ORIGINAL RESEARCH

A Study to Determine the Correlation between the Intercondylar and Interdental Widths in South Indian Population: A Cross-sectional Study

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Abstract

Aim: Anatomical landmarks that remain fairly constant throughout an individual's life help determine the position of the artificial teeth closer to that of their predecessors. The aim of the present study was to evaluate whether there is a relationship between the intercondylar widths (ICWs) and the interdental widths (IDWs) in the maxillary and mandibular arches in dentate subjects.

Materials and methods: The study was conducted in two parts, with 80 dentate subjects in total. Initially, in the first 40 subjects, a mathematical index was obtained by dividing the mean ICWs by the mean IDWs. In the second part, the ICW was measured and was used along with the index obtained in the first part, to estimate the IDW. These estimated values were then verified with the real IDWs by direct intraoral measurements. An arbitrary earpiece facebow (ARTEX® Gesichtsbogen Facebow) was used to measure the ICW. Statistics was done using SPSS software version 18 using Karl Pearson's correlation test and paired *t*-test.

Results: The IDW was correlated to the ICW; the maximal correlation was found between ICW and lower 6–6 width (L6-6W) (*p* value 0.033) and the lowest correlation was found between ICW and upper 6–6 width (U6-6W) (*p* value 0.046).

Conclusion: ICW can be used as an additional guide to position denture teeth. This method suggested would result in a better buccolingual positioning of the posterior teeth, which would help avoid encroaching on the tongue space, thereby improving phonetics and speech with dentures.

Clinical significance: ICW bears a relationship with the IDWs in the maxillary and mandibular arches. ICW being a fairly constant anatomical landmark can be used as an additional guide aid in positioning the artificial teeth.

Keywords: Denture teeth positioning, intercanine width, intercondylar width, intermolar width.

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Introduction

Esthetic appearance is most often one of the common concerns of a patient who seeks prosthodontic rehabilitation. Achieving acceptable esthetics and functionality while rehabilitation of missing natural teeth is often posed as a challenge. The arrangement of artificial teeth for complete dentures may appear to some experienced dentists and dental technicians as a straightforward procedure.[1] It is a challenge to accurately position the artificial teeth in a complete denture prosthesis for a patient who has lost all his natural teeth and does not possess any previous records such as photographs or dental casts.

Clinically, many investigators have recommended the arrangement of artificial teeth to be in a relationship similar to the patient's natural ones or they recommend the use of anatomical landmarks as guides for the correct placement of teeth.[1] Over the years, norms, criteria, and guidelines for proper tooth selection and arrangements have been suggested by the dental profession. However, the selection and arrangement of teeth for edentulous patients in a natural and aesthetically pleasing form and function have remained a challenging task for most dental professionals.[2]

Many facial measurements like bizygomatic width, intercommissural width, interpupillary width, interalar width, and intercanthal width have been used for the estimation of the width of the maxillary anterior teeth. Yet no single measurement has proved to be completely reliable.[3] A great number of conducted studies on the human face prove the existence of significant variations in parameters among different races, nations, and populations as well as among individuals.[4] Latta et al.[5] studied the accuracy of some

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of the most frequently used anatomic landmarks used for denture teeth positioning which included width of the mouth, interalar distance, bizygomatic width, and interpupillary distance. A total of 109 edentulous patients revealed that these measurements varied greatly. The width of the mouth had a range from 36 to 68 mm, interalar width from 29 to 63 mm, bizygomatic width from 125 to 168 mm, and interpupillary distance from 38 to 73 mm. When divided into race and sex, the variation remained statistically significant. They recommended that the use of these landmarks in complete dentures could be questionable.

The fact that incisive papilla is a soft tissue anatomical landmark that has been used frequently for anterior tooth arrangement was described by Mersel and Ehrlich;[6] Grove and Christensen.[7] Harper[8] concluded that the incisal edges of the maxillary central incisors should be set within a range of 5–8 mm in front of the center of the papilla. Hickey et al.,[9] Martone,[10] and Murray[11] suggested this distance to be 8 to 10 mm, whereas Schiffman[12] related the canines to a line bisecting the papilla. Erlich and Gazit[13] concluded that the labial surfaces of the maxillary central incisors were at a mean distance of 12–13 mm anterior to the midpoint of the papilla.

Proper arrangement of teeth and occlusal vertical dimension are the key elements that contribute to the dentofacial esthetics of the edentulous patients.[2]

In the literature, there have been very few studies that assess the relationship of intermolar and intercanine widths and compare the values with intercondylar widths (ICWs). Hence, this study aims to evaluate whether there is a correlation between the ICWs and the interdental widths (IDWs) in the maxillary and mandibular arches in dentate subjects. A constant ratio was then derived, which can be used as an additional guide for the arrangement of denture teeth.

Methodology

The study was carried out in the Department of Prosthodontics, AB Shetty Memorial Institute of Dental Sciences, Mangaluru. The study began in 2019 and was completed over a period of 2 years. Eighty subjects were included in the study based on 80% power and 5% level of significance. Ethical clearance was obtained from the institute's ethical committee and written consent was obtained from each subject. A single trained investigator recorded all the data to avoid any interexaminer bias. For the purpose of the study, subjects belonging to the age groups of 18–45 years, with full complement of teeth and molar class I relation, were included in the study. The subjects with periodontal disease, subjects with full veneer crowns on canines or molars, subjects who have undergone orthodontic treatment or with supernumerary teeth were excluded from the study. The study first aimed to determine the ratio between ICW and IDW. The ICW was measured using an average earpiece facebow (ARTEX® Gesichtsbogen Facebow). The anterior part of the facebow has a millimeter scale that indicates the intercondylar distance (Figs 1 and 2). Measurements were recorded from the anterior part of facebow. The IDWs were measured directly on the subjects, with a pair of calipers (Figs 3 to 6), and recorded as follows:

Upper 3–3 Width (U3-3W) = the distance between the cusp tips of maxillary canines;
Lower 3–3 Width (L3-3W) = the distance between the cusp tips of mandibular canines;
Upper 6–6 Width (U6-6W) = the distance between the mesiobuccal cusp tips of maxillary first molars;
Lower 6–6 Width (L6-6W) = the distance between the mesiobuccal cusp tips of mandibular first molars.

A ratio between intercanine width and the intercondylar distance and interfirst molar width and the intercondylar distance was then obtained. Furthermore, a mathematical index was obtained by comparing the mean interdental measurements with the mean intercondylar distance. Following this, a comparison of the estimated IDWs with the actual values measured on the remaining 40 subjects. IDWs were estimated using the mathematical index, following which a comparison of the estimated IDWs with the existing values measured on the rest of the 40 subjects was done.

The data obtained were subjected to statistical analysis using Karl Pearson's correlation test and paired *t*-test.

Results

At the beginning of the study, 40 subjects were included, of which 20 were males and 20 were females. ICW and IDW were measured in these subjects and the mean was calculated. A ratio was then obtained from the mean ICWs and the mean IDWs.

ICW/U3-3W = 3.31849

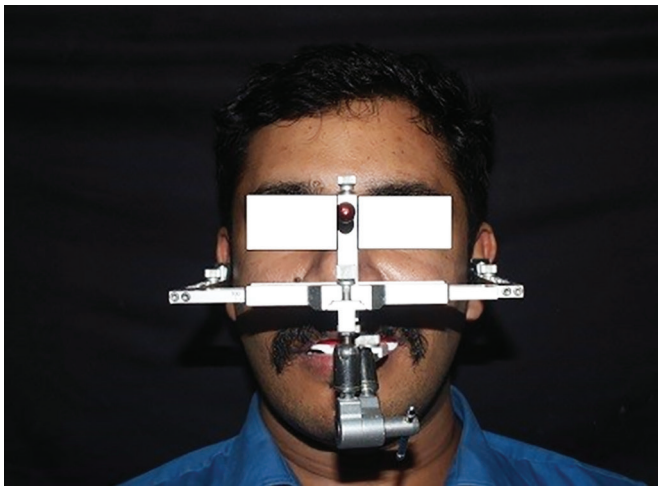

Fig. 1: Measuring the intercondylar distance using an average earpiece facebow

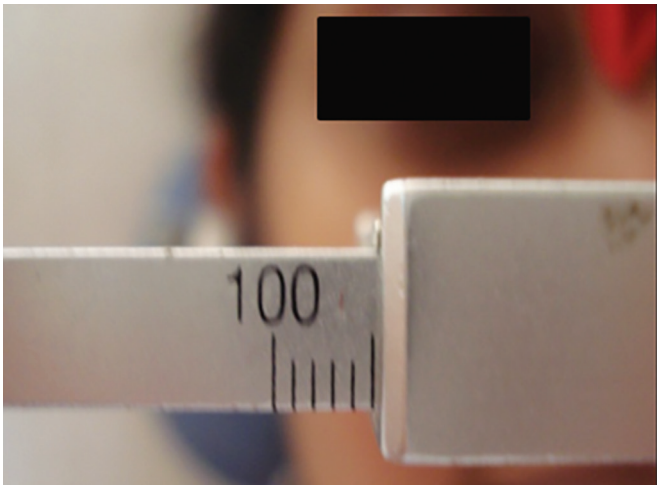

Fig. 2: Millimeter scale on the anterior part of the facebow that indicates the intercondylar distance

Fig. 3: Measuring the intercanine width in the maxillary arch

Fig. 4: Measuring the interfirst molar width in the maxillary arch

Fig. 5: Measuring the intercanine width in the mandibular arch

Fig. 6: Measuring the interfirst molar width in the mandibular arch

ICW/L3-3W = 4.19325
ICW/U6-6W = 2.37261
ICW/L6-6W = 2.7227

These data were subjected to statistical analyses, and it was found to be statistically significant (p <0.05) (Table 1).

Following these measurements, maxillary intercanine distance was found to range between 30.0 and 36.5 mm with a mean of 34.35 mm. When the mandibular intercanine distance was measured, it ranged from 23.5 to 35 mm, with a mean of 27.18 mm. The maxillary interfirst molar distance was found to range between 34.0 and 55.0 mm, with a mean of 48.21 mm, and the mandibular interfirst molar distance was found to range between 31.5 and 50.0 mm, with a mean of 42.11 mm. The actual and estimated values when compared showed no statistical significance (Table 2). It was found that the mean intercanine width in the maxillary arch (U3-3W) and the mean interfirst molar width in the mandibular arch (L6-6W) were significantly different in males and females (p = 0.004 for U3-3W and p = 0.012 for L6-6W). The mean ICW for both sexes was 114.58 with females having a significantly (p <0.05) shorter ICW (mean = 112.05, s.d = 5.094) than males (mean = 117.10, s.d = 4.706) (Table 3).

Table 1: Karl Pearson's correlation between ICWs and IDWs

Group	*Ratio*	*Pearson correlation*	*p value*
ICW			
U3-3W	3.31849	0.328	0.338
L3-3W	4.19325	0.322	0.042
U6-6W	2.37261	0.311	0.046
L6-6W	2.37261	0.338	0.033

The IDW was correlated to the ICW; the maximal correlation was found to range between ICW and L6-6W (p = 0.033) and the lowest correlation was found to range between ICW and U6-6W (p = 0.046).

Discussion

Treating edentulism demands restoring the function, esthetics, and comfort of the patient.[5] One of the factors for successful complete dentures is the correct positioning of the artificial teeth, both anteroposteriorly and mediolaterally, with emphasis on the compensating curves.[2] Numerous methods are presented in literature for the ideal arrangement of teeth with most of them dependent upon the physical characteristics like the interalar width, bizygomatic width, and facial heights. Besides these intraoral

Table 2: Paired *t*-test to compare the real and calculated interdental values

					95% Confidence interval for mean			
	N	*Mean*	*Std deviation*	*Mean difference*	*Lower bound*	*Upper bound*	*t-test value*	*p value*
U3-3W				−0.152	−1.002	0.698	−0.356	0.723
Actual	40	34.43	2.101					
Estimated	40	34.50	1.698					
L3-3W				−0.163	−1.095	0.769	−0.348	0.729
Actual	40	27.41	2.640					
Estimated	40	27.34	1.344					
U6-6W				−0.122	−1.676	1.433	−0.156	0.877
Actual	40	48.57	4.325					
Estimated	40	48.33	2.379					
L6-6W				−0.77	−1.457	1.303	−0.111	0.912
Actual	40	42.08	3.864					
Estimated	40	42.11	2.072					
ICW				0.050	−2.412	2.512	0.040	0.958
Actual	40	114.58	5.420					
Estimated	40	114.55	5.638					

Table 3: Paired *t*-test to examine the differences in IDWs and ICWs in males and females

				95% Confidence interval for mean			
	N	*Mean*	*Std deviation*	*Lower bound*	*Upper bound*	*t-test value*	*p value*
U3-3W							
Female	20	33.63	2.089	33.16	34.50	−2.940	0.004
Male	20	35.02	1.488	34.55	35.50		
Total	40	34.43	1.899	34.00	34.85		
L3-3W						−1.820	
Female	20	26.99	2.154	26.30	27.68		0.073
Male	20	27.83	1.960	27.20	28.45		
Total	40	27.41	2.089	26.94	27.87		
U6-6W							
Female	20	47.88	3.492	46.76	49.00		0.062
Male	20	49.26	2.723	48.39	50.13		
Total	40	48.57	3.188	47.86	49.28	−1.976	
L6-6W							0.012
Female	20	41.22	3.311	40.16	42.28		
Male	20	42.93	2.599	42.10	43.77	−2.579	
Total	40	42.08	3.081	41.39	42.76		
ICW							
Female	20	112.06	6.094	110.42	113.68	−4.606	0.000
Male	20	117.10	4.706	115.60	118.60		
Total	40	114.58	5.495	113.35	115.80		

landmarks such as incisive papilla, intercanine distance has also been used for selection and arrangement of teeth.[14] Anatomical landmarks that remain fairly constant throughout the individual's life help determine the position of the teeth closer to that of their predecessors. The present study makes use of the ICW as one such anatomical landmark.

In 1986, Hoffman et al.[15] evaluated the relation between interalar width and intercanine width on 340 fully dentate subjects. The interalar ratio is most often employed in arranging the teeth, but they found that these two widths did not correlate. The interalar width was 3% lesser than the intercanine width and 30% smaller than the intercanine circumferential distance.

LaVere et al.[16] assessed the length and width of the central incisors in 488 participants and compared the measurements with facial width using the Trubyte tooth indicator. Results of the study suggested that the use of facial as a guide to select the anterior teeth would result in more than 50% of the teeth selected to be narrower than the natural incisor and 72% would be longer than the natural teeth present previously.

The maxillary intercanine widths in the previous studies done by Keshvad et al.[1] and Debnath et al.[17] have a mean of 33.45 and 34.68 mm, respectively. In the present study, the maxillary intercanine width was found to range between 30.0 and 36.5 mm with a mean of 34.43 mm, which is in accordance with the above-mentioned studies. The mandibular intercanine width in a study done by Keshvad et al.[1] had a mean of 27.05 mm which is similar to the mean of 27.21 mm obtained in our study.

In the studies conducted by Keshvad et al.[1] and Debnath et al.,[17] the mean intermolar width was 51.56 and 54.78 mm, respectively. The mean intermolar width obtained in our study was 48.57, which

is similar to the aforementioned studies. Similarly, the mean value of the mandibular intermolar width in our study was 42.08 mm, which is in accordance with the values of the study carried out by Keshvad et al.[1]

Lazi et al.[18] measured the intercondylar distance between the centers of condyle in posteroanterior cranial radiographs of the Croatian population. The inter condylar distance (ICD) had the range of 110–145 mm, with the mean of 126 mm. There was a significant difference found between males and females.

In the present study, the IDWs in both maxillary and mandibular arches were correlated to the ICW, where the highest correlation was found to range between ICW and L6-6W and the lowest correlation was found to range between ICW and U6-6W. This is in contrast to the previous studies conducted by Keshvad et al.,[1] Shrestha et al.,[14] and Debnath et al.[17] which found the highest correlation between ICW and U6-6W. A possible explanation for this is that the study has been conducted on different populations.

Keshvad et al.[1] and Debnath et al.[17] in their study obtained the mean intercondylar distance of 110.54 and 109.15 mm, respectively. The mean ICW for both sexes in our study was 114.58 with the female population having an incomparably (p <0.05) shorter ICW than males. This could be explained by the fact that females have a smaller skull size than males.

The results of the study suggest that completely edentulous patients would benefit if a simple measurement could be used to determine the size of their teeth leading to optimal function and esthetics. This method may also guide the laboratory technicians to accurately position the teeth buccolingually, without actually seeing the patient in the chair.

The limitations of this study are that a pair of manual calipers was used to record the intercanine and intermolar widths directly in the oral cavity that could have led to some inaccuracies. A larger sample size could help us achieve a more definitive result.

This method suggested would result in a better buccolingual positioning of the posterior teeth, which would help avoid encroaching on the tongue space, thereby improving phonetics and speech with dentures. However, this is not the only approach to position posterior teeth, but it is an additional guideline, particularly for inexperienced or amateur clinicians while rehabilitating a patient with a complete denture prosthesis.

In the future, studies can be done to assess the difference between the left and right side of the finished dentures and compare using this study method and conventional methods.

Conclusion

The observations of the present study suggest that during the selection of teeth for complete denture prosthesis, the measurements of the ICW can be used as a guide for the prediction of buccolingual position of teeth in complete dentures.

This would in turn result in a better outcome in terms of comfort, function, and esthetics of the patient.

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