COMPARISON OF DISTANCE BETWEEN MAXILLARY CENTRAL INCISORS AND INCISIVE PAILLA IN DENTATE INDIVIDUALS WITH DIFFERENT ARCH FORMS

Majid Zia, Azad Ali Azad, Salman Ahmed

Department of Prosthodontics, Dental Section, Ayub Medical College, Abbottabad, *Armed Forces Institute of Dentistry, Rawalpindi, **Nishtar Medical College, Multan, Pakistan

Background: After loss of natural teeth, provision of prosthodontic services almost becomes necessity in the present day living. To provide effective mastication teeth have peculiar forms. To make it more efficient both functionally and biologically, they are arranged in particular geometric manner referred to as dental arch. The objective of this study was to compare the distance between mesial edge of the maxillary central incisors and posterior border of the incisive papilla in dentate individuals with different arch forms. **Methods:** After sample selection, impressions were made for upper and lower arches and the resultant casts were standardised. Arch forms were assessed by their morphological description. Measurements on cast were recorded for incisive papilla (IP) and maxillary central incisor (CI) distance after securing it on cast surveyor. **Results:** Ovoid arch form was the most frequently observed arch form both in males (57%) and females (68%) while their combination (Ovoid Square and Ovoid tapered) were the least commonly observed arch forms (4% and 5% each). Gender seems to be important in about 1/4th of the dentate individuals, regarding both the type of the arches and CI-IP distance. **Conclusion**: Ovoid type of arches was the commonest arch form seen in either sex. There is no significant difference between males and females in ¾[th] of dentate individuals, regarding the type of dental arch as well as CI-IP distance.
Keywords: Incisive papilla, arch forms, anatomic landmarks

INTRODUCTION

After loss of natural teeth, provision of prosthodontic services almost becomes necessity in the present day living. To provide effective mastication teeth have peculiar forms. To make it more efficient both functionally and biologically, they are arranged in particular geometric manner referred to as dental arch.

The earlier researchers have described different arch forms as Square, Ovoid, and Tapered.[1] Combinations of these forms are well recognized in prosthodontics.[2] In the treatment of edentulous patients, effective relocation of anterior artificial teeth in the pre existing natural position is of utmost importance.[3] Prosthodontists agree upon the fact that dental prostheses should represent approximately the same amount of tissue in the same position from where it was lost.[4]

Prostheses cannot be exact substitute of natural teeth, however if prepared properly based upon some measurable parameters then they are not only functionally stable but also biologically and aesthetically viable.[5,6] These results can be achieved effectively with the help of some anatomical landmarks as under:[7,8]

1. The maxillary labial vestibule
2. The incisive papilla
3. The mandibular labial vestibule
4. The maxillary tuberosity
5. Retro molar pad
6. Palatal gingival margin[9,10]

The incisive papilla is an important landmark as it is an immobile structure and usually does not shift in adult life.[11,12] The researchers have used incisor to incisive papilla distance as a biometric guide.[13,10] However, no significant published work has been sighted so far on this subject in our country. The present study aims at knowing this distance in our people with different arch forms. This will reduce the dentist's chair side effort and patient's time by allowing the dental laboratory technicians to reproduce the relationship established between the natural teeth and the orofacial investing tissues[14], especially in the absence of pre extraction records.

PATIENTS AND METHODS

This cross-sectional study was conducted in the Prosthodontic Department of Armed Forces Institute of Dentistry, Rawalpindi from 18th May 2006 to 17th Nov 2006, on one hundred and fifty patients, selected by non-probability convenience sampling. Males and Females of 20–40 years age, having intact maxillary dental arch and mandibular arch with any missing posterior tooth or teeth unilaterally or bilaterally except right and left first premolars or those with mandibular posterior tooth or teeth requiring crown placement.

Patients having horizontal and vertical overlap of maxillary central incisors >2 mm, over erupted teeth in maxillary arch, maxillary or mandibular midline diastema, any degree of crowding in maxillary and mandibular dentition, visible attrition of maxillary central incisor involving incisal edges, rotation of maxillary or mandibular central incisors, maxillary and mandibular dentition exhibiting pathological migration and grade II or III mobility, history of previous

orthodontic treatment, diseases of oral mucosa including infective and non-infective lesions and edentulous lower arch were not included in the study.

After explanation of the objective of the study the patients were thoroughly assessed for inclusion and exclusion criteria. The main criterion was the availability of intact maxillary arch demonstrating clear presentation of incisive papilla. When considered suitable for the study full informed consent was taken regarding the clinical procedure.

Irreversible hydrocolloid (CA 37, Cavex Holland BV) with a water powder ratio of 21 grams to 55 ml of room temperature tap water was hand mixed in a rubber bowl and loaded into stainless steel stock tray. After introduction of impression tray inside the patient's mouth, the alginate was allowed to set for three and a half minutes to insure an adequate final set. The alginate impression was then removed; rinsed and evaluated for any discrepancy and disinfected for ten minutes in a moist headrest cover. The impression was removed from the headrest cover after ten minutes and rinsed thoroughly and cast were made using Type 4 dental stone (Die stone, Dentamerica CA 91744 USA) mixed for fifteen seconds by hand then vacuum mixed for twenty seconds then poured into the impression by using vibrator at medium setting and allowed to set for 45 minutes. Casts was then retrieved securely and examined for any faults.

Standardization was done by making the base of the cast after retrieval of the cast by using base former and a double bubble levelling instrument which was capable of levelling the cast in two planes. Type 4 dental stone (Die stone, Dentamerica CA 91744 USA) was mixed for fifteen seconds by hand then vacuum mixed for twenty seconds then poured into the base former for receiving the cast, at this point levelling instrument (level IV, Kaohsiung Taiwan) was placed in an horizontal manner in such away that tips of both canines and posterior teeth at least touches the levelling instrument in order to avoid any antero-posterior as well as lateral tilts. Any surface irregularities of the stone were trimmed to get uniform surface on all sides. Stone was allowed to set. Cast was then retrieved from the base after 45 minutes. Arch form was assessed on cast by their morphological descriptions.

Incisive papilla was first identified, and then the boundaries were marked by using hard lead pencil, the pencil was sharpened for each cast independently.

The cast was secured to cast surveyor (Degussa, GB Dental und Goldhalbzeug D-6000 Frankfurt 1). The horizontal distance between vertical pin of the surveyor and the mesial edges of the maxillary central incisors were measured by placing protector in such away that its 90 degree marking was almost super imposing the vertical pin of the surveyor which at this stage is touching the posterior border of the incisive papilla. After securing protector in this manner sticky wax was applied to protector and the vertical pin to stop any unwanted movement. Horizontal distance was measured on the calibrated transparent protector by using caliper device placed at one end which is coinciding with the vertical pin and the other end on the incisal edges.

RESULTS

Results of the study are shown in tables-1 to 3. Equal number of males and females participated in the study with male to female ratio of 1:1. Seventy percent patients were 20–30 years old while 30% patients belonged to the age group 31–40 years (Table-1). Ovoid arch form was the most common type of arch seen in males as well as females, 57% and 68% respectively (Table-2). Ovoid square and ovoid tapered arch forms were the least common types of arches seen in either sex, 4% and 5% respectively (Table-2). Measurement of Central incisor to incisive papilla distance is shown in (Table-3). Square arch form had minimum CI-IP distance (range 9–11 mm, mean 10 mm in females, and range 9.5–1.5 mm with mean value of 10.5 mm in males). Tapered arch form had maximum CI- IP distance (ranging from 12.5–13.5 mm in males and 11.5–13 mm in females with mean values of 13 mm and 12.5 mm respectively). This is depicted in (Table-3).

Table-1: Age Distribution of the patients

Age Group in Years	Number	%
20–30	105	70
31–40	45	30

Table-2: Frequency distribution of different arch forms

Arch Form	Males (n=75)		Females (n=75)	
	Patients	%	Patients	%
Ovoid	43	57.3	51	68.0
Square	18	24.0	6	8.0
Tapered	8	10.6	10	13.3
Ovoid Square	3	4.0	4	5.3
Ovoid Tapered	3	4.0	4	5.3

Table 3: Statistical analysis of data (*t*-test)

Arch forms	CI-IP Distance in mm (Male)		CI-IP Distance in mm (Female)		Degree of freedom	*t*-value	*p*-value
	Range	Mean±SD	Range	Mean±SD			
Ovoid	10.0–12.5	11.2±0.50	9.5–11.5	10.5±0.64	92	6.14	<0.05
Square	9.5–11.5	10.5±0.49	9.0–11.0	10.0±0.70	22	1.6	>0.05
Tapered	12.5–13.5	13.0±0.41	11.5–13.0	12.5±0.49	16	2.6	<0.05
Ovoid Square	10.5–11.0	10.8±0.28	9.5–11.5	10.3±1.03	5	0.92	>0.05
Ovoid Tapered	11.0–12.5	11.8±0.76	11.0–12.5	12.0±0.70	5	0.35	>0.05

DISCUSSION

Prosthodontists who treat a large number of edentulous patients realize that there are a number of patients who cannot be satisfied aesthetically, functionally or both. For these patients, even a more objective selection criterion will be unsuccessful. However, for the majority of edentulous patients, a simple objective technique involving anatomical measurements would provide at least a starting point for tooth selection. This is most valuable for patients who request denture fabrication and have no previous denture or dental records to utilize for this process.

An average position of the maxillary anterior teeth to stable landmarks such as maxillary central incisor to incisive papilla distance has been mentioned as an important anthropometric tool facilitating prosthetic teeth arrangement in prosthodontics.[1,6,10–24] In the present study an effort was made to measure this distance in dentate male and female individuals with different arch forms. These arch forms have already been recognized in the literature with some difference in the nomenclature. The assessment of arch forms has been done by their geometrical description in the present as well as previous literature[1,4,6,14,25–27] In the present study an effort has been made (based upon observation) and identifying combination of previously recognized arch forms (ovoid square, ovoid tapered). The study was planned to see whether measurements of CI to IP distance in dentate individuals can provide some meaningful guidelines for maxillary anterior teeth arrangement while dealing with prosthodontic patients having similar arch forms, as have been observed in this study.

The study was conducted on 150 dentate individuals (75 males and 75 females) having different arch forms as mentioned earlier. It was observed that ovoid arch form was the commonest type of arch form found both in males and females (57.3 vs. 68%).

This seems converse to the results of earlier studies conducted on evaluating the maxillary arch forms by Kook[25] and Nakatsuka[26] in Nakatsuka's study the most frequent arch form was that of round square arches where as kook considered square arches as common according to their conclusion. Combined arch forms that are ovoid square and ovoid tapered were the least common forms in males as well as females (4% and 5.3%). This fact has not been described previously in our part of the world. Although lesser number of individuals were seen with these arch forms, the possibility exists that incorporation of this idea may prove of some additional benefit, especially while fabricating dentures for those who actually have these arch forms.

Square arch forms were second to the ovoid forms in either sex (24% vs. 8%). This is also not in accordance with the results of research in other parts of the world as described above in the sequence of availability of different arch forms. Tapering forms of dental arches were seen in (10.3%) males and (13.3%) females.

This particular study strictly followed the core objective that is why comparative analyses has been done only with those studies who worked on evaluation of maxillary arch forms, although there are certain studies who have comparable results with this as far as the prevalence of arch form is concerned but that would be of no benefit because they carried out their research on mandibular arches which has a huge difference in morphological behaviour to maxilla.

Equal number of males and females participated in the study (male to female ratio 1:1). Their ages ranged from 20–40 years. Previously, the studies conducted on arch forms and CI - IP distance also considered the same age group with some minor differences,[12, 14, 20] the obvious reason was anatomical stability and integrity of natural dentition with in this age group. This is imperative and obligatory while formulating rehabilitative guidelines for management of patients in prosthodontics.

An interesting observation was that the frequency of ovoid arch form was more in females (68%) while square arch form was more common in males (24%), however over all; frequently seen arch form in males was also the same as were in females that is the ovoid arch form. Knowledge of this anatomical parameter may be of considerable reliance, especially regarding the positioning of anterior maxillary teeth in prosthodontics. Similar observations were made by the earlier researchers.[12,13,22,28]

Ovoid arches of males and females were apparently of the same shape; however mean CI - IP distance in males with ovoid arches was different from that in females (11.2 mm vs. 10.5 mm). In case of square forms, slight difference in the mean was observed (10 vs 10.5 mm). Statistical analysis (paired sample t-test) revealed that there was no significant difference ($p<0.05$) in CI-IP distance in males and females with square ovoid square and ovoid tapered arch forms ($p>0.05$). However total number of individual males and females in the present study with these types of arches as a whole was 41 (27%) which signifies that in about 1/4th of edentulous patients with the above mentioned arch forms, the gender is irrelevant and measurement of CI-IP distance can be of no additional benefit. The individuals with ovoid and tapered arch forms, the two most frequently seen arch in this study (63% and 16% respectively) showed a significant difference in CI-IP distance between males and females ($p<0.05$). Collectively the individuals with these arch forms participating in the present study constituted about (79%) of the total, which means that

measurement of CI-IP distance in about 3/4th of patients having prosthodontic treatment with these arch forms could be of additional benefit, besides taking care of the other factors regarding the rehabilitative process. A thorough search of the published literature did not revealed a single example of previous work on this aspect of prosthoddontics, to be cited as a reference.

Statistical analysis of type of arches in males and females (Chi-square test) revealed no significant difference in arch forms between males and females with ovoid, square, ovoid square and ovoid tapered arch forms ($p>0.05$). However, males and females with tapered arches revealed significant difference in the type of arch ($p<0.05$). Individuals with tapered arches constituted about 24% of the total. It is apparent from these findings that gender difference is significant only in about 1/4th of the dentate individuals regarding the type of the arch while it is not in 3/4th. However this is not the end, rather it is the beginning. Further studies are required on larger samples to see the difference in more detail.

CONCLUSION

Ovoid types of arches were the commonest arch form seen in either sex. There is no significant difference between males and females in 3/4th of dentate individuals, regarding the type of dental arch as well as CI–IP distance.

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Address for Correspondence:
Dr. Majid Zia, Department of Prosthodontics, Women Medical College, Abbottabad, Pakistan. **Cell:** +92-300-9759299
Email: drmajidzia@gmail.com