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COMPARING ANTERIOR TOOTH WIDTH IN NATURAL TEETH & DIFFERENT COMMERCIAL ARTIFICIAL ACRYLIC TOOTH MOULDS : A CROSS SECTIONAL STUDY.

Dental Science

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ABSTRACT

Aim: The aim in this in vitro study was to collect data on the widths of permanent anterior teeth and to relate these measurements to some of the available artificial anterior tooth moulds and to compare the ratio between the mesiodistal width of maxillary and mandibular natural anterior teeth

Materials And Method: One thousand subjects were selected for the study. Impressions from irreversible hydrocolloid were made to obtain the casts. The measurements were made on the casts obtained. The mesiodistal width of the individual tooth was obtained by measuring the maximum distance between the mesial and distal contact points of the tooth to the nearest whole millimeter using vernier calipers on a line parallel to occlusal plane. Eleven different ranges of artificial anterior teeth were examined all of which were of acrylic. For each range, the mesiodistal diameter of various artificial permanent maxillary and mandibular anterior teeth was noted from mould chart provided by the manufacturer. Obtained information was then tabulated which gave the detail of all ranges and means of artificial anterior teeth and it was compared to evaluate the difference between anterior tooth width in natural teeth and different commercially available artificial acrylic tooth moulds.

Results: The average mesiodistal width of maxillary anterior natural teeth was 48.52mm which ranged from 40.04 - 58.97mm and for the mandibular anterior natural teeth it was 38.22mm which ranged from 29.97 - 46.22mm .The ratio between the mesiodistal width of maxillary and mandibular anterior natural teeth was 78.75%, which varied from the anterior ratio given by Bolton. There was a variation in the mesiodistal width on right and left side of dental arch showing that the anterior teeth were not mirror images of one another. The mesiodistal width of artificial anterior teeth studied was smaller than the mesiodistal width of natural anterior dentition.

Conclusion: The results of the present study showed that the mesiodistal width of maxillary and mandibular anterior denture teeth were predominantly in the smaller sizes as compared to mesiodistal width of maxillary and mandibular anterior natural teeth. No moulds were found which were larger than the normal range of natural anterior six teeth. So the choice of teeth for prosthesis of the population requiring fairly large teeth was extremely limited.

KEYWORDS

Artificial Teeth Moulds, Natural Teeth, Commercial, Anterior, Mesiodistal Width.

INTRODUCTION

Smile is the most visible record of a dentist's care of a patient. Webster's Third New International Dictionary defines "esthetic" as "appreciative of, responsive to, or zealous about the beautiful; having a sense of beauty or fine culture." Each of us has a general sense of beauty. However, our own individual expression, interpretation, and experience make it unique. The selection of anterior teeth is very important[1], for that it plays a vital role in the facial expression of each individual, and this should be in harmony with the facial values. It is a matter of great concern, when planning treatment to replace artificial teeth in the region of maxilla and mandible since they are the most exposed teeth while speaking and smiling affecting the esthetic personality of an individual.

Prosthodontists generally acknowledge that commercially available denture teeth may not be dimensionally representative of natural teeth in mesiodistal width.[2] So it is important to determine the adequate tooth size. Several of the methods and techniques were given by different authors for the selection of the anterior six teeth. Biometric measurements or estimations, habitual choices on the part of the dentists and the preference expressed by the patient are the most frequently used. They are all intended to help the dentist find the mould similar to the missing natural teeth, which may be difficult when no records of the dimensions, shapes or shade of the natural teeth are available.[3]

Tooth manufacturers provide variety of mould guides and charts to assist dentist in selection of anterior teeth[4]. But, little effort seems to have been made by the manufacturers of artificial teeth to ensure that the moulds of artificial teeth correspond to these measurements of natural teeth.[5]

Hence this study was planned to collect data on the widths of permanent anterior teeth and to relate these measurements to some of the available artificial anterior tooth moulds and to compare the ratio between the mesiodistal width of maxillary and mandibular natural anterior teeth and to find the variation in the size of anterior natural teeth on the right and left side of the dental arch.

MATERIALS AND METHODS

One thousand subjects (500 male and 500 female) with a mean age of 27.4years (range, 19-49 years) were selected for the study based on the following criteria:

1. All anterior six teeth present with no pathological or physiological variation.
2. No history of orthodontic treatment.
3. No obvious loss of tooth material mesiodistally as a result of caries, fracture or excessive proximal wear.
4. Only fully erupted permanent teeth were measured.
5. No restoration of any kind present.
6. No congenital defect or deformed teeth.
7. There should not be any crown in the anterior tooth segment.

Alginate impressions (Zelgan Plus, Denstply®,) of maxillary and mandibular teeth of the subjects were made and casts were poured in type III dental stone (Goldstone, Asian Chemicals®,) using standard protocols (Fig. 1). The casts were retrieved after final setting of stone and then trimmed and bases were applied on the

casts using base formers (Fig. 2). Then the casts were placed on the surveying table having their occlusal plane parallel to floor and the mesiodistal width of the individual tooth was obtained by measuring the maximum distance between the mesial and distal contact points of the tooth to the nearest whole millimeter using vernier calipers on a line parallel to occlusal plane (Fig. 3). A single investigator measured individual tooth in the maxillary and mandibular teeth thrice, from right canine to left canine. In few instances in which the two measurements differed by more than 0.2mm, the teeth were remeasured.[6] All the three reading were added and the average value was taken as the width of the individual tooth to reduce the operator bias. The sum of mesiodistal dimensions of the anterior teeth on the right and left side of the maxillary teeth were calculated. Then the readings of all the teeth were added to get the combined mesiodistal width the maxillary and mandibular anterior six teeth. The sum of mesiodistal dimensions of the anterior teeth on the right and left side of the maxillary arch were calculated and they were compared to see the symmetry between the right and left side of the maxillary and mandibular teeth.

Different manufacturers and stockists were approached concerning the ranges of the artificial teeth available. Eleven different ranges of artificial anterior teeth were examined all of which were of acrylic. For each range, the mesiodistal diameter of various artificial permanent maxillary and mandibular anterior teeth was noted from mould chart provided by the manufacturer. Obtained information was then tabulated which gives detail of all ranges and means of artificial anterior teeth and it was compared to evaluate the difference between anterior tooth width in natural teeth and different commercially available artificial acrylic tooth moulds.

The brands which were chosen are as follows:
1. Cosmo HXL teeth (Dentsply®)
2. AcryPan XL (Ruthinium® group)
3. AcryRock (Ruthinium® group)
4. AcryLux (Ruthinium® group)
5. Ivostar® (Ivoclar vivadent)
6. Dentura®
7. Pyrax®
8. Major dent®
9. Trubyte® IPN®
10. Yamachi® dental
11. Justi Blend®

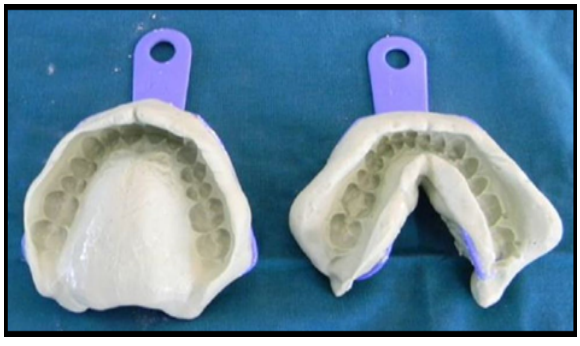

Figure 1: Maxillary & Mandibular Primary Impressions Made In Irreversible Hydrocolloid.

Figure 2: Stone Casts Retrieved.

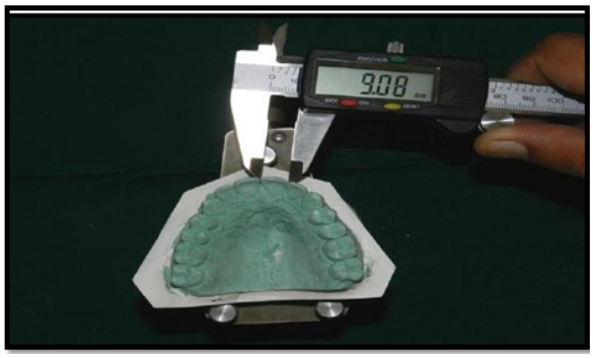

Figure 3: Mesiodistal Width Of The Individual Tooth Was Measured Using Digital Vernier Caliper.

RESULTS AND OBSERVATION

The mean mesiodistal width for maxillary central incisor, lateral incisor and canine for right side was 8.99mm, 7.19mm and 8.12mm and for left side was 8.97mm, 7.16mm and 8.09mm respectively. The average mesiodistal width of the anterior teeth on right side of maxillary arch was 24.30mm and on left side was 24.22mm with a total of 48.52mm.

The mean mesiodistal width for mandibular central incisor, lateral incisor and canine for right side was 5.8mm, 6.24mm and 7.04mm and for left side was 5.81mm, 6.27mm and 7.06mm respectively. The average mesiodistal width of the anterior teeth of right side in mandibular arch was 19.08mm and on left side was 19.14mm with a total of 38.22mm.

The mean mesiodistal width for maxillary central incisor, lateral incisor and canine by Nelson and Ash[6] for either right or left side was 8.5mm, 6.5mm and 7.5mm respectively with a total width of six anterior teeth 45mm and for mandibular it was 5mm, 5.5mm and 7mm respectively with a total of six anterior teeth 35mm (Table 1).
The average mesiodistal of maxillary anterior teeth width obtained was 48.52mm in 1000 subjects with a range of 40.04 - 58.97mm. It was found to be 49.01mm in males with a range of 40.04 - 58.97mm and 48.03mm in females with a range of 40.04 - 57.12mm.Trubyte was having the largest mean total anterior width among artificial teeth i.e. 46.62mm followed by Ivoclar Vivadent i.e. 45.38mm of the eleven brands but was smaller than mean total anterior width in natural dentition.

The average mesiodistal width of maxillary central incisor obtained was 9mm in 1000 subjects with a range of 7.29-11.09mm. It was found to be 9.1mm in males with a range of 7.29-11.09mm and 8.9mm in females with a range of 7.29 - 10.64mm. Trubyte was having the largest mean total anterior width among artificial teeth i.e. 8.6mm followed by Ivoclar Vivadent i.e. 8.5mm of the eleven brands but was smaller than mean total anterior width of central incisor in natural dentition (Table 2).

The comparison was made between the obtained mesiodistal width of mandibular anterior natural teeth with the different commercially available tooth moulds. The average mesiodistal width obtained was 38.22mm in 1000 subjects with a range of 29.97 - 46.22mm. It was found to be 38.58 mm in males with a range of 29.97 - 46.22 mm. It was 37.84mm in females with a range of 29.97 - 45.03mm. AcryLux was having the largest mean total anterior width among artificial teeth i.e. 36.12mm followed by AcryPan XL i.e. 36.03 mm of the eleven brands but was smaller than mean total anterior width in natural dentition.

The average mesiodistal width of mandibular central incisor obtained was 5.8mm in 1000 subjects with a range of 4.19 - 7.27mm. It was found to be 5.8mm in males with a range of 4.19-7.25mm. It is 5.8mm in females with a range of 4.42 - 7.27mm. Trubyte, AcryLux and AcryPan XL were having the largest mean width of central incisor among artificial teeth i.e. 5.3mm with a range of 4.55 - 6.25mm, 4.4 - 6.2mm, and 4.4 - 6.5mm respectively of the eleven brands but was smaller than mean total anterior width of central incisor in natural dentition (Table 3). The ratio between mesiodistal width of the mandibular anterior and mesiodistal width of maxillary anterior teeth of the study population was 78.75%

whereas according to Bolton[7] it was 77.2%, according to Lundstrom[8] it was 79% and according to data given by Nelson and Ash[6] it was 77.78% (Table 4**).**

Table- 1 The Mean Mesiodistal Width Of Individual Anterior Tooth , All Anterior Teeth And Mesiodistal Width Of Anterior Teeth Given By Nelson And Ash.

	Right				Left				Total of six anterior teeth	Width given by Nelson and Ash				
	CI	L	C	Total (right)	CI	L	C	Total (left)		CI	L	C	Total	Total of six anterior teeth
Maxillary	8.99	7.19	8.12	24.3	8.97	7.16	8.09	24.22	48.52	8.5	6.5	7.5	22.5	45
Mandibular	5.8	6.24	7.04	19.08	5.81	6.27	7.06	19.14	38.22	5	5.5	7	17.5	35
CI=centralincisor,L=lateralincisor,C=canine														
***Allthereadingsareinmillimetres(mm)														

Table -2Range Of Total Maxillary Anterior Teeth Width, Mean And Standard Deviation In Natural Dentition And Artificial Denture Teeth.

S No:	Gender	Range of CI width (mm)	Mean CI Width (mm)	Range of six anterior teeth (mm)	Mean (mm)	SD (six anterior teeth)
1	Male	7.29-11.09	9.1	40.04-58.97	49.01	3.61
2	Female	7.29-10.64	8.9	40.04-57.12	48.03	3.2
3	Combined (M+F)	7.29-11.09	9	40.04-58.97	48.52	3.43
4	CosmoHXL	7.3–10	8.4	40.2-53.8	45.03	3.46
5	AcryPanXL	7.2-9.2	8.2	38.8-52	44.64	3.33
6	AcryRock	6.8-9.7	8.1	39.6-52.8	44.5	3.49
7	AcryLux	7.3-9.2	8.1	40.6-50.5	44.21	2.68
8	Ivoclar Vivadent	7.7-9.3	8.5	40.4-48.7	45.38	2.62
9	Pyrax	7.2-8.8	8	39.3-46.5	42.35	2.05
10	Dentura	7.3-8.8	8.1	40.1-47.4	44.47	3.01
11	MajorDent	7.2-9.6	8.1	41-49.5	44.83	2.53
12	Yamachi	7.6–9	8.2	41.6-49.4	45.18	2.36
13	TruByte	7.4-10.2	8.6	40-54.5	46.62	4.18
14	JustiBlend	7.3–9	8.3	38.36-48.9	43.63	2.82
SD=StandardDeviation						

Table-3 Range Of Total Mandibular Anterior Teeth Width, Central Incisor Width, Mean And Standard Deviation In Natural Dentition And Artificial Denture Teeth

SNo:	Gender	Range of CI width (mm)	Mean CI Width (mm)	Range anterior teethwidth (mm)	Mean (mm)	SD (six anterior teeth)
1	Male	4.19-7.25	5.8	29.97-46.22	38.58	2.97
2	Female	4.42-7.27	5.8	29.97-45.03	37.84	2.69
3	Combined (M+F)	4.19-7.27	5.8	29.97-46.22	38.22	2.84
4	CosmoHXL	4.3-5.7	5.1	29.8-39.5	34.07	3.8
5	AcryPanXL	4.4-6.5	5.3	32.3-41.2	36.03	3.14
6	AcryRock	4.5-5.7	5.1	30.7-40.7	34.5	3.02
7	AcryLux	4.4-6.2	5.3	32.3-41.2	36.12	3.19
8	Ivoclar Vivadent	4.8-5.6	5.1	32.9-37.6	34.83	1.8
9	Pyrax	4.8-5.5	5.1	30.4-34.5	32.92	1.61
10	Dentura	4.4-6.1	5.2	31.6-38.4	34.96	2.99
11	MajorDent	4.8-5.7	5.2	32.5-38	35	1.94
12	Yamachi	5-5.6	5.2	32.4-36.7	34.07	1.48
13	TruByte	4.55-6.25	5.3	30.5-45	35	3.25
14	JustiBlend	4.5-5.5	5	29.86-35.77	32.08	2.07
SD=StandardDeviation						

Table-4 Ratio Between Mesiodistal Width Of Maxillary And Mandibular Anterior Teeth

Ratio between Mesiodistal Width of Maxillary and Mandibular Anterior Natural Teeth.				Width given by Nelson and Ash	Bolton	Lundstrom
	Right	Left	Total	Total	-	-
Maxillary	24.3	24.22	48.52	45	-	-
Mandibular	19.08	19.14	38.22	35	-	-
Ratio(%)			78.75%	77.78%	77.2%	79%

%-Percentage
***All reading sare in millimetres(mm)

DISCUSSION

The key role of prosthodontist is to restore the aesthetics which is lost due to loss of anterior teeth. The selection of six maxillary anterior teeth for edentulous patients is made primarily for aesthetics and they must be in harmony with surrounding oral environment in terms of size. The artificial substitutes must be actual reproductions of their natural teeth to completely satisfy their aesthetic requirements in terms of size. Ideally artificial teeth that are similar in size to patient's natural teeth are desirable.[1,9] Many factors adversely influence the esthetic quality of a denture, such as improper tooth position or inadequate vertical dimension; however one common factor appears to be inappropriate selection of maxillary denture teeth, because of a lack of availability of physiological tooth mould sizes.[4]

Mac Gregor[10] stated that one of the commonest prosthetic errors is to use artificial denture teeth which are too small, thus making them appear obviously false. This was also corroborated by various authors. If the anterior teeth are small, then the cuspids are too near to the median line, thus resulting in narrowing of the intercuspid width and throwing the bicuspids into undue prominence and the general effect is a mouth full of teeth[11]. When anterior teeth that are too small are used, complete dentures fail to convey realism[12], thus teeth which gives natural esthetics should be given.

This study sought to provide comparative data to assess the extent to which denture tooth moulds were physiologically representative of natural dentition of Indian population. The width of maxillary anterior natural teeth was examined because these six teeth were the primary determinants of a personality. Once the width was established, selection of tooth form will dictate other dimensions.

According to Ash and Nelson there was no difference in the mesiodistal width of natural teeth on the left and right of the arch. The results of the present study show variation in the calculated values and the values given by the Ash and Nelson.[6]For mesiodistal width of central incisor, lateral incisor and canine, in maxilla, the variation in width for central incisor, lateral incisor and canine was 0.49mm, 0.69mm and 0.62mm on right side and 0.47mm, 0.66mm and 0.59mm on left side respectively. In mandible, the variation in width for central incisor, lateral incisor and canine was 0.8mm, 0.74mm and 0.04mm on right side and 0.81mm, 0.77mm and 0.06mm on left side respectively.

The variation in the total width of the anterior teeth in the maxilla and mandible according to the present study and the value given by Ash and Nelson[6] was 3.52mm and 3.22mm respectively.

The width of maxillary six anterior teeth was found to be 53.61mm by Scandrett et al[13], 53.7mm by MC Arthur and mandibular six anterior teeth was 41mm by Mc Arthur which was more than the values from the Ash and Nelson[6] and values from the present study. Varjao et al[14] found the width of maxillary six anterior teeth to be 52.12mm, 53.35mm, 55.61mm and 53.04mm in White, Mullato, Black and Asians subjects respectively and Gomes et al[15] found it as 53.67mm in Brazilian population.

It was seen that most of the values were not consistent with the values which were given by Ash and Nelson[6]. Most of the values calculated by different authors were more than the values given by Ash and Nelson and also the values calculated in the present study were more than the values given by Ash and Nelson[6].

Tooth size ratio is a valid diagnostic tool that allows an educated prediction of treatment outcomes. The proper relationship of the total mesiodistal width of maxillary dentition to the mesiodistal width of mandibular dentition will favour an optimal treatment occlusion.[16] The ratio between mandibular anterior teeth and maxillary anterior teeth is a percentage relationship and is called as "anterior ratio". It was stated that there exists a direct relationship between the anterior teeth ratio and the overbite[7], so change in the ratio will affect the phonetics of the patient. The tooth size ratio also contributes a great deal in balanced occlusion, facial harmony and esthetics. Maxillary and mandibular anterior teeth should be in harmony to achieve optimal esthetics in a patient. The ratio given by Bolton[7]in excellent occlusion cases was 77.2%, by Lundstrom[8] subjects with random occlusion was 79% and by Ballard[17],in ideally treated cases was 75%. The anterior ratio calculated from the mesiodistal widths given by Ash and Nelson was 77.78%. Santoro et al[16] found anterior ratio to be 78.1% in Dominican Americans, Richardson et al[18] found it to be 77% in American Negros, Bernabe[19] found it to be 78.09% ±2.64% in Peruvian population, Johe et al[20] found anterior ratio as 77.52%, 77.44% and 77.55% in Caucasians, African Americans and Hispanics respectively, Uysal et al[21] found it as 78.26 in Turkish population, Paredes et al[22] found it as 78.32 % in Spanish population. According to the present study, ratio between mandibular anterior teeth and maxillary anterior teeth was **78.75%,** indicated that the anterior ratio in the study population was more than the Bolton's ratio and the ratios found in the other populations. Smith et al[23] found anterior ratio to be 79.6%, 79.3% and 80.5% in white, black and Hispanics respectively, these values were more than the values from the present study and Bolton's ratio.

The results of the present study showed that the mesiodistal width of maxillary and mandibular anterior denture teeth were predominantly in the smaller sizes as compared to mesiodistal width of maxillary and mandibular anterior natural teeth. This was also corroborated by other authors as Baer and Reynolds[2], Rajeev Srivastav[24], La Vere[25] and Mc Arthur.

Some authors have cited the reasons for using smaller mesiodistal width artificial teeth. Hardy[11]stated that the use of small teeth is probably large due to inertia, for some time the use of a tooth of proper dimension necessitates some grinding of ridge lap to place it properly in position, small teeth need no grinding so small teeth are used.

McArthur[26] stated that, small teeth are more used because most of the manufacturers supplies small size anterior tooth moulds, (probably because of the manufacturer's elimination of little-use moulds). McArthur stated that with aging the proximal wear will take place and therefore in older age there will be narrowing of teeth. But maximum proximal wear is approximately 0.1 mm on each surface, that is decrease in mesiodistal width of maxillary anterior teeth from canine to canine will be approximately by 1.2 mm due to proximal wear. But this reduction in mesiodistal width is not sufficient to justify the selection of artificial teeth which are very much narrower compared to their natural predecessor.

Although 1000 subjects were included for the study, further implementations of the study may involve increase of the sample size. Studies can also be extended to include relationship between geometric progression of width and length of maxillary anterior teeth and anatomical landmarks such as inner-canthal distance, inter-alar distance, inter-commisural distance and philtrum.

CLINICAL SIGNIFICANCE

The results of the study can be useful to clinicians during rehabilitation of anterior teeth. Although various shapes and sizes of artificial teeth are made available by the manufactures, they may not represent the exact required width. The size of the maxillary anterior teeth obtained from the study included the variations in tooth width in both the arches and among genders. It may be useful for the clinicians and manufacturers as a guide towards ideal rehabilitation or inventory planning of artificial teeth.

SUMMARY

According to the study, it can be concluded that :

1) The average mesiodistal width of maxillary anterior natural teeth was 48.52mm which ranged from 40.04 - 58.97mm and for the mandibular anterior natural teeth it was 38.22mm which ranged from 29.97 - 46.22mm .
2) The ratio between the mesiodistal width of maxillary and mandibular anterior natural teeth was 78.75%, which varied from the anterior ratio given by Bolton.
3) There was a variation in the mesiodistal width on right and left side of dental arch showing that the anterior teeth were not mirror images of one another.
4) The mesiodistal width of artificial anterior teeth studied was smaller than the mesiodistal width of natural anterior dentition.
5) The variation was seen in the width of teeth in males and females, so further studies were required to calculate the variation in the width of anterior teeth of males and females.
6) It was seen that the available moulds for six maxillary and mandibular anterior teeth were predominantly smaller in their size distribution than that of the population that will need them. No moulds were found which were larger than the normal range of natural anterior six teeth. So the choice of teeth for prosthesis of the population requiring fairly large teeth was extremely limited.

Thus the dentist should be aware of the discrepancy in the width range of natural versus artificial teeth.

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