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Morphological study on the mental region of Japanese adults

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We used cephalograms to investigate the correlation between the craniofacial morphology of skeletal Class I craniofacial morphology in Japanese adults and the mandibular symphysis, measuring the angles between the mandibular plane and symphysis, and the angles between the symphysis and mandibular central incisor. We observed the correlations between ∠SNA and Thickness Point B and Thickness Pogonion; between ∠SNB and Thickness Point B and Thickness Pogonion; between ∠ANB and Idm-Me; between FMA and Idm-Me, Thickness Point B, and Thickness Pogonion; between IMPA and ∠Idm-X to MP, ∠L1 to Idm-X, Thickness Point B and Thickness Pogonion; and between Gn-Cd and Idm-Me and Thickness Pogonion. In females, correlations were observed between ∠SNA and Thickness Point B and Thickness Pogonion (mm); between ∠SNB and ∠Idm-Me to MP, Thickness Point B, and Thickness Pogonion; between FMA and ∠Idm-Me to MP, ∠Idm-X to MP, ∠X-Me to MP, Idm-Me, and Thickness Point B; between IMPA and ∠Idm-Me to MP, ∠Idm-X to MP, ∠L1 to Idm-X, and Thickness Point B; and between Gn-Cd and Idm-Me. These results suggested the importance of monitoring movement of the mandibular anterior teeth during orthodontic treatment because skeletal differences affect the inclination of these teeth and the morphology of the symphysis. (J Osaka Dent Univ 2023; 57: 1-9)

Key words : Cephalometric analysis ; Mandibular symphysis ; Orthodontic treatment ; Skeletal Class I craniofacial morphology

INTRODUCTION

The morphology and position of the mental region are directly related to the provision of orthodontic treatment, such as diagnosing the need for tooth extraction, selection of the extraction site, determining the amount and mode of mandibular anterior tooth movement, and establishment of treatment goals.[1] The mandibular symphysis, which forms the mental region as demonstrated in lateral cephalometric radiographs, has a significant effect on the axes of the mandibular anterior teeth, the positional relationship between the maxilla and mandible, and the soft tissue morphology of the facial profile. Genetics, endocrinology, and biomechanics affect the morphology of the symphysis.[2-5] In particular, regarding biomechanics, it is thought that external forces (such as occlusal forces) applied to the symphysis change due to differences in jawbone morphology, affecting the stress generated inside the symphysis, and possibly causing changes in bone remodeling.[6] Thus far, anatomical research, studies based on Angle's classification system using cephalometric radiographs, and studies of skeletal classification have been conducted on the symphysis, especially.[6-13] However, there are currently few reports on the correlation between orthodontic evaluation items and the morphology of the mental region in skeletal Class I occlusions.[9, 14] Here, we studied the morphology of the mandibular symphysis in patients with a skeletal Class I relationship using lateral cephalometric radiographs.

MATERIALS AND METHODS

Subjects

Of the patients who visited the Department of Orthodontics, Osaka Dental University Hospital between 2019 and 2021, we selected 96 males and 86 females with a skeletal Class I relationship who met the selection criteria. We defined skeletal Class I as having an ANB angle of 1.5°-3.5°, in accordance with the value obtained by Iizuka *et al.,* which is the most common reference value for cephalometric analysis in clinical orthodontics in Japan.[15] The criteria for selection were healthy males and females with no history of any disease that affects growth and development of the teeth, jaws, or facial cranium, a balanced and harmonious facial profile in terms of the morphology of the maxilla and mandible, no abnormalities in the number of teeth excluding third molars, no morphological abnormalities in any of the teeth excluding third molars, a normal mesiodistal occlusion of both dental arches, and an overbite and overjet of 1.0 mm to no more than 3.0 mm (Table 1).

Methods

Maxillofacial morphology

The measurements of ∠SNA, ∠SNB, ∠ANB, FMA, IMPA, Gn-Cd (mm) were recorded using cephalometric radiograph analysis to evaluate the maxillofacial morphology (Fig. 1). Measurement points and measurement items of the symphysis, reference planes, and other measurement items were set from the cephalometric radiographs based on previous studies (Fig. 2).[2, 8, 13, 16-18]

Measurement points

The measurement points were B (Point B): Anterior limit of mandibular apical base, B': Intersection of perpendicular lines from B to the mandibular plane, Pog (Pogonion): Most prominent point of the man-

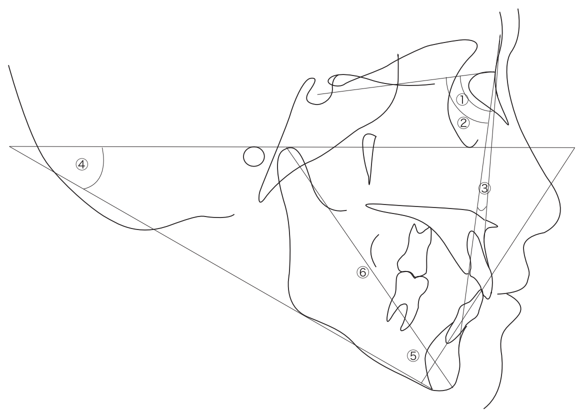

Fig. 1 Measurements on the lateral cephalogram.
① ∠SNA (angle), ② ∠SNB (angle), ③ ∠ANB (angle), ④ FMA (angle), ⑤ IMPA (angle), and ⑥ Gn to Cd (mm) .

Table 1 Characteristics of the subjects in this study

Parameter	Males (n=96)	Females (n=86)	t-test (M and F)
∠SNA (angle)	82.31±3.51	81.55±3.67	NS
∠SNB (angle)	79.73±3.34	78.95±3.59	NS
∠ANB (angle)	2.60±0.67	2.58±0.82	NS
FMA (angle)	24.26±6.22	26.74±5.91	*
IMPA (angle)	95.82±8.65	94.31±7.50	NS
Gn-Cd (mm)	133.01±6.62	123.20±5.22	*
∠Idm-Me to MP (angle)	84.15±5.85	81.63±5.53	NS
∠Idm-X to MP (angle)	88.45±10.15	85.61±7.01	*
∠X-Me to MP (angle)	75.86±12.34	76.10±11.67	NS
∠L1 to Idm-X (angle)	6.92±4.44	9.30±6.60	NS
∠L1 to X-Me (angle)	18.33±8.97	17.90±10.30	NS
Idm-Me (mm)	36.07±3.57	31.92±3.57	*
Thickness Point B (mm)	9.51±1.88	8.92±1.56	*
Thickness Pogonion (mm)	15.80±2.30	14.57±1.53	*

Mean±SD, NS: Not significant, *$p < 0.05$.

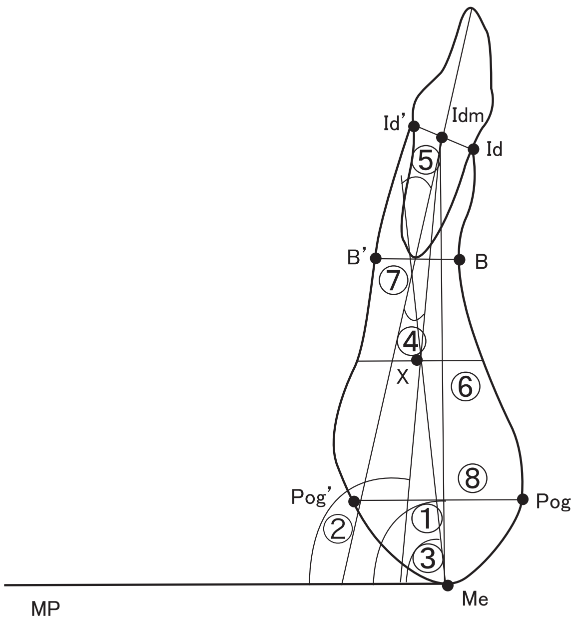

Fig. 2 Measurements of the mandibular symphysis.
① ∠Idm-Me to MP (angle), ② ∠Idm-X to MP (angle), ③ ∠X-Me to MP (angle), ④ ∠L1 to Idm-X (angle), ⑤ ∠L1 to X-Me (angle), ⑥ Idm-Me (mm), ⑦ Thickness point B (mm), and ⑧ Thickness Pogonion (mm)

dibular mental region with respect to the mandibular plane, Pog’: Intersection of a perpendicular line drawn from Pog to the mandibular plane, Me (Menton): Lowest point of the mandibular symphysis, Id (Infradentale): Most anterior point of the alveolar process of the mandibular central incisors, Id’ (Lingual infradentale): Most posterior point of the alveolar process of the mandibular central incisors, Idm: Midpoint of Id and Id’, X: Midpoint on the symphysis where a perpendicular line passing through the midpoint of Idm and Me passes through, and MP (Mandibular plane): Tangent to the mandibular plane passing through Me.

Measurement items

The measurement items were ∠Idm-Me to MP: The angle between the whole symphysis and the MP, ∠Idm-X to MP: The angle between the alveolar part of the symphysis and the MP, ∠X-Me to MP: The angle between the base of the symphysis and MP, ∠L1 to Idm-X: The angle between the mandibular central incisor tooth axis and alveolar axis of the symphysis, ∠L1 to X-Me: The angle formed by the mandibular central incisor tooth axis and basal axis of the symphysis, Idm-Me (mm): The distance between Idm-Me at the height of the symphysis, Thickness Point B (mm): The distance within the symphysis of the perpendicular line drawn from point B to Idm-Me at the thickness at point B of the symphysis, and Thickness Pogonion (mm): The distance within the symphysis of the perpendicular line drawn from Pog to Idm-Me at the thickness at Pog of the symphysis.

Method of analysis

The mean and standard deviation of each measurement obtained from the cephalogram were calculated and compared. In addition, using the statistics software EZR software (N Office, Tokyo, Japan), the correlation between each measured value was evaluated.

RESULTS

When comparing the measurements between males and females, significant differences were observed in FMA and Gn-Cd (mm) for maxillofacial morphology, and in ∠Idm-X to MP, Idm-Me (mm), Thickness Point B (mm), and Thickness Pogonion (mm) for symphysis morphology (Table 1). In addition, to examine the correlation between each measurement based on the obtained data, the correlation coefficient r and the risk value p were calculated using the statistical processing software EZR, and a correlation was defined as an r value of 0.2 or greater and a p value of less than 0.05. As a result, in males, correlations were observed between ∠SNA and the thickness of the symphysis; between ∠SNB and the thickness of the symphysis; between ∠ANB and the length of the symphysis; between FMA and the length of the symphysis and the thickness of the symphysis; between IMPA and the inclination of the symphysis and the thickness of the symphysis; and between Gn-Cd (mm) and the length of the symphysis and the thickness of the symphysis.

In females, correlations were observed between ∠SNA and the thickness of the symphysis; between ∠SNB and the inclination of the symphysis

Table 2 Correlation between measurments of the maxillofacial morphology and mandibular symphysis in males

Maxillofacial morphology	Mandibular symphysis	*r* value	*p* value
∠SNA (angle)	∠Idm-Me to MP (angle)	0.0227	0.8262
	∠Idm-X to MP (angle)	−0.0605	0.5578
	∠X-Me to MP (angle)	0.1017	0.324
	∠L1 to Idm-X (angle)	0.0426	0.6799
	∠L1 to X-Me (angle)	−0.0443	0.6681
	Idm-Me (mm)	−0.00318	0.7582
	Thickness Point B (mm)	0.2626	0.00972
	Thickness Pogonion (mm)	0.2304	0.0238
∠SNB (angle)	∠Idm-Me to MP (angle)	−0.0072	0.9438
	∠Idm-X to MP (angle)	−0.1037	0.3146
	∠X-Me to MP (angle)	0.0982	0.3411
	∠L1 to Idm-X (angle)	0.0312	0.7626
	∠L1 to X-Me (angle)	−0.0758	0.4626
	Idm-Me (mm)	−0.1046	0.3105
	Thickness Point B (mm)	0.2649	0.00908
	Thickness Pogonion (mm)	−0.2098	0.0402
∠ANB (angle)	∠Idm-Me to MP (angle)	0.1484	0.1488
	∠Idm-X to MP (angle)	0.1832	0.0738
	∠X-Me to MP (angle)	0.0332	0.7478
	∠L1 to Idm-X (angle)	0.0475	0.6453
	∠L1 to X-Me (angle)	0.1163	0.2591
	Idm-Me (mm)	0.3919	0.000078
	Thickness Point B (mm)	0.0037	0.9713
	Thickness Pogonion (mm)	0.127	0.2173
FMA (angle)	∠Idm-Me to MP (angle)	0.00593	0.9542
	∠Idm-X to MP (angle)	−0.1061	0.3035
	∠X-Me to MP (angle)	−0.1643	0.1096
	∠L1 to Idm-X (angle)	−0.1538	0.1346
	∠L1 to X-Me (angle)	−0.0666	0.5189
	Idm-Me (mm)	0.3716	0.000193
	Thickness Point B (mm)	−0.4116	0.00003086
	Thickness Pogonion (mm)	−0.2127	0.0374
IMPA (angle)	∠Idm-Me to MP (angle)	0.111	0.2813
	∠Idm-X to MP (angle)	−0.2518	0.0133
	∠X-Me to MP (angle)	0.0678	0.5112
	∠L1 to Idm-X (angle)	0.399	0.000056
	∠L1 to X-Me (angle)	0.616	0.5222
	Idm-Me (mm)	0.0315	0.76
	Thickness Point B (mm)	0.314	0.00183
	Thickness Pogonion (mm)	0.2046	0.0454
Gn-Cd (mm)	∠Idm-Me to MP (angle)	−0.0234	0.8207
	∠Idm-X to MP (angle)	−0.0344	0.7388
	∠X-Me to MP (angle)	−0.1314	0.2019
	∠L1 to Idm-X (angle)	0.0822	0.4259
	∠L1 to X-Me (angle)	0.0509	0.6223
	Idm-Me (mm)	0.4592	0.0000025
	Thickness Point B (mm)	0.0778	0.4512
	Thickness Pogonion (mm)	0.3962	0.000064

Table 3 Correlation between measurments of the maxillofacial morphology and mandibular symphysis in females

Maxillofacial morphology	Mandibular symphysis	*r* value	*p* value
∠SNA (angle)	∠Idm-Me to MP (angle)	0.1739	0.1092
	∠Idm-X to MP (angle)	0.039	0.7214
	∠X-Me to MP (angle)	−0.00105	0.9923
	∠L1 to Idm-X (angle)	0.0322	0.7681
	∠L1 to X-Me (angle)	−0.1484	0.1725
	Idm-Me (mm)	−0.0015	0.989
	Thickness Point B (mm)	0.3962	0.0158
	Thickness Pogonion (mm)	0.3471	0.0217
∠SNB (angle)	∠Idm-Me to MP (angle)	0.2122	0.0498
	∠Idm-X to MP (angle)	0.047	0.6668
	∠X-Me to MP (angle)	0.0298	0.7847
	∠L1 to Idm-X (angle)	−0.006092	0.9556
	∠L1 to X-Me (angle)	−0.1274	0.0758
	Idm-Me (mm)	−0.0182	0.8675
	Thickness Point B (mm)	0.2096	0.0479
	Thickness Pogonion (mm)	−0.3141	0.0297
∠ANB (angle)	∠Idm-Me to MP (angle)	−0.1279	0.2404
	∠Idm-X to MP (angle)	−0.0375	0.7316
	∠X-Me to MP (angle)	−0.1165	0.2854
	∠L1 to Idm-X (angle)	0.1463	0.1789
	∠L1 to X-Me (angle)	0.1296	0.2343
	Idm-Me (mm)	0.0769	0.4816
	Thickness Point B (mm)	0.0936	0.3911
	Thickness Pogonion (mm)	−0.0925	0.3968
FMA (angle)	∠Idm-Me to MP (angle)	−0.5347	0.00000011
	∠Idm-X to MP (angle)	−0.4528	0.000012
	∠X-Me to MP (angle)	−0.2243	0.03785
	∠L1 to Idm-X (angle)	0.0351	0.7477
	∠L1 to X-Me (angle)	−0.0248	0.8205
	Idm-Me (mm)	0.4806	0.0000028
	Thickness Point B (mm)	−0.3655	0.0005385
	Thickness Pogonion (mm)	−0.201	0.0634
IMPA (angle)	∠Idm-Me to MP (angle)	0.3082	0.00388
	∠Idm-X to MP (angle)	0.5032	0.00000078
	∠X-Me to MP (angle)	0.04525	0.6791
	∠L1 to Idm-X (angle)	0.3344	0.00165
	∠L1 to X-Me (angle)	0.6332	0.6111
	Idm-Me (mm)	−0.1415	0.1937
	Thickness Point B (mm)	0.3564	0.000754
	Thickness Pogonion (mm)	0.1979	0.0676
Gn-Cd (mm)	∠Idm-Me to MP (angle)	−0.0604	0.5806
	∠Idm-X to MP (angle)	−0.1749	0.1071
	∠X-Me to MP (angle)	−0.03408	0.7554
	∠L1 to Idm-X (angle)	0.02903	0.7907
	∠L1 to X-Me (angle)	−0.1493	0.1699
	Idm-Me (mm)	0.3057	0.004204
	Thickness Point B (mm)	−0.1016	0.3515
	Thickness Pogonion (mm)	0.1789	0.09926

and the thickness of the symphysis; between FMA and the inclination of the symphysis, the length of the symphysis, and the thickness of the symphysis; between IMPA and the inclination of the symphysis and the thickness of the symphysis; and between Gn-Cd (mm) and the length of the symphysis (Tables 2 and 3).

DISCUSSION

Materials

The participants of this study included patients who visited the Department of Orthodontics of the Osaka Dental University Hospital who had a skeletal Class I maxillofacial morphology based on the reference values reported by Iizuka *et al.*[15] The ∠ANB expresses the anteroposterior relationship between the maxillary and mandibular apical bases and is often used to classify skeletal patterns; hence, it was used as a classification criterion in this study. Since Angle's classification of malocclusion was proposed, the maxillofacial classification has tended to emphasize only anterior and posterior factors. However, there are many cases that cannot be explained only by classification based on such factors, and it has been pointed out that this classification is not necessarily useful for predicting the direction of growth and determining the appropriate treatment approach.[19, 20] Therefore, we also ensured that subjects included in the study had both an overbite and overjet ranging from 1.0 mm to not more than 3.0 mm. Patients with an edge-to-edge occlusion or open bite were excluded. A comparison of maxillofacial morphology between males and females showed a significantly larger FMA in females and a significantly larger Gn-Cd (mm) in males. However since the mean values of all the measured items were within the standard deviation of values reported by Iizuka *et al.,* we determined that the subjects in the present study were an appropriate representation of skeletal Class 1 maxillofacial morphology.

Morphology of the symphysis

According to the apical basal theory proposed by Lundstöm, the growth of the apical base is natural and is not influenced by orthodontic stimulation or masticatory function, and although its size is not defined, the morphology of the apical base is greatly influenced by the occlusion and morphology of the dental arch.[21] Matsuda, Ichikawa *et al.,* Worms, and Yoshitani reported that in skeletal Class III cases, the lingual inclination of the mandibular anterior teeth compensates for the anteroposterior disharmony of the jawbone; this is referred to as dental compensation.[9, 13, 22, 23] Lundstöm, Ichikawa *et al.* and Nakagawa *et al.* divided the apical base of the symphysis into two parts, namely the alveolar symphysis and the basal symphysis.[9, 21, 24] On the other hand, Enlow added a third part, called the drift layer, in between these two parts.[25]

In the present study, we defined the two points of point B and Pogonion, thus measuring the same parts of the alveolar symphysis and basal symphysis as before. Based on the relationship between malocclusion and the morphology of the symphysis, Ito classified the general form of the symphysis into five types, namely type A (overall thickness is small), type B (thickness of the mandibular central incisor apex is small), type C (thickness of mandibular central incisor apex is large), type D (gourd-shaped), and type E (near-uniform thickness overall). He reported that 55% of Angle Class I cases are type C, 30% are type B, and very few are types A, B and D.[16] Although this study did not examine the general form, the thickness at Pogonion increased relative to the thickness at point B for both males and females, and it was inferred that most of the subjects had morphologies similar to types B and C, as reported by Ito. Ito also investigated the labiolingual diameter of the symphysis at point B and the maximum thickness of the symphysis in Angle Class I cases. The Pogonion thickness used in this study does not necessarily correspond to the maximum thickness, but it is close to the value measured by Ito. In addition, Ichikawa *et al.* and Kanai *et al.* measured the thickness of the symphysis with different skeletal patterns. The measurements taken at point B in the present study tended to be slightly larger than those in skeletal Class I cases taken by Ichikawa *et al.*.[9, 26] Furthermore, although the measurements taken at the Pogonion were almost the same as those taken by Ichikawa *et al.,* they were slightly larger than those taken by Kanai *et al.*

Compared with females, males had significantly greater values of ∠Idm-X to MP, Idm-Me (mm), Thickness Point B, and Thickness Pogonion. As Idm-Me (mm), Thickness Point B, and Thickness Pogonion correspond to the length and thickness of the symphysis, the size of the symphysis is larger in males and thus consistent with the results reported by Ichikawa *et al.*[9] As for ∠Idm-X to MP, since the measurement point X was located at the center of the symphysis, it was thought that the difference in the size of the symphysis created the difference between males and females.

Relationship between the maxillofacial morphology and the morphology of the symphysis

With regards to ∠SNA, ∠SNB, and Gn-Cd (mm), which are measurements that demonstrate the anteroposterior relationship of maxillofacial morphology, we found that there was a correlation between ∠SNA and Thickness Point B and Thickness Pogonion in both males and females. Furthermore, there was a negative correlation between ∠SNB, Thickness Point B, and Thickness Pogonion in both males and females. In terms of Gn-Cd (mm), there was a correlation between Idm-Me (mm) and Thickness Pogonion in males, and with Idm-Me (mm) in females. Although the subjects in this case had a skeletal Class I relationship, the maxillofacial morphology tended to be closer to skeletal Class II when ∠SNA was large or ∠SNB was small, and conversely, close to skeletal Class III when ∠SNA was small and ∠SNB was large.

Ichikawa *et al.* found significant differences in Thickness point B between skeletal Class I and Class II, and between skeletal Classes I and III for both males and females; the measurements were significantly smaller in skeletal Class III than in skeletal Classes I and II, which was a trend consistent with our results here.[9] However, they stated that there was no significant difference between malocclusions in the length of the symphysis and thickness of the pogonion. Although the measurements of Thickness Point B in this study were slightly larger than the measurements at point B of the skeletal Class I data presented by Ichikawa *et al.,* the thickness at the Pogonion was almost the same. In terms of the thickness of the symphysis, Ito reported that in Angle Class I, Class II, and Class III occlusions, there were almost no differences in Thickness Point B and the maximum thickness between Class I and Class II. However, Thickness Point B tended to be less thick in Class III malocclusions.[16] In addition, Jacobson reported that the maximum thickness of the symphysis was smaller in Class III malocclusions when compared to subjects with normal occlusions, similar to the results we obtained. In addition, since a correlation was observed between Gn-Cd (mm) and Idm-Me (mm), we determined that there was a correlation between the length of the mandible and the length of the symphysis.[18]

In this study, ∠FMA is a measurement item that indicates the vertical maxillofacial positional relationship. Factors that make orthodontic treatment difficult are the size of ∠FMA, which indicates the degree of inclination of the mandibular plane, and the morphology of the symphysis. If the mandibular plane has a large inclination, it is difficult to normalize the vertical overbite relationship of the anterior teeth, and when the thickness of the symphysis is small, labiolingual movement of the mandibular anterior teeth is challenging, which in turn makes it difficult to normalize the overjet of the anterior teeth. Thus, both the inclination of the mandibular plane and the morphology of the symphysis have important effects on the improvement of the overbite of the anterior teeth.

In this study, we observed correlations between ∠FMA and Idm-Me (mm), Thickness Point B, and Thickness Pogonion in males, and between ∠FMA, Idm-Me (mm) and Thickness Point B in females. Regarding the relationship between vertical malocclusion and symphysis, Tanaka *et al.* reported that the thickness at point B of the symphysis and mandibular anterior apex becomes smaller as the mandibular plane angle becomes larger.[27] In addition, Haskell focused on the inclination of the mandibular plane and reported that the mentum was smaller in low-angle cases and that this was particularly noticeable in vertically overgrown mandibles with functional impairment.[28] Kanai *et al.* reported that in long-face maxillofacial morphology cases, addition of bone to the posterior alveolus of the symphysis takes place normally. However, these patients tend to have difficulty closing their lips, have active orbicularis oris and mentalis muscles, and experience non-physiological pressure from these muscles which is continuously applied to the labial alveolar plate. This makes bone resorption likely, thus shortening the distance between the root and the labial alveolar plate.[26] In this study, a negative correlation was found between the FMA and the thickness of the symphysis, which is consistent with previous reports. In addition, since a positive correlation was observed between FMA and Idm-Me (mm) in this study, our results were consistent with those reported by Tanaka *et al.,* wherein there were positive correlations between the inclination of the mandibular plane and the length and height of the symphysis.[27]

Regarding the inclination of the mandibular anterior teeth and the morphology of the symphysis, there was a correlation between IMPA, ∠Idm-X to MP, ∠L1 to Idm-X, Thickness Point B, and Thickness Pogonion in males. In females, there was a correlation between ∠Idm-Me to MP, ∠Idm-X to MP, ∠L1 to Idm-X, and Thickness Point B. Idm-Me indicates the inclination of the entire symphysis, and Idm-X indicates the inclination of the alveolar region of the symphysis. Regarding the inclination of the symphysis relative to the mandibular plane, Ichikawa *et al.* reported that both males and females demonstrated significant differences in ∠Idm-X to MP between malocclusions and that the alveolar region of the symphysis showed a labial inclination relative to the mandibular plane in skeletal Class II cases compared to Class I cases, and a lingual inclination in skeletal Class III cases compared to Class I cases.[9] However, they also mentioned that with regards to the Me-X, which shows the inclination of the symphysis base, X-Me to MP did not show significant differences between males and females nor among malocclusions, and thus the results of our study were similar to those reported by Ichikawa *et al.*

Ichikawa *et al.* also studied the mandibular central incisor axis and inclination of the symphysis and mentioned that ∠L1 to Idm-X, representing the angle between the mandibular central incisor axis and the alveolar region of the symphysis, showed a labial inclination of the central incisors relative to the inclination of the alveolar region in skeletal Class I and Class II cases, while skeletal Class III cases had nearly the same inclination of the central incisors as the inclination of the alveolar region of the symphysis. However, we noted a correlation between the mandibular central incisors and the inclination of the alveolar region of the symphysis, which differed from the results reported by Ichikawa *et al.* Furthermore, they reported that with respect to ∠L1 to X-Me, the central incisors showed a labial inclination relative to the inclination of the base of the symphysis in skeletal Class II cases compared with Class I cases and that the central incisors showed a lingual inclination relative to the inclination of the base of the symphysis in skeletal Class III cases compared with Class I cases, which is different from our results, where no correlations were observed. However, the inclination of the mandibular anterior teeth correlated with the thickness of the symphysis.

CONCLUSION

The morphology and position of the mental region are closely associated with the provision of orthodontic treatment, such as diagnosing the need for extractions, selection of which teeth to extract, the amount and mode of movement of the mandibular teeth, and establishment of treatment goals. The mandibular symphysis that forms the mental region is said to have a great influence on the axial inclination of the mandibular teeth, the positional relationship between the maxilla and mandible, and the soft tissue morphology of the lateral profile. Factors that make orthodontic treatment challenging include the inclination of the mandibular plane and morphology of the symphysis. If the mandibular plane has a large inclination, it is difficult to normalize the vertical overbite of the anterior teeth, and when the thickness of the symphysis is small, the labiolingual movement of the mandibular anterior teeth is challenging, which in turn makes it difficult to normalize the overjet of the anterior teeth. In this manner, both the inclination of the mandibular plane and the morphology of the symphysis have an important impact on the overbite of the anterior teeth.

In the present study, we observed a correlation between the measurement items ∠SNA and ∠SNB, which shows the anteroposterior positional relationship of the maxillofacial morphology, ∠FMA, which shows the vertical positional relationship, and the thickness of the symphysis. There was also a correlation between the inclination of mandibular anterior teeth and the inclination of the symphysis. These results suggest the importance monitoring the movement of the mandibular anterior teeth during orthodontic treatment because skeletal differences affect the inclination of these teeth and the morphology of the symphysis.

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