ORIGINAL ARTICLE

Association Between Face Form and Incisive Papilla to Maxillary Central Incisor Distance in Dentate Individuals

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Abstract

Background: The incisive papilla is a stable landmark commonly used to guide the position of the maxillary central incisors in complete denture fabrication, but the extent to which its relationship to the central incisors varies with facial form remains incompletely defined. This study aimed to evaluate the association between face form and the incisive papilla-to-maxillary central incisor distance in dentate individuals.

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 as square, tapering, or ovoid, 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 one-way ANOVA, with $p<0.05$ considered significant.

Results: Tapered face form was most common (52.0%), followed by square (39.0%) and ovoid (9.0%). The mean papilla-incisor distance differed significantly across face forms, being highest in the tapered group (12.49 ± 0.44 mm) and lowest in the square group (9.99 ± 0.58 mm) ($P = 0.001$). Age and sex showed no significant association with the distance across the overall sample.

Conclusion: Face form is significantly associated with the incisive papilla-to-maxillary central incisor distance and should be incorporated into papilla-based guides for anterior tooth positioning.

Keywords: *Incisive papilla, face form, maxillary central incisor, complete denture.*

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Introduction

Selecting and positioning the maxillary anterior teeth so that they harmonize with a patient's facial morphology remains one of the more subjective steps in complete denture fabrication. Since Williams first proposed that the outline of the face corresponds to the shape of the maxillary central incisor, face form has been classified into square, tapering and ovoid categories and used as a guide for anterior tooth selection and arrangement.[1] More recent geometric and photographic analyses have refined this classification and confirmed that face form can be assessed reproducibly using standardized reference lines and angles.[1] Beyond tooth selection, several studies have shown that facial measurements correlate with underlying dental arch and tooth dimensions: Jassim et al. found that intercondylar and intercanine distances varied significantly across square, tapering and ovoid facial forms, Chunhabundit et al. derived equations predicting anterior tooth size from two-dimensional facial measurements and Alshamri et al. confirmed significant correlations between maxillary anterior tooth dimensions and common facial landmarks.[2,3,4]

Separately, the incisive papilla has been established as a reliable intraoral landmark for locating the maxillary central incisors after tooth loss, because its posterior border undergoes comparatively little positional change during the transition to the edentulous state.[5] Multiple population-based studies have measured the horizontal papilla-incisor distance and proposed reference values for prosthodontic use, including Sapkota et al. in a Nepalese population and Sunila and Maria across three South Indian states.[6,7] However, these papilla-incisor studies have generally

reported a single pooled estimate for the study population rather than examining whether the distance itself varies systematically with face form. If face form genuinely reflects underlying arch morphology, as suggested by the tooth-selection and facial-measurement literature, then the papilla-incisor distance, which depends directly on the anteroposterior position of the central incisors relative to a fixed palatal landmark, would be expected to differ meaningfully between square, tapering and ovoid face forms. Testing this hypothesis directly has clinical value: if face form predicts the papilla-incisor distance, clinicians could apply face-form-specific reference ranges rather than a single average value when positioning artificial anterior teeth for edentulous patients, potentially improving denture esthetics and function. Data addressing this specific association are limited, particularly in South Asian populations. The present study therefore evaluated the association between face form and the incisive papilla-to-maxillary central incisor distance in a cohort of dentate Bangladeshi adults.

Objective

To evaluate the association between face form and the incisive papilla-to-maxillary central incisor distance in dentate individuals.

Materials and methods

This descriptive cross-sectional study was conducted in the Department of Prosthodontics, Bangladesh Medical University (BMU), Shahbag, Dhaka, over a six-month period and enrolled 100 dentate adults aged 20 to 40 years who attended the outpatient department for treatment of the lower arch. Participants were recruited through non-probability convenience sampling and were required to have an intact, periodontally sound maxillary dental arch with an Angle's Class I relationship and no history of orthodontic treatment, maxillary surgery, anterior restorations, incisal attrition, crowding, midline diastema, or soft-tissue pathology involving the incisive papilla. After a brief structured interview, each participant's face form was clinically classified as square, tapering, or ovoid using two imaginary reference lines drawn from a point approximately 2.5 cm anterior to the tragus to the angle of the mandible, with parallel, converging and diverging line relationships corresponding respectively to the three forms. A maxillary alginate impression was recorded using standardized powder-liquid ratios, rinsed, disinfected and poured in dental stone within 15 minutes to produce a standardized cast. The posterior border of the incisive papilla was outlined on the cast with a hard lead pencil and the cast was mounted on a surveyor; a calibrated transparent protractor referenced to the surveyor's vertical analyzing pin and the papilla's posterior border was used to guide measurement of the horizontal distance to the labial embrasure of the maxillary central incisors with a digital vernier caliper accurate to 0.01 mm. Ethical approval was obtained from the Institutional Review Board of BMU and written informed consent, confidentiality safeguards and coded data storage were maintained throughout. Data were analyzed in SPSS as mean ± standard deviation for continuous variables and frequencies for categorical variables; one-way analysis of variance (ANOVA) was used to compare the papilla-incisor distance across face-form, age and sex categories, with $p<0.05$ considered statistically significant.

Result:

Table 1: Demographic characteristics of the study participants

Characteristic		Frequency (n)	Percentage (%)
Age group (years)	20–30 years	70	70
	31–40 years	30	30
Gender	Male	59	59
	Female	41	41
Total		100	100

Table 1 shows the baseline demographic characteristics of the study participants. The study population comprised 100 dentate individuals aged 20 to 40 years, including 70 participants (70.0%) aged 20-30 years and 30 (30.0%) aged 31-40 years; 59 participants (59.0%) were male and 41 (41.0%) were female.

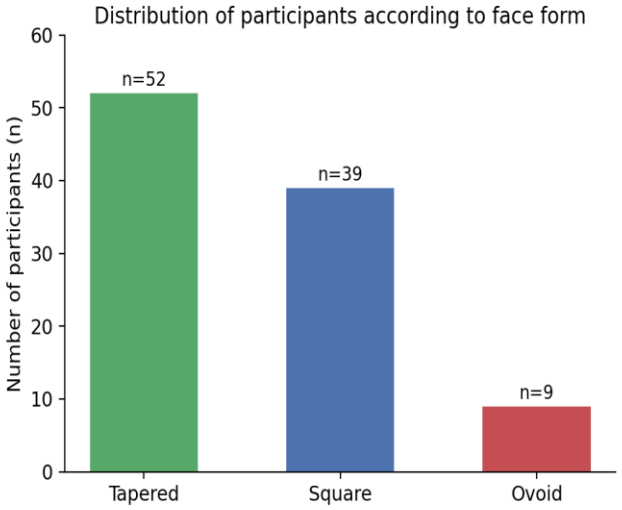

Figure 1. Distribution of participants according to face form

Figure 1 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

Face form	Range (mm)	Mean ± SD (mm)	P-value
Tapered	12.00–13.50	12.49 ± 0.44	0.001
Square	9.50–11.00	9.99 ± 0.58	0.001
Ovoid	10.50–12.50	11.39 ± 0.69	0.001

The mean incisive papilla-to-maxillary central incisor distance differed significantly across the three face-form groups (Table 2). Participants with a tapered face form showed the highest mean distance (12.49 ± 0.44 mm), followed by those with an ovoid face form (11.39 ± 0.69 mm) and a square face form (9.99 ± 0.58 mm); one-way ANOVA confirmed that this difference was statistically significant (P = 0.001).

Table 3: Incisive papilla-to-maxillary central incisor distance according to age group and sex

Variable	Category	Mean ± SD (mm)	Mean difference (mm)	P-value
Age group	20–30 years	11.35 ± 1.17	0.14	0.574
	31–40 years	11.49 ± 1.12	0.14	0.574
Sex	Female	11.31 ± 1.18	0.13	0.584
	Male	11.44 ± 1.14	0.13	0.584

Table 3 shows the invasive papilla to maxillary central incisor distance according to age and sex. The mean distance was not statistically significant among the age and sex group (p=>0.05).

Discussion

The present study found a statistically significant association between face form and the incisive papilla-to-maxillary central incisor distance, with the tapered face form showing the greatest distance, followed by the ovoid and square forms. This pattern parallels the geometric relationship originally proposed by Williams and later refined by Ashok and Ganapathy, who demonstrated that tapering face forms are associated with narrower, more elongated dental arches, whereas square face forms correspond to broader, more compactly proportioned arches.[1] A narrower, more tapering arch configuration would be expected to project the central incisors further forward relative to the stable posterior border of the incisive papilla, which is consistent with the higher mean distance recorded in the tapered group in the present study. Jassim et al. similarly reported that intercondylar and intercanine distances varied significantly across square, tapering and ovoid facial forms, with the tapering form showing distinct proportional relationships compared with the other two forms,[2] while Chunhabundit et al. and Alshamri et al. both demonstrated that anterior tooth dimensions can be reliably predicted from facial measurements, reinforcing the biological basis for a face-form-dependent papilla-incisor relationship.[3,4]

The magnitude of the present findings, particularly the markedly smaller mean distance in the square face-form group (9.99 ± 0.58 mm) compared with the tapered group (12.49 ± 0.44 mm), extends earlier papilla-incisor literature that largely reported single pooled estimates without face-form stratification. Shin and Kim reported an overall papilla-incisor distance close to the classical 12 to 13 mm range in a Korean sample,[5] a value that corresponds closely to the tapered face-form subgroup in the present cohort but considerably overestimates the distance recorded for participants with a square face form. Sapkota et al., working in a Nepalese population and Sunila and Maria, who studied three South Indian states, likewise reported papilla-incisor values within a comparable overall range but did not examine face-form-specific variation.[6,7] The wide range identified here, spanning from below 10 mm to above 12 mm depending on face form, suggests that a single universal papilla-incisor estimate may be insufficiently precise for clinical use and that face-form-specific reference values, as generated in the present study, could improve the accuracy of anterior tooth positioning during complete denture fabrication.

In contrast to the strong face-form effect, neither age group nor sex showed a statistically significant association with the papilla-incisor distance when the sample was analyzed as a whole. This finding should be interpreted alongside the broader odontometric literature, which consistently demonstrates sexual dimorphism in dental and arch dimensions when face form is not accounted for. Pandey and Ma, Mehta et al., Shetty et al. and Sireesha et al. each reported statistically significant male-female differences in canine and molar dimensions in South Asian populations,[8-11] Bhargava et al. documented sex-related differences extending to the mesiodistal width of the maxillary anterior teeth and Mazumder et al. found consistently greater arch perimeter in males across four ethnic groups.[12,13] Outside South Asia, Salem et al. confirmed that intercanine width remained a reliable sex indicator in an adult Egyptian sample.[14] The apparent discrepancy between this literature and the non-significant sex difference observed in the present aggregate analysis is most plausibly explained by the fact that face form was not held constant when age and sex were examined; sex-related differences in the papilla-incisor distance may become apparent once face form is controlled for, particularly within the square face-form category. Rai et al. similarly noted that sex-related differences in arch dimensions can vary depending on the underlying arch configuration[15] and Karim and Baban's machine-learning-based sex-estimation model performed best when multiple craniodental parameters were combined rather than analyzed individually,[16] supporting the interpretation that face form functions as an important effect modifier that should not be ignored when evaluating age- or sex-related variation in the papilla-incisor distance.

Conclusion

This study demonstrates a statistically significant association between face form and the horizontal distance between the incisive papilla and the maxillary central incisors, with the tapered face form showing the greatest distance and the square face form the smallest. Age and sex showed no significant association with this distance when analyzed across the overall sample, indicating that face form is the dominant determinant of papilla-incisor variation in this population. These findings support the use of face-form-specific reference values, rather than a single universal estimate, when the incisive papilla is used to guide the horizontal positioning of maxillary anterior teeth in complete denture fabrication.

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