A MORPHOLOGICAL STUDY ON THE SOFT AND HARD TISSUE FACIAL PROFILE OF HARMONIOUS KOREAN YOUNG ADULT FEMALES*

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INTRODUCTION

The primary purpose of orthodontic treatment is to obtain balanced occlusion with harmonious facial profile. Angle (1907)[1] stated: "The study of orthodontia is indissolubly connected with that of art as related to the human face." Therefore, the artist's mind is necessary for orthodontists in treating orthodontic patients.

Tweed (1966)[2] pointed out the objects of orthodontic treatment as follows: (1) The best balance and harmony of facial lines that is possible, (2) Stability of the denture after treatment, (3) Healthy oral tissues, and (4) An efficient chewing mechanism. Concerning the treatment goal, he gave the highest priority to the balance and harmony of facial line. The patient's concern about orthodontic treatment is also facial appearance. Then, it is possible to say that the correction of the facial profile is one of the important objectives of orthodontic treatment.

It is difficult to establish the criteria of harmony or beauty in the facial profile. The soft and hard tissues which consist of the craniofacial complex have individual differences. And the evaluation of the facial profile changes individually, racially, and with the times.

Since the roentgenographic cephalometry which was developed by Broadbent (1931)[3] and Hofrath (1931)[4] was introduced to orthodontic field, a number of authors (Brodie, et al. (1938)[5], Brodie (1953)[6], Tweed (1954)[7], Wylie (1947, 1952)[8,9], Downs (1948, 1952)[10,11], Steiner (1953, 1959)[12,13], Bjork (1955, 1963)[14,15], Riedel (1957)[16], Graber (1942, 1954)[17,18], Ricketts (1961, 1972)[19,20], Kayukawa (1954, 1955)[21,22], Iizuka (1958)[23], Iizuka, et al. (1957, 1957)[24,25], Sakamoto (1959)[26], Sakamoto, et al. (1963)[27], Nakago (1964)[28], Yamauchi, et al (1967)[29]) made progress in the study of growth and development, and morphological study of craniofacial complex with this method. The roentgenographic cephalometry has been also applied to clinical orthodontics such as diagnosis, treatment planning, and the evaluation of treatment results.

In Korea, after Ahn's research (1961)[30] on the morphological study with roentgeno-cephalometry, Yoo (1970)[31], Jang (1971)[32], Yang (1974)[33]. Lee (1975)[34], Son (1975)[35], Yoo (1976)[36], Lee[37], Kang (1979)[38], Choi (1980)[39], Lee (1984)[40] reported the same kinds of studies after 1970.

* This research was reported at the 340th regular meeting of the Osaka Odontological Society, September 14th, 1985, Osaka.

However, these researchers dealt with the skeletal and denture pattern of the face in the lateral head films. The assessment of soft tissue profile was neglected.

Soft tissue profile varies with the changes of skeletal and denture pattern in growth and development or orthodontic treatment. Therefore soft tissue analysis is necessary for the assessment of the facial profile.

Changes of the soft and hard tissue profile induced with the growth and development and orthodontic treatment have been studied by a number of researchers (Downs (1956)[41], Ricketts (1960)[42], Burstone (1959, 1967)[43,44], Riedel (1950, 1957)[45,46], Baum (1966)[47], Bloom (1961)[48], Subtelny (1961, 1959)[49,50], Wylie (1955)[51], Holdaway (1956, 1983)[52,53], Merrifield (1966)[54], Uesato (1968)[55], Uesato, et al. (1978)[56], Yamauchi (1959)[57], Yogosawa (1961)[58] Ito, et al. (1967)[59], Namura, et al. (1974)[60], Kinoshita, et al. (1982)[61], Kim, et al. (1970)[62], Park (1971, 1972)[63,64], Oh (1982)[65]).

Recently, adult orthodontics is becoming popular due to the technical progress in the orthodontic materials and orthodontic treatment. In adult orthodontics there are two types of treatment procedures: Ordinary orthodontics and surgical orthodontics.

The objectives of these treatment procedures are a beautiful soft tissue profile and a balanced hard tissue profile.

Before treatment orthodontists should have objectives which are achievable with their techniques. In this connection, the standard which guides treatment objectives should be established.

The purposes of this study are to analyze the soft and hard tissues of attractive young Korean females and to establish the standard for orthodontic treatment objectives.

MATERIALS AND METHODS

The oral examination and evaluation of the facial profiles of the 96 Korean young females who are television and movie stars or fashion models, has been made. Five orthodontists selected 36 females from subjects mentioned above based on the occlusion and facial profile, eliminating personal preference of the selectors.

These 36 subjects consisted of six 18-year-olds, ten 19-year-olds, seven 20-year-olds, five 21-year-olds, four 22-year-olds, two 23-year-olds, one 24-year-old, and one 25-year-old. The mean age was 20.16 years.

From the head films of the selected 36 subjects, 30 head films were finally chosen for the study.

The cephalograms were traced on matted acetate tracing papers and digitized for the microcomputer analysis.

Hard tissue analysis

For the purpose of the hard tissue analysis, Downs analysis, Northwestern analysis, Steiner analysis, Wylie analysis, Tweed analysis, and dimensional linear analysis were made. Cephalometric landmarks and reference planes used in this study were as follows (Fig. 1 A,B):

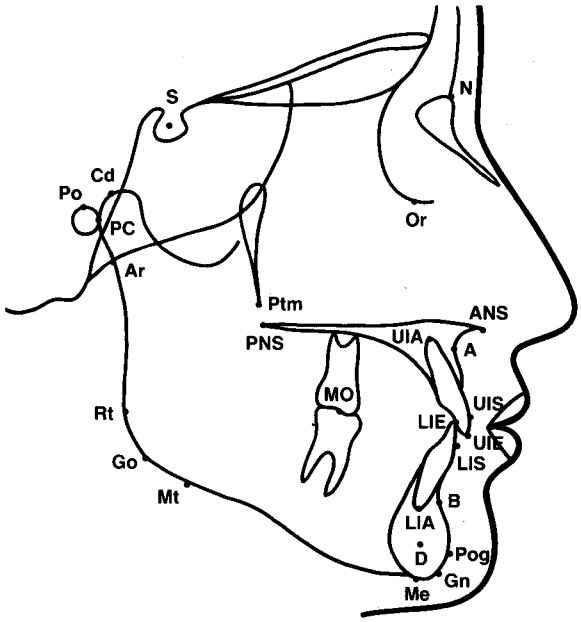

Fig. 1-A Cephalometric landmarks used in the present study

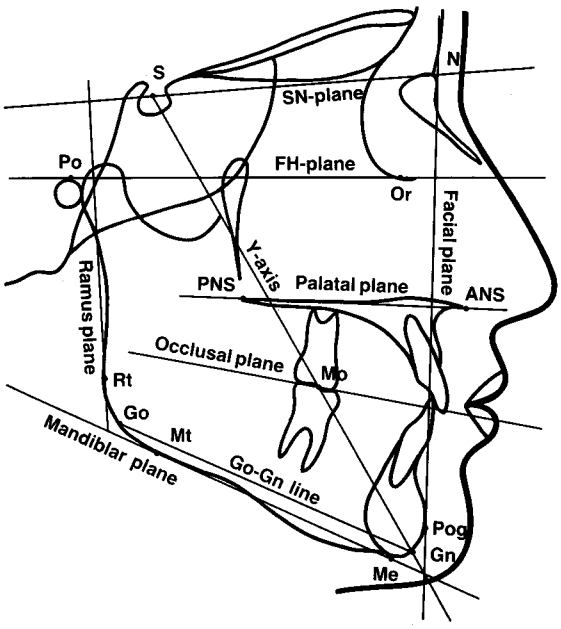

Fig. 1-B Cephalometric reference planes used in the present study

Sella turcica (S)- - - Midpoint of the hypophysial fossa in the median plane.

Nasion (N)- - - The most anterior point of the nasofrontal suture in the median plane.

Anterior nasal spine (ANS)- - - The tip of the bony anterior nasal spine in the median plane.

Point A (A)- - - The deepest midline point in the curved bony outline from the base to the alveolar process of the maxilla.

Upper incisal surface (UIS)- - - The most prominent point on the labial surface of the maxillary central incisor from N–A line.

Upper incisal edge (UIE)- - - The incisal edge of the maxillary central incisor.

Root apex of upper incisor (UIA)- - - The root tip of the maxillary central incisor.

Molare (Mo)- - - The center of occlusal surface of the maxillary and mandibular first molar.

Lower incisal surface (LIS)- - - The most prominent point on the labial surface of the mandibular central incisor from N–B line.

Lower incisal edge (LIE)- - - The incisal edge of the mandibular central incisor.

Root apex of lower incisor (LIA)- - - The root tip of the mandibular central incisor.

Point B (B)- - - The deepest midline point in the curved bony outline from the base to the alveolar process of the mandible.

Pogonion (Pog)- - - The most anterior point of the bony chin in the medial plane.

Gnathion (Gn)- - - The point between the most anterior and the most inferior point of the chin.

Menton (Me)- - - The most caudal point in the outline of the symphysis.

Point D (D)- - - Center of the symphysis.

Mandibular tangent (Mt)- - - The point where the mandibular plane from menton touches

to the lower border of the mandible.

Gonion (Go)- - - The midpoint of the angle of the mandible.

Ramus tangent (Rt)- - - The point where the ramus plane from articulare touches to the posterior border of the mandible.

Articulare (Ar)- - - The point of intersection of the inferior cranial base surface and the averaged posterior surfaces of the mandibular condyles.

Porion (Po)- - - The midpoint of the line connecting the most superior point of the radiopacity generated by each of the two ear rods of the cephalostat.

Post condylar point (Pc)- - - The most posterior point of the condyle.

Condylion (Co)- - - The most posterior superior point on the curvature of the average of the right and left outlines of the condylar head.

Pterygomaxillary fissure (Ptm)- - - The most inferior point on the average of the right and left outlines of the pterygomaxillary fissure.

Posterior nasal spine (Pns)- - - The most posterior point at the sagittal plane on the bony hard palate.

Sella-nasion plane (S—N plane)- - - Line connecting sella with nasion.

Frankfort horizontal plane (F—H plane)- - - Line joining orbitale with porion.

Palatal plane- - - Line connecting the tip of the anterior nasal spine with the tip of the posterior nasal spine.

Occlusal plane- - - Line passing through one half the cusp height of the first permanent molars and one half the overbite of the incisors.

Mandibular plane- - - Line from menton tangent to the posteroinferior border of the mandible.

Gonion-gnathion line (Go-Gn line)- - - Line connecting gonion and gnathion.

Facial plane- - - Line connecting nasion and pogonion.

Y-axis- - - Line joining sella turcica and gnathion.

Ramus plane- - - Line from articulare tangent to the posteroinferior border of the mandible.

Nasion-point A line (N—A line)- - - Line connecting nasion and point A.

Nasion-point B line (N—B line)- - - Line connecting nasion and point B.

Point A-point B line (A—B line)- - - Line connecting point A and point B.

Point A-pogonion line (A—P line)- - - Line connecting point A and pogonion.

Nasion-point D line (N—D line)- - - Line connecting nasion and point D.

Soft tissue analysis

For the evaluation of the soft tissue facial profile, the following measurements which were developed by Holdaway (1983)[53] were taken (Fig. 2):

Soft tissue facial angle- - - The angle formed by a line drawn from soft-tissue nasion (the point where the sella-nasion line crosses the soft-tissue profile) to the soft-tissue chin (the point overlying the hardtissue suprapogonion of Ricketts measured to the Frankfort horizontal plane).

Nose prominence- - - The distance from the nose tip to the line perpendicular to Frankfort

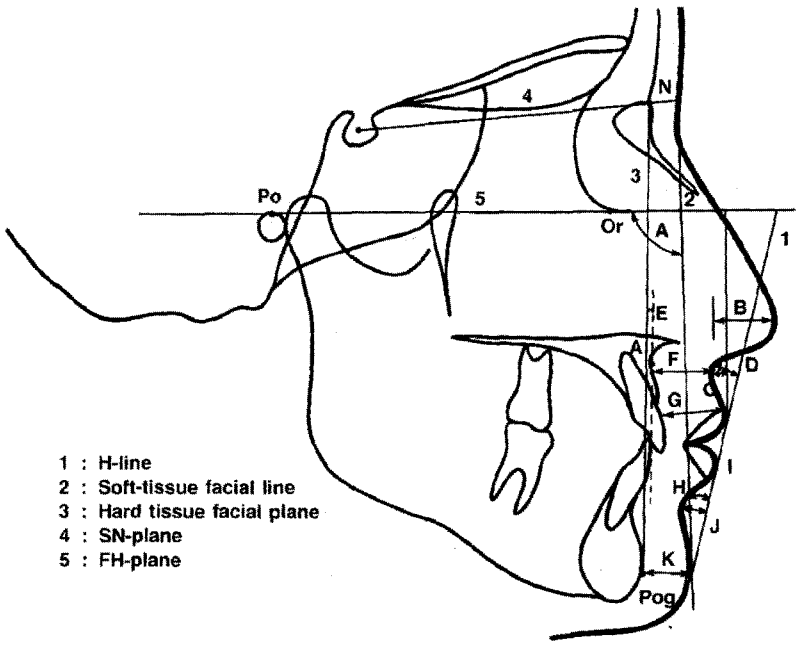

Fig. 2. Cephalometric landmarks used for the soft-tissue analysis (Holdaway)

horizontal and running tangent to the vermilion border of the upper lip and the depth of the incurvation of the upper lip to the line.

Superior sulcus depth- - - The depth of superior sulcus to the line perpendicular to Frankfort horizontal and tangent to the vermilion border of the upper lip.

Soft-tissue subnasale to H line- - - The distance from the point of greatest incurvation between the nose tip and the vermilion border of the upper lip to the H line (The line connecting the soft-tissue chin and the tip of the upper lip).

Skeletal profile convexity- - - The distance from point A to nasion-pogonion line.

Basic upper lip thickness- - - The thickness of soft tissue at a level of the base of the alveolar process, measured about 3mm. below point A.

Upper lip strain measurement- - - The usual thickness of the soft tissue at the vermilion border level.

H angle- - - The angular measurement of the H line to the soft-tissue nasion-pogonion line.

Lower lip to H line- - - The distance from the lower lip to the H line. When the lower lip is situated behind the H line, the measurement is considered to be a minus figure.

Inferior sulcus to the H line- - - The distance from the point of greatest incurvation between the vermilion border of the lower lip and the soft-tissue chin to the H line.

Soft-tissue chin thickness- - - The distance between the two vertical lines representing the rd-tissue and soft-tissue facial planes at the level of pogonion.

The angular and linear measurements mentioned above were made with the micro-computer le II puls, 48K system).

›mparisons of groups were performed with the Student's t test.

RESULTS

I Hard tissue analysis

The following analyses were performed on the Korean adult females with harmonious facial tissues:

1. Downs analysis
2. Northwestern analysis
3. Steiner analysis
4. Wylie analysis
5. Tweed analysis
6. Dimensional linear analysis

The mean values and standard deviations were calculated. Comparisons were made between the present subjects and the groups of subjects used in the original researches of analysis mentioned above, Korean adult females reported by Lee[37], and Japanese normal occlusion subjects.

1. Downs analysis

Fig. 3A, B show the items of Downs analysis for skeletal and denture patterns. The maximum, minimum, and mean values for the present subjects were calculated and comparisons were made between the present subjects and the subjects used in the Downs' study (1948)[10] (Table 1).

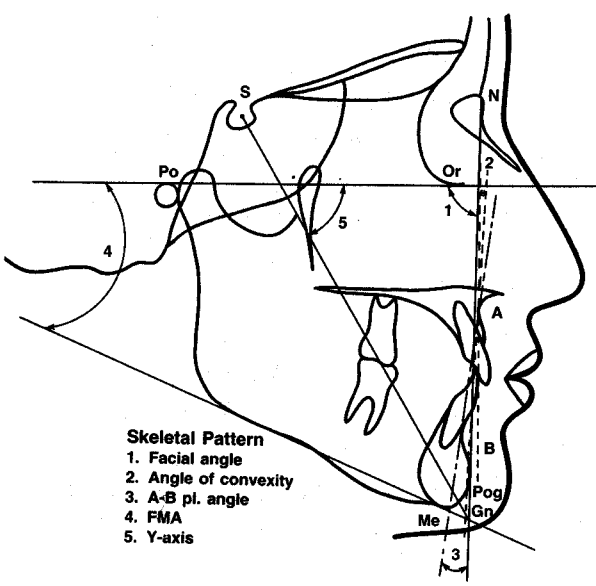

Fig. 3-A The measurement of Downs analysis (skeletal)

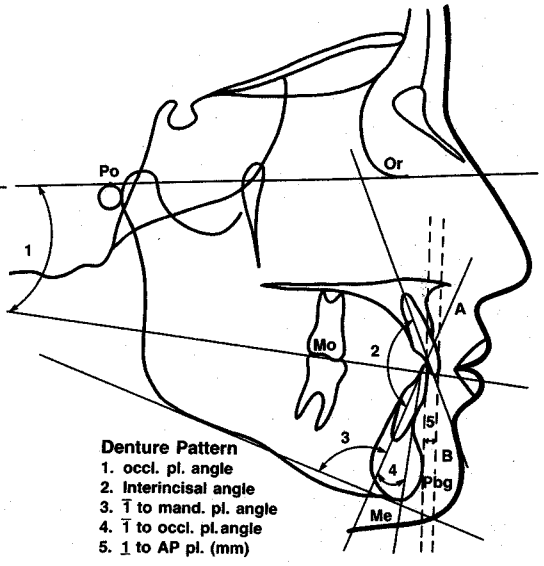

Fig. 3-B The measurement of Downs analysis (Denture)

Table 1 Mean values of Downs analysis in Korean female adult (the present study) and comparison of values in the present study and Downs' study (Caucasian)

	present study				by Downs'			
	Max.	Min.	Mean.	S.D.	Mean.	S.D.	T-value	sig.
Facial angle	89.32	83.88	86.60	2.72	87.8	3.57	1.32	−
Angle of convexity	6.32	−1.64	2.34	3.98	0.	5.09	1.78	−
A-B pl. angle	−2.13	−6.17	−4.15	2.02	−4.6	3.67	0.55	−
FMA	34.00	16.00	26.71	4.47	21.9	3.24	4.06	*
Y-axis	66.23	60.33	63.28	2.95	59.4	3.82	3.96	*
Occl. pl. angle	12.48	6.68	9.08	3.40	9.3	3.83	0.21	−
Interincisal angle	137.32	124.10	130.71	6.61	135.4	5.76	2.53	*
$\overline{1}$ to mand. pl. angle	95.61	85.67	90.64	4.97	91.4	3.78	0.57	−
$\overline{1}$ to occl. angle	23.29	13.25	18.27	5.02	14.5	3.48	2.86	*
$\underline{1}$ to AP pl. (mm)	7.17	3.93	5.55	1.67	2.7	1.80	5.71	*

* significant at 0.05 level

The values for the mandibular plane angle, Y-axis angle, $\overline{1}$ to occlusal plane angle, and $\underline{1}$ to A−P plane angle were significantly greater in the present subject group ($p<0.05$). The value for the interincisal angle was significantly smaller in the present subject group ($p<0.05$).

These results indicated that the mandible of the present subjects was more retrognathic, and the maxillary and mandibular incisors of the present subjects inclined more labially than those of Caucasians.

Table 2 shows the comparison of skeletal and dentofacial relationships in the present subjects and the normal Korean female subjects used in Lee's research[37]

Table 2 Comparison of values in the present study and normal Korean female adult (by Lee)

	present study		by Lee			
	Mean.	S.D.	Mean.	S.D.	T-value	sig.
Facial angle	86.60	2.72	86.54	3.35	1.65	−
Angle of convexity	2.34	3.98	6.23	5.25	2.01	*
A-B pl. angle	−4.15	2.02	−4.90	4.68	0.07	−
FMA	26.71	4.47	27.00	5.87	0.24	−
Y-axis	63.28	2.95	64.53	4.19	1.96	−
Occl. pl. angle	9.08	3.40	10.47	4.88	1.67	−
Interincisal angle	130.71	6.61	123.96	9.74	2.78	*
$\overline{1}$ to mand. pl. angle	90.64	4.97	96.78	7.05	4.32	*
$\overline{1}$ to occl. pl. angle	18.27	5.02	22.88	6.63	4.54	*
$\underline{1}$ to AP pl. (mm)	5.55	1.67	7.07	2.32	4.60	*

* significant at 0.05 level

Comparison of the values for the present subjects and the normal subjects used in Lee's research[37] showed significant differences between the two groups. In the present subjects, the maxillae were retrognathic and the maxillary and mandibular incisors were lingually inclined with significantly smaller values for the angle of convexity, $\overline{1}$ to mandibular plane angle, $\overline{1}$ to occlusal plane angle, and distance $\underline{1}$ to A–P plane ($p<0.05$), and with significantly greater values for the interincisal angle ($p<0.05$). And facial profiles in the present subjects were straight type.

Table 3 shows the comparison of the measurement values in the present subjects and the normal Japanese subjects used in the study of Iizuka and Ishikawa (1957)[25].

Table 3 Comparison of values in the present study and Japanese standard (by Iizuka and Ishikawa)

	present study		by Iizuka et al.			
	Mean.	S.D.	Mean.	S.D.	T-value	sig.
Facial angle	86.60	2.72	84.83	3.05	2.58	*
Angle of convexity	2.34	3.98	7.58	4.95	4.86	*
A-B pl. angle	−4.15	2.02	−4.81	3.50	0.93	−
FMA	26.71	4.47	28.81	5.23	1.81	−
Y-axis	63.28	2.95	65.38	5.63	1.87	−
Occl. pl. angle	9.08	3.40	11.42	3.64	2.82	*
Interincisal angle	130.71	6.61	124.09	7.63	3.90	*
$\overline{1}$ to mand. pl. angle	90.64	4.97	96.33	5.78	4.43	*
$\overline{1}$ to occl. pl. angle	18.27	5.02	23.84	5.28	4.59	*
$\underline{1}$ to AP pl. (mm)	5.55	1.62	8.92	1.88	8.06	*

* significant at 0.05 level

In the present subjects, the mandible was prognathic and the maxillary and mandibular incosors were inclined lingually, resulting in a significantly greater facial angle and interincisal angle ($p<0.05$), and smaller angle of convexity, occlusal plane angle, $\overline{1}$ to mandibular plane angle, $\overline{1}$ to occlusal plane angle, and distance $\underline{1}$ to A–P plane ($p<0.05$).

2. Northwestern analysis

Fig. 4A, B show the items of Northwestern analysis. And Table 4 indicates the maximum, minimum, and mean values of the present subjects and the results of the comparison between the present subjects and the subjects of Riedel's study (1957)[16].

The values for the S–N to mandibular plane angle and distance $\underline{1}$ to N–P were significantly greater, and the SNA angle and SNB angle were significantly smaller in the present subjects ($p<0.05$).

As a result, the statistical value showed that the present subjects had retruded the mandible and labially inclined maxillary and mandibular incisors, compared with those of a Caucasian subject. And the apical bases were small but the apical base relationship was balanced.

Table 5 shows the comparison between the present subjects and the subjects used in Lee's study[37].

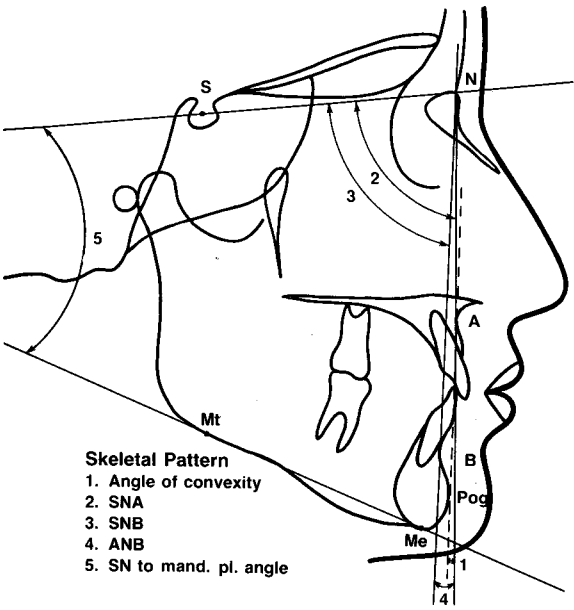

Fig. 4-A The measurement of Northwestern analysis (skeletal)

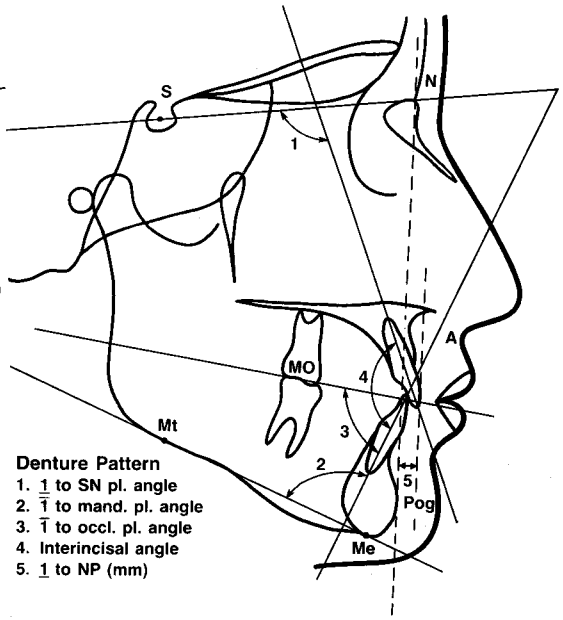

Fig. 4-B The measurement of Northwestern analysis (Denture)

Table 4 Mean values of Northwestern analysis in Korean female adult (the present study) and comparison of values in the present study and Riedel's study (Caucasian)

	present study				by Riedel's			
	Max.	Min.	Mean.	S.D.	Mean.	S.D.	T-value	Sig.
Angle of convexity	6.32	−1.64	2.34	3.98	1.62	4.78	0.69	−
SNA	81.98	76.16	79.07	2.91	82.01	3.89	3.56	*
SNB	79.63	74.43	77.03	2.60	79.97	3.60	3.87	*
ANB	3.49	0.59	2.04	1.45	2.04	1.81	0.00	−
SN to mand. pl. angle	38.72	30.86	34.79	3.93	31.71	5.19	2.78	*
1 to SN pl. angle	108.12	98.56	103.34	4.78	103.97	5.75	0.50	−
1̄ to mand. pl. angle	95.61	85.67	90.64	4.97	93.09	6.78	1.71	−
1̄ to Occl. pl. angle	66.71	76.75	71.73	5.02	69.37	6.43	1.71	−
Interincisal angle	137.32	124.10	130.71	6.61	130.98	9.24	0.14	−
1 to NP (mm)	11.14	6.08	8.61	2.53	5.51	3.15	4.55	*

* significant at 0.05 level

The range of standard deviation for each measurement was small in the present subjects. And the values for the angle of convexity, SNA angle, SNB angle, 1̄ to mandibular plane angle, 1̄ to occlusal plane angle, interincisal angle, and distance 1 to N–P were significantly smaller, but 1 to S–N plane angle was greater in the present subjects.

Table 5 Comparison of values in the present study and normal Korean female adult (by Lee)

	present study		by Lee			
	Mean.	S.D.	Mean.	S.D.	T-value	Sig.
Angle of convexity	2.34	3.98	6.23	5.25	2.01	*
SNA	79.07	2.91	82.56	3.15	4.83	*
SNB	77.03	2.60	78.23	3.57	4.40	*
ANB	2.04	1.45	4.26	1.92	5.40	*
SN to mand. pl. angle	34.79	3.93	35.40	5.81	0.50	—
$\underline{1}$ to SN pl. angle	103.34	4.78	102.82	7.66	2.96	*
$\overline{1}$ to mand. pl. angle	90.64	4.97	96.78	7.05	4.32	*
$\overline{1}$ to occl. pl. angle	71.73	5.02	67.12	6.63	4.54	*
Interincisal angle	130.71	6.61	123.96	9.74	2.78	*
$\underline{1}$ to NP (mm)	8.61	2.53	9.94	3.37	4.37	*

* significant at 0.05 level

The statistical values mentioned above indicated that the present subjects showed more straight profile, compared with Lee's[37] normal Korean female adult subjects.

Table 6 shows the comparison between the present subjects and the subjects used in the study of Iizuka and Ishikawa (1957)[25]. Since they did not measure the S–N to mandibular plane angle, the comparison was not made on this measurement.

Table 6 Comparison of values in the present study and Japanese standard (by Iizuka and Ishikawa)

	present study		by Iizuka et al.			
	Mean.	S.D.	Mean.	S.D.	T-value	Sig.
Angle of convexity	2.34	3.98	7.58	4.95	4.86	*
SNA	79.07	2.91	82.32	3.45	4.27	*
SNB	77.03	2.60	78.90	3.45	2.53	*
ANB	2.04	1.45	3.39	1.77	3.48	*
SN to mand. pl. angle	34.79	3.93	—	—	—	
$\underline{1}$ to SN pl. angle	103.34	4.78	104.54	5.55	0.12	—
$\overline{1}$ to mand. pl. angle	90.64	4.97	96.33	5.78	4.43	*
$\overline{1}$ to occl. pl. angle	71.73	5.02	66.16	5.28	4.59	*
Interincisal angle	130.71	6.61	124.09	7.63	3.90	*
$\underline{1}$ to NP (mm)	8.61	2.53	11.74	2.73	5.04	*

* significant at 0.05 level

In the present subjects, the facial profile was straight with significantly smaller values ($p < 0.05$) for the angle of convexity, SNA angle, SNB angle, ANB angle, $\underline{1}$ to S–N plane angle, $\overline{1}$ to

mandibular plane angle, $\overline{1}$ to occlusal plane angle, and distance $\underline{1}$ to N–P plane and higher value for the interincisal angle ($p<0.05$).

3. Steiner analysis

Fifteen measurements were made on the Steiner analysis (Fig. 5).

Table 7 shows the maximum, minimum, and mean values of the present subjects. Comparisons were made between mean values of the present study and ideal values of Steiner's study, because he did not perform the statistical analysis.

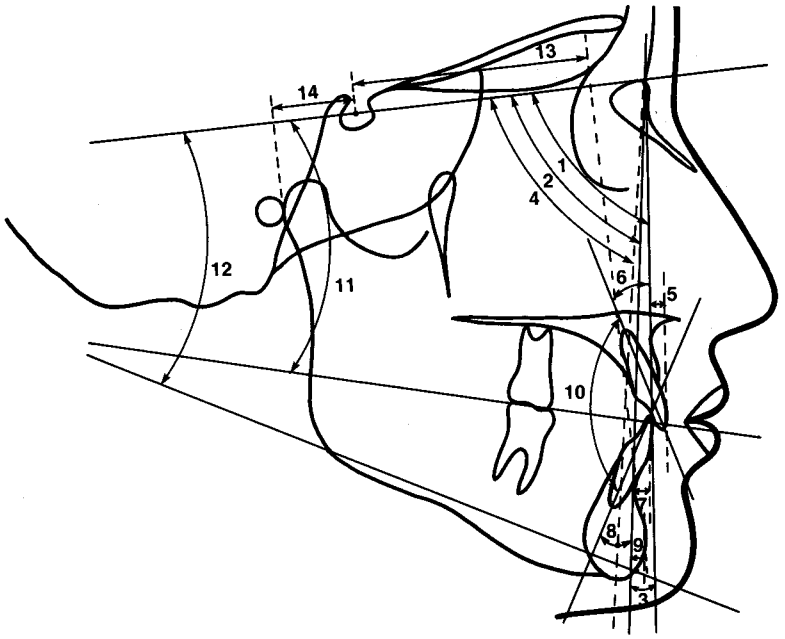

Fig. 5. The measurement of Steiner analysis

In the present subjects, the values for the SNA angle, SNB angle, SND angle, $\overline{1}$ to N–B angle and SL (distance) were smaller and $\underline{1}$ to N–A angle, 1 to N–A (distance), $\overline{1}$ to N–B (distance), Go-Gn to S–N angle, and S–N to occlusal plane angle were greater than Steiner's ideal values. And ANB angle and interincisal angle were about the same.

From the view point of the Steiner analysis, the present subjects had retrognathic but balanced maxillae and mandibles with proclined incisors. However, the differences between the present subjects and Steiner's ideal were within the acceptable range in Steiner's orthodontic diagnosis.

Table 7 shows the comparison of the present subjects and the subjects used in the study of Uesato, et al. (1978)[56]. Uesato, et al. (1978)[56] reported the ideal values for Steiner analysis, using 25 Japanese and Japanese American patients who were excellent facial profiles after orthodontic treatment at his office.

The mean values for each measurement of both groups were almost the same with the exception of SL distance. (SL of the present subjects was 3.31 mm larger than that of Uesato's study).

Table 7 Mean values of Steiner analysis in Korean female adult (the present study) and comparison of values in the present study, Steiner's (Caucasian) and Uesato et al. (Japanese and Japanese American)

	present study				Steiner's ideal	Uesato et al. ideal
	Max.	Min.	Mean.	S.D.		
SNA	81.98	76.16	79.07	2.91	82	80
SNB	79.63	74.43	77.03	2.60	80	77
ANB	3.49	0.59	2.04	1.45	2	3
SND	77.32	71.98	74.65	2.67	76	75
$\underline{1}$ to N-A (mm)	6.91	3.61	5.26	1.65	4	4
$\underline{1}$ to N-A (Angle)	28.25	20.39	24.27	3.88	22	23
$\overline{1}$ to N-B (mm)	7.66	3.72	5.69	1.97	4	5
$\overline{1}$ to N-B (Angle)	27.94	18.02	22.98	4.96	25	26
Po to N-B (mm)	3.52	0.58	2.05	1.47	not Established	2
Pǫ & to N-B	11.80	−1.50	3.65	3.01	Varies	3
$\underline{1}$ to $\overline{1}$ (Angle)	139.06	126.44	132.75	6.31	131	128
Occl. to S-N	21.80	9.50	17.68	3.25	14	18
Go-Gn to S-N	38.72	30.86	34.79	3.93	32	34
SL (mm)	50.23	37.69	43.69	6.27	51	47
SE (mm)	25.89	20.05	22.97	2.92	22	21

4. Wylie analysis

Fig. 6 shows the measurement items of the Wylie analysis. The measurement values for the present subjects and the comparison between the present subjects and the subjects used in the study of Wylie (1947)[8] were indicated in Table 8.

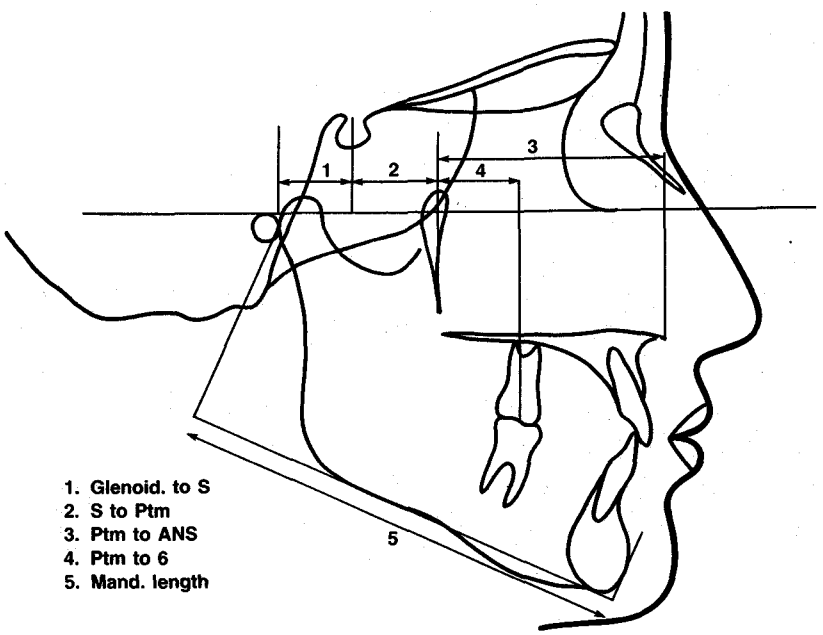

Fig. 6. The measurement of Wylie analysis

Table 8 Mean values of Wylie analysis in Korean female adult (the present study) and comparison of value in the present study, Wylie's study (Caucasian), and normal Korean female adult (by Lee)

	present study				by Lee		T-value	Sig.	Wylie's original
	Max.	Min.	Mean.	S.D.	Mean.	S.D.			
Glenoid. to S	23.70	9.40	18.22	2.76	17.54	2.28	1.18	–	17
S to Ptm	24.30	12.10	18.88	3.34	19.65	2.53	1.15	–	17
Ptm to ANS	59.90	49.10	53.25	2.95	53.59	3.23	0.46	–	52
Ptm to 6	23.40	12.00	16.93	3.23	20.61	5.86	3.12	*	16
Mand. Length	125.50	100.90	112.38	5.76	108.46	4.86	3.21	*	101

* significant at 0.05 level

All measurement values of the present subjects except the ptm to 6 (distance) were larger than the Wylie study. Those differences might be due to the age difference of both subjects. (The present subjects: 20.16 years old, Wylie's subjects: 11.5 years old)

Wylie analysis consisted of the anteroposterior linear measurements of the craniofacial skeleton. Then, it can be said that the balance of the craniofacial skeleton of both groups resemble the data mentioned above.

Table 8 shows the comparison of measurement values between the present subjects and the Korean normal subjects used in the Lee's study[37].

In the present subjects, the mandible grew well and relation of first molars was good, resulting in a significantly greater madibular length ($p<0.05$) and smaller ptm to 6 (distance) ($p<0.05$).

Table 9 shows the comparison of measurement values between the present subjects and Japanese normal subjects used in the study of Iizuka and Ishikawa (1957)[25].

Table 9 Comparison of values in the present study and Japanese standard (by Iizuka and Ishikawa)

	present study		by Iizuka et al.		T-value	Sig.	Wylie's original
	Mean.	S.D.	Mean.	S.D.			
Glenoid. to S	18.22	2.76	19.98	2.80	2.70	*	17
S to Ptm	18.88	3.34	17.90	3.49	1.22	–	17
Ptm to ANS	53.25	2.95	52.53	2.47	1.16	–	52
Ptm to 6	16.93	3.23	20.47	3.00	4.90	*	16
Mand. length	112.38	5.76	109.87	4.33	2.18	*	101

* significant at 0.05 level

The values for the glenoid-sella (distance) and ptm-U6 (distance) were significantly smaller and the mandibular length (distance) was greater in the present subjects ($p<0.05$).

The statistical analysis indicated that the present subjects had greater mandible and more stabilized maxillary molars than Japanese normal subjects.

5. Tweed analysis

Three measurement items of Tweed analysis were shown in Fig. 7. And the result of the statistical analysis was indicated in Table 10.

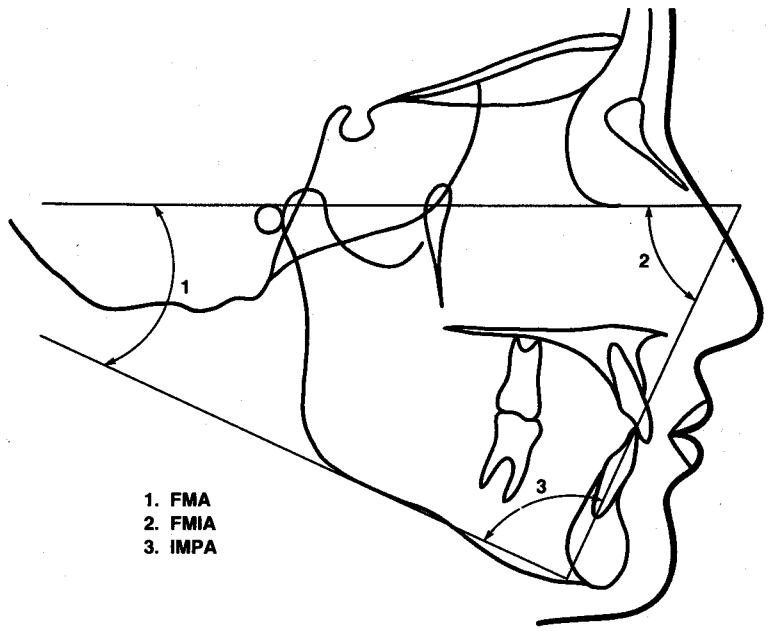

Fig. 7. The measurement of Tweed analysis

Table 10 Mean values of Tweed analysis in Korean female adult (the present study) and comparison of value in the present study, Tweed's study (Caucasian) and normal Korean female adult (by Lee)

	present study				by Lee		T-value	Sig.	Tweed's original
	Max.	Min.	Mean.	S.D.	Mean.	S.D.			
FMA	34.00	16.00	26.71	4.47	27.0	5.87	0.21	—	25
FMIA	71.70	50.90	62.65	5.07	57.14	7.13	3.30	*	68
IMPA	101.90	81.80	90.64	4.98	96.78	7.05	3.83	*	87

The mean values of the present subjects were compared with the values reported by Tweed (1954)[7], because Tweed did not perform the statistical analysis. In the present subjects, the values for the Frankfort mandibular plane angle and incisor mandibular plane angle were greater and Frankfort mandibular incisor angle was smaller than the Tweed's values.

The values mentioned above indicated that the present subjects were hyper divergent type

with proclined mandibular incisors.

Table 10 shows the comparison of measurement values between the present subjects and the Korean normal subjects used in the study of Lee[37].

In the present subjects, the mandibular incisor was upright with significantly smaller values for the incisor mandibular plane angle and greater Frankfort mandibular incisor angle ($p<0.05$).

Table 11 shows the comparison of measurement values between the present subjects and the Japanese normal subjects used in the study of Iizuka and Ishikawa (1957)[25].

Table 11 Comparison of values in the present study and Japanese standard (by Iizuka and Ishikawa)

	present study		by Iizuka et al.				Tweed's original
	Mean.	S.D.	Mean.	S.D.	T-value	Sig.	
FMA	26.71	4.47	28.81	5.23	1.81	—	25
FMIA	62.6	5.07	54.63	6.47	5.73	*	68
IMPA	90.64	4.98	96.33	5.78	4.43	*	87

The value for the Frankfort mandibular incisor angle was significantly greater and the value for the incisor mandibular plane angle was significantly smaller in the present subjects ($p<0.05$). The mandibular incisors of the present subjects were more upright than Japanese normal subjects in the statistical analysis.

6. Dimensional linear analysis

Eighteen measurements were made on the dimensional linear analysis by Sakamoto, et al. (1963)[27]. Fig. 8 shows the measurement areas of the analysis.

A comparison of the measurement values between the present subjects and the subjects used in the study of Sakamoto, et al. (1963)[27] was made (Table 12).

The present subjects exhibited signigicantly greater values for the N-Ans, S'-Ptm', Gn-Cd, and Pog'-Go, while values for the A'-ptm', Is-Is', Ii—Ii', Mo-Mi, and S—S' were significantly smaller.

As a result, the upper facial height and the size of the mandible of the present subjects were greater than the Japanese normal subjects.

II Soft tissue analysis

Holadaway (1983)[53] presented the soft-tissue analysis which demonstrated the inadequecy of using a hardtissue analysis alone for treatment planning. The present study applied his analysis and made his 11 measurements.

Mean values and standard deviations were calculated. And comparisons of the values in the present study and Holdaway's study were made:

1. Measurements of Holdaway analysis on the present study

The mean values and the standard deviations for the present subjects were shown in Table 13.

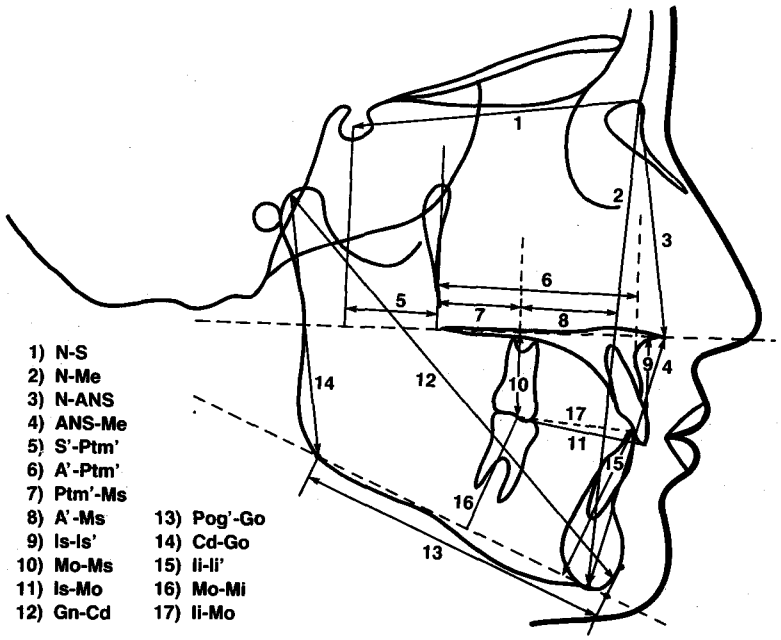

Fig. 8. The measurement of Dimensional linear analysis

Table 12 Mean values of dimensional linear analysys in Korean female adult (the present study) and comparison of values in the present study and Japanese standard (by Sakamoto, Miura and Iizuka)

	present study				by Sakamoto et al.			
	Max.	Min.	Mean.	S.D.	Mean.	S.D.	T-value	Sig.
1) N-S	71.38	66.70	69.04	2.34	68.4	2.4	1.15	–
2) N-Me	133.46	121.24	127.35	6.11	125.4	4.6	1.60	–
3) N-ANS	61.59	56.09	58.84	2.75	55.3	2.7	5.57	*
4) ANS-Me	75.16	66.34	70.75	4.41	72.2	3.7	1.56	–
5) S'-Ptm'	23.50	18.54	21.02	2.48	19.1	2.9	2.99	*
6) A'-Ptm'	49.39	44.63	47.01	2.38	48.3	2.5	2.25	*
7) Ptm'-Ms	21.79	16.43	19.11	2.68	19.2	2.8	0.14	–
8) A'-Ms	30.13	25.67	27.90	2.23	26.9	2.5	1.78	–
9) Is-Is'	31.28	27.26	29.27	2.01	31.9	2.0	5.61	*
10) Mo-Ms	27.41	22.50	24.55	2.86	24.2	1.9	0.65	–
11) Is-Mo	35.13	31.03	33.08	2.05	33.6	2.3	1.01	–
12) Gn-Cd	130.75	118.93	124.84	5.91	119.3	4.4	4.72	*
13) Pog'-Go	84.31	75.65	79.98	4.33	77.2	3.8	2.97	*
14) Cd-Go	69.24	59.76	64.50	4.74	62.4	4.9	1.85	–
15) Ii-Ii'	45.57	40.73	43.15	2.42	44.5	1.5	3.04	*
16) Mo-Mi	34.31	29.65	31.98	2.33	33.8	2.2	3.46	*
17) Ii-Mo	32.32	28.18	30.25	2.07	30.4	2.2	0.30	–
18) S-S' (FH)	21.48	15.86	18.67	2.81	20.7	2.8	3.10	*

*significant at 0.05 level

2. Comparisons of soft-tissue analysis in the present subjects and Holdaway's subjects

Table 13 and Fig. 9 show the comparison of softtissue analysis in the present study and the Holdaway's study.

Table 13 Mean values of soft-tissue analysis in Korean female adult (the present study) and comparison of values in the present study and Holdaway's study (Caucasian)

	present study				by Holdaway's		
	Max.	Min.	Mean.	S.D.	Max.	Min.	Ideal
A. Soft-tissue facial angle	96.6	73.6	88.7	5.02	98.0	84.0	91.0
B. Nose prominence	22.1	11.1	15.14	2.69	24.0	14.0	16.0
C. Superior sulcus depth	6.8	1.7	3.7	1.28	4.0	1.0	3.0
D. Soft-tissue subnasal to H-line	11.5	3.4	7.96	2.18	7.0	3.0	5.0
E. Skeletal profile convexity	5.6	−2.9	1.26	2.14	4.0	−2.0	0
F. Basic upper lip thickness	16.8	10.7	13.3	1.39	16.0	14.0	15.0
G. Upper lip strain measurement	17.0	11.4	13.73	1.51	15.0	13.0	14.0
H. H angle	20.3	9.3	14.19	3.01	15.0	7.0	10.0
I. Lower lip to H-line	5.3	−3.7	4.0	1.84	2.0	−1.0	0
J. Inferior sulcus to H-line	9.9	0.5	4.07	2.06	6.0	4.0	5.0
K. Soft-tissue chin thickness	15.7	7.5	11.57	1.89	12.0	8.0	10.0

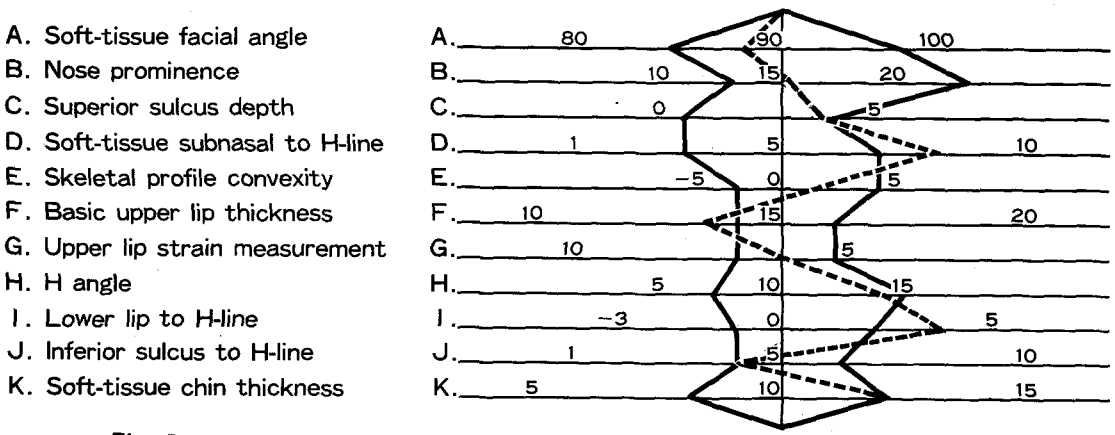

Fig. 9. Comparison of polygon in the present study and Holdaway's study

(1) Soft-tissue facial angle

The mean value, maximum value, and minimum value for the present study were 88.7 degrees (SD 5.02), 99.6 degrees, and 73.6 degrees respectively.

Holdaway's results, however, showed an ideal value of 91 degrees, with an acceptable range of +-7 degrees. The difference of about 2 degrees between these two studies was thought to be small and within the acceptable range, because (hard-tissue) facial angle of the present subjects was also 1 degree smaller than the Caucasian, and the oriental chin was rather smaller than the Caucasian.

(2) Nose prominence

Holdaway's ideal value was 16 mm and the range was 14 – 24mm, while the values for the present subjects were 11.1 – 22.1 mm, with the mean value of 15.4 mm (SD 2.69).

These results might show that the racial difference of nose height between Korean and Caucasian was not so large in these subjects.

(3) Superior sulcus depth

Holdaway's ideal value was 3mm and the range was 1–4mm, while the values for the present subjects were 1.7–6.8mm, with the mean value of 3.7mm (SD 1.28).

(4) Soft-tissue subnasal to H line

Holdaway's ideal value was 5mm and the range was 3–7mm, while the values for the present subjects were 3.4–11.5mm, with the mean value of 7.96mm (SD2.18). Large values of the measurements for the present subjects might be due to the relatively small chins of the present subjects.

(5) Skeletal profile convexity

The mean value, maximum value, and minimum value of the measurements for the present subjects were 1.26mm (SD2.14), 5.6mm, and -2.9mm respectively. Instead, Holdaway's values were -2 – 4mm, with the mean value of 0 mm.

The large measurement value of the angle of convexity for the present subjects reflected this result.

(6) Basic upper lip thickness

This measurement varies with the lip thickness and the strain of the upper lip. Holdaway's ideal value was 15mm and the range was 14 – 16mm, while the values for the present subjects were 13.3 – 16.8mm, with the mean value of 13.3mm (SD 1.39).

(7) Upper lip strain measurement

Following Holdaway's report, in the subject with harmonious denture and lip structure, this measurement is 1mm less than the basic upper lip thickness. Holdaway's ideal values was 14mm and the range was 13 – 15mm, while the values for the present subjects were 11.4 – 17.0mm, with the mean value of 13.73mm (SD 1.51).

(8) H angle

This angle is related to the skeletal convexity or the position of the chin.

Holdaway's ideal value was 10 degrees and the range was 7 – 15 degrees, while the values for the present subjects were 9.3 – 20.3 degrees, with the mean value of 14.19 degrees (SD 3.01).

(9) Lower lip to H line

This measurement is not only affected by the position of the lower incisors but also the position of the chin.

Holdaway's ideal value was 0 mm and the range was -1 – 2mm, while the value for the present subjects were -3.7 – 5.3mm, with the mean value of 4mm (SD 1.84).

(10) Inferior sulcus to H line

This measurement indicates the axial inclinations of the lower anterior teeth after leveling procedures.

Holdaway's ideal value was 5mm and the range was 4 – 6mm, while the values for the present subjects were 0.5 – 9.9mm, with the mean value of 4.07mm (SD 2.06).

(11) Soft-tissue chin thickness

This measurement is also the indicator of the lower incisors' position. Large chin thickness requires protrusive position of the lower anteriors

Holdaway's ideal value was 10mm and the range was 8 – 12mm, while the values for the present subjects were 7.5 – 15.7mm, with the mean value of 11.57mm (SD 1.89).

III Standard values, standard deviations, and the polygon charts

For the purpose of the establishment of the treatment goals of the diagnosis in adult orthodontics and surgical orthodontics, standard values, standard deviations, and the polygon charts of the present subjects for each analysis mentioned above were made (Fig. 10-16).

CEPHALOMETRIC ANALYSIS
DOWNS

	MAX.	MIN.	MEAN	S.D.
FACIAL ANGLE	89.32	83.88	86.60	2.72
ANGLE OF CONVEXITY	6.32	-1.64	2.34	3.98
A-B PLANE ANGLE	-2.13	-6.17	-4.15	2.02
MAND.PL. ANGLE	34.00	16.00	26.71	4.47
Y-AXIS ANGLE	66.23	60.33	63.28	2.95
CANT OF OCCL.PL.A.	12.48	6.68	9.08	3.40
INTERINCISAL ANGLE	137.32	124.10	130.71	6.61
L-1 TO MAND.PL.A.	95.61	85.67	90.64	4.97
L-1 TO OCCL.PL.A.	23.29	13.25	18.27	5.02
U-1 TO A-P PL.(MM)	7.17	3.93	5.55	1.62

(STANDARDIZED BY KANG GOO HAN)

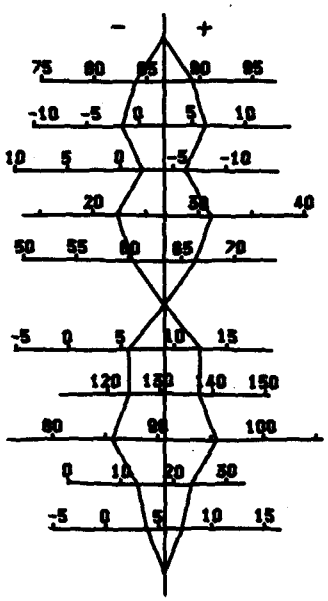

Fig. 10. Standards of Korean female adult

CEPHALOMETRIC ANALYSIS

NORTHWESTERN

	MAX.	MIN.	MEAN	S.D.
ANGLE OF CONVEXITY	6.32	-1.64	2.34	3.98
SNA	81.98	76.16	79.07	2.91
SNB	79.63	74.43	77.03	2.60
ANB	3.49	0.59	2.04	1.45
SN TO MAND.PL. A.	38.72	30.86	34.79	3.93
U-1 TO SN PL.ANGLE	108.12	98.56	103.34	4.78
L-1 TO MAND.PL.A.	95.61	85.67	90.64	4.97
L-1 TO OCCL.PL.A.	76.75	66.71	71.73	5.02
INTERINCISAL ANGLE	137.32	124.10	130.71	6.61
U-1 TO NP (MM)	11.14	6.08	8.61	2.53

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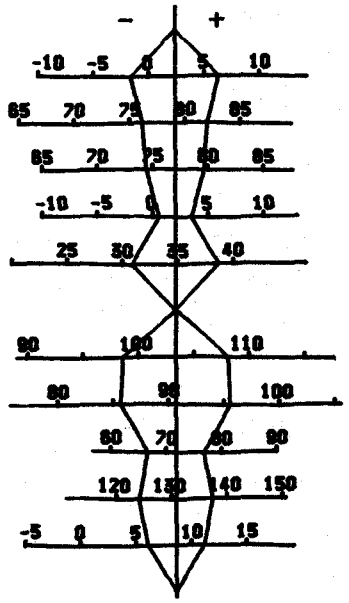

Fig. 11. Standards of Korean female adult

CEPHALOMETRIC ANALYSIS

STEINER

	MAX.	MIN.	MEAN	S.D.
SNA (ANGLE)	81.98	76.16	79.07	2.91
SNB (ANGLE)	79.63	74.43	77.03	2.60
ANB (ANGLE)	3.49	0.59	2.04	1.45
SND (ANGLE)	77.32	71.98	74.65	2.67
U-1 TO NA (MM)	6.91	3.61	5.26	1.65
U-1 TO NA (ANGLE)	28.25	20.39	24.27	3.88
L-1 TO NB (MM)	7.66	3.72	5.69	1.97
L-1 TO NB (ANGLE)	27.94	18.02	22.98	4.96
Po TO NB (MM)	3.52	0.58	2.05	1.47
Po&L-1 TO NB	11.80	-1.50	3.65	3.01
U-1 TO L-1(ANGLE)	139.06	126.44	132.75	6.31
OCCL TO SN(ANGLE)	21.80	9.50	17.68	3.25
GoGn TO SN(ANGLE)	38.72	30.86	34.79	3.93
SL (MM)	50.23	37.69	43.69	6.27
SE (MM)	25.89	20.05	22.97	2.92

(STANDARDIZED BY KANG GOO HAN)

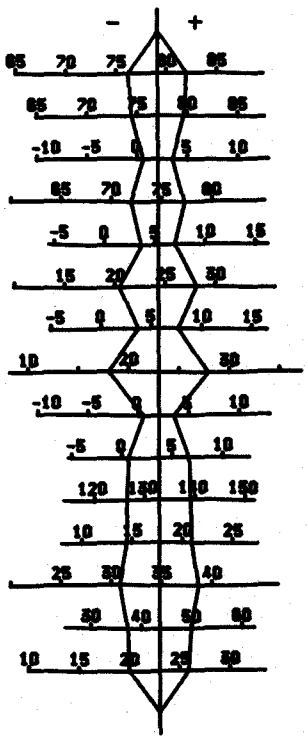

Fig. 12. Standards of Korean female adult

CEPHALOMETRIC ANLYSIS
WYLIE

	MAX.	MIN.	MEAN	S.D.
Glenoid TO S	23.70	9.40	18.22	2.75
S TO Ptm	24.30	12.10	18.88	3.34
Ptm TO ANS	59.90	49.10	53.25	2.95
Ptm TO 6	23.40	12.00	16.93	3.23
Mand.Length	125.50	100.90	112.38	5.76

(STANDARDIZED BY KANG GOO HAN)

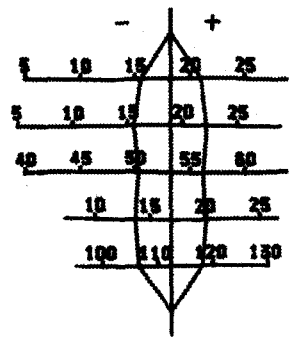

Fig. 13. Standards of Korean female adult

CEPHALOMETRIC ANALYSIS
TWEED

	MAX.	MIN.	MEAN	S.D.
FMA	34.00	16.00	26.71	4.47
FMIA	71.70	50.90	62.65	5.07
IMPA	101.90	81.80	90.64	4.98

(STANDARDIZED BY KANG GOO HAN)

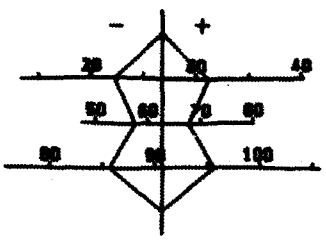

Fig. 14. Standards of Korean fermale adult

CEPHALOMETRIC ANALYSIS
DIMENSIONAL LINEAR

	MAX.	MIN.	MEAN	S.D.
(1) N-S	71.38	66.70	69.04	2.34
(2) N-Me	133.46	121.24	127.35	6.11
(3) N-ANS	61.59	56.09	58.84	2.75
(4) ANS-Me	75.16	66.34	70.75	4.41
(5) S'-Ptm'	23.50	18.54	21.02	2.48
(6) A'-Ptm'	49.39	44.63	47.01	2.38
(7) Ptm'-Me	21.79	16.43	19.11	2.68
(8) A'-Me	30.13	25.67	27.90	2.23
(9) Is-Is'	31.28	27.26	29.27	2.01
(10) Mo-Me	27.41	22.50	24.55	2.86
(11) Is-Mo	35.13	31.03	33.08	2.05
(12) Gn-Cd	130.75	118.93	124.84	5.91
(13) Pog'-Go	84.31	75.65	79.98	4.33
(14) Cd-Go	69.24	59.76	64.50	4.74
(15) Ii-Ii'	45.57	40.73	43.15	2.42
(16) Mo-Mi	34.31	29.65	31.98	2.33
(17) Ii-Mo	32.32	28.18	30.25	2.07
(18) S-S'(FH)	21.48	15.86	18.67	2.81

(STANDARDIZED BY KANG GOO HAN)

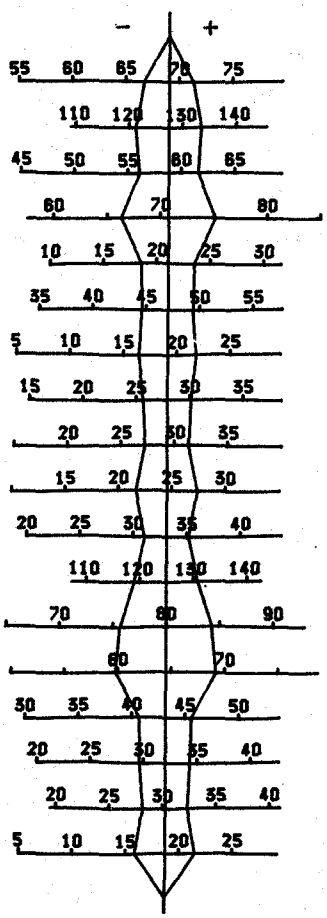

Fig. 15. Standards of Korean female adult

SOFT-TISSUE CEPHALOMETRIC ANALYSIS
HOLDAWAY

	MAX.	MIN.	MEAN	S.D.
A. SOFT-TISSUE FA.	96.60	73.60	88.70	5.02
B. NOSE PROMINENCE	22.10	11.10	15.14	2.69
C. SUPE.SUL.DEPTH	6.80	1.70	3.70	1.28
D. SOFT-T.SUB.TO H	11.50	3.40	7.96	2.18
E. SKEL.PROF.CONVE	5.60	-2.90	1.26	2.14
F. BASIC U-LIP THI	16.80	10.70	13.30	1.39
G. U-LIP STRAIN ME	17.00	11.40	13.73	1.51
H. H ANGLE	20.30	9.30	14.19	3.01
I. L-LIP TO H-LINE	5.30	-3.70	4.00	1.84
J. INFE.SUL.TO H-L	9.90	0.50	4.07	2.06
K. SOFT-T.CHIN THI	15.70	7.50	11.57	1.89

(STANDARDIZED BY KANG GOO HAN)

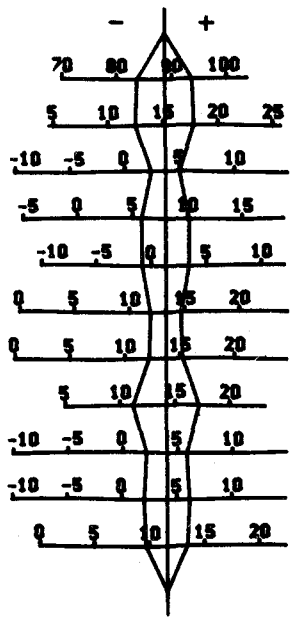

Fig. 16. Standards of Korean female adult

CONCLUSION

For the purpose of the establishment of the treatment goal for adult orthodotics, soft and hard tissue analyses of the lateral head films of 30 Korean female adults who are television and movie stars or fashion models has been made. And the comparisons of measured results in the present study and results obtained from Caucasian, Korean, and Japanese Subjects were made.

The results obtained were as follows.

1. **Hard-tissue analysis**

(1) The comparison between the present subjects and Caucasion subjects

The present subjects had retruded mandibles and labially inclined maxillary and mandibular incisors, compared with the Caucasian. And the present subjects were hyper-divergent type with proclined mandibular incisors.

(2) The comparison between the present subjects and Korean normal female adults (Lee)

In the present subjects, the maxillae were retrognathic and the maxillary and mandibular incisors were lingually inclined. So, facial profiles in the present subjects were straighter, com-

pared with normal Korean female adult subjects.

(3) The comparison between the present subjects and Japanese normal subjects (Iizuka, et al.)

In the present subjects, the mandible was prognathic and the maxillary and mandibular incisors were inclined lingually. And the upper facial height and the size of the mandible of the present subjects were greater than the Japanese normal subjects.

2. Soft-tissue analysis

Of 11 measurements of the soft-tissue analysis, the values of soft-tissue subnasal to H line and lower lip to H line were out of the Holdaway's acceptable range. This might be due to the relatively retruded mandible of the present subjects. The fact that most measurements were within the acceptable range means that the soft tissue moves with the hard tissue.

3. Standard values and the polygon charts of the present subjects

The standard values, standard deviations, and polygon charts of the present subjects for Downs, Northwestern, Steiner, Wylie, Tweed, dimensional linear, and soft-tissue analyses were made.

These items might be good treatment objectives for diagnosis and treatment planning of adult orthodontics and surgical orthodontics.

ACKNOWLEDGEMENTS

The author is indebted to Professor Z. Kinoshita for his valuable advice and encouragement during this work, and to Dr. T. Kawamoto, Dr. I.B. Kim, and Dr. M. Hamada for their helpful suggestion and assistance.

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調和된 側貌上의 軟硬組織의 形態學的 硏究

— 韓國人 成人女子에 對하여 —

大阪齒科大學 矯正學敎室

姜 九 漢·木下善之介

……》國文抄錄《……

本 硏究目的은 女子成人矯正을 위한 治療目標를 樹立하기 爲한 基準을 設定하는데 있다.

利用된 硏究資料는 96名의 韓國人 TV탈랜트와 영화배우 또는 패션모델중 咬合과 顔貌를 評價하여 選定된 30名의 側貌頭部X線規格寫眞이었으며 選定된 標本의 平均年齡은 20.16歲였다.

硏究方法은 側貌硬組織分析을 위해 Downs分析, Northwestern分析, Steiner分析, Wylie分析, Tweed分析, Dimensional linear分析法이 利用되었고 側貌軟組織分析을 위해 Holdaway軟組織分析法이 適用되었다.

調査된 計測値들은 Apple Ⅱ 48K system을 利用하여 各項目에 對한 平均値와 標準偏差를 算出하였으며 白人, 韓國人, 日本人의 旣存計測値와 比較하였다.

그 硏究結果는 다음과 같다.

Ⅰ. 硬組織分析

(1) 本 硏究와 白人과의 比較

本 硏究에서는 白人에 比해 下顎이 後退되었고 上·下顎切齒는 脣側傾斜를 보였다. 또한 下顎下緣傾斜가 심했다.

(2) 本 硏究와 韓國人正常成人女子(李 硏究)의 計測値 比較

李의 硏究計測値에 比해서 上顎이 後退되어있고 上·下顎切齒는 舌側傾斜를 보였다. 따라서 本 硏究의 顔貌形態는 李의 韓國人正常成人女子에 比해서 直線型顔貌를 보였다.

(3) 本 硏究와 日本正常人의 計測値 比較

日本正常人에 比해 下顎이 突出되었고 上·下切齒는 舌側傾斜를 보였다. 또한 顔貌의 上部高徑과 下顎크기는 日本正常人에 比해 크게 나타났다.

Ⅱ. 軟組織分析

軟組織分析의 11項目中 H-線에 對한 軟組織 subnasal과 下脣의 計測値가 Holdaway의 acceptable range를 벗어났다. 그 理由는 本硏究에서 下顎이 相對的으로 後退樣相을 보였기 때문이라고 思料된다. 以外項目의 計測値들이 acceptable range內에 있다는 것은 軟組織이 硬組織의 移動에 따라 움직이고 있음을 意味한다.

Ⅲ. Downs分析, Northwestern分析, Steiner分析, Wylie分析, Tweed分析, Dimensional linear measurements分析을 위한 平均値, 標準偏差, Polygon圖表를 作成함으로써 韓國成人女子矯正의 診斷과 治療目標를 정하는데 指針이 된다고 思料된다.