

Anterior Teeth Esthetics in Prosthodontics and Restorative Dentistry

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Abstract

Dental esthetics is an important concern for patients seeking prosthodontic restorative dental treatment. Beauty has specific proportions of face and teeth having optimal symmetry, height, and width. Analyses of facial and dental parameters are necessary for medical science and dentistry.

The selection of teeth has a vital role in the restoration of esthetics in dental treatment. The aim of this review is to present an overview of facial and dental esthetics and present various aspects of dental esthetics including facial esthetics, dental esthetics, and biomaterials for esthetic restoration. The anterior teeth' shape and size play an important role in developing pleasing dental and facial esthetics. Facial and dental aesthetics are enhanced if there is a golden proportion (GP) between the maxillary anterior teeth. According to the GP of teeth, the visible width of the lateral incisor to the central incisor is 62% of the, and the visible width of the canine to the lateral incisor is 62%. In anterior esthetic restoration, it is important to know the various esthetic elements that make teeth and face harmony and symmetry.

The restorative biomaterials that can be used for the esthetic restoration of anterior teeth are ceramic/zirconia, composite, PEEK, and indirect resin. At present various newer ceramic biomaterials are being developed with various treatment modalities to produce esthetic results. Restoration of anterior teeth with esthetic standards and considering parameters of face and teeth helps in producing esthetic results. Porcelain veneer and dental composite restorations are esthetic restorations and help to improve the tooth shape and color.

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Introduction

The beauty of the face is the combination of features that result in pleasure to the mind. The physical appearance of the face greatly affects the confidence of the patient. The ideal face is proportionate and attractive. Hence, beauty has specific proportions of face and teeth having optimal symmetry, height, and width. Proportional faces are balanced in both vertical and horizontal portions. The face can be divided into 3 distinct divisions which are also known as the rule of thirds (upper, middle, and lower face) from the following landmarks; the superior border of the face is trichion (hairline), nasion, sub-

nasale and inferior border of the face (menton). In addition, the face is divided into horizontal fifths consisting of the width of each eye, lateral canthus to the lateral hairline, and inter-canthal distance.

Facial and dental esthetics are a major requirement of prosthetic and prosthodontic treatments.^{1, 2} Four important components of esthetic dental treatments are; (a) frame and reference, (b) proportion and idealism, (c) symmetry, and (d) perfective and illusion.³ Furthermore, the teeth size, shape, visibility, and gingival esthetics play an important role in restoring the esthetics in edentulous patients.^{4, 5} Face and dental midline also play an important role in facial esthetics.^{6, 7} The proportionate anterior teeth size in prostheses results in harmony with the overall facial appearance. Esthetic restorative treatment in anterior teeth should be done in ways that maximize the esthetic outcome. On the other way, facial landmarks also play a vital role in the selection of

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teeth for the prosthetic rehabilitation of patients.⁸
⁹ The aim of this review is to present an overview of facial and dental esthetics and present various aspects of dental esthetics including facial esthetics, dental esthetics, and biomaterials for esthetic restoration.

Facial Esthetics and Proportions

Facial beauty is governed by facial symmetry and proportions. Ideal proportions of the face and teeth have specific proportions, i.e., golden proportion (GP) and it has specific proportions of 1.618 (larger to smaller) or 0.618 (smaller to larger).¹⁰ Still, in various populations, the GP of the face is difficult to find and the facial measurements show deviations from GP although the soft tissue shows facial balance.¹¹

The face can be divided into vertical fifths but very less populations show this proportion and show variations in facial proportions. In a study done by Milutinovic et al.¹² in the Serbian population (24 celebrity Caucasians) and anonymous females (83 Caucasians), the attractive celebrity females had smaller faces and showed the facial fifths and thirds and most facial parameters had ideal proportions.

Considering the standard in treating creates facial esthetics, TMJ health, physiologic health, and quality of life. In completely edentulous patients, the facial types of the patient have been used to select the teeth shape. The three common facial types are euryprosopic (transversely wide and broad), mesoprosopic (average type), and leptoprosopic (face is vertically tall and transversely narrow).

The facial index is used in classifying the facial types and it is the ratio of naso-menton height to bizygomatic width and it is used to classify the faces into broad, average, and narrow.¹³⁻¹⁶ Face measurements can be done by direct or indirect methods. Direct facial measurements can be done directly in patients and are a reliable method. Indirect face measurements can be done on photographs or videographs. Different studies show the various facial types in various populations. In the Nepalese population, the majority of the facial type had narrow (69%) followed by average (24%) and broad (7%).¹ Similarly, in the Iraqi population, the majority had narrow (80%) followed by average (16%) and broad (4%) types of face.¹⁴ In the Turkish population, the majority had narrow (37.58%), average (28.33%), and broad (34.10%) types of faces.¹⁵ Hence, in South

Asia, the narrow face is a common facial type compared to the average and broad face.

Various anatomic landmarks are used to select the size of the anterior teeth, e.g. interpupillary line, bizygomatic width, mouth width, and nose width.¹⁷ There is a positive relationship between the width of the central incisor to the bizygomatic width and the maxillary central incisor width is 1/16th of the bizygomatic width.^{18, 19} A study done by al-el-Sheikh and al-Athel²⁰ in the Saudi population found a positive relationship between the inter-canine tip width and nose width. Their study also showed significant correlations between inter-alar distance, inter-pupillary distance, and the width of the six anterior teeth. In addition, significant differences between both sexes were found. Another study by Al-Wazzan²¹ in the same population studied the correlations of inter-canthal distance with widths of central incisors and found a significant relationship between inter-canthal distance and the 4 incisors only. They did not find correlations of inter-canthal distance with the widths of 2 central incisors and the width of the 6 anterior teeth. Yodsuwan et al.²² studied the correlations of inter-alar (nose) width and inter-canine width (tip to tip) and width of the mouth and maxillary inter-canine width (distal to distal) and found poor correlations in the Thai population. Similarly, Hasanreisoglu et al.²³ performed a correlation study between the nose width, inter-canine distance, and inter-canine tip distance in Turkish students and found a positive relationship between these measurements. Latta et al.²⁴ studied North American edentulous patients and also found no correlations between inter-commissural width, inter-alar width, and/or interpupillary width. Varjão and Nogueira²⁵ studied Brazilian subjects and also found a weak correlation between inter-commissural width and distal of canines in their study.

Dental Esthetic and Proportions

The maxillary anterior teeth's shape and size play an important role in dental and facial esthetics.¹⁰ Facial and dental aesthetics are enhanced if the widths of maxillary anterior teeth proportion show GP when viewed from the front. Moreover, according to the GP of teeth, the visible width of the lateral incisor (LI) to the central incisor (CI) is 62% and the visible width of the canine to the lateral incisor is 62%.¹⁰ Figure 1 shows the GP of maxillary central and lateral incisors. Leven¹⁰ applied GP in medicine and dentistry,

especially in the perceived widths of maxillary anterior teeth.

In various studies, GP was not found in different populations; Turkish, North American, Jordanian, Croatian, Indian, Iranian, Brazilian, Hungarian, Malaysian, Bangladeshi, Londoners, Irish, Portuguese, Korean, Japanese, and Nepalese.^{1, 5, 23, 26-38} The results of teeth proportions in these studies deviated from GP. In North America, various anterior teeth proportions have been proposed.³¹ Preston³¹ recommended 66% for LI/CI instead of 62% and 84% for the CN/LI which is called Preston Proportion. Similarly, Ward³² gave the Recurrent Esthetic Dental (RED) proportion for the LI/CI and C/LI and the ratios ranged from 60% to 80% but he preferred a 70% ratio. Furthermore, Calcada et al.³⁶ did a study in the Portuguese population and found that the anterior teeth proportions showed a 66% Preston proportion rather than the GP and the RED proportion.

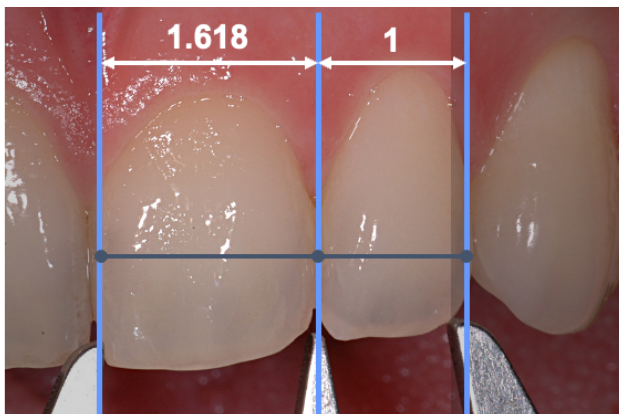


Figure 1. Golden proportion (GP) of teeth.

Another important ratio of anterior teeth is the golden standard (GS) where width/height (W/H) ratios of maxillary anterior teeth are 80%. However, the W/H ratios of maxillary anterior teeth may vary from 75-85%.^{39, 40} Tsukiyama et al.⁴¹ studied the W/H ratios of maxillary anterior teeth in 157 Asians and 142 Caucasians and they found that there was a difference in the W/H ratios of all maxillary anterior teeth between Asians and Caucasians. The anterior maxillary teeth in Asians are more slender with greater W/H ratios compared to those in Caucasians. Finally, for esthetic rehabilitation, the GP in the anterior teeth width ratios and the W/H ratios of the maxillary anterior teeth serve as a useful guide in the establishment of an attractive smile.

Dental parameters for the dental esthetics
The optimal dental esthetic includes various parameters for the anterior teeth. In relation to the facial midline, the dental midline is straight but can be slightly oblique.⁴² Smile lines follow the convexity of the lower lip.⁴³ The incisal plane is either convex, sinuous or a combination of both.

Anterior teeth alignment can diverge in at least one plane.⁴³ Central incisors are symmetrical, slightly mesially inclined, may overlap slightly, and are positioned more in a facial position. Mesial tooth inclinations are more pleasing and incisal edges of the central incisors may be slightly misaligned if their gingival margins are not level. The lateral incisors may differ bilaterally in inclination, rotation, and shape. The labiolingual inclination of the canines can be slightly asymmetrical.

Esthetic Keys

There are five main esthetic keys in dentistry given by Kokich et al.⁴⁴ and includes the following; midline, occlusal plane, incisal edge position, incisal plane/smile line, and gingival level.

Midline

In order to have good dental esthetics, the dental midline should be straight. But people often don't notice the facial/dental midline discrepancies. Midlines don't need to be in the center of the face but they must be straight. The central incisors should be symmetrical.

Occlusal Plane

The occlusal plane is an imaginary line that passes the incisal edges of the incisors and then touches the cusp tips of the posterior teeth. Ideally, the extension of the incisal plane should be in harmony with the lower lip.

Incisal Edge Position

Incisal edge position is important and it is necessary to evaluate the incisal plane and occlusal plane relationship. Ideally, the occlusal and incisal planes are on the same level.

Incisal Plane/ Smile Line

There should be harmony between the incisal line and the curvature of the lower lip.⁴⁵ In addition, the smile line follows the convexity of the lower lip.

Gingival Level

Ideally, the gingival margins of both central incisors are symmetrical. Need to determine tooth size/position first. Using gingiva as a reference should be avoided to position

incisal edges. Gingiva shows a reduction with eruption or recession. Tooth asymmetry is more noticeable than gingival asymmetry.

Figure 2 shows the intraoral figure of a woman with esthetic problems; midline shift and unesthetic teeth which needed esthetic dental treatments to increase the esthetic of teeth.⁴⁶ Figure 3 shows an intraoral view of a male patient with esthetic teeth with ideal functional and biological conditions.⁴⁷

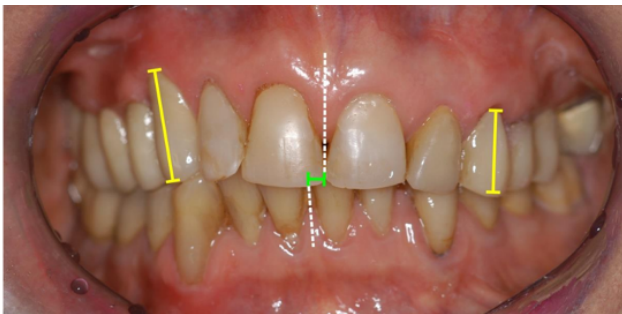


Figure 2. The teeth of a female showing a midline shift in the mandibular arch, and crown height discrepancy in anterior teeth. Surgical crown lengthening and fixed prosthodontic treatments were done to improve the esthetics. Adapted with permission from Ref.⁴⁶



Figure 3. Teeth of a 31-year-old male with esthetic teeth with ideal functional and biological conditions. Adapted with permission from Ref.⁴⁷

Biomaterials for Esthetic Restorations

Human teeth are characterized by various shades from opaque to translucent areas. Hence, when selecting the shade of teeth which involves a basic shade selection and the identification of opaque and translucent areas. A balance of the opaque and translucent shades is an important factor in obtaining a good esthetic outcome.

The restorative biomaterials that can be used for the esthetic restoration of anterior teeth are ceramic/zirconia, composite, PEEK, and indirect resin. At present various newer ceramic biomaterials are being developed with various treatment modalities to produce esthetic results. The porcelain restorations achieve good esthetic results with a more balanced harmony.⁴⁸ The use of digital technologies such as 3D printing and intraoral scanners has simplified and resulted in increased esthetic results.⁴⁸⁻⁵¹



Figure 4. Teeth of a 31-year-old male with esthetic teeth with ideal functional and biological conditions. (a) Pretreatment photographs, (b) digital smile design, (c) mock-up, (d) tooth preparation, (e) ceramic veneer, and (f) cementation. Adapted with permission from Ref.⁴⁷

Ceramic/ Zirconia

Anterior porcelain veneer restorations can restore the teeth's shape and color with good shape and create contact between adjacent teeth to achieve horizontal stability for the dental arch and bring the patient's esthetics. Porcelain veneers and crowns can restore teeth discolorations from various causes such as trauma, fluorosis, tetracycline, etc. They are

made from computer-aided design and computer-aided manufacturing (CAD/CAM) techniques. At present, they can be fabricated in a single day using faster-sintering technologies and producing optimal esthetics and mechanical properties.^{52, 53} Figure 4 shows the esthetic restoration of anterior teeth on a 31-year-old male patient using ceramic restorations using a digital smile design.⁴⁷

The use of digital technologies such as 3D printing and intraoral scanners has simplified and resulted in increased esthetic results.⁴⁸⁻⁵⁰ Figure 5 shows the anterior esthetic restoration with zirconia crowns of a 51-year-old female with the use of 3D printing and other digital techniques.⁴⁸

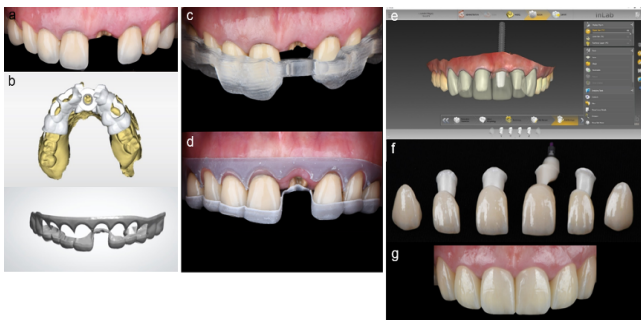


Figure 5. Anterior esthetic restoration with zirconia crowns of a 51-year-old female with fracture of left central incisor with the use of 3D printing and digital techniques. Adapted with permission from Ref ⁴⁸ (a) Pretreatment photograph, (b) 3D design of surgical guides, (c-d) try-in of the surgical guides, (e) 3D design of final crowns, (f) final zirconia crowns, and (g) final zirconia crowns in patients.

Currently, ceramic materials and technology are increasingly being improved and widely used in clinical practice.^{54, 55} The oxide porcelain is essentially zirconia oxide, this type is poor in light conductivity, so when indicated for front teeth is often chiseled, affecting aesthetics, moreover, they are very hard and cannot be worn and glued to tooth tissue, while the glass porcelain line that overcomes this disadvantage has the optical properties of the teeth. At present translucent ceramic biomaterials are being developed increasing the esthetics.⁵⁶ Natural, preserved by the chemical adhesive mechanism to increase the durability of the restoration. Furthermore, when choosing the adhesive, it is necessary to adhere to the step of coating with an anti-oxidant after attaching and polishing

carefully. The closer the adhesive surface is to the thin layer of cement, the less disintegration will be reduced of cement.

Resin-based composite (RBC)

Commercially available RBCs can provide esthetic restorations as they have opaque and translucent materials. The opaque shades are used for inner restoration as dentine or for opaque margins whereas the translucent shades are used as final layers or for incisal translucencies. Most often they are named “dentin” for opaque shades and “enamel” for translucent shades.⁵⁷

RBCs have good clinical success mainly for the Class III, IV, and diastema closure and they provide excellent results with lower costs compared to ceramic restorations. Figure 6 shows the composite restoration for the esthetic restoration of the maxillary anterior teeth. Case 1 with fractures one incisor and Case 2 with fractured both incisors.⁵⁷ Esthetic direct anterior restorations show a success rate of 95% (Class III) and of 90% (Class IV) after 10 years.^{8, 9} The esthetic outcome of an RBC restorations depends on various factors, i.e. the material properties, composite opacity and translucency, adhesive technique, shade selection, operator skills, surface finish, and biological factors.



Figure 6. Composite restoration for the esthetic restoration of the maxillary central incisors. Case 1 with fracture of left incisor and Case 2 with fracture of both central incisors. Adapted with permission from Ref.⁵⁷

Limitations of RBC include fracture resistance and surface instability compared to ceramic restorations.⁵⁷ But they have partially been solved by the introduction of newer composites such as micro-hybrid composites, nano-filled, and nano-hybrid composites. Regardless of the mechanical properties, other properties have been improved for the RBCs in a few decades, such as optical properties and biocompatibility.

Furthermore, the development of RBCs has led the clinician to reproduce the shade and the translucencies of natural teeth. Different layering techniques have been recommended for producing esthetic results.³³ Composite restoration failures (shade adjustments, shape modification, o contact point augmentation) can be repaired and can be carried out either immediately or on old restorations (secondary caries or fractures).

Social, Cultural, and Environmental Factors for Dentofacial Esthetics

Physical appearance is an essential factor in social interaction. The face and teeth are important elements in the evaluation of physical appearance. Recently, there has been an increase in interest in dental esthetics among patients and dentists especially in prosthodontics and restorative dentistry. The smile along with the teeth affects the face attractiveness and this has an important role in social interaction. It has been shown that dentofacial aesthetics play an important effect in self-perceives and others' perceptions towards themselves. Generally, younger people are more concerned regarding their dental aesthetics.⁵⁸

In addition, severe esthetic impairments are associated with reduced psychological well-being and women have more impacts than men.⁵⁸ Hence, the female gender and psychological elements are the main predictors of dental treatment. Understanding the expectations of dental esthetics and treatment outcomes can help to improve dental esthetics. It should also be noted that the natural tooth is influenced by a neutral environment and surface feature, and the natural tooth has translucency, transparency, opalescence, and fluorescence. The tooth color results from three dimensions: hue, value, and chroma. In clinical practice, it is of utmost importance for dentists to include the patient's feedback to meet the patient's

expectations of the treatment and to avoid aesthetic treatment failures.

Conclusions

In anterior esthetic restoration, it is important to know the various esthetic elements that make teeth and face harmony and symmetry. Analyses of facial and dental parameters are necessary for medical science and dentistry. It is necessary to know the esthetic standards and parameters of the face and teeth. Porcelain veneer and dental composite restorations are esthetic restorations and help to improve the tooth shape and color. In dentistry, the clinician and technician must move beyond intuitive appraisal and use fundamental esthetic principles to help achieve an esthetically pleasing smile also preserve their individuality.

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The data used to support the findings of this study are available from the corresponding author upon request.

Declaration of Interest

The authors report no conflict of interest.

References

1. Rokaya D, Kitisubkanchana J, Wonglamsam A, et al. Nepalese Esthetic Dental (NED) Proportion in Nepalese Population. *Kathmandu Univ Med J (KUMJ)*. 2015;13(51):244-249.
2. Mack MR. Perspective of facial esthetics in dental treatment planning. *J Prosthet Dent*. 1996;75(2):169-176.
3. Bhuvaneshwaran M. Principles of smile design. *J Conserv Dent*. 2010;13(4):225-232.
4. Humagain M, Rokaya D, Srii R, et al. Gender Based Comparison of Gingival Zenith Esthetics. *Kathmandu Univ Med J (KUMJ)*. 2016;14(54):148-152.
5. Al-Marzok MI, Majeed KRA, Ibrahim IK. Evaluation of maxillary anterior teeth and their relation to the golden proportion in Malaysian population. *BMC Oral Health*. 2013;13:1-5.
6. Niraula N, Acharya R, Humagain M, et al. Dental-Facial Midline: An Esthetic Based Classification. *Open Dent J*. 2021;15(Suppl-3, M4):405-409.
7. Kai R, Umeki D, Sekiya T, Nakamura Y. Defining the location of the dental midline is critical for oral esthetics in camouflage orthodontic treatment of facial asymmetry. *Am J Orthod Dentofacial Orthop*. 2016;150(6):1028-1038.
8. Rokaya D, Suttagul K, Sapkota B, Maharjan SK. Gender based comparison of the relationships of maxillary anterior teeth and facial measurements. *J Int Dent Med Res*. 2018;11(2):465-469.
9. Srimanekarn N, Arayapisit T, Pookuantong O, et al. Determining of canine position by multiple facial landmarks to achieve natural esthetics in complete denture treatment. *J Prosthet Dent*. 2022;127(6):860-865.
10. Levin EI. The updated application of the golden proportion to dental aesthetics. *Esthet Dent Today*. 2011;5:22-27.
11. Shah PK, Shrestha S, Rokaya D. Facial Esthetic Analysis of Nepalese Subjects. *Open Dent J*. 2022;16(Suppl 2, M4):e187421062111191.

12. Milutinovic J, Zelic K, Nedeljkovic N. Evaluation of Facial Beauty Using Anthropometric Proportions. *ScientificWorldJournal*. 2014;2014:428250.
13. Garson JG. The Frankfort craniometric agreement, with critical remarks thereon. *J Anth Inst Gr Br Ire*. 1885;14:64-83.
14. Kassab NH. The selection of maxillary anterior teeth width in relation to facial measurements at different types of face form. *Al-Rafidain Dent J*. 2005;5:15-23.
15. Arslan SG, Genc C, Odabas B, Kama JD. Comparison of facial proportions and anthropometric norms among Turkish young adults with different face types. *Aesthetic Plast Surg*. 2008;32:234-242.
16. Mudjari S, Erwansjah E, Damayanti R, et al. Three Smile Components on Different Facial Types of Young Adult Population in Makassar. *J Int Dent Med Res*. 2023;16(1):219-223.
17. Sellen PN, Jagger DC, Alan H. Methods used to select artificial anterior teeth for the edentulous patient: a historical overview. *Int J Prosthodont*. 1999;12:51-58.
18. Berry FH. Is the theory of temperaments the foundation of the study of prosthetic art? *Dent Mag*. 1905;1:405-413.
19. Pound E. Lost - Fine Arts in the Fallacy of the Ridges. *J Prosthet Dent*. 1954;4:6-16.
20. al-el-Sheikh HM, al-Athel MS. The relationship of interalar width, interpupillary width and maxillary anterior teeth width in Saudi population. *Odontostomatol Trop*. 1998;21(84):7-10.
21. Al-Wazzan KA. The relationship between intercanthal dimension and the widths of maxillary anterior teeth. *J Prosthet Dent*. 2001;86:608-612.
22. Yodsuwan D, Srisamaung J, Santaveesuk O, Srinukul S. Relationship between canine lines, cusp tips and distal of the maxillary canines and corners of the mouths in the Thai Esarn sample. *Khon Kaen Dent J*. 2003;6:1-17.
23. Hasanreisoglu U, Berksun S, Aras K, Arslan I. An analysis of maxillary anterior teeth: facial and dental proportion. *J Prosthet Dent*. 2005;94:530-538.
24. Latta GH, 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;65:250-254.
25. 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;18:513-515.
26. Petricevic N, Celebic A, Ibrahimagic-Seper L, Kovacic I. Appropriate proportions as guidelines in selection of anterior denture teeth. *Med Glas*. 2008;5:103-108.
27. Ali-Fayyad M, Jamani KD, Aqrabawi J. Geometric and Mathematical Proportions and their Relations to Maxillary Anterior Teeth. *J Contemp Dent Pract*. 2006;7:62-70.
28. Murthy BV, Ramani N. Evaluation of natural smile: Golden proportion, RED proportion, Golden percentage. *J Conserv Dent*. 2008;11:16-21.
29. Mahshid M, Khoshvagti A, Varshosaz M, Vallaei N. Evaluation of golden proportion in individuals with an esthetic smile. *J Esthet Restor Dent*. 2004;16:185-192.
30. Wolfart S, Thorman H, Freitag S, Kern M. Assessment of dental appearance following changes in incisor proportions. *Eur J Oral Sci*. 2005;113:159-165.
31. Preston JD. The golden proportion revisited. *J Esthet Dent*. 1993;5:247-251.
32. Ward DH. Proportional smile design using the recurring esthetic dental (RED) proportion. *Dent Clin North Am*. 2001;45:143-154.
33. Pini NP, de-Marchi LM, Gribel BF, et al. Analysis of the Golden Proportion and Width Height Ratios of Maxillary Anterior Dentition. *J Esthet Restor Dent*. 2012;24:402-414.
34. Forster A, Velez R, Antal M, Nagy K. Width ratios in the anterior maxillary region in a Hungarian population: Addition to the golden proportion debate. *J Prosthet Dent*. 2015;110:211-215.
35. Bukhary SM, Gill DS, Tredwin CJ, Moles DR. The influence of varying maxillary lateral incisor dimensions on perceived smile aesthetics. *Br Dent J*. 2007;203:687-693.
36. Calcada D, Correia A, Araujo F. Anthropometric analysis of anterior maxillary teeth with digital photography - a study in a Portuguese sample. *Int J Esthet Dent*. 2014;9:370-380.
37. Condon M, Bready M, Quinn F, et al. Maxillary anterior tooth dimensions and proportions in an Irish young adult population. *J Oral Rehabil*. 2011;38:501-508.
38. Lee SP, Lee SJ, Hayashi K, Park YS. A three-dimensional analysis of the perceived proportions of maxillary anterior teeth. *Acta Odontol Scand*. 2012;70:432-440.
39. Wolfart S, Quaes AC, Freitag S, et al. Subjective and objective perception of upper incisors. *J Oral Rehabil*. 2006;33:489-495.
40. Rokaya D, Humagain M, Amornvit P. Maxillary Anterior Teeth Proportions for Creating Esthetically Pleasuring Smile in Nepalese Patients. *J Nepal Health Res Council*. 2018;16(3):362.
41. Tsukiyama T, Marcushamer E, Griffin TJ, et al. Comparison of the anatomic crown width/length ratios of unworn and worn maxillary teeth in Asian and white subjects. *J Prosthet Dent*. 2012;107:11-16.
42. Melo M, Ata-Ali J, Ata-Ali F, et al. Evaluation of the maxillary midline, curve of the upper lip, smile line and tooth shape: a prospective study of 140 Caucasian patients. *BMC Oral Health*. 2020;20(1):42.
43. Seixas MR, Câmara CA. The smile arc: review and synthesis. *Dental Press J Orthod*. 2021;26(3):e21spe23.
44. Kokich VO, Jr., Kiyak HA, Shapiro PA. Comparing the perception of dentists and lay people to altered dental esthetics. *J Esthet Dent*. 1999;11(6):311-324.
45. Singh AV, Mahamuni A, Gaharwar JS, et al. Evaluation of Change in the Facial Profile and Aesthetics in Relation to Incisor Position in Both Maxillary and Mandibular Arches. *Cureus*. 2023;15(1):e34403.
46. Runte C, Dirksen D. Symmetry and Aesthetics in Dentistry. *Symmetry*. 2021;13(9):1741.
47. Caetano GM, Slomp C, Andrade JP, et al. Partial Ceramic Veneer Technique for Challenging Esthetic Frontal Restorative Procedures. *Dent J*. 2023;11(4):101.
48. Kongkiatkamon S, Rokaya D. Full Digital Workflow in the Esthetic Dental Restoration. *Case Rep Dent*. 2022;2022:8836068.
49. Humagain M, Rokaya D. Integrating Digital Technologies in Dentistry to Enhance the Clinical Success. *Kathmandu Univ Med J (KUMJ)*. 2019;17(68):256-257.
50. Rokaya D, Kongkiatkamon S, Heboyan A, et al. 3D-Printed Biomaterials in Biomedical Application. In Jana S, Jana S, (Eds). *Functional Biomaterials: Drug Delivery and Biomedical Applications*. Singapore: Springer Singapore 2022:319-339.
51. Thongma-eng P, Banthithkunanon P, Pisitanusorn A. Influence of Scan Strategies on the Accuracy of 3-Dimensional Optical Scanner for Face Scanning. *J Int Dent Med Res*. 2022;15(3):1127-1132.
52. Li L, Zhao C, Du Z, et al. Rapid-sintered dental zirconia for chair-side one-visit application. *Int J Appl Ceram Technol*. 2019;16(5):1830-1835.
53. Kongkiatkamon S, Peampring C. Effect of Speed Sintering on Low Temperature Degradation and Biaxial Flexural Strength of 5Y-TZP Zirconia. *Molecules (Basel, Switzerland)*. 2022;27(16).
54. Vaiani L, Boccaccio A, Uva AE, et al. Ceramic Materials for Biomedical Applications: An Overview on Properties and Fabrication Processes. *J Funct Biomater*. 2023;14(3):146.
55. Choosuk S, Piangsuk T. The Effects of Clinical Procedures on Strength of Dental Zirconia: A Literature Review. *J Int Dent Med Res*. 2023;16(3):1317-1322.
56. Kongkiatkamon S, Booranasonphone K, Tongtaksin A, et al. Comparison of Fracture Load of the Four Translucent Zirconia Crowns. *Molecules (Basel, Switzerland)*. 2021;26(17):5308.
57. Paolone G, Scolavino S, Gherlone E, et al. The "Pre-Finishing" Approach in Direct Anterior Restorations. A Case Series. *Dent J*. 2021;9(7):79.
58. Närhi L, Mattila M, Tolvanen M, et al. The associations of dental aesthetics, oral health-related quality of life and satisfaction with aesthetics in an adult population. *Eur J Orthod*. 2023;45(3):287-294.