ORIGINAL ARTICLE

Gender Differences in the Distance Between Incisive Papilla and Maxillary Central Incisors Among Different Face Forms

Nahar KN[1], Shahid H[2], Ansary JA[1]

Abstract

Background: The incisive papilla is a stable anatomical landmark widely used to guide the horizontal placement of the maxillary central incisors during complete denture fabrication, yet limited data exist on how the papilla-to-incisor distance varies by sex within different face forms. This study aimed to determine gender-based differences in the horizontal distance between the incisive papilla and the maxillary central incisors across square, tapering and ovoid face forms among dentate adults.

Methods: This descriptive cross-sectional study included 100 dentate adults aged 20-40 years attending the Department of Prosthodontics, Bangladesh Medical University. Face form was clinically classified, maxillary casts were obtained and the papilla-incisor distance was measured on a cast surveyor using a calibrated protractor and a digital caliper. Data were analyzed in SPSS using mean ± standard deviation and the independent-samples t-test, with $p<0.05$ considered significant.

Results: The tapered face form was most common (52.0%), followed by square (39.0%) and ovoid (9.0%). Males showed a consistently greater mean papilla-incisor distance than females across all face forms, with mean differences of 0.24 mm (tapered), 0.52 mm (square) and 0.25 mm (ovoid).

Conclusion: Sex-related differences in the papilla-incisor distance are present within every face-form category and are most pronounced in the square face form, supporting the use of sex- and face-form-specific reference values in prosthodontic tooth positioning.

Keywords: *Incisive papilla, face form, maxillary central incisor, sexual dimorphism.*

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Introduction

The incisive papilla is a small, pear-shaped elevation of fibrous connective tissue overlying the nasopalatine neurovascular bundle at the anterior end of the palatine raphe and it remains one of the most frequently cited anatomical landmarks for locating the maxillary anterior teeth during complete denture fabrication.[1] Because natural teeth are lost with progressive alveolar bone resorption, the labial contour and horizontal position of the maxillary central incisors can no longer be judged from the residual ridge alone and clinicians must rely on stable intraoral landmarks that persist despite this remodeling. Among the candidate landmarks, the incisive papilla has attracted the widest clinical use because its posterior border shows comparatively little positional change after tooth loss and several investigators have used the horizontal distance between this landmark and the labial surface of the central incisors, commonly termed the papilla-incisor distance, as a practical guide for anterior tooth arrangement.[1,2]

Reported papilla-incisor distances vary considerably between populations and part of this variability has been attributed to differences in craniofacial and dental arch morphology rather than to measurement error alone. Facial form, traditionally classified according to Williams' typal concept into square, tapering and ovoid categories, has long been proposed to correspond with the outline of the maxillary central incisor and, by extension, with the underlying dental arch.[3]

Independent of facial form, sexual dimorphism is well established in human dental and craniofacial measurements, with males consistently showing larger arch dimensions, intercanine widths and tooth crown dimensions than females across diverse populations.[4,5] However, whether this sex-related size difference persists, diminishes, or reverses when the papilla-incisor distance is examined separately within each face-form category has not been adequately explored and most previous papilla-incisor studies have reported pooled or sex-combined values.[2,6]

This gap is clinically relevant because prosthodontists select and arrange anterior teeth for edentulous patients of both sexes and a landmark-based guide that ignores sex-specific variation within face-form subgroups risks producing dentures with sub-optimal midline and incisor positioning. Data from South Asian populations addressing this specific interaction remain scarce. The present study therefore examined the horizontal distance between the incisive papilla and the maxillary central incisors, stratified simultaneously by sex and face form, in a cohort of dentate Bangladeshi adults.

Objective

To determine gender-based differences in the horizontal distance between the incisive papilla and the maxillary central incisors across square, tapering and ovoid face forms among dentate adults.

Materials and methods

This descriptive cross-sectional study was carried out in the Department of Prosthodontics, Bangladesh Medical University (BMU), Shahbag, Dhaka, over a period of six months. A total of 100 dentate adults attending the outpatient department for treatment of the lower arch were evaluated.

Sample Selection

Inclusion criteria: Participants with an intact maxillary dental arch, periodontally sound maxillary anterior teeth, an Angle's Class I occlusal and arch relationship, of either sex and within 20-40 years of age were included.

Exclusion criteria: Individuals with a supernumerary tooth in the maxillary arch, maxillary midline diastema, any degree of anterior crowding, visible incisal attrition, rotation of the maxillary anterior teeth, a history of orthodontic treatment, a soft-tissue lesion involving the incisive papilla, a history of maxillary surgery, restorations or fractures of the anterior teeth, enamel chipping, or developmental dental anomalies were excluded.

Data Collection Procedure

Participants were selected using a non-probability convenience sampling technique after a structured interview and clinical examination confirmed eligibility. Face form was clinically assessed with the participant seated upright in a neutral head position, using two imaginary lines drawn approximately 2.5 cm anterior to the tragus and extending to the angle of the mandible; parallel lines defined a square form, lines converging toward the chin defined a tapering form and lines diverging toward the chin defined an ovoid form. A maxillary impression was recorded with high-viscosity alginate using manufacturer-recommended powder-liquid ratios and a standardized mixing technique, then rinsed and disinfected. Casts were poured in dental stone within 15 minutes of impression-making and standardized using a base former. The incisive papilla was identified and its posterior border outlined with a hard lead pencil on the cast, which was then secured to a cast surveyor. A calibrated transparent protractor was positioned with its 90-degree mark superimposed on the surveyor's vertical analyzing pin, itself aligned with the posterior border of the papilla and secured with sticky wax to prevent displacement. The horizontal distance from this reference point to the labial embrasure between the maxillary central incisors was recorded with a digital vernier caliper to the nearest 0.01 mm.

Ethical Consideration

Ethical approval was obtained from the Institutional Review Board of BMU, Shahbag, Dhaka. Written informed consent was secured from all participants after the purpose, procedure and potential physical risks of impression-taking were explained in the local language. Data were coded, anonymized and stored in a locked cabinet accessible only to the research team and no hospital records were used to supplement participant data.

Statistical Analysis

Data were entered and analyzed using SPSS software, with continuous variables summarized as mean ± standard deviation and categorical variables as frequencies and percentages; between-sex comparisons within each face-form category were performed using the independent-samples t-test and comparisons across face forms were performed using one-way analysis of variance (ANOVA), with a p-value of less than 0.05 taken as the threshold for statistical significance.

Result:

Table 1: Age distribution of study participants

Age group	Frequency (n)	Percentage (%)
20–30 years	70	70
31–40 years	30	30
Total	100	100

As shown in Table 1, the majority of participants (70.0%) were aged 20-30 years, while the remaining 30.0% were aged 31-40 years.

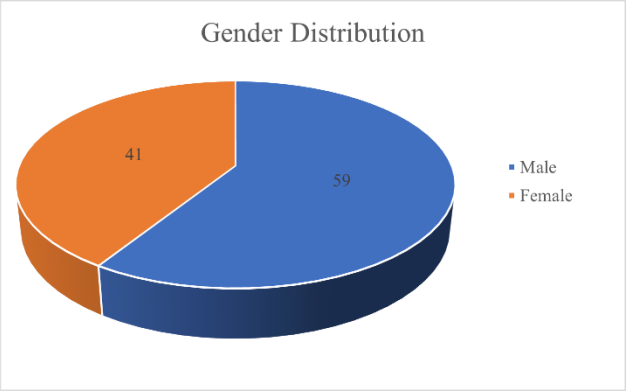

Figure 1: Distribution of the study participants by sex

Figure 1 shows the sex distribution of study participants. Male participants accounted for 59.0% of the study population, while female participants accounted for 41.0%.

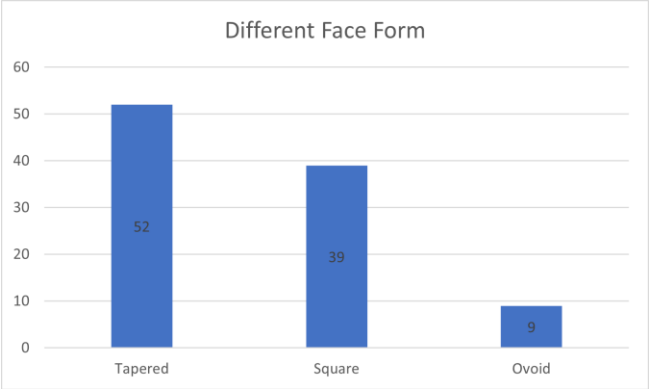

Figure 2. Distribution of participants according to face form

Figure 2 shows the distribution of participants according to face form. Tapered face form was the most common, accounting for 52.0% of participants, followed by square face form (39.0%) and ovoid face form (9.0%).

Table 2: Incisive papilla-to-maxillary central incisor distance according to face form and sex

Face form	Sex	Range (mm)	Mean ± SD (mm)
Tapered	Male	12.00–13.50	12.59 ± 0.48
	Female	12.00–13.00	12.35 ± 0.30
Square	Male	9.50–11.00	10.19 ± 0.51
	Female	9.00–10.50	9.67 ± 0.57
Ovoid	Male	10.50–12.50	11.50 ± 0.79
	Female	10.50–12.00	11.25 ± 0.65

Among participants with tapered face form, the mean distance was 12.59 ± 0.48 mm in males and 12.35 ± 0.30 mm in females. For square face form, the corresponding means were 10.19 ± 0.51 mm and 9.67 ± 0.57 mm, respectively. Among participants with ovoid face form, the mean distance was 11.50 ± 0.79 mm in males and 11.25 ± 0.65 mm in females.

Table 3: Comparison of incisive papilla-to-maxillary central incisor distance between males and females within each face form

Face form	Male, mean ± SD (mm)	Female, mean ± SD (mm)	Mean difference (mm)	P-value
Tapered	12.59 ± 0.48	12.35 ± 0.30	0.24	0.31
Square	10.19 ± 0.51	9.67 ± 0.57	0.52	0.007
Ovoid	11.50 ± 0.79	11.25 ± 0.65	0.25	0.619

The mean distance was higher in males than females across all three face forms. The mean differences were 0.24 mm for tapered, 0.52 mm for square and 0.25 mm for ovoid face forms. The source thesis did not report sex-specific hypothesis tests; therefore, corresponding P-values are not reported here.

Discussion

In the present study, the mean papilla-to-central-incisor distance ranged from 9.67 mm in females with a square face form to 12.59 mm in males with a tapered face form, a range broadly consistent with values reported in earlier papilla-incisor studies conducted in other populations. Shin and Kim reported a mean papilla-to-incisor distance close to the classical 12 to 13 mm estimate in a Korean sample and although their analysis did not stratify participants by face form, the overall magnitude of their measurements aligns closely with the tapered face-form values recorded in the present cohort.[1] Similarly, findings from Sapkota et al. among dentate Nepalese adults showed comparable papilla-incisor distances and, in agreement with the present results, a tendency toward larger values in male participants, although their study likewise did not examine this difference within face-form subgroups.[2] Sunila and Maria, working across three South Indian states, reported population-specific variation in papilla-related measurements and highlighted that regional and ethnic differences in palatal and arch morphology can meaningfully shift the papilla-incisor relationship, a consideration that may partly explain why the present values sit toward the lower end of previously published ranges for the square face-form group.[6]

The observation that the square face-form group displayed both the smallest papilla-incisor distance and the largest male-female difference (0.52 mm) merits particular attention. Ashok and Ganapathy demonstrated that face form can be reliably differentiated using objective geometric criteria and reported that women were disproportionately represented among square and ovoid face-form categories, whereas tapering forms were more common in men.[3] If square-form arches are structurally narrower and more compactly

proportioned, as suggested by earlier arch-form literature, this could plausibly compound the sex-based skeletal size difference already documented for maxillary dental measurements, producing the amplified male-female gap observed here. This interpretation is consistent with a substantial body of odontometric literature demonstrating that male dental and arch dimensions consistently exceed female dimensions. Pandey and Ma, for instance, found that mesiodistal and labiolingual canine dimensions were significantly larger in males than in females, while Mehta et al. reported a similar male predominance for maxillary first molar dimensions.[4,5] Shetty et al. and Sireesha et al. independently confirmed that canine and inter-canine width measurements retain significant sexual dimorphism across different Indian populations[7,8] and Bhargava et al. documented sex-related differences extending even to the mesiodistal width of the maxillary central and lateral incisors themselves.[9] Findings from Mazumder et al. among four ethnic groups of northeastern India similarly showed that arch perimeter, closely related to the anteroposterior and transverse dimensions measured in the present study, was consistently greater in males.[10] Outside South Asia, Salem et al. reported that both maxillary and mandibular intercanine widths remained reliable indicators of sex in an adult Egyptian sample, reinforcing that the sex-related pattern observed in the present tapered and ovoid groups is not population-specific.[11]

By contrast, the comparatively smaller sex difference noted in the ovoid group (0.25 mm) parallels findings from Rai et al., who reported that palatal and maxillary arch depth measurements, while generally larger in males, showed narrower absolute sex gaps in curved or rounded arch configurations compared with angular ones.[12] Karim and Baban recently applied machine-learning models to odontometric and arch-dimension data and confirmed that combining several anterior-tooth and arch parameters, rather than relying on a single linear measurement, improves the accuracy of sex estimation, a finding that supports the present study's emphasis on evaluating the papilla-incisor distance jointly with face form rather than in isolation.[13] Facial-proportion-based prediction models further corroborate a biological link between craniofacial form and anterior tooth position: Jassim et al. showed that intercondylar and intercanine distances varied significantly across square, tapering and ovoid facial forms, Chunhabundit et al. derived tooth-size prediction equations from two-dimensional facial measurements in a Thai population and Alshamri et al. confirmed significant correlations between maxillary anterior tooth dimensions and common facial measurements in an adult sample.[14,15,16] Taken together, these findings suggest that face form is not merely a cosmetic classification but an effect modifier of the magnitude of sexual dimorphism in the papilla-incisor relationship, a nuance that prosthodontists should consider when using papilla-based norms to position maxillary anterior teeth for edentulous patients of either sex.

Conclusion

This study demonstrates that the horizontal distance between the incisive papilla and the maxillary central incisors varies not only with face form but also with sex within each face-form category, with males consistently exceeding females and the square face-form group showing the widest sex-based difference. These findings indicate that papilla-based guides for anterior tooth positioning in complete denture fabrication should be applied with attention to both facial morphology and the patient's sex rather than as a single universal value. Incorporating sex and face-form-specific reference ranges into prosthodontic practice may improve the accuracy of anterior tooth placement and enhance denture esthetics for edentulous patients of both sexes.

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