

## Acceptable Deviation between Facial and Dental Midlines in Dentate Population

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**Abstract** The success of the dental restorations largely depends on its esthetics, although various literature reviews recommend that anterior teeth midline be placed coinciding the facial midline, the amount of acceptable deviation between facial and dental midline has not been fully investigated. To observe the acceptable deviation between the dental and facial midline. Facial photographs of 200 students aged about 18–30 years of both sexes, without any missing teeth, with complete alignment of anterior teeth, were selected and scanned on to computer screen. Using specialized programme, the crown width of the central incisor in the mouth and on photograph was ensured constant. The distance between the facial midline, (obtained by bisecting intercanthal line) and the mesial surfaces of the central incisors were read on the computer. 44.4 % Boys and 55 % of Girls showed deviation between dental and facial midline in the range of 0–1 mm. while, 54 % of boys and 33 % of girls showed deviation of the dental and facial midline in the range 1–2 mm. 37 % of boys and 8 % of girls showed deviation of dental midline with facial midline with the range of 2–3 mm. 80 % of the study population showed maxillary and mandibular dental midlines never coincide. Majority of the study

population showed deviation between facial midline and anterior teeth midline within the range of 0–1 mm.

**Keywords** Facial midline · Dental midline · Acceptable deviation

### Introduction

The term “Esthetic” is used to connote that some thing seen is pleasant. Over the centuries as artists have developed the management of esthetic process into principles of visual perception, they have enabled to create scenes of intense vitality, beauty, depth and realism all on a 2D canvas [1]. As dental restorations are subjected to the same perceptual process, understanding of perceptual principle can eliminate confusion in achieving the realm of esthetics and maintaining esthetic harmony [1, 2]. Dentist who understands the principles of visual perception can fabricate the restoration with confidence to meet, the esthetic demands subtly and wisely without violating the principles of reality [3, 4].

The study of the relationships existing between different objects is made visible by the contrast in color, line and texture. This is called Composition [1]. The ordering of, a part of composition to give the individual total effect of the “whole” is called Unity. Unity exists in two types: Static unity and dynamic unity. The regular geometric shapes, such as snowflakes and crystals, exhibit static unity [1]. Plants and animals exhibit dynamic unity. Repetitions of shape, color and line are cohesive forces [1]. Success of a dentist lies in making use of these static cohesive forces to fabricate prosthesis, to suit a living dynamic human being [5]. Consider an instance, where anterior teeth placement is done on the unchanging curve of a circle [1]. The resulting denture gives a dull dead appearance, immediately noticeable in a

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living dynamic mouth as something abnormal [5]. The objective of a dentist is to provide dynamic and not static unity. Dentogenic factor helps us in achieving this [6–8].

The term “Dentogenic” means, the art, practice and techniques used to achieve esthetic goals in dentistry [8, 9]. Lombardi noted that proper location of the dental midline was necessary for stability of the dental composition as improper placement of the midline would produce tension that make the viewer feel that the line must move to its proper place to produce stability & permanence [3, 5]. Various complete denture textbooks [3, 7, 9, 10] recommend that the mesial surfaces of maxillary central incisors be in contact with the imaginary vertical line that bisects the face. Anatomical landmarks like, incisive papilla, labial frenum, tubercle of upper lip have been used to estimate the position of the central incisor for complete denture prostheses. Using tubercle of the upper lip as the midline of the face, Latta [11, 12] found that in 70 % of 100 patients the average distances of the mid-palatal suture, nasopalatine papilla and labial frenum were less than 1 mm from the midline and the range may vary as much as 5.5 mm. Tjan [13] suggested that, an imaginary line dividing the middle lobe of the upper lip could be used to establish the facial midline, as it is closer to the mouth compared to other landmarks. Miller [13] suggested that center of the philtrum should be considered as the most reliable guide to the facial midline.

Because no human face is symmetrical, there can be no hard and fast rule for determining the facial midline [14]. The artistic judgment of the individual clinician therefore must be used. Since the amount of deviation of the anterior tooth midline from the facial midline that is noticeable to a viewer is unknown, the purpose of this investigation was to determine the observable deviation between the anterior tooth and facial midlines in a limited sample of dentate subjects confining to a specific area and age group.

## Materials

The HP Pavilion Laptop had the Following Configurations

### Hardware

HP Pavilion laptop model-dv6000, with 1,024 MB of random access memory. Optical drive and other generic input devices like keyboard and mouse. A graphics card that supports a SXGA high-resolution display and 15" LCD color monitor.

### Software

Windows XP Professional. Adobe Photoshop Version 7.0 is an authentic photo editing software with Advanced

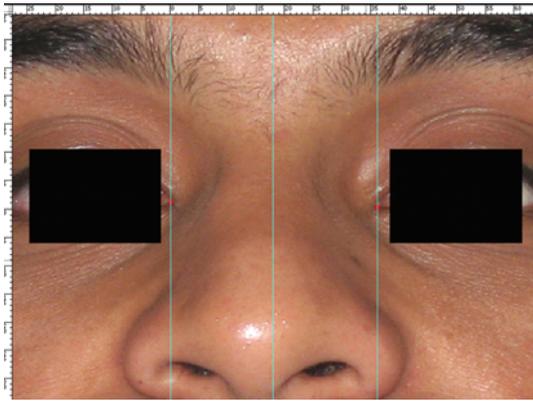
Composting, which means various measurements can be made using the image without hampering the image quality. Microsoft office suite and Corel word perfect, to record and analyze the result.

Canon—A620 digital camera with the following specifications were used for the study. A minimum of 5 Mega Pixels is recommended for dental/medical photography [15–18]. The camera used in the study was of the resolution 7.1 Mega Pixels. It had a color monitor with 2" LCD, which could be turned up to 270° that helped to view tall objects of interest, without lifting the camera above the head. Camera had optical zoom 4× for better the image quality. Recommended optical zoom for dental/medical photography is 3×. Lens specifications of the camera were 7.3–29.2 mm, which produces images equivalent to the lens of 35–140 mm [15, 18, 19]. Minimum lens specification recommended at international conferences to produce image of adequate accuracy [15, 17, 18], is 35 mm.

## Method

Around 200 students were selected for the study conducted in, The Oxford Dental College and Hospital. The consent from the ethical committee from the same institution was obtained. Exclusion criteria for the study sample include, students with restorations in the anterior teeth region, clinical evidence periodontal disease, misalignments of teeth like rotations, spacing in the anterior region, congenital deformities of head and neck region. Students with ideal alignment of anterior teeth aged in the range of 18–30 years were selected. Each student was seated on a chair at a fixed position in relation to the camera lens. Reference points were anterior border of the ear lobe to the camera lens. This placed the eye of the subject in straight line with the lens. Thus, the position of the subject in relation to the camera lens was standardized at a fixed distance of 130 cm. All the students were asked to remove their spectacles while shooting the photographs. Students head position was fixed on the cephalostat with help of zygomatic clamps and was asked to rest his/her chin on the chin rest. Cheek retractor was fixed to the student and they were instructed to close their mouth at the maximum intercuspation of their teeth and to look at the camera lens while shooting the photograph. The width of the central incisor in the mouth and on the photographs was measured in millimeters. Camera was preset to its reproduction ratio 1:2 where in the image size was half as that of the object. Minimum recommended ratio is 1:10 for portrait views [15–18]. Each photograph was edited using Adobe Photoshop V7.0.

Photographs were aligned with interpupillary line parallel to the frame of the screen. Image was magnified using zoom tool such that width of the central incisor on the



**Photo 1** Inter canthal distance, computation of facial midline (36 mm)



**Photo 2** Deviation of facial midline with maxillary teeth midline on computer screen (3 mm)



**Photo 3** Deviation of maxillary & mandibular teeth midlines on computer screen (2 mm)

student co-incide with that on the image. Two points were marked on inner canthus of the eye at the medial border of the punctum using the ‘Pen tool’. Guidelines were drawn on these points. The distance between the two points was measured and noted in millimeters as depicted in Photo 1. Facial midline was obtained by dropping the perpendicular to bisect the inter-canthal distance. Dental midline between the upper central incisors was obtained using the guide tool. The deviation between the facial midline and the maxillary dental midline was noted in millimeters as depicted in Photo 2. In the same manner deviation between

the facial midline and mandibular dental midline was noted in millimeters as depicted in Photo 3. The difference between the maxillary and mandibular dental midline was obtained by subtracting the later reading from the former in millimeters. The images were stored in JPEG format.

**Results**

**Statistical Methods**

Student *t* test has been used to find the significance of study parameters between male and female. Reference interval has been calculated using Non-parametric (Percentile) method [20, 21].

- + Suggestive significance  $0.05 < P < 0.10$ .
- \* Moderately significant  $0.01 < P \leq 0.05$ .
- \*\* Strongly significant  $P \leq 0.01$ .

Results as tabulated in the Table 1 and pictorial presentation in graph 1, proved that, about 55 % of women and 48 % of men showed deviation in the range of 0–1 mm, 37 % of women and 50 % of men showed deviation in the range of 1–2 mm and 8 % of women and 3.7 % of men showed the deviation in the range of 2–3 mm. Standard deviation of the above results were insignificant as *P* values ranged from 0 to 3 for women and 0–4 for men.

**Discussion**

The midline is the most important focal spot in an esthetic smile. An off- center midline is readily recognized by the patient [4, 22]. Boucher recommends that the long axis of central incisors should be parallel to the long axis of the face and the midline of the dental arch should be located near the middle of the face [7, 23]. The means of the distances from the facial midline to the upper dental midline was found to be  $1.62 \pm 0.43$  mm in males and  $1.32 \pm 0.16$  mm in females and is statistically insignificant, Even when segregated into male and females, mean distances remained less than 2 mm. The means of the distances between upper and lower dental midline is found to be  $1.45 \pm 0.88$  mm in males and  $1.26 \pm 0.83$  mm in females. The upper and lower

**Table 1** Comparison of deviation of facial midline with maxillary teeth between male and female population

Deviation with maxillary teeth	Male (n = 108)	Female (n = 100)	Total (n = 208)
Up to 1.0 mm	48 (44.4 %)	55 (55.0 %)	103 (49.5 %)
1.00–2.00 mm	54 (50.0 %)	37 (37.0 %)	91 (43.8 %)
2.00–3.00 mm	4 (3.7 %)	8 (8.0 %)	12 (5.8 %)
Mean ± SD (min–max)	$1.29 \pm 0.72$ (0–4.0)	$1.17 \pm 0.67$ (0–3.0)	$1.23 \pm 0.69$ (0–4.0)

dental midlines never coincide in almost 80 % of the population [24–26]. However, the standard deviation in the current study found to be statistically insignificant.

Although approximately 63 % of all measurements fall within this narrow band, clinical significance may only be minimal because the range varied as much as 4.2 mm. Surely, a midline discrepancy this large would result in an unacceptable esthetic placement for artificial teeth [27, 28].

Another interesting finding was neither the facial nor the anatomic measurements changed significantly with age [2, 28, 29]. The above findings are quite possible to play an important role in prosthetic tooth selection and arrangement in complete and removable partial denture prosthodontics [24, 30]. Statistical data obtained from similar studies may provide a good starting point for contouring wax occlusion rims. The data can also be used as a reliable guide for setting the maxillary central incisors for esthetic and phonetic requirements in the trial wax denture [25, 26, 31]. In this study some photographs where exact alignment of the interpupillary line to the frame of the screen when not possible were discarded.

The results of this study when compared with that of another similar study proved to give similar results [32]. In arrangement of artificial teeth, the mid line may be placed in precision with facial mid line or at a slight variance from the facial midline (not > 2 mm) with no loss in natural appearance [14, 33]. The most reliable guide in making this decision would be the patient's natural tooth prior to extraction [4, 5]. In the absence of pre-extraction records, it would be most prudent to place the maxillary midline in the exact middle of the mouth using the interpupillary line as a guide [26, 27].

### Limitation

The study was conducted on photographs of subjects, which is a 2D substitute for 3D object (face), future scope of this study lies in using advanced imaging techniques to obtain 3D image of the individual [18, 34]. A recent study conducted on students of five different Brazilian universities concluded, that there exists no significant co relation between maxillary dental midline and the bisector of interpupillary line [35]. Similar results of the above study are yet to be assessed in Indian population.

### Conclusion

Overall means of the deviations between facial midline and upper dental midlines were less than 2 mm. This study concludes to state, while arranging artificial teeth for the dentures, the midline may be placed coinciding with facial mid-line or slightly at a variance from it and not to exceed 2 mm.

### References

- Lombardi RE (1973) The principal of visual perception and their clinical application to denture esthetics. *J Prosthet Dent* 29: 358–382
- Kern BE (1967) Anthropometric parameters of tooth selection. *J Prosthet Dent* 17:431–437
- Charles M, Heartwell JR, Rahn AO (1986) Syllabus of complete denture, IV edn. Lea & Febiger, Philadelphia, pp 256–260
- Frush JP, Fisher RD (1956) How dentogenics interpret the personality factor. *J Prosthet Dent* 6:441–449
- Krajicek DD (1962) Simulation of natural appearance. *J Prosthet Dent* 12:28–33
- Sharry JJ (1969) Complete denture prosthodontics, 2nd edn. Mc Grane, New York, p 235
- Boucher CO, Hickey JC, Zarb GA (1975) Prosthodontic treatment for edentulous patients, IV edn. C.V. Mosby Co., St. Louis, pp 387–388
- Wright SM (1974) Prosthetic reproduction of gingival pigmentation. *Br Dent J* 136:367–372
- Goldstein RE (1969) Study of need for esthetics in dentistry. *J Prosthet Dent* 21:589–598
- Culpepper WD, Mitchell PS, Blass MS (1973) Esthetic factor in anterior tooth restoration. *J Prosthet Dent* 30:576–582
- Latta GH Jr (1988) The midline and its relation to anatomic landmarks in the edentulous patient. *J Prosthet Dent* 59:681–683
- Cesario VA Jr, Latta GH Jr (1984) Relationship between the mesiodistal width of the maxillary central incisor and interpupillary distance. *J Prosthet Dent* 52:641–643
- Tjan AH, Miller GD, Josephene GP (1984) Some esthetic factors in a smile. *J Prosthet Dent* 51:24–28
- Pound E (1954) Lost-fine arts in the fallacy of the ridges. *J Prosthet Dent* 4:6–16
- Bengel W (2006) Mastering digital dental photography: 9–55
- Sharland MR (2004a) Dental imaging for the general dental practitioner: 3 extra oral imaging. *Dent Update* 31:385–390
- Sharland MR (2004b) Dental imaging for the general dental practitioner: 2 intra oral imaging. *Dent Update* 31:328–332
- Mckenow HF, Murray AM, Sandler PJ (2005) How to avoid common errors in clinical photography. *J Orthod*. 32:43–54
- Doldo T, Fiorelli G, Patane B (1999) A comparison of three digital cameras for internal photography. *J Clin Orthod* 33: 588–593
- Rosner B (2000) Fundamentals of biostatistics, 5th edn. American Public Health Association, Washington, pp 112–114
- Venkataswamy MR (2002) Statistics for mental health care research. *J Econ Hist* 58:432–467
- Ortman HR, Tsao DH (1979) Relationship of the incisive papilla to the maxillary central incisors. *J Prosthet Dent* 42:492–496
- Lyun BD (1964) The significance of anatomic landmarks in complete denture service. *J Prosthet Dent* 14:456–459
- Beder OE (1971) Esthetics—an enigma. *J Prosthet Dent* 25: 588–591
- Mack MR (1996) Perspective of facial esthetics in dental treatment planning. *J Prosthet Dent* 75:169–176
- Morley J (1997) Smile design specific considerations. *J Calif Dent Assoc* 25:633–637
- Peck H, Peck S (1970) A concept of facial esthetics. *Am J Orthod* 40:284–317
- Levin E (1978) Dental esthetics and the golden proportion. *J Prosthet Dent* 40:244–252
- Cox NH, van der Linden FP (1971) Facial harmony. *Am J Orthod* 60:175–183
- Lombardi RE (1974) A method for the classification of errors in dental esthetics. *J Prosthet Dent* 32:501–513

31. Collett HA, Briggs DL (1954) Personality factors relating to over adaptation to dentures. *J Prosthet Dent* 4:269–273
32. Cardash HS, Ortmanier Z, Laufer BZ (2003) Observable deviation of the facial and anterior tooth midlines. *J Prosthet Dent* 89:282–285
33. Mashid M, Khoshvaqhti A, Varshosaz M, Vallaei N (2004) Evaluation of golden proportion in individuals with an esthetic smile. *J Esthet Restor Dent* 16:185–192; discussion 193
34. Christensen GJ (2005) Important clinical uses for digital photography. *J Am Dent Assoc* 136:77–79
35. Eskelsen E, Ferandes CB, Pelogia F, Cunha LG, Pallos D, Neisser MP, Liporoni PC (2009) Concurrence of maxillary dental midline and bisector to the interpupillary line. *J Esthet Restor Dent* 21:37–41; discussion 42