

Evaluation of Maxillary Dental Midline Alignment with Facial Landmarks in an Iranian Population

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Abstract

Background and Aim: Proper alignment of the maxillary dental midline is crucial for successful prosthetic rehabilitation and orthodontic treatment. This study investigated the alignment of the maxillary dental midline with three facial landmarks, the facial midline, philtrum, and nasal tip, in an Iranian population

Materials and Methods: Photographs of 608 randomly selected individuals were taken, each captured in a frontal view while smiling. A Nikon D5300 digital camera with a 105-mm lens was used, positioned 1.2 meters from the subjects. A metallic scale marked with millimeters was placed along the face in each photo to serve as a reference for resizing during later computer analysis. The distances between the maxillary dental midline and each facial landmark (facial midline, philtrum, and nasal tip) were measured using Adobe Photoshop software, and the data were analyzed with SPSS software. Data analysis was conducted using independent t-tests for group comparisons and paired t-tests for left-right directional comparisons. The significance level was set at 0.05 for all tests.

Results: The alignment results revealed that the philtrum coincided with the maxillary dental midline in 3.3% of cases, the facial midline aligned in 1.6%, and the nasal tip showed only minor alignment with the dental midline.

Conclusion: Significant differences were found in the alignment of the maxillary dental midline with the facial midline, philtrum, and nasal tip, with the highest alignment seen at the philtrum, followed by the facial midline and the nasal tip showing a minor alignment.

Key Words: Dental midline, coincidence, facial midline, philtrum, nasal tip

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Received: 7 Aug 2024
Accepted: 20 Oct 2024

➤ **Cite this article as:** Ranjzad H, Ostovarrad F, Mirzaei F, Ghorbani Z. Evaluation of Maxillary Dental Midline Alignment with Facial Landmarks in an Iranian Population. J Iran Dent Assoc. 2024; 36(3-4):78-83.

Introduction

Facial symmetry refers to the correspondence in size, shape, and relative position of features on opposite sides of a dividing line or around a central axis. (1) Clinically, this symmetry is

observed as balance and coordination among facial structures. The alignment of the dental and facial midlines is vital to facial symmetry, significantly influencing prosthetic rehabilitation and orthodontic treatments. (2) The dental

midline is the line running down the center of the maxillary and mandibular arches when the teeth are in maximum contact. (3) Achieving a symmetrical dental midline is essential when arranging anterior artificial teeth. A harmonious relationship between the dental midline and facial structures is critical to creating an attractive smile, giving patients a sense of symmetry and balance. (4) In an ideal smile, nearly all the maxillary teeth are visible, making the alignment of the maxillary central incisors' midline with the facial midline more critical than that of the mandibular incisors. Proper alignment of the dental midline is vital for achieving optimal occlusion and aesthetics in prosthetic and orthodontic treatments.

Misalignment between the maxillary dental midline and the midline of the face or mouth often necessitates prolonged clinical procedures to correct the midline. (5) Facial symmetry is assessed using several landmarks, including interpupillary distance, nasion, nasal tip, philtrum, and the center of the chin. The facial midline should coincide with the dental midline to achieve facial symmetry (6,7). Most prior studies have focused on the incisive papilla to determine the correct placement of the central maxillary teeth in complete dentures. However, there is a notable lack of research involving other variables such as the philtrum, nasal tip, and facial midline. Also, The esthetic significance of dental symmetry and midline location has not been determined conclusively in an Iranian Population. This study was conducted to enhance the knowledge and awareness of prosthetic and cosmetic dental specialists regarding the facial landmarks that most closely align with the maxillary dental midline, given its crucial role in prosthetic treatments.

Materials and Methods

This study, received ethical approval code #315 and was conducted at the Department of Prosthodontics, Guilan Dental School, Iran. It involved 608 participants, both male and female, aged between 20 and 50 years.

Participants included in the study met specific criteria: they had all anterior teeth present and

aligned typically, with no history of orthodontic, restorative, or prosthetic treatment, no prior cosmetic surgery of the jaws or rhinoplasty, no crowding or spacing in the upper and lower dental arches, and no apparent facial or dental arch asymmetry or defects.

Three frontal-view photographs of each subject were taken while laughing, using a Nikon D5300 digital camera equipped with a 105-mm lens, positioned 1.2 meters from the subjects. The photographs were captured under consistent lighting conditions, with subjects in a natural head position and no head rotation. A metallic scale with millimeter markings was placed along the face in all photographs to serve as a reference for resizing the images during computer analysis (Figure 1).

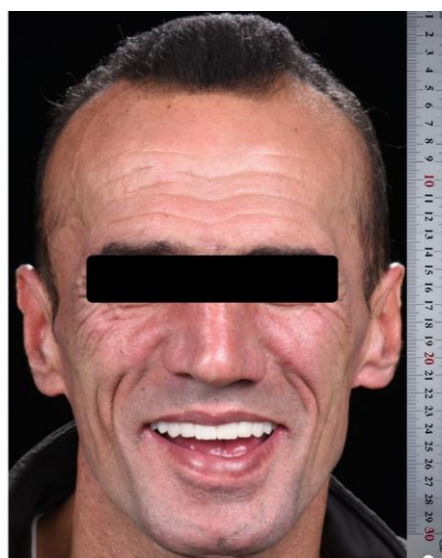


Figure 1. Facial portrait of a study participant

The best photograph of each participant was selected for midline analysis using Adobe Photoshop CC 2017 (version 21). The software was utilized to verify the alignment of the horizontal line with the horizontal axis.

Standard anatomical definitions were employed to identify critical points on the face. The dental midline was defined as a line perpendicular to the horizontal axis of the image, passing through the contact area of the maxillary central incisors. The Pogonion, Philtrum, and Nasal tip were marked with fine dots on the image, and

the facial midline was established by connecting the Nasion and Pogonion with a line of 0.1 mm thickness. The distances between each facial landmark (facial midline, philtrum, and nasal tip) and the maxillary dental midline were then measured. The level of significance for statistical analysis was set at 0.05.

Reliability of Measurements:

To assess the reliability of the measurements, the Intraclass Correlation Coefficient (ICC) was employed, with the selected ICC type aligning with the study design. Results indicated a high level of measurement reliability, as ICC values above 0.80 signify strong agreement.

Sample Size Justification:

The sample size of 608 participants was determined based on similar studies to achieve a statistical power of 80%, allowing for the detection of significant differences in distances between facial landmarks and the maxillary dental midline. This sample size supports robust statistical analysis with a 95% confidence level.

Statistical Analysis:

Data analysis was conducted using SPSS software version 25. Independent t-tests were applied to compare means between different groups, and paired t-tests were utilized to compare means in left-right directions.

A significance level of 0.05 was set for all statistical tests. Additionally, the ICC was employed to assess the reliability of measurements.

Results

The minimum distances between the maxillary central teeth midline and the facial midline, philtrum, and nasal tip were 0 mm, 0 mm, and 0.40 mm, respectively, while the maximum distances were 4.60 mm, 4.10 mm, and 7.70 mm, respectively. The mean and standard deviation of these distances were as follows:

- Facial midline: 1.36 ± 0.86 mm
- Philtrum: 1.51 ± 0.91 mm
- Nasal tip: 1.74 ± 1.32 mm

In 159 participants (26.2%), the facial midline was positioned to the right of the maxillary central teeth midline, while in 439 participants (72.2%), it was to the left. Only 10 participants

(1.6%) showed a coincidence between the facial midline and the maxillary central teeth midline. For the philtrum, in 279 subjects (45.9%), it was located to the right of the maxillary central teeth midline, and in 309 subjects (50.8%), it was to the left. Coincidence between the philtrum and the maxillary central teeth midline was observed in 20 subjects (3.3%).

The nasal tip was on the right of the maxillary central teeth midline in 279 subjects (45.9%) and on the left in 329 subjects (54.1%). No coincidence was found between the nasal tip and the maxillary central teeth midline.

Statistical analysis revealed significant differences in the distances between the maxillary central teeth midline and the facial midline, philtrum, and nasal tip across genders ($p=0.001$). The mean distances were significantly greater in men than in women for all three landmarks, as presented in Table 1. A significant relationship was also observed between aging and the distance between the maxillary central teeth midline and the facial midline, with the distance increasing as subjects aged.

Additionally, Paired t-test analysis (Table 2) revealed significant differences in the mean distances between the maxillary dental midline and the facial landmarks (facial midline, philtrum, and nasal tip) when comparing the left and right sides. Specifically, the facial midline had a significantly greater distance from the dental midline on the left side ($p<0.001$). The philtrum also showed a slight but significant difference between the left and right sides ($p=0.042$), while the nasal tip exhibited a notable difference ($p<0.001$), with more considerable distances on the left side.

Discussion

The dividing line used to achieve symmetry is known as the midline, serving as the fundamental reference for all esthetic deviations (8). Although the human face is not inherently symmetrical, and there is no single definitive benchmark for midline detection, deviations in midlines are readily noticeable by patients (1). According to the importance of establishing the maxillary dental midline in

Table 1. Comparison of maxillary dental midline distance to facial landmarks (facial midline, philtrum, and nasal tip) by gender using Test Statistics

Variable	Gender	Mean $\pm$ SD	Test Statistic	p-value
Facial Midline	Male	1.43 $\pm$ 1.02	2.01	0.045
	Female	1.29 $\pm$ 0.67		
Philtrum	Male	1.61 $\pm$ 1.02	2.51	0.013
	Female	1.42 $\pm$ 0.79		
Nasal Tip	Male	2.01 $\pm$ 1.52	4.92	<0.001
	Female	1.49 $\pm$ 1.05		

Table 2. Comparison of the maxillary dental midline distance to facial landmarks (facial midline, philtrum, and nasal tip) in left and right directions using paired t-test

Variable	Left Mean $\pm$ SD	Right Mean $\pm$ SD	Paired t	p-value
Facial Midline	1.45 $\pm$ 0.92	1.19 $\pm$ 0.58	4.12	<0.001
Philtrum	1.64 $\pm$ 0.85	1.49 $\pm$ 0.92	2.03	0.042
Nasal Tip	1.97 $\pm$ 1.60	1.48 $\pm$ 0.83	4.92	<0.001

harmony with facial component while replacing anterior teeth, To achieve a balanced smile while fabricating fixed or removable prosthesis, the goal of this study was to establish general guidelines for evaluating maxillary dental midline to facial soft-tissue midline discrepancies, based on the data collected in Iranian population.

The present study's findings indicated a significant difference between both genders' maxillary dental and facial midline. Only 1.6% of cases showed a coincidence between the maxillary dental midline and the facial midline. These results were consistent with those reported by Gharahchahi, where the maxillary dental midline coincided with the facial midline in 37.3% of cases, while in 62.7%, this alignment was not observed. Gharahchahi's study concluded that the facial midline could not serve as a reliable guide for the arrangement of anterior artificial teeth in dentures (9), which aligns with the present study's findings. In contrast, Khan et al. Reported that in 82.8% of cases, the dental midline was in line with the facial midline, with 17.2% showing no match between the two midlines. These findings differ from the present study, potentially due to variations in measurement methods and their accuracy. In Khan's study, a piece of floss or a scale was used to assess the alignment of the dental

midline with the facial midline, while the present study utilized photographic analysis with measurements performed to an accuracy of 0.1 mm (10). However, Kurian's study highlighted that using floss to determine the dental midline can lead to inaccurate results due to difficulty identifying points and the parallax effect during visualization (8). Farahani, Bidra, and Singh also examined the relationship between the facial midline and the maxillary teeth midline and the various anatomical landmarks of the face and mouth. Their findings, which indicate a statistically significant distance between the dental midline and facial midline, are consistent with the results of the study. (1, 6, 11).

In the present study, the distance between the maxillary teeth midline and the philtrum was significantly different in both men and women. In 45.9% of cases, the philtrum was positioned to the right, while in 50.8% of cases, it was positioned to the left of the maxillary teeth midline. Only 3.3% of cases showed a coincidence between the midline of the philtrum and the maxillary teeth, with a mean distance of 1.52 mm. In Gharahchahi's study, the mean distance between the maxillary teeth midline and the philtrum was 1.19 mm. This difference in means may be due to variations in measurement methods and the larger statistical population in the present study (9). In contrast,

Miller's study (12) reported a 70.4% coincidence rate between the maxillary dental midline and the philtrum, significantly higher than the 3.3% observed in the present study. The discrepancy in results may be attributed to the different measurement methods employed. In Miller's study, each examiner answered four questions about the samples, whereas in the present study, measurements were conducted using computer software capable of detecting even slight differences. Additionally, the inclusion criteria differed between the studies; Miller's study only required participants to have 12 regular anterior teeth, whereas the present study employed more stringent inclusion criteria.

Another significant finding of this study was the minimal coincidence between the midline of the maxillary teeth and the nose tip. No similar study has specifically examined the alignment of the dental midline with the nasal tip, underscoring the need for future research in this area. Bidra and Farahani explored the proximity of facial landmarks to the oral midline and found that the nose tip deviated the most from the facial midline (1, 6). The closest landmark to the oral midline was the dental midline, followed by the philtrum and the tip of the nose. These findings are broadly consistent with the results of the present study.

In contrast, the study by Kurian et al. identified the philtrum, the nose tip, and the dental midline as the nearest landmarks to the oral midline. Singh's study found that the closest landmark to the midline of the mouth was the philtrum, followed by the dental midline and the tip of the nose. Due to these differing orders of landmark proximity, directly comparing their results with the present study is not feasible (8, 11).

In the present study, the mean distance between the tip of the nose and the maxillary teeth midline was 1.43 mm in men and 1.29 mm in women. Overall, the mean distance between the maxillary teeth midline and the midlines of the face, philtrum, and nasal tip was significantly greater in men than in women.

The method of measurement and its accuracy play a crucial role in determining the reliability of the results. Utilizing software for measurements offers a higher level of precision

compared to manual clinical measurements performed on patients, as it significantly reduces the potential margin of error. Furthermore, factors such as the sample size and the age of the subjects can have a considerable impact on the outcomes, potentially influencing the overall findings of the study (13). Future studies could focus on conducting long-term analyses to better understand the influence of these factors across various communities. Additionally, it is strongly recommended that similar research be carried out in more diverse populations to enhance the generalizability and robustness of the findings, ensuring they are applicable across broader demographic groups.

Conclusion

In summary, the distance between the maxillary teeth midline and the midlines of the face, philtrum, and the nasal tip is significant, with the philtrum showing the most conformity with the maxillary teeth midline, followed by the facial midline and the tip of the nose.

References

1. Farahani A, Jafari K, Hemmati A, Naghizadeh A, Nemati R, Farahani MH. Assessment of the Relationship Between Facial and Dental Midlines with Anatomical Landmarks of the Face and Oral Cavity. *Turkish journal of orthodontics*. 2019; 32(4): 200.
2. Silva BP, Jiménez-Castellanos E, Martinez-de-Fuentes R, Fernandez A, Chu S. Perception of maxillary dental midline shift in asymmetric faces. *International Journal of Esthetic Dentistry*. 2015; 10 (4).
3. Jain AR. Coincidence of facial midline with dental midline in Chennai population. *Drug Invention Today*. 2018;10(6):99-106.
4. Mosharraf R, Abtahi D, Porrabani M. An investigation on the facial midline distance to some anatomic landmarks of the jaws among people with natural dentition. *Journal of Dental Medicine*. 2004; 16(4):31-8.
5. Bishara SE, Burkey PS, Kharouf JG. Dental and facial asymmetries: a review. *The Angle Orthodontist*. 1994;64(2):89-98.
6. Bidra AS, Uribe F, Taylor TD, Agar JR, Rungruanunt P, Neace WP. The relationship of facial anatomic landmarks with midlines of the face

- and mouth. The Journal of Prosthetic Dentistry. 2009;102(2):94-103.
7. Frese C, Staehle HJ, Wolff D. The assessment of dentofacial esthetics in restorative dentistry: a review of the literature. The Journal of the American Dental Association. 2012;143(5):461-6.
8. Kurian N, Gandhi N, Daniel AY, Varghese VS, Daniel S, Mehdiratta S. Digital analysis of facial landmarks in determining facial midline among Punjabi population. CHRISMED Journal of Health and Research. 2018;5(2):99.
9. Gharachahi J, Mahdavian S, Asadzadeh N, Rahbar A. Evaluation of dental midline relation to some landmarks of the face and mouth. Journal of Dentistry. 2008;9(1):41-50.
10. Khan MF, Qamar K, Naeem S. Coincidence of Facial Midline with Dental Medline. Pakistan Oral & Dental Journal. 2014;34(2).
11. Singh A, Nagpal A, Kaur M, Kaur B, Mahajan M. The relationship of facial and dental midlines with various anatomic landmarks of face and oral cavity. Journal of Dentistry and Oral Hygiene. 2016;8(5):23-31.
12. Miller EL, Bodden Jr WR, Jamison HC. A study of the relationship of the dental midline to the facial median line. The Journal of prosthetic dentistry. 1979;41(6):657-60.
13. Zimblar MS, Kokoska MS, Thomas JR. Anatomy and pathophysiology of facial aging. Facial plastic surgery clinics of North America. 2001;9(2):179-87, vii.