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SOFT TISSUE PROFILES OF YOUNG ORIENTAL ADULTS

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The purpose of this study was to compare four groups of Oriental young adults (169 males and 174 females) with normal occlusion and well balanced faced. Lateral cephalograms of 100 Koreans, 100 Chinese, 72 Vietnamese and 71 Japanese were digitized and six profile measures were computed. Analyses of variance showed that total facial profile(Gl'-Pr'-Pg') of Chinese was significantly less convex than the profile of Koreans or Vietnamese. Facial profile(Gl'-Pr'-Pg') of Chinese was also significantly less convex than that of Vietnamese. Holdaway's soft tissue angle(Pg'-LS:N-B) was significantly greater in Vietnamese than Chinese and Koreans, who were in turn greater than Japanese. The upper lip of Vietnamese is significantly closer to Ricketts' esthetic plane, than Chinese; Koreans and Japanese are significantly further behind the plane than Chinese. The lower lip of Koreans and Japanese was close to the esthetic plane, while Chinese and Vietnamese were approximately 2mm ahead. The nasolabial angle was significantly smaller for Chinese and Japanese than Koreans and Vietnamese. Sex differences were primarily dependent on the nose; total facial convexity and the nasolabial angle were significantly larger in females than males. The results of this study demonstrate that a single standard of facial profile is not sufficient or appropriate for Oriental patients.

Key Words : Cephalometrics, Oriental, Adults, Normal occlusion, Soft-tissue profile

Facial balance, as expressed by the soft tissue profile, has long been accepted as an important treatment goal in orthodontics and prosthodontics. The soft tissue profile was originally thought to be entirely dependent on the underlying hard tissues; teeth placed in optimal occlusion meant a balanced soft tissue[1]. The soft tissue profile holds its major role in the balance of the lips, the stability of incisors and esthetic harmony of facial appearance[2]. The definition of well-balanced facial profile is conspicuously a dispute to all orthodontists. Yet, the determination of standardized facial profile is not as obscure and of relativity as some would believe, at least not within the Western hemisphere and within the norms of Caucasian ethnicity[3]. Abundant literatures have been dealt with the concept of facial esthetics[4]. Nevertheless the deliberation of these subjects in orthodontic bibliographies is considerably finite, particularly with regard to racial differences. Craniofacial morphology of different Asian ethnic groups has been shown to differ from Caucasian references[5]. Among the significant differences cited for Asian are their greater lower face height, noses less prominent, more protrusive lips, less obtuse nasolabial angle, and greater facial convexity[6]. While relationships exist between hard and soft tissues[7,8], they are less than perfect[9], suggesting that reference data for soft-tissue profiles are necessary to assess facial harmony and provide visual objectives for treatment.

Divergencies in soft tissue profile have been demo

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Table 1. Sample sizes by population and sex.

Population	Males	Females	Total
Chinese	50	50	100
Korean	58	42	100
Vietnamese	41	31	72
Japanese	20	51	71
Total	169	174	343

nstrated among various racial groups. A photographic study of the soft tissue profile of Afro-Americans revealed that Afro-American men and women are more protrusive in soft tissue profile than Caucasian men and women, and those of Afro-American men are more protrusive than Afro-American women[10]. Other investigations of the soft tissue profile have been ubiquitous on Thai individuals[11], on southern Chinese[12], and on Japanese individuals[13,14,15], each naught categorical differences among the various ethnic groups of Asian populations.

In the past the craniofacial morphology of Asian has been viewed as similarity with groups being almost identical to each others. Individual norms for Asian subgroup have been established. The chinese has been the most studied with reference data from Taiwan, Hong Kong, main land China, and Singapore[16,17,18,19]. Regional ethnic differences between the groups were not evaluated. In the past, the Japanese have also been considered as a relative homogenous group. However Nakahashi[20] identified possible difference among the Japanese in western Japan. He has proposed that modern Japanese went through transformation from the late Jomon period to the present with significant regional differences in the degrees and rate of change in certain craniofacial features, especially the facial height. Miura's[21] study among the main land Chinese also indicated there were significant regional differences among the Mongolians in Hohhot and the Hans Chinese in Beijing, Shanghai, Guangzhou, and Changchun. The Mongol have larger facial angle with small mandibular and gonial angle. Despite the attempts to identify regional differences with some of the Asian subgroup, there are no studies which have systemically evaluated clinically relevant difference between Asian

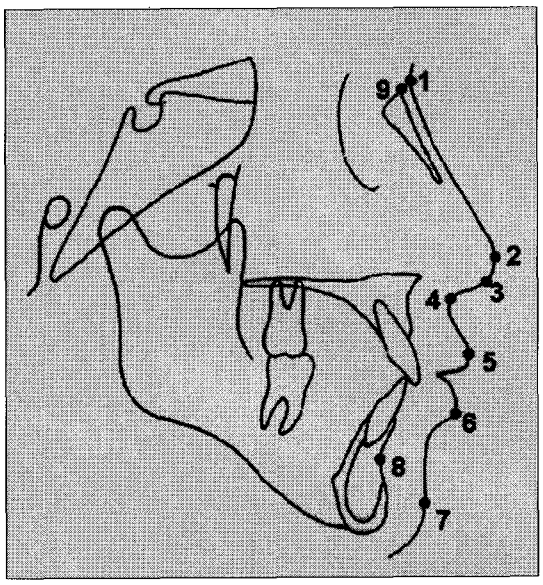

Fig. 1 Nine landmarks identified on cephalogram.
1. Gl(Glabella): the most anterior point of the forehead, in region of the supraorbital ridges.
2. Pr(Pronasale): the most anterior point on the nasal tip
3. Co(Columella): a landmark on the inferior surface of the nose representing the anterior delimiter of the nasolabial angle.
4. Sn(Subnasale): the junction of the columella of the nose with the philtrum of the upper lip
5. LS(Labrale Superius): the mucocutaneous junction of the upper lip and philtrum
6. LI(Labrale Inferius): the mucocutaneous border of the lower lip
7. Pg'(Soft-tissue Pogonion): the most anterior point on the soft tissue chin
8. B(B Point): the deepest point in the concavity of the anterior mandible between the alveolar crest and Pogonion
9. N(Nasion): junction of the frontal and nasal bones at the nasofrontal suture

groups.

The criteria of ideal facial form or balance cannot be universally accepted. Because racial differences are more evident in the face than any other body parts[22], reference data of one racial group cannot be indiscriminately applied to other racial groups[23-30]. It is the purpose of this study is to evaluate the soft-tissue profiles of Orientals with normal occlusion. Japanese,

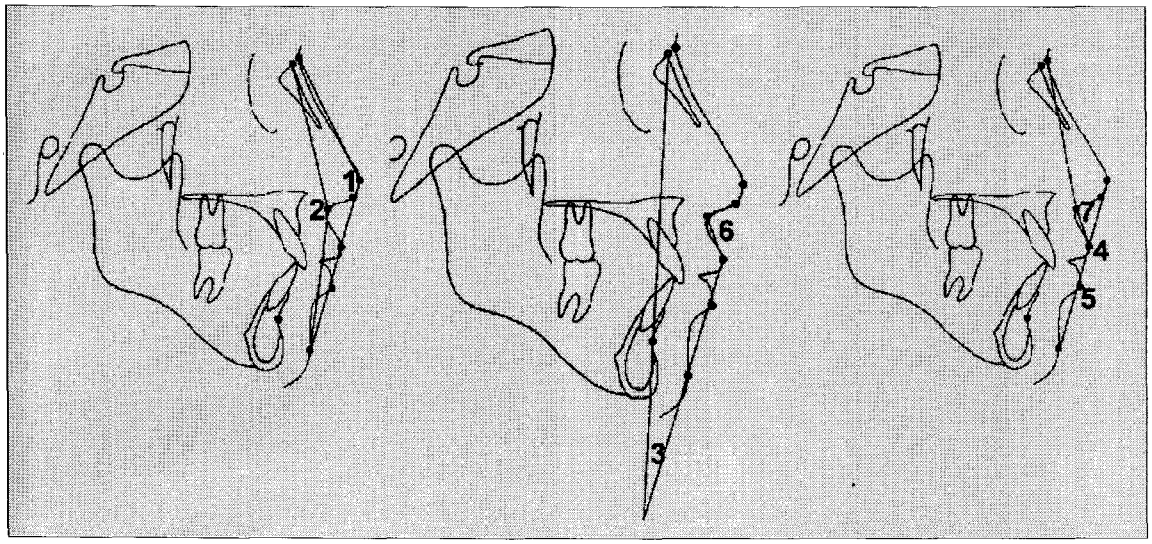

Fig. 2 computed seven measurements on cephalogram
1. Total facial convexity
2. Facial convexity
3. Holdaway's soft-tissue angle
4. Rickett's upper lip to E-line
5. Rickett's lower lip to E-line
6. Nasolabial angle
7. Gl-Sn-LS

Chinese, Vietnamese, and Korean were compared because they are markedly heterogeneous, they make up a substantial portion of the US population, and they have not previously been compared.

MATERIALS AND METHODS

Populations

The subjects (Table 1) of this study included 169 males and 174 females, selected based on the following criteria:

1) Class I molar relationships
2) Clinically acceptable occlusion and pleasing face
3) Adults between 18 and 25 years of age

The data were derived from lateral cephalograms taken with the subjects' heads oriented in the Frankfort horizontal plane. The subjects were not instructed to position the lips in a any way.

Based on standard definitions[31], nine landmarks were identified on each cephalogram including glabella (Gl), pronasale (Pr), columella (Co), subnasale(Sn), labrale superiorus(LS), labrale inferiorus(LI), soft-tissue Pog-onion (Pg'), B point(B), and nasion(N) (Fig. 1).

Table 2. Random method errors and definitions of the measurements

Measure	Abbreviation	Method Error
1 Total facial convexity	Gl'-Pr-Pg'	N.S.
2 Facial convexity	Gl'-Sn-Pg'	N.S.
3 Holdaway's soft-tissue angle	LS-Pg':N-B	N.S.
4 Rickett's upper lip to E-line	Pr-Pg':LS	N.S.
5 Rickett's lower lip to E-line	Pr-Pg':LI	N.S.
6 Nasolabial angle	Co-Sn-LS	N.S.

N.S.; non-significant

Seven measurements were computed to evaluate groups differences in soft-tissue profile(Fig. 2). The linear measurements were corrected for magnification. Replicate analysis of 60 cephalograms showed that there was no significant systematic error. Random method errors and definitions of the measures are given in Table 2.

Group and sex specific distributions for each of the

Table 3. Soft-tissue profile measurements of young oriental adults with normal occlusion.

Measure	Sex	Chinese		Korean		Japanese		Vietnamese	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
GL-Pr-Pg	♂	147.0	4.4	145.0	4.2	145.2	5.8	145.0	4.6
	♀	148.5	4.7	146.2	3.5	147.0	4.6	148.1	4.6
Gl-Sn-Pg	♂	170.7	4.7	169.9	5.2	169.2	5.9	167.9	4.2
	♀	171.0	5.1	170.1	5.2	169.5	4.5	169.8	5.2
Pg-LS:N-B	♂	12.9	3.6	12.0	3.6	4.1	5.3	14.7	3.5
	♀	11.9	4.4	11.3	4.3	5.0	5.2	13.1	4.3
LS:Pr-Pg	♂	-0.9	2.2	-2.0	2.1	-2.9	2.3	-0.1	1.9
	♀	-0.7	2.6	-2.0	2.6	-1.9	2.3	-0.1	2.1
LI:Pr-Pg	♂	1.7	2.7	0.4	2.6	-0.3	2.7	1.8	2.2
	♀	1.5	2.4	1.0	2.6	1.3	2.6	2.1	2.7
Co-Sn-LS	♂	85.6	10.4	94.5	12.6	90.7	10.7	95.3	11.7
	♀	92.6	12.1	93.7	12.3	91.3	9.9	99.4	9.8

measures were evaluated. Because skewness and kurtosis were not significantly different from zero, central tendencies and dispersion were described by means and standard deviations, respectively. A two factor analysis of variance was used to evaluate group and sex differences. Due to significant interaction, group and sex effects were evaluated separately for Merrifield's Z angle.

RESULTS

Group differences (Table 3,4)

Analyses of variance showed significant group differences in total facial profile. Post-hoc tests showed that the group differences can be attributed to the Chnese. Including the nose(Gl'-P-Pg'), Chinese had significantly less convex profiles than either Koreans or Vietnamese; excluding the nose(Gl'-Sn-Pg') they had a significantly less convex profile than Vietnamese only.

Lower facial profile, as defined by LS-Pg', also showed significant group differences. Relative to N-B, the Vietnamese had the most protrusive upper lip, followed by the Chinese and Koreans, and Japanese, whose lower facial plane was almost parallel with N-B. All group differences were statistically significant except the Chinese and Koreans.

The position of the upper lip to Ricketts' esthetic plane(Pr-Pg') also demonstrated significant group differences. The upper lip of Vietnamese was more or less on Ricketts' E-line for Vietnamese, approximately 1 mm behind the esthetic plane for Chinese, 2 mm behind for koreans, and 2-3 mm behind for Japanese. All comparisons were significantly different except the Korean-Japanese.

The lower lips also showed significant group differences. The lower lips of these groups were either on or in front of the E-line. Koreans and Japanese were closest to the E-line; the Chinese and Vietnamese lower lip were approximately 2 mm in front of the E-line.

Finally, the groups showed significant differences in the nasolabial angle(Co-Sn- LS). There was a range of approximately 10 degrees between groups. Post-hoc tests showed that the Chinese and Japanese had signi

Table 4. Analysis of variance comparing facial profile of Chinese(C), Korean(K), Japanese(J) and Vietnamese(V) young adults.

Measure	F Ratio	Prob	Predicted Means** C	K	J	V
Gl-Pr-Pg	4.39	0.005	147.8	145.5	146.5	146.3
Gl-Sn-Pg	2.89	0.036	170.9	170.0	169.5	168.7
Pg-LS:N-B	68.4	<0.001	12.4	11.7	4.8	14.0
LS:Pr-Pg	15.04	<0.001	-0.8	-2.0	-2.3	-0.1
LI:Pr-Pg	4.74	0.003	1.6	0.7	0.8	2.0
Co-Sn-LS	7.93	<0.001	89.1	94.4	90.5	97.3

** Adjusted for group differences

Table 5. Analysis of variance of sex difference in facial profile- adjusted for population differences.

Measure	F Ratio	Prob	Predicted Means** Males	Female
Gl-Pr-Pg	13.61	<0.001	145.6	147.5
Gl-Sm-Pg	1.25	0.26	169.5	170.2
Pg-LS:N-B	2.33	0.13	11.3	10.6
Pg-LS:Po-Or	0.03	0.86	74.1	74.2
LS:PrPg	0.97	0.33	-1.4	-1.2
LI:Pr-Pg	2.53	0.11	1.0	1.5
G-Sn-LS	5.26	0.022	91.1	94.1

** Adjusted for group differences

ficantly smaller angles than the Koreans and Vietnamese.

Sex differences (Table 5)

Sex differences in soft-tissue profile of Orientals are primarily dependent on the protrusion and orientation of the nose. The angle of total facial convexity(Gl'-Pr-Pg') and the nasolabial angle(Co-Sn-LS) were significantly larger in females than males. Sex differences in facial convexity indicate that females have a less protrusive nose than males. Differences of the nasolabial angle suggest that the inclination of the nose - as defined by the columellar region - is oriented more superiorly in females than males.

DISCUSSION

While facial profiles have been reported for various oriental populations[32,33], these results are the first to compare more than two Oriental populations. The differences shown clearly demonstrate that separate reference data are necessary. While profile of Chinese was less convex than the Vietnamese profile, total profile was less convex in Chinese than Koreans or Vietnamese. This suggests that that Korean noses are more procumbent than Chinese, but that their skeletal base is not necessarily more protrusive. Satravaha and

Schlegel[11] showed that if the nose is included in the profile, no significant differences between Chinese and Thai adults. Chinese and Koreans had Holdaway's soft tissue angles that were significantly smaller than Vietnamese, suggesting that their flatter profiles and greater lip protrusion were associated with more protrusive mandibles. The Japanese displayed the smallest Holdaway angle, indicating that they had relatively greater mandibular retrusion and less upper lip protrusion than the other samples. Lin[34] showed that Merrifield's Z angle for the Chinese(74.1 deg.) was significantly larger than the 63.6 degrees reported by Shieshikura[35] for Japanese. Based on Ricketts' esthetic plane, the lips of Vietnamese were more protrusive than the other Oriental populations. Koreans and Japanese lip were the most retrusive. The nasolabial angle was significantly smaller for Chinese and Japanese than Koreans and Vietnamese, was probably associated with orientation of the nasal floor rather than the lip.

Our estimates of facial profile for Chinese were similar to those reported by Lew et al.[5], even though their estimates of lip protrusion were greater than ours. The Holdaway angle reported for Chinese by Lew et al.[5] was 3-4 deg. larger than we reported. Corresponding closely with our results, Lin[34] showed that Chinese adults with normal occlusion had lower lips that were slightly (0.3mm) and upper lips what were 1.2mm behind the E-line. Our results also support previous estimates of lip positions for Japanese and Chinese[11,35]. Our estimates for the nasolabial angle of Chinese are slightly smaller than previously reported by Lew et al.[5] and Satravaha and Schlegel[11].

Sex differences

The results also showed that sex differences were primarily dependent on the nose. Total facial convexity and the nasolabial angle were significantly larger in females than males. Subtelny[8] showed sex significant differences in total profile convexity but not for soft tissue convexity. He showed approxiately 2 degrees more convexity in females than males, as shown in this study. Bishara et al.[36] described sex differences in the growth pattern for total profile convexity but not for soft tissue profile. Lin[34] has also shown that there is no sex differences in skeletal profile of Chinese adults with normal occlusion. Lin[34] also showed that there were no sex difference for Chinese for the Holdaway angle and the distances of the lip to the esthetic plane. The difference in lip position and soft tissue thickness reported for Caucasians[37,38,39] were not substantiated for Orientals. Chiu and Clark[40] showed a significant sex difference between Chinese men and women in the nasolabial angle(90.1 for males and 97.4 for females). They did not show a sex difference in facial profile (N-Sn-Pg), which was 163.4 deg (5.9 sd). Upper lip from E-line did not show a sex difference (average-0.6), although lower lip did (males 1.0 vs 1.9 for females).

Comparison of Orientals and Caucasians

Bishara et al.[36] estimate that total facial convexity of males and females at 140.2 deg. and 138.9 deg., respectively. The results of this study show that total facial convexity of orientals to be substantially larger (145.0-148.1 deg.). Facial convexity (without the nose) of Orientals was also larger than previously reported for Caucasians. Similar differences in convexity have been previously reported for Chinese and Thais[5,11]. Skeletal convexity has also been reported to be significantly greater in Chinese and Japanese than Caucasian norms[5,34].

Chiu and Clark[40] showed that the lower third of the face showed the greatest differences between young adult southern Chinese with Class I occlusions and their Caucasian counterparts. The Chinese profile was more convex and the lip more protrusive. In comparison with Caucasians, Park et al.[6] showed that the incisors of Koreans were more protrusive and the lips were more protruded. In comparison with Caucasians, Engel and Spolter[41] showed that Japanese had more protrusive teeth and a more vertical mandibular growth pattern.

Compared to Caucasians[36] protrusion of the upper lip, as measured by Holdaway's soft tissue angle, was greater in Chinese, Koreans, and Vietnamese, Lew et al.[5] showed that the lips of Chinese were more

protrusive than Caucasians. Protrusion of the Japanese lip compared well with the Caucasian standards. It has been suggested that the Holdaway angle[42] should be between 7-9 degrees with normal ANB angles, and it should increase as the ANB increases.

Our results show that Oriental lips are significantly more protrusive than those of Caucasians. Ricketts[37] suggested that the upper lip should be approximately 4 mm behind his esthetic plane and the lower lip should be located 2mm behind the plane; these estimates are only slightly less than those reported by Bishara and coworkers[36]. In contrast, the upper lips of Orientals are only slightly behind while the lower lips tend to be ahead of the esthetic plane, as previously reported for Chinese adults with normal occlusion[34,35]. The nasolabial angle of Oriental is also different that that of Caucasians. Lew et al.[5] showed that the Chinese nasolabial angle was less obtuse than that of Caucasians (nasolabial=95).

SUMMARY AND CONCLUSION

It is meaningful for the clinician in a heterogenous country such as the United States to have the appreciation for the differences among various ethnic groups, especially for Asian people who have make up 2.76 % (1990 US Census from US population of 248,709,873) of the US population. Besides it is pertinent to have current reference data. Multifarious physical anthropologists have proposed that the generations' weight and height of every developing Asian countries tend to increase year by year. Henceforth multivariate analyses are imperative to determine the relative contribution of the different variables toward determining group differences. The precipitated results of present study proclaim that a single archetype of soft tissue facial profile is not competent and felicitous for Asian patients.

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국문초록

아시아 성인 연조직 측모의 비교분석

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이 연구는 정상 교합과 양호한 안모를 가진 169명의 남자와 174명의 여자 아시아 각국 인을 대상으로 연조직 측모의 특징을 비교 분석하기 위하여 시행되었다.

100명의 한국인, 100명의 중국인, 72명의 월남인 및 71명의 일본인으로부터 촬영된 측모두부방사선사진 상에서 9개의 계측점을 설정하고 전산 입력한 뒤 6 개의 연조직 계측 항목에 대한 측정을 시행한 후 통계 처리하였다.

분산 분석에서 중국인의 총 측모(GI′-Pr-Pg′)는 한국인이나 월남인에서 보다 적은 돌출도를 보였다($P<0.01$). 중국인의 안면평면측모(GI′-Sn′-Pg′) 역시 월남인 보다 적은 돌출각을 나타내었다($P<0.01$). 홀더웨이의 하순각(Pg′-LS : N-B)은 월남인에서 가장 컸고 다음으로 중국인, 한국인, 일본인의 순으로 크게 나타났다. 월남인의 상순은 중국인에서보다 리켓츠의 심미적 기준선에 더 많이 근접하였고 한국인과 일본인에서의 상순은 기준선 보다 후방에 위치하였다. 한국인과 일본인의 하순은 심미적 기준선에 근접한 반면 중국인과 월남인의 하순은 기준선 보다 2 mm 전방에 위치하였다. 한국인과 월남인의 비순각은 중국인과 일본인에서 보다 큰 것으로 나타났다. 남녀 간의 성차는 기본적으로 코의 높이에서 상이하였고 이로 인하여 여자에서의 총 측모각과 비순각이 남자보다 크게 나타났다($P<0.001$).

이러한 결과는 아시아 각국인 들의 연조직 측모에 대하여 단일 표준치에 의한 분석 평가가 적절하지 않으며 각 인종별 표준치 설정의 필요성을 시사한다.

주요 단어 : 측모두부방사선사진, 아시아 성인, 정상교합자, 연조직측모