Distance Between the Most Prominent Labial Surface of Maxillary Central Incisors to the Posterior Limit of Incisive Papilla in Various Arch Forms

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Abstract

Introduction: Arranging artificial teeth has always been a challenging work since edentulous alveolar ridges are in a constant verge of physiological resorptive changes. Incisive papilla is a reliable biometric guide which can be used as a reference for arrangement of anterior teeth, since it is a stable intraoral anatomical landmark unless surgically modified.

Objective: This study was conducted to determine the mean distance between the most prominent labial surface of maxillary central incisors to the posterior limit of incisive papilla in various arch forms.

Materials and Methods: The study was carried out among 170 undergraduate students of BPKIHS, after obtaining ethical clearance from Institutional Review Committee, BPKIHS. Maxillary impressions were made with alginate impression materials and casts were poured with dental stone. Distance from the posterior limit of incisive papilla to maximum convexity of central incisor (Papillo-Incisal Distance, PID) was measured with a Digital Vernier caliper with a precision of 0.01mm. The arch forms were analyzed and classified into ovoid, tapering and squarish arch, subjectively based on morphological parameters. The intra-examiner reliability of the measurement was tested in 17 casts calculating Cronbach's Alpha. Pearson Chi-square test was applied to explore the relation of the arch forms with age and gender. One-way ANOVA was used to check the association between the mean PID between with different arch forms.(p value = 0.05)

Results: The mean distance from the labial surface of maxillary central incisors to the posterior limit of incisive papilla was 11.58±1.32 mm. The mean papillo-incisal distance varied with respect to different arch forms which was statistically significant (P<0.05). The mean PID of oval, squarish and tapering arch forms were 11.86 mm, 10.82 mm and 11.93 mm respectively.

Conclusion: Incisive papilla is a valuable starting point in the preliminary location of maxillary incisors during fabrication of dentures. The suggested mean PID for arranging central incisors is 11.58 mm.

Key words: Arch forms; Incisive papilla; Papillo-incisal distance

Introduction

Anterior teeth are considered as the natural ornaments on the face and the loss of teeth negatively influences the oral function as well as social life and day to day activities.[1] Placement of the anterior teeth should not only improve the function, but should also be esthetically pleasing to enhance the psychology of the patient.[2,3] Though the replacement of anterior teeth is a challenging endeavor, it is possible to place artificial teeth within the natural limitations by correctly utilizing certain anatomic references.[4,5] The incisive papilla (IP) is a stable and noticeable

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anatomical landmark which persists during the progression from dentate to edentulous state, until otherwise surgically modified. A precise communication between the dentist and the dental laboratory technician is imperative for the proper arrangement of anterior teeth and success of complete denture treatment.

Materials and Methods

The study was carried out among 170 undergraduate students of BPKIHS, Dharan during a period of a year (April 2017- Dec 2017). Ethical clearance was obtained from Institutional Review Committee (IRC), BPKIHS, Dharan (Ref No.302/073/074). Sample size was calculated in reference to a study carried out by Naz et al with the mean Papillo-Incisal Distance (PID)±SD being 11.06 ±1.46 mm.[6]

Sample size calculation:
$N = Z^2 \times \sigma^2 / L^2$
Where,
N = Sample size
Z =1.96 at 5% level of significance,
Standard deviation (σ) =1.46 and
Margin of error (L)= 2% of Mean

Inclusion criteria comprised participants with natural healthy dentitions and well aligned dental arches with presence of all incisors, canines, premolars and molars present. Participants with interdental spacing, crowding, history of previous orthodontic treatments, restored anterior teeth and other deformities of teeth and jaws were excluded from the study.

Maxillary perforated stock metal trays were selected in accordance with arch form and size of the participants and impressions were made with irreversible hydrocolloid impression material (Zelgan, Dentsply) following the manufacturer instructions for mixing; using the supplied water powder measuring scoop and cylinder. After hand mixing, the impression material was loaded onto the tray, seated onto the maxillary arch of the participant and allowed to set for 3.5 minutes to ensure an adequate final set. The impression was then removed, rinsed, valuated for any discrepancy and disinfected for 10 minutes using 2% glutaraldehyde.

The casts were poured with type III dental stone (Kalstone, India) and cast bases constructed using standard base former and damaged stone casts were discarded. Each cast was placed on a horizontal surface and boundaries of incisive papilla was identified and marked with a lead pencil. The cast was then secured on a surveyor (Marathon-Surveyor 103) (Fig 1) and the occlusal plane of maxillary cast was oriented parallel to horizontal plane using a glass plate. Distance from the posterior limit of incisive papilla to maximum convexity of central incisor (Papillo-Incisal Distance) was measured with a Digital Vernier caliper (Mitutoyo corp., Japan) with a precision of 0.01mm (Fig 2). The fixed jaw blade of the caliper was extended 14 mm from the original for effective measurements. The PID was measured three times for each individual cast, the mean of which was concluded as a final measurement of PID. The digital caliper was checked and rechecked for proper functioning after every 10 casts measurements using a metallic ball of diameter 4.74 mm.

The arch forms were also assessed taking considerations of their basic morphological description and classified into ovoid, tapering and squarish arch (Fig 3a,3b,3c) as followed in previous studies conducted by Avhad, Tembhurne and Sar and Zia, Azad and Ahmed.[7,8] The intra-examiner reliability of the measurement was tested in 17 casts (10% of sample) calculating Cronbach's Alpha. The Cronbach's Alpha, Intra-Class Correlation and 95% CI obtained were 0.991, 0.991 and (0.974-0.997) respectively which suggested that clinical intra-examiner reproducibility for recording variables was very good.

Results

Out of the 170 participants, the overall Mean±SD of PID was (11.58 ±1.32) mm; the Mean PID±SD in male being 11.66 ± 1.36 mm and in female 11.46 ± 1.27 mm. Pearson Chi-square test was applied to the variables which showed that there was no significant difference between the arch forms according to age and gender.

The mean PID in the tapering arch form was 11.93 mm followed by oval and squarish arch form being 11.86 mm and 10.82 mm respectively (Table 1). One-way ANOVA revealed the significant differences in the mean PID between different arch forms. Post-hoc revealed the mean PID of oval and tapering arch forms varied significantly compared to squarish arch form. But no significant difference was observed in between the groups: tapering and oval.

Table 1: Frequency distribution and mean PID among studied samples

Participants	N	Arch Form			
		Oval	Squarish	Tapering	P value*
Male	100	48 (48%)	31 (31%)	21 (21%)	0.815
Female	70	34 (48.6%)	19 (27.1%)	17 (24.3%)	
Mean PID (mm) ±SD	11.58±1.32	11.86±1.21	10.82±1.16	11.93±1.38	
P value*	0.61(T-test)	<0.001(ANOVA test)			

*The mean difference is significant at the 0.05 level

Figure 1: Marking the most prominent labial surface of central incisors

Figure 2: Measurement of papillo-incisal distance using digital vernier caliper

Figure a: Oval arch *Figure b: Squarish arch* *Figure c: Tapering arch*

Figure 3: Classification of maxillary arch forms in studied population

Discussion

Achieving a beautiful smile requires consideration of a number of factors including the position of incisal edges in relation to lower lip, the amount of tooth and gingival display during a resting and full/expanded smile, tooth proportion, lip support, the axial and the bucco-lingual inclination of teeth, negative space and gingival level.[9] In contrary to the posterior teeth, selection of anterior teeth is guided moreover by esthetics than function. The natural teeth demonstrate a fixed positional relationship to the various facial landmarks, which should be mimicked during the prosthetic teeth replacements. Incisive papilla being one of the most stable intraoral anatomical landmarks, which resist the age changes from dentate to edentulous stage, and acts as a valuable as well as reliable reference for the proper positioning of the anterior teeth to the same natural tooth position. PID has been measured in various populations including Chinese, Taiwanese, Iraqi and Yemini, Jordanians and Malays with respect to different races and ethnicity and a standard norm has been formulated that forms the base for the arrangement of prosthetic anterior teeth in complete denture.[10-14] However, there is paucity of researches that considered the relationship between the mean PID and variables like arch forms and morphology of incisive papilla.

Although PIDs in many studies have been measured from the center of the incisive papilla, but the posterior border being is more reliable as it is least affected by the resorptive process. Hence, this study has considered the posterior border of incisive papilla to measure the PID.

In this study comparable participants of male and female were enrolled (59% and 41% respectively), the overall mean PID±SD recorded was 11.58 mm±1.32 mm which was in concordance with the studies by Shin and Kim and Shrestha et al. [15,16] Independent t test revealed there was no significant differences in the mean PID between the males and females which was in agreement with to the studies by Grave and Becker and Shrestha et al. [17] In contrast to this result, Shin and Kim reported the mean PID between males and female varied significantly that could be due to the huge difference in number of male and female participants in the study,70 and 33 respectively.

Oval arch form (48.20%) was the most predominant type among the participants, followed by squarish arch (29.40%) and tapering arch forms (22.40%). (Table 1) The findings were similar to the study of Ehrlich and Gazit where majority of participants had oval arch form followed by square and tapered arch forms.[18] However, this was in contrast to the study done in Korean population where squarish arch form was more common which could be due to their mongoloid origin and tapered arch form was more common in North Americans.[19]

The mean PID was studied with respect to different arch forms and the result showed the distance varied significantly. The mean PID±SD for oval arch form was (11.86±1.21) mm, squarish (10.82±1.16) mm and tapering (11.93±1.38) mm. This result was in contrast to the study by Shrestha et al.[17] Our study revealed that the mean PID of oval and tapering arch form varied significantly to that of squarish arch form. This could be due to the fact that the incisors and canine in squarish arch form lie in a straight line and closer to the incisive papilla.

Conclusions

The mean distance between the most prominent labial surface of maxillary central incisors and the posterior limit of incisive papilla in the studied sample was (11.58±1.32) mm which is not significantly associated to the gender and age of individuals. However, the papillo-incisal distance significantly varied with respect to different arch forms.

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