Research Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2019;9:2:38-44.

Relationship Between Arch Width and Vertical Facial Morphology In Untreated Adults of Kerala Population

Varun Goyal[1*] Gunjan Gupta[2] Nishant Gupta[3] Bhagat Tanwar[4] Divyam Girdhar[5] Arisha Izhar[6]

[1]Reader, Department of Orthodontics, Sudha Rustagi College of Dental Sciences and Research, Faridabad, Haryana, India.
[2]Senior Lecturer, Department of Prosthodontics, Sudha Rustagi College of Dental Sciences and Research, Faridabad, Haryana, India.
[3]Reader, Department of Orthodontics, Sudha Rustagi College of Dental Sciences and Research, Faridabad, Haryana, India.
[4]Senior Lecturer, Department of Endodontics, Sudha Rustagi College of Dental Sciences and Research, Faridabad, Haryana, India.
[5]Senior Lecturer, Department of Endodontics, Sudha Rustagi College of Dental Sciences and Research, Faridabad, Haryana, India.
[6]Senior Lecturer, Department of Orthodontics, Sudha Rustagi College of Dental Sciences and Research, Faridabad, Haryana, India.

ABSTRACT

Introduction: It is a general understanding amongst Orthodontists that there is a definite relationship between dental arch width and vertical facial morphology.

Aims and Objective: To make a regression equation to find out the arch width for the patient from his growth pattern. **Material and methods:** Jarabak's ratio was used as a measure for determining the growth pattern and maxillary models were used for measuring the arch width.

Results: There exists a direct correlation between patient's growth pattern and the arch width of the patient and Jarabak's ratio can be used to find the ideal arch width for the patient for his arch wire selection and fabrication.

Conclusion: Jarabak's ratio can be used for determining the arch width of the patient.

Keywords: Arch width, intermolar, intercanine, jarabak's ratio, growth pattern.

INTRODUCTION

Factors such as age, sex, and ethnic group are important in making a proper orthodontic treatment plan; another important factor is the facial growth pattern and its several clinical characteristics[1]. It is generally accepted among orthodontists that a relationship exists between vertical facial morphology and the dental arch width.

A subject with a high MP – SN angle (steep MP) tends to have a longer face, and one with a low MP – SN angle (flat MP) often has a shorter face[2,3]. A long-face individual usually has narrower transverse dimensions (dolichofacial) and a short face individual has wider transverse dimensions (brachyfacial)[2,3,4]

A question therefore arises as to the relationship between vertical facial morphology and dental arch width. Also, is there any difference in arch widths between male and female subjects?

Although several studies have addressed this topic, but their results were inconclusive for example most of these studies used MP-SN angle as a measure of vertical facial pattern but due to natural cranial variation, there may be variation in the anterior cranial base (SN), which may tip up or down[5].

For both males and females, there is a trend that as MP-SN angle decreased, arch width increased. Using postero-anterior (PA) Cephalograms, Christie (1977) found that adult brachyfacial males, when compared with 'standard' males, had greater maxillary and mandibular widths[6]. No difference,

Received: Dec. 5, 2018**: Accepted**: Jan. 17, 2019
***Correspondence Dr. Varun Goyal.**
Department of Orthodontics, Sudha Rustagi College of Dental Sciences and Research, Faridabad, Haryana, India.
Email: varungoyal29@gmail.com

pISSN 2278-0076
eISSN 2321-9270

however, was found in the arch widths of brachyfacial versus standard females.

Jarabak ratio is the ratio between posterior face height (PFH, S-Go) and anterior face height (AFH, Na-Me) and is another measurement for vertical facial morphology not based on the mandibular plane. A subject with a high Jarabak ratio tends to have a shorter face, and one with a low Jarabak ratio often have longer face. The purpose of the present study was to investigate if dental arch widths are correlated with vertical facial types (Jarabak ratio) and an attempt was made to find out a definite relationship between vertical facial pattern and dental arch width. Clinically, preformed arch wires are routinely used by many orthodontists regardless of the facial type and gender of the patients.

The purpose of the present study was to investigate if dental arch widths are correlated with vertical facial types (Jarabak ratio) and an attempt was made to find out a definite relationship between vertical facial pattern and dental arch width. Relationship between vertical facial morphology and arch width has been found for different ethnic and racial groups previously. Most investigators have concluded that there are significant differences between the diverse ethnic and racial groups, and many standards have been developed for different ethnic groups. All these studies indicate that normal measurements for one group should not be considered normal for every other race or ethnic group[7]. This will help in making individualized arch wires according to each patient's Jarabak's ratio for the population type.

MATERIALS & METHODS

Sample selection:

This study included 150 untreated adults of Kerala population aged between 18 to 48 years of age and having angle class I malocclusion on whom cephalometric and cast analysis was done. Cephalometric analysis was done to find Jarabak's ratio and cast analysis was done to find the Intercanine and Intermolar width.

Inclusion criteria

a) Angle class I malocclusion b) Full dentition except third molars c) Pre-treatment lateral cephalogram and maxillary and mandibular dental casts available. d) Individuals between 18-48 years of age

Exclusion criteria

a) Previous orthodontic treatment b) Edentulous spaces, history of trauma, c) Significant cuspal wear d) Extensive restorations or prosthetics e) Anterior and posterior crossbites f) crowding (>4 mm) or spacing (>4 mm)

Cephalometric analysis: -

For each subject, Jarabak's ratio was measured from the Anterior facial height (AFH, Na-Me) and Posterior facial height (PFH, S-Go). Lateral Cephalograms were taken and study casts were made for each individual using a standardized and specified technique. Cephalograms was traced onto .003-inch acetate paper (figure 1). The mandibular plane was drawn from Menton (Me) to the Gonion which was taken as a constructed landmark on the intersection of tangents at the posterior and inferior border of mandible (figure 2).

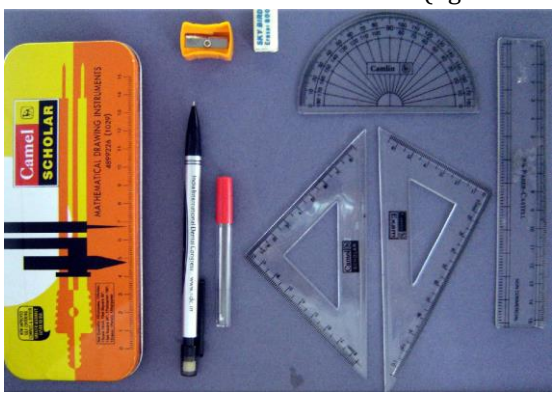

Fig 1: Tracing utensils.

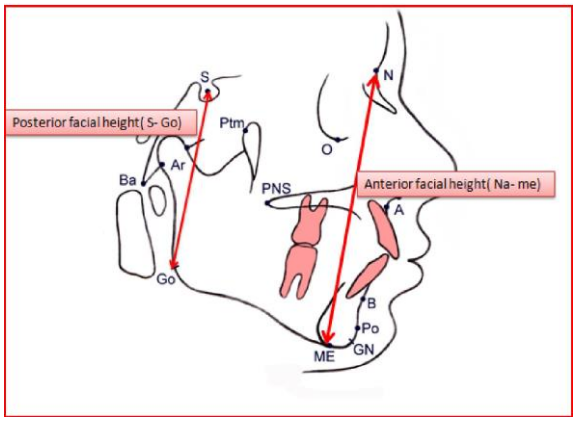

Fig 2: Jarabak's ratio tracing landmarks

Dental cast analysis

Upper and lower impressions were made for each subject and dental cast measurements were performed using a digital calliper accurate to 0.01 mm(figure 3). The following maxillary and mandibular dimensions were measured and following measurements were calculated

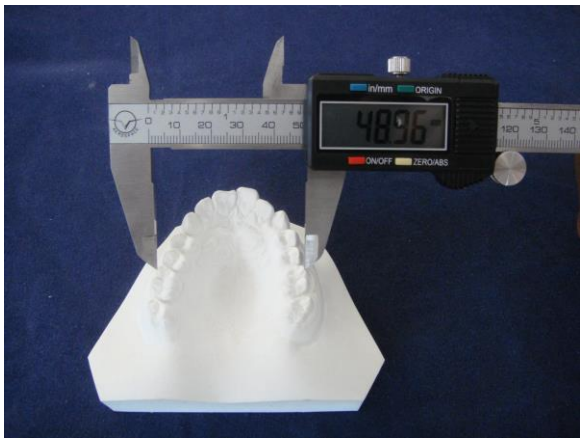

Fig 3: Measuring intercanine width using digital Vernier calliper.

a) Intercanine width (from cusp tip of canine of the right side to canine cusp tip of the left side) b) Intermolar width (from Mesiobuccal cusp tip of the first molars of the right side to the Mesiobuccal cusp tip of the molar of the left side)

Descriptive statistics, including the mean and SD, were calculated for all measurements. A Student's two-tailed t-test was used to determine if the differences in measurements between the male and female groups were significant. Moreover, regression analyses were carried out to determine the degree to which Jarabak's ratio variation was predicted by dental arch width in males and females separately. Significance for all statistical tests was predetermined at $P < 0.05$.

RESULTS

Table 1: Descriptive stastics.

Sex		Jarabak's Ratio	Intercanine Width(Maxillary Arch)	Inetrmolar Width(Maxillary Arch)	Intercanine Width(Mandibular Arch)	Intermolar Width (Mandibular Arch)
M	Mean	66.9314	36.1731	53.0641	28.1026	46.2436
	N	78	78	78	78	78
	Std. Deviation	5.63960	2.63817	3.15133	2.41526	2.94621
F	Mean	65.1572	35.7569	51.7361	27.9722	45.9167
	N	72	72	72	72	72
	Std. Deviation	6.06699	2.81094	3.51653	3.02558	2.72055
Total	Mean	66.0798	35.9733	52.4267	28.0400	46.0867
	N	150	150	150	150	150
	Std. Deviation	5.89633	2.72127	3.38641	2.71679	2.83539

Table 2: Correlation Of Jarabak's Ratio With Intercanine Width And Intermolar Width Of Maxillary And Mandibular Arch In Males And Females.

Sex			Intercanine Width(Maxillary Arch)	Inetrmolar Width(Maxillary Arch)	Intercanine Width(Mandibular Arch)	Intermolar Width (Mandibular Arch)
M	Jarabak ratio	r	.300	.264	.249	.303
		p	0.008	0.019	0.028	0.007

		N	78	78	78	78
F	Jarabak ratio	r	.290	.147	.140	.254
		p	0.013	.219	.240	0.031
		N	72	72	72	72

Table 3: Comparison Between Male And Female Arch Widths.

	sex	N	Mean	Std. Deviation	t
Jarabak ratio	M	78	66.3594	5.58101	2.27200
	F	72	64.1919	6.10119	p=0.025
Icwmax (Intercanine widh of maxillary arch)	M	78	36.5321	2.15072	3.54400
	F	72	34.9097	3.36649	p<0.001
Imwmax (Intermolar widh of maxillary arch)	M	78	53.2949	3.09633	3.54200
	F	72	51.4167	3.39739	p<0.001
Icwmand (Intercanine widh of mandibular arch)	M	78	28.5256	2.09962	2.55700
	F	72	27.4583	2.96903	p=0.012
Imwmand (Intermolar width of mandibular arch)	M	78	46.5385	2.49515	2.51100
	F	72	45.5000	2.56740	p=0.013

Table 4 : Comparison Of Arch Widths Among High, Medium And Low Jarabak's Ratio Groups.

		N	Mean	Std. Deviation	F	p
icwmax	<62	45	36.2111	2.48744	1.266	.285
	62 - 65	29	36.0000	1.58114		
	>65	76	35.3882	3.45601		
imwmax	<62	45	53.3111	2.50293	2.809	.064
	62 - 65	29	51.5517	4.11952		
	>65	76	52.1711	3.41912		
icwmand	<62	45	27.7333	2.71695	1.153	.318
	62 - 65	29	27.6207	2.06006		
	>65	76	28.3289	2.70500		
imwmand	<62	45	46.5778	2.60671	4.297	0.015
	62 - 65	29	44.8621	3.12506		
	>65	76	46.1711	2.19325		

Regression Equation For Calculation Of Jarabak Ratio From Intercanine Width Of Maxillary Arch In Males And Females

Regression Analysis

For males:-

JARABAK'S RATIO = 43.727+0.641 x Intercanine Width Maxillary Arch

For Females **JARABAK'S RATIO** = 42.788+0.626 x Intercanine Width Maxillary Arch

Regression Equation For Calculation Of Jarabak Ratio From Intermolar Width Of Maxillary Arch In Males And Females

For Males:-

JARABAK'S RATIO = 41.829+0.473 x Intermolar Width Of Maxillary Arch

For Females

JARABAK'S RATIO = 52.055+0.253 x Intermolar Width Of Maxillary Arch

Regression Equation For Calculation Of Jarabak Ratio From Intercanine Width Of Mandibular Arch In Males And Females

For males:-

Regression Analysis

JARABAK'S RATIO = 50.579+0.582 x Intercanine Width Of Mandibular Arch

For Females

JARABAK'S RATIO = 57.291+0.281 x Intercanine Width Of Mandibular Arch

Regression Equation For Calculation Of Jarabak Ratio From Intermolar Width Of Mandibular Arch In Males And Females

For males:-

JARABAK'S RATIO = 40.095+0.580 x Intermolar Width Of Mandibular Arch

For Females

JARABAK'S RATIO = 39.105+0.567 x Intermolar Width Of Mandibular Arch

Table 1 shows the descriptive statistics of the population under study. Also it was demonstrated that males had larger dental arch widths than females ($P < 0.05$). Table 2 shows the correlation between Jarabak ratio and intercanine width and intermolar width of maxillary and mandibular arches. The relation between Inetrcanine width of maxillary arch of males ($p = 0.008$) and intermolar width of mandibular arch of males ($p = 0.007$) was very highly significant ($p< .01$). In Male population the relation between Jarabak ratio and intermolar width of maxillary arch ($p = 0.019$), intercanine width mandibular arch($P= 0.028$) was significant($p< .05$). In female population Only the Intercanine width of maxillary arch ($p=0.013$) and intermolar width of mandibular arch ($p=0.031$) was significantly related to the Jarabak's ratio ($p< .05$). The intermolar width of maxillary arch ($p= 0.219$) and intercanine of mandibular arch ($p= 0.240$) was not significantly related to the Jarabak ratio. Table 3 shows the comparison between male and female population of the intercanine widths and intermolar widths of the maxillary and mandibular arch. It was clearly demonstrated that males have significantly larger dental arch widths than the females. Table 4 shows the comparison of intercanine and intermolar widths in high, medium and low jarabak's ratio groups. The high Jarabak's ratio group had larger arch widths than the low Jarabak's ratio group for most measurements. Using regression analysis linear regression equations were formed between the Jarabak ratio and the arch widths for the population under study. The linear regression equations will give predictable and good results for all intercanine widths and intermolar widths in both male and female population except for the intermolar width of maxillary arch and intercanine of the mandibular arch for females because of the statistically insignificant correlation of these variables to the Jarabak ratio.

DISCUSSION

The objectives of this study were to investigate if a relationship exists between dental arch width and the vertical facial pattern determined by the Jarabak ratio, and to examine the differences in dental arch widths between male and female untreated adults.

Factors such as age, sex, and ethnic group are important in making a proper orthodontic treatment plan; another important factor is the facial growth pattern and its several clinical characteristics1. It is generally accepted among orthodontists that a relationship exists between vertical facial morphology and the dental arch width. A long-face individual usually has narrower transverse dimensions (dolichofacial) and a short-face individual has wider transverse dimensions (brachyfacial) according to Ricketts et al. (1982)[2], Enlow and Hans (1996)[3], and Wagner and (2005)[4] . A question therefore arises as to the relationship between vertical facial morphology and dental arch width. Also, is there any difference in arch widths between male and female subjects?

Lateral cephalograms and dental casts were obtained from 150 untreated adults between 18 and 48 years of age with no crossbite, minimal crowding, and spacing. The results of this study were analysed with regression line fit plots. The sample was drawn randomly from a group of untreated subjects, allowing the use of this analysis. Because the independent variable (Jarabak Ratio) and all of the predictor measurements were continuous variables, it was more appropriate to analyse the data with regression analysis rather than ANOVA. The jarabak ratio (The ratio of posterior face height (PFH, S – Go) to anterior face height (AFH, Na – Me) is another measurement for vertical facial morphology not based on the mandibular plane29) was used as the measurement of vertical facial morphology in the present study. However, due to natural cranial variation, there may be variation in the anterior cranial base (SN), which may tip up or down.

Only skeletal Class I (as determined by ANB angle) subjects were examined because more dental compensation is expected in skeletal Class II or III subjects, which might obscure the relationship between vertical facial morphology and transverse dental arch widths. The present study investigated untreated adult males and females separately. It has previously been demonstrated that males and females exhibit different skeletal facial dimensions[8,9,10,11] as well as differences in maxillary and mandibular arch widths[11] . Unfortunately, any of the earlier studies that examined arch width and mandibular plane angle combined the genders[10,11].

In addition, the present sample was limited to non-growing, adult individuals, unlike many of the previous investigations that included only growing children[9,10].

Ideally, this type of study should be conducted using patients with ideal dentitions without any crowding or spacing. However, due to difficulties in finding ideal untreated subjects and subsequent limitations in sample size, those with crowding and spacing up to 4 mm were included. For the maxillary arch, there was a statistically significant direct relationship between the Jarabak ratio and Intercanine width for both males and female however there was significant correlation between maxillary intermolar width with jarabak's ratio only for males. For the mandibular arch, it was found that males had a statistically significant correlation between jarabak ratio and intermolar width whereas for females only intermolar width and not the intercanine width showed such positive corelation. For both males and females, as arch width increased, Jarabak ratio increased. Nasby et al. (1972) , who demonstrated narrower mandibular intermolar widths in high-angle children, the present data did supports such a relationship between mandibular intermolar width and Jarabak ratio[10]. Wagner and Chung (2005) found that while the growth of the maxilla plateaus at about 14 years of age, the skeletal width of the mandible continues to grow, at least in low- and average angle groups. It is conceivable that as the mandible continues to increase in width, the mandibular molars compensate by inclining lingually and thereby maintaining the intermolar width. In fact, a number of authors have suggested that individuals with increased vertical dimensions have posterior teeth that tend to be more buccally.

CONCLUSIONS

1. The dental arch widths in males were significantly greater than those in females.

2. For both males and females, as arch width increased, Jarabak's ratio increased.

3. Since dental arch width is associated with gender and facial vertical morphology, using individualized arch wires according to each patient's pre-treatment arch form and widths is suggested during orthodontic treatment.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Guilherme J , Bombonatti R , Cruz K S , Hassaunuma C Y , Del Santo Jr M 2004 Buccolingual inclinations of posterior teeth in subjects with different facial patterns . American Journal of Orthodontics and Dentofacial Orthopedics 125 : 316 – 322

2. Ricketts R M , Roth R H , Chaconas S J , Schulhof R J , Engel G A 1982 Orthodontic diagnosis and planning . Rocky Mountain Data Systems , Denver

3. Enlow D , Hans M G 1996 Essentials of facial growth . W.B. SaundersCompany , Philadelphia

4. Wagner D C , Chung C-H 2005 Transverse growth of the maxilla and mandible in untreated girls with low, average, and high MP-SN angles:a longitudinal study . American Journal of Orthodontics and Dentofacial Orthopedics 128 : 716 – 723

5. C. Matthew Forster , Elaine Sunga and Chun-Hsi Chung 2008 Relationship between dental arch width and vertical facial morphology in untreated adults. European Journal of Orthodontics 30: 288–294

6. Howes A 1957 Arch width in the premolar region — still the major problem in orthodontics . American Journal of Orthodontics 43 : 5 – 31

7. Christie T E 1977 Cephalometric patterns of adults with normal occlusion . Angle Orthodontist 47 : 128 – 135

8. Wei S H 1970 Craniofacial width dimensions . Angle Orthodontist 40 :141 – 147

9. Eroz U B , Ceylan I , Aydemir S 2000 An investigation of mandibular morphology in subjects with different vertical facial growth patterns .Australian Orthodontic Journal 16 : 16 – 22

10. Faraj Behbehani, E.Preston Hicks, Cynthia Beeman, G.Thomas Kluemper , Mary K. Rayens 2006 Racial Variations in Cephalometric Analysis between Whites and Kuwaitis. Angle Orthodontist,Vol 76: 406-411.

11. Stephen F Snodell, Ram S. Nanda, G. Frans Currier 1993 A longitudinal cephalometric study of transverse and vertical craniofacial growth. American Journal of Orthodontics and Dentofacial Orthopaedics ;104 :471-483.