Assessment of chin morphology in different skeletal dysplasia – A cross-sectional study

ABSTRACT

Objective: The objective of the study is to evaluate the morphology of the symphyseal region of adult skeletal Class II and Class III malocclusion as compared with Skeletal Class I subjects.

Materials and Methods: The symphyseal width and height were evaluated using data from 80 lateral cephalograms of the age range of 18 years to 25 years. Average growing Skeletal Class II ($n = 30$) and Class III ($n = 20$) subjects were used as a comparison group. Average growing normal occlusion samples ($n = 30$) were used as controls.

Results: Alveolar height was similar in all groups. The width of the symphyseal region including basal width, the width of the cervical region of the lower central incisor at the cementoenamel junction, and symphysis width were found to be similar in all groups. There is no significant difference in gonial angle in both Class II and III groups as compared to control. Articular angle showed no significant difference. Mandibular incisor dentoalveolar height (L1-AH) was found to be significantly higher in the Class II group ($P < 0.05$).

Conclusions: There are no definite morphological differences in the symphyseal region between average grower Class I, Class II, and Class III skeletal malocclusions except mandibular incisor dentoalveolar height (L1-AH) and incisor mandibular plane angle which is higher whereas ramus length and body length which is lesser in Class II group as compared with controls. Width of the cervical region of the lower central incisor at the cementoenamel junction (Id-Id') and incisor mandibular plane angle was lower than control in Class III subjects.

Keywords: Anteroposterior dysplasia, chin morphology, skeletal jaw dysplasia

INTRODUCTION

Mandibular symphysis is one of the important regions of the craniofacial complex as it serves as a primary reference area for evaluation of the facial profile, facial proportions, and esthetics in the lower one-third of the face. While planning orthognathic surgeries and orthodontic treatment, one should consider chin size in terms of the stability of the outcomes and the esthetic benefits for the patient.[1] Chin is morphologically divided into two regions, the dentoalveolar symphysis and basal symphysis. The dentoalveolar symphysis includes the alveolar process and lower incisors. The long axis of the basal symphysis differs cephalometrically from that of the alveolar symphysis.[2] Furthermore, it is the basal bone structure that limits the movement of mandibular incisors confined within the bone, which is recommended. Henceforth, the facial esthetics and the stability of orthodontic treatment depend on the position of the mandibular incisors, which are contained in the alveolar process of the mandibular symphysis.[3]

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Since the chin is considered a central anatomical point for the harmony and convexity of the face, jaw surgeries may require genioplasty to achieve harmonic and desirable results.[4]

Previous studies and literature all agreed upon the correlation between facial types and morphology of the mandibular symphysis but inappropriate sample size and methodology.[5,6] There is a definite influence of vertical growth pattern; that the symphysis is thin and elongated in patients with long faces, whereas it is thicker in those with short faces. On the contrary, sagittal jaw discrepancy might be reflected in the morphology of the symphysis and help to diagnose the shape of the symphysis. In addition, the height and projection of the basal symphysis influence the position of the adjacent soft tissue and are significant in terms of aesthetic and facial harmony.[7] Sagittal jaw discrepancy might be reflected in the morphology of the symphysis and help to diagnose the shape of the symphysis.[1] The purpose of the study was to evaluate symphyseal morphology in adults of different skeletal dysplasia.

MATERIALS AND METHODS

This cross-sectional study was conducted on 80 lateral cephalograms comprising of equal numbers of male and female patients in the age range of 18–25 years having a full complement of teeth, without any craniofacial disorder or abnormal growth were selected. The sample size was calculated using G-power software based on the results of the study (Mandibular symphysis morphology and dimensions in different anteroposterior jaw relationships) conducted by Susan *et al*.[14] α and β-error was set at 5%. The effect size calculated was 0.46. The lateral cephalograms were obtained from the patient record files and also from the patients visiting the outpatient department of the Department of Orthodontics and Dentofacial Orthopaedics, Ethical clearance was obtained from Institutional Ethical Committee with reference number 1174/Ortho/13 dated 23.09.2013. Selected subjects for this study were divided into two groups, i.e., Class II average angle (n = 30) and Class III average angle (n = 20) based on ANB angle[8] and SN-MP Angle.[9] The inclusion criteria of Class II group were: Angle Class II molar relation with ANB angle >40 with convex profile and retrognathic mandible whereas Class III group were having Angle Class III molar relation with ANB Angle <10, Overjet <1 mm, edge-to-edge bite, negative overjet and overbite at maximum intercuspation of posterior teeth and concave profile with the prognathic mandible.

The control group consisted of average growing subjects having Class I normal occlusion (n = 30) collected from the same institution. The normal occlusion criteria were: Class I molar and canine relationships with pleasant profile, a normal range of overjet (2–4 mm) and overbite (2–4 mm), good alignment without any missing teeth, and no prior orthodontic treatment. All cephalograms were traced manually by a single examiner using a protractor with 0.5°-and 0.5-mm accuracy. All the landmarks and variables used in the study were based on previous studies to allow a more comprehensive and compendious study of the mandibular structure [Figures 1-4 and Table 1]. To determine the errors associated with cephalometric tracing, 20 radiographs were selected randomly. The tracings and measurements were repeated 10 days after the initial measurements by the same operator. Average differences between the first and second measurements were tested using paired t-test. Statistical analyses and calculations of the parameters were performed using SPSS for Windows version 15.00 (SPSS Inc., Chicago, IL, USA).

RESULTS

Table 2 shows the comparison between control with Class II average angle variables. Similarly, a comparison between the control and Class III average angle is shown in Table 3.

Ramus length was found to be significantly shorter in the Class II group as compared to control ($P < 0.05$), whereas Class III groups showed no significant difference ($P > 0.05$). There is no significant difference in gonial angle in both Class II and III groups as compared to control. Articular angle showed no significant difference. Mandibular incisor dentoalveolar height (L1-AH) was found to be significantly higher in the Class II group ($P < 0.05$) [Table 1]. 1/MP

Table 1: Definition of parameters used in the study

Parameters	Definition
Malv-Saj	Length of a line drawn from Malv to Saj
Saj-Me	Length of a line drawn from the Saj to point Me
Sym width	The symphysis width was defined as the distance from the pogonion to the most convex point of the lingual curvature of the symphysis
Id-Id′	The distance between the most anterosuperior (Id) and most posterosuperior (Id′) point on the mandibular alveolus
B-B′	The distance between the B and B′ (the lingual projection of the B points at the lingual symphysis border) point
L1-AH	The perpendicular distance between the lower incisor tip and mandibular plane
Ramus length	Linear distance between Condylion and constructed Gonion point
Mandibular Base Length	The distance between gonion-pogonion projected perpendicular to the mandibular plane
Cd-Gn	The distance between condylion and gnathion points
Gonial angle	Angle formed by the points Ar, Go and Me at Go
Articular angle	Angle formed by the points S, Ar and Go at Ar
1/MP	The angle from the mandibular central incisor's axis to the mandibular plane (Go-Me)

Malv: Midpoint of the anterior alveolus, Saj: Symphysis-alveolar junction

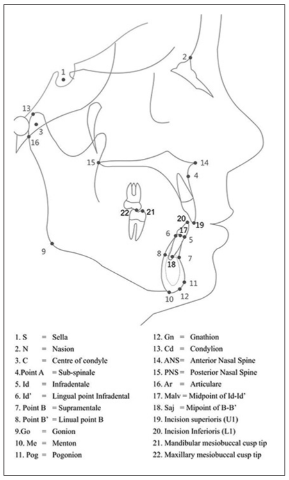

Figure 1: Cephalometric landmarks used in the study

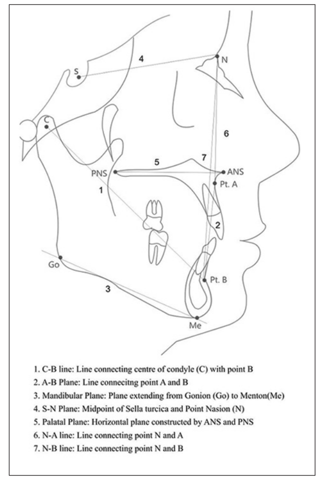

Figure 2: Cephalometric planes used in the study

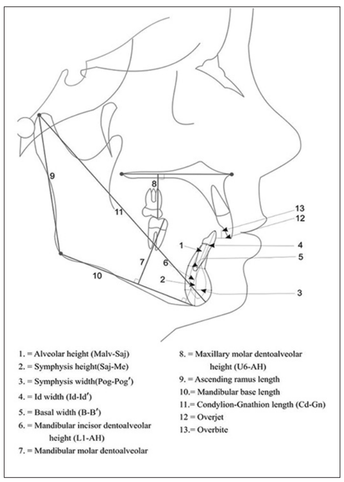

Figure 3: Cephalometric linear measurements used in the study

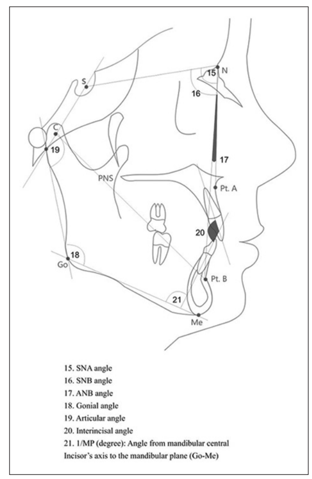

Figure 4: Cephalometric angular measurements used in the study

were found to be significantly higher in the Class II group whereas significantly lower in Class III subjects. Id width is significantly higher in the control group as compared with Class III [Table 3] while there is no difference between Class II and the control group. Basal width, Infradental width, and symphysis width were found to be similar in the control group as well as in Class II and Class III groups [Tables 2 and 3].

DISCUSSION

Oral surgeons and orthodontists encounter various mandibular positions in their patients. Moderate to extreme retrognathic and prognathic mandibular positions are often found, and challenging treatment decisions must be made to maximize the esthetic and functional benefits to each patient. The facial esthetics and the stability of orthodontic treatment may depend on the position of the mandibular incisors, which are contained in the alveolar process of the mandibular symphysis.[10] Thus, the choice of the treatment plan should be greatly influenced by the morphology of the symphysis and the position of the mandibular incisors. Sexual dimorphism was well evident, with males having a comparatively larger symphyseal width as compared to females.[11] The literature states that the dimensions of facial soft tissues vary considerably as a result of sexual dimorphism and age. However, the groups compared in our study were uniform concerning the distribution of both variables and sex, which enabled us to undertake comparative studies.[12]

Alveolar height did not demonstrate any significant relationship which was following Chung *et al*. study.[13] This implied that the height of the incisors can therefore be increased, within limits, to camouflage the vertical incisor relationship in the high angle group. There is a definite correlation between symphysis height and SN-MP angle which was in agreement with that of previous studies.[14-16]

According to Buschang *et al*.,[17] and Swasty *et al*.,[18] in high mandibular plane angle, upper and lower anterior teeth

Table 2: Dental and skeletal characteristics of the control and Class II subjects

Variables	Control (*n*=30), mean±SD	Group II (*n*=30), mean±SD	*P*
Malv-Saj	12.07±1.57	12.52±1.42	0.686 (NS)
Saj-Me	22.47±2.95	22.10±1.11	0.935 (NS)
Sym width	14.44±1.33	14.45±1.26	1.00 (NS)
Id-Id′	5.92±0.66	5.97±0.47	0.988 (NS)
B-B′	9.00±1.27	9.32±1.19	0.796 (NS)
L1-AH	39.93±2.12	41.97±1.93	0.03*
Ramus length	59.65±4.78	54.60±3.84	0.001**
Mandibular base length	77.53±4.57	73.55±5.39	0.13 (NS)
Cd-Gn	118.15±5.24	111.15±6.03	0.0001***
Gonial angle	125.37±4.60	125.90±4.51	0.979 (NS)
Articular angle	141.43±4.80	143.50±5.71	0.58 (NS)
1/MP	97.41±6.89	105.10±7.75	0.002***

Malv: Midpoint of the anterior alveolus, Saj: Symphysis-alveolar junction, SD: Standard deviation, NS:Not significant, *(S), **(S-Significant) ***(HS-Highly significant)

Table 3: Dental and skeletal characteristics of the control and class III subjects

Variables	Control (*n*=30), mean±SD	Group III (*n*=20), mean±SD	*P*
Malv-Saj	12.07±1.57	11.73±1.16	0.871 NS
Saj-Me	22.47±2.95	20.91±2.70	0.209 NS
Sym width	14.44±1.33	14.36±1.59	0.999 NS
Id-Id′	5.92±0.66	5.36±0.44	0.006**
B–B′	9.00±1.27	8.60±1.72	0.833 NS
L1–AH	39.93±2.12	40.93±2.31	0.701 NS
Ramus length	59.65±4.78	56.86±8.04	0.212 NS
Mandibular base length	77.53±4.57	80.13±7.35	0.517 NS
Cd-Gn	118.15±5.24	120.80±6.90	0.737 NS
Gonial angle	125.37±4.60	126.86±5.40	0.786 NS
Articular angle	141.43±4.80	143.90±6.13	0.501 NS
1/MP	97.41±6.89	89.10±6.77	0.001**

Malv: Midpoint of the anterior alveolus, Saj: Symphysis-alveolar junction, SD: Standard deviation, NS: Not significant, **(S-Significant)

Table 4: Student *t*-testing for pairwise comparison

Variables	Group II versus III *P*
Malv-Saj	0.31 NS
Saj-Me	0.46 NS
Symphysis width	0.09 NS
Id-Id′	0.10 NS
B-B′	0.11 NS
L1-AH	0.88 NS

Malv: Midpoint of the anterior alveolus, Saj: Symphysis-alveolar junction, NS: Not significant

may continue their eruption in an attempt to maintain a positive overbite, bringing their alveolar bony support with them, increasing total symphyseal height, suggestive of existing dentoalveolar compensation in high angle patients. There might be a compensatory mechanism simultaneously enlarging the vertical dimensions while reducing the labiolingual dimensions of the symphysis.[14-16] It might have been influenced by the attachment of the geniohyoid and genioglossus muscle at the basal level of the symphysis.[19] When comparison was made between Class II and III [Table 4], there was no significant difference in symphysis width and height, indicating that vertical rather than the sagittal was the major influencing factor in skeletal dysplasia.

However, in Class III patients, the lower incisor is more lingually inclined and the associated alveolar bone is more upright than Class-II and mandibular incisors are extruded greater to its bone base and natural compensation elongates the symphysis.[20] Interestingly, in our studies, the Class II group demonstrated significantly higher L1-AH as compared to control but comparable to the Class III group. The positioning and shape of the lips, depth of the mentolabial groove, the soft tissue suprajacent to the mandibular symphysis, and position of the lower incisive are the most important aspects to be considered for the surgical procedure of genioplasty.[21]

CONCLUSIONS

At present, the improvement in esthetics in orthognathic surgery is usually supplemented by genioplasty to treat facial deformities. Three-dimensional evaluation of chin morphology assists oral surgeons to do chin surgeries accurately. The result of this study showed that there are no definite morphological differences in the symphyseal region between average grower Class I, Class II, and Class III skeletal malocclusions except L1-AH and 1/MP which is higher whereas ramus length and Cd-Gn which is lesser in the Class II group as compared with controls. Id-Id' and 1/MP were lower than control in Class III subjects.

Limitations

Although it was a two-dimensional study, further three-dimensional studies using cone-beam computed tomography are required to assess chin morphology accurately.

Since this study was conducted only on average growers, a further study including different vertical patterns with sexual dimorphism should be done.

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Conflicts of interest

There are no conflicts of interest.

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