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Cephalometric standards for Japanese adults with skeletal Class I craniofacial morphology

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We used cephalograms to investigate each measurement item of the maxillofacial morphology of skeletal Class I Japanese adult males and females with individualized normal occlusion. We also calculated the standard values of the Steiner analysis, which is widely used for setting treatment goals in orthodontic practice. In comparison with pre-existing Japanese measurements on growing children, in males, our results showed larger values for ∠SNB, ∠SND, U1 to NA (mm), U1 to NA (angle), Po to NB, Interincisal angle, SL, and SE, and smaller values for ∠ANB, L1 to NB (angle), ∠Occl to SN, and ∠GoGn to SN. In females, ∠SNB, ∠SND, U1 to NA (angle), Po to NB, Interincisal angle, SL, and SE showed large values, while ∠ANB, L1 to NB (angle), ∠Occl to SN, and ∠GoGn to SN, showed smaller values. Based on the results of our study, it is necessary to consider a new ratio for the relationship between the distances L1 to NB (mm) and Po to NB (mm) in Japanese because of Japanese facial features. (J Osaka Dent Univ 2023; 57: 179-186)

Key words: Cephalometric standards; Steiner analysis; Orthodontic treatment; Skeletal Class I craniofacial morphology

INTRODUCTION

Ever since Broadbent[1] introduced the basic techniques for radiographic cephalometry, this measurement method has been used in orthodontic clinical practice. Many analyses using this method with Japanese adults with normal occlusion as subjects have been conducted by Kayukawa,[2,3] Iizuka and Ishikawa,[4] as well as others. Their analytical methods have been well established. At present, these analytical methods have been applied to case analysis in orthodontic clinics as standard values for Japanese adults with normal occlusion, and have become one of the treatment goals in diagnosis. In particular, the Steiner analysis[5] focuses on the relationship between the ANB angle and the U1 to NA angle, between the ANB angle and the L1 to NB angle, and between the position of the maxillary and mandibular central incisors relative to the NA and NB lines. The position of the mandibular central incisor plays an important role in the esthetics of the face. With a focus on the relationship between the ANB angle and the inclination of the maxillary and mandibular central incisors, and between the position of the incisal edges of the maxillary and mandibular central incisors, therapeutic target analysis was done by Steiner to determine the occlusal relationship of the anterior teeth based on the ANB angle.

Steiner believes that age, sex, race, individual differences, and growth must be considered when setting treatment goals. In Japan, few studies have investigated the relationship between the maxillofacial complexes and dentition using Steiner's analysis. In particular, there has been no systematic study of standard values in normal adults. Therefore, to understand the morphological characteristics of Japanese adults with normal occlusion and to establish guidelines for clinical orthodontics, we investigated each measurement item of craniofacial morphology of skeletal Class I Japanese adult males and females with individualized normal occlusion. We also calculated the standard values of the Steiner analysis, which is widely used for setting treatment goals in orthodontic practice.

MATERIALS AND METHODS

Subjects

The participants in the survey were 1,049 fifth-year students enrolled in Osaka Dental University from 2014 to 2021. Among them, 92 male and 81 female students with skeletal Class Ⅰ maxillofacial morphology and individualized normal occlusion met the inclusion criteria: healthy students who do not have a medical history that might have influenced the growth and development of the teeth, the jaws, or the facial skeleton, and whose bilateral jaw morphology is balanced and harmonized. In orthodontic clinical practice in Japan, the most commonly used cephalometric reference value seems to be the analysis of Iizuka *et al.*[4] We used their analysis as the reference for this study. For males, ∠ANB was 1.5°-3.5°, Interincisal angle was 120°-132°, and ∠FMA was 20°-33°. For females, ∠ANB was 1.5°-3.5°, Interincisal angle was 120°-132°, and FMA was 23°-34°. With regard to occlusion, there should be no abnormality in the number of teeth and no morphological abnormalities in any of the teeth other than the third molars. All of the teeth should be erupted and be in proper maxillomandibular occlusal relation. The pericentric occlusal relationship of the maxillary and mandibular dental arches should be normal, and the both overbite and overjet should be within 1.0-3.0 mm.

Methods

We measured the 14 Steiner analysis items shown in Figure 1 using cephalometric images. The Student's *t*-test was performed on each measurement value comparing males and females. A comparative analysis was done using pre-existing measurement values for Japanese,[6,7] Japanese-Americans,[8] and Caucasians.[5] With regard to facial height based on the mean FMA values obtained, males with ≥26° were assigned to the high-angle

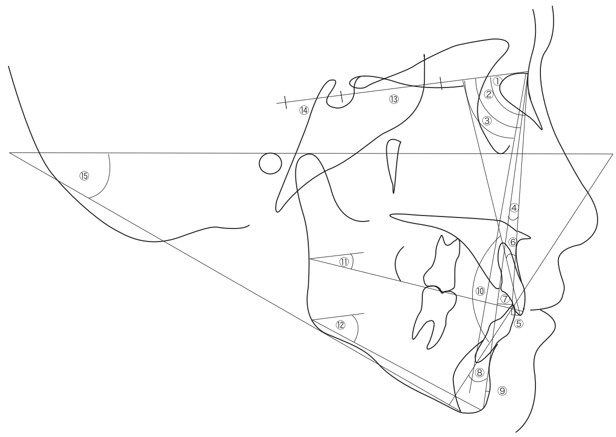

Fig. 1 Measurements on the lateral cephalogram. ① ∠SNA (angle), ② ∠SNB (angle), ③ ∠ANB (angle), ④ ∠SND (angle) (angle formed by the SN plane and the line through the point (D) of the center of the mass of cross-section of the body of the symphysis and S), ⑤ U1 to NA (mm) (shortest distance from edge of the maxillary central incisor to the NA line), ⑥ ∠U1 to NA (angle) (angle formed by the NA line and the axis of the maxillary central incisor), ⑦ L1 to NB (mm) (shortest distance from edge of the mandibular central incisor to the NB line), ⑧ ∠L1 to NB (angle) (angle formed by the NB line and the axis of the mandibular central incisor), ⑨ Po to NB (mm), ⑩ ∠Interincisal (angle), ⑪ ∠Occlusal to SN (angle), ⑫ ∠GoGn to SN (angle), ⑬ SL (mm) (distance from S to the point (L) of the intersection formed by a line from the most anterior point of the mandible (Po) to the SN plane), ⑭ SE (mm) (distance from S to the point (E) of the intersection formed by a line from the most distal point of the head of the condyle perpendicular to the SN plane), ⑮ FMA

Table 1 Subjects in the present study

Subjects	Japanese adults (Yamagata)	Japanese adults (Matsuura)	Japanese adults (Sakata)	Japanese children (Miura)	Japanese-American children (Uesato)
Number	172 (91 M, 81 F)	90 (40 M, 50 F)	19 (21 M, 17 F)	90 (40 M, 50 F)	50 (25 M, 25 F)
Age	Adult	Adult	Adult	7 y 11 m-12 y 4 m	11 y 6 m-18 y 6 m
Mean age	Adult	Adult	Adult	10 y 9 m	14 y 6 m

group, and those with <26° were in the low-angle group; females with ≥29° were in the high-angle group, and those with <29° were in the low-angle group. A comparative analysis was conducted between the groups (Table 1).

RESULTS

In this study, when we compared adult Japanese males and females having skeletal I maxillofacial morphology we found that males had significantly greater ∠SNA, ∠SNB, ∠SND, SL, and SE than females, and significantly smaller ∠Occl to SN and ∠GoGn to SN. Males in the low-angle group showed significantly larger ∠SNA, ∠SNB, ∠SND, and SL than did the low-angle group, and significantly smaller U1 to NA (mm), Interincisal angle, ∠Occl to SN, and ∠GoGn to SN. Females in the low-angle group had significantly larger ∠SNA, ∠SNB, ∠SND, Interincisal angle, and SL than the high-angle group, and significantly smaller U1 to NA (mm), ∠Occl to SN, and ∠GoGn to SN. When our results were compared with pre-existing Japa-

Table 2 Comparison of measurements for males and females

Parameter	Males n=91	Females n=81	t-test (Males and Females)
∠SNA (angle)	82.88±3.23	81.42±3.66	*
∠SNB (angle)	80.18±3.20	78.85±3.49	*
∠ANB (angle)	2.72±0.68	2.57±0.71	NS
∠SND (angle)	76.96±3.28	75.68±3.52	*
U1 to NA (mm)	6.93±1.88	6.99±1.71	NS
U1 to NA (angle)	25.23±4.90	25.13±4.44	NS
L1 to NB (mm)	7.53±2.03	7.06±1.61	NS
L1 to NB (angle)	25.85±4.76	25.90±4.80	NS
Po to NB (mm)	1.79±1.25	1.72±1.21	NS
Interincisal (angle)	125.54±11.98	125.29±5.74	NS
Occl to SN (angle)	15.64±3.50	17.79±4.21	*
GoGn to SN (angle)	30.73±4.19	34.27±4.93	*
SL (mm)	54.05±7.18	46.73±7.56	*
SE (mm)	24.57±3.44	21.57±3.13	*
FMA	25.61±3.58	28.80±3.44	*

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

Table 3 Comparison of pre-existing measurement values for Japanese

Parameter	Japanese adults (M) (Yamagata)	Japanese adults (F) (Yamagata)	Japanese adults (M) (Matsuura)	Japanese adults (F) (Matsuura)	Japanese children (M) (Miura)	Japanese children (F) (Miura)
∠SNA (angle)	82.88±3.23	81.42±3.66	82.67±2.84	81.49±2.36	81.0±3.1	81.5±3.4
∠SNB (angle)	80.18±3.20	78.85±3.49	79.03±2.54	78.07±2.89	76.2±3.1	77.2±3.0
∠ANB (angle)	2.72±0.68	2.57±0.71	3.67±2.60	3.42±2.10	4.9±1.7	4.1±1.8
∠SND (angle)	76.96±3.28	75.68±3.52	–	–	72.8±3.2	73.9±3.1
U1 to NA (mm)	6.93±1.88	6.99±1.71	–	–	5.5±1.7	6.2±1.9
U1 to NA (angle)	25.23±4.90	25.13±4.44	21.60±7.52	22.35±5.50	23.5±4.7	24.7±5.2
L1 to NB (mm)	7.53±2.03	7.06±1.61	8.46±2.87	7.53±2.12	7.8±1.7	7.8±2.4
L1 to NB (angle)	25.85±4.76	25.90±4.80	28.78±4.08	28.89±4.19	31.5±4.5	31.0±6.6
Po to NB (mm)	1.79±1.25	1.72±1.21	–	–	0.44±1.4	0.43±1.2
Interincisal (angle)	125.54±11.98	125.29±5.74	126.50±5.51	125.39±4.41	120.3±5.8	120.3±10.1
Occl to SN (angle)	15.64±3.50	17.79±4.21	16.56±3.27	18.03±3.35	21.0±3.8	19.2±3.7
GoGn to SN (angle)	30.73±4.19	34.27±4.93	–	–	36.4±4.3	36.1±4.6
SL (mm)	54.05±7.18	46.73±7.56	–	–	40.1±5.5	41.9±6.2
SE (mm)	24.57±3.44	21.57±3.13	–	–	21.6±3.3	20.6±2.7
FMA	25.61±3.58	28.80±3.44	30.13±5.32	30.33±5.76	–	–

nese measurements, ∠SNB and U1 to NA (angle) were larger, and ∠ANB, L1 to NB (mm), L1 to NB (angle), Interincisal angle and ∠Occl to SN were smaller in males in our study than for those in Matsuura's study[7] on adults with normal mesiodistal occlusal relationship with the maxillary and mandibular dental arches. In females, U1 to NA (angle) was larger and ∠ANB and L1 to NB (angle) were smaller than Matsuura's values.

When the results of our study were compared with those of Sakata *et al.,*[9] who selected the values of 1°-3° for ∠ANB, which was similar to that of our study, we found larger values for ∠SNA, ∠SNB, ∠ANB, U1 to NA (mm), U1 to NA (°), L1 to NB (mm), L1 to NB (angle), and SL, and smaller values for Interincisal angle and ∠Occl to SN. When our results were compared with the report by Miura *et al*[6] on growing children with normal occlusion, we found larger values in males for ∠SNB, ∠SND, U1 to NA (mm), U1 to NA (angle), Po to NB, Interincisal angle, SL, and SE, and smaller values for ∠ANB, L1 to NB (angle), ∠Occl to SN,

Table 4 Comparison of pre-existing measurement values for Japanese, Japanese-Americans and Caucasians

Parameter	Japanese adults (M and F) (Yamagata)	Japanese adults (M and F) (Matsuura)	Japanese adults (M and F) (Sakata)	Japanese children (M and F) (Miura)	Japanese-Americans (Uesato)	Caucasians (Steiner)
∠SNA (angle)	82.20±3.52	82.08±2.66	80.23±3.50	81.3±3.2	79.8	82
∠SNB (angle)	79.55±3.40	78.55±2.75	78.31±3.57	76.8±3.0	77	80
∠ANB (angle)	2.765±0.69	3.53±2.35	1.92±0.56	4.5±1.7	2.8	2
∠SND (angle)	76.35±3.45	—	76.13±3.60	73.4±3.1	74.8	75
U1 to NA (mm)	6.96±1.80	—	5.06±0.62	5.9±1.8	4.1	4
U1 to NA (angle)	25.18±4.69	21.97±6.55	23.82±3.45	24.1±4.9	22.2	22
L1 to NB (mm)	7.31±1.86	8.46±2.87	4.59±0.37	7.8±2.1	4.7	4
L1 to NB (angle)	25.87±4.78	28.83±4.10	24.49±3.93	31.2±5.6	25.5	25
Po to NB (mm)	1.76±1.23	—	1.47±0.87	0.43±1.3	2.4	—
Interincisal (angle)	125.42±9.56	125.81±4.94	129.75±6.04	120.3±8.5	128.3	131
Occl to SN (angle)	16.65±3.99	17.29±3.37	17.60±3.74	20.0±3.7	18.3	14
GoGn to SN (angle)	32.40±4.89	—	34.45±7.13	36.2±4.5	34.4	32
SL (mm)	50.60±4.89	—	47.40±1.00	41.1±3.0	46.8	51
SE (mm)	23.16±3.44	—	23.70±0.31	21.0±5.9	21.5	22
FMA	25.61±3.62	30.23±5.51	—	—	—	—

Table 5 Comparison of measurements for low angle and high angles in males

Parameter	Low angle n=48	High angle n=43	t-test (Low angle and High angle)
∠SNA (angle)	83.38±2.91	82.34±3.48	*
∠SNB (angle)	80.70±2.71	79.59±3.58	*
∠ANB (angle)	2.68±0.69	2.77±0.66	NS
∠SND (angle)	77.47±2.80	76.40±3.65	*
U1 to NA (mm)	6.81±2.12	7.59±1.58	*
U1 to NA (angle)	25.41±3.99	25.02±5.74	NS
L1 to NB (mm)	7.23±2.00	7.86±2.02	NS
L1 to NB (angle)	25.55±4.72	26.17±4.78	NS
Po to NB (mm)	1.96±1.22	1.59±1.25	NS
Interincisal (angle)	124.92±15.85	126.23±4.73	*
Occl to SN (angle)	15.14±3.31	16.20±3.62	*
GoGn to SN (angle)	28.52±3.25	33.19±3.73	*
SL (mm)	55.60±6.30	52.31±7.72	*
SE (mm)	24.67±3.48	24.48±3.40	NS
FMA	22.76±1.93	28.79±1.94	*

Table 6 Comparison of measurements for low and high angles in females

Parameter	Low angle n=40	High angle n=41	t-test (Low angle and High angle)
∠SNA (angle)	82.35±3.93	80.52±3.13	*
∠SNB (angle)	79.65±3.85	78.07±2.90	*
∠ANB (angle)	2.70±0.67	2.45±0.72	NS
∠SND (angle)	76.38±3.82	75.00±3.05	*
U1 to NA (mm)	6.63±1.73	7.34±1.62	*
U1 to NA (angle)	24.89±4.53	25.37±4.35	NS
L1 to NB (mm)	6.84±1.34	7.28±1.80	NS
L1 to NB (angle)	25.98±4.46	25.83±5.12	NS
Po to NB (mm)	1.78±1.25	1.67±1.15	NS
Interincisal (angle)	126.04±5.69	124.56±5.69	*
Occl to SN (angle)	16.98±4.22	18.59±4.03	*
GoGn to SN (angle)	31.61±3.64	36.87±4.64	*
SL (mm)	48.56±7.98	44.95±6.67	*
SE (mm)	21.39±7.98	21.74±3.23	NS
FMA	25.75±1.68	31.77±1.65	*

and ∠GoGn to SN. In females, we found larger values for ∠SNB, ∠SND, U1 to NA (angle), Po to NB, Interincisal angle, SL, and SE, and smaller values for ∠ANB, L1 to NB (angle), ∠Occl to SN, and ∠GoGn to SN. When our results were compared to pre-existing values for Japanese Americans,[8] we found larger values for ∠SNA, ∠SNB, ∠SND, U1 to NA (mm), U1 to NA (angle), L1 to NB (mm), SL, and SE, and smaller values for Po to NB, Interincisal angle, Occl to SN, and ∠GoGn to SN. When our results were compared with pre-existing values for Caucasians,[5] we found larger values for ∠SND, U1 to NA (angle), L1 to NB (mm), Occl to SN, and SE, and a smaller value for Interincisal angle (Tables 2-6).

DISCUSSION

In order to obtain the reference values for Steiner's analysis of skeletal Class I Japanese adults, we used the reference values of Iizuka *et al.*,[4] which are commonly used in Japan. In the skeletal pattern of our subjects, the ANB angle which indicates the horizontal jaw relationship between the maxilla and the mandible was 1.5°-3.5° for both males and females, and FMA, which indicates the vertical jaw relationship, was 20°-33° for males and 23°-34° for females. Interincisal angle was 120°-132°, and the overbite and overjet were both 1-3 mm. Regarding the standard values for cephalometric analysis that have been reported so far, normal occlusion, ideal occlusion, and good facial features are the main selection criteria for the data.[4, 8, 10-14] There are a few reports using ∠ANB as a selection criterion.[9, 15] However, in previous reports that mainly used the Angle Class I occlusal relationship as the inclusion criteria, because the range of the value for ∠ANB was within the limit of our selection criteria, it was considered appropriate to compare their data with ours. In addition, facial height was classified into low-angle and high-angle groups based on the average value of FMA, and the values for each group were compared. Because many Japanese with malocclusion have maxillofacial morphologies with high angles, it is important to obtain standard values for both high and low angles.

Comparison with pre-existing measurements

The main purpose of this study was to understand the characteristics of skeletal Class I maxillofacial morphology in Japanese adults using Steiner's analysis, and to use this for the treatment goals of orthodontic clinics. By comparing the reference values obtained in this study with the patient's measurements, it will be possible to understand the characteristics of the patient's maxillofacial morphology. This is expected to be useful for diagnosis and treatment planning. Regarding the standard values for skeletal Class I Japanese adults, compared with Matsuura's report,[7] our subjects showed larger values for ∠SNB and U1 to NA (angle), and smaller values for L1 to NB (mm), L1 to NA (angle), and ∠Occl to SN. As a selection criterion for his sublects, Matsuura selected a mesiodistal occlusal relationship between the maxillary and mandibular dental arches is normal (Angle Class Ⅰ). It is thought that the difference in the selection criterion caused the different results. In addition, the selection criteria in our study for FMA were smaller than Matsuura's, suggesting that the angle of inclination of the mandibular anterior teeth was reduced. When the results of our study were compared with those of Sakata *et al.,*[9] we found larger values for ∠SNA, ∠SNB, ∠SND, U1 to NA (mm), U1 to NA (angle), L1 to NB (mm), L1 to NB (angle), and SL, and smaller values for Interincisal angle and ∠Occl to SN. The selection criterion of the study of Sakata *et al.* were almost the same as those of the study by Uesato *et al.* However, in our study, because we added the values of FMA, Interincisal angle, and overjet into the selection criterion, we think that our results were different from those of Sakata *et al.* In addition, since the values of ∠SNA, ∠SNB, and SL were larger than those of other studies, this would suggest that the subjects of our study had a larger anteroposterior diameter of the maxilla and mandible. Compared to pre-existing measured values for Japanese Americans,[8] ∠SNA, ∠SNB, ∠SND, U1 to NA (mm), U1 to NA (angle), L1 to NB (mm), SL, and SE of our study had larger values, while Po to NB, Interincisal angle, Occl to SN, ∠GoGn to SN had smaller values. Uesato *et al.* chose acceptable occlusion, incisor relationship, and balanced facial profile as the selection criteria for their study, which may have produced results different from ours, which did not set a criterion for facial appearance.

Changes in reference values due to growth and development

Compared to the reports by Miura *et al*[6] on growing children with normal occlusion, ∠SNB, ∠SND, U1 to NA (mm), U1 to NA (angle), Po to NB, Interincisal angle, SL, and SE of our study had larger values in males, and ∠ANB, L1 to NB (angle), ∠Occl to SN, ∠GoGn to SN were smaller. In females, ∠SNB, ∠SND, U1 to NA (angle), Po to NB, Interincisal angle, SL, and SE had larger values than in Miura's study, while ∠ANB, L1 to NB (angle), ∠Occl to SN, and ∠GoGn to SN were smaller. These results suggest that ∠SNB, ∠SND, Po to NB, SL, and SE increased, and ∠ANB decreased due to growth and development in the skeletal pattern of the mandible, and that L1 to NB (angle) and ∠Occl to SN decreased due to lingual inclination of the anterior mandibular teeth. This increased the Interincisal angle in the denture pattern. These results suggest that we need to consider that the reference values change with growth and development.

Comparison by facial height

In our study, we also examined differences in reference values caused by differences in facial height. Comparison of the low-angle and high-angle groups in males showed that ∠SNA, ∠SNB, ∠SND, and SL were significantly larger in the low-angle group and, U1 to NA (mm), Interincisal angle, ∠Occl to SN, and ∠GoGn to SN were significantly smaller. Among females, ∠SNA, ∠SNB, ∠SND, Interincisal angle, and SL were significantly larger, while L1 to NB (mm), Occl to SN, and ∠GoGn to SN were smaller. In the high angle group, in order to keep ∠ANB between 1.5°-3.5°, the length of the mandible is larger than that in the low angle cases, resulting in larger ∠SNB, ∠SND, and SL. In addition, the mandibular anterior teeth are inclined lingually to maintain a normal occlusal relationship, resulting in a larger Interincisal angle and smaller L1 to NB (mm) and ∠Occl to SN. The maxillofacial morphology of Japanese with malocclusion often has a large facial height, suggesting that it is necessary to set treatment goals that take into account differences in maxillofacial morphology when performing orthodontic treatment.

Setting treatment goals for the soft tissues

Steiner's analysis[5] focuses on the inclination of the maxillary and mandibular central incisors relative to ∠ANB, NA line, and NB line, and the position of the incisors. It sets the occlusal relationship of the anterior teeth based on ∠ANB, to establish the treatment goal for the individual. However, although improvement of the hard tissue is obtained clinically, soft tissue morphology may not always be satisfactory. Steiner[5] states that sex differences, age, race, amount of growth, and individual differences, must be considered when setting treatment goals. Hagiwara *et al.*[16] stated that it is necessary to consider the thickness of the lips and the thickness of the soft tissues in the mental region in the formulation of orthodontic treatment plans that include tooth movement. The aesthetics of the facial soft tissues should be included in the evaluation of treatment results. Oliver[17] stated that thin lips are more likely to reflect changes in hard tissues than thick lips, and it is thought that there may be differences in lip morphology between females with thin lips, and males with thick lips.

Yogosawa[18] explained that changes in the thickness of soft tissues, including the soft tissues on point B, which are important for soft tissue profile features, are related to the upward and downward movement of the lower lip. He reported that the lateral face of soft tissue at point B was thicker, and the soft tissue in the mental region was thinner, as the lower lip moved vertically. Since the amount of Pogonion protrusion increases or decreases with mandibular rotation and the labial-lingual inclination of the mandibular central incisor, soft tissues change with orthodontic treatment. In the Steiner analysis, we set a treatment goal by citing Holdaway's hypothesis,[19, 20] which states that a good profile can be obtained when the ratio of the distance between the NB line and the mandibular central incisor and the distance between the NB line and Pogonion is 1:1. In addition, various morphologies of the mental region also affect the morphology of the facial profile. In their study of facial soft tissue morphology, Sakata *et al.*[9] extracted the subjects where the distance of Po to NB was more than 2 mm. The reason was that Uesato *et al.* reported that their subjects in their study had good facial profile when the distance of Po to NB was 2.4 mm on average. Sakata *et al.*[9] evaluated the facial soft tissue using the E-line,[21] and reported that 60% of the subjects had good facial profile. In our study, the values for L1 to NB (mm) were 7.53 ± 2.03 for males and 7.06 ± 1.61 for females, with an average of 7.31 ± 1.86. For Po to NB (mm), the values were 1.79 ± 1.25 for males and 1.72 ± 1.21 for females, with an average of 1.76 ± 1.23. Steiner[5] also stated that for the mandibular anterior teeth, the reference value of FMIA was 65 ± 5° for the Tweed triangle, and that the reference value for L1 to NB (mm) in his analysis was 3.5 mm to 5.5 mm. He stated that even if the distance of the L1 to NB is greater than 7-8 mm, the distance of Po to NB should be smaller than 7-8 mm to express a good facial profile. This value was not similar to Holdaway's hypothesis. Po to NB values in our study were smaller than the 2.4 mm in the study by Uesato *et al.*

CONCLUSION

Based on the results of our study, Steiner's idea of the ratio between L1 to NB (mm) and Po to NB, and the characteristics of Japanese facial features, it is necessary to consider a new ratio for the relationship between the position of the mandibular anterior teeth and the mental region in Japanese. In recent years, many studies have reported on the evaluation of facial aesthetics.[22-24] It has been suggested that it is necessary to set numerical targets that consider soft tissue morphology for Steiner analysis when diagnosing orthodontic treatment, setting treatment goals, and evaluating treatment results. As well, it is important to grasp the morphology of individual soft tissues.

This study was conducted with the approval of the Ethics Committee of Osaka Dental University (Approval No. 110801).

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