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Analysis of the Skeletal Pattern and Mandibular Symphyseal Architecture in Pakistani Adults

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Abstract

Introduction: The aim of this study is to ascertain the height, thickness, and height-to-thickness ratios of the mandibular symphysis with different sagittal and vertical patterns.

Methodology: This cross-sectional study examined 101 lateral cephalograms of untreated orthodontic patients. Adults (18 to 45 years) of either gender who had lateral cephalograms were included. All cephalograms were traced and examined by a single researcher. Anteroposterior (AP) & vertical skeletal measurements were taken in all participants in relation to symphyseal height, thickness, & ratio between height & thickness. SPSS-26 was used for data analysis.

Results: A non-significant difference was found in anteroposterior and vertical skeletal measurements among males and females. There were no major variations in symphyseal dimensions when analyzed with respect to the anteroposterior skeletal classification (ANB°). Significant associations between the three symphyseal measures and Gonial angle were found in males.

Conclusions: Males had higher mean symphyseal vertex, thickness, & height-thickness ratio than females. AP skeletal categorization was not substantially correlated with symphyseal height, thickness, or ratio (ANBo).Significant relationships existed between Gonial angle & symphyseal height, thickness, & ratio.

Keywords: Cephalometric radiography, height, skeletal anteroposterior, symphyseal measurement, thickness

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Introduction

The mandibular symphysis [MS] is a vital part of mandibular anatomy and is crucial in determining profile of the patients.MS morphology also has an important part in diagnosis and treatment planning of orthodontic patients. MS is important for orthodontic treatment because it defines the limit of orthodontic tooth movement.[1,2]

The tooth movement should occur within the boundaries of MS without causing damage to adjacent supporting structures. However, some unfavorable outcomes following orthodontic treatment have been documented, particularly at the mandibular anterior region, including decreased alveolar bone thickness (ABT), bony dehiscences, and cortical plate perforation. Additionally, the initial thickness is correlated with the severity of alveolar bone loss following orthodontic treatment. Along with facial type, alveolar bone thickness varies. Therefore, the alveolar bone's consistency is regarded as the limit for tooth

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movement, and going beyond it could have a detrimental effect on the bony support.[3,4]

It has been found that the mandibular symphysis grows differently from childhood to adulthood in both genders. The symphyseal dimensions of males change more significantly and later than those of females. With age, the ratio between symphysis height and thickness increase. Bjork's criteria for determining the pattern of mandibular rotation includes assessment of symphyseal architecture during growth. When symphyses are long and narrow, mandibular rotation during growth tends to be mostly vertical; when they are short and wide, it tends to be mostly horizontal. In the vertical pattern, it has been observed that mandibular symphysis has greater lingual inclination. In determining the morphology of the chin, the symphysis ratio is important. According to the previous studies, a smaller symphysis ratio indicates a prominent chin and found more common in increasing ratios indicate receding chins in males.[1,4,5]

Sagittal growth patterns also have an impact on the symphyseal architecture. The morphology and size of MS may be affected by dentoalveolar compensation that takes place during the growth phase as a result of sagital discrepancy. The AP position of the mandible and, subsequently, the MS may be indirectly impacted by the vertical growth direction. [4,6] The relationship between MS architecture & various skeletal jaw variations has been the subject of numerous researches. However, these researches revealed both similarities and differences.[2,6-11]

The primary aim of this study is to measure the height, thickness, and ratio of symphyseal architecture with different sagital and vertical skeletal patterns. A secondary objective is to determine if the morphology of the symphysis can predict the skeletal patterns.

Methodology

This prospective cross-sectional study was carried out over a period of 06 months (1st January, 2022 to June, 2022) at the Humdard College of Medicine and Dentistry. The research was reviewed & approved by IRB at same institution. A total of one hundred one (101) patients presented in the outpatient department were included in our study after taking written informed consent. The non-probability sampling technique was used. The openepi calculator was used to calculate the sample size keeping the prevalence of malocclusion i.e.93%,[12] margin of error = 5% and 95% confidence interval, then calculated sample size was 101.Both males and females with skeletal malocclusions between the ages of 18 and 45 were evaluated. Patients having any craniofacial disorders, abnormalities, trauma, prior orthodontic therapy, orthognathic surgery, or mandibular injuries were expelled from research.

The study was started after the approval of IRB. Written informed consent was signed by selected patients. Both a clinical examination and the patient's medical history were obtained.

The patient's Frankfurth horizon plane was parallel to the floor during the lateral cephalogram, and the mandible was in central occlusion with the unstrained lips. All lateral cephalograms were traced manually using a black lead pencil, mm ruler and soft eraser.

It was conducted using SPSS, 26. According to Kolmogorov-Smirnov tests, data were usually distributed. Each independent factor &dependent variables were evaluated using the Pearson correlation coefficient. According to ANBo values, an association between AP skeletal classification & symphyseal variables were considered. The strength of association was determined using Spearman's correlation. For symphyseal measurements, means &standard deviations were computed & summarized. An independent sample t-test ($P<0.05$) was used to examine the differences between genders in MS dimensions.

Result

In this study, one hundred one patients with skeletal malocclusion were included. 62 (61.3%) were male and 39 (38.6%) were female. Table I: presents the average skeleton dimensions by gender. Statistically insignificant gender based difference were observed for anteroposterior and vertical skeletal measurements as P-value = > 0.05. It also explains that there are almost no differences in symphysis height, thickness, or ratio by gender, although women tend to have smaller symphyses. As P > 0.05.

Table II: demonstrates the measurements for each skeleton class. Symphysis dimensions and skeletal morphology are related.

Table III: demonstrates the relationships between various skeletal metrics and the dimensions of the symphysis. SNAo and symphyseal height and thickness were correlated statistically significantly but insignificantly in females and males. Significant associations between the three symphyseal measures and Gonial angle were found in males.

Table IV: demonstrates the relationship between the three symphyseal dimensions and the ANB° classification of the anteroposterior skeleton. There were no statistically significant correlations among the variables.

Variable	Gender	Mean ± SD	P-value
ANB°	Male	3.29±2.6	0.003
	Female	1.37±3.15	
SNB°	Male	78.3 ± 3.8	0.366
	Female	77.6± 3.8	
SNA°	Male	81.03 ± 5.0	0.75
	Female	81.6 ± 4.5	
SNMP°	Male	33.05 ± 6.7	0.432
	Female	31.79 ± 12.4	
Ar-Go-Me°	Male	9.11 ± 2.56	0.226
	Female	8.46 ± 2.8	
Symphyseal height, mm	Male	31.53 ±5.4	0.298
	Female	30.41±5.1	
Symphyseal thickness, mm	Male	15.11 ± 2.9	0.133
	Female	14.15 ± 3.2	
Height/thick ratio, %	Male	2.4 ±1.5	0.23
	Female	2.1 ± 0.5	

Table I: Mean vertical, anteroposterior skeletal measures and symphyseal measurements with respect to gender

Variable	Class	n	Mean ± SD
Symphyseal height, mm	Class-I	33	29.1±2.3
	Class-II	31	29 ±2.5
	Class-III	37	30.5 ± 5.3
Symphyseal thickness, mm	Class-I	33	14.2±3.3
	Class-II	31	14.58±3.7
	Class-III	37	14.63 ±3.1
Height/thick ratio, %	Class-I	33	1.85± 1
	Class-II	31	1.9± 1
	Class-III	37	2.25 ± 1

Table II: Mean symphyseal dimensions in each skeletal dysplasia

Symphyseal measurement	Correlation	ANB°	SNA°	SNB°	SNMP°	Ar-Go-Me°
Females (n=62)						
Symphyseal height	R	0.208	0.35	0.19	0.18	-0.05
	p-value	0.210	0.021	0.115	0.16	0.751
Symphyseal thickness	R	0.006	0.4	0.206	-0.29	-0.1
	p-value	0.972	0.021	0.843	0.023	0.751
Height/ thickness ratio	R	-0.152	-0.266	-0.14	0.242	0.06
	p-value	0.362	0.107	0.367	0.061	0.721
Males (n=39)						
Symphyseal height	R	0.1	0.13	0.101	-0.101	0.37
	p-value	0.52	0.347	0.545	0.545	0.012
Symphyseal thickness	R	0.1	0.148	0.149	-0.149	-0.49
	p-value	0.19	0.374	0.371	0.371	0.001
Height/ thickness ratio	R	-0.152	-0.26	-0.028	0.028	0.66
	p-value	0.362	0.107	0.867	0.867	< 0.001

Table III: Correlations between symphyseal measurements and skeletal pattern

A-P Skeletal pattern	Correlation	Symphyseal height	Symphyseal thickness	Height/thick ratio
Class I (N = 33)	r	0.04	0.06	0.003
	p-value	0.831	0.8	1.0
Class II (N = 31)	r	0.061	0.1	-0.041
	p-value	0.77	0.55	0.9
Class III (N = 37)	r	0.3	0.2	-0.1
	p-value	0.11	0.3	0.7

Table IV: Correlations between sagittal skeletal classification and symphyseal measurements

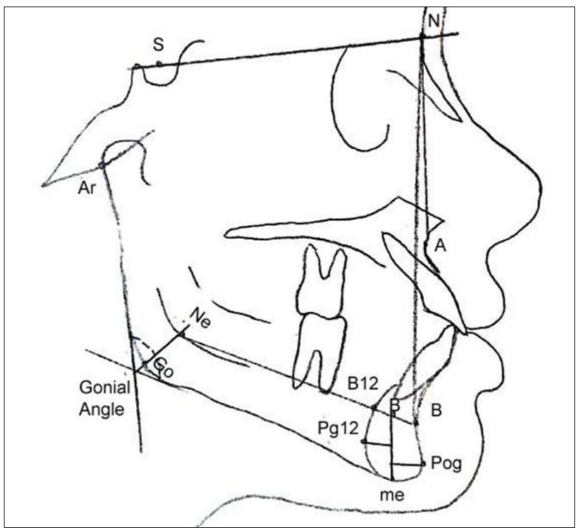

Fig. I: S,sella; N,nasion; Pog,pogonion; Me,menton; Go,gonion; Ar,aticulare; Ne,nerve;

Discussion

This study explains the relationship between various sagittal and vertical skeletal patterns and symphyseal measurements (height, thickness, and height/thickness ratio).[13]The mean symphyseal height was shown to be sexually dimorphic in this study. Males (21.22 mm) had a higher mean symphyseal height than females (18.25 mm). Another study by Gómez Y et all found that males had bigger symphyseal vertical dimensions than females also correlate findings of this study.[14]Additionally, height to thickness ratio in both males & females was nearly 1.5, indicating that, on average, height is 1.5x higher than thickness. This contradicts prior research that showed symphysis ratio is less in men than in women.[15]The mean symphyseal ratio was higher in female samples.[16] This may be explained by ethnicity difference.[17]

The association between the size of the symphyses and the anteroposterior skeletal arrangement was investigated in this study. Except for SNA°, there was no correlation among other variables in either gender. This variable did not correlate with ratio (H/T) in females but has a marginal to marginally significant correlation with symphyseal height &thickness.. This contradicts Torgut and Akan's[18] finding that symphyseal vertical growth is inversely correlated with ANB°.[19]

When ANB° was evaluated, correlations among ANB° values and symphysis height, thickness and ratio were found to be statistically non-significant. Study by Ricardina Nobre et al[16] symphysis width was significantly greater in class 2 div 2 subjects.[20]

In comparison to females (P = 0.721), we found a strong positive association between the Gonial angle & symphysis ratio in males (P 0.001). This was predicted since the symphysis ratio, which is calculated as height divided by thickness, would be higher in hyperdivergent people. Aki et al[15] also revealed that those with receding chins have a higher symphysis ratio, Gonial angle, and both lower and anterior face height.[21]

A substantial inverse relationship between the Gonial angle and symphysis thickness was observed (P = 0.001). The Previous study by I˙smailCeylan et all[22] also explain this relationship. The masseter muscle hyper function may be responsible for the increase in thickness.[23]

Study by Marghalani HYA et all[1] also supports our finding of negative correlation between gonial angle and symphyseal thickness.[24]

Limitations: The study did not evaluate the structures in all three dimensions; instead, it used 2D lateral cephalograms.[25] Which is the limitation of our study. Additionally, the study's sample size was small because of the strict inclusion criteria used. Future large-scale 3D studies are necessary to verify findings & assess added factors in relation to symphyseal measurements.

It is recommended to conduct additional research on Gonion-Nerve in people with various AP skeletal patterns in order to completely comprehend this relationship. The morphological characteristics of MS were clarified by this research.

Conclusion

According to the study's findings: Males had considerably higher mean symphyseal height, thickness, & height-thickness ratio than females. AP skeletal categorization was not substantially correlated with symphyseal height, thickness, or ratio (ANBo). Significant relationships existed between Gonial angle & symphyseal height, thickness, & ratio. Future large-scale 3D studies are necessary to verify findings & assess added factors in relation to symphyseal measurements.

Ethical Approval

The study was approved by the Ethical Review Board of Humdard College of Medicine and Dentistry. (No. ERC/BDS/016/2022)

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This study received no grant from any funding agency, commercial, or not-for-profit sectors.

Conflict of Interest

It is declared that the authors don't have any conflict of interest.

Authors' Contribution

AF: conception, design, supervision, analysis and/or interpretation, literature review, critical review

QA: conception, design, materials, analysis and/or interpretation, writer

AN: supervision, materials, data collection and/or processing, critical review

SR: supervision, data collection and/or processing, literature review, writer

SAW: Write up

SSH: supervision, data collection and/or processing, literature review, critical review

ZB: Write up

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