prosthet Dent* 1998;80:163-8.
- Hayakawa I. *Principles and Practices of Complete Dentures*. 1st ed. Tokyo: Quintessence Publishing; 1999. p. 71.
- Bell RA. The geometric theory of selection of artificial teeth: Is it valid? *J Am Dent Assoc* 1978;97:637-40.
- Berkun S, Hasanreisoglu U, Gökdeniz B. Computer-based evaluation of gender identification and morphologic classification of tooth face and arch forms. *J Prosthet Dent* 2002;88:578-84.
- Wolfart S, Menzel H, Kern M. Inability to relate tooth forms to face shape and gender. *Eur J Oral Sci* 2004;112:471-6.
- Hyde TP, McCord F, Macfarlane T, Smith J. Gender aesthetics in the natural dentition. *Eur J Prosthodont Restor Dent* 1999;7:27-30.
- Mavroskoufis F, Ritchie GM. The face-form as a guide for the selection of maxillary central incisors. *J Prosthet Dent* 1980;43:501-5.
- Burchett PJ Jr, Christensen LC. Estimating age and sex by using color, form, and alignment of anterior teeth. *J Prosthet Dent* 1988;59:175-9.
- Sellen PN, Jagger DC, Harrison A. The selection of anterior teeth appropriate for the age and sex of the individual. How variable are dental staff in their choice? *J Oral Rehabil* 2002;29:853-7.
- Scandrett FR, Kerber PE, Umrigar ZR. A clinical evaluation of techniques to determine the combined width of the maxillary anterior teeth and the maxillary central incisor. *J Prosthet Dent* 1982;48:15-22.
- Sellen PN, Jagger DC, Harrison A. An assessment of the ability of dental undergraduates to choose artificial teeth which are appropriate for the age and sex of the denture wearer: A pilot study. *J Oral Rehabil* 2001;28:958-61.
- Clapp GW. How the science of esthetic tooth form selection was made easy. *J Prosthet Dent* 1955;5:598-608.
- Ibrahimagic L, Jerolimov V, Celebic A, Carek V, Baucic I, Zlataric DK. Relationship between the face and the tooth form. *Coll Antropol* 2001;25:619-26.
- Seluk LW, Brodbelt RH, Walker GF. A biometric comparison of face shape with denture tooth form. *J Oral Rehabil* 1987;14:139-45.
- Shaweesh AI, Al-Dwairi ZN, Shamkhey HD. Studying the relationships between the outlines of the face, maxillary

- central incisor, and maxillary arch in Jordanian adults by using Fourier analysis. *J Prosthet Dent* 2015;113:198-204.
25. Wegstein PG, Horvath SD, Stemmann J, Lüthi M, Blatz MB. Three-dimensional analysis of the correlation between anterior tooth form and face shape. *Int J Periodontics Restorative Dent* 2014;34:765-71.
26. Brodbelt RH, Walker GF, Nelson D, Seluk LW. Comparison of face shape with tooth form. *J Prosthet Dent* 1984;52:588-92.
27. Wright WR. Correlation between face form and tooth form in young adults. *J Am Dent Assoc* 1942;9:1388-92.
28. Lindemann HB, Knauer C, Pfeiffer P. Morphometric relationships between tooth and face shapes. *J Oral Rehabil* 2004;31:972-8.
29. Varjão FM, Nogueira SS, Russi S, Arioli Filho JN. Correlation between maxillary central incisor form and face form in 4 racial groups. *Quintessence Int* 2006;37:767-71.
30. Pound E. Recapturing esthetic tooth position in the edentulous patient. *J Am Dent Assoc* 1957;55:181-91.
31. Nallaswamy D. Textbook of Prosthodontics. New Delhi: Jaypee Brothers Medical Publishing Ltd.; 2003. p. 169-77.
32. Lee JH. Dental Aesthetics. Bristol: John Wright and Sons; 1962. p. 21.
33. Wehner PJ, Hickey JC, Boucher CO. Selection of artificial teeth. *J Prosthet Dent* 1967;18:222-32.
34. McCord JF, Grant AA. Registration: Stage III – Selection of teeth. *Br Dent J* 2000;188:660-6.
35. Gomes VL, Gonçalves LC, Costa MM, Lucas Bde L. Interalar distance to estimate the combined width of the six maxillary anterior teeth in oral rehabilitation treatment. *J Esthet Restor Dent* 2009;21:26-35.
36. Kern BE. Anthropometric parameters of tooth selection. *J Prosthet Dent* 1967;17:431-7.
37. Mavroskoufis F, Ritchie GM. Nasal width and incisive papilla as guides for the selection and arrangement of maxillary anterior teeth. *J Prosthet Dent* 1981;45:592-7.
38. Gomes VL, Gonçalves LC, do Prado CJ, Junior IL, de Lima Lucas B. Correlation between facial measurements and the mesiodistal width of the maxillary anterior teeth. *J Esthet Restor Dent* 2006;18:196-205.
39. Ellakwa A, McNamara K, Sandhu J, James K, Arora A, Klineberg I, *et al.* Quantifying the selection of maxillary anterior teeth using intraoral and extraoral anatomical landmarks. *J Contemp Dent Pract* 2011;12:414-21.
40. Tripathi S, Aeran H, Yadav S, Singh SP, Singh RD, Chand P. Canine tip marker: A simplified tool for measuring intercanine distance. *J Prosthodont* 2011;20:391-8.
41. Smith BJ. The value of the nose width as an esthetic guide in prosthodontics. *J Prosthet Dent* 1975;34:562-73.
42. Hasanreisoglu U, Berksun S, Aras K, Arslan I. An analysis of maxillary anterior teeth: Facial and dental proportions. *J Prosthet Dent* 2005;94:530-8.
43. Vuttiparum N, Benjakul C. Relationship between the width of maxillary central incisors and philtrum. *J Dent Assoc Thai* 1989;39:233-9.
44. Sinavarat P, Anunmana C, Hossain S. The relationship of maxillary canines to the facial anatomical landmarks in a group of Thai people. *J Adv Prosthodont* 2013;5:369-73.
45. Varjão FM, Nogueira SS. Intercommissural width in 4 racial groups as a guide for the selection of maxillary anterior teeth in complete dentures. *Int J Prosthodont* 2005;18:513-5.
46. Lieb ND, Silverman SI, Garfinkel L. An analysis of soft tissue contours of the lips in relation to the maxillary cuspids. *J Prosthet Dent* 1967;18:292-303.
47. Cesario VA Jr, Latta GH Jr. Relationship between the mesiodistal width of the maxillary central incisor and interpupillary distance. *J Prosthet Dent* 1984;52:641-3.
48. Isa ZM, Tawfiq OF, Noor NM, Shamsudheen MI, Rijal OM. Regression methods to investigate the relationship between facial measurements and widths of the maxillary anterior teeth. *J Prosthet Dent* 2010;103:182-8.
49. Al Wazzan KA, Al Haidan A, Al Madi EM, Al Murfarj A. The relationship between facial references and mesiodistal width of maxillary anterior teeth among Saudi patients. *Alex Dent J* 1995;20:39-45.
50. Abdullah MA. Inner canthal distance and geometric progression as a predictor of maxillary central incisor width. *J Prosthet Dent* 2002;88:16-20.
51. Lucas BL, Bernardino-Júnior R, Lopes-Júnior I, Gonçalves LC, Gomes VL. Comparison of three anthropometric techniques for tooth selection. *Eur J Prosthodont Restor Dent* 2012;20:67-70.
52. Freihofer HP. Inner intercanthal and interorbital distances. *J Maxillofac Surg* 1980;8:324-6.
53. House JE. Dental esthetics utilizing anterior prosthetic teeth: Their selection and arrangement for removable dentures. Minnesota: Complete Denture Course; 1976. p. 1-39.
54. Barretto RL, Mathog RH. Orbital measurement in black and white populations. *Laryngoscope* 1999;109 (7 Pt 1):1051-4.
55. Lucas BL, Bernardino-Júnior R, Gonçalves LC, Gomes VL. Distance between the medialis angles of the eyes as an anatomical parameter for tooth selection. *J Oral Rehabil* 2009;36:840-7.
56. Ehrlich J, Gazit E. Relationship of the maxillary central incisors and canines to the incisive papilla. *J Oral Rehabil* 1975;2:309-12.
57. Schiffman P. Relation of the maxillary canines to the incisive papilla. *J Prosthet Dent* 1964;14:469-72.
58. Lau GC, Clark RF. The relationship of the incisive papilla to the maxillary central incisors and canine teeth in Southern Chinese. *J Prosthet Dent* 1993;70:86-93.
59. Grove HF, Christensen LV. Relationship of the maxillary canines to the incisive papilla. *J Prosthet Dent* 1989;61:51-3.
60. Amin WM, Taha ST, Al-Tarawneh SK, Saleh MW, Ghzawi A. The relationships of the maxillary central incisors and canines to the incisive papilla in Jordanians. *J Contemp Dent Pract* 2008;9:42-51.
61. Varjão FM, Nogueira SS, Filho JN. The center of the incisive papilla for the selection of complete denture maxillary anterior teeth in 4 racial groups. *Quintessence Int* 2008;39:841-5.
62. Lombardi RE. The principles of visual perception and their clinical application to denture esthetics. *J Prosthet Dent* 1973;29:358-82.
63. van der Burgt TP, ten Bosch JJ, Borsboom PC, Kortsmit WJ. A comparison of new and conventional methods for quantification of tooth color. *J Prosthet Dent* 1990;63:155-62.
64. Hassel AJ, Nitschke I, Dreyhaupt J, Wegener I, Rammelsberg P, Hassel JC. Predicting tooth color from facial features and gender: Results from a white elderly cohort. *J Prosthet Dent* 2008;99:101-6.
65. Dummett CO, Sakumura JS, Barens G. The relationship of

- facial skin complexion to oral mucosa pigmentation and tooth color. *J Prosthet Dent* 1980;43:392-6.
66. Esan TA, Olusile AO, Akeredolu PA. Factors influencing tooth shade selection for completely edentulous patients. *J Contemp Dent Pract* 2006;7:80-7.
 67. Jahangiri L, Reinhardt SB, Mehra RV, Matheson PB. Relationship between tooth shade value and skin color: An observational study. *J Prosthet Dent* 2002;87:149-52.
 68. Gozalo-Diaz D, Johnston WM, Wee AG. Estimating the color of maxillary central incisors based on age and gender. *J Prosthet Dent* 2008;100:93-8.
 69. Brodbelt RH, O'Brien WJ, Fan PL, Frazer-Dib JG, Yu R. Translucency of human dental enamel. *J Dent Res* 1981;60:1749-53.
 70. Hasegawa A, Ikeda I, Kawaguchi S. Color and translucency of *in vivo* natural central incisors. *J Prosthet Dent* 2000;83:418-23.
 71. Goodkind RJ, Schwabacher WB. Use of a fiber-optic colorimeter for *in vivo* color measurements of 2830 anterior teeth. *J Prosthet Dent* 1987;58:535-42.
 72. Young L Jr, Glaros AG, Moore DJ, Collins JF. Assessing shade differences in acrylic resin denture and natural teeth. *J Prosthet Dent* 1994;71:575-80.

