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Quick Response Code:

Website: www.jorthodsci.org
DOI: 10.4103/jos.jos_149_21

Comparative assessment of various cephalometric facial planes with intercanine width in orthodontic patients

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Abstract

OBJECTIVE: The study was conducted to evaluate the relationship of various cephalometric skeletal patterns in the vertical and anteroposterior planes with intercanine width in untreated orthodontic patients.

METHOD AND MATERIAL: This study included dental cast and cephalometric radiographs of 100 patients (69 females and 31 males) of the age range 13 to 33 years. Skeletal parameters including SNA, SNB, SNMP angles were found from lateral cephalometric radiographs. Intercanine widths including upper intercanine widths (UICW) and lower intercanine widths (LICW) were measured by a digital caliper.

RESULTS: The correlation of intercanine width with SNA, SNB, and SNMP angles was analyzed by applying Pearson correlation coefficient. According to statistical analysis, the only insignificant correlation was analyzed between UICW with SNB and LICW with SN-MP.

CONCLUSIONS: The overall result showed statistically significant relationship of various cephalometric skeletal patterns in the sagittal and vertical planes with intercanine width.

Keywords:

Arch width, facial planes, inter canine width, sagittal and vertical skeletal pattern

Introduction

There is a close relationship between normal occlusion and alveolar arch form. Skeletal outlines play a significant role in occlusal development as well as execute restrictions to the amount of anteroposterior movement of anterior teeth during treatment.^[1] Definitive orthodontic diagnosis and treatment planning have had a significant association with dental arch dimensions.^[2] Enduring variations in dental arch dimensions have been appreciated in subsequent orthodontic treatments.^[3] In non-extraction cases during alignment stage of orthodontic treatment, there is an

increase in maxillary arch in transverse plane ranging from 1.53 mm to 2.96 mm in intermolar width and 0.55 to 2.13 mm in the intercanine width. It is assumed that rectangular stainless steel arch wires produce dental arch expansion in transverse plane by endorsing the buccal movement of premolars and molars. Maintenance of dental arch form is an essential element for the stability of treatment as the risk of post-retention relapse is significantly increased by changing intercanine width.^[4] Sufficient information of the aspects affecting the dimension and outline of the dental arch helps in the treatment planning of different malocclusions to get more fruitful results regarding function, esthetics, and stability.^[5] Dental arches are dynamic

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How to cite this article: Khan EB, Soomar S, Shah M, Fatima S, Khan S, Ahmed Z, *et al.* Comparative assessment of various cephalometric facial planes with intercanine width in orthodontic patients. J Orthodont Sci 2022;11:22.

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Submitted: 31-May-2021
Revised: 30-June-2021
Accepted: 20-Oct-2021
Published: 04-May-2022

in nature; they transform efficiently in the course of growth and development, during which they transition from deciduous to mixed to permanent dentition, and less so in adulthood.^[6] Remodeling of alveolar bone, contractile properties of gingival fibers, sutural growth in the upper arch, maxilla-mandibular relationships of the teeth are various causes of variations in form and size of the dental arch. Transitional dentition in the dental arch showing speedy variations as compared to smaller variations are observed in a functional permanent dentition. For starting early orthodontic treatment, it is essential to have adequate knowledge of the changes occurring in the dental arches between mixed and permanent dentition in transverse and sagittal planes. Diet, environmental factors, and cultural variants influence the growth and development of dental arches.^[7] The sella-nasion-mandibular plane (SN-MP) is one of the most significant angles for determining vertical facial pattern. Facial types are examined using different parameters, such as the angular relationship of sella-nasion to mandibular plane, the proportion of lower to upper anterior facial heights, and the gonial angle. A short face patient is likely to have low SN-MP angle and one with long face often has high SN-MP.^[8] Most orthodontists at their clinics routinely use preformed arch wires irrespective of the sex and facial type of the patient. Understanding the key features of different malocclusions with skeletal and dental structures is essential in order to establish a proper treatment plan with adequate mechanics and retention regime.^[8] Multiple studies have been conducted but not a single study showing correlation of facial patterns in both vertical and anteroposterior planes with inter caninewidth in the same patient has been done. The correlation of lower arch intercanine width to SN-MP angle was statistically significant ($P < 0.05$) and weak with $r = -0.431$.^[9]

In previous studies, There was statistically significant but weak correlation between Inter-canine width and sagittal skeletal parameters with P -value < 0.05 .^[10]

The purpose of this study was to examine if a direct or inverse correlation exists between various cephalometric skeletal facial patterns and intercanine width, and consequently, to assess the choice of archwires for specific arch forms in specific facial patterns.

Objectives

To determine the association between intercanine width and skeletal bases in sagittal and vertical plane. To compare the intercanine width between skeletal vertical and skeletal anteroposterior plane.

Settings and design

This was a cross sectional study design, conducted at the OPD of Orthodontics, Sindh Institute of Oral

Health Sciences, Jinnah Sindh Medical University, Karachi. By using the online sample size calculator for correlation, the sample size calculated was 40; but for accuracy of results, we increased the sample size to 100. A non-probability consecutive sampling technique was used.

Methods and Material

The inclusion criteria in this research were patients of either gender having permanent dentition till 1st molars bilaterally, any skeletal class, good quality casts, and lateral cephalogram of high clarity. Patients admitted with re-orthodontic treatment, any skeletal asymmetry, mixed dentition/supernumerary teeth, hypodontia, prosthesis (post, dental implants, and fixed partial dentures), orofacial clefting/craniofacial syndromes, unilateral or bilateral posterior crossbites, poor incisor definition due to superimposed teeth, incisor rotations, patient with any surgical treatment history, or inferior image quality of lateral cephalogram were excluded from the study group.

Patients were selected on the basis of inclusion criteria and their records including clinical examination, patient's impression, dental casts, and lateral cephalogram were taken. Sella-nasion point A (SNA), sella-nasion point B (SNB), sella-nasion mandibular plan (SN-MP) were traced and measured on every lateral cephalogram. Intercanine width was measured using a digital vernier caliper accurate to 0.001 mm on dental casts were taken from the facial cusp tip of canine bilaterally.^[11]

Statistical analysis used

SPSS Statistics Version 23 was used as the data analyzer. The mean, minimum, maximum and the standard deviation were calculated for numerical variables like SNA, SNB, SN-MP, and intercanine width. Pearson correlation coefficient was used to determine the correlation coefficients among the SNA, SNB, SN-MP angles and intercanine width.

Results

Dental cast and cephalogram of 100 patients were assessed. The mean, minimum, maximum, and standard

Table 1: Intercanine width and skeletal parameters

	<i>n</i>	Maximum	Mean	Std. Deviation	Minimum
PT'S AGE	100	33	19.05	5.046	13
SNA	100	91.5	81.575	4.5195	68.0
SNB	100	90.0	78.105	4.3463	67.0
SNMP	100	50.0	32.125	5.9329	19.0
UICW	100	44	34.22	3.010	28
LICW	100	35	26.85	2.897	19
<i>n</i>	100				

deviation of age, intercanine width including upper and lower intercanine width, and skeletal sagittal (SNA, SNB) and vertical (SNMP) parameters are reported in Table 1.

The mean age value of 19.05 ± 5.046 years where the minimum age was 13 years and the maximum age was 33 years. There were 69 females (69%) and 31 males (31%) in the study sample. The minimum value of UICW was 28 mm and the maximum value was 44 mm with the mean value of 34.22 ± 3.010 mm. The minimum value of LICW was 19 mm and the maximum value was 35 with a mean value of 31.57 ± 2.87 mm. The minimum SNA value was 68° and the maximum value was 91.5° with a mean value of $81.57 \pm 4.51^\circ$. The minimum SNB value was 67° and the maximum value was 90° with a mean value of $78.105 \pm 4.34^\circ$. The minimum SN-MP value was 19° and the maximum value was 50° with a mean value of $32.56 \pm 5.28^\circ$ are reported in Table 1.

To analyze the correlation between intercanine width and skeletal planes, there was a weak positive/significant correlation ($P = 0.014$) of UICW and SNA with a Pearson correlation coefficient $r = 0.245$ and an insignificant correlation of UICW with SNB. The correlation between intercanine width and sagittal skeletal parameters is demonstrated in Table 2. LICW revealed a significant positive correlation with SNA ($P = 0.047$) and SNB ($P = 0.027$) with Pearson correlation coefficient $r = -0.199$ and $r = -0.221$.

Table 2: Correlations

		SNA	SNB	SN-MP
UICW	Correlation (<i>r</i>)	0.245 *		-.226*
	<i>P</i>	0.014		0.024
LICW	Correlation (<i>r</i>)	0.199 *	0.221*	
	<i>P</i>	0.047	0.027	
*Correlation is significant at the 0.05 level (2-tailed)				
		UICW	SNB	
UICW	Pearson Correlation	1	0.169	
	Sig. (2-tailed)		0.093	
	<i>n</i>	100	100	
SNB	Pearson Correlation	0.169	1	
	Sig. (2-tailed)	0.093		
	<i>n</i>	100	100	
		SNMP	LICW	
SNMP	Pearson Correlation	1	0.018	
	Sig. (2-tailed)		0.856	
	<i>n</i>	100	100	
LICW	Pearson Correlation	0.018	1	
	Sig. (2-tailed)	0.856		
	<i>n</i>	100	100	

SNMP revealed a significant negative correlation with UICW ($P = 0.024$) with Pearson correlation coefficient $r = 0.226$ and an insignificant correlation with LICW.

Conclusions

A patient with increased sagittal skeletal pattern has increased intercanine width while an increased vertical skeletal pattern has decreased upper intercanine width with no significant effect on lower intercanine width.

Discussion

Every person in the universe is born with a different facial pattern with high rate of variation. To comprehend the variation in shape and size of dental arches, it is necessary to assess the relationship of the skeletal pattern with dental arch dimensions.^[12] Multiple factors are involved in dental arch width variations.^[13] Understanding the features of dental arch width of different types of malocclusions with skeleton-dental characteristics would aid to conclude appropriate treatment objectives and effective treatment outcomes. The study was carried out to find the relation of intercanine width with cephalometric facial patterns in two planes (the sagittal and vertical planes). There were more females subjects present in the sample so this study did not give results based on gender.

As per the results of this study, patients with increased SNA angle had a wider upper dental arch and vice versa, same as the study carried out by Shahroudi AS, Etezadi T.^[3] These results were contrary to another study that stated that patients with higher SNA and SNB angles had a narrower maxillary dental arch in the canine area.^[9] SNB and UICW have an insignificant correlation. Mandibular dental arch width increased as the SNA and SNB increased, same as the results of another study.^[9]

According to the results of this study, a significant negative correlation between SN-MP and UICW has been reported, supported by some studies.^[10,12,13] In the present study, there was an insignificant correlation between SN-MP and LICW, and patients with high SN-MP were seen to have decreased UICW with no relation to LICW. It means that LICW and SN-MP are independent of each other.

According to the present study, patients with maxillary prognathism and low angle have increased upper intercanine width. In bimaxillary prognathism cases, only lower transverse width had increased in canine region.

SNA is a part of the nasomaxillary complex; it represents the point and aspect of the upper jaw in the sagittal

direction and is affected by the anterior cranial base directly. However the mandible is represented by SNB in the sagittal direction and is influenced by the location and dimension of the mandible. Thus, it is affected by the rotation of the lower jaw relative to the anterior cranial base. Rotation of the lower jaw is inconstant due to various reasons such as ecological factors, molar extrusion, way of breathing, and rotation of the upper jaw.^[5]

A high angle (SN-MP) patient is expected to have a constricted arch and elongated face, whereas a low angle (SN-MP) patient is likely to have a wide arch and short face.^[10,14,15] Discrepancy of intercanine width and sagittal skeletal pattern may be due to race and ethnicity.^[9] Preferably, such an investigation ought to utilize patients with ideal dentitions with no arch length discrepancy (ALD). Since it was difficult to find ideal untreated orthodontic patients and the sample size was restricted, those with ALD of up to 6 mm were included in this study. The present study includes all malocclusion groups in contrast to the study in which the inclusion criteria was only of skeletal class I subjects (with ANB angle of 2 ± 4). There is variation in the shape and size of dental arches determined by many authors. Due to difference in race, ethnicity, environmental conditions and physiological factors, orthodontists should determine the variation in form and size rather than treat all subjects as a single ideal. The arch dimensions across the canines should not be changed to achieve a stable occlusion and customized arch wires must be inserted in subjects with different sagittal and vertical skeletal pattern. In orthodontic practice at clinics, the choice of a preformed archwire is a critical step with edge wise appliance. Sometimes orthodontists neglect this step as they might think that light nickel titanium archwires will not change arch width. But, at clinical trials during leveling and alignment stage, significant arch width changes were observed, by using preformed archwires and upgrading the main archwire to customized stainless-steel wire for correction of this arch form will cause “round-tripping” of the teeth thus, increase in the duration of treatment. Stable treatment results can be achieved by maintaining the arch form. Muscular balance helps in assessing the intercanine width of each patient and any unplanned expansion in canine region could cause instability.^[16] Single arch form shape doesn't satisfy orthodontists.^[17] Hence it is important for clinicians to make the precise design for the arch or they choose the suitable form from archwire blanks.^[18] Musculature effect on transverse dimension and vertical facial morphology. Numerous studies have been done to assess the role of masticatory muscles in craniofacial growth. Individuals with wider transverse head dimensions presented with heavy or strong mandibular elevator muscles.^[19,20] Short face (Brachyfacial pattern) patients are often related to

strong masticatory musculature. Increased mechanical load on the jaws caused by hyperfunction of the muscles, which, in turn, may initiate growth at sutures and bone apposition results in enhanced transverse deposition of bone bases and growth of the jaws for the dental arches. Increased masseter muscle mass seen in short face people, which affects the angulation of molar teeth, results in more lingually inclined posterior teeth. The impact of muscular actions (ultrasonography) on arch proportions in various faciodental configurations will make this study more flexible.^[18]

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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