Comparison of symphysis morphology in normodivergent patients of short and normal mandible

Shiza Tassadaq Syed[a], Amjad Mahmood[b], Rozina Nazir[c]

Abstract

Introduction: Mandibular Symphysis (MS) is one of the most important regions of craniofacial complex. Understanding its morphology is important both for differential diagnosis and orthodontic treatment planning. Hence the purpose of this study was to measure symphysis morphological traits of patients with deficient mandibles versus that of normal mandible patients.

Material and Methods: It was a cross-sectional study that was carried out in Out Patient's Department of Margalla Institute of Health Sciences**.** The duration of this study was six months from June 2015 to January 2016. Thirty four normal angle patients with MMA in the range of 25.5° ± 5.3° were included in the study. McNamara analysis was done to divide them into two groups, first group of patients with short mandible and the second group of patients with normal mandible. On cephalogram, angle B-Pog-Me, angle B-B_1-Gn and perpendicular distance from Pog to B-Me line were measured for all patients. The readings were compared for the two groups of patients.

Results: The angle B-B_1-Gn (symphysis vertical dimension) and anterior prominence of MS (perpendicular distance between Pogonion and B-Me line) showed no significant differences between the two groups ($P>0.05$). The angle B-Pog-Me (symphysis convexity) was found to be greater in short mandible group of patients. This parameter showed statistically significant difference between the two groups ($P<0.05$).

Conclusions: Patients with short mandible have different symphyseal morphology than patients with normal mandible. Anterior prominence of symphysis and its vertical dimensions are increased in long mandible patients. But symphyseal convexity is increased in short mandible patients showing statistically significant difference between the two groups.

Keywords: Chin; esthetics; face; mandible

Introduction

Mandibular Symphysis (MS) is one of the most important regions of craniofacial complex. Understanding its morphology is important both for differential diagnosis and orthodontic treatment planning. It is a primary reference for esthetic considerations in lower third of face [1] and also a predictor of mandibular growth rotation.[2] Extreme variability of chin form may be the result of compensative growth developing in response to the most structurally efficient jaw form, contiguous soft and hard tissue environment and intrinsic genotype.[3,4]

Several researches have been done regarding symphysis morphology in patients with different craniofacial parameters. For example in high and low angle patients, patients with different anteroposterior dimensions, deep bite, patients with different lower incisor inclination and crowding and their relation with symphysis morphology, effects of incisor retraction on symphysis morphology after orthodontic treatment and sexual dimorphism.

Esenlik E et al[5] found that Class II division 1 patients exhibit greater symphysis height and symphysis width was greater in hypodivergent group than in class I control. Symphysis width is a major factor in differential diagnosis of Class II div 1 cases

[a] Corresponding Author: BDS. Resident, Dept. of Orthodontics, Margalla Institute of Health Sciences, Rawalpindi,Pakistan. Email: shiza_tassadaq@hotmail.com
[b] BDS, FDS RCS. Professor, Dept of Orthodontics, Margalla Institute of Health Sciences, Rawalpindi, Pakistan.
[c] BDS, FCPS. Associate Professor, Dept of Orthodontics, Margalla Institute of Health Sciences, Rawalpindi, Pakistan.

rather than symphysis height. But the study did not account for symphysis morphology in normal angle patients. Kirschneck C et al [6] found that marked chin prominence of Class II division 2 patients develops not before late mixed dentition due to increased growth inhibition of alveolar process. Karlsen AT [7] found that Class II div 1 patients with deep bite have protrusive chins but without deep bite have retrusive chins. Yu Q et al[8] found significant correlation between lower incisor inclination and its associated alveolar bone. Uysal T et al [9] and Joseph M [10] found significant relationships between mandibular incisor crowding and basal bone dimensions. Sarikaya et al [11] found that symphysis width decreases with incisor retraction. Mangla R et al [12] found that symphysis in hypodivergent facial type had short height, large depth, small ratio(height/depth) and larger symphysis angle. Opposite was true for hyperdivergent facial types. In their study, sexual dichotomy was also found. Symphyseal height and depth was smaller in females than in males. These findings were similar to those of Aki T et al.[13] Tang N et al[14] found morphological differences in symphyseal regions between class II and class III skeletal malocclusions with different abnormal vertical sagittal patterns. Nojima K et al[15] found that symphysis had a lingual inclination and smaller curve between alveolar and basal bone in skeletal class III malocclusion requiring orthognathic surgery than in normal occlusion group. Molina-Berlanga et al[16] found that vertical facial pattern is significant factor in mandibular symphysis alveolar morphology and lower incisor positioning both for Class I and Class III patients. Al-Khateeb et al[17] found that MS morphology in Class III is different than those of Class I and Class II relationships. Alveolar part of mandibular symphysis compensated for skeletal relationship in Class III pattern. MS dimensions were strongly correlated to anterior facial dimensions. Hence the rationale of this study was to find out about morphological differences between patients with short mandible versus those with normal mandible. This can help us in orthodontic diagnosis and treatment planning. Chin projection, thickness of chin pad, depth of the labiomental fold and lower-lip position are considered important variables in the preoperative analysis for an ideal chin profile.

Material and Methods

It was a cross-sectional study. Non probability consecutive sampling was done. Thirty two patients of Out Patient's Department of Margalla College of Dentistry, Margalla Institute of Health Sciences (MIHS) were included in the sample. Both male and female patients of CVM stage 5 were included. Patients with any craniofacial anomalies, syndromes, previous orthodontic treatment, orthognathic surgery or trauma to mandible were excluded from the study.

This study was approved from Ethical Review Committee of MIHS. Informed written consent was taken from the selected patients. Patient's history was taken and clinical examination done. Lateral Cephalogram was taken with the patient's Frankfurt horizontal plane parallel to floor, mandible in centric occlusion and lips at rest.

Lateral cephalograms were traced manually in a dark room using matt acetate tracing paper 0.07 mm thick, size 30 x 21 cm, attached to the radiographs with adhesive tape. Points and lines were marked with a black lead pencil (Goldfish® Autocrat 5000 Eraser Tip Pencil # 2½ HB), millimetre ruler and soft eraser. When double images of the anatomical bony structures were visualised, both images were traced and a mean position between them was found for determining the cephalometric points. On cephalogram, effective maxillary length, effective mandibular length and MMA angle were measured.

Only patients of normal angle with MMA in range of 25.5° ± 5.3° were taken.[17] McNamara analysis was done for all patients to divide them in two groups, first group of patients with short mandible and the second group of patients with normal mandible. MS was traced on each lateral cephalogram. B-Pog-Me angle, B-B_1-Gn angle and perpendicular distance from Pog to B-Me line were measured in all patients. Definitions of mandibular symphysis points and parameters are given in Table I. The readings were recorded on a chart.

Table I: Definitions of Symphysis Points and Measured Parameters[17]

Mandibular Symphysis Points and Parameters	Definitions
Point B	The most posterior point on the profile of mandible between alveolar crest and chin point
Pogonion (Pog)	The most anterior point of the mandibular symphysis in midline
Gnathion (Gn)	The most anterior inferior point of mandibular symphysis in midline
Point B_1	A point formed by the intersection between a perpendicular line dropped from point B to the tangent drawn on inner contour of mandibular symphysis at the shortest distance from point B
B-B_1-Gn angle	The angle between point B, point B_1 and Gnathion; it gives an indirect reflection of the vertical dimension of mandibular symphysis
B-Pog-Me angle	The angle formed between point B, Pogonion and Menton; It reflects the convexity of the mandibular symphysis
Perpendicular distance from pogonion 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

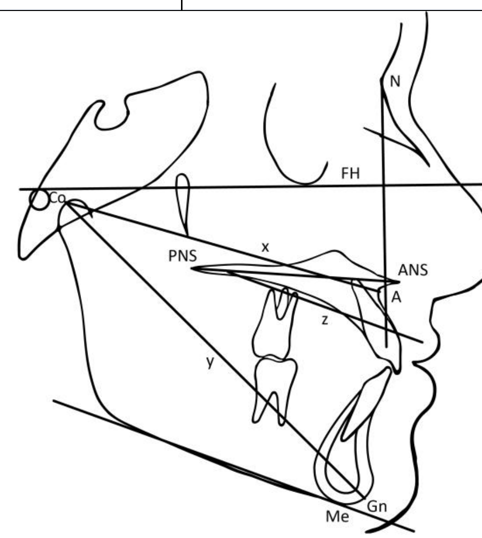

Fig. 1: x is Effective Maxillary Length, y is the Effective Mandibular Length and z is MMA

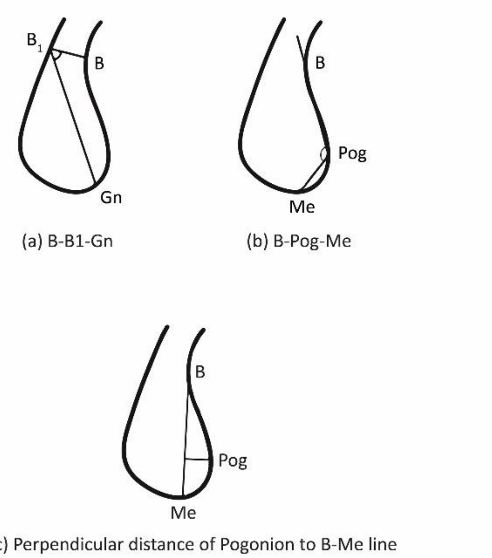

Fig.2. (a) Symphysis vertical dimension (B-B1-Gn), (b) Symphysis convexity (B-Pog-Me), (c) Anterior prominence of mandibular symphysis(Pog to B-Me)

Results

Mean and Standard Deviation (SD) of mandibular symphysis parameters were calculated for both groups (short and normal mandible patients) using Statistical Package for Social Science (SPSS version 16). Independent t-test was employed to investigate differences between measured MS parameters in the two groups. The results of the test were considered to be significant at P < 0.05.

Table II: Mean and Standard Deviation(SD) for Mandibular Symphysis Measured Parameters

	Length	N	Mean	Std. Deviation	Std. Err of Mean
Symphysis Convexity	short	20	130.20	5.71	1.28
	normal	12	121.79	11.15	3.22
Symphysis vertical Dimension	short	20	49.85	5.14	1.15
	normal	12	49.50	5.55	1.60
Anterior prominence of symphysis	short	20	4.60	0.82	0.18
	normal	12	5.25	1.21	0.32

Mean and SD of MS parameters in short and normal mandible patients are shown in Table II. The angle B-B_1-Gn (symphysis vertical dimension) and anterior prominence of MS (perpendicular distance between Pogonion and B-Me line) showed no significant differences between the two groups since the P value for these parameters was greater than 0.05. The angle B-Pog-Me (symphysis convexity) was found to be greater in short mandible group of patients showing that in short mandible patients, symphysis is flatter anteriorly, is less convex and less prominent. This parameter showed statistically significant difference between the two groups (P < 0.05)

Table III: Independent samples t-test for Mandibular Symphysis Measured Parameters
***statistically significant**

Mandibular Symphysis Measured Parameters	p-value	95% Confidence Interval of the Difference	
		Lower	Upper
Symphysis convexity	0.008*	2.341	14.476
Symphysis vertical dimension	0.858	-3.600	4.300
Anterior prominence of symphysis	0.080	-1.384	0.084

Discussion

In short mandible patients, there is dentoalveolar compensation; upper incisors are retroclined and lower incisors are proclined. It is a common clinical finding in our setup that the chin of short mandible is more prominent. So, the purpose of our study was to determine if such a compensation exists in the symphysis region of patients with short mandible too. Both male and female patients of CVM stage 5 were included so that the most substantial craniofacial growth was completed.

Tang N et al[14] stated that the influence of an abnormal vertical skeletal pattern on symphyseal morphological characteristics is greater than that of an abnormal sagittal skeletal pattern[14].Therefore, in our study, only patients of normal angle were included to rule out the effects of high or low angle on symphysis morphology and focus our study on the effects of mandibular length on chin.

Gracco et al[18] found that the total thickness of the symphysis was greater in short-faced subjects than in long-faced subjects indicating that wide range of incisor movements are preferred in Class II hypodivergent cases than in Class II hyperdivergent cases. Similar results were found in another study[13] showing that larger symphysis width provides wider range of incisor movements and greater chance of non extraction approach to treatment. Conversely, persons with greater symphysis height and a small chin would be candidates for an extraction treatment plan to compensate for arch length discrepancies. It should be remembered that the symphysis region may limit not only sagittal but also vertical tooth movement.

Anterior prominence of symphysis mean value was less in short mandible patients than in normal mandible patients but this difference was also not statistically significant(p value = 0.08) This finding demonstrates less chin prominence in short mandible patients. An increase in mandibular size increases chin prominence. This finding was similar to the previous study recently conducted.[17] Rosenstein[19] found that the anteroposterior dimension of the symphyseal outline increased to 3.66 mm in boys and 1.93 mm in girls 8-17 years of age. According to him, this measurement was always higher in boys at any given age. In our study, both male and female patients were included. Garn et al[20], in a study of > 400 subjects covering 2 full generations, stated that both symphyseal height and symphyseal thickness show evidence of genetic control.

Symphysis vertical dimension mean value was more in normal mandible patients than in short mandible patients. But this difference was not statistically significant (p value=0.6)

Symphysis convexity angle in short mandible patients was more than in normal mandible patients. This value was statistically significant (p value=0.008) in our study. In the previous study although the findings were similar, yet they were not significant.[17] This value indicates that the symphysis is flatter anteriorly in short mandible patients and is not prominent. The prominent chin area in short mandible patients in our clinical setting might be because of the horizontal vertical growth pattern and genetic control, not as a compensation for short mandibular length.

Dentoalveolar compensation is usually a good camouflage for the underlying AP skeletal discrepancy. Changes in the inclination of the lower incisors to compensate for the skeletal discrepancy in different AP relationships might cause surface remodeling of MS, affecting its morphology.

Although the differences in symphysis morphology between short and normal mandible patients were small on clinical level, they can still be of some importance to the clinician. They can be used in combination with the other cephalometric findings to identify the general pattern of the skeletal relationship. They can also help us in deciding extraction or non extraction treatment plan for a particular patient. These findings reflect the importance of carrying out a thorough analysis for each patient for the purposes of diagnosis and treatment planning.

One of the limitations of this study was that the sample distribution was not equal among groups. This is due to strict patient selection criteria. It may be useful to include larger populations in future studies.

Conclusions

Patients with short mandible have different symphysis morphology than patients with normal mandible. Anterior prominence of symphysis and symphysis vertical dimension is more in long mandible patients. But symphysis convexity is more in short mandible patients showing statistically significant difference.

References

1. Buschang PH, Julien K, Sachdeva R, Demirijian A. Childhood and pubertal growth changes of the human symphysis. Angle Orthod 1992; 62: 203-10
2. Skieller VB, Bjork A, Linde-Hansen T. Prediction of mandibular growth rotation evaluated from a longitudinal implant sample. Am J Orthod 1984; 86: 359-70
3. Gould SJ. The exaptive excellence of sprandels as a term and prototype. Proc Natl Acad Sci USA 1997; 94: 10750-55
4. Haskell BS. The human chin and its relationship to mandibular morphology. Angle Orthod 1979 Jul; 49(3):153-66
5. Esenlik E, Sabuncuoglu FA. Alveolar and Symphysis regions in patients with skeletal class II division 1 anomalies with different vertical growth patterns. Eur J Dent 2012; 6: 123-132
6. Kirschneck C, Romer P, Proff P, Lippold C. Association of dentoskeletal morphology with incisor inclination in angle class II patients: A retrospective cephalometric study. Head & Face Medicine 2013; 9:24. doi: 10.1186/1746-160X-9-24
7. Karlsen A: Craniofacial morphology in children with angle class II-1 malocclusion with and without deep bite. Angle Orthod 1994; 64: 437-46
8. Yu Q, Pan X, Ji G, Shen G. The Association between Lower Incisal Inclination and Morphology of the Supporting Alveolar Bone - A Cone-Beam CT Study. Int J Oral Sci 2009;1(4): 217-23
9. Uysal T, Yagci A, Ozer T, Veli I, Ozturk A. Mandibular anterior bony support and incisor crowding: Is there a relationship? Am J Orthod Dentofacial Orthop 2012; 142 (5):645-53
10. Joseph M. An evaluation of the mandibular symphysis as it relates to long-term post-orthodontic crowding and facial divergence [dissertation]. Saint Louis University; 2012.
11. Sarikaya S, Haydar B, Ciger S, Ariyurek M. Changes in alveolar bone thickness due to retraction of anterior teeth. Am J Orthod Dentofacial Orthop 2002; 122: 15-26
12. Mangla R, Singh N, Dua V, Padmanabhan P, Khanna M. Evaluation of mandibular morphology in different facial types. Contemporary Clinical Dentistry 2011; 2(3)200-6
13. Aki T. Nanda RS, Currier GF, Nanda SK. Assessment of symphysis morphology as a predictor of direction of mandibular growth. Am J Orthod Dentofacial Orthop 1994;106:60-9
14. Tang N, Zhao ZH, Liao CH, Zhao MY. Morphological characteristics of mandibular symphysis in adult skeletal class II and class III malocclusions with abnormal vertical skeletal patterns. Hua Xi Kou Qiang Yi Xue Za Zhi 2010; 28(4):395-8
15. Nojima K, Sakamoto T, Isshiki Y. Relationships between mandibular symphysis morphology and lower incisor inclination in skeletal class II malocclusion requiring orthognathic surgery. Bull Tokyo Dent Coll 1998; 39(3):175-81
16. Molina-Berlanga N, Llopis-perez J, Flores-Mir C, Puigdollers A. Lower incisor dentoalveolar compensation and symphysis dimensions among class I and III malocclusion patients with different facial vertical skeletal patterns. Angle Orthod 2013; 83(6):948-55
17. Al-Khateeb SN, Al Maaitah EF, Abu Alhaija ES, Badran AS. Mandibular Symphysis morphology in different anteroposterior jaw relationships. Angle Orthod 2014; 84(2):304-9
18. Gracco A, Luca L, Bongiorno BC, Siciliani G. Computed tomography evaluation of mandibular incisor bony support in untreated patients. Am J Orthod Dentofac Orthop 2010;138:179-87
19. Rosenstein SW. A longitudinal study of anteroposterior growth of the mandibular symphysis. Angle Orthod 1964; 34: 155-67
20. Garn SM, Lewis AB, Vicinus JH. The inheritance of symphyseal size during growth. Angle Orthod 1963; 33:222-31
21. Swasty D, Lee J, Huang JC, et al. Cross-sectional human mandibular morphology as assessed in vivo by cone-beam computed tomography in patients with different vertical facial dimensions. Am J Orthod Dentofacial Orthop 2011; 139:377–89
22. Endo T, Ozoe R, Kojima K, Shimooka S. Congenitally missing mandibular incisors and mandibular symphysis morphology. Angle Orthod 2007; 77:1079–84