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Research Article

CORRELATION OF DENTALARCH WIDTH IN VERTICAL FACIAL MORPHOLOGY

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ABSTRACT

Facial morphology is unique to every individual in world. Preformed arch wires are used by clinician regardless of arch width and shape and vertical facial morphology which leads to relapse. Hence, present study is designed to investigate the gender differences in dental arch width and also to correlate it with vertical facial morphology in untreated adults of 17- 25 years of age irrespective of sagittal indicators. Jarabak's ratio and steepness of mandibular plane angle (GoGn to SN) was measured by FACAD orthodontic tracing software version 3.11 on lateral cephalograms of each subject. Directdental arch width measurements of maxillary and mandibular intercanine, interpremolar, and intermolar widths were obtained individually by Vernier calipers on study model. The arch width of males and females were analyzed and the differences between them were tested for significance using a Student's t-test. It was concluded that dental arch width is associated with gender and vertical facial morphology. Thus, using individualized arch wires according to each subject's pre-treatment arch width and form is recommended.

INTRODUCTION

Dental casts helps to visualize the occlusion & dentition from all aspects, to analyze the degree & severity of malocclusion and to derive the diagnosis & plan for treatment. They provide a permanent record and are also used for direct measurements for arch width, shape, length, perimeter, crowding, spacing etc. which are more precise and valid for analysis. It should be emphasized that study models are absolutely essential as starting and finishing records in orthodontics.

Jucienne Salgado Ribeirostated that the dimensions of the dental arch have considerable impact on orthodontic diagnosis and treatment planning, affecting space availability, dental esthetics, dentition stability and prospects for a favorable development[1].

In daily clinical practice, with the increased use of preformed arch wires routinely by many orthodontists regardless of the facial type and gender of the patients to correct transverse dimensions of the dental arches, so increased knowledge of a link between facial proportion and dental arch width can be of immense help to orthodontists. Hence, there is a need to correlate different arch width with acceptable esthetic facial framework of male and female

The purpose of the present study is to correlate dental arch widths with vertical facial types if there are any differences in maxillary and mandibular dental arch width between untreated male and female adults.

Aim and Objectives of the Study

To correlate dental arch width (direct measurement on plaster cast) and to compare gender differences in various vertical facial morphology (hypodivergent, normodivergent, hyperdivergent) by Jarabak's ratio and GoGn to SN (on lateral cephalogram) in untreated adults.

MATERIALS AND METHOD

The present study is carried out in the Department of Orthodontics and Dentofacial Orthopedics, Government Dental College & Hospital, Ahmedabad. It was approved by the ethical committee. 180 adult subjects (17-25 years) from Government Dental College & Hospital, Ahmedabad were selected for the study.

Selection Criteria

Inclusion Criteria

- Age group of the selected subjects in the range of 17-25 years. (Mean age – 21.5 years)

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- Subjects with CVMI stage 6(Hassel and Farman method completion of growth).
- No previous history of orthodontic treatment, surgery, trauma.
- No apparent facial asymmetry.
- All permanent teeth should be present except 3rd molars.
- Vertical facial morphology defined in Average, Hypo divergent and Hyper divergent type according to Jarabak's ratio and GoGn to SN.

Exclusion Criteria

- Missing or supernumerary teeth.
- TMJ disorder, muscle dysfunction and presence of unilateral chewing.
- Any other systematic disturbances.
- Any other oral destructive habits, habit of bruxism & presence of attrition.
- Presence of any developmental dental anomalies, dental caries and restoration

Cephalometric Study

For all the subjects, standardized lateral cephalometric radiographs were taken in centric occlusion with lips in relaxed and the Frankfort plane oriented horizontally according to Natural Head Position (NHP) to classify samples. The digital cephalometric tracing was done using FACAD orthodontic tracing software version 3.11.

Following Cephalometric Parameters were Measured

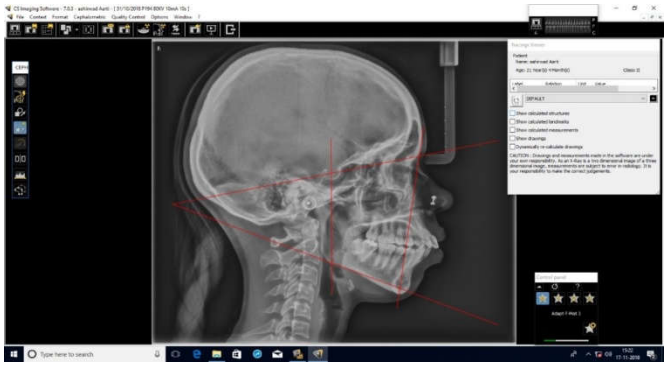


Figure shows cephalometric parameters in software

(FACAD orthodontic tracing software version 3.1)

Cephalometric Parameters

Anterior facial height(Nasion-Menton)
Posterior facial height(Sella-Gonion)
Jarabak's ratio = Posterior facial height (S-Go) x 100 Anterior facial height(N-Me)
Go-Gn to SN

Model Study

Upper and lower alginate impressions were taken and dental casts were prepared. Dental cast measurements were recorded manually by using a Digital Vernier calipers (HI-MEZAR) 150X0.01mm/6X0.0005in accurate to 0.01mm.

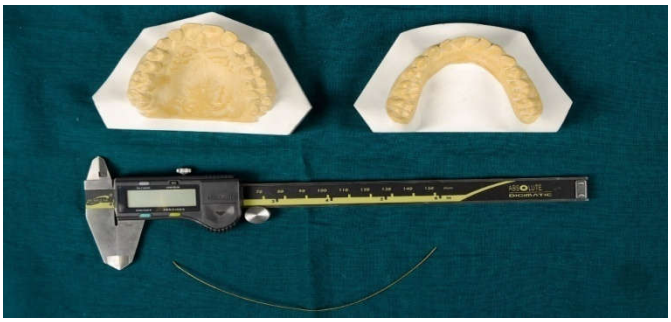


Figure shows armamentarium of model study

The following maxillary and mandibular arch width measurements were obtained.

Maxillary dental arch width Measurements

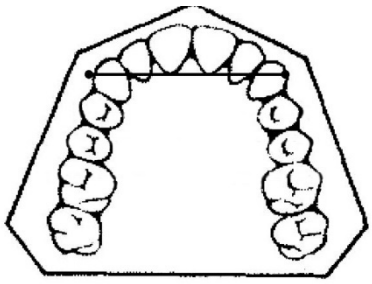


Figure shows intercanine width (cusptip)

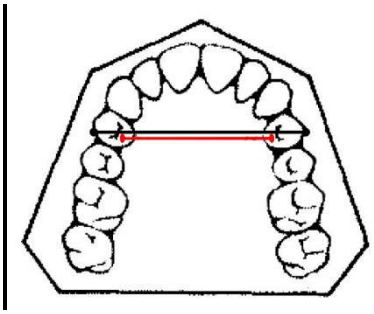


Figure shows interpremolar width
black - buccal cusp tip
red - palatal cusp tip

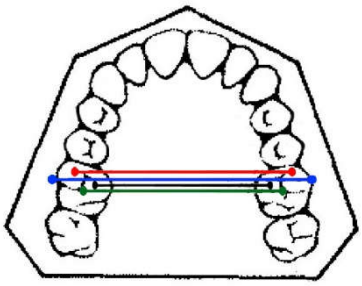


Figure shows intermolar width
red -mesiobuccal cusp tip
black-mesiopalatal cusp tip
blue- most buccal aspect
green-central groove

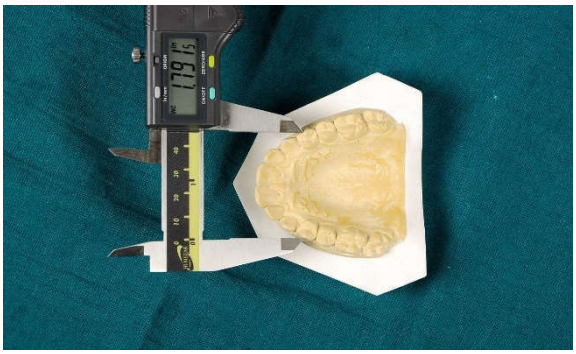


Figure shows measurement in the maxillary cast model

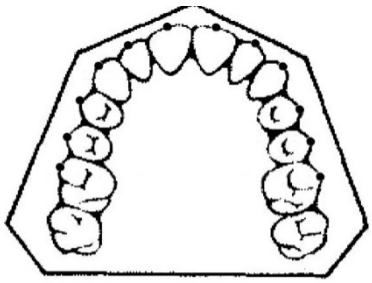


Figure shows method to identify U, V and Square arch form in maxilla.

facial height than females in hypodivergent and normodivergent growth pattern.

Jarabak's ratio is nonsignificant in hypodivergent (p≤0.066), significant but to lesser extent in normodivergent (p≤0.024*) and nonsignificant (p≤1) in hyperdivergent growth pattern. Males have higher Jarabak's ratio than females in hypodivergent and normodivergent growth pattern.

GoGn to SN is nonsignificant in all 3 group patterns (p≤0.195, p≤0.051 and p≤1).Males have higher GoGn to SN value than females in hypodivergent and normodivergent growth pattern.

Mandible dental arch width Measurements

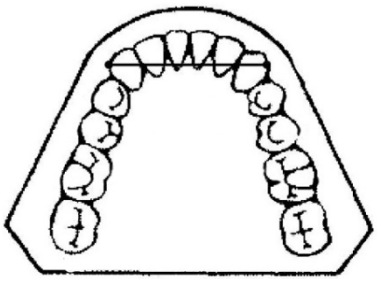


Figure shows inter canine width (cusp tip)

Table I Intragroup comparison of various cephalometric parameters in vertical facial morphology groups according to gender

Group	Parameter	Gender	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	P value
Hypo	NMe	Male	30	109.40	5.531	1.010	10.633	<0.001**
		Female	30	98.77	2.861	.522		
	SGo	Male	30	76.500	4.4237	.8077	7.3333	<0.001**
		Female	30	69.167	2.6792	.4892		
	JR	Male	30	71.5203	2.73108	.49862	1.25467	0.066 NS
		Female	30	70.2657	2.45458	.44814		
	GOGN-SN	Male	30	25.767	3.0477	.5564	.9000	0.195 NS
		Female	30	24.867	2.2087	.4032		
Normo	NMe	Male	30	106.03	3.499	.639	3.447	0.003*
		Female	30	102.59	4.866	.904		
	SGo	Male	30	65.700	3.3130	.6049	.3000	0.690 NS
		Female	30	65.400	2.4155	.4410		
	JR	Male	30	62.9900	1.24273	.22689	-.69333	0.024*
		Female	30	63.6833	1.07128	.19559		
	GOGN-SN	Male	30	29.667	2.2944	.4189	-1.4000	0.051 NS
		Female	30	31.067	3.0843	.5631		
Hyper	NMe	Male	30	110.00	2.639	.482	0.000	1 NS
		Female	30	110.00	2.639	.482		
	SGo	Male	30	58.067	2.8154	.5140	0.0000	1 NS
		Female	30	58.067	2.8154	.5140		
	JR	Male	30	56.0600	2.33025	.42544	.00000	1 NS
		Female	30	56.0600	2.33025	.42544		
	GOGN-SN	Male	30	35.467	1.7367	.3171	0.0000	1 NS
		Female	30	35.467	1.7367	.3171		

Table 1 shows comparison of various cephalometric parameters in vertical facial morphology groups according to gender.

Anterior facial height (N-Me) is highly significant in hypodivergent (p<0.001**), significant in normodivergent (p≤0.003*) and nonsignificant (p≤1) in hyperdivergentgrowth pattern. Males have higher anterior facial height than females in hypodivergent and normodivergent growth pattern.

Posterior facial height (S-Go) is highly significant in hypodivergent (p<0.001**), significant but to lesser extent in normodivergent (p≤0.690) and nonsignificant (p≤1) in hyperdivergent growth pattern. Males have higher posterior

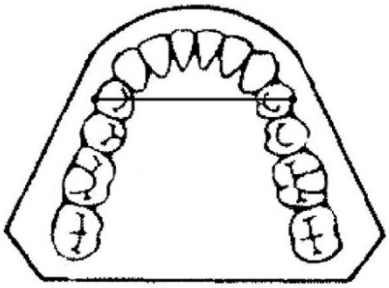
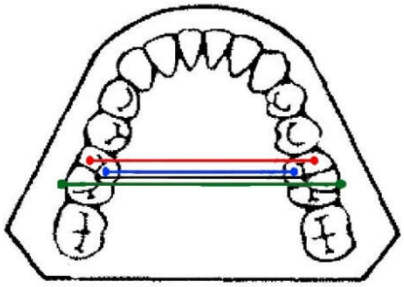


Figure shows inter premolar width
black - buccal cusp tip



blue-mesiopalatal cusp tip
green- most buccal aspect
black- central groove

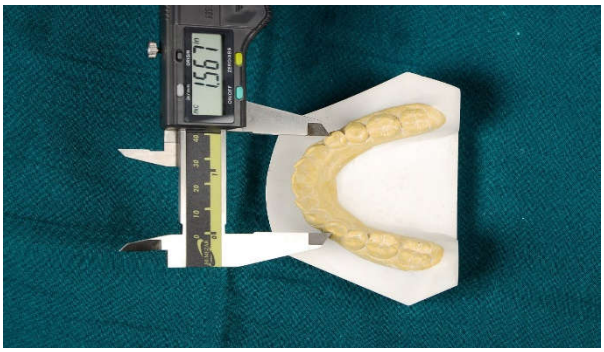


Figure shows measurement in the mandibular cast model

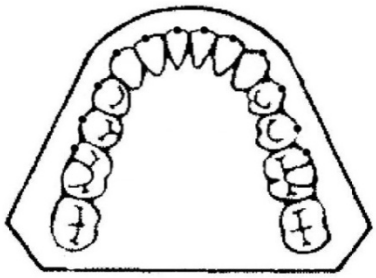


Figure shows method to identify U, V and Square arch form in mandible

DATA AND RESULTS

The statistical methods that were employed in the present study are Mean, Standard deviation, Standard error, P value, One way ANOVA, Independent "t" test, CHI-SQUARE TEST and Post hoc tuckey test (LSD)

Table II Intergroup comparison of various parameters in cephalometric study.

Table II A N-Me (Anterior facial height)

Group	N	Min.	Max.	Mean	S.D.	F value	P value
Hypo divergent	60	96	119	104.08	6.914		
Normo Divergent	60	96	112	104.34	4.536	26.675	<0.001**
Hyper divergent	60	106	118	110.00	2.617		

Table II B S-Go (Posterior facial height)

Group	N	Min.	Max.	Mean	S.D.	F value	P value
Hypo divergent	60	65.0	86.0	72.833	5.1787		
Normo divergent	60	60.0	72.0	65.550	2.8785	228.759	<0.001**
Hyper divergent	60	53.0	66.0	58.067	2.7914		

Table II C Jarabak'sRatio

Group	N	Min.	Max.	Mean	S.D.	F value	P value
Hypo divergent	60	64.61	74.76	70.8930	2.65101		
Normo Divergent	60	60.80	65.50	63.3367	1.20225	716.948	<0.001**
Hyper divergent	60	52.80	60.80	56.0600	2.31042		

Table II D GoGn-SN

Group	N	Min.	Max.	Mean	S.D.	F value	P value
Hypo Divergent	60	20.0	30.0	25.317	2.6775		
Normo Divergent	60	24.0	37.0	30.367	2.7860	259.059	<0.001**
Hyper divergent	60	32.0	39.0	35.467	1.7219		

[2a] Mean of Anterior facial height (N-Me) is highly significant (p< 0.001**).

[2b] Mean of Posterior facial height (S-Go) is highly significant (p<0.001**).

Anterior facial height is similar in hypodivergent and normodivergent but greater in hyperdivergent group. However, posterior facial height is greater in hypodivergent followed by normodivergent and hyperdivergent growth pattern.

[2c] Mean of Jarabak's ratio is ishighly significant (p<0.001**).

[2d] Mean of GoGn to SN is highly significant (p<0.001**).

Isaacson co *et al* (1970)[2]stated that the width of the palate through the molar areas increased as the MP-SN decreased. The mean width for the high angle group is 35.6 mm. This increased to a mean of 38.12mm for the average group and 40.57 for the low angle group. If the alveolar ridges and facial sutures greatly increase vertically in excess of vertical increases at the mandibular condyle, the mandible will rotate backwards.

C. Matthew Forster, Elaine Sunga and Chun-Hsi Chung (2008)[3] stated that in both males and females, as MP – SN angle increased, arch width tended to decrease. Strong masticatory musculature is often associated with a brachyfacial pattern (short face). This, in turn, may cause an induction of sutural growth and bone apposition which then results in increased transverse growth of the jaws and bone bases for the dental arches.

Table III A Intergender comparison of Maxillary dental arch width in Hypodivergent group

Parameter	Gender	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	P value
ICW	Male	30	35.1318	2.62731	.47968	.47800	0.540 NS
	Female	30	34.6538	3.34101	.60998		
IPW Buccal	Male	30	42.1463	2.67455	.48830	-.46500	0.505 NS
	Female	30	42.6113	2.69683	.49237		
IPW Palatal	Male	30	29.8937	3.35292	.61216	-2.15133	0.005*
	Female	30	32.0450	2.27919	.41612		
IPW Distal	Male	30	37.4900	1.83541	.33510	1.44150	0.075 NS
	Female	30	36.0485	3.95563	.72220		
IMW Mesiobuccal	Male	30	51.1860	3.45056	.62998	-1.77900	0.015*
	Female	30	52.9650	1.80990	.33044		
IMW Mesiopalatal	Male	30	38.9897	3.07906	.56216	-.61900	0.312 NS
	Female	30	39.6087	1.25889	.229840		
IMW Buccal	Male	30	53.7327	2.28068	.41639	-2.40033	0.001*
	Female	30	56.1330	2.79974	.51116		
IMW Central	Male	30	45.8817	2.52125	.46031	.10000	0.851 NS
	Female	30	45.7817	1.45068	.26486		
IMW Mesial	Male	30	45.5853	2.43767	.44506	-.52200	0.327 NS
	Female	30	46.1073	1.55345	.28362		
IPW (Pont's index)	Male	30	36.9811	1.91655	.38331	.94165	0.087 NS
	Female	30	36.0395	2.05287	.37480		
IMW (Pont's index)	Male	30	45.6870	2.33016	.42543	-.24533	0.630 NS
	Female	30	45.9323	1.50781	.27529		

Table 3A shows intergender comparison of Maxillary Dental arch width in model study of Hypodivergent group.

Intercaninewidth($p \leq 0.540$), Interpremolar width (buccal) ($p \leq 0.505$),Interpremolar width (distal) ($p \leq 0.075$), Intermolar width (mesiopalatal) ($p \leq 0.312$), Intermolar width (central) ($p \leq 0.851$), Intermolar width (mesial) ($p \leq 0.327$), Interpremolar width (Pont's index) ($p \leq 0.087$) and Intermolar width (Pont's index)($p \leq 0.630$) are Nonsignificant.

Interpremolar width (palatal)($p \leq 0.005$ *) and Intermolar width (mesiobuccal) ($p \leq 0.015$ *) is significant but to lesser extent.Females have greater interpremolar width (palatal) and Intermolar width (mesiobuccal) than in males.

Intermolar width (buccal) ishighlysignificant ($p \leq 0.001$*). Females have greater width than in males.

Females have statistically significant interpremolar width (palatal) and Intermolar width (mesiobuccal and buccal).

Table 3B shows intergender comparison of Maxillary Dental arch width in model study of Normodivergent group.

Intercanine width ($p \leq 0.070$), Interpremolar width (buccal) ($p \leq 0.453$), Interpremolar width (distal) ($p \leq 0.057$), Intermolar width (mesiopalatal) ($p \leq 0.067$), Intermolar width (central) ($p \leq 0.052$), Intermolar width (mesial) ($p \leq 0.124$), Interpremolar width (Pont's index) ($p \leq 0.114$) is nonsignificant Males have statistically significant interpremolar width (palatal) and Intermolar width (mesiobuccal and buccal). Females showed greater calculated intermolar width.

Interpremolar width (palatal) ($p \leq 0.188$*), Intermolar width (Pont's index) ($p \leq 0.010$*) is significant but to lesser extent.
Intermolar width (mesiobuccal), Intermolar width (buccal) is highly significant ($p < 0.001$**).Males have greater width than in females.

Table III B Intergender comparison of Maxillary dental arch width in Normodivergent group

Parameter	Gender	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	P value
ICW	Male	30	36.8063	1.95021	.35606	-.88237	0.070 NS
	Female	30	37.6886	1.74081	.31783		
IPW Buccal	Male	30	44.5850	2.86965	.52392	.50800	0.453 NS
	Female	30	44.0770	2.31040	.42182		
IPW Palatal	Male	30	35.1647	3.11095	.56798	.98033	0.188 NS
	Female	30	34.1843	2.56939	.46910		
IPW Distal	Male	30	37.2289	1.95893	.35765	1.43003	0.057 NS
	Female	30	35.7989	3.51735	.64218		
IMW Mesiobuccal	Male	30	52.3907	3.26477	.59606	10.95367	<0.001**
	Female	30	41.4370	4.02503	.734870		
IMW Mesiopalatal	Male	30	45.8603	3.15467	.575960	1.39333	0.067 NS
	Female	30	44.4670	2.59254	.47333		
IMW Buccal	Male	30	55.8310	2.45833	.44883	5.93433	<0.001**
	Female	30	49.8967	3.89276	.71072		
IMW Central	Male	30	45.9163	2.49540	.45559	1.37367	0.052 NS
	Female	30	44.5427	2.86576	.52321		
IMW Mesial	Male	30	44.5279	2.31356	.42962	-.82540	0.124 NS
	Female	30	45.3533	1.70684	.31162		
IPW (Pont's index)	Male	30	36.8035	1.97148	.35994	-.79335	0.114 NS
	Female	30	37.5969	1.67605	.32870		
IMW (Pont's index)	Male	30	43.1086	2.41026	.44757	-1.77535	0.010*
	Female	30	44.8840	2.66639	.48681		

Table III C Intergender comparison of Maxillary dental arch width in Hyperdivergent group

Parameter	Gender	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	P value
ICW	Male	30	35.9696	1.57218	.28704	2.65630	<0.001**
	Female	30	33.3133	2.24689	.41022		
IPW Buccal	Male	30	41.6420	1.91862	.35029	-.93533	0.099 NS
	Female	30	42.5773	2.37870	.43429		
IPW Palatal	Male	30	38.0223	2.01503	.36789	4.30900	<0.001**
	Female	30	33.7133	3.14790	.57472		
IPW Distal	Male	30	40.4203	1.75078	.31965	3.66917	<0.001**
	Female	30	36.7511	3.07147	.56077		
IMW Mesiobuccal	Male	30	55.0183	2.87295	.52453	3.71133	<0.001**
	Female	30	51.3070	2.95460	.53943		
IMW Mesiopalatal	Male	30	46.1767	2.51570	.45930	6.54533	<0.001**
	Female	30	39.6313	2.86869	.52375		
IMW Buccal	Male	30	58.5957	2.44639	.44665	7.85200	<0.001**
	Female	30	50.7437	3.11477	.56868		
IMW Central	Male	30	54.1923	2.39992	.43816	7.65533	<0.001**
	Female	30	46.5370	2.71689	.49603		
IMW Mesial	Male	30	55.1803	2.98655	.54527	7.68767	<0.001**
	Female	30	47.4927	4.10643	.74973		
IPW (Pont's index)	Male	30	37.7232	1.63681	.31500	1.87769	0.001*
	Female	30	35.8455	2.22189	.40566		
IMW (Pont's index)	Male	30	53.1533	4.13337	.75465	8.71633	<0.001**
	Female	30	44.4370	1.86881	.34120		

Table 3Cshows intergender comparison of Maxillary Dental arch width in model study of Hyperdivergent group Inter premolar width Buccal is nonsignificant (p≤0.099).

Intercaninewidth,Inter premolar width Palatal, Inter premolar width Distal, Inter premolar width (Pont's index)Males have greater interpremolar width except in buccal aspect. Intermolar width (mesiobuccal), Intermolar width Mesiopalatal, Intermolar width Buccal, Intermolar width Central, Intermolar width Mesialand Intermolar width (Pont's index) is highly significant (p<0.001**).

Intercanine width, Interpremolar width except in buccal aspect and Intermolar width is greater in Malesis significant (p≤0.001*).

Calculated interpremolar and intermolar width is higher in Males.

Mandava Prasad *et al* (2013)[4] stated that one genetic factor is patient's ethnic background and concluded that the relationship is found to be an inverse relation in both males and females of untreated South Indian adults, as MP‑SN angle increased, the dental arch widths tended to decrease. A generalized prediction is done for the dental arch widths with a given SN‑MP. The dental arch widths of males were found to be wider than females among untreated South Indian adults.

Sadia ShabbirJumani, Gul-E-Erum and Imtiaz Ahmed (2014)[5]stated relationship is found to be an inverse relation in both males and females of untreated Pakistani adults, as MP-SN angle increased, the dental arch widths tended to decrease. Secondly, the dental arch widths of males were found to be wider than females among untreated adults.

C. Matthew Forster, Elaine Sunga and Chun-Hsi Chung (2008)[3] stated that the dental arch widths in males were significantly greater than those in females.

R. Ferro *et al* (2017)[6] stated that males exhibit higher dental arch values in comparison to females.

Table IV Intergroup comparison of Maxillary dental arch width in vertical facial morphology groups. (ANOVA)

Parameter	N	Hypodivergent		Normodivergent		Hyperdivergent		F value	P value
		Mean	SD	Mean	SD	Mean	SD		
ICW	60	34.8928	2.98957	37.2475	1.88598	34.6414	2.34314	20.683	<0.001**
IPW Buccal	60	42.3788	2.67316	44.3310	2.59557	42.1097	2.19384	14.149	<0.001**
IPW Palatal	60	30.9693	3.04233	34.6745	2.87163	35.8678	3.40396	40.374	<0.001**
IPW Distal	60	36.7692	3.14245	36.5139	2.91326	38.5857	3.09296	8.225	<0.001**
IMW MB	60	52.0755	2.87524	46.9138	6.61107	53.1627	3.44233	31.434	<0.001**
IMW MP	60	39.2992	2.35294	45.1637	2.94769	42.9040	4.24825	48.796	<0.001**
IMW Buccal	60	54.9328	2.80612	52.8638	4.40138	54.6697	4.83581	4.510	0.012*
IMW Central	60	45.8317	2.03996	45.2295	2.75266	50.3647	4.62153	42.856	<0.001**
IMW Mesial	60	45.8463	2.04357	44.9476	2.05277	51.3365	5.26290	59.195	<0.001**
IPW (Pont's index)	60	36.4675	2.02970	37.1719	1.86699	36.7350	2.16682	1.713	0.184 NS
IMW (Pont's index)	60	45.8097	1.94976	44.0113	2.67594	48.7952	5.42492	25.771	<0.001**

Table 4shows intergroup comparison of Maxillary Dental arch width parameters in vertical facial morphology groups (ANOVA).

- Inter canine width, Interpremolar width Buccal, Interpremolar width Palatal, Interpremolar width Distal, Intermolar width Mesiobuccal, Intermolar width Mesiopalatal, Intermolar width Central, Intermolar width Mesial and Intermolar width (Pont's index) is highly significant.
- Intermolar width Buccal is statistically significant.
- Inter premolar width (Pont's index) is nonsignificant.

Table V Individual group wisecomparison of Maxillary dental arch width with vertical facial morphology (Post Hoc- Tuckey LSD test)

Parameter	Comparison between		Mean Difference (I-J)	Std. Error	Sig.
ICW	Hypo	Normo	-2.35465*	.44702	<0.001**
		Hyper	.25138	.44702	0.840 NS
	Normo	Hyper	2.60603*	.44702	<0.001**
IP Buccal	Hypo	Normo	-1.95217*	.45577	<0.001**
		Hyper	.26917	.45577	0.825 NS
	Normo	Hyper	2.22133*	.45577	<0.001**
IP Palatal	Hypo	Normo	-3.70517*	.56852	<0.001**
		Hyper	-4.89850*	.56852	<0.001**
	Normo	Hyper	-1.19333	.56852	0.093 NS
IP Distal	Hypo	Normo	.25533	.55706	0.891 NS
		Hyper	-1.81650*	.55706	0.004*
	Normo	Hyper	-2.07183*	.55706	0.001*
IM Most Buccal	Hypo	Normo	5.16167*	.84211	<0.001**
		Hyper	-1.08717	.84211	0.402 NS
	Normo	Hyper	-6.24883*	.84211	<0.001**
IM Palatal	Hypo	Normo	-5.86450*	.59882	<0.001**
		Hyper	-3.60483*	.59882	<0.001**
	Normo	Hyper	2.25967*	.59882	0.001*
IM Buccal	Hypo	Normo	2.06900*	.75005	0.018*
		Hyper	.26317	.75005	0.934 NS
	Normo	Hyper	-1.80583*	.75005	0.045*
IM Central Groove	Hypo	Normo	.60217	.60642	0.582 NS
		Hyper	-4.53300*	.60642	<0.001**
	Normo	Hyper	-5.13517*	.60642	<0.001**
IM Mesial	Hypo	Normo	.89871	.63708	0.338 NS
		Hyper	-5.49017*	.63440	<0.001**
	Normo	Hyper	-6.38887*	.63708	<0.001**
IPW	Hypo	Normo	-.70438	.38457	0.163 NS
		Hyper	-.26747	.38289	0.765 NS
	Normo	Hyper	.43691	.38115	0.487 NS
IMW	Hypo	Normo	1.79833*	.67365	0.023*
		Hyper	-2.98550*	.67082	<0.001**
	Normo	Hyper	-4.78383*	.67365	<0.001**

Table 5 shows individual group wise comparison of Maxillary Dental Arch Width with vertical facial morphology.

All the parameters are highly significant (p≤0.001*)

- Intercanine width is more in normo followed by hypo and hyper
- Interpremolar width (buccal) is more in normo than hypo and hyper and interpremolar width (palatal, distal and calculated (Pont's)) is more in hyper than normo and hypo.
- Intermolar width (mesiobuccal, central groove, mesial and calculated (Pont's)) is more in hyper than hypo and normo, intermolar (mesiopalatal) is more in normo than hyper and hypo and intermolar (most buccal) is more in hypo than hyper and normo.

Table 6A shows intergender comparison of Mandibular Dental arch width in model study of Hypodivergent group

Intercanine width (p≤0.001**), Interpremolar width (buccal) is highly significant (p≤0.001 *). Females have greater width than in males.

Intermolar width (mesiobuccal) (p≤0.083), Intermolar width (mesiolingual) (p≤0.215), Intermolar width (buccal) (p≤0.918), Intermolar width (central) (p≤0.751) isNon significant.
Females have greater intercanine and interpremolar width (buccal) but no gender difference is found in intermolar width.

Table VI A Intergender comparison of Mandibular Dental arch width in model study of Hypodivergent group.

Parameter	Gender	N	Mean	S.D.	Std. Error Mean	Mean Difference	P value
ICW	Male	30	25.4593	2.93853	.53650	-4.60267	<0.001**
	Female	30	30.0620	4.12623	.75334		
IPW Buccal	Male	30	34.3770	2.11990	.38704	-2.46833	<0.001**
	Female	30	36.8453	1.72660	.31523		
IMW Mesio Buccal	Male	30	45.3487	2.41373	.44068	-1.22237	0.083 NS
	Female	30	46.5710	2.89903	.53834		
IMW Mesio Lingual	Male	30	33.9452	2.24966	.41073	-.67511	0.215 NS
	Female	30	34.6203	1.85805	.34503		
IMW Buccal	Male	30	49.6473	5.91528	1.07998	-.12749	0.918 NS
	Female	29	49.7748	3.12858	.58096		
IMW Central	Male	30	40.6070	2.17310	.39675	-.20783	0.751 NS
	Female	30	40.8148	2.80226	.52037		

Table VI B Intergender comparison of Mandibular Dental arch width in model study of Norm divergent group

Parameter	Gender	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	P value
ICW	Male	30	36.99	1.47824	.26989	2.91233	<0.001**
	Female	30	34.07	2.27991	.41625		
IPW buccal	Male	30	36.68	3.51071	.64096	3.12800	<0.001**
	Female	30	33.55	2.31616	.42287		
IMW MesioBuccal	Male	30	37.56	1.93827	.35993	-2.99472	<0.001**
	Female	30	40.55	2.15750	.39390		
IMW Mesio Lingual	Male	30	36.27	1.91422	.34949	-.09020	0.888 NS
	Female	30	36.36	2.90653	.53066		
IMW Buccal	Male	30	45.63	2.26636	.41378	-.20267	0.723 NS
	Female	30	45.83	2.14399	.39144		
IMW Central	Male	30	42.10	2.59826	.47437	-.65267	0.329 NS
	Female	30	42.75	2.53631	.46306		

Table 6 B shows intergender comparison of Mandibular Dental arch width in model study of Normodivergent group.
Intercanine width, Interpremolar width (buccal) and Intermolar width (mesiobuccal) is highly significant (p≤0.001**).
Intermolar width (mesiolingual) (p≤0.888), Intermolar width (buccal) (p≤0.723), Intermolar width (central) (p≤0.329) is nonsignificant.

Males have greater intercanine and interpremolar (buccal) but intermolar (mesiobuccal), females have greater width. No gender difference is found in other intermolar width.

R. Ferro *et al* (2017)[6] stated that males exhibit higher dental arch values in comparison to females.

C. Matthew Forster, Elaine Sunga and Chun-Hsi Chung (2008)[3] found that the dental arch widths in males were significantly greater than those in females.

Mandava Prasad *et al* and Sadia ShabbirJumani, Gul-E-Erum and Imtiaz Ahmed (2013)[4] stated that the dental arch widths of males were found to be wider than females among untreated South Indian adults and Pakistani patients respectively.

Table VI C Intergender comparison of Mandibular Dental arch width in model study of Hyper divergent group

Parameter	Gender	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	P value
IPW	Male	30	31.08	1.83555	.33512	1.30300	0.070 NS
	Female	30	29.78	3.40719	.62206		
IPW buccal	Male	30	34.39	2.05240	.37472	-.37615	0.482 NS
	Female	30	34.76	2.02694	.37639		
IMW Mesio Buccal	Male	30	42.52	2.32869	.42516	2.95583	0.001*
	Female	30	39.56	3.92587	.71676		
IMW Mesio Lingual	Male	30	37.52	1.89301	.35152	-.11600	0.831 NS
	Female	30	37.64	2.25153	.41107		
IMW Buccal	Male	30	44.80	2.24270	.40946	3.60700	<0.001**
	Female	30	41.19	3.49547	.63818		
IMW Central	Male	30	40.93	1.62657	.29697	1.64500	0.011*
	Female	30	39.29	3.03010	.55322		

Table 6C shows intergender comparison of Mandibular Dental arch width in model study of Hyperdivergent group

Intercanine width (p≤0.070), Interpremolar width (buccal) (p≤0.482), Intermolar width (mesiolingual) (p≤0.831) is non significant.Intermolar width (mesiobuccal), Intermolar width (buccal) is highly significant (p≤0.001**)

Intermolar width (central) is significant but to lesser extent (p≤0.011*).No gender difference for intercanine and interpremolar width. Males have more intermolar width except intermolar width (mesiolingual).

Table 7shows intergroup comparison of Mandibular Dental arch width parameters in vertical facial morphology groups (ANOVA).

Inter canine width, Intermolar width Mesiobuccal, Intermolar width Mesiolingual, Intermolar width Buccal, Intermolar width Central is statistically highly significant.

Interpremolar width Buccal is nonsignificant.

Table VII Intergroup comparison of Mandibular dental arch width parameters in vertical facial morphology group (ANOVA)

Parameter	N	Hypodivergent		Normodivergent		Hyperdivergent		F value	P value
		Mean	SD	Mean	SD	Mean	SD		
ICW	60	27.76	4.24	35.53	2.41	30.43	2.79	88.790	<0.001**
IPW buccal	60	35.61	2.29	35.11	3.34	34.57	2.03	2.337	0.100 NS
IMWMesio Buccal	60	45.95	2.71	39.08	2.53	41.04	3.53	84.346	<0.001**
IMW Mesio lingual	60	34.28	2.08	36.32	2.44	37.58	2.07	33.807	<0.001**
IMW Buccal	60	49.71	4.71	45.73	2.19	43.00	3.43	52.558	<0.001**
IMW Central	60	40.71	2.48	42.43	2.57	40.11	2.55	13.529	<0.001**

Table VIII shows individual group wise comparison of Mandibular dental arch width with vertical facial morphology (Post- hoc tuckey LSD test).

Parameter	Comparison between		Mean Difference (I-J)	Std. Error	Sig.
ICW	Hypo	Normo	-7.76817*	.59234	<0.001**
		Hyper	-2.67083*	.59234	<0.001**
	Normo	Hyper	5.09733*	.59234	<0.001**
IP Mesiobuccal	Hypo	Normo	.49717	.47816	0.300 NS
		Hyper	1.03795*	.48018	0.032*
	Normo	Hyper	.54078	.48018	0.262*
IP Buccal	Hypo	Normo	6.86927*	.54511	<0.001**
		Hyper	4.91107*	.54284	<0.001**
	Normo	Hyper	-1.95820*	.54284	<0.001**
IM Mesiolingual	Hypo	Normo	-2.04170*	.40386	<0.001**
		Hyper	-3.30388*	.40555	<0.001**
	Normo	Hyper	-1.26218*	.40386	0.002*
IM Buccal	Hypo	Normo	3.97667*	.65806	<0.001**
		Hyper	6.71183*	.65806	<0.001**
	Normo	Hyper	2.73517*	.65529	<0.001**
IM Central	Hypo	Normo	-1.71785*	.46452	<0.001**
		Hyper	.60132	.46452	0.197*
	Normo	Hyper	2.31917*	.46257	<0.001**

Table 8 shows individual group wise comparison of Mandibular Dental arch width with vertical facial morphology.

All the parameters are highly significant ($p \leq 0.001$**)

Amit Kumar Khera et al (2012)[7] mandibular 1st intermolar width is least in hyperdivergent.

Genetic and environmental factors, with skeletal, dental or functional repercussions is responsible dental arch width variations stated byHemamaliniBalaji by 2017[8]

Increased loading of the jaws from masticatory muscle hyperfuction might lead to increased sutural growth and bone apposition, resulting in increased transversal growth of the maxilla and broader bone bases for the dental arches by Wagner and Chung in 2005[9]

Mandibular dental arch width also shows variation intercanine width is less in hypo and hyper than normo, Interpremolar width is more in hypo than normo and hyper andintermolar width (mesiobuccal and buccal) is more in hypo followed by hyper and normo, intermolar (mesiolingual) is more in hyper than normo and hypo and intermolar (central) is more in normo than in hypo and hyper.

Mandava Prasad et al (2013)[4] stated the relationship is found to be an inverse relation in both males and females of untreated South Indian adults, as MP‑SN angle increased, the dental arch widths tended to decrease. A generalized prediction is done for the dental arch widths with a given SN‑MP. The dental arch widths of males were found to be wider than females among untreated South Indian adults.

Sadia ShabbirJumani and Gul-E-Erum, Imtiaz Ahmed (2014)[5]stated relationship is found to be an inverse relation in both males and females of untreated Pakistani adults, as MP-SN angle increased, the dental arch widths tended to decrease. Secondly, the dental arch widths of males were found to be wider than females among untreated adults.

For Maxillary and Mandibular Dental arch Width

Accordingto Amber Farooq, Amjad Mahmood and Abdul Jabbar (2015)[10] as SN-MP angle increased inter canine width tended to decrease in both maxilla and mandible with nonsignificant gender difference. There is significant but weak correlation of SN-MP angle with inter canine width.

Amber Farooq, Abdul Jabbarb and Afeef Umar Zia (2016)[11]stated that in both males and females, as SN-MP angle increased; arch width tended to decrease at inter pre-molar and inter-molar areas. P value is significant at 0.05 level in comparison of SN-MP angle with inter first pre-molar width and Inter-molar width in maxilla and mandible in low, normal and high SN-MP angle categories.

R. Ferro et al (2017)[6] stated that small variations in upper and lower intercanine width while higher variations were observed in the upper intermolar width.

SUMMARY AND CONCLUSION

Dentofacial pattern of every individual is different and consists of many variations. Evaluating the relationship between the dental arch and vertical facial morphology is imperative in order to understand the variation in size and shape of the dental arches.

Following Conclusions were drawn from the study

Sexual dimorphism found incephalometric parameters

Males have higher anterior facial height, posterior facial height, Jarabak's ratio and GoGn to SN than females in hypodivergent and normodivergent growth pattern.

Sexual dimorphism for Maxillary Dental arch width

Hypodivergent group - females had greater interpremolar width (palatal), Intermolar width (mesiobuccal) and Intermolar width (buccal).

Normodivergent group - males had greater interpremolar width (palatal), Intermolar width (mesiobuccal) and Intermolar width (buccal). Females had more calculated intermolar width (Pont's index).

Hyperdivergent group - males had greater intercanine width, interpremolar width except in buccal aspect and greater intermolar width.

Sexual dimorphism for Mandibular Dental arch width

Hypodivergent group- females had greater intercanine and interpremolar width (buccal) but no gender difference was found in intermolar width.

Normodivergent group- males had greater intercanine and interpremolar (buccal) but females had greater intermolar (mesiobuccal) width. No gender difference was found in other intermolar width.

Hyperdivergent group - no gender difference for intercanine and interpremolar width. Males had more intermolar width except intermolar width (mesiolingual).

On comparingMaxillary Dental arch width in vertical facial morphology groups.

- Hyperdivergent had more interpremolar (palatal and distal), intermolar with (mesiobuccal, central and mesial) and calculated intermolar width (Pont's index).
- Normodivergent had moreintercanine, interpremolar (buccal) and intermolar (mesiopalatal).
- Hypodivergent had moreintermolar width (buccal).

On comparing Mandibular Dental arch width in vertical facial morphology groups.

- Hypodivergent had more Interpremolar (buccal), intermolar (mesiobuccal and buccal).
- Normodivergent had more intercanine and intermolar (central) width.
- Hyperdivergent had more intermolar (mesiolingual) width.

Arch shape(U, V and square shape) was non-significant in all groups of vertical facial morphology..
Dental arch width is susceptible to vary along with vertical facial morphology

Bucco-lingual inclination and width, Arch shape, Rotations, type of Occlusion & alveolar growth could be probable contributing factors for disparity in dental arch width.

Correct identification of a patient's dental arch width and arch form is an important aspect for achieving a stable treatment result, failure to preserve the arch integrity might increase the probability of relapse. Improper shape of arch wire can result in periodontal breakdown, recurrence of crowding particularly when inter‑canine width and inter-molar width have been expanded. So, individual customization of arch wire should be preferred for particular patient.

Further study can be advocated to overcome the limitations of present study with more sample size and other growth parameters which influence the dento-facial framework along with sagittal discrepancy indicators.

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