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Cephalometric Soft Tissue Profile Analysis of Young Adult Koreans and Comparison with Caucasians

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CEPHALOMETRIC SOFT TISSUE PROFILE ANALYSIS OF YOUNG ADULT KOREANS AND COMPARISON WITH CAUCASIANS

By

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DEDICATION

to

My parents, wife, son and daughter,

in appreciation for their many sacrifices

which have made my education possible.

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VITA

The author, Joong-Chul Ahn, is the second son of Seok-Joon Ahn and Eun-Hee Ahn. He was born on November 23, 1952, Seoul, Korea.

He graduated from Seoul High School in Seoul, Korea, in February, 1971. His predental study was completed at College of Liberal Arts and Science, Seoul National University and he received the degree of Bachelor of Science in February, 1973. He entered Seoul National University, College of Dentistry, in March, 1973 and received Doctor of Dental Surgery degree in February, 1977. Following graduation he attended the Korean army and served three years as a dental officer. In 1978, while attending military service, he was married to Seung-Jin Lee and they have two children, Joon-Hyung and Joo-Young.

After three years of military service, he began his general practice in Seoul, Korea, in 1980.

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CHAPTER I

INTRODUCTION

Cryer in 1904 stressed three basic principles in the correction of malocclusions of the teeth and their supporting structures. First, he advised the orthodontist to carefully study the facial outline, especially as it should appear in the age group with which he was dealing; second, the difference in treatment demanded by the male and female type of face must be remembered; and third, the individual variation should be considered and each case treated according to its own merits and requirements. To these principles should be added the fourth one "racial difference". To be able to accurately interpret the problem existing in a patient and to select the appropriate treatment plan, calls for the use of the norms or standards for patients of different ages, sex, and races.

There have been numerous studies considered facial esthetics of Caucasians through either a philosophical approach (a method of appraising facial profile simply by discussion of opinions based on observations by various men) or a clinical approach (a method based on scientific investigation such as anthropologic, radiologic and photographic methods). However, a review of the Korean literature reveals that there exists few studies considered with an evaluation of facial esthetics in the Korean.

With the increasing number of Koreans seeking treatment from the orthodontist, the oral and maxillofacial surgeon, the plastic and reconstructive surgeon, and the maxillofacial prosthodontist, it has become apparent that there is a need to determine soft tissue profile norms for the Korean.

It was not the purpose of this paper to offer information on techniques to change the facial profile by altering the shape of soft tissue. Rather, it is hoped that through this work, some of the informations about the Korean's profile will be opened to clinicians, and that will increase their diagnostic knowledge for the Korean people. Hence, an attempt was made to get a more complete assessment of the soft tissue profile in young Korean adults and to evaluate the difference between Koreans and Caucasians.

The main objectives of this study may be summarized in five statements:

1. To analyze the soft tissue profile of a normal sample from radiographs of young Korean adults.
2. To establish the soft tissue profile "norms" or standards for the young Korean adults.
3. To determine the sexual difference between Korean males and females in the integumental profile.
4. To compare the soft tissue profile differences racially between Caucasians and Koreans using various measurements.
5. In addition, to detect any significant differences between the previous Korean studies and this study.

CHAPTER II

REVIEW OF LITERATURE

A. CAUCASIAN STUDIES

Angle was one of the first orthodontists to write about facial harmony and beauty. In his chapter on facial art, Angle (1907) used such terms as "harmony or inharmony, beauty or ugliness, and perfection or deformity." He stated, "The study of orthodontia is indissolubly connected with that art as related to the human face." He emphasized the importance of the mouth in facial esthetics and the necessity for a full complement of teeth in normal occlusion as being critical for the best balance, harmony, and proportions of the mouth in its relation to the other facial features. Angle further stated that in the analysis of any profile, the upper teeth, not the lower, established the curve of the lower lip.

Lischer, in 1919, considered variations and modifications of facial features and discussed the variations in the length of the upper lip as well as the relative protrusion and retrusion of the lips when viewed in profile. He classified modifications of the facial features which were caused by anomalies of the dentition into (a) malrelation of the lips, (b) malfunction of the lips, (c) malformation of the lips, and (d) malformation of the jaws and their processes.

Weurpel (1937), in his article 'On facial balance and harmony' discussed the importance for the orthodontist to understand clearly what type of face he is operating upon, whether it be Greek, Roman, Greco-Roman, Semitic or Mongolian. He stated that the final objective, aside from the restoration of normal occlusion, should be to restore the face to its very best appearance and that distortion of the facial type should be avoided. He considered the nasal line was of vast importance in the appearance of the individual and stressed the importance of the length and the direction of the line forming the upper lip, from the end of the nose to the beginning of the lip.

Hellman (1939) utilized absolute measurements from the sixty-two young adult males (dental and premedical students) who had the full complement of teeth in normal occlusion and he determined means and standard deviations of certain elements involved in facial height, width, and depth. He found that their facial features were extremely variable even though they revealed normal occlusion.

Riedel (1950) gathered the opinions of seventy-two practicing orthodontists concerning their subjective evaluations of the traced soft-tissue profile outlines of twenty-eight subjects. Two groups of patients were examined: (1) children and adults possessing clinically normal occlusions and (2) cases of orthodontically corrected malocclusions. Facial esthetics were rated as "good", "fair", and "poor". He found a remarkable uniformity of opinion concerning soft tissue profile outlines among these orthodontists. Riedel stressed that the soft-tissue profile was closely related to the skeletal and dental structures.

Tweed (1953) developed his rule of "compensation". This was the principle of clinically relating the mandibular incisor axis to the mandibular plane in plus or minus equivalents according to the variation of the Frankfort-mandibular plane angle. He felt that ideal facial balance is reached in a given patient, regardless of the severity of the Frankfort-mandibular plane angle, if clinically, the axis of the lower incisor can be made to reach a 65 degree angle with the Frankfort plane.

Stoner (1955) devised a method of analyzing the facial profile, which he termed "photometric analysis". He established certain landmarks on the profile, particularly on the lower face, from the profile photographs. The angle between the Frankfort plane and the facial plane (a plane tangent to soft-tissue nasion and pogonion) was evaluated. And from this facial plane, sagittal positions for the upper lip, lower lip, and chin were assessed on the basis of angular measurements.

He studied thirty-four profile photographs that exhibited excellent form and balance which were taken from case reports in dental and orthodontic literature. Stoner also studied pretreatment and post-treatment profile photographs of fifty treated cases from his patients and the mean and standard deviation of each record were tabulated and compared.

The study indicated that the forehead and nose did not change significantly during treatment. Increases in vertical dimension of the hard tissues were reflected proportionately in the overlying soft tissues.

Pelton and Elsasser (1955), utilizing the Elsasser orthometer (an anthropometric instrument to obtain profile point readings in relation to a vertical plane 20 mm. anterior to the point nasion and at right angles to the Frankfort horizontal plane), studied the forward and downward growth of the integumental profile. The sample included 3,676 white males and 3,153 white females in the 5 to 24 years age range. The horizontal distance from the plane of reference to the subnasale, to the upper incisor, and to the soft tissue pogonion were measured. And the vertical distance from nasion to subnasion and from nasion to the lowest chin point were also evaluated. The sample was divided into six groups according to their ages in both sexes. They compared the means of various measurements in different age groups and concluded that there was an increase in facial prognathism with advancing age. And they found that the increase in mandibular prognathism was greater in females. They concluded on the basis of this cross-sectional study that the basic facial pattern changed with growth.

Muzj (1956) used a soft tissue profile analysis which he called "Muzj's fronto-facial angle". This was formed by two lines which, starting from the subnasale point, went upward to the frontal point and downward to gnathion. He also drew a horizontal line joining subnasale to Bolton point, intersecting the frontal facial angle, to determine the forward or backward position of gnathion. He concluded that not only did the forehead play an important role but also was one of the principal elements to be considered in examination of the soft tissue profile.

Riedel (1957), with a view to determining concepts of facial esthetics, attempted an investigation of esthetics, not from the view-

point of the orthodontist, but from the one of the general public. He analyzed the facial patterns of thirty Seattle Seafair queens and princesses. Tracings were made from the lateral headfilms with teeth in occlusion and means were derived for various skeletal, dental and soft tissue angular measurements, as well as linear measurements. The following measurements of the soft tissue were included: (1) The thickness of the tissue of the upper lip from the most labial surface of the maxillary incisor to the most prominent portion of the soft tissue of the upper lip. (2) The tissue thickness from the labial surface of the most prominent mandibular incisor to the most prominent point on the soft tissue of the lower lip. (3) The tissue thickness from point A to the innermost curvature of the soft tissue between the nose and the upper lip. (4) The thickness from the most labial surface of the upper incisor to the most prominent point of the lower lip, and (5) The lines were drawn on the soft tissue profile outlines from the chin to the lower lip and from the chin to the upper lip. From his findings of the soft tissue profile, he concluded that in approximately one-half of the cases, the upper lip, lower lip, and chin fell on a straight line which was in disagreement with artist's concepts that nose, upper lip, lower lip, and chin should fall along a single plane. He also concluded that the public's concepts of acceptable facial esthetics were apparently in good agreement with standards established by orthodontists on the basis of normal occlusion.

In 1957, Ricketts published the article 'Planning treatment on the basis of the facial pattern and an estimate of its growth'. The first part of this article was dealt with cephalometric procedures

and findings, culminating in the application of a single head film for the estimation of growth and treatment changes. In the second part, he discussed the esthetic consideration in treatment planning. A line drawn from the end of the nose to the chin was used to describe the mouth to the adjacent structures such as nose, cheek, and chin. This line was referred to as the "esthetic plane" and the lips were measured anterior or posterior to this line. After analyzing three profile pictures which appeared on the covers of leading magazines within a month's time, he stated that the lower lip was approximately 2 mm. and the upper about 4 mm. posterior to this line, with a standard deviation of ± 3 mm. He observed that most orthodontists termed a case "disharmonious" or "imbalanced" when the lips extended forward of this plane.

On consideration of some of his data on cross-sectional basis, Ricketts found (1960) with respect to mandibular incisor, facial contour , and lip relations, a consistent decrease in convexity of the face from the "deciduous dentition age to the full adult dentition age." Lips were seen to become progressively more retracted relative to the esthetic plane.

In his later article (1968), Ricketts established a working hypothesis for an objective of the lower lip in treatment of patients of pubertal age or for the typically finished case at the age of 12 to 14 years. The mean was adopted to be -2 mm. ± 3.0 for the lower lip behind the "E" plane.

Recently, in the "Comprehensive Computer Description" (C.C.D.) he stated that the lower lip fell 2 mm. ± 2.0 behind the "E" plane at age 8½ and decreased (less protrusive) 0.2 degree per year.

He gave the "law of lip relationship" which stated, "In the normal white person at maturity, the lips are contained within a line from the nose to the chin, the outlines of the lips are smooth in contour, the upper lip is slightly posterior to the lower lip when related to that line, and the mouth can be closed with no strain."

Burstone (1958) devised a method of direct integumental analysis by employing angular readings that described facial components to the skull as a whole (inclination angles) and to each other (contour angles). These readings were made from oriented lateral headplates exposed to show both hard and soft tissue detail. A sample of fifteen males' and twenty-five females' "acceptable" faces chosen by three artists at the Herron Institute of Art from more than 100 frontal and lateral photographs was used and he complied an integumental profile grid of acceptable young adult faces from which graphic comparison could be made. Seven points were selected on the soft tissue profile view: glabella, subnasale, superior labial sulcus, labiale superius, labiale inferius, inferior labial sulcus, and soft tissue menton. He related these points to the nasal floor and to each other, thereby establishing inclination and contour angles. A mean value and standard deviation for a group of acceptable young Caucasian adult faces were then established.

In 1959, Burstone studied "integumental contours and extension patterns" of two samples from the same artist-chosen Herron sample. The first sample represented an adolescent group of eleven males and twenty-six females with a mean age of 14.7 years and a range from 13.4 to 15.6, which includes an age range at which orthodontic treatment is terminated in many instances. The second, a young adult group,

possessed a mean age of 23.8 with a range from 16.5 to 36.3 including fifteen males and twenty-five females. In terms of orthodontic treatment, this sample reflects the post-retention period. Through the use of lateral cephalometrics, he measured seven horizontal and three vertical extensions of the soft tissue from adjacent hard-tissue points. As the horizontal reference plane, he used a line connecting anterior and posterior nasal spines, while the perpendicular line to this nasal floor plane was used as the vertical reference line. He noted sex differences in the integumental profile and found that males, in general, had greater horizontal extension of soft tissue in the areas inferior to the nose. Significant differences were demonstrated in the integumental profile when maturational changes occured: lower facial, mandibular, interlabial, superior labial, inferior labial, and supramental inclinations.

Bowker and Meredith (1959) measured integumental extensions from the facial plane in twenty-six Caucasian girls and twenty-two Caucasian boys, 5 to 14 years of age. All were normal, healthy children participating in a longitudinal research program at the State University of Iowa. They were not selected on the basis of facial characteristics or orthodontic needs. The distances perpendicular to a line passing through skeletal nasion and pogonion and along with this line were measured. And the angular relationship of the nasion-pogonion line to a cranial base line was also measured. He concluded that the variability of the soft tissue had no relation to the hard tissue.

Subtelny (1959) studied the profile characteristics of soft-tissue facial structures and their relationship to underlying skeletal

structures in a longitudinal cephalometric investigation of thirty subjects from the files of the Charles Bingham Bolton Study of the Face of the Growing Child at Western Reserve University. The sample, equally divided as to sex, was recorded at intervals of from 3 months to 18 years. All of the subjects had normal skeletal profile meaning that there was no abnormal protrusion or retrusion of facial structures. He found that in both sexes the skeletal profile became less convex with age, but the total soft tissue profile (including the external nose) increased in convexity with progression of growth. The soft tissue profile, excluding the nose, showed a tendency to remain relatively stable in its degree of convexity. In this regard, the soft tissue changes were not analogous to those of the skeletal profile. The soft tissue increment with growth related to the middle third of the face was found to increase proportionally more than the soft tissue covering the lower face. The skeletal and integumental chins became more prominent to the cranium with increasing mandibular prognathism. But, with the increment in mandibular prognathism, there was a concomitant recession and uprighting of the lower denture and alveolar plate in relation to the profile. The nose continued to grow doward and forward from 1 to 18 years of age and was responsible for increasing the total convexity of the soft tissue profile with age. The more rapid and disproportionate forward repositioning of the nose tip and chin added to the impression that the lips were receding within to total facial profile. Both lips showed a fairly constant vertical and horizontal relationship to their underlying alveolar processes and anterior teeth. The composite results of his study indicate that all parts of the soft tissue profile do not

directly follow the underlying skeletal profile.

Neger (1959) introduced a method to evaluate the soft tissue profile in a quantitative manner on a profile photograph using six profile angular relationships between the upper lip, lower lip, and chin. This method was employed in examining one group of persons with normal, excellent occlusions and acceptable facial form and other groups with malocclusions. The first group consisted of 15 males and 33 females of Caucasian who has not been treated orthodontically and of age range from 9 to 16 years. The second group included 43 Class II division 1 malocclusion, 14 Class II division 2 malocclusion, and 13 Class III malocclusions of both sexes from his office records. He found that a proportionate change or improvement of the soft tissue profile does not necessarily accompany extensive dentition change, and that, therefore, one can no longer rely entirely on a dentoskeletal analysis for accurate information on the soft tissue facial profile changes which have occurred during orthodontic treatment. He stressed the need for evaluating the soft-tissue profile as a separate entity, apart from the dentoskeletal analysis.

Altemus (1963) duplicated Burstone's study on a black patient sample consisted of 25 males and 25 females, aged 12-16 years with acceptable face and normal occlusion. Comparing Burstone's measurements, he concluded that his group had larger mean values in all areas except glabella, menton, and incision. Stomion and subnasale were thinner, and soft tissue chin extensions were similar to Caucasian values.

Mink (1963) studied cephalometrics of the soft-tissue profile

of fourteen Caucasian girls and eleven Caucasian boys with excellent mixed dentitions, aged 8-11 years to develop a standard of measurements. The criteria used were: the first permanent molars and central incisors were in occlusion, Class I primary cuspids, well-positioned and anterior teeth, and a maximum of 40 percent overbite and 3 mm. of overjet. The children were selected in part, from the contestants in a Smile Contest, and in part, from the Pedodontic Department at the Indiana University School of Dentistry. The measurements were made of profile-angles, lip-thickness and lip-length. The male sample and the female sample within the mixed dentition group were compared. The lower face of the female sample was less convex than in the male. Generally the lips were thicker in the male children. And he compared the mixed dentition group to a group of adolescents and concluded that the lower face of the adolescent was less convex. He also found that the lips were thicker, the lip-protrusion to the line from Sn to Pg' were less, and the lip length were longer in the adolescent group.

Hambleton (1964) discussed three different methods of evaluation of the soft tissue covering the skeletal face, which are Ricketts' "esthetic plane" (a line connects the nose and chin), Steiner's "S" plane (a plane from the chin to the middle of the "S" formed by the lower border of the nose and the upper lip), and Holdaway's "H" line (a straight line from the point of chin tangent to the upper lip). And he decided that the Holaway H angle was most useful. This angle was formed by the intersection of the line NB to a straight line tangent to the soft tissue chin and the upper lip. Hambleton considered the H line most useful bacause it considered the foundation for soft tissue

by its relation to the line NB and the angle ANB and because it was tangent to the upper lip, where he thought that orthodontic treatment was most effective.

Merrifield (1966) developed the "profile line" from soft-tissue pogonion tangent to the most anterior point of either the lower or upper lip. He also developed the "Z" angle (formed by the intersection of Frankfort and the profile line) to give a critical description of lower face relationship. Samples for his study came from three sources. Forty cephalometric roentgenograms from more than 100 nonorthodontic normal faces collected by Tweed as of "nonorthodontic normals". Forty taken at the completion of treatment from Tweed's files as of "orthodontic normals". And forty taken at the completion of treatment from his own files. From the tracings of 120 roentgenograms taken with the teeth and lips together the angles of the Tweed diagnostic triangle, ANB angle, Z angle as well as the soft tissue thickness of the upper lip and chin were studied. He stressed the importance of the total chin thickness rather than bony chin alone in profile evaluation. He also stated that in balanced faces the upper lip should fall on the profile line with the lower lip tangent or slightly behind the "profile line". He indicated that the 80 degrees of "Z" angle with a range of plus or minus 5 degrees is normal in the adults and 78 degrees is normal in patients 11 to 15 years of age.

Burstone (1967) studied lip posture and its natural, horizontal and angular relationships to the facial profile. The importance of relaxed lip posture and its reproducibility were established. The effects of lip incompetence and other inherent factors were shown to

affect profile changes. He utilized a sample of thirty-two boys and girls, 13 to 15 years of age, selected on the basis of facial appearance from a group of 3,000 Caucasian children by nonorthodontists (teachers, artists, and housewives). He found that the average interlabial gap was 1.8 ± 1.2 mm. in centric occlusion and 3.7 ± 1.6 mm. in rest position of the mandible. He evaluated the relative length of the upper and lower lips. The upper portion was measured from subnasale to stomion (lowest point on the upper lip) and the lower portion was measured from stomion (highest point on the lower lip) to gnathion perpendicular to the palatal plane. Significant differences in length of the lips were noted between boys and girls in the normal adolescent sample; the average lengths for the upper lip are 24 mm. for boys and 20 mm. for girls and for the lower lip are 50 mm. for boys and 46 mm. for girls. And the ratio between upper and lower lip was 1 to 2. Another method of evaluating the length of the upper lip was measured from the inferior border of the upper lip to the tip of the incisal edge at a right angle to the palatal plane. In the normal face it was 2.3 mm. ± 1.9.

He used a line connecting subnasale and soft-tissue pogonion to evaluate the relative protrusion or retrusion of the lips. A perpendicular linear distance from the subnasale-pogonion plane to the most prominent point on the upper and lower lips were measured. In the normal adolescent sample, the upper lip was 3.5 mm. ± 1.4 anterior to the line and the lower lip was 2.2 mm. ± 1.6 anteriorly. To investigate the nose length, he used two perpendicular lines dropped to the palatal plane from subnasale and the tip of nose. And the result was 15.5 mm. ± 2.8

in normal adolescent sample.

He employed the upper lip inclination measured by the intersection of the line subnasale-labrale superius with the palatal plane to evaluate the protrusion of the upper lip. Normally, the lip was slightly flared, forming an angle of 97.5 degrees. He also measured the protrusion of the upper lip relative to the inferior border of the nose. This was done by the nasolabial angle, which was formed by the intersection of a line, originating at subnasale, tangent to the lower border of the nose and a line from subnasale to labrale-superius. A typical nasolabial angle was approximately 74 degrees. He stressed the importance of this angle since the layman was likely to evaluate upper lip protrusion in relation to the nose.

Gonzales-Ulloa and Stevens (1968) who were the plastic and reconstructive surgeons have proposed the use of a 0-degree meridian to define the position of the soft-tissue chin. They suggested that in most adult faces presently considered beautiful, the soft tissue chin should lie tangent to a line perpendicular to Frankfort horizontal which intersects soft tissue nasion.

Peck and Peck (1970), in order to determine the public's concept of pleasing facial esthetics, studied the cephalograms and photographs of fifty-two Caucasian young adults (49 female and 3 male), each acclaimed previously in some manner by a segment of the general population as possessing qualities of the most pleasing facial esthetics. The sample included professional models, beauty contest winners, and performing stars noted for their facial attractiveness. Cephalometric appraisals using the Margolis, Downs, and Steiner analysis were

complied and they concluded that the general public admires a fuller, more protrusive dentofacial pattern than customary cephalometric standards.

To identify further the public's concept of pleasing facial esthetics, utilizing frontal and profile photographs of the same sample, the facial qualities of symmetry, harmony, proportion and orientation were defined and examined. He delivered a series of reversed "S's" concept on the harmonious right profile and stated that regularity and evenness are essential traits for pleasing profile. He also stressed the relative severity of the three depressions in the harmonious soft tissue profile; one at nasion, another at subnasal, and the last at supramentale. He showed that in over one half of the sample, Sn depression was the steepest one and the N depression was the least.

In his profilometric analysis, using nasion, pronasale, labrale superius, pogonion and tragion, he measured angular relationships of nose, upper lip, and chin in both horizontal and vertical dimension.

Foster (1973) altered the traced profile of a white female adult in order to construct seven silhouette facial profiles with identical profile outlines except for the lips, which were advanced in 2 mm. increments. These were sent to the following groups: general dentists, art students, orthodontists, a black lay group, a Chinese lay group, and a white lay group, to select the most pleasing male and female profiles at ages eight, twelve, sixteen, and adult.

Various standard soft-tissue analyses were performed on the silhouette profiles, and it was found that all the groups preferred fuller profiles for younger ages and straighter profiles for the adults.

The orthodontic group preferred a straighter adult female profile and a more protrusive adult male profile than did the other groups. A straighter adult male preference over female was indicated by most groups which may indicate that, in the future, orthodontists might establish a straighter adult male profile.

Chaconas and Bartroff (1975), in their article, 'Prediction of normal soft tissue facial changes', studied the serial lateral cephalometric roentgenograms obtained from the files of the Bolton Study at Western Reserve University. The sample consisted of 46 Caucasian children for whom records were taken yearly from 10 to 16 years of age. None of the subjects had received orthodontic treatment and the radiographs were taken with the teeth and lips closed together. Twenty-three of the sample were males and 23 were females; 20 had Class I occlusions, 22 had Class II occlusions, and 4 had Class III occlusions. To quantitatively evaluate the soft tissue, 12 soft tissue points were selected and the "profile root vertical (PRV)", which was drawn between glabella and soft tissue pogonion, was used. Then lines were drawn perpendicular from the individual landmarks to the PRV. To evaluate the proportional changes in the profile, he used two angular measurements; H angle (the angle between the PRV and a line tangent to the most anterior points on the soft tissue chin and the upper lip) was used to evaluate the lip convexity; R angle (the angle between the PRV and the Ricketts' E line) was used to evaluate the total face convexity.

He concluded that the mean incremental growth of the facial profile of males was greater than females between 10 and 16 years of age. He also found that the greatest incremental growth took place in

nose and the males exhibiting twice as much as growth of the females. The male profile, however, grew more vertically than female one and resulted in the way that the female and male profile convexities remained relatively the same at 16 years of age.

In 1975, Worms, Isaacson, and Speidel reported an article 'Surgical orthodontic treatment planning: Profile analysis and mandibular surgery' to the meeting of Midwestern Angle Society.

Eleven landmarks such as glabella, eye, subnasale, superior labial sulcus, labiale superius, stomion, labiale inferius, inferior labial sulcus, soft tissue pogonion, soft tissue menton, and throat were used in soft tissue analysis. The facial contour angle suggested by Burstone, glabella-subnasale-pogonion was stressed as the most important angle in soft tissue analysis. Other useful diagnostic angles and measurements such as the throat length, lip-chin-throat angle, and lip protrusion were also suggested. They also suggested Cutcliff's soft tissue vertical proportions to assess the quality of vertical harmony of the soft tissue, which is as follows: The total facial height between the eye and soft tissue menton is divided into fifths. The upper facial height (eye-subnasale) is 2/5, the upper lip length (subnasale-stomion) is 1/5, and the lower lip length (stomion-soft tissue menton) is the remaining 2/5. A diagnostic contour protractor was also designed to evaluate the position and proportion of the soft tissue points quickly.

Lines (1978) sent seven series of five facial profile silhouettes to each of various groups of participants and gathered their opinion about the desirable facial profile for males and females. The participants were medical and dental students, oral surgeons, orthodontists,

dental hygienists, dentists, and nonprofessional persons, for a total of 347. Each series was preceded by an explanatory drawing demonstrating the specific angle with which that series of profile choices was concerned. Each participant was asked to indicate the profile he thought best exemplified the ideal angulation for that series, one for the male, and one for the female profile in each series.

Seven different angles; the interlabial prominence angle, the relative chin prominence, the angle of nasal prominence, the nasal tip angle, the angle of the inferior labial sulcus, the nasolabial angle, and the columellar length angle, were used. And he concluded that the orthodontists tended to prefer both male and female to have slightly more prominent lips than did oral surgeons. Oral surgeons preferred profiles with more prominent chins and longer columella length. He found that the most participants liked a fuller lip, less prominent chin, less prominent nose, more obtuse nasal tip, more obtuse mentolabial groove, more obtuse nasolabial angle, and smaller nose in female than in male.

Legan and Burstone, in 1980, designed a new soft tissue cephalometric analysis for orthodontic surgery by modifying Burstone's previously developed soft tissue profile analysis. The means and standard deviations for a population of 40 white adults (20 men and 20 women) between the ages of 20 and 30 were developed. All the patients in the sample were orthodontically untreated with Class I occlusions and had vertical facial proportions that were determined to be within normal limits (N-ANS/ANS-Me was between .75 and .85 according to the data base of Univ. of Connecticut). In this analysis, he used six

measurements for facial form, and seven for lip position and form measurements by utilizing twelve soft tissue landmarks, and established the means and standard deviations for young adult Caucasians. As a horizontal reference plane (HP), a line through nasion 7 degrees up from sella-nasion line was constructed. And a line perpendicular to the horizontal plane was dropped from glabella and was used as a vertical reference plane.

Scheideman (1980) accomplished a comprehensive cephalometric analysis of "normal" adults by examining fifty-six adult Caucasians with Class I skeletal and dental relationships and good vertical facial proportions (the upper and lower anterior facial heights were within 15 percent of norms- 1:1). They were students at Baylor College of Dentistry and Caruth School of Dental Hygiene and consisted of 24 female and 32 male of 20 years of age or older. The cephalometric films were taken with the mandible in centric relation and the lips relaxed. He used a wire plumb line in the radiographic field to establish a true vertical reference line. Neither orbital registration nor nasion was used. As a horizontal reference line, lines S-N minus 9 degrees for females and S-N minus 8 degrees for males were used. Then he oriented the tracings parallel to the X, Y axis on the computer graph. The linear, angular measurements, and ratios were then calculated for each sex in terms of means and standard deviations.

In 1981, Spradley et al evaluated the normal anteroposterior positions of five soft tissue points inferior to the nose for a selected Caucasian sample by using different horizontal and vertical reference lines. They studied twenty-five male and twenty-five female young

adults with ages ranging from 19 to 32, exhibiting pleasing facial profiles and normal sagittal and vertical skeletal relationships. Lateral cephalometric radiographs of the subjects were taken in natural head position with the lips in repose. They used a plumb line, constructed by suspending a 1 kg. weight from a wire 0.012 inch in diameter hanging freely in front of the subject's face, to establish a true extracranial vertical reference plane. And a true horizontal reference plane was constructed perpendicular to this plane. Then they measured the five soft tissue points anteroposteriorly from the subnasale vertical perpendicular to the true horizontal plane. In addition, the same soft tissue points were analyzed relative to the Frankfort horizontal and to a nasion vertical perpendicular to the true horizontal and the Frankfort horizontal. For all four methods used, they found that the standard deviations become progressively larger from superior labial sulcus to soft tissue pogonion. And they found that the subnasale vertical perpendicular to the true horizontal plane was the most reliable plane since the smallest standard deviations were obtained. They stressed the usefullness of this method of sagittal soft tissue assessment because it did not depend on the position of the chin and nose.

B. KOREAN STUDIES

Park (1971) was the first dentist who studied the soft tissue profile of Korean adolescents. He investigated 53 males and 54 females, 17 to 22 years of age who had normal occlusion and acceptable profile. Employing Burstone's analysis, he used eight profile landmarks and eighteen measurements concerning profile angles, lip length, and lip thickness. He compared soft tissue profile between Korean males and females, and between Koreans and Caucasians. He stated that Korean males had less convex profile than Korean females. And he found that the upper and the lower lip were more convex in males than in females with regard to the line from Sn to Pg'. The inclination of the upper and the lower lip were found greater in males than in females. In his study of soft tissue thickness, he found that Korean males had thicker upper and lower lips, and thicker upper lip sulcus area than Korean females.

Comparing his study to Burstone's work, he stated that Koreans had straighter lower face and more protrusive upper and lower lips than Caucasians. He concluded that it was in the lower facial area not in the upper one where there was a difference in convexity between Koreans and Caucasians.

Choi, in 1974, studied profile changes in orthodontically treated patients of 59 Korean young females, aged from 17 to 22. He used 9 soft tissue points and 3 different lines such as Holdaway H-line, Ricketts E-plane, Steiner S-line and compared the differences between pre and post- treatment of several angular and linear measurements. He stated that soft tissues of the facial profile were closely related and dependent on the underlying dentoskeletal frameworks as Riedel stressed.

He also found that the thickness of the upper lip increased during orthodontic treatment. The conclusions drawn were that there was a high degree of correlation between the increment of the upper lip thickness and incisor movements.

In 1976, Kang, studied the differences between sexes in the dentoskeletal framework and the soft tissue profile of 42 Korean males and 42 Korean females aged from 17 to 22 years with normal occlusion and acceptable facial appearance. The male sample was selected from the dental students and the female sample was selected partially from the patients who came in the department of radiology and partly from the contestants of '1971 healthy teeth contest.' He measured angular relationships of teeth, alveolus, and lips in relation to the FH line, the occlusal plane, the mandibular plane and the Ricketts' esthetic plane to determine the positional relationships among them. He found that the Korean males had a more acute lower facial angle (Sn,UL-LL,Pg') and a more rounded profile than did females due to a rather flatness of the lower 1/3 of the females' face. He also stated that the angle formed by lips was greater than the one formed by teeth or alveolar bones possibly due to the thickness of the lips. And he stressed that the lip position was not entirely related to teeth and bony supporting tissue.

Lee (1982) studied the Korean children with mixed dentition to investigate a relationship existing in the dentoskeletal framework and the soft tissue profile around the face. He compared the sexual differences between boys and girls who had the normal occlusion and acceptable profile. The lateral cephalograms were taken from 67 boys and 68 girls with mean age of 10.3 years, and 10.4 years, respectively. He used the

N'-Pg' line as a reference line for soft tissue analysis and measured the soft tissue thickness at twelve different points on the profile. He stated that, in general, boys showed longer and thicker nose than did girls. The soft tissue thickness was found to be minimal in the region of nasion, greater in the region of pogonion, and greatest in the region of point A. But, he noticed that only the soft tissue thickness over point A showed a significant sexual difference. The upper and lower lip position were found to be located anteriorly to the Ricketts' esthetic plane in both Korean sexes.

In 1982, Oh studied 166 males and 209 females of Korean aged from 7 to 19 years with normal occlusion and acceptable profiles and he derived the normal standards of soft tissue profile in Korean by roentgenocephalometric analysis. He divided the sample into five groups according to their age. 12 soft tissue profile landmarks were plotted and 23 linear length, 9 soft tissue thickness, 8 vertical height, 12 angles of soft tissue profile, and 3 vertical proportion of the face were measured. He concluded his results as follows: 1) From the basis of N-Pog. plane, the growth of facial soft tissue in the middle region especially nose area was greater than the other facial regions. 2) The growth of the facial soft tissue was greatest in superior labial sulcus and the thickness of soft tissue nasion gradually became thinner with growth. 3) In adults, the upper and the lower lip were thicker in males than in females. 4) The lower lip was thicker than the upper lip in all age groups and in both sexes. 5) In adult group, there were significant differences between male and female in the vertical linear measurements of the lower face. In general, males had longer

upper and lower lips than females. 6) The males had more protrusive upper and lower lips than females.

He also compared the Korean facial profile to Caucasian profile and stated that Koreans had a straighter facial convexity angle due to a more protrusive lower face, a more protrusive upper and lower lips, and a longer upper face than a lower face.

Lee and Sohn, in 1984, performed a cephalometric investigation for a group of Korean adults with normal occlusion and acceptable profile. Their sample included 46 males and 55 females over the age of 18. They were selected by orthodontists from the 1980's freshmen class in Yonsei University as the ones having good balanced and harmonized faces without any growth deformity. Utilizing various bony and soft tissue points, they studied vertical and horizontal skeletal profile as well as the soft tissue profile of Korean adults. Their findings pertinent to this study were as follows: 1) Females had a more protrusive chin point (Pg') than males. 2) Males had a longer lower 1/3 of the face (Sn-Me') than females. 3) Males had more protrusive upper and lower lips than females. 4) Males had a deeper mentolabial sulcus than females. 5) Generally, males had a longer upper and lower lip length.

One of the interesting measurements in their study of skeletal pattern was the angle of SNO which indicated the anteroposterior position of the orbitale to the cranial base. The significantly larger angle of SNO found in Koreans revealed that the zygomatic bone was located more anteriorly in Koreans than in Caucasians. They also found that the cranial base of Koreans was more tilted upward than that of Caucasians relative to the Frankfort horizontal plane.

CHAPTER III

MATERIALS AND METHODS

A. MATERIAL

The present investigation utilized standardized lateral head cephalometric films of 32 males and 41 females from a sample of 100 males and 100 females of Korean young adults. The male subjects were selected from a boys' high school and from the dental school students, Seoul National University (S.N.U.), whereas the female samples were selected from a girls' high school and from the nursing school students, S.N.U. in Seoul, Korea. The age ranges were 17 to 23 for female subjects and from 18 to 25 for male samples. The sample had been originally selected on the basis of satisfactory facial esthetics by three faculty members in the department of orthodontics, College of Dentistry, S.N.U. And this sample was formerly used for the purpose of cross-sectional study of the skeletal pattern of Korean young adults.

The criteria for the selection of the each subject were that he/she had 1) no observable facial abnormality determined by three faculty members, 2) Angle Class I molar relationship with normal overjet (3.0 mm. ± 1.0) and overbite (2.5 mm. ± 1.0), 3) full complement of permanent teeth in proper occlusion without crossbite, 4) no previous orthodontic, prosthodontic, plastic and reconstructive surgery, and maxillofacial surgery treatment, 5) good physical and mental health.

B. METHODS

1. Radiographic Method

All the cephalometric roentgenograms were taken by an expert x-ray technician in the department of radiology of the dental school, Seoul National University. By means of a cephalostat, the subject's head was positioned so that the Frankfort horizontal plane was parallel to the floor and with his/her midsagittal plane parallel to the film. The lip posture was that of initial light closure, with the mandible in centric occlusion.

The distance from the x-ray tube to the center of subject was 150 cm., and 15 cm. from the subject to film. The exposure time was 0.5 second with 90 kilovoltages peak, and 15 milliamperes. There is a slight difference between the Korean and the American standard distance from the anode to the subject, that is, a 5 feet (152.4 cm.) for the American standard and 150 cm. for Korean standard. But this difference appears on the film surface as less than 0.5 % of the length, which is negligible.

2. Tracing Method

The subjects were selected on the basis of clarity of the hard and soft tissue landmarks on the radiograph and 32 male and 41 female films were gathered. The cephalograms were traced over an illuminated viewing box using 0.003 matte translucent acetate tracing paper with a 0.3 mm. 3-H lead pencil. The tracings included the outline of soft tissue structures as well as some osseous structures. From each lateral headplate, the nose, the upper and lower lips, the chin, and the soft tissue covering the midsagittal plane of the frontal bone were traced.

The cranial structures, such as the nasal bone, the orbit, the upper and lower jaws and teeth, and the cranial base were routinely traced. Each subject was traced twice and the second tracings were superimposed on the first ones. If a particular difference was found between them, then the correction was made on the first tracings after reimposing on the cephalograms. In addition, to determine the accuracy of operations performed in tracing the radiographs, picking the landmarks, and taking the measurements done in this study, 12 cephalometric films (every sixth cephalogram) were retraced and remeasured two weeks after the originals were performed. The two sets of data were then compared statistically by the "t" test. No measurement out of the thirty-six measurements was found to be significantly different at 5 % probability level. This suggested that the duplicates would rarely disagree with the initial works.

3. Method of Measurements

Relating eleven hard tissue points and fifteen soft tissue points, thirty-six measurements were utilized in this study.

Hard Tissue Points (Figure 1)

(1) Nasion (N) - The junction of the frontonasal suture at the most posterior point on the curve at the bridge of the nose.

(2) Porion (P) - The point located at the most superior border of the external auditory meatus. The left one was used in this study.

(3) Orbitale (Or) - The lowest point on the inferior border of the bony orbit. The mean point between the right and the left orbitale was used.

(4) 'A' point (A) - The most posterior point on the curve of the maxilla between the anterior nasal spine and the maxillary dental alveolus on the midsagittal line.

(5) Upper incisor edge (1) - The incisal tip of the most protruded maxillary central incisor.

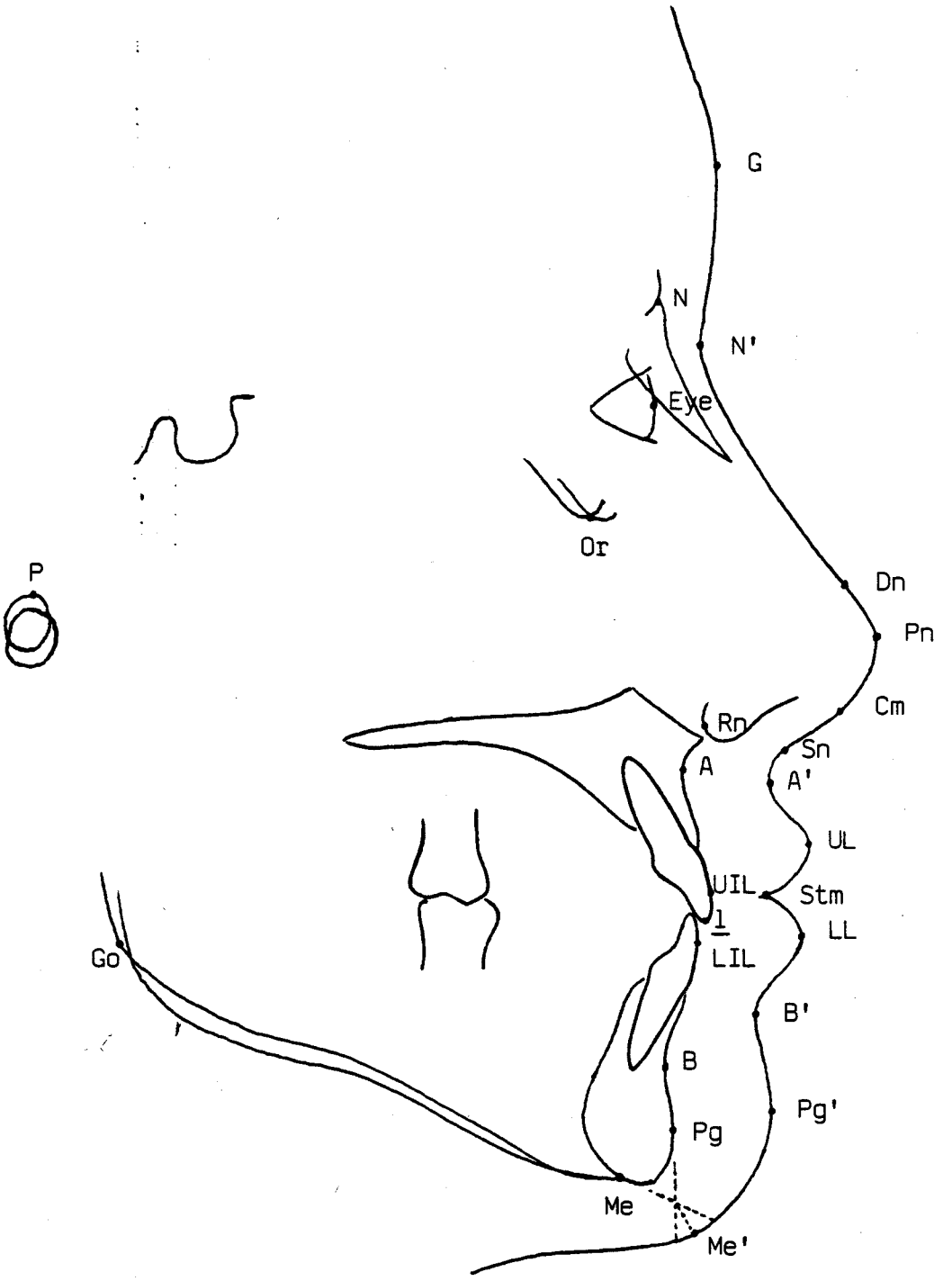

Figure 1 Points

(6) Upper incisor labial (UIL) - The most protruded point on the labial surface of the maxillary central incisor.

(7) Lower incisor labial (LIL) - The most protruded point on the labial surface of the mandibular central incisor.

(8) 'B' point (B) - The most posterior point on the curve from infradentale to pogonion on the anterior surface of the symphyseal outline of the mandibule.

(9) Pogonion (Pg) - The most anterior point on the contour of the bony chin.

(10) Menton (Me) - The point at the junction between the mandibular symphyseal outline and the inferior border of the mandibular body.

(11) Gonion (Go) - The midpoint of the angle of the mandible. The left one was used in this study.

Soft Tissue Points (Figure 1)

(1) Glabella (G) - The most prominent point on the midsagittal plane of the forehead.

(2) Soft tissue nasion (N') - The most concave point on the soft tissue overlying the area of the frontonasal sulcus.

(3) Pronasale (Pn) - The most prominent or anterior point of the tip of the nose.

(4) Columella point (Cm) - The most inferior point on the columella of the nose.

(5) Subnasale (Sn) - The point at which the nasal septum merges with the upper lip on the midsagittal plane.

(6) Soft tissue A point (A') - The point of greatest concavity in the middle of the upper lip between subnasale and labrale superius.

(7) Labrale superius (UL) - The most anterior point on the upper lip.

(8) Stomion (Stm) - The junction of the upper and the lower membranous lip.

(9) Labrale inferius (LL) - The most anterior point on the lower lip.

(10) Soft tissue B point (B') - The point on greatest concavity

in the midline of the lower lip between the labrale inferius and soft tissue pogonion.

(11) Soft tissue pogonion (Pg') - The most anterior point on the soft tissue chin.

(12) Soft tissue menton (Me') - The midpoint on the soft tissue chin intersected between the line extending from nasion to pogonion and the line from gonion to menton.

(13) Eye - The most anterior point on the eyeball. The mean point between the right and the left one was used.

(14) Root of the nose (Rn) - The most posterior point on the left ala of nose.

(15) Dorsum of the nose (Dn) - The point tangent to the nose when a line was drawn from the soft tissue nasion along the dorsal line of the nose.

Reference Planes (Figure 2)

(1) Horizontal reference plane - The Frankfort horizontal plane was used. In this study, the left porion was connected to the mean point of the right and the left orbitale.

(2) Vertical reference plane - The line perpendicular to the Frankfort horizontal plane was used.
a) G - vertical to FH plane
b) N' - vertical to FH plane

(3) Upper facial line (G,Sn) - The line from the glabella to the subnasale.

(4) Lower facial line (Sn,Pg') - The line from the subnasale to the soft tissue pogonion.

(5) Ricketts' esthetic plane (E plane) - The line from the tip of nose tangent to the soft tissue chin.

Measurements (Figure 3)

a. Vertical facial lengths

(1) Upper facial height (G-Sn) - The distance from the glabella to the subnasale measured along the upper facial line.

(2) Eye height (Eye-Sn) - The distance from the eye to the subnasale measured along the upper facial line.

(3) Lower facial height (Sn-Me') - The distance from the subnasale to the soft tissue menton measured along the lower

Planes

1) Frankfort horizontal plane

2-a) G - vertical to FH plane

2-b) N' - vertical to FH plane

3) Upper facial plane

4) Lower facial plane

5) Ricketts' 'E' plane

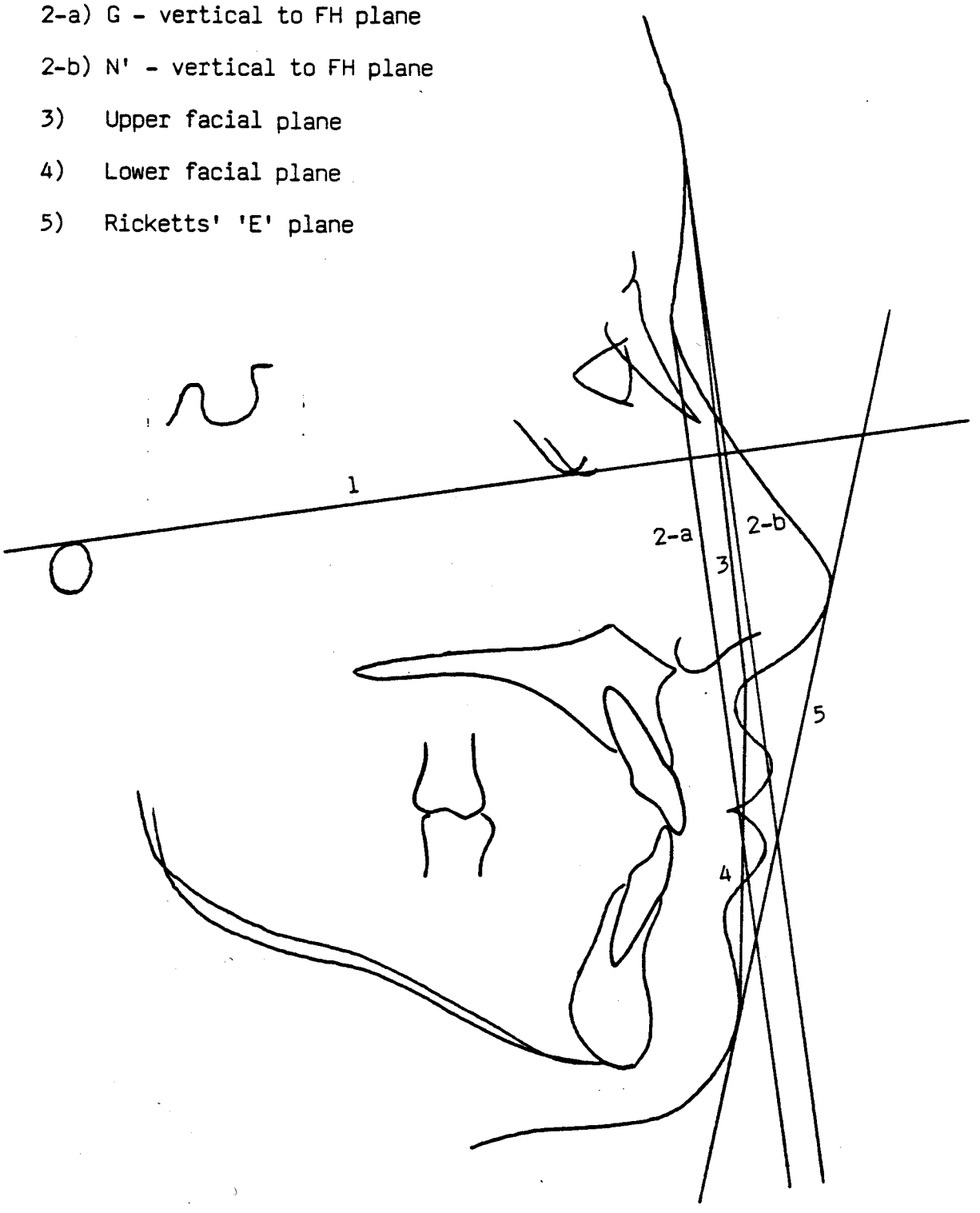

Figure 2

facial plane (Sn,Pg').

(4) Upper lip length (Sn-Stm) - The distance from the subnasale to the stomion measured along the lower facial plane (Sn,Pg').

(5) Lower lip length (Stm-Me') - The distance from the stomion to the soft tissue menton measured along the lower facial plane (Sn,Pg').

a'. Vertical proportion of the face

Eye-Sn : Sn-Me' - The ratio between the eye height and the lower facial height.

Sn-Stm : Stm-Me' - The ratio between the upper lip length and the lower lip length.

Eye-Sn : Stm-Me' - The ratio between the eye height and the lower lip length.

G-Sn : Sn-Me' - The ratio between the upper facial height and the lower facial height.

b. Angles of facial contour

(6) Facial contour angle (G-Sn-Pg') - The angle formed by the upper facial plane (G-Sn) and the lower facial plane (Sn-Pg').

(7) Nasofacial contour angle (G-Pn-Pg') - The angle formed by the line from glabella to pronasale and the line from pronasale to soft tissue pogonion.

(8) E angle (E plane to FH plane) - The inner angle formed by the Ricketts' esthetic plane to the Frankfort horizontal plane.

(9) Z angle (Pg'-LL or UL to FH plane) - The inner angle formed by the plane from the soft tissue pogonion to the most protrusive lip (either upper lip or lower lip) and the Frankfort horizontal plane.

c. Maxillary and mandibular soft tissue protrusion

(10) Subnasale protrusion (Sn-G 1 FH plane) - The distance of the subnasale from the line perpendicular to the Frankfort horizontal plane through glabella, measured parallel to the FH plane.

Planes

1) Frankfort horizontal plane

2-a) G - vertical to FH plane

2-b) N' - vertical to FH plane

3) Upper facial plane

4) Lower facial plane

5) Ricketts' 'E' plane

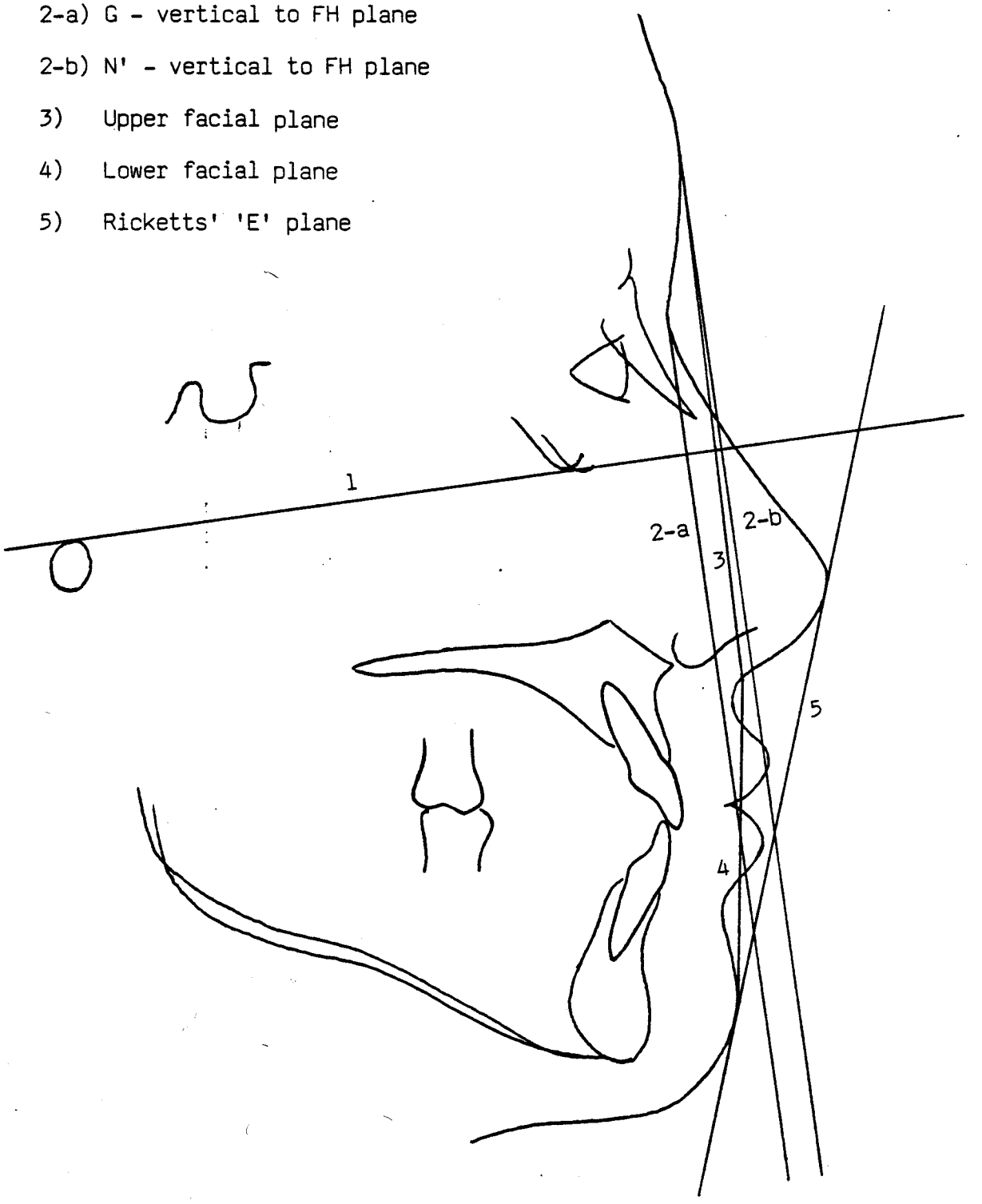

Figure 2

facial plane (Sn,Pg').

(4) Upper lip length (Sn-Stm) - The distance from the subnasale to the stomion measured along the lower facial plane (Sn,Pg').

(5) Lower lip length (Stm-Me') - The distance from the stomion to the soft tissue menton measured along the lower facial plane (Sn,Pg').

a'. Vertical proportion of the face

Eye-Sn : Sn-Me' - The ratio between the eye height and the lower facial height.

Sn-Stm : Stm-Me' - The ratio between the upper lip length and the lower lip length.

Eye-Sn : Stm-Me' - The ratio between the eye height and the lower lip length.

G-Sn : Sn-Me' - The ratio between the upper facial height and the lower facial height.

b. Angles of facial contour

(6) Facial contour angle (G-Sn-Pg') - The angle formed by the upper facial plane (G-Sn) and the lower facial plane (Sn-Pg').

(7) Nasofacial contour angle (G-Pn-Pg') - The angle formed by the line from glabella to pronasale and the line from pronasale to soft tissue pogonion.

(8) E angle (E plane to FH plane) - The inner angle formed by the Ricketts' esthetic plane to the Frankfort horizontal plane.

(9) Z angle (Pg'-LL or UL to FH plane) - The inner angle formed by the plane from the soft tissue pogonion to the most protrusive lip (either upper lip or lower lip) and the Frankfort horizontal plane.

c. Maxillary and mandibular soft tissue protrusion

(10) Subnasale protrusion (Sn-G 1 FH plane) - The distance of the subnasale from the line perpendicular to the Frankfort horizontal plane through glabella, measured parallel to the FH plane.

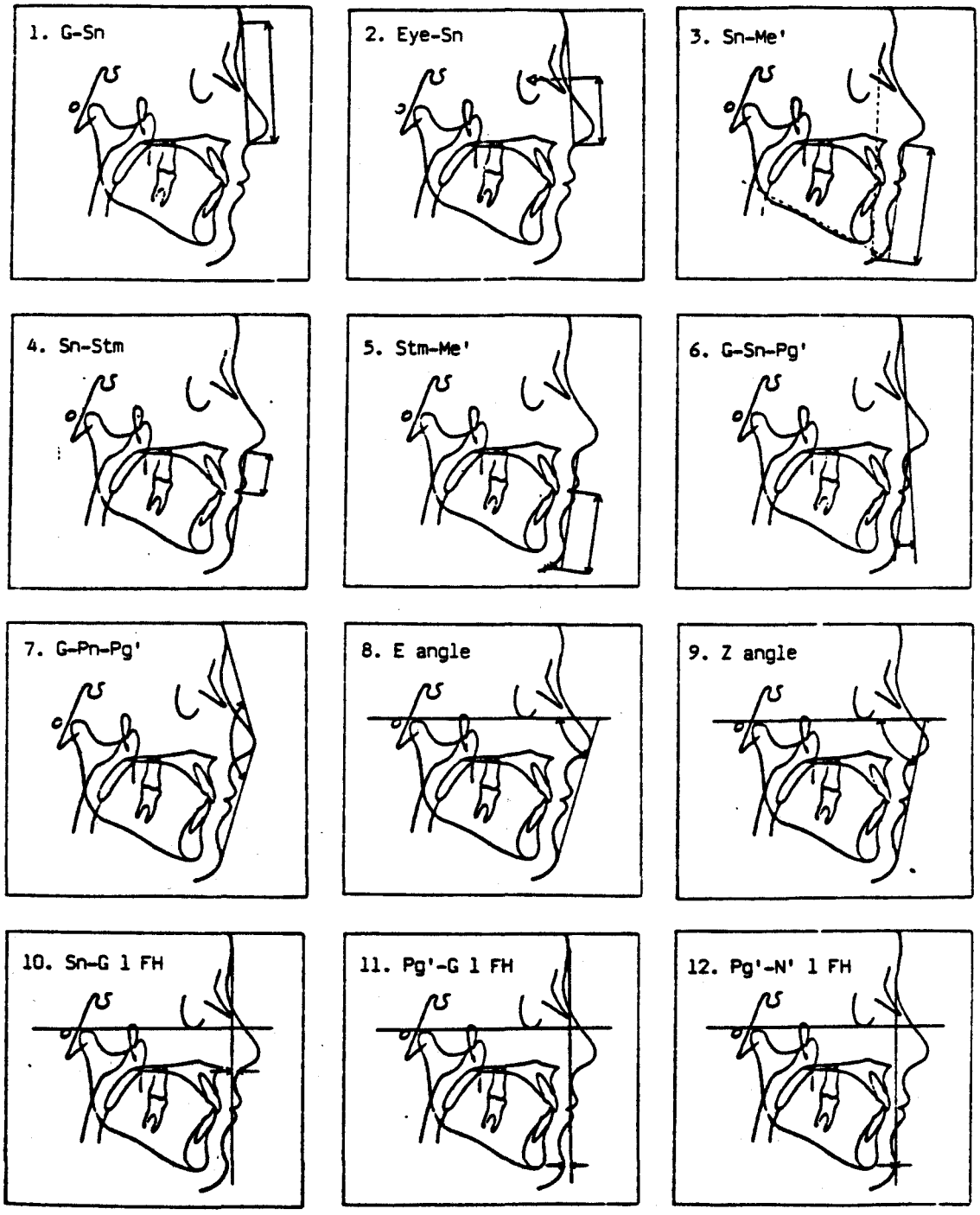
1. G-Sn
2. Eye-Sn
3. Sn-Me'
4. Sn-Stm
5. Stm-Me'
6. G-Sn-Pg'
7. G-Pn-Pg'
8. E angle
9. Z angle
10. Sn-G 1 FH
11. Pg'-G 1 FH
12. Pg'-N' 1 FH

Figure 3

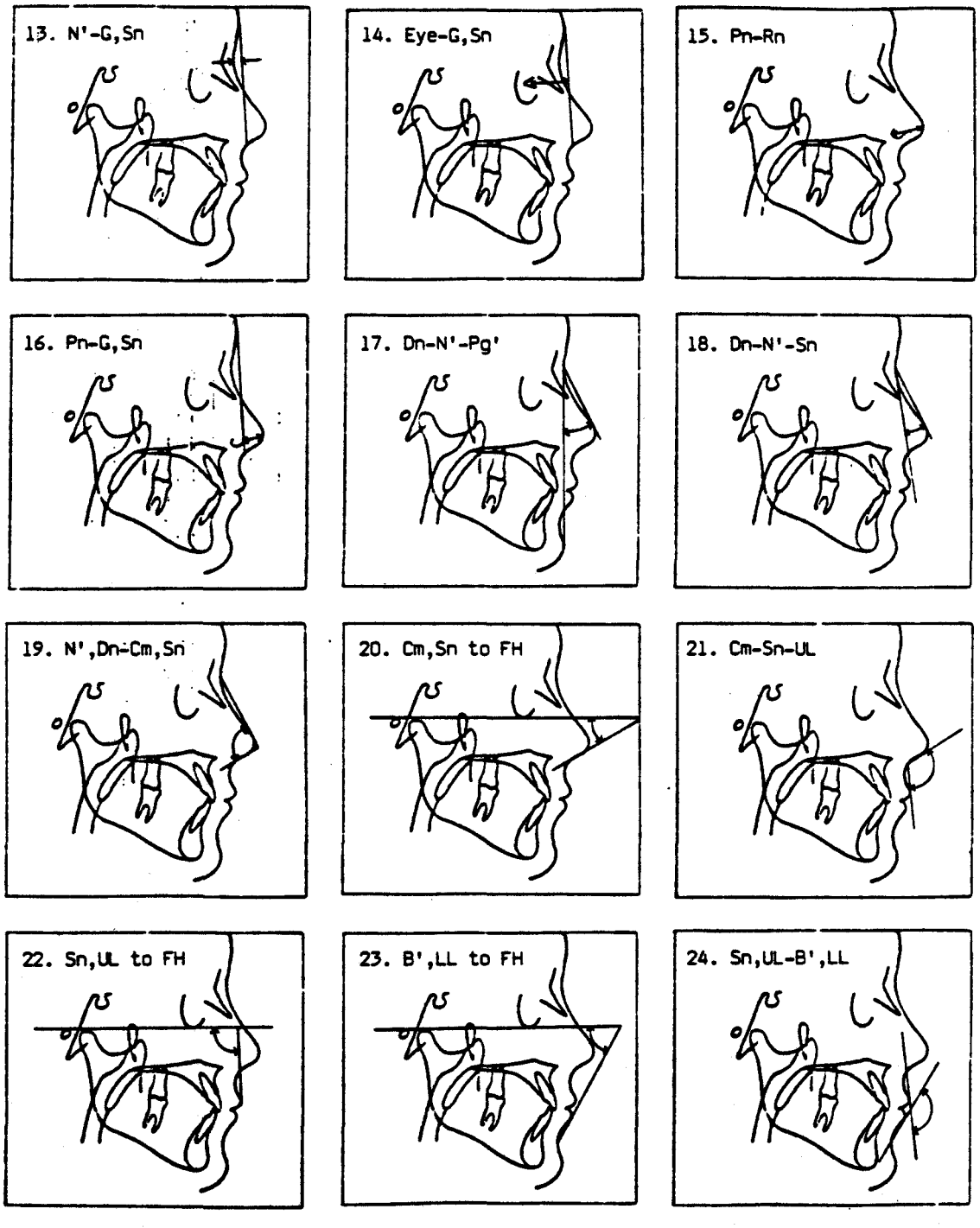

Figure 3 continued

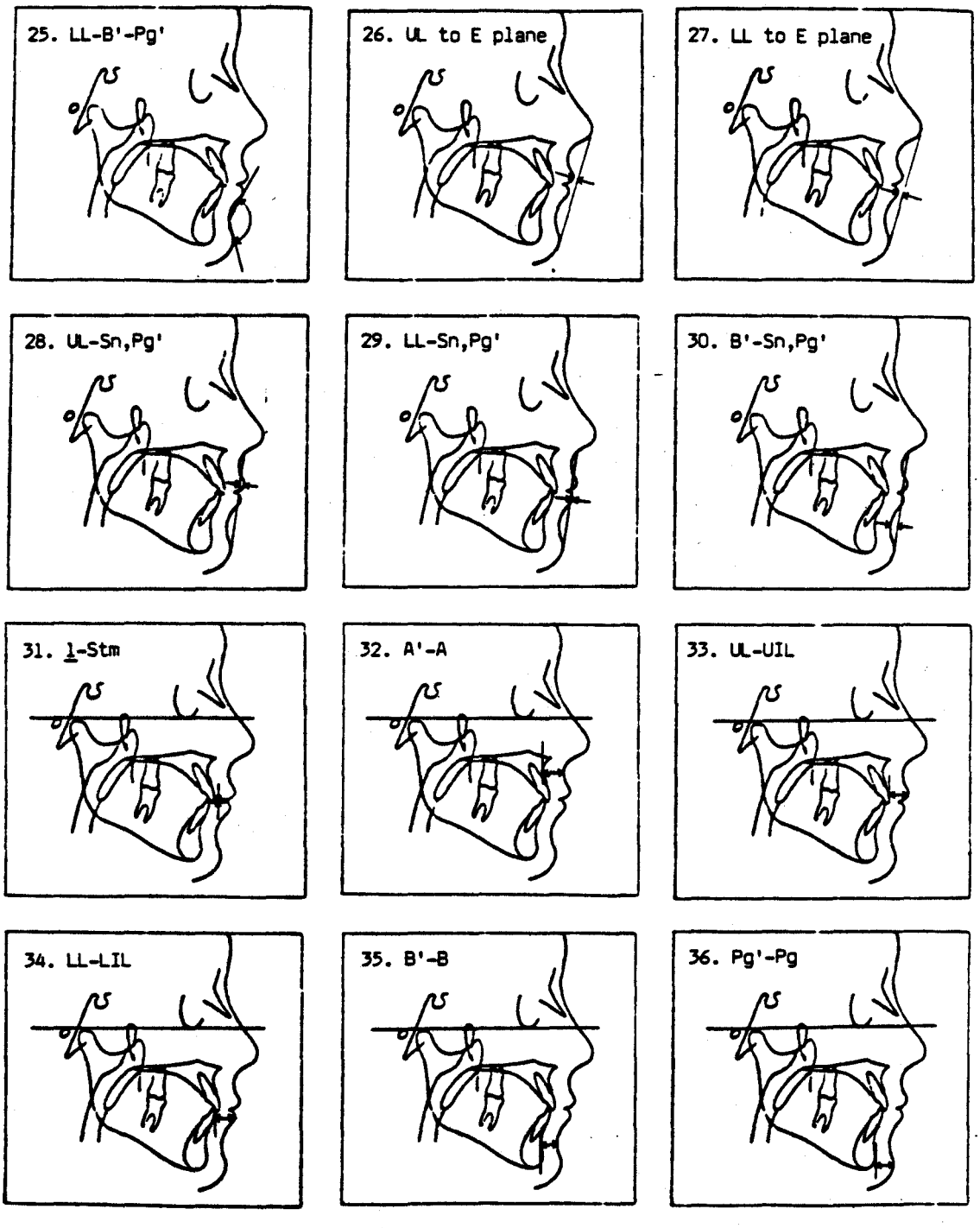

Figure 3 continued

(11) Chin protrusion (Pg'-G ⊥ FH plane) - The distance of the soft tissue pogonion from the line perpendicular to the Frankfort horizontal plane through glabella, measured parallel to the FH plane.

(12) 0-degree Meridian (Pg'-N' ⊥ FH plane) - The distance of the soft tissue pogonion from the line perpendicular to the Frankfort horizontal plane through soft tissue nasion, measured parallel to the FH plane.

d. Eye, nose depth

(13) Soft tissue nasion depth (N'-G,Sn) - The distance from the soft tissue nasion to the upper facial plane (G,Sn), measured perpendicularly.

(14) Eye depth (Eye-G,Sn) - The distance from the eye to the upper facial plane (G,Sn), measured perpendicularly.

(15) Nose depth (Pn-Rn) - The direct distance from the tip of nose to the most posterior point of the ala of nose.

(16) Columella depth (Pn-G,Sn) - The distance from the tip of nose to the upper facial plane (G,Sn), measured along the line of Pn-Rn.

e. Angles of nose

(17) Nasal prominence to chin angle (Dn-N'-Pg') - The angle formed from the dorsum of nose through the soft tissue nasion to the soft tissue pogonion.

(18) Columella length angle (Dn-N'-Sn) - The angle formed from the dorsum of nose through the soft tissue nasion to the subnasale.

(19) Nasal tip angle (N',Dn-Cm,Sn) - The angle formed by the intersection of a line from the soft tissue nasion to the dorsum of nose with a line from the subnasale to the columella point.

(20) Columella inclination angle (Cm,Sn to FH plane) - The inner angle formed by the intersection of a line from the subnasale to the columella point with the Frankfort horizontal plane.

(21) Nasolabial angle (Cm-Sn-UL) - The angle formed by the intersection of the line columella to subnasale, and the line from subnasale to labiale superius.

f. Angles of lips

(22) Upper lip inclination (Sn,UL to FH plane) - The angle formed by the intersection of the line from subnasale to labiale superius with the Frankfort horizontal plane.

(23) Lower lip inclination (B',LL to FH plane) - The angle formed by the intersection of the line from soft tissue B point to labiale inferius with the Frankfort horizontal plane.

(24) Interlabial prominence angle (Sn,UL-B',LL) - The angle formed by the intersection of the line from subnasale to labiale superius with the line from soft tissue B point to labiale inferius.

(25) Mentolabial sulcus angle (LL-B'-Pg') - The angle formed by the intersection of the line from labiale inferius to soft tissue B point with the line from soft tissue B point to soft tissue pogonion.

g. Linear measurements of lips

(26) Upper lip to E plane - The perpendicular distance from the most prominent point of the upper lip to the Ricketts' E plane.

(27) Lower lip to E plane - The perpendicular distance from the most prominent point of the lower lip to the Ricketts' E plane.

(28) Upper lip protrusion (UL-Sn,Pg') - The perpendicular distance from the most prominent point of the upper lip to the lower facial plane (Sn,Pg').

(29) Lower lip protrusion (LL-Sn,Pg')- The perpendicular distance from the most prominent point of the lower lip to the lower facial plane (Sn,Pg').

(30) Mentolabial sulcus depth (B'-Sn,Pg') - The perpendicular distance from the soft tissue B point to the lower facial plane (Sn,Pg').

(31) Upper incisor exposure ($\underline{1}$-Stm) - The vertical distance from the inferior border of the upper lip to the edge of the upper incisor, measured perpendicular to the Frankfort horizontal plane.

h. Soft tissue thickness

(32) Upper labial sulcus thickness (A'-A) - The distance from the

soft tissue A point to the skeletal A point measured along the Frankfort horizontal plane.

(33) Upper lip thickness (UL-UIL) - The distance from the most prominent point of the upper lip to the most prominent point on the labial surface of the upper incisor, measured along the Frankfort horizontal plane.

(34) Lower lip thickness (LL-LIL) - The distance from the most prominent point of the lower lip to the most prominent point on the labial surface of the lower incisor, measured along the Frankfort horizontal plane.

(35) Mentolabial sulcus thickness (B'-B) - The distance from the soft tissue B point to the skeletal B point measured along the Frankfort horizontal plane.

(36) Chin thickness (Pg'-Pg) - The distance from the soft tissue pogonion to the skeletal pogonion measured along the Frankfort horizontal plane.

4. Statistical Method

From the means and standard deviations of thirty-six measurements for Korean males and females, statistical analysis was made by means of the two tailed "t" test to find sexual differences in Koreans (Table 2).

The same method was also performed to obtain information of racial differences between Koreans and Caucasians. However, not all of the thirty-six measurements could be compared between two races. In stead, a statistical comparison was made only between the measurements on which the previous Caucasian studies had been performed for the same age group (young adults) and which also had the established means and standard deviations (Table 3).

The comparison between this study's Korean sample and the other Korean studies' sample (same age group young adults) was made in the same way (Table 4).

CHAPTER IV

RESULTS

A. KOREAN MALE VS. KOREAN FEMALE

In the comparison of the Korean yound adult males and females, the data shown in TABLE 2 was recorded.

The data for thirty-six measurements (6 vertical linear, 17 horizontal linear, and 13 angular measurements) was presented as the following eight categories: (a) Vertical facial lengths and proportions (b) Angles of facial contour (c) Maxillary and mandibular soft tissue protrusion (d) Eye, nose depth (e) Angles of nose (f) Angles of lips (g) Linear measurements of lips (h) Soft tissue thicknesses. The comparison was made between Korean males and Korean females by means of the student "t" test (two tailed).

a. Vertical facial lengths and proportions: There were significantly larger values in Korean males than in Korean females in all these measurements (TABLE 2-a).

1. G-Sn (Upper facial height): larger in male ($p < .01$)
2. Eye-Sn (Eye height): larger in male ($p < .01$)
3. Sn-Me' (Lower facial height): larger in male ($p < .01$)
4. Sn-Stm (Upper lip length): larger in male ($p < .01$)
5. Stm-Me' (Lower lip length): larger in male ($p < .01$)

However, there was no significant difference between Korean males and Korean females in vertical proportional relationships of the soft tissue profile.

b. Angles of facial contour: There were significant differences between Korean males and Korean females in the three of these angular measurements (TABLE 2-b).

1. G-Sn-Pg' (Facial contour angle): larger in male ($p < .05$)
2. G-Pn-Pg' (Nasofacial contour angle): larger in female ($p < .01$)
3. E plane to FH plane (E Angle): larger in female ($p < .05$)
4. Most protrusive lip to Pg'-FH plane (Z Angle): not significantly different

c. Maxillary and mandibular soft tissue protrusion: There was no significant difference in maxillary soft tissue protrusion at subnasale region between Korean males and Korean females. However, in the mandibular soft tissue protrusion, Korean females showed larger values than did Korean males (TABLE 2-c).

1. Sn-G 1 FH plane (Subnasale protrusion): not significantly different
2. Pg'-G 1 FH plane (Chin protrusion): larger in female ($p < .05$)
3. Pg'-N' 1 FH plane (0-degree meridian): not significantly different, although female had larger values

d. Eye, nose depth: Korean males showed significantly larger values in the three of these measurements than Korean females (TABLE 2-d).

1. N'-G,Sn (Soft tissue nasion depth): not significantly different
2. Eye-G,Sn (Eye depth): larger in male ($p< .01$)
3. Pn-Rn (Nose depth): larger in male ($p< .01$)
4. Pn-G,Sn (Columella depth): larger in male ($p< .01$)

e. Angles of nose: There were no significant differences in all of these angles between Korean males and Korean females (TABLE 2-e).

1. Dn-N'-Pg' (Nasal prominence to chin): not significant
2. Dn-N'-Sn (Columella length angle): not significant
3. N',Dn-Cm,Sn (Nasal tip angle): not significant
4. Cm,Sn-FH plane (Columella inclination angle): not significant
5. Cm-Sn-UL (Nasolabial angle): not significant

f. Angles of lips: There were no significant differences in all of these angular measurements of lips between Korean males and Korean females although females had a larger value than males (TABLE 2-f).

1. Sn,UL to FH plane (Upper lip inclination): not significant
2. B',LL to FH plane (Lower lip inclination): not significant
3. Sn,UL-B',LL (Interlabial prominence angle): not significant
4. LL-B'-Pg' (Mentolabial sulcus angle): not significant

g. Linear measurements of lips: The distances of the upper and the lower lip to the Ricketts' E plane were not statistically significant between Korean males and Korean females. However, there were significantly larger values in Korean males than in Korean females for the upper lip protrusion in relation to the lower facial plane (Sn-Pg'). There was also significant difference for the upper lip covering the upper incisors between Korean males and females (TABLES 2-g).

1. UL-E plane (Upper lip protrusion): not significant
2. LL-E plane (Lower lip protrusion): not significant
3. UL-Sn,Pg' (Upper lip protrusion): larger in males ($p < .05$)
4. LL-Sn,Pg' (Lower lip protrusion): not significant
5. B'-Sn,Pg' (Mentolabial sulcus depth): deeper in males ($p < .05$)
6. $\underline{1}$-Stm (Upper incisor exposure): larger in females ($p < .05$)

h. Soft tissue thickness: Korean males had significantly larger values in soft tissue thicknesses at lower face area than Korean females (TABLE 2-h).

1. A'-A (Upper labial sulcus thickness): larger in male ($p < .01$)
2. UL-UIL (Upper lip thickness): larger in male ($p < .01$)
3. LL-LIL (Lower lip thickness): larger in male ($p < .01$)
4. B'-B (Mentolabial sulcus thickness): not significant
5. Pg'-Pg (Chin thickness): not significant

B. KOREAN VS. CAUCASIAN

The comparison was made between the results of this study and those of previous Caucasian studies where the same methods, same measurements for the same age groups had been used.

a. Vertical facial lengths and proportions: There was no difference between this study and Culcliffe's ideal values in the vertical linear measurements as well as in the vertical proportion. However, the values in Worms' study were significantly smaller than those of this study (TABLE 3-a).

1. G-Sn (Upper facial height): smaller in Worms' study ($p < .01$)
2. Sn-Me' (Lower facial height): smaller in Worms' study ($p < .01$)
3. Sn-Stm (Upper lip length): smaller in Worms' study ($p < .01$)
4. Stm-Me' (Lower lip length): smaller in Worms' study ($p < .01$)

b. Angles of facial contour (TABLE 3-b):

1. G-Sn-Pg' (Facial contour angle):
   - larger in Worms', and in Legan's studies than in this study ($p < .01$)
   - larger in female of Scheideman's study than in female of this study ($p < .01$)
2. G-Pn-Pg' (Nasofacial contour angle): smaller in Worms' study ($p < .01$)
3. Most protrusive lip to Pg'-FH plane (Z Angle): larger in Merrifield's study ($p < .01$)

c. Maxillary and mandibular soft tissue protrusion (TABLE 3-c):

1. Sn-G 1 FH plane (Subnasale protrusion): larger in Scheideman's female ($p < .01$)
2. Pg'-G 1 FH plane (Chin protrusion): not significantly different, comparing this study with Legan's and Scheideman's studies.
3. Pg'-N' 1 FH plane (0-degree meridian): not significantly different, comparing this study with Spradley's and Scheideman's studies

d. Eye, nose depth: Comparing these measurements with Worms' study, the followings were significantly different (TABLE 3-d).

1. N'-G,Sn (Soft tissue nasion depth): smaller in Worms' study ($p < .01$)
2. E-G,Sn (Eye depth): not significantly different
3. Pn-Rn (Nose depth): larger in Worms' study ($p < .01$)
4. Pn-G,Sn (Columella depth): larger in Worms' study ($p < .01$)

e. Angles of nose (TABLE 3-e):

1. N',Dn-Cm,Sn (Nasal tip angle): smaller in Scheideman's study, in both male ($p < .05$) and female ($p < .05$)
2. Cm,Sn-FH plane (Columella inclination angle): not significantly different, although the values were larger in Scheideman's study in both sexes
3. Cm-Sn-UL (Nasolabial angle): larger in all three Caucasian studies ($p < .01$)

f. Angles of lips: It was not appropriate to compare these measurements with the other Caucasian studies except the mentolabial sulcus angle because of the difference in choosing a sample or in selecting a horizontal reference plane and points. In this study the author used the FH plane, whereas Burstone and Crowe utilized the palatal plane as a horizontal reference line to measure angular relationships of lips (TABLE 3-f).

1. LL-B'-Pg' (Mentolabial sulcus angle):
   - smaller in Scheideman's study both male ($p < .01$) and female ($p < .05$)
   - smaller in Worms' study ($p < .01$)

g. Linear measurements of lips (TABLE 3-g):

1. UL-E plane (Upper lip protrusion):
   - less protrusive in Scheideman's study both male ($p < .01$) and female ($p < .01$)
   - more than one standard deviation (of this study) less protrusive in Ricketts' study
2. LL-E plane (Lower lip protrusion):
   - less protrusive in Scheideman's study both male ($p < .01$) and female ($p < .01$)
   - more than one standard deviation less protrusive in Ricketts' study
3. UL-Sn,Pg' (Upper lip protrusion): less protrusive in Worms' study ($p < .01$) and in Legan's study ($p < .01$)
4. LL-Sn,Pg' (Lower lip protrusion): less protrusive in Worms'

study ($p < .01$) and in Legan's study ($p < .01$)

5. B'-Sn,Pg' (Mentolabial sulcus depth): deeper in Worms' study ($p < .01$)
6. $\underline{1}$-Stm (Upper incisor exposure): larger in female of Burstone's study ($p < .05$)

h. Soft tissue thickness (TABLE 3-h): Comparing this study with Burstone's study and with Scheideman's study, the followings were found to be significantly different.

1. A-A' (Upper labial sulcus thickness):
   - thicker in Burstone's study both male ($p < .01$) and female ($p < .01$)
   - thicker in Scheideman's study in male only ($p < .05$)
2. UL-UIL (Upper lip thickness):
   - thicker in Burstone's study both male ($p < .01$) and female ($p < .01$)
   - thicker in Scheideman's study both male ($p < .01$) and female ($p < .01$)
3. LL-LIL (Lower lip thickness):
   - thicker in Burstone's study both male ($p < .01$) and female ($p < .05$)
   - thicker in Scheideman's study both male ($p < .01$) and female ($p < .01$)
4. B-B' (Mentolabial sulcus thickness):
   - thinner in Burstone's study both male ($p < .01$) and female ($p < .01$)

- thinner in Scheideman's study both male ($p < .01$) and female ($p < .01$)

5. Pg'-Pg (Chin thickness): thinner in female both in Burstone's study ($p < .01$) and Scheideman's study ($p < .01$)

C. KOREAN (this study) VS. KOREAN (other studies)

The comparison was made between this study and the previous Korean studies of Park (1971), Oh (1981), and Lee & Sohn (1984) in which the same methods for the same measurements had been used (TABLE 4).

1. Vertical facial lengths and proportions: It was not appropriate to compare the author's study with the other Korean studies for these measurements because of the differences in using the vertical reference planes. Park used the perpendicular plane to the palatal plane (ANS-PNS) and Oh and Lee & Sohn used the perpendicular plane to the FH plane while the author used two constructed lines, one from the glabella to the subnasale for the upper facial measurements and the other from the subnasale to the soft tissue menton for the lower facial measurements. Park and Lee & Sohn measured the vertical distances of soft tissue with the lips in rest position, while the author and Oh measured them with the lips together.

2. Angle of facial contour (TABLE 4-1): Comparing this study with Lee & Sohn study, there was a significant larger female value of the facial convexity angle (G-Sn-Pg') in Lee & Sohn study than in the author's study ($p < .01$).

3. Maxillary and mandibular soft tissue protrusion (TABLE 4-2): There was no significant difference between this study and the other Korean study (Lee & Sohn) for the subnasale protrusion (Sn-G 1 FH plane) and for the chin protrusion (Pg'-G 1 FH plane).

4. Angle of nose (TABLE 4-3): There was no significant difference between this study and the other Korean study (Lee & Sohn) for the nasolabial angle (Cm-Sn-UL).

5. Angle of lips (TABLE 4-4): There was a significant difference in the mentolabial sulcus angle (LL-B'-Pg') in female between this study and Park's study.

1) LL-B'-Pg' (Mentolabial sulcus angle):
   - more acute angle in Park's female than in the author's female ($p < .05$)

6. Linear measurements of lips (TABLE 4-5):

1) UL to E plane: less protrusive in Oh's female than in the author's female ($p < .05$)
2) LL to E plane: not significantly different
3) UL-Sn,Pg' (Upper lip protrusion):
   - more protrusive in Park's male and female than in the author's study ($p < .01$)
   - more protrusive in Oh's male and female than in the author's study ($p < .05$)
   - less protrusive in Lee & Sohn's female than in the author's

study ($p < .01$)

7. Soft tissue thickness: Comparing this study with the studies done by Park and Oh, the following significant differences were found:

   1) UL-UIL (Upper lip thickness): thicker in Park's female than in the author's female ($p < .01$)

   2) LL-LIL (Lower lip thickness): thicker in Park's male and female than in the author's study ($p < .01$)

TABLE 1

LIST OF RANGES, MEANS, AND STANDARD DEVIATIONS OF SOFT TISSUE MEASUREMENTS FOR KOREAN YOUNG ADULTS

Measurement	Dimension	Min.	Max.	Mean	S.D.
G-Sn	VL	69.00	92.50	76.02	4.86
Sn-Me'	VL	63.00	84.00	74.46	4.84
Eye-Sn	VL	43.20	58.10	49.16	3.55
Sn-Stm	VL	20.20	29.50	24.68	2.25
Stm-Me'	VL	42.80	58.50	49.72	3.58
$\underline{1}$-Stm	VL	0.00	6.10	2.63	1.13
G-Sn : Sn-Me'	Ratio	76.02 : 74.46 = 1.02 : 1			
Eye-Sn : Sn-Me'	Ratio	49.16 : 74.46 = 2 : 3.03			
Sn-Stm : Stm-Me'	Ratio	24.68 : 49.72 = 1 : 2.01			
Eye-Sn : Stm-Me'	Ratio	49.16 : 49.72 = 1 : 1.01			
Soft tissue nasion depth	HL	2.80	13.50	6.73	1.93
Eye depth	HL	8.60	19.00	13.15	2.38
Nose depth	HL	20.00	28.50	24.21	2.09
Columella depth	HL	11.40	17.50	14.27	1.48
Subnasale protrusion	HL	-1.00	14.30	5.48	3.58
Chin protrusion	HL	-13.00	19.30	2.09	6.09
0-degree meridian	HL	-7.00	23.00	7.23	6.06
UL to E plane	HL	-5.00	5.00	-0.49	2.08
LL to E plane	HL	-3.00	6.50	1.39	1.91
UL protrusion	HL	2.20	11.50	6.42	1.98
LL protrusion	HL	1.20	10.00	5.51	1.74
Mentolabial sulcus depth	HL	-6.00	0.50	-1.92	1.28
A'-A	HL	9.80	18.00	13.59	1.99
UL-UIL	HL	7.10	16.00	11.86	2.06
LL-LIL	HL	9.60	17.00	13.48	1.68
B'-B	HL	9.20	16.50	12.85	1.36
Pg'-Pg	HL	9.50	19.00	13.05	1.76
Facial contour angle	Angle	-7.20	19.50	7.76	4.94
Nasofacial contour angle	Angle	139.00	163.00	150.40	4.80
E angle	Angle	65.00	85.00	76.36	4.25
Z angle	Angle	58.80	90.00	72.51	6.43
Columella inclination	Angle	3.00	45.00	23.64	7.50
Nasal prominence to chin	Angle	23.90	37.30	28.79	3.13
Columella length angle	Angle	15.00	28.30	21.11	2.30
Nasal tip angle	Angle	63.50	101.00	81.21	7.58
Nasolabial angle	Angle	62.00	117.30	93.51	10.52
Upper lip inclination	Angle	92.10	129.50	110.11	8.34
Lower lip inclination	Angle	30.40	68.60	47.66	8.25
Interlabial angle	Angle	93.00	143.20	117.58	10.32
Mentolabial sulcus angle	Angle	109.50	154.00	132.25	9.93

VL : Vertical linear measurement HL : Horizontal linear measurement

TABLE 2

COMPARISON OF SOFT TISSUE PROFILE VARIABLES BETWEEN KOREAN MALES AND FEMALES

No.	Measurement	Sex	Min.	Max.	Mean	S.D.	t-value	
a.	Vertical facial length							
1.	G-Sn	M	69.00	92.50	77.91	5.60	3.1210	**
	(Upper facial height)	F	69.30	84.30	74.53	3.61		
2.	Eye-Sn	M	43.80	57.40	50.66	3.52	3.4193	**
	(Eye height)	F	43.20	58.10	47.99	3.14		
3.	Sn-Me'	M	66.00	84.00	77.79	4.41	6.5458	**
	(Lower facial height)	F	63.00	78.70	71.85	3.34		
4.	Sn-Stm	M	20.80	29.50	25.67	2.40	3.5816	**
	(Upper lip length)	F	20.20	27.40	23.90	1.80		
5.	Stm-Me'	M	44.50	58.50	52.00	3.50	5.7838	**
	(Lower lip length)	F	42.80	52.60	47.94	2.47		
a'	Vertical proportion of the face							
	Eye-Sn : Sn-Me'	M	50.66 : 77.79 = 2 : 3.07				2 : 3 (Cutcliffe)	
		F	47.99 : 71.85 = 2 : 2.99					
	Sn-Stm : Stm-Me'	M	25.67 : 52.00 = 1 : 2.03				1 : 2 (Cutcliffe)	
		F	23.90 : 47.94 = 1 : 2.01					
	Eye-Sn : Stm-Me'	M	50.66 : 52.00 = 1 : 1.02				1 : 1 (Cutcliffe)	
		F	47.99 : 47.94 = 1 : 1.00					
	G-Sn : Sn-Me'	M	77.91 : 77.79 = 1.00 : 1				1 : 1 (Worms)	
		F	74.53 : 71.85 = 1.04 : 1					

Sample sizes : Korean males N = 32
Korean females N = 41

N.S. - Not significant
* - Significant at 5 % probability level
** - Significant at 1 % probability level

TABLE 2 CONTINUED

No.	Measurement	Sex	Min.	Max.	Mean	S.D.	t-value	
	b. Angles of facial contour							
6.	G-Sn-Pg'	M	-7.20	19.50	9.25	5.51	2.3583	*
	(Facial contour angle)	F	-2.00	18.10	6.59	4.14		
7.	G-Pn-Pg'	M	139.00	163.00	148.75	5.20	2.6883	**
	(Nasofacial contour angle)	F	140.30	161.60	151.68	4.08		
8.	E plane to FH plane	M	65.00	85.00	74.93	5.00	2.6343	*
	(E angle)	F	70.80	82.10	77.47	3.19		
9.	Most protrusive lip to Pg'-FH plane	M	59.00	90.00	71.41	7.34	1.2880	N.S.
	(Z angle)	F	58.80	82.90	73.35	5.56		
	c. Maxillary and mandibular soft tissue protrusion							
10.	Sn-G 1 FH plane	M	-1.00	14.30	5.54	4.02	0.1413	N.S.
	(Subnasale protrusion)	F	-0.30	13.50	5.42	3.23		
11.	Pg'-G 1 FH plane	M	-13.00	19.30	0.36	7.23	2.1914	*
	(Chin protrusion)	F	-8.60	13.40	3.43	4.69		
12.	Pg'-N' 1 FH plane	M	-7.00	23.00	5.91	7.48	1.6597	N.S.
	(0-degree Meridian)	F	-3.40	16.00	8.26	4.48		
	d. Eye, nose depth							
13.	N'-G,Sn	M	3.80	13.50	7.17	2.18	1.7635	N.S.
	(Soft tissue nasion depth)	F	2.80	10.40	6.38	1.64		
14.	Eye-G,Sn	M	12.00	19.00	14.90	1.68	7.2376	**
	(Eye depth)	F	8.60	15.60	11.79	1.92		

TABLE 2 CONTINUED

No.	Measurement	Sex	Min.	Max.	Mean	S.D.	t-value	
15.	Pn-Rn (Nose depth)	M F	22.50 20.00	28.50 27.00	25.75 23.01	1.49 1.66	7.2984	**
16.	Pn-G,Sn (Columella depth)	M F	11.50 11.40	17.50 16.90	14.77 13.88	1.62 1.23	2.6809	**
e.	Angles of nose							
17.	Dn-N'-Pg' (Nasal prominence to chin)	M F	24.00 23.90	35.20 37.30	29.31 28.38	3.17 3.07	1.2635	N.S.
18.	Dn-N'-Sn (Columella length angle)	M F	15.00 18.00	27.20 28.30	20.92 21.26	2.44 2.20	0.6269	N.S.
19.	N',Dn-Cm,Sn (Nasal tip angle)	M F	63.50 67.90	101.00 97.20	79.80 82.28	8.49 6.69	1.3728	N.S.
20.	Cm,Sn to FH plane (Columella inclination angle)	M F	3.00 15.30	45.00 41.40	21.78 25.08	8.87 5.94	1.8936	N.S.
21.	Cm-Sn-UL (Nasolabial angle)	M F	62.00 73.50	110.30 117.30	92.46 94.31	10.56 10.53	0.7449	N.S.
f.	Angles of lips							
22.	Sn,UL to FH plane (Upper lip inclination)	M F	96.40 92.10	129.50 123.90	109.23 110.78	8.66 8.11	0.7847	N.S.
23.	B',LL to FH plane (Lower lip inclination)	M F	30.40 32.00	62.20 68.60	45.96 48.98	8.68 7.74	1.5707	N.S.
24.	Sn,UL-B',LL (Interlabial prominence angle)	M F	93.00 96.80	137.00 143.20	116.76 118.21	9.77 10.80	0.5923	N.S.
25.	LL-B'-Pg' (Mentolabial sulcus angle)	M F	109.50 111.00	150.00 154.00	130.68 133.47	9.92 9.87	1.1940	N.S.

TABLE 2 CONTINUED

No.	Measurement	Sex	Min.	Max.	Mean	S.D.	t-value	
	g. Linear measurement of lips							
26.	UL to E plane (Upper lip protrusion)	M F	-5.00 -4.50	5.00 2.90	-0.35 -0.59	2.62 1.55	0.4913	N.S.
27.	LL to E plane (Lower lip protrusion)	M F	-3.00 -2.50	6.50 5.10	1.49 1.31	2.38 1.47	0.3824	N.S.
28.	UL-Sn,Pg' (Upper lip protrusion)	M F	3.00 2.20	11.50 9.40	6.93 6.01	2.30 1.59	2.0124	*
29.	LL-Sn,Pg' (Lower lip protrusion)	M F	1.20 2.50	10.00 9.50	5.93 5.17	2.09 1.34	1.8625	N.S.
30.	B'-Sn,Pg' (Mentolabial sulcus depth)	M F	-6.00 -4.10	0.00 0.50	-2.30 -1.62	1.47 1.02	2.3252	*
31.	$\underline{1}$-Stm (Upper incisor exposure)	M F	0.50 0.00	4.00 6.10	2.28 2.90	0.76 1.28	2.4048	*
	h. Soft tissue thickness							
32.	A'-A (Upper labial sulcus thickness)	M F	10.50 9.80	18.00 16.90	14.94 12.53	1.51 1.65	6.4068	**
33.	UL-UIL (Upper lip thickness)	M F	11.00 7.10	16.00 13.40	13.47 10.60	1.38 1.56	8.1358	**
34.	LL-LIL (Lower lip thickness)	M F	11.50 9.60	17.00 15.40	14.59 12.60	1.42 1.31	6.1785	**
35.	B'-B (Mentolabial sulcus thickness)	M F	10.50 9.20	16.50 15.50	13.17 12.59	1.46 1.23	1.8294	N.S.
36.	Pg'-Pg (Chin thickness)	M F	9.50 9.70	19.00 16.30	13.10 13.00	1.83 1.72	0.2237	N.S.

TABLE 3

COMPARISION OF SOFT TISSUE PROFILE VARIABLES BETWEEN KOREAN AND CAUCASIAN (MALES AND FEMALES)

		KOREAN		CAUCASIAN			CAUCASIAN			CAUCASIAN		
Measurement	Sex	Mean	S.D.	Mean	S.D.	t-value	Mean	S.D.	t-value	Mean	S.D.	t-value
a. Vertical facial length				[Cutcliffe]			[Worms]					
G-Sn	M	77.9	5.6									
	F	74.5	3.6									
	M&F	76.0	4.9				69.0	3.7	7.8822**			
Eye-Sn	M	50.7	3.5									
	F	48.0	3.1									
	M&F	49.2	3.6	50.0	---	------	50.0	4.0	1.0858^{ns}			
Sn-Me'	M	77.8	4.4									
	F	71.9	3.3									
	M&F	74.5	4.8	75.0	---	------	67.0	3.6	8.6349**			
Sn-Stm	M	25.7	2.4									
	F	23.9	1.8									
	M&F	24.7	2.3	25.0	---	------	22.0	1.8	6.4211**			
Stm-Me'	M	52.0	3.5									
	F	47.9	2.5									
	M&F	49.7	3.6	50.0	---	------	45.0	2.8	7.1522**			

a' Vertical proportion of the face				
Eye-Sn : Sn-Me'	M&F	49.2 : 74.5 = 2 : 3.03 [KOREAN]	M&F	50 : 75 = 2 : 3 [Cutcliffe]
Sn-Stm : Stm-Me'	M&F	24.7 : 49.7 = 1 : 2.01 [KOREAN]	M&F	25 : 50 = 1 : 2 [Cutcliffe]
Eye-Sn : Stm-Me'	M&F	49.2 : 49.7 = 1 : 1.01 [KOREAN]	M%F	50 : 50 = 1 : 1 [Cutcliffe]
G-Sn : Sn-Me'	M&F	76.0 : 74.5 = 1.02 : 1 [KOREAN]	M&F	69 : 67 = 1.03 : 1 [Worms]

Sample sizes : Korean adult M = 32, F = 43; Cutcliffe adult = unpublished; Worms adult M = 20, F = 20

TABLE 3 CONTINUED

Measurement	Sex	KOREAN Mean	S.D.	CAUCASIAN Mean	S.D.	t-value	CAUCASIAN Mean	S.D.	t-value	CAUCASIAN Mean	S.D.	t-value
b. Angles of facial contour				[Worms]			[Legan]			[Scheideman]		
G-Sn-Pg'	M	9.3	5.5							10.8	4.2	1.2261^{ns}
	F	6.6	4.1							11.0	4.8	3.9187**
	M&F	7.8	4.9	11.0	4.3	3.4628**	12.0	4.0	4.6374**			
G-Pn-Pg'	M	148.8	5.2									
	F	151.7	4.0									
	M&F	150.4	4.8	141.0	4.6	10.1017**						
E angle	M	74.9	5.0	[Owen's 9y old child]								
	F	77.5	3.2									
	M&F	76.4	4.3	72.0	4.0	------						
Z angle	M	71.4	7.3									
	F	73.4	5.6	[Merrifield]								
	M&F	72.5	6.4	80.0	5.0	5.5348**						
c. Maxillary and mandibular soft tissue Protrusion												
Sn-G 1 FH plane	M	5.5	4.0							7.5	4.4	1.9026^{ns}
	F	5.4	3.2							7.9	3.8	2.8350**
	M&F	5.5	3.6				6.0	3.0	0.7473^{ns}			
Pg'-G 1 FH plane	M	0.4	7.2							3.0	7.7	1.3951^{ns}
	F	3.4	4.7							3.6	5.8	0.1517^{ns}
	M&F	2.1	6.1	[Spradley]			0.0	4.0	1.9571^{ns}			
Pg'-N 1 FH plane	M	5.9	7.5	6.5	5.4	0.4729^{ns}				5.8	7.3	0.0540^{ns}
	F	8.3	4.5	7.2	4.1	1.2727^{ns}	[Gonzales-Ulloa]			6.0	5.8	0.3121^{ns}
	M&F	7.2	6.1				0.0	2.0	------			

Sample sizes : Legan adult M = 20 Scheideman adult M = 32 Spradley adult M = 80
F = 20 F = 24 F = 60
Merrifield adult M&F = 30 Gonzales-Ulloa = unpublished

TABLE 3 CONTINUED

Measurement	Sex	KOREAN Mean	KOREAN S.D.	CAUCASIAN Mean	CAUCASIAN S.D.	CAUCASIAN t-value	CAUCASIAN Mean	CAUCASIAN S.D.	CAUCASIAN t-value	CAUCASIAN Mean	CAUCASIAN S.D.	CAUCASIAN t-value
d. Eye, nose depth					[Worms]			[legan]			[Scheideman]	
N'-G,Sn	M	7.2	2.2									
	F	6.4	1.6									
	M&F	6.7	1.9	4.0	1.3	8.0117**						
Eye-G,Sn	M	14.9	1.7									
	F	11.8	1.9									
	M&F	13.2	2.4	14.0	2.1	1.7690^{ns}						
Pn-Rn	M	25.8	1.5									
	F	23.0	1.7									
	M&F	24.2	2.1	29.0	2.2	11.4262**						
Pn-G,Sn	M	14.8	1.6									
	F	13.9	1.2									
	M&F	14.3	1.5	18.0	1.7	11.9569**						
e. Angles of nose												
N',Dn-Cm,Sn	M	79.8	8.5							75.8	7.4	2.0078*
	F	82.3	6.7							77.9	6.5	2.5832*
	M&F	81.2	7.6									
Cm,Sn-FH plane	M	21.8	8.9							24.6	8.1	1.3162^{ns}
	F	25.1	5.9							27.4	5.3	1.5733^{ns}
	M&F	23.6	7.5									
Cm-Sn-UL	M	92.5	10.6							111.4	11.7	6.7720**
	F	94.3	10.5							111.9	8.4	6.9982**
	M&F	93.5	10.5	119.0	7.3	13.6471**	102.0	8.0	4.4566**			

TABLE 3 CONTINUED

Measurement	Sex	KOREAN Mean	S.D.	CAUCASIAN Mean	S.D.	t-value	CAUCASIAN Mean	S.D.	t-value	CAUCASIAN Mean	S.D.	t-value
f. Angles of lips				[Worms]						[Scheideman]		
LL-B'-Pg'	M	130.7	9.9							122.0	10.1	3.4798**
	F	133.5	9.9							127.9	12.3	2.0105*
	M&F	132.3	9.9	122.0	11.7	4.9552**						
g. Linear measurement of lips												
UL to E plane	M	-0.4	2.6				[Ricketts]			-6.8	1.9	11.2426**
	F	-0.6	1.6							-5.8	2.0	11.5184**
	M&F	-0.5	2.1				-4.0	3.0	------			
LL to E plane	M	1.5	2.4							-3.9	2.1	9.5787**
	F	1.3	1.5							-2.4	2.2	8.0537**
	M&F	1.4	1.9				-2.0	2.0	------			
UL-Sn,Pg'	M	6.9	2.3				[Legan]					
	F	6.0	1.6									
	M&F	6.4	2.0	2.4	1.5	11.0526**	3.0	1.0	10.0707**			
LL-Sn,Pg'	M	5.9	2.1									
	F	5.2	1.3									
	M&F	5.5	1.7	2.3	1.5	9.9651**	2.0	1.0	11.9263**			
B'-Sn,Pg'	M	-2.3	0.8									
	F	-1.6	1.0									
	M&F	-1.9	1.3	-4.2	1.3	8.9945**	[Burstone]					
1-Stm	M	2.3	0.8				2.3	2.6	0.0000^{ns}			
	F	2.9	1.3				3.7	1.7	2.1556*			
	M&F	2.6	1.1									

Sample size : Ricketts = unpublished

TABLE 3 CONTINUED

Measurement	Sex	KOREAN Mean	KOREAN S.D.	CAUCASIAN Mean	CAUCASIAN S.D.	t-value	CAUCASIAN Mean	CAUCASIAN S.D.	t-value
h. Soft tissue thickness				[Burstone]			[Scheideman]		
A'-A	M	14.9	1.5	17.2	1.8	4.5959**	15.9	1.7	2.4951*
	F	12.5	1.7	13.8	1.4	3.2144**	12.9	1.5	0.9549^{ns}
UL-UIL	M	13.5	1.4	15.1	1.9	3.2514**	16.1	1.5	7.1682**
	F	10.6	1.6	11.8	1.5	3.0257**	12.9	1.3	5.9764**
LL-LIL	M	14.6	1.4	16.3	1.5	3.7944**	16.3	1.5	4.6868**
	F	12.6	1.3	13.4	1.7	2.1556*	14.5	1.2	5.8470**
B'-B	M	13.2	1.5	11.9	1.2	2.9393**	11.4	1.5	4.8000**
	F	12.6	1.2	10.9	1.1	5.7592**	10.8	1.1	6.0145**
Pg'-Pg	M	13.1	1.8	13.6	1.8	0.8878^{ns}	12.5	1.8	1.3333^{ns}
	F	13.0	1.7	11.6	1.4	3.4616**	10.8	1.6	5.1438**

ns - Not significant
* - Significant at 5 % probability level
** - Significant at 1 % probability level

Age range : Korean M = 18y - 25y Scheideman M = 21y - 35y Legan M&F = 20y - 30y
F = 17y - 23y F = 20y - 32y

Burstone M&F = 16.5y - 36.3y

Spradley M&F = 19y - 32y

TABLE 4

COMPARISON OF SOFT TISSUE PROFILE VARIABLES BETWEEN THIS STUDY AND OTHER KOREAN STUDIES (MALES AND FEMALES)

		Author		Park			Oh			Lee & Sohn		
Measurement	Sex	Mean	S.D.	Mean	S.D.	t-value	Mean	S.D.	t-value	Mean	S.D.	t-value
1. Angle of facial contour												
G-Sn-Pg'	M	9.3	5.5							9.9	3.9	0.5642^{ns}
	F	6.6	4.1							9.1	3.8	3.0832**
2. Maxillary and mandibular soft tissue protrusion												
Sn-G 1 FH plane	M	5.5	4.0							5.0	3.7	0.5678^{ns}
	F	5.4	3.2							6.2	3.5	1.1488^{ns}
Pg'-G 1 FH plane	M	0.4	7.2							-1.1	5.3	1.0602^{ns}
	F	3.4	4.7							2.2	5.9	1.0728^{ns}
3. Angle of nose												
Cm-Sn-UL	M	92.5	10.6							94.4	10.2	0.7963^{ns}
	F	94.3	10.5							97.8	10.3	1.6336^{ns}
4. Angle of lips												
LL-B'-Pg'	M	130.7	9.9	131.6	10.6	0.3886^{ns}	134.2	10.1	1.4302^{ns}			
	F	133.5	9.9	129.5	9.4	2.0081*	136.7	7.3	1.7279^{ns}			
5. Linear measurements of lips												
UL to E plane	M	-0.4	2.6				-0.4	1.6	0.0000^{ns}			
	F	-0.6	1.6				-1.4	1.7	2.2521*			
LL to E plane	M	1.5	2.4				1.7	1.4	0.4209^{ns}			
	F	1.3	1.5				0.7	1.7	1.7361^{ns}			
UL-Sn,Pg'	M	6.9	2.3	8.3	2.0	2.9536**	8.0	1.6	2.2884*	7.2	1.6	0.6799^{ns}
	F	6.0	1.6	7.5	1.0	5.6031**	6.7	1.3	2.2491*	5.4	1.3	2.0262*

TABLE 4 CONTINUED

Measurement	Sex	Author Mean	Author S.D.	Park Mean	Park S.D.	Park t-value	Oh Mean	Oh S.D.	Oh t-value	Lee & Sohn Mean	Lee & Sohn S.D.	Lee & Sohn t-value
LL-Sn,Pg'	M	5.9	2.1	6.6	2.3	1.4036^{ns}	5.8	1.6	0.2204^{ns}	5.7	2.1	0.4137^{ns}
	F	5.2	1.3	5.7	2.0	1.3924^{ns}	5.1	1.3	0.3581^{ns}	4.7	1.5	1.7088^{ns}
1-Stm	M	2.3	0.8				2.6	1.4	1.0633^{ns}			
	F	2.9	1.3				2.5	1.2	1.4920^{ns}			
6. Soft tissue thickness												
A'-A	M	14.9	1.5				14.4	1.2	1.5126^{ns}			
	F	12.5	1.7				12.7	1.6	0.1074^{ns}			
UL-UIL	M	13.5	1.4	14.1	2.6	1.2024^{ns}						
	F	10.6	1.6	11.9	2.0	3.4139**						
LL-LIL	M	14.6	1.4	15.5	1.0	3.4486**						
	F	12.6	1.3	13.6	1.5	3.4065**						
B'-B	M	13.2	1.5				12.7	1.0	1.6180^{ns}			
	F	12.6	1.2				12.8	1.1	0.8475^{ns}			
Pg'-Pg	M	13.1	1.8	13.4	2.0	0.6950^{ns}	13.0	1.6	0.2407^{ns}			
	F	13.0	1.7	13.1	1.6	0.2937^{ns}	13.4	1.4	1.2026^{ns}			

	Author	Park	Oh	Lee & Sohn
Sample sizes :	M = 32	M = 53	M = 35	M = 46
	F = 41	F = 54	F = 46	F = 55
Age range :	17y - 25y	17y - 22y	17y - 19y	over 18y

CHAPTER V

DISCUSSION

A. Vertical proportion of the face

Cutcliffe suggested soft tissue vertical proportion of the face to localize the harmony of the face in Caucasians. The total facial height between the eye and the soft tissue menton was divided into fifths. The eye height (eye-subnasale) was 2/5, the upper lip length (subnasale-stomion) was 1/5, and the lower lip length (stomion-soft tissue menton) was the remaining 2/5.[34] He has found that there was a 2:3 ratio between the eye height and the lower facial height (subnasale-soft tissue menton), a 1:2 ratio between the upper and the lower lip length, and a 1:1 relationship between the eye height and the lower lip length. The findings of the present study gave support to the use of these proportions although in the Korean males of this study, the mean values of all measurements were significantly larger than in the Korean females (TABLE 2-a). The ratio of the eye height to the lower facial height was 2:3.07 in the Korean males, slightly different from the ratio of 2:2.99 in the Korean females. However, these ratios approximate the 2:3 ratio of Cutcliffe's ideal value. The proportion between the upper lip and the lower lip in the Korean male samples was 1:2.03 and was 1:2.01 in female samples, which were close to the ratio of 1:2 as Cutcliffe stated. The eye height in proportional to the lower lip length for Korean appeared 1:1.02 in

male subjects and 1:1 in the females, which also agreed with Cutcliffe's Caucasian ideal ratio of 1:1.

Another vertical facial proportionality used in this study was the ratio of the upper facial height (G-Sn) to the lower facial height (Sn-Me'), which was originally reported in Legan and Burstone study.[38] In their study, they measured the vertical distance from glabella to subnasale and from subnasale to soft tissue menton perpendicular to "the horizontal line" which was constructed by drawing a line 7 degrees upward to the line from sella to nasion. In this study, however, the author utilized two constructed lines as in Worms' study to measure the upper and the lower facial heights; one was a line of G-Sn and the other was a line of Sn-Me'. Although there were differences in using a vertical reference plane as well as in selecting the relative position of landmark (eg. soft tissue menton) between Legan's study and Worms' study, both Caucasian studies showed that there was approximately one to one ratio between the upper face and the lower face. Korean females in this group had a slightly longer upper facial height than lower facial height (74.53 mm.:71.85 mm. = 1.04:1), which agreed with the finding of Lee and Sohn study.[46] The male ratio, however, was found to be 1:1 (77.91 mm.: 77.79 mm.) in this study, which coincided with the result of Worms. Thus, this present study showed no significant difference in the vertical proportion of the soft tissue profile between Korean males and Korean females, although Korean males showed significantly larger values in all of these five measurements than Korean females (TABLE 2-a).

It was not appropriate to compare the vertical facial dimensions statistically between this study and Cutcliffe's study due to the unpub-

lished data of Cutcliffe's study. However, the combined mean values of both sexes in this study were very close to the ideal values of Cutcliffe's. For this study's values and for Cutcliffe's ideal values respectively, the eye height was 49.2 mm. (50.7 mm./48.0 mm. in males/females) and 50 mm., the lower facial height was 74.5 mm. (77.8 mm./71.9 mm. in males/females) and 75.0 mm., the upper lip length was 24.7 mm. (25.7 mm./23.9 mm. in males/females) and 25.0 mm., and the lower lip length was 49.7 mm. (52.0 mm./47.9 mm. in males/females) and 50.5 mm. In comparing this study with Worms' study, however, the values were significantly smaller in three measurements out of four measurements in Worms' study.

b. Angles of facial contour

Four angles were employed to evaluate the convexity of the soft tissue profile (TABLE 2-b). The facial contour angle was designed by Burstone to focus upon soft tissue structures which were closely analogous to structures utilized for measuring the degree of convexity of the skeletal profiles. The nasofacial contour angle and the 'E' angle were utilized so that the nose as well as chin could be included in the measurements of facial convexity. These were required because the nose has a marked and sometimes indirect influence upon the total cosmetics of the soft tissue profile. The 'Z' angle was also used to evaluate the soft tissue profile convexity with relation to the lip and the chin.

1. The facial contour angle (G-Sn-Pg'): This measurement of the convexity of the soft tissue profile, excluding the nose, was found to be larger in Korean males (9.25 degrees $\pm$ 5.51) than in Korean females

(6.59 degrees ± 4.14). This revealed that Korean males had more convex profile than Korean females. This finding of more convex profile in males was in agreement with the study of Pelton and Elsasser[11] in Caucasian study and with the previous Korean studies.[43,36]

The combined mean of this measurement for Koreans in this study was 7.8 degrees ± 4.9, while in Worms' study[34] it was 11.0 degrees ± 4.3, and in Legan's study[38] it was 12.0 degrees ± 4.0. In Scheideman's study[39] it was 10.8 degrees ± 4.2 in males and 11.0 degrees ± 4.8 in females. As this angle shows a clockwise increase, the profile becomes more convex, suggesting Class II facial pattern. Thus, the larger value of this measurement in Caucasian studies indicate that Caucasians have a more convex profile than Koreans. However, this contour angle is not specific as to the cause of the difference. Further evaluation of anteroposterior relationship of the subnasale and the soft tissue pogonion would be necessary.

Comparing the author's study with Lee and Sohn's Korean study,[46] it was found that female samples in Lee and Sohn's study showed a larger value (9.1 degrees ± 3.8) of the facial contour angle than the females (6.6 degrees ± 4.1) in this study (TABLE 4-1), although this value was still smaller than in Caucasian studies. The larger facial convexity angle in Lee and Sohn's female group was a combined result of the more protrusive subnasale (6.2 mm.) and the less protrusive chin (2.2 mm.) than this study (5.4 mm./3.4 mm. respectively), although they were found to be statistically non-significant.

2. Nasofacial contour angle (G-Pn-Pg'): This angular measurement of the convexity of the soft tissue profile, including the nose, showed

the same trend as in the facial contour angle. The significantly smaller angle of this measurement in Korean males (148.75 degrees ± 5.2) than in Korean females (151.68 degrees ± 4.08) showed that Korean males had a more prominent nose than did Korean females. In Worms' Caucasian study, it was found to be a smaller value (141.0 degrees ± 4.6) than in the present study, which indicated that the nose tip of Caucasians is in a more forward position than that of Koreans.

3. 'E' angle: Connecting the Ricketts esthetic plane to the Frankfort horizontal plane forms what Owen[41] called the "E angle". It relates the nose to the chin in the soft tissue profile. In Owen's search, the mean value of 72.0 degrees ± 4.0 for 9 year-old Caucasian children was established (TABLE 3-b). In present study, however, this angle was found to be larger (75.0 degrees ± 5.0 in males and 77.5 degrees ± 3.2 in females) than that of Owen's children value. Because of the imcompletion of growth and maturation changes in children, Owen's value for this angle couldn't be compared to this study. Further nose growth and mandibular growth could affect this angle.

Between Korean samples, however, the comparison was made and the E angle for Korean females was found to be significantly larger than that of Korean males (TABLE 2-b), which also indicated a more prominent nose in Korean males than in Korean females.

4. 'Z' angle: The angle formed by the Frankfort horizontal plane and the line from the soft tissue pogonion to the most anterior point of either the upper or the lower lip (Z angle) was originally established by Merrifield[25] to define facial esthetics in relation to the chin and the lip, excluding the nose. An apparent difference was found between this study

and Merrifield study (TABLE 3-b). The Korean young adults had an average of 72.5 degrees ± 6.4 for this angle whereas the Caucasian adults in Merrifield study had 80.0 degrees ± 5.0. This finding exhibited greater protrusion of lips in the Korean adult face than in the Caucasian adult face. However, no difference was found between the Korean young males and the Korean young females in this study (71.4 degrees ± 7.3 / 73.4 degrees ± 5.6 respectively) although this angle was highly variable.

In considering the facial contour in the soft tissue profile, it is important to evaluate the anteroposterior position of the foundation of the nose (subnasale) and the chin separately. The following three measurements were utilized in this study to meet this purpose.

c. Maxillary and mandibular soft tissue protrusion

To evaluate the horizontal extension of the soft tissue profile, a vertical line of reference was needed. In this study, the author used two vertical reference lines; one is a perpendicular line to the Frankfort horizontal plane through glabella (G), and the other is a perpendicular line to the Frankfort horizontal plane through soft tissue nasion (N'). By measuring the horizontal prominence of the subnasale (Sn) and the chin (Pg'), the anteroposterior relationship of the maxillary and mandibular soft tissue can be determined.

1. Maxillary soft tissue protrusion (Sn-G perpendicular to FH line): This measurement is important in planning treatment for anterior maxillary advancement or reduction and for total alveolar or Le Fort I maxillary horizontal advancement or reduction.[38] A negative number or smaller value suggests maxillary retrusion, whereas a large positive number indicates maxillary protrusion.

Comparing the measurement of the males (5.5 mm. ± 4.0) reported in this study with that of the females (5.4 mm. ± 3.2), the author found that Korean males and females had similarity in maxillary soft tissue protrusion. However, in Caucasian study, this value was found to be larger in Scheidemen's study (7.5 mm. / 7.9 mm. in males / females). On the other hand, there was no difference between this study and Legan's Caucasian study (6.0 mm.), although the value was slightly larger in Legan's study. This difference between Caucasian studies may be due to the differences resulting from sample selection.

Previous Korean studies[42,46] which evaluated the skeletal facial pattern of Koreans stated that Koreans had more protrusive maxilla than Caucasians. Thus, it is interesting to note that Koreans in this study had less protrusive soft tissue maxilla (Sn) than Caucasians. This possibly can be explained by the fact that Caucasians have thicker soft tissue at the upper lip region than Koreans (TABLE 3-h).

Subtelny[21] stated that the soft tissue structures overlying the skeletal landmarks did not follow the same pattern of the bony profile and the configuration of the midsagittal soft tissue profile could be affected by differences in the thickness of the soft tissue. He also found that there was a comparatively greater increase in the thickness of the soft tissue covering the maxillary jaw than in the soft tissue covering the mandibular symphysis and the forehead area.

TABLE 4 shows that there was no significant difference between this study and Lee and Sohn's study for this measurement.

2. Mandibular soft tissue protrusion (Pg'-G perpendicular to FH line): This measurement gives an indication of mandibular soft tissue

prognathism or retrognathism in relation to the forehead. However, this measurement must be evaluated in conjunction with others. In other words, if Pg' is positioned posteriorly, further examination is necessary to determine whether the cause is a small hard tissue chin, small mandible, average-sized mandible positioned posteriorly, thin soft-tissue chin, or a combination of these.[38]

Legan's study[38] showed that Caucasian adults had a chin which lies tangent to a line perpendicular to the Frankfort horizontal plane through glabella with a standard deviation of 4.0 mm. (TABLE 3-c)

In this study, Korean males showed a similar value (0.4 mm.) to Legan's value with a greater standard deviation of 7.2 mm., while Korean females showed a more protrusive chin (3.4 mm. $\pm$ 4.7) than that of Legan's females. Lee and Sohn's study[49] also indicated that Korean females had more protrusive soft tissue chin (2.2 mm. $\pm$ 5.9) than Korean males (-1.1 mm. $\pm$ 5.3) (TABLE 4). This observation of the Korean female chins being more prominent than Korean males' (TABLE 2-c) is contrary to current clinical thinking for Caucasians in which they suggest that Caucasian male chins are more prominent than Caucasian females'. However, in Scheideman's study[39] it was found that males and females had similar prominence in the chin area (3.0 mm. $\pm$ 7.7 / 3.6 mm. $\pm$ 5.8 mm. in males/ females) with slightly larger average mean in females.

Comparing the means of this study with Legan's and Scheideman's studies, it was found that there was no difference in the chin prominence between Koreans and Caucasians.

3. 0-degree meridian (Pg'-N' perpendicular to FH line): When comparing the soft tissue chin prominence using the soft tissue nasion (N')

perpendicular to FH plane, it was observed that the results also supported the above finding. In Spradley's study[40] this value was found to be 6.5 mm./7.2 mm. in males/females respectively, and in Scheideman's study[39] it was 5.8 mm./6.0 mm. in males/females, while in the present study it was 5.9 mm./8.3 mm. in males/females. Thus there was no difference in the chin prominence between Koreans and Caucasians. However, the standard deviations of this measurement and of the previous measurement (Pg'-G 1 FH) were much larger in both Korean and Caucasian studies than the one observed in maxillary soft tissue protrusion. This may be the consequence of more variation between individuals in the anteroposterior location of the chin. In general, the soft tissue pogonion was located 6 to 8 mm. anterior to N' perpendicular to FH plane both in this study and in Caucasian studies (Spradley, Scheideman). It should be noted that females had more protrusive chin than males in this study as well as in Spradley, and in Scheideman studies.

Gonzales-Ulloa and Stevens, however, previously proposed that the soft tissue pogonion was tangent to N' perpendicular to FH plane in pleasing adult profile.

d. Eye, nose depth

A line was drawn from the glabella to the subnasale and the distances from this line to the eye, and to the soft tissue nasion were measured to evaluate the anteroposterior position of them. Comparing these measurements with Worms' study, the present study showed significant differences between Koreans and Caucasians. The soft tissue nasion of Koreans was more deeply located in the upper face. Relative to sex diffrences in Koreans, it was noted that Korean males had deeper eyes than

Korean females (TABLE 2-d).

To evaluate the nose depth in anteroposterior dimension, the direct distance from the tip of nose (Pn) to the most posterior point on the ala of nose (Rn) was measured. The nose of adult Caucasians, as it has been acknowledged in general, was larger than that of Koreans. Not only the total depth of the nose but also the columella depth of the nose were significantly larger in Caucasian adults than in Korean adults. There was about 5 mm. difference (24.2 mm./29.0 mm. in Koreans/Caucasians respectively) of nose depth and approximately 4 mm. difference (14.3 mm./ 18.0 mm. in Koreans/Caucasians) in columella depth between two races.

Subtelny[21] stated that the nose grows in a forward direction to a proportionately greater degree than do the other soft tissues of the facial profile and nose growth continues until the early adulthood in a downward and forward direction. Thus, it is usual that the nose will become more inclined in a forward direction and the tip of the nose will become more acute during the later stages of development.

Sex defference in Koreans was also found in this measurement. Korean males had larger anteroposterior dimension (25.75 mm. $\pm$ 1.49) in nasal depth than Korean females (23.01 mm. $\pm$ 1.66), which resulted in more convex profile in Korean males than in Korean females as it was previously found in the nasofacial contour angle.

e. Angles of nose

It seems the opportune time, at this point, to evaluate the nose with relation to the other soft tissue structures which cover the skeletal profile. For this purpose, five related angles were measured in this study. TABLE 2-e shows that from these five angle measurements, no

angle was found to be significantly different between Korean males and females. However, the columella inclination angle (Cm,Sn-FH plane) was slightly larger in Korean females than in Korean males, although it was not significantly different.

Korean males had 21.8 degrees ± 8.9 and Korean females had 25.1 degrees ± 6.0 for this measurement. Although this result indicated that Korean females had a slanted upward nose, the values of this measurement in both sexes were highly variable with range from 3 degrees tp 45 degrees in Korean males and from 15.3 degrees to 41.4 degrees in Korean females.

TABLE 3-e shows the results of comparison of the nose between Koreans and Caucasians. The nasal tip angle which indicates the relationship between the base of the nose (columella) and the bridge of the nose was found to be smaller in Scheideman's study (75.8 degrees ± 7.4 / 77.9 degrees ± 6.5 in males/females) than in this study (79.8 degrees ± 8.5/ 82.3 degrees ± 6.7 in males/females). This revealed that Koreans had a more obtuse nose tip than Caucasians. However, comparing the columella inclination (Cm,Sn-FH) itself between Koreans and Caucasians, the author found that there was no difference between two races although the Caucasian value was slightly larger. This finding indicated that the obtuse nasal tip angle in Koreans was mainly due to a steeper inclination of the bridge of nose (a line extending along the projecting part of the nasal dorsum) which was a result of short nasal depth.

One of the most significant differences between Koreans and Caucasians was found in the nasolabial angle (Cm-Sn-UL). This angle is a somewhat useful measurement to evaluate the protrusion of the upper lip although it takes into account the inclination of the columella of nose.

In orthognathic surgical point of view, this angle is an important one in treatment planning for patients with anteroposterior maxillary dysplasias. An acute nasolabial angle will often allow the retraction of the maxilla or the retraction of the upper incisors, or both. An obtuse nasolabial angle suggests a degree of maxillary hypoplasia and calls for a maxillary advancement or orthodontic proclination of maxillary incisors.[38] Since the layman is likely to evaluate upper lip protrusion in relation to nose, this angle may be significant clinically.[26]

The typical nasolabial angles found in Caucasian studies were 102.0 degrees ± 8.0 in Legan's study, 119.0 degrees ±7.3 in Worms' study, and 111.4 degrees ± 11.7 / 111.9 degrees ± 8.4 in Scheideman's males/ females. However, acute nasolabial angles, 92.46 degrees ± 10.56 in males and 94.31 degrees ± 10.53 in females were seen in this Korean study. And this acute nasolabial angle was in accordance with the result of Lee and Sohn's Korean study in which they found 94.4 degrees ± 10.2 in males and 97.8 degrees ± 10.3 in females. Although this angle for Korean females was significantly larger than Korean males in Lee and Sohn's study, there was no significant difference between Korean males and females in the present study.

Since it was found that there was no difference in the columella inclination between this study and the Caucasian studies, it was the author's opinion that the acute nasolabial angle in Koreans was possibly due to the more procumbence of the upper lip which maybe the result of the more procumbent upper incisors. Park[46] indicated the significant differences in dental measurements between Koreans and Caucasians in his cephalometric study of Korean adults. He found that Koreans had a smaller

interincisal angle due to the more labially inclined upper and lower incisors than Caucasians. Thus the upper and lower lips of Koreans were shown to be more protruded than those of Caucasians. The procumbence of the lips will be evaluated as the next step in this study. However, it should be pointed out that the nasolabial angle was also highly variable in both races.

f. Angles of lips

The inclinations of the upper lip (Sn,UL-FH) and the lower lip (B',LL-FH) were evaluated relative to the Frankfort horizontal plane. And the interlabial prominence angle (A',UL-B',LL) which are closely similar to the interdental prominence angle was employed so that the procumbence between the lips should be included in evaluation of lips. Finally, the mentolabial sulcus angle (LL-B'-Pg') was measured for evaluation of the lower lip sulcus.

The results for Korean young adults shown in TABLE 2-f indicated that there was no significant difference in any of these measurements between Korean males and females although Korean females had a slightly flatter lower face than Korean males.

It was not appropriate, in this study, to compare the angular measurements of lips between Koreans and Caucasians because of the difference in preference of using a horizontal reference line and in selecting the landmarks. The palatal plane (ANS-PNS) have been used in most Caucasian studies as a horizontal reference line to evaluate the lip inclination whereas the FH plane was utilized in this study.

It was found in Ricketts study[27] that Caucasians had 1.0 degrees ± 3.5 tilt-up palatal plane relative to the FH plane. However, in

Park's study,[46] this value for Koreans was -0.5 degrees / 0.2 degrees in males/females respectively, which means Koreans have somewhat tilted down or parallel palatal plane to the FH plane. In Mitani's Japanese study,[50] this value was -2.1 degrees / -1.8 degrees in males/females respectively, which indicates that Japanese also have tilted down palatal plane. This difference between the two races in this nasal floor inclination made the author prefer the Frankfort horizontal plane to the palatal plane as a horizontal reference plane.

The mentolabial sulcus angle was the only one that could be compared statistically between Koreans and Caucasians from the four angular measurements of lips. And there was a significant difference in this angle between the two races. Koreans in this study demonstrated a more obtuse angle (130.7 degrees ± 9.9 / 133.5 degrees ± 9.9 in males/females) than Caucasians in Worms' study (122.0 degrees ± 11.7) and in Scheideman's study (122.0 degrees ± 10.1 in males and 127.9 degrees ± 12.3 in females), which revealed that Caucasians had more concave lower lip sulcus than did Koreans. This straighter mentolabial sulcus angle in Koreans was also found in the previous Korean studies[43,48] (TABLE 4-4) and it partially affected the straighter looking facial profile in Koreans.

g. Linear measurements of lips

Anteroposterior lip position was evaluated by two reference lines ; one was Ricketts' E plane and the other was a line drawing from subnasale to soft tissue pogonion. The amount of lip protrusion or retrusion was measured as a perpendicular linear distance from these lines to the most prominent points of the upper and lower lips. The "esthetic plane (E plane)" represented by a line from the end of the nose to the

chin was initially used by Ricketts.[13] He stated that in Caucasians the lips should be contained slightly within this line, whereas Blacks and Asians may have a more protrusive lip position.[27] In this study, the upper lip to the esthetic plane was found to be -0.4 mm. ± 2.6 in males and -0.6 mm. ± 1.6 in females, which was closer to the esthetic plane than Ricketts' finding (-4.0 mm. ± 3.0) and Scheideman's study (-6.8 mm. /-5.8 mm. in males/females). In the lower lip measurement to the E plane, Koreans also had a more protrusive lower lip than Caucasians. The value of 1.5 mm. ± 2.4 was found in Korean males and 1.3 mm. ± 1.5 in Korean females whereas in Caucasian studies from -2.0 mm. (Ricketts) to -3.9 mm. (Schedeman) were found for this measurement.

It should be noted that the esthetic plane is affected by the prominence of nose and chin. In analyzing the relation of nose and chin, it was previously found in this study that Koreans had a shorter nasal depth than Caucasians, while the two races had the similar chin prominence which was not significantly different. Thus, the author can guess that the differences in these lip measurements between the two races are partially due to the more protrusion of nose in Caucasians and/or, in part, due to the more prominent lips in Koreans.

The slightly fuller lips found in Caucasian females than Caucasian males relative to E plane in Scheideman's study can also be explained by this way (TABLE 3-g). Ricketts[13] stated that the lips of males were slightly more retracted in relationship to nose and chin than in females probably due to the more prominent nose and chin. However, this sex difference in the lip prominence was not found in this study although Korean males had the nose somewhat larger than females. This possibly

can be explained by a more protrusive chin of Korean females which compensates the shorter depth of nose and results in a similar looking fullness of lips between Korean males and females relative to the E plane.

It also be noted that in both Koreans and Caucasians the upper lip rests slightly behind the lower lip (-0.5 mm./1.4 mm. in Koreans and -4.0 mm./-2.0 mm. in Ricketts Caucasian samples) to the E plane in normal adult faces with lips in normal closure.

Another plane utilized in this study for evaluating the antero-posterior relationship of the lips was the Sn-Pg' plane which avoided the area of the nose. In the normal adolescent sample, Burstone[26] found that the upper and the lower lips fell forward of this plane 3.5 mm., and 2.2 mm. respectively. But in the adult sample of Worms' and of Legan's study, it was found to be less protrusive in the upper lip than in Burstone's adolescent sample. The values of 2.4 mm./2.3 mm. in the upper lip/lower lip were found in Worms' study and 3.0 mm./2.0 mm. in Legan's study. In the present study, however, the average protrusion of Korean adults to this line was 6.4 mm. in the upper lip and 5.5 mm. in the lower lip. Again, it was found that Koreans had more protrusive upper and lower lips relative to the Sn-Pg' line than Caucasians.

Although Subtelny[21] stated that not all of the soft tissue facial profile would manifest the characteristics of the underlying skeletal profile and that the soft tissue of the upper face was not directly related to the hard tissue of the upper face, the findings in the above two measurements of lips coincided with the previous findings about Korean skeletal pattern which indicated the dental bimaxillary protru-

sion of Koreans.

The mentolabial sulcus depth was also measured perpendicular to the Sn-Pg' plane. An average of -4.2 mm. was found to be pleasing in Worms' Caucasian study while -2.3 mm. and -1.6 mm. were found in Korean males and females respectively. There was significant difference between Korean males and Korean females in this measurement. Comparing Koreans in this study to Caucasians in Worms' study, it also appeared that Caucasians had deeper mentolabial sulcus than Koreans. Since this measurement is related to subnasale and chin, the anteroposterior positions of these two soft tissue points affect the sulcus depth. From previous findings in this study it was noted that the subnasale in Caucasians was in a more forward position than in Koreans while the chins were similar in their protrusion between the two races. This more protrusion of the subnasale may partially affect the deeper mentolabial sulcus in Caucasians. However, the soft tissue thickness at each points on the facial profile should be evaluated.

For evaluating the vertical extension of the upper lip, the distance from the incisal edge of the maxillary central incisor to the lower border of the upper lip (1-Stm) was measured. A large value of this measurement indicates a excessive exposure of the upper incisor teeth, a "gummy" smile. And this is due to whether a short upper lip, or a vertical maxillary excess or a combination of both. In this case, superiorly repositioning of the maxilla is the one of the matter of choices for correcting a vertical maxillary excess. However, this upper incisor exposure should be measured clinically with the patient's lip

in a relaxed posture.

The value for this measurement in Korean young adults with the lips of initial closure was 2.3 mm. ± 0.8 in males and 2.9 mm. ± 1.3 in females. And significantly larger value was found in Korean females than in Korean males. By comparing this measurement between Koreans and Caucasians, it was observed that there was a slight more exposure of the upper incisor in Burstone's Caucasian female subjects (3.7 mm. ± 1.7) than in this Korean female subjects (2.9 mm. ± 1.3).

In the another Korean study done by Oh,[48] the value for this measurement was found to be similar to this study (2.6 mm./2.5 mm. in males/females) and there was no difference between this study and Oh's study.

h. Soft tissue thickness

The soft tissue of the face is quite irregular and variable and does not readily suggest the planes of reference within the soft tissue itself and, therefore, if such planes are to be established, they must utilize dental or skeletal landmarks.[16] There is a lack of uniform correspondence in a vertical plane between skeletal and soft tissue landmarks. Thus a compromise method was adopted in this study as in Burstone's study in which he measured the amount of horizontal extension of integumental landmarks from adjacent skeletal points parallel to a horizontal reference plane. The horizontal reference plane utilized in Burstone's study was the nasal floor (PNS-ANS), whereas it was the Frankfort horizontal plane in this study.

Five different points along the facial profile were measured parallel to the Frankfort horizontal plane. They were the upper labial

sulcus (A'-A), the upper lip (UL-UIL), the lower lip (LL-LIL), the lower labial sulcus (B'-B), and the soft tissue chin (Pg'-Pg).

TABLE 2-h shows the means, the standard deviations, and the statistics for these measurements in Korean young adult subjects. It was interesting to find that Korean males had thicker soft tissues than Korean females at the areas above the lower lip. In both Korean male and female samples, the results obtained were not different from those of previous Korean studies[43,48] except the upper lip thickness of females and the lower lip thickness in Park's study, which were significantly thicker than in this sample.

Comparing Koreans and Caucasians in soft tissue extensions (TABLE 3-h), it was striking to find that Koreans had significantly thinner soft tissue thickness at the upper lip sulcus, the upper lip, and the lower lip area than Caucasians, while Caucasians had significantly thinner soft tissue at the lower lip sulcus than Koreans. The soft tissue thickness at the pogonion point, however, was significantly thinner in Caucasian females than in Korean females whereas males had no difference between the two races.

In general, in both Korean and Caucasian studies, it was found that males had thicker soft tissues than females and the soft tissues at the upper lip sulcus, at the upper lip, and at the lower lip were thicker than those at the lower lip sulcus and the chin area. In other words, the soft tissue thickness around the upper and the lower lip were thicker than the chin area in both races. This is probably due to the high degree of development of the orbicularis oris complex.

CHAPTER VI

SUMMARY AND CONCLUSION

1. This investigation was designed to study a normal sample of the soft tissue profile of young Korean adults. The material consisted of standard lateral cephalometric radiograms of 32 Korean males and 41 Korean females age ranged from 17 to 25 years.
2. By use of thirty-six measurements (6 vertical linear, 17 horizontal linear, and 13 angular measurements) from the profile tracings, means and standard deviations were tabulated for both sexes of Korean young adults.
3. These data were used to compare soft tissue profiles between Korean males and females, between Koreans and Caucasians, and between this study and previous Korean studies. And the following conclusions were obtained in this study.
   a. Vertical proportion of the face

      No difference was found between Korean sexes in the vertical proportion of the face, although the males showed significantly longer facial heights than the females. It was found that Cutcliffe's ideal vertical proportion of the Caucasian faces could be applied to the Korean faces.
   b. Facial contour

      In general, with or without excluding nose, Korean males had a

more convex profile than Korean females and Caucasians had a more convex profile than Koreans.

c. Maxillary and mandibular soft tissue protrusion

- There was no difference between Korean sexes in subnasale protrusion. On the other hand, Caucasians showed a more protrusive subnasale than Koreans due to the thicker soft tissues at this area.
- In the evaluation of chin prominence, it was found that Korean females had a more protrusive chin than Korean males. In contrast, there was no difference in chin prominence between Koreans and Caucasians.

d. Eye, nose depth

- Eyes of Korean females were in a more forward position than those of males relative to the upper facial line (G,Sn), whereas Koreans and Caucasians had similar eye depth.
- However, in nose, Korean males had a longer horizontal dimension than females, and so did Caucasians than Koreans.

e. Angles of nose

- There was no difference between Korean sexes in the angular measurements of nose.
- Koreans had a more obtuse nose tip than Caucasians mainly due to a steeper inclination of the bridge of nose.

f. Lips

- More protrusive upper and lower lips were found in Koreans than in Caucasians, while no significant difference was seen between Korean sexes.

- Generally, upper lip rested slightly behind lower lip in both races.
- The mentolabial sulcus of Koreans was straighter and shallower than that of Caucasians.

g. Soft tissue thickness

- In both Koreans and Caucasians, sex difference was noted in the integumental extensions. And, generally, males had thicker soft tissues at the areas inferior to nose than females.
- It was interesting to find that Koreans had significantly thinner soft tissue extensions from the area inferior to nose to lower lip and Caucasians had significantly thinner soft tissue extension at the lower lip sulcus area.

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The thesis is therefore acceped in partial fulfillment of the requirements for the degree of Master of Science.

2/18/85
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