Original Research Paper

Orthodontology

RELIABILITY OF PREDICTED ARCH LENGTH BASED ON MEASURED INTER CANINE WIDTH AND SEX DETERMINATION USING MEASURED INTER CANINE WIDTH AND INTER MOLAR WIDTH IN NORTH GUJARAT POPULATION"

Dr. Shailja K. Vaishnav	Post graduate student, Department of Orthodontics and Dentofacial Orthopaedics, Narsinhbhai Patel Dental College and Hospital, Sankalchand Patel University, Visnagar, Gujarat, India.
Dr. Manish Desai*	Reader, Department of Orthodontics and Dentofacial Orthopedics, Narsinhbhai Patel Dental College and Hospital, Sankalchand Patel University, Visnagar, Gujarat. *Corresponding Author
Dr. Ajay K. Kubavat	Professor and Head, Department of Orthodontics and Dentofacial Orthopedics, Narsinhbhai Patel Dental College and Hospital, Sankalchand Patel University, Visnagar, Gujarat.

ABSTRACT **AIM:** To assess the reliability of Predicted Arch Length (PAL) by linear regression equation based on measured ICW and determines gender by means of measured ICW and IMW in North Gujarat population. **MATERIALS AND METHODS:** The dental casts of 50 patients were selected. ICW, IMW and AL on each dental cast were measured. Regression analysis was done to analyze the linear regression equation for PAL and measured arch length (MAL). **RESULT:** Statistically, significant difference was present between PAL and MAL in upper and lower arch. ICW and IMW between male and female subjects in both arch showed no difference. **CONCLUSION:** showed PAL was higher and significant than MAL. Weak correlation was found with the given formula by Paulino V. et al so, this study established a new formula for north Gujarat population and concluded that ICW and IMW can be used for sex determination.

KEYWORDS : ICW, IMW, Predicted Arch Length

INTRODUCTION:

The arch length (AL), Inter canine width (ICW), and Inter molar width (IMW) are essential for diagnosis and treatment planning and are closely related factors in orthodontics. Prediction of the change in AL as a consequence of transverse expansion could be helpful in orthodontic treatment planning as reported by many authors. [1]

It has been reported by various clinicians that the anterior portion of the dental arch expands more than the posterior portion at the time of maxillary sutural expansion and is likely to be related to the resistance of the zygomatic buttresses. Others have reported that the mandibular arch is observed to "follow" maxillary arch expansion because of the influence of occlusion and alterations in the extraoral tissue drape. [2]

Study casts have always been important in orthodontic diagnosis and treatment planning. They are a tool of basic diagnosis that can tell us about the patient's occlusion in 3 planes of space. Traditionally, conventional calipers have been used to measure dental casts manually. Today, several digital methods are available for measurement of tooth size. [3]

Many studies have been done to predict the arch length based on inter canine and inter molar width and one of which is done by Paulino V. et.al., they have given a regression equation for predicting the AL of upper and lower arch based on ICW in Spanish population. [1] But we could not find any literature on the reliability of this regression equation in North Gujarat population. Thus, this study is carried out to find the reliability of this regression equation in North Gujarat population.

Gender recognition forms a part of medico-legal as well as archaeological aspects and determination of gender can be done in various ways. It becomes necessary in mass disasters like tsunami, earthquakes, cyclones etc. Odontometric characteristics have a major role in sex determination in such situations especially where only skeletal fragments are available like jaw with teeth in it. It becomes valuable tool in forensic studies. [4] Based on searched literature sex determination was done in different populations but no study in North Gujarat was found. Thus this study is carried out for sex determinations on the basis of measured inters canine width and inter molar width in north Gujarat population.

MATERIALS AND METHODS:

The dental casts of 50 North Gujarat patients (25 male, 25 female) with a mean age of 18 years (14- 25 years) in the permanent dentition attending the Orthodontic Department of the University of Sankalchand Patel, Visnagar, were selected. Regression analysis was also being done to analyze the applicability of the linear regression equation for predicted arch length and measured arch length.

The following linear measurements were performed on the study models: The linear parameters included in our study belonged to two categories one group belonged to the measured values and the other group belonged to the calculated values.

Measured values:

A total of 6 parameters will be measured on the upper and lower study models. The ICW and IMW were measured using Digital Vernier Caliper whereas AL were measured using the Brass Wire.

• Upper ICW – Maximum linear width between the upper canines.
• Lower ICW – Maximum linear width between the lower canines.
• Upper IMW – Maximum linear width between the upper molars.
• Lower IMW – Maximum linear width between the lower molars.
• Upper AL – From the mesial contact point of upper 1st permanent molar to the mesial contact point of upper 1st permanent molar on the opposite side.
• Lower AL – From the mesial contact point of lower 1st permanent molar to the mesial contact point of lower 1st permanent molar on the opposite side.

Calculated parameters

• The calculated AL of both upper and lower arches was derived from calculation based on the linear regression equation given by Paulino V. et al.

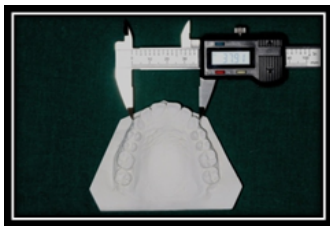• The regression equation states that AL in mm = 1.36 ICW + 29.39.

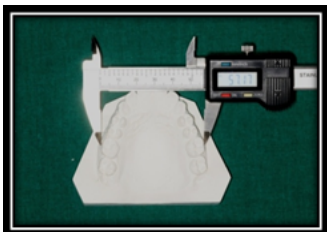**Figure I: Measuring the ICW of maxillary arch with the Digital Vernier Caliper.**

Figure II: Measuring the IMW of maxillary arch with the Digital Vernier Caliper.
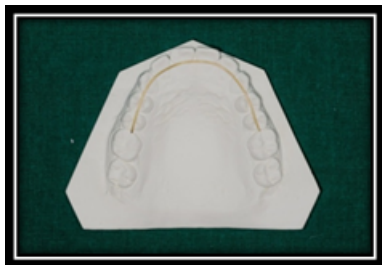

Figure III: Measuring the AL of maxillary arch with the Brass wire.

RESULT:

ICW and IMW between male and female subjects in upper and lower arch showed no significant difference (P > 0.05). These values also depicted greater ICW and IMW in Males as compared to Females in both the arches, with maxillary IMW being more specific.

Predicted arch length was higher (Upper = 78.81 ± 4.04 mm) (Lower = 67.03 ± 3.70 mm) than Original Arch Length (Upper = 75.50 ± 6.70 mm) (Lower = 63.94 ± 5.35 mm) in both the arches. Statistically, significant difference was present between Predicted arch length and Original Arch Length in upper and lower arch. (P ≤ 0.05)

[Table I] ICW and AL wise regression analysis in Upper Arch

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.332	.111	.092	6.3886

[Table II] Regression Analysis

Model	Sum of Squares	Df	Mean Square	F	P Value
Regression	243.398	1	243.398	5.964	0.018 S
Residual	1959.102	48	40.815		
Total	2202.500	49			

[Table III] Formula To Predict Upper Arch Length

Model	Unstandardized Coefficients		Standardize Coefficients	t Value	P Value
	B	Std. Error	Beta		
(Constant)	48.193	11.218		4.296	0.000
UICW	.751	.307	.332	2.442	0.018

Statistically, significant correlation was present between ICW and AL in upper arch with R = 0.332 and R2 = 0.111. (P ≤ 0.05) so, our study established a new formula to predict Upper Arch Length = 48.193 + 0.751 (UICW).

[Table IV] Inter Canine Width and Arch Length wise regression analysis in Lower Arch

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.231	.053	.034	5.2636

[Table V] Regression analysis

Model	Sum of Squares	df	Mean Square	F	P Value
Regression	74.974	1	74.974	2.706	0.106
Residual	1329.846	48	27.705		
Total	1404.820	49			

[Table VI] formula to Predict Lower Arch Length

Model	Unstandardized Coefficients		Standardized Coefficients	t Value	P Value
	B	Std. Error	Beta		
(Constant)	51.727	7.461		6.933	0.000
LICW	.440	.267	.231	1.645	0.106

Statistically, no significant correlation was present between ICW and AL in Lower Arch with R = 0.231 and R2 = 0.053. (P > 0.05) So, we established a new formula to predict Lower Arch Length = 51.727 + 0.440 (LICW).

DISCUSSION:

Several correlations were found between the measurements of width on the dental casts. The highest correlation was between AL and ICW in both arches, showing that changes in one magnitude may be directly related to the other. It is not usual to find such a high correlation between two variables as was found between AL and ICW.

In the present study, both the arches showed predicted arch length was higher and significant than Original Arch Length. It cannot be compared with those of Germane et al. [6], since those authors found a correlation in patients after orthodontic treatment and not in patients who had not undergone any orthodontic treatment.

Motoyashi et al. [8] also reported small values for arch perimeter increase as a consequence of intermolar mandibular expansion of the order of 0.37 mm, but greater than the values of Germane et al. [6] and Ricketts et al. [1] of 0.27 and 0.25 mm, respectively.

In current study, statistically significant correlation was present between Inter Canine Width and Arch Length in upper arch with R = 0.332 and R2 = 0.111. (P ≤ 0.05) We have used formula given by Paulino V. et al. [1] to calculate predicted Arch Length was (AL in mm = 1.36 ICW + 29.39) Soni VK [10] found a high correlation coefficient between arch-length and inter-canine width for both arches, and a regression equation was established between both magnitudes. Which makes it possible to predict the size of one of the variable by knowing the size of the other, but our result was not in concurrence with them.

So, we have established new formula for maxillary and mandibular arch with the help of regression analysis i.e. 48.193 + 0.751 (Inter Canine Width Upper) and 51.727 + 0.440 (Inter Canine Width Lower) respectively for North Gujarat population.

In gender determination, statistically no significant difference was present in Inter Canine Width and Inter Molar Width between male and female subjects in both arches (P > 0.05)

Current study depicted greater Inter canine and Inter molar

width in Males as compared to Females in both the arches with maxillary inter-molar arch width being more specific.

Similar results we found in a study done by Rao GV et al [4] and Deniel MJ. [9] determining the role of inter-canine and inter-molar width in identification of sex of individuals. They showed Inter canine and inter molar width for males were higher than females in both maxilla and mandible and concluded that inter-canine and inter-molar widths can be used as a tool in sex determination. We could conclude that inter-molar arch width may be useful in determining the gender of dental remains accurately, of individuals with missing canine teeth.

CONCLUSION:
- In the present study, both the arches showed predicted arch length was higher and significant than Original Arch Length.
- The regression equation given by Paulino V. et al [1] in Spanish population for the prediction of arch length based on measured inter canine width is not reliable to be used in North Gujarat population as very weak correlation was found.
- So, we have established new formula for maxillary and mandibular arch with the help of regression analysis i.e. 48.193 + 0.751 (Inter Canine Width Upper) and 51.727 + 0.440 (Inter Canine Width Lower) respectively for North Gujarat population. Thus, a new regression equation has to be applied in larger sample size for other population in India.
- Current study depicted greater ICW and IMW in Males as compared to Females in both the arches with maxillary IMW being more specific. So, we suggest that IMW may be helpful in determining the sex accurately, especially in cases where canines are absent.

REFERENCES:
1. Paulino V, Paredes V, Gandia JL, Cibrian R. Prediction of arch length based on intercanine width. The European Journal of Orthodontics. 2008 Jun 1;30(3):295-8.
2. Hnat WP, Braun S, Chinhara A, Legan HL. The relationship of arch length to alterations in dental arch width. American Journal of Orthodontics and Dentofacial Orthopedics. 2000 Aug 1;118(2):184-8.
3. Paredes V, Gandia JL, Cibrian R. New, fast, and accurate procedure to calibrate a 2-dimensional digital measurement method. American journal of orthodontics and dentofacial orthopedics. 2005 Apr 1;127(4):518-9.
4. Rao GV, Kiran G. Sex determination by means of inter-canine and intermolar width-a study in Telangana population. Asian Pac J Health Sci. 2016;3(4):171-5.
5. Adkins MD, Nanda RS, Currier GF. Arch perimeter changes on rapid palatal expansion. American Journal of Orthodontics and Dentofacial Orthopedics. 1990 Mar 1;97(3):194-9.
6. Germane N, Lindauer SJ, Rubenstein LK, Revere Jr JH, Isaacson RJ. Increase in arch perimeter due to orthodontic expansion. American Journal of Orthodontics and Dentofacial Orthopedics. 1991 Nov 1;100(5):421-7.
7. Tibana RH, Meira Palagi L, Miguel JA. Changes in dental arch measurements of young adults with normal occlusion—a longitudinal study. The Angle Orthodontist. 2004 Oct;74(5):618-23.
8. Motoyoshi M, Hirabayashi M, Shimazaki T, Namura S. An experimental study on mandibular expansion: increases in arch width and perimeter. The European Journal of Orthodontics. 2002 Apr 1;24(2):125-30.
9. Daniel MJ, Khatri M, Srinivasan SV, Jimsha VK, Marak F. Comparison of inter-canine and inter-molar width as an aid in gender determination: A preliminary study. Journal of Indian Academy of Forensic Medicine. 2014;36(2):168-72.
10. Soni V.K. et al .Using inter canine width for arch length prediction in jaipur population. IOSR-JDMS May-June 2013;2(7);2279-0861
11. Gorea RK, Sharma M. Odontometric study of canines in Indian population for sex determination. JINPAFO. 2010; 1: 34-37.
12. Acharya AB, Angadi PV, Prabhu S, Nagnur S. Validity of the mandibular canine index (MCI) in sex prediction: Reassessment in an Indian sample. Forensic Sci Int. 2011 ;130; 204(1-3): 207
13. Sonika V, Harshaminder K, Madhushankari GS, Kennath JA. Sexual dimorphism in the permanent maxillary first molar: A study of the Haryana population (India). J. Forensic Odontos tomatology. 2011; 29(1): 37-43.
14. Kapila R, Nagesh KS, R Iyengar A, Mehkri S. Sexual dimorphism in human mandibular canines: a radiomorphometric study in South Indian population. J Dent Res Dent Clin Dent Prospects. 2011; 5(2): 51-4.