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CORRELATION OF MANDIBULAR SYMPHYSIS MORPHOLOGY AND DIMENSIONS WITH CRANIOFACIAL PARAMETERS IN DIFFERENT TYPES OF SKELETAL MALOCLUSSION IN HIMACHAL POPULATION

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ABSTRACT **Aim:** To assess the correlation of Mandibular Symphysis (MS) morphology and dimensions with craniofacial parameters in different types of skeletal malocclusion in Himachal population. **Materials and Methods:** One hundred and forty lateral cephalograms (70 females and 70 males with mean ages of 22.3 ± 2.9 years and 22.5 ± 2.6 years,respectively) of subjects with Class I, Class II, and Class III skeletal relationships were traced. The craniofacial and mandibular symphysis parameters were measured using Autocad software. **Statistical Analysis:** All mandibular symphysis parameters were compared between the three groups using independent t-test and were correlated with the craniofacial parameters using the Pearson correlation coefficient. **Results:** Mandibular symphysis dimensions and area were found to be larger in Class III skeletal relationship compared to Class I and Class II; concavity angle of the chin, inclination of the alveolar part of the mandibular symphysis toward the mandibular plane were also found to be larger in Class III group. **Conclusions:** The concavity angle, the vertical dimension, the inclination of alveolar part of mandibular symphysis was more in the Skeletal Class III pattern. So, the dimensions and morphology of Mandibular symphysis in the Class III relationship were different than those in Class I and Class II relationships.

KEYWORDS :

INTRODUCTION

The mandibular symphysis is the most important anatomical structure of the mandible serving as a primary reference for esthetic considerations in the lower third of the face.[1] It contributes to the composition and balance of facial harmony, hence should be considered while making decisions during orthodontic treatment.[2] The mandibular symphysis is associated not only with the orthodontic treatments but also is associated with the types of malocclusion[3], mandibular growth[4] and inclination of lower incisors.[5]

One of the important factors in orthodontic treatment planning is the position of the lower incisors to the supporting bone, which further is important for the assessment of treatment progress and treatment outcome.[6] Morphologically, the mandibular symphysis can be divided into two regions, the dentoalveolar and the basal symphysis. Lower incisors and the alveolar process constitute the dentoalveolar symphysis whereas the basal symphysis is the part of the main body of the mandibular symphysis, located apically, setting the hard menton outline.[2] The vertical and sagittal positions of the lower incisors and the mental protruberance are important determinants in planning occlusal and skeletal relations for orthodontic treatment and orthognathic surgical procedures. Therefore, an understanding of the structure and function of basal and alveolar bone is essential.[1]

The long axis of the lower incisors cephalometrically matches the long axis of the alveolar process and its inclination is influenced by facial type. This classical concept dates from the tweed era and defines the lingual inclination of the alveolar long axis (IMPA) in subjects with a high mandibular plane (FMA), while in subjects with low mandibular planes, the long axis is more buccally tipped. According to this view, the positioning error of the lower incisors could compromise the stability of orthodontic results and facial esthetics.[6]

Inclination of the lower incisors may indirectly affect the shape of mandibular symphysis during the growth period; dentoalveolar compensation occurring during that period as a result of anteroposterior (AP) jaw discrepancy might be reflected in the morphology and dimension of mandibular symphysis. Vertical growth direction may have an indirect effect on the Anteroposterior position of the mandible and, subsequently, on mandibular symphysis. However, no studies have been done to investigate the relationship between Mandibular symphysis and Anteroposterior jaw discrepancies in Himachali population.[11] So, the aim of this study was to assess the morphology and dimensions of the mandibular symphysis in different anteroposterior skeletal jaw relationships in Himachal population and the correlation of different craniofacial parameters with its shape and/or dimensions.

MATERIALS & METHODS

This study was conducted in Department of Orthodontics and Dentofacial Orthopaedics, Himachal dental college, Sundernagar. One hundred and forty (70 females and 70 males with mean ages of 22.3 ± 2.9 years and 22.5 ± 2.6 years,respectively) were selected .The subjects were divided into three groups;Skeletal Class I, ClassII and Class III, according to **Steiner's**[12] ANB angle as follows:-

1. **GROUP I:-** Skeletal Class I (ANB angle = 2º ± 4º)(n= 50)
2. **GROUP II:-** Skeletal Class II (ANB angle >4º)(n=50)
3. **GROUP III:-** Skeletal Class III (ANB angle <2º)(n=40)

The inclusion criteria were as follows:

1. No history of orthodontic treatment, orthognathic surgery.
2. No history of craniofacial anomalies
3. No history of trauma to the mandible.
4. Maxillary to mandibular plane angle that was within normal limits (25.5º ± 5.3º)

METHOD

The criteria for selection of patients radiographs was from the pretreatment orthodontic records of patients attending the orthodontic clinics at the Himachal dental college. All Lateral cephalograms were taken in centric occlusion with lips in repose and Frankfort Plane Horizontal according to natural head position. All Lateral cephalograms were traced manually in a dark room using matt acetate tracing paper attached to the radiographs using 3H pencil (**Figure 1**). All Mandibular symphysis tracings were then scanned into a computer and processed through a custom-made software program. Magnification of linear distances due to scanning was compensated for by the software. When the image of mandibular symphysis appeared inside a special window of the software, it was possible to identify and digitize six points yielding to five angular and five linear measurements to describe the morphology and dimensions of mandibular symphysis. The area of mandibular symphysis was also assessed. All of the variables were measured by the Autocad software (**Figure 2**). The following cephalometric points and parameters were traced:-

Table 1: Definition of the Craniofacial and Dentoalveolar Cephalometric Parameters

Cephalometric Variables	Definition
SNA	Angle formed by intersection of Sella-Nasion and Nasion-A point
SNB	Angle formed by intersection of Sella-Nasion and Nasion-B point
ANB	Angle formed by intersection of Nasion-B point and Nasion-A point
L1/Md	Angle formed by intersection of long axis of the most prominent mandibular incisor and mandibular plane
UAFH	The distance from Nasion to Anterior nasal spine
LAFH	The distance from Anterior nasal spine to Menton point
TAFH	The distance from Nasion to Menton

Table 2:Definition of the Symphysis Points used in the study

Mandibular Symphysis Points and Parameter	Definition
Point B	The most posterior point on the profile of the mandible between the chin point and the alveolar crest
Pogonion(pog)	The most anterior point of the mandibular symphysis in the midline
Gnathion(gn)	The most anterior inferior point of the mandibular symphysis in the midline
Menton(me)	The lower most point of the mandibular symphysis in the midline
Point B1	A point formed by the intersection between a perpendicular line dropped from point B to the tangent drawn on the inner contour of mandibular symphysis at the shortest distance from point B
Point Id	The most anterior superior point of the labial mandibular alveolar crest, situated between the lower central incisors

Table 3:Showing the angular measurements of mandibular symphysis used in the study

B-B1-Gn	The angle between point B, point B1, and Gnathion; It gives an indirect reflection of the vertical dimension of the mandibular symphysis.
B-Pog-Me	The angle formed between point B, Pogonion, and Menton; It reflects the convexity of the mandibular symphysis.
Id-B-Pog	The angle between point Id, point B, and Pogonion; It reflects the concavity of the mandibular symphysis
Id-B/Md	The angle between a line connecting Id to Point B and the mandibular plane; It reflects the inclination of the alveolar part of the mandibular symphysis in relation to the mandibular plane.
B-Pog/Md	The angle between a line connecting Point B to Pogonion and the mandibular plane; It reflects the inclination of the skeletal part of the mandibular symphysis in relation to the mandibular plane.

Table 4:Showing the linear measurements of mandibular symphysis used in the study

Id-B	The linear distance from Id to point B
B-Pog	The linear distance from point B to Pogonion
Pog-Me	The linear distance from Pogonion to Me
Id-Me	The linear distance from Id to Me, representing the total length of Mandibular symphysis
Perpendicular distance from Pog to B-Me line	The perpendicular distance from Pogonion to the line connecting point B and Menton to represent the anterior prominence of Mandibular symphysis
Area,mm^2	The total area confined within the outer border of Mandibular symphysis and bounded superiorly by the line connecting Id and the most superior point of the lingual mandibular alveolar crest

Figure 1: showing mandibular symphysis points , parameters & craniofacial cephalometric parameters tracings done on lateral cephalogram

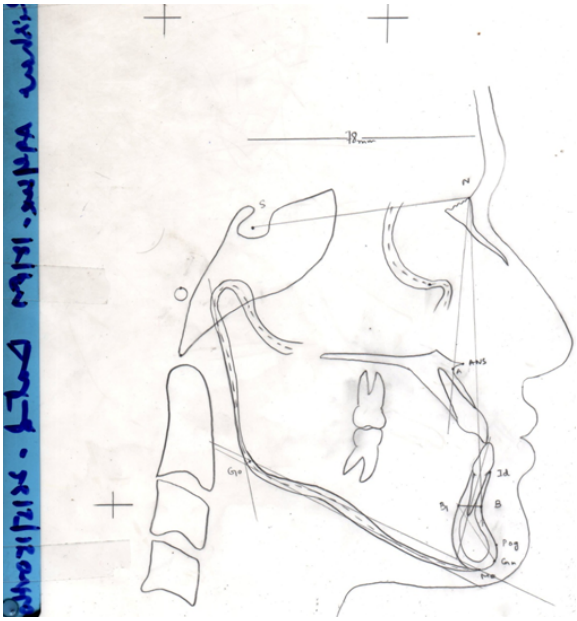
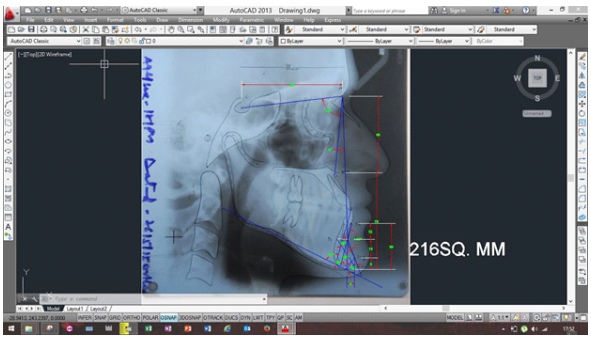


Figure 2: showing mandibular symphysis points , parameters & craniofacial cephalometric parameters done on AutoCAD software



RESULTS

Independent t- test was done to measure Mandibular Symphysis parameters in the three anteroposterior groups and differences between males and females. Pearson correlation coefficient- was done to assess the relationship between the Mandibular symphysis parameters and the craniofacial and dentoalveolar parameters.

DISCUSSION

For the orthodontic diagnosis and treatment planning, a clear understanding of Mandibular symphysis growth and morphology is useful, since the mandibular symphysis morphology changes with mandibular growth and orthodontic treatment. It has been observed that there is always camouflage of the underlying anteroposterior discrepancies by dentoalveolar compensation. The dentoalveolar compensation by the lower incisors leads to change in the morphology of the mandibular symphysis by surface remodelling.

The anteroposterior thickness of the alveolar bone in the symphysis region determines the distance available for the orthodontic movement of the incisors. The labiolingual inclination of the central incisor significantly correlates with the labiolingual inclination of the associated alveolar bone. So various mandibular symphyseal points and parameters were taken to correlate the morphology and dimensions of mandibular symphysis in various skeletal malocclusions.

In the present study ,the mean value of vertical dimension of mandibular symphysis .i.e B-B1-Gn in class I malocclusion was 62.5+4.73, in class II malocclusion was 58.6+5.7 and in class III malocclusion was 64.4+4.82 expressing the vertical dimension of mandibular symphysis was largest in Class III group and least in class

II group. When comparison was done between the different types of skeletal malocclusion it was found that the difference is significant in class I to Class II group and in Class II to Class III group($p<0.05$). This may be because most of the class III malocclusion has excessive lower facial height in adult patients which result in the downward and backward rotation of the mandible resulting in increase in the vertical dimension of the mandibular symphysis. This is in accordance with the study conducted by **Ellis E et al. (1984)**who reported that excessive lower facial height is a frequent finding in class III malocclusion.

The mean value of concavity of mandibular symphysis .i.e Id-B-Pog in class I was 148.9+7.1, in class II was 147.4+6.6 and in class III was 151.1+5. This may be because class III malocclusion showed the lesser anterior concavity of mandibular symphysis in hyperdivergent young adults. This in accordance with the study conducted by **Yamada et al. (2007)**Although the results were significant in all the groups. The mean value of Id-B/Md expressing the inclination of alveolar part of mandibular symphysis in relation to the mandibular plane in class I was 88.0+7.6, in class II was 90.7 +8 and in class III was 86.9+6.46. which showed that decreased angle in class III maloclussion results in greater inclination of alveolar part of mandibular symphysis as compared to class II malocclusion. This is in accordance with the study done by **Yamada et al(2007)** who reported that in Class III skeletal relationship there is compensation of skeletal discrepancy by retroclination of lower incisors. This compensation of lower incisors lead to surface remodelling of the outer surface of the mandibular symphysis to follow the inclination of lower incisors leading to its retroclination as well. Such retroclination of alveolar part of symphysis would result in less concavity of anterior contour of mandibular symphysis. The results of our study is also in favour of study conducted by **Quan Yu et al. (2009)**who also reported that the morphology of alveolar bone is affected by incisor inclination.

The convexity of the contour of the skeletal part of mandibular symphysis was evaluated by angular and linear parameters : the angle B-Pog-Me and the Perpendicular distance from Pog to B-Me line. The mean value of convexity of mandibular symphysis i.e. B-Pog-Me in Class I was 130.1+9.4, in class II was 137.5+8.5 and in class III was 132.2+7.7. The mean value of Perpendicular distance from Pog to B-Me line in class I was 4.28+0.38, in class II was 3.98+0.5, in class III was 4.56+0.93. Although the angular measurement was smaller in class III than in class II but no significant difference was seen between them. Linear measurement was larger in class III and smallest in class II. This may be because of the increase in the size of mandible in class III malocclusion resulting in the increase in the chin prominence in skeletal class III patients as comparison to class II patients. The results of our study is in accordance with the study conducted by **Mouakeh M (2001)** who reported that increased mandibular size in class III results in the decrease of the convexity of mandibular symphysis.

The mean value of skeletal inclination of mandibular symphysis (B-Pog/Md) in class I was 61.28+7.29, in class II was 62.48+7.10, in class III was 55.72+5.36. expressing the inclination of skeletal part of mandibular symphysis in relation to mandibular plane was lesser in Class III due to hyperdivergent growth pattern in class III adults but no significant difference between groups were found($p>0.05$) .

The mean value of the linear measurements of mandibular symphysis**(Id-B)** in class I was 10.32+3.06, in class II was11.45+3.57, in class III was 11.5+2.9. Of **(B-Pog)** in class I was 13.6+2.0, in class II was 13.7+2.4, in class III was 14.8+2.5. Of **(Pog-Me)** in class I was 10.1+1.84, in class II was 10.02+2.2, in class III was 11.08+1.92 and **(Id-Me)** in class I was 32.3+3.1, in class II was 34.1+2.8, in class III was 32.1+2.2. Now these linear measurements were found to be greater in Class III group. The mean value of Area of mandibular symphysis in class I was 441.4+76.9, in class II was 442.6+67.1, in class III was 452.9+56.0. Also the area of the mandibular symphysis is again greater in Class III group. This may be because most of the class III malocclusion has excessive lower facial height. As the lower facial height increases the total length of the mandibular symphysis also increases. This may be related to the dentoalveolar compensation in the vertical dimension resulting in the increase in the mandibular symphysis length. This is in accordance with the study conducted by **Buschang PH et al (1992) & Swasty D et al (2011)**. who also reported that the increase facial height will also result in the increased mandibular length.

The morphology and dimension of mandibular symphysis in males and females**,** exhibited greater mandibular symphysis in males than females. This is in accordance with the study done by **M.MallarChakravarty (2011)** who reported sexual dimorphism between males and females with respect to craniofacial complex. There is significant difference between males and females in B-B1-Gn, Id-B-Pog, B-Pog/Md, Id-B, B-Pog, Id-Me, perpendicular distance from Pog to B-Me line and area of mandibular symphysis.

When correlation of craniofacial parameters SNB, AFH,UAFH, LAFH,L1/Md and dentoalveolar parameters with mandibular symphysis parameters was done, it was seen that the upper anterior facial height ,lower anterior facial height and total facial height had a strong correlation with the linear measurements of the mandibular symphysis, i.e, Id-B, B-Pog, Pog-Me, Id-Me. This is in accordance with the study done by **Swasty D et al (2011).**who said that there is an attempt of upper and lower anterior teeth to erupt to maintain a positive overbite when the lower facial height increases. This inturn brings the alveolar bony support of the upper and lower anterior teeth with them resulting in increase in the total mandibular symphysis length. It is also seen that there is a strong correlation between the lower incisor inclination and the mandibular symphysis inclination (Id-B/Md and B-Pog/Md).

From the above findings, it is seen that different skeletal patterns have got some variation in the Mandibular symphysis morphology. Thus, the craniofacial composition and Mandibular symphysis morphology should be taken into consideration to identify the different skeletal malocclusions for the purpose of diagnosis and treatment.

Table 5 : Showing descriptive statistics for the mandibular symphysis measured parameters in different anteroposterior skeletal jaw relationships

MS PARAMETERS	Class I Mean±S.D (n=90)	ClassII Mean±S.D (n=90)	Class III Mean±S.D (n=90)	Difference Class I to Class II	Difference Class I to Class III	Difference Class II to Class III
B-B1-Gn	62.50±4.73	58.6±5.71	64.4±4.82	3.90*	-1.90	-5.80*
Id-B-Pog	148.9±7.16	147.4±6.63	151.14±5.0	-1.50*	-2.20*	-3.74**
B-Pog-Me	130.1±9.4	137.5±8.53	132.2±7.72	-2.40*	-2.10*	5.30
Id-B/Md	88.08±7.60	90.78±8.42	86.98±6.46	1.30	3.10*	1.80**
B-Pog /Md	61.28±7.29	62.48±7.10	55.72±5.36	-1.20	5.56	6.76
Id-B	10.32±3.06	11.45±3.57	11.5±2.99	-1.13*	-1.18**	-0.05**
B-Pog	13.62±2.08	13.76±2.40	14.8±2.53	-0.14	-1.18*	-1.04*
Pog-Me	10.1±1.84	10.02±2.23	11.08±1.92	0.02**	-0.98	-1.06
Id-Me	32.3±3.11	34.1±2.80	32.15±2.26	-1.80**	-0.15	1.95*
Pog to B-Me	4.28±0.38	3.98±0.55	4.56±0.93	0.30**	-0.28*	-0.58**
Area	441.4±76.9	442.66±67.1	452.96±56.0	-1.20	-11.56**	-10.3*

Table 6: Descriptive statistics for the mandibular symphysis parameters in males and females and the difference between them

MS PARAMETERS	Males (n=135) Mean±S.D	Females (n=135) Mean±S.D	T value (n=270)	P value
B-B1-Gn	63.50±5.93	61.01±6.00	2.65	**0.00****
Id-B-Pog	150.3±6.29	149.1±6.81	-2.76	**0.00****
B-Pog-Me	136.1±6.99	134.67±11.4	-1.81	0.07
Id-B/Md	89.4±8.80	89.0±6.20	-0.17	0.86
B-Pog /Md	61.11±7.40	60.55±7.68	-2.38	**0.01***
Id-B	11.58±3.33	10.60±2.69	2.66	**0.00****
B-Pog	14.52±2.16	13.04±2.47	-2.61	**0.00****
Pog-Me	10.56±1.87	10.31±2.70	1.39	0.16
Id-Me	35.14±2.86	33.52±3.18	-1.95	**0.04***
Pog to B-Me line	4.15±0.79	4.14±0.77	2.28	**0.00****
Area	467.70±70.13	424±59.5	-5.08	**0.03****

p<0.05and p<0.01 (significant)*; p<0.01(highly significant) ** ;
p>0.05(not significant)

Table 7: Showing the Pearson correlation between the craniofacial measurements and dentoalveolar parameters and mandibular symphysis parameters in the total sample

VARIABLES (n =270)	SNA		SNB		ANB		L1Md		UAFH		LAFH		TAFH	
	R	P	r	P	R	P	R	P	r	P	R	P	R	p
B-B1-Gn	0.035	0.56	-0.03	0.62	.072	0.23	.002	0.97	-.033	0.58	.048	0.43	.0166	0.78
Id-B-Pog	0.023	0.706	.047	0.44	-.038	0.53	.023	0.70	-.007	0.90	-0.02	0.74	-0.035	0.56
B-Pog-Me	0.005	0.934	-.022	0.71	.055	0.36	-.008	0.89	-.112	0.06	.025	0.68	-0.055	0.36
Id-B/Md	-.008	0.98	-.040	0.51	-.051	0.40	-.234	0.00*	-0.05	0.36	.044	0.47	0.05	0.41
B-Pog /Md	0.035	0.566	.008	0.89	.026	0.67	.21	0.00*	-.038	0.53	-.008	0.98	-0.023	0.70
Id-B	-0.07	0.238	-.060	0.32	-.012	0.84	-.038	0.53	-.312	.001*	-0.78	0.00*	-0.77	0.00*
B-Pog	-0.01	0.793	-.019	0.75	-.032	0.60	.274	0.00*	-.46	.001*	-0.20	0.00*	0.70	0.00*
Pog-Me	0.049	0.472	-.204	0.00*	0.04	0.51	0.14	0.02*	-.76	.001*	0.19	0.00*	0.17	.005*
Id-Me	-0.06	0.272	0.22	0.00*	-.115	0.05	-.215	0.00*	.127	0.03*	-0.70	0.00*	-0.21	0.00*
Pog to B-Me line	0.100	0.101	0.033	0.58	0.088	0.14	.018	0.76	.018	0.76	.77	0.00*	0.019	0.75
Area	-0.06	0.294	-0.02	0.74	-0.06	0.03	-0.03	0.62	-.022	0.71	-.012	0.84	-0.009	0.88

p<0.05and p<0.01 (significant)*; p<0.01(highly significant) ** ;
p>0.05(not significant)

CONCLUSION

The following conclusions were drawn from the study:-

1. The vertical dimension of mandibular symphysis and inclination of alveolar part of mandibular symphysis was more in skeletal class III maloclussion as compared to other maloclussion groups with lesser concave anterior contour of mandibular symphysis reflecting compensation for skeletal pattern in class III maloclussion.
2. The morphology and dimension of mandibular symphysis were greater in Himachali males than Himachali females.
3. Area of Mandibular symphysis was also greater in Class III rather than Class I and Class II and Strong correlation exists between facial height and Mandibular symphysis length.
4. When correlation of craniofacial parameters with mandibular symphysis parameters was done, it was seen that the upper anterior facial height, lower anterior facial height and total facial height had a strong correlation with the linear measurements of the mandibular symphysis.

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