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Evaluation of the Relation of Maxillary Canine and Edge of Central Incisor to Incisive Papilla in Indian Population with Respect to Arch Form

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Abstract Finding the most suitable position for artificial anterior teeth in the absence of pre-extraction records presents a new challenge with every denture and has resulted in a variety of measurements. It encompasses the knowledge of anatomy and physiology of oral tissue. In this study, the relation between anatomical landmarks the tips of the maxillary canines, edge of central incisor and center of incisive papilla was evaluated and compared with respect to arch form in Indian population. Arch forms were accessed by their morphological description as square, tapering or ovoid arch. Measurements on the casts were recorded for incisive papilla and maxillary central incisor distance, by digital vernier caliper and photographic technique was used to record the relation between tips of the canine and the centre of the incisive papilla. The mean distance between edge of central incisor to center of incisive papilla for square arch, oval arch and tapered arch was found as 9.667, 9.991 and 10.912 mm respectively. When all the 300 casts were taken together, it indicated that 51.3 % of intercanine lines passed through the center, 18.1 % of inter canine lines passed posterior and 30.6 % of the intercanine lines passed anterior to the center of incisive papilla. χ^2 (Chi square) values concluded they differ significantly and significant number of intercanine lines crossed through the center of the incisive papilla irrespective of the arch form.

Keywords Incisive papilla (IP) · Irreversible hydrocolloid · Type III gypsum · Anatomical landmarks · Arch forms · Intercanine lines (C1 C2)

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Introduction

For completely edentulous patients, to achieve a correct speech, lip support and harmonious incisal guidance the maxillary anterior teeth should be positioned as close as possible to the positions originally occupied by natural teeth, which is a challenge for dentists in the absence of pre-extraction records. The surface anatomy of oral tissues offer clues that helps to locate the proper position of anterior teeth within the dental prosthesis and the most obvious anatomical landmark that appears to have survived intact from the dentate to edentulous state is the incisive papilla. Schiffman [1] stated that maxillary incisors fall approximately 8–10 mm anterior to the point of intersection of a line that bisects the midline of the palate perpendicularly through the incisive papilla. This perpendicular bisecting line also extends outwards approximately through the mid of the maxillary canines. According to Heartwell [2], the positions of teeth in dentulous situations usually follow the form and shape of the arch and the shape of the arch has not been altered or destroyed by atrophy, resorption, accident, or surgical procedures. By using incisive papilla, cuspid lines, distance between incisive papilla and central incisors, arch forms etc. as a guide, it is possible to more closely place artificial teeth in approximately the position that it was in the patient's natural dentition. However, most previous studies have been conducted in Caucasian samples, and the findings have been extrapolated to other ethnic groups. This study, which is part of an ongoing investigation, into the application of various commonly used guidelines to the Indian group, was undertaken to see if the relationships claimed for the incisive papilla are valid for this population Hence, the purpose of this clinical study was to evaluate and compare the relation of tips of the maxillary canines

and edge of central incisor to the center of incisive papilla in antero-posterior position with respect to arch form in Indian population.

Materials and Methods

Selection of Subjects

A total of 1,000 patients of age 30–40 years were selected randomly from the out-patient department. Out of the 1,000 patients 300 patients were selected for the study. They were selected on the basis of the following criteria i.e. All maxillary incisors, canines, premolars, first molars should present. Subjects having gross malalignment, supraerupted teeth, history of orthodontic treatment, diastema between anterior teeth and severe attrition of canines were excluded, although subjects with mild attrition were accepted. They were divided into three groups according to the shape or form of the arch, i.e. square arch, oval arch and tapered arch, each of 100 subjects respectively.

Impression Making and Cast Preparation

Impression of the maxillary arch was made with irreversible hydrocolloid (alginate) impression material and poured with Type III gypsum, dental stone (Kalstone). The prepared casts were standardized with the occlusal plane parallel to the horizontal plane with the help of leveling scale/spirit level (Fig. 1).

The Incisal edge of central incisors, the anterior point of incisive papilla, the posterior point of incisive papilla, midpoint of incisive papilla and the tips of canines, were marked on the cast by marker pencil. The tips of the canines were approximated if they were attrited. The midpoint of incisive papilla was determined by dividing the incisive papilla in two equal halves. A circle of 1 mm diameter was drawn around the midpoint of incisive papilla taking midpoint as centre.

Measurement with Digital Vernier Caliper

The distance between the mesio-incisal edge to midpoint of incisive papilla was measured with the help of digital vernier caliper (Fig. 2).

Tracing of Photograph

Linear measurements between two objects in a three dimensional relationship imposes problems when the objects were not aligned on the same plane in three dimensions. To reduce this error, photographic technique was used. A custom made device (Fig. 3) copying stand was designed for holding the camera (Nikon COOLPIX S10) in a constant position (1 feet away from the occlusal plane) to standardize the photograph. Photographs with a 1:1 image were produced. The tips of the canines and the center of the incisive papilla were remarked on photograph. The flat edge of a ruler was laid across the dental arch from premolars to premolars with the front edge touching the tips of the canines. A line was drawn touching the tips of both right and left canines (Fig. 4).

Relation of the Line Joining the Tips of the Canines with the Center of the Incisive Papilla

Measurements of 0.5 mm or less were considered to be the center of the papilla. Lines those lie anterior and posterior to the 0.5 mm radius were taken as lines anterior to center of incisive papilla or as lines posterior to the center of the incisive papilla depending on where they lie.
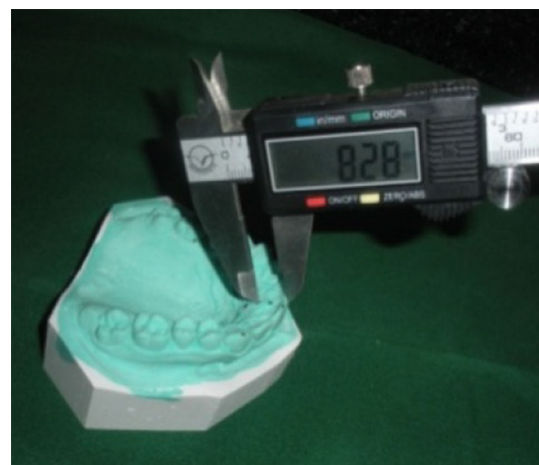

Fig. 1 Use of spirit level to check the occlusal plane parallelism to horizontal plane

Fig. 2 Measurement with digital vernier caliper
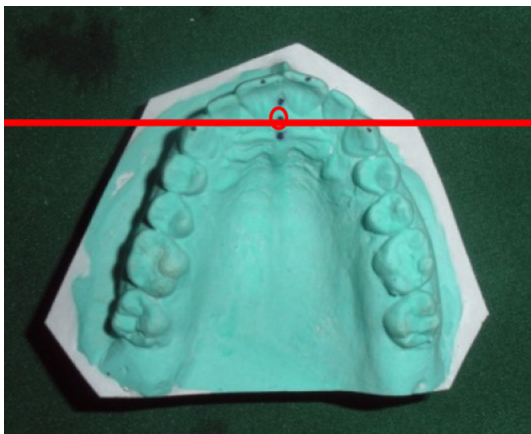
Fig. 3 Custom made device

Fig. 4 Traced photograph

Data Analysis

The above mentioned linear measurements were recorded five times and a mean value of each measurements was determined.

Results

These observations were then statistically analyzed to determine the level of confidence and significance to comparatively evaluate these values obtained.

The mean distance between edge of central incisor to center of incisive papilla for square arch, oval arch and

tapered arch was 9.667, 9.991 and 10.912 mm and the range was 6.8 mm (7–13.8 mm), 5 mm (7.4–12.4 mm) and 5.4 mm (8.1–13.5 mm) respectively. One way analysis of variance (ANOVA) showed that the distance between incisal edge and the center of incisive papilla was affected by change in shape or form of the arch (Table 1).

But when Scheffe analysis was applied, P value between the square arch and the oval arch was 0.251, is (>0.05) giving non-significant results. But in the other comparisons between the square arch and tapered arch P was 0.000 and between oval arch and tapered arch P was 0.000 giving statistically significant results (Table 2).

Taking a radius of 0.5 mm around the center of incisive papilla as center, in square arch 47 % of intercanine lines passed through the midpoint, 13 % of lines passed posterior and 40 % of lines passed anterior to the midpoint of incisive papilla. In oval arch 55 % of intercanine lines passed through the midpoint, 15 % of lines passed posterior and 30 % of lines passed anterior to the center of incisive papilla. In tapered arch 52 % of intercanine lines passed through the midpoint, 26 % of lines passed posterior and 22 % of lines passed anterior to the center of incisive papilla. When all the 300 casts were taken together, it indicated that 51.3 % of intercanine lines passed through the center, 18.1 % of inter canine lines passed posterior and 30.6 % of the intercanine lines passed anterior to the center of incisive papilla (Chart 1). χ^2 (Chi square) values concluded they differ significantly and significant number of intercanine lines crossed through the center of the incisive papilla irrespective of the arch form.

Discussion

Results indicated that the form of the dental arch (square, ovoid or tapering) has no bearing on the relation of the tips of the canines to the center of the incisive papilla. It was similar to the study made by Grave and Becker [3] as previously mentioned.

The arrangement of the anterior teeth for the square arch places the central incisors more nearly horizontal with the cuspids. The arrangement of the anterior teeth for the tapered arch places the central incisors farther forward than the cuspids. The arrangement of the anterior teeth for the ovoid arch places the anterior teeth in a gentle curve [2] which was according to the results obtained.

According to Schiffman [1] 78.3 % intercanine lines passed through the center of incisive papilla out of 507 casts. However, in this study 51.3 % of intercanine lines passed through the center of incisive papilla out of 300 casts. The difference in percentage may be due to racial difference. However this figure was very similar to that of Ehrlich and Gazit [4]. They observed that out of 430 casts,

Table 1 ANOVA

Groups	N	Mean	SD	F value	P value	Result
Square arch	100	9.667	1.30152	22.099	0.000	Significant
Oval arch	100	9.991	1.53709			
Tapered arch	100	10.912	1.26773			
Total	300	10.19	1.46777			

Table 2 Multiple comparisons (Scheffe analysis)

Different arches		P value	Result
Square arch	Oval arch	0.251	Non significant
Square arch	Tapered arch	0.000	Significant
Oval arch	Tapered arch	0.000	Significant
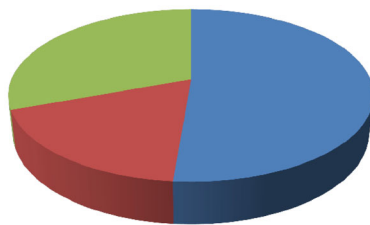
■ C1 C2 passes through the mid point of IP 51.3 %

■ C1 C2 passes through posterior to midpoint of IP 18.1 %

■ C1 C2 passes through anterior to midpoint of IP 30.6 %

Chart 1 Relation between canine and center of incisive papilla in 300 casts

in 248 casts, 57.6 % of cases the intercanine line crossed through the center of incisive papilla, In 72 casts (16.7 %) it passed through anterior to the center of papilla and In 110 casts (25.7 %), the line was posterior to the center of papilla. In 60 % of the square type arches the intercanine line passed through the center of incisive papilla. 28 % were anterior to the center of papilla but only 10 % posterior to the center of papilla. In ovoid and tapering types the intercanine lines passed through the center in over 50 %. It was also comparable to the results of Sawiris [5] study where 64 % of the intercanine lines were found to pass by ±1 mm from the center of the papilla. According to Lau and Clark [6] in 57.3 % of casts, intercanine lines passed through the middle third, in 12.2 % through anterior third and in 30.5 % through the posterior third, similar to Indian population.

In this study the mean distance between incisal edge of central incisor and center of incisive papilla was 9.667, 9.991 and 10.912 mm for square, oval and tapered arch respectively. The figure falls within the recommended range of 8–10 mm and is comparable to the findings of Sawiris [5] (8.5 mm), Mavroskoufis and Ritchie [7] (10.2 mm), Huang et al. [8] (mean of 9.21 mm) and Lau and Clark [6] (mean 9.22 mm for men and 9.09 mm in the women) and Zia et al. [9].

According to Zia et al. [9] measurement of central incisors to incisive papilla distance was minimum for square arch forms. (The range was 9–11 mm with mean 10 mm in females, and range was 9.5–11.5 mm with mean value of 10.5 mm in males for square arch). Tapered arch forms had maximum central incisor–incisive papilla distance (ranging from 12.5–13.5 mm in males and 11.5–13 mm in females with mean values of 13 and 12.5 mm respectively). The results were almost similar to the study done on Indian population.

Conclusion

The guidelines recommended for Caucasians could be used as starting points in the preliminary location of maxillary incisors and canine teeth during construction of dentures for Indian population.

The practical significance of this study lies in its application to complete denture prosthodontics. A line bisecting the incisive papilla that is perpendicular to the long axis of the cast can be used to fairly well establish the antero-posterior positions of the canines. By transcribing the position of the intercanine line on a well contoured occlusion rim, a combined mesiodistal width of the six maxillary anterior teeth from midcanine to midcanine can be determined. It provides both the dentist and laboratory technicians with a better method for location and placement of anterior teeth.

However, it has been suggested more recently that edentulism alters the characteristic features of the lips and the relationship of the jaws so that the like hood of actually placing artificial teeth in the same position as natural teeth seems doubtful. Therefore instead of adhering rigidly to a rule, a dental technician without the chance of seeing the patient, should make use of such anatomic landmarks in the construction of wax occlusion rims, so that it approximates the final position of the artificial teeth. The dentist should use a combination of biometric guides, phonetic tests, and denture space identification to reproduce the relationships established between natural teeth and the orofacial investing tissue. This will help to reduce the clinical time of both the dentist and the patient. The dentist on receiving the wax rim should make adjustment according to the individual requirements of patient.

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