

# RELATIONSHIP AMONG INTERCANINE WIDTH, INTERMOLAR WIDTH AND ARCH LENGTH IN UPPER AND LOWER ARCHES

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## ABSTRACT

*Intercanine width, intermolar width and arch length are essential for diagnosis and treatment planning and are closely related factors in orthodontics. The purpose of this study was to determine the correlation between these measurements and how these measurements are related to each other.*

*Dental casts of 100 orthodontic patients (72 females and 28 males) with a mean age of 18.7 years (12-38 years) in the permanent dentition attending the orthodontic department of the University of Lahore, Lahore, Pakistan were randomly selected. The casts were photocopied 1/1 with maximum contrast. Measurements were made on the photocopies of the upper and lower dental casts. Correlation between variables was determined using spearman's rho correlation coefficient.*

*The data showed very high correlation between intercanine width and intermolar width of both upper and lower arches and a weak correlation was observed between upper intercanine width and upper arch length as well as lower arch length. Correlation was significant between upper and lower arch lengths.*

**Key words:** Intercanine width, Intermolar width, Arch length, Correlation

## INTRODUCTION

Arch form and arch dimensions are two important factors in case assessment, diagnosis and treatment planning. Arch dimension is explained by arch width, arch length and arch depth. Arch width is noted by measuring intercanine width, interpremolar width and intermolar width. The relationship between intercanine width (ICW), intermolar width (IMW) and arch length (AL) is important in treatment planning. As a result of transverse expansion, intercanine and intermolar width will increase as well as there is a change in arch length and arch perimeter.

Adkins used splinted hyrax expander on 21 patients with age range of 11.5 years to 17 years. There was an increase in ICW (2.9mm) and IMW (6.5mm) whereas the arch length showed a decrease of 2.9mm.<sup>1</sup>

Rickets et al stated that, for each millimeter of arch width increase at the canines and molars, Arch length increased by 1mm and 0.25 mm, respectively. However, they did not include the method used to obtain these values.<sup>2</sup>

Amin F and Ijaz A conducted a study in mixed dentition using a fixed expander and showed an increase in ICW (3.54mm), IMW (4.42mm) and AL (1.42 mm).<sup>3</sup>

Using a mathematical model for quantitative comparison of the effects of various types of orthodontic expansion of the mandibular arch perimeter, Germane et al found that increase in ICW is more effective in gaining arch perimeter than the increase in IMW.<sup>4</sup>

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Hnat et al combined two mathematical functions, the hyperbolic cosine and beta functions, to study the relationship between arch length and alterations in dental arch width, the former for the six anterior teeth and the latter for the remaining dentition posterior to the canines. They stated that, from a clinical point of view, most of the arch length increase occurred in the anterior segment for all alterations in arch width.<sup>5</sup>

Motoyoshi et al in a study attempted to estimate the increase in arch perimeter associated with mandibular lateral expansion using a three-dimensional model for simulating mandibular expansion, showed that a 1mm increase in intermolar width resulted in an increase in arch perimeter of 0.37 mm.<sup>6</sup>

Therefore the aim of the present study was to determine the relationship between intercanine width (ICW), intermolar width (IMW), and arch length (AL) in both upper and lower arches.

## METHODOLOGY

This cross sectional study was carried out at the orthodontic department, the University of Lahore. One hundred patients, both male and females at permanent dentition stage were included in the study. All of them were Pakistani and lived in the city of Lahore. Two had received orthodontic treatment without any tooth reduction or extraction while 98 subjects had not undergone orthodontic treatment.

The inclusion criteria of the casts were permanent dentition from first molar to first molar. The casts with tooth agenesis, extractions and large restorations that could change the mesiodistal diameter of the tooth were excluded from the study.

Measurements were made on the photocopies of study models. The models were photocopied 1/1 with maximum contrast and teeth touching the glass (Mita DC-1435). The following reference points were marked with thin and soft pencil.

- Cusp tips of permanent canines.
- Mid central points of first permanent molars.

Fig 1

The following linear measurements were performed on the photocopies of the upper and lower models.

- **Intercanine width (ICW)** The distance between cusp tips of cuspids.

- **Intermolar width (IMW)** The distance between mid central points of first permanent molars.
- **Arch length** The distance from a line perpendicular to the mesial surface of the permanent first molars to the central incisors.

## STATISTICAL ANALYSIS

The statistical package for social sciences (SPSS 16) was used to assess measurement means, standard errors and standard deviations. Table 1

Correlation between variables was determined using spearman's correlation coefficient. The reproducibility of the method was analysed by determining intraexaminer measurement error. For this purpose, twenty dental casts from the present study were randomly selected. The measurements were again determined by the same examiner after six weeks in order to obtain the intra examiner error, which in turn, calculated by the coefficients of variation (CVs). These CVs ( $CV = \text{standard deviation} \times 100 / \text{mean}$ ) are expressed as a percentage. The CV was very low.

## RESULTS

A high correlation was observed between UICW and UIMW,  $r = 0.35$  as well as between LICW,  $r = 0.39$  and LIMW,  $r = 0.33$  while a weak correlation was found between UICW and UAL,  $r = 0.01$  and LAL,  $r = 0.12$  (table 2).

A high correlation was observed between UAL and LAL,  $r = 0.61$ .

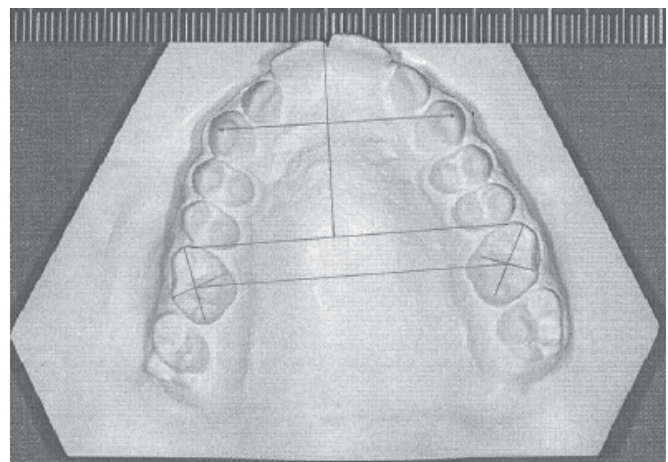


Fig 1: Upper model showing intercanine width, inter-molar width and arch length.

TABLE 1: MINIMUM , MAXIMUM, MEAN, STANDARD ERROR AND STANDARD DEVIATION OF ICW, IMW AND AL OF UPPER/LOWER ARCHES

	n	Descriptive Statistics				
		Minimum	Maximum	Mean	Std. Error	Std. Deviation
UICW	100	27.00	42.00	34.58	0.26	2.64
UIMW	100	36.50	50.50	44.62	0.27	2.77
UAL	100	20.50	35.50	27.76	0.32	3.28
LICW	100	21.00	33.00	26.27	0.24	2.48
LIMW	100	31.00	49.00	41.22	0.31	3.17
LAL	100	17.50	35.50	23.14	0.24	2.46

TABLE 2: SPEARMAN'S CORRELATION COEFFICIENT BETWEEN ICW, IMW &amp; AL OF BOTH UPPER AND LOWER ARCHES

	UICW	UIMW	UAL	LICW	LIMW	LAL
UICW		0.35**	0.01	0.39**	0.33**	0.12
UIMW			-0.11	0.41**	0.72**	-0.05
UAL				0.07	-0.16	0.51**
LICW					0.42**	0.24*

\*Correlation is significant at the 0.05 level

\*\*Correlation is significant at the 0.01 level

## DISCUSSION

Germane and friends found a correlation between AL and ICW using a mathematical model of the dental arch. They reported that arch perimeter increase due to intercanine expansion were intermediate between those of the incisors and molars, the first millimetre of expansion causing a 0.73 mm increase in the perimeter.<sup>4,7</sup>

The present finding cannot be compared with those of Germane and friends, since those authors found a correlation in patients after treatment and not in patients who had not undergone any orthodontic treatment

Adkins et al, when studying 21 consecutively treated orthodontic patients (11.5-17 years of age) who required the use of a rapid palatal expansion device, found that the premolar width increase was the best predictor of the increase in arch perimeter.<sup>1</sup> The correlation found between AL and IMW was less significant. The increase in ICW and IMW was 2.9mm and 6.5mm respectively. An increase of 4.27mm was observed in arch perimeter whereas the arch length

showed a decrease of 2.9mm. The study suggested that this decrease in arch length might be due to the palatal movement of incisors. The mesial tip of the incisors was reported to be due to the elastic recoil of transseptal fibers. The maxillary central incisors tend to extrude relative to cranial base and mostly upright to tip lingually. This movement helps to close diastema and also shortens arch length.<sup>8,9</sup>

Tibana et al also found significant correlation between UICW and LAL, but only weak correlation between ICW and AL within the same arch.<sup>10</sup> The present study found a weak correlation between UICW and UAL as well as UICW and LAL.

In another study, expansion attained after maxillary expansion in mixed dentition period was 3.54mm in canine region and 4.88mm in molar region.<sup>3</sup> Arch length showed an increase of 1.42mm, unlike the decrease reported in earlier studies.<sup>1,8,9</sup>

The reason for this increase was probably due to the fact that measurements were recorded immediately on completion of expansion. After retention for six months, a slight decrease in arch length was noted

which was statistically insignificant and was probably due to elastic recoil.

In a study of Paulino and Paredes the dental casts of 197 Spanish patients ( 119 females and 78 males) with a mean age of 18 years (11-26years) in the permanent dentition were selected. ICW, IMW and AL on each dental cast were measured using a digital method (paredes,2003; Paredes et al, 2006). The data showed a very high correlation between ICW and AL, both for upper and lower arches.<sup>11</sup>

The results of present study are not in accordance with study of Paulino and Paredes probably because of few differences. The method of digitization was different in both studies. The study casts were digitized with a conventional Hewlett Packard Scan Jet 11 Cx/T scanner using an accurate and easy calibration system to obtain dental cast dimensions in millimeters by Paulino and Paredes while measurements were recorded on the photocopies of study models in the present study. The models were photocopied 1/1 with maximum contrast and teeth touching the glass (Mita DC-1435).

The reference points marked for intermolar width were different in both studies. Maximum linear width between molars at their buccal surfaces was noted in Paulino and Paredes study but the distance between mid central points of first permanent molars was noted in present study.

There may be a factor of racial variation in arch form and dimentions in both studies.

In present study, it was noted that if there was an increase in ICW, there was also an increase in IMW but increase in AL was unpredictable in the same arch as well as in the opposite arch.

## CONCLUSION

A high correlation was found between ICW and IMW for both arches while a weak correlation was found between UICW and UAL and LAL. A high correlation was observed between UAL and LAL.

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