6-1984

Cephalometric Changes in the Soft Tissue Chin after Orthodontic Treatment

Ruchi Nanda Singh

CEPHALOMETRIC CHANGES IN THE SOFT TISSUE CHIN
AFTER ORTHODONTIC TREATMENT

by

Ruchi Nanda Singh

This study was performed to cephalometrically assess the soft tissue chin changes from orthodontic treatment and after 5 years post-treatment. Variability in the soft tissue chin structure between the different facial types and between the sexes was also evaluated.

Sixty patients, treated by Dr Ricketts, were selected from the Rocky Mountain Data system files. Pretreatment, post-treatment and 5 year post-treatment cephalograms were taken on each patient and the soft tissue chin thickness was measured at six points around the symphysis. Means and standard deviations were calculated for each point on the symphysis by sex and facial type.

The post-treatment data indicated an overall mean increase in the soft tissue chin thickness in the total sample with a range of 0.4 - 0.8 mm over the six measured points around the symphysis. Five years post-treatment data showed an increase in the soft tissue chin thickness

with a range of 1.0 - 1.2 mm around the symphysis. The male sample demonstrated a greater increase in the soft tissue chin thickness than the female sample. The total female sample did not show a significant increase in the soft tissue chin thickness; however, the dolichofacial female group showed a thickness increase with a range of 0.9 - 1.3 mm after treatment and a range of 1.0 - 1.3 mm 5 years after treatment.

The male dolichofacial group showed the greatest amount of increase in the soft tissue chin thickness with a range of 0.8 - 1.4 mm after treatment and 1.6 - 2.5 mm 5 years post-treatment.

The soft tissue chin thickness was found to vary at all points around the symphysis except for the two points at, and closest to, menton. The mesofacial female sample showed a more even thickness around the chin after treatment.

Females, after 15 years of age, showed no increase in the soft tissue chin thickness. Patients younger than 9 years of age showed a smaller "B" point thickness than the rest of the group.

It was concluded that the soft tissue chin thickness does not increase uniformly around the symphysis and that the thickness varies between the facial types. This study demonstrates the importance of evaluating the soft tissue chin thickness before treatment and of considering the changes that occur after treatment.

LOMA LINDA UNIVERSITY
Graduate School

CEPHALOMETRIC CHANGES IN THE SOFT TISSUE CHIN AFTER ORTHODONTIC TREATMENT

by

Ruchi Nanda Singh

A Thesis in Partial Fulfillment of the Requirements for the Degree Master of Science in Orthodontics

---

June, 1984

Each person whose signature appears below certifies that this thesis in his opinion is adequate, in scope and quality, as a thesis for the degree of Master of Science.

_________________________, Chairman
Lee E. Olsen, Assistant Professor of Orthodontics

____
James R Wise, Associate Professor of Orthodontics

____
Norman S Carter, Assistant Professor of Orthodontics

____
Gary G. Morikone, Associate Professor of of Orthodontics

____
Grenith J Zimmerman, Associate Dean School of Health

ACKNOWLEDGMENTS

A thesis is the result of the efforts of many people. It is with sincere appreciation that the author cites the efforts of the following people:

To the members of my research committee: Drs. Lee E. Olsen, James R. Wise, Norman S. Carter, Gary G. Morikone, and Grenith J. Zimmeramn.

To the Foundation for Orthodontic Research for their invaluable assistance.

To Dr. Robert Ricketts for the use of his records.

To my husband, Mahender, for all the patience and consideration.

The author would especially like to thank her father, Dr Ram Sarup Nanda, without whose understanding, encouragement and support none of this would have been possible.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

Orthodontics has, as its treatment goals, the creation of a functional occlusion and a harmonious soft-tissue profile. Harmony is sometimes difficult or impossible to attain because the soft tissue overlying the teeth and bones is highly variable in its thickness (Figure 1) and hard tissue skeletal landmarks and measurements can deviate considerably from the facial form the patient expresses with the soft tissue. These variations in thickness come about not only because the underlying structures are out of balance, but also because the thickness and tone of the soft tissue vary with each individual [6,13] Burstone,[2,3] Hambleton,[6] Merrifield,[11] Subtelny,[24,25] Bowker and Meredith,[1] and Neger[13] demonstrated that variation, not uniformity, exists in the soft veneer. Research performed by Hambleton[6] showed that patients may appear either more or less convex in their profiles than is indicated by their hard tissue. This is because of differences in the thickness of the soft tissue, particularly at the junction of the nose and upper lip and in the region of the chin.

Statement of the Problem

This study was conducted in order to assess the changes in the soft tissue chin after orthodontic treatment. Morphological facial changes often accompany orthodontic therapy. The regional changes in the soft tissue which accompany orthodontic treatment still require investigation. In this study, the soft tissue chin changes were evaluated in relationship to the facial profile, as well as differences in the soft tissue morphology between the various facial types (i.e., mesofacial, brachyfacial and dolichofacial).

Assessment of the Soft Tissue Profile

Orthodontists,[20,21] artists,[2] and the general public[14,20] have been involved in research in which they assessed good facial esthetics for males as well as females. Authors have also compared present esthetic standards to ancient Greek,[10] Egyptian and Roman[6] art. Some of these studies have been accomplished by constructing a photographic profilometric analyses to provide an objecttive view of the facial profile.[14]

Riedel[21] in 1957 found that the public's concept of acceptable facial esthetics is apparently in agreement with standards established by orthodontists on the basis of normal occlusion. Lines, et al.[10] observed that males averaged a slightly greater chin prominence than females, and there was a preference by the public for a deeper mentolabial groove for men than women. The fact that male chins are more prominent after growth was also found by Burstone,[3] Merrifield,[11] Sarnäs and Solow.[22] and Subtelny.[24,25] Females do not attain the same degree of straightness in the skeletal profile as males, since they are less prognathic.[25] Peck and Peck[14] found a progressive flattening of the facial profile, and an increase in the geniolabial angle with age.

Merrifield[11] measured the total chin thickness in millimeters by including the bony chin lying anterior to the line NB and measuring to pogonion and the integumental overlay at the same point. He states that the osseous chin and its soft tissue overlay vary greatly in individuals and that the total chin thickness should be equal to, or slightly greater than, the upper lip thickness.

Significance of Muscle Function

Disharmonies and disproportions of the face, as well as imbalances of the lips and their surrounding musculature, have been classified in various ways by Burstone,[2] Ricketts,[18,19] Peck & Peck[14] and Midtgard et al.[12] Muscle pull and oral habits have a strong influence on the structure of the soft tissue. One of the problems contributing to malocclusion and disharmonies of the face is the mentalis habit.[16,19] It is easily recognized as a severe manifestation of bilateral and peripheral lip strain, accompanied by mentalis function and elevation of the integument of the chin, in an attempt to gain lip closure. Chronic mentalis habits are usually associated with either isolated conditions of a protrusive denture, inadequate lip length and a long or retrognathic type of face or a mild combination of all three factors.[25] The patient must exert a maximum effort to close the lips, and a "balling up" of the tissue in the area just anterior to the roots of the lower incisors is usually the diagnostic sign.[16] Ricketts[19] states that this condition frequently results in a very unpleasant appearance of the lips and the illusion of a weak chin.

Facial Form

Cranial and facial patterns have a strong genetic origin. Wuerpel[26] in 1937 was one of the first to categorize faces into proportional types in horizontal and vertical dimensions. Zwemer and Lorber,[28] in 1976, classified the cranium and face into six types on a consideration of proportionality, or ratio, between their length and width. They divided the cranium into dolichocephalic, mesocephalic and brachycephalic types and the facial measurements into leptoprosopic, mesoprosopic and euryprosopic as related to height, width and the depth of the skull.

Ricketts[19] has classified facial types into three basic patterns:

1. Mesofacial, which is the most average facial pattern.

2. Brachyfacial, which is a horizontal growth pattern.

3. Dolichofacial, which is a vertical growth pattern.

The chin symphysis differs in different facial types.[17] Patients with mandibular prognathism, or with greater alveolar heights and more retrognathic patterns, often have long, narrow chin symphyses. Thin dimensions of the symphysis are often associated with dolichfacial patterns. The brachyfacial person often exhibits a symphysis with thick, square outlines. The hard tissue symphysis seems to be unaffected by orthodontic treatment, except for the adaptation of the planum alveolar, the alveolar bone and point "B" towards the direction of force as the teeth are moved forward or backward.[19]

MATERIAL AND METHODS

A sample of 60 Caucasian patients treated by Dr. Ricketts was selected from the Rocky Mountain Data System files. These cases were selected according to cephalometric films which revealed (1) good hard and soft-tissue detail; (2) teeth in full occlusion; (3) lips in closed position; and (4) no orthodontic appliances in place.

The following cephalometric angle measurements were used in order to classify the patients into the three facial types designated by Ricketts;[19] i.e., mesofacial, brachyfacial, and dolichofacial.(Figure 2)

1. Facial Axis
2 Mandibular Arc
3 Lower Face Height
4. Mandibular Plane Angle

The Ricketts' cephalometric normals for these measurements are shown in Figure 2. Together, the above mentioned four angles determined whether the facial pattern was mesofacial, brachyfacial or dolichofacial.

There was a fairly equal sex distribution with the sample being made up of 31 males and 29 females. The total sample (60 patients) was chosen so that it consisted of an equal number (20) of patients from each facial type;

i.e., mesofacial, brachyfacial and dolichofacial type patients. The mesofacial group had eleven males and nine females and the brachyfacial and dolichofacial group consisted of 10 females and 10 males each. Fifty-one patients had a Class II, division 1 dental malocclusion. The dolichofacial group had no patients with a Class I malocclusion and there were no patients in the total sample with a Class III malocclusion (Table 1).

Pretreatment, post-treatment and 5 year post-treatment cephalograms were required on each patient. The post-treatment and 5 year post-treatment cephalograms were used to evaluate changes after treatment and long term changes in the soft tissue chin, respectively. All cephalograms (pretreatment = T_1, post-treatment = T_2, and 5 year post-treatment = T_5) were evaluated by using the Ricketts' analysis (Figure 2).

The method of integumental extension measurement in this study was established by utilizing skeletal landmarks [Pterygoid Root Vertical plane (PTV) and Frankfort Horizontal plane (FH)] since the soft tissue of the face is somewhat variable, and does not readily suggest planes of reference within the soft tissue itself. Horizontal, vertical and diagonal extensions were made from the hard tissue to the soft tissue chin at various designated points on the symphysis. The horizontal extensions were parallel to the FH plane and the vertical extensions were parallel to the PTV plane. The FH and PTV planes are perpendicular to each other. The hard tissue analysis was utilized along with the soft tissue since separate analyses of either the soft tissue or the dento-skeletal patterns alone have proved inadequate or misleading (Figure 2).

The chin thickness was registered at 6 different locations around the symphysis. For simplicity of measurement, the alphabetical symbols "B", "a", "b", "c", "d", "e", are used for each of the soft-tissue chin landmarks (Figures 2 and 3). It should be pointed out that these symbols are not names of landmarks, but are employed to facilitate the recording of measurements. The soft tissue landmarks were derived from horizontal and vertical extensions of the skeletal landmarks of the chin. All extensions, except from the points c and d, were made parallel to the Frankfort Horizontal plane (FH) and perpendicular to the Pterygoid Root vertical (PTV) to extend to the soft tissue chin. The locations of the alphabetical symbols or points are defined below:

"B" point - Skeletal "B" point was described by Downs as the most superior point at the deepest curvature of the outline of the symphysis. A horizontal extension was made from this point to the soft tissue and was termed "B" point.

"a" point - This point is a horizontal extension of skeletal supra-pogonion or protuberance menti (Pm) point.

This supra-pogonion point was selected at the anterior border of the symphysis between the point "B" and pogonion where the curvature changes from concave to convex.

"b" point - This point on the soft tissue chin was a horizontal extension of the skeletal landmark, pogonion (Pog). The most anterior point on the curve of the outline of the symphysis can be termed pogonion. This is a point on the mental protuberance at the midline.

"c" point and "d" point - In order to label points "c" and "d", "b" point and pogonion were extended horizontally from the symphysis parallel to Frankfort Horizontal. Point "e" and menton were extended vertically parallel to the pterygoid root vertical to meet the horizontal extension of pogonion. The angle formed by the intersection of the above mentioned lines was divided into thirds and extensions were drawn to the soft tissue chin to form points "c" and "d". (Figure 3a,b,)

"e" point - This point on the soft tissue chin was a vertical extension of the skeletal landmark, menton. Menton is termed the most inferior point on the lower border of the midline curve of the symphysis.

Hard tissue to soft tissue distances were measured for each point ("B" - "e") in millimeters before treatment, after treatment and 5 years post-treatment. The recordings were measured to the nearest 0.5mm.

Statistical means and standard deviations were computed for the total sample, and the three facial types, to find averages for the distances between the hard tissue symphysis and the soft tissue chin. Additionally, the three facial types were divided according to sex and the means and standard deviations were computed for males and females in each facial type. A comparison of T_1, T_2 and T_5 changes in the soft tissue chin, as well as for the different facial types, was accomplished for males and females in an analysis of variance test. Composite tracings, representing the changes, were completed in order to make a visual comparison of the changes from the beginning of treatment with the end of treatment and 5 years post-treatment. A statistical analysis of the data; namely the means, standard deviations, and "t" tests, were calculated.

RESULTS

Table 1B shows that the average age before treatment was 10 years and 7 months with a standard deviation of 2 years and 1 month. The average age after treatment was 14 years and 6 months with a standard deviation of 2 years and 1 month and the average age at least 5 years post-treatment was 21 years and 6 months with a standard deviation of 3 years and 5 months. As shown in Table 1A, a differentiation was also made between the extraction and nonextraction groups, along with a differentiation of the various classifications of malocclusion. The extraction group, which made up 38 percent of the sample, was limited to four premolar extractions only.

Averages and standard deviations for the various points ("B" - "e"), designated on the symphysis to measure the distance between the hard and soft tissue chin, were deduced for, a) the total group, (Table 1B), b) the different facial types (Table 1B), and c) and for males and females in each category (Table 2A,B,C). Changes in the soft tissue chin thickness after treatment, and five years post treatment are shown on Tables 3(i-iv). The underlined numbers are the distances that showed a significant increase in the soft tissue chin thickness. It was discovered that at post-treatment, the chin thickness varies at all points on the symphysis except for the two points at, and closest to, menton ("d", "e") (Table 4). Females had a more even soft tissue chin thickness around the symphysis than males, as is evident in Tables 3i-iv and 4.

The results of the present study show that overall the soft tissue chin, in both males and females, thickens after orthodontic treatment (T_2) and 5 years post-treatment (T_5). The total female sample in this study, however, did not show a statistically significant thickening of the soft tissue chin even though the dolichofacial group of females showed a significant increase in the soft tissue chin thickness after treatment (T_2). These results are shown in Tables 1B and 3i-iv.

When comparing 5 year post retention records (T_5) with those at the end of treatment (T_2), the females showed no statistically significant increase in the soft tissue thickness of the chin. The male sample did have an increase in the soft tissue thickness of the chin when T_2 and T_5 records were compared (Table 3i-iv). However, the total sample consisted of only two males over the age of 18 years and thus the sample did not consist of a significant adult male population.

After comparing the three facial types in males and females, as shown in Tables 3i-iv, it was discovered that the soft tissue chin thickness increased most in the dolichofacial group (Group 3) after treatment (T_2) and 5 years post-treatment (T_5). The mesofacial group showed the least amount of change in the soft tissue chin thickness at T_2 and T_5. Regression tests to determine which of the independent variables age, sex, group, 1-APog, $\underline{1}$-APog, MP, MA, FA and LFH, classification affected the points "B" - "e" at T_1, T_2 or T_5, we determined that age, sex and group were the only variables that influenced the points "B" - "e" (See Tables 5 and 6) The other variables did not affect the changes on points "B" - "e" in a statistically significant manner.

Thus, an analysis of variance was run using age, sex and group as the only independent variables. This analysis of variance was used to assess the statistical significance these variables may have on "B" - "e" point at T_1, T_2, T_5 (Table 6).

At T_1, age, sex and group have a significant influence on points "B" - "e".

At $T_2 - T_1$, age and group seem to be significant on changes at points "B" - "e".

At $T_5 - T_1$, sex and group influence these points. This is more apparent in the 5 year post-treatment changes when compared with post-treatment measurements (Table 6).

At T_2, group and age are significant, although only at "B", "d" and "c", "d" points respectively.

At T_5, only sex is significant at points "d" and "e".

DISCUSSION

In order to understand the changes that took place in the soft tissue chin thickness after orthodontic treatment and after 5 years post-treatment; eleven hypotheses were analyzed and an attempt made to evaluate some of these changes.

1. The total distance between the hard and soft tissue chin should increase after treatment in all facial types. This assumes a correction of the overjet and, or bimaxillary protrusion.

After treatment (T_2), there was a significant increase in the overall thickness of the soft tissue chin at all points on the symphysis ("B" - "e") in both males and females. Five years after treatment, there was an increase in the soft tissue thickness with a a range of 1.1 - 1.2 mm on points "B" - "e" (Table 3i-iv).

The total mesofacial group soft-tissue chin thickness increased only at the points "B" and "a" which were within a range of 0.3 - 0.6 mm after treatment, and 5 years post-treatment range was 0.7 - 1.0 mm. Brachyfacial patients had a soft tissue chin thickness increase at all points and the range was 0.3 - 0.9 mm after treatment (T_2) and 1.2 - 1.5 mm 5 years post-treatment (T_5). The greatest soft tissue chin thickness increase was in the dolichofacial group. All points around the symphysis increased with a range of 0.7 - 1.2 mm after treatment and 1.2 - 1.8 mm after 5 years post-treatment. Females of the brachyfacial and mesofacial group showed a negligible increase in the soft tissue chin thickness and dolichofacial females showed increases at points "B", "a" and "b" with a range of 0.9 - 1.2 mm. Dolichofacial males showed the greatest amount of increase at post-treatment (T_2) with a range of 0.9 - 1.4 mm and 5 years post-treatment T_3 with a range of 1.6 - 2.5 mm. These figures reflect the average range of increase in the soft tissue chin at points "B" - "e".

Thus, the soft tissue chin thickness increased after treatment and 5 years after treatment progressively in the mesofacial, brachyfacial and dolichofacial groups. The change between 5 years post-treatment (T_5) and post-treatment (T_2) was also significant in dolichofacial patterns (Table 3i-iv).

Most studies show that the soft tissue chin is closely related to the degree of the prognathism of the hard tissues.[6,7] In nearly all cases, the distribution of the soft tissue of the chin over the symphysis will change as the teeth are moved.[17 20]

Additional research on the chin has been done by Hambleton,[6] Subtelny[24] and others who demonstrated that the male profile becomes straighter than the female profile because the male chin grows to a greater degree, even though it usually starts later.

Garner,[5] in 1974 states that Rosenstein (no reference given) measured hard-tissue chin growth on both treated and nontreated patients at the Northwestern Orthodontic Clinic and in his private practice. His results indicated that the chin button grows early in girls and late in boys, but the amount of the hard-tissue chin growth is twice as much in boys as in girls. The soft tissue chin tends to compensate by thinning in most instances.

The subjects in the present study, however, did not seem to follow the above mentioned soft tissue chin pattern. The soft tissue chin of the total male sample increased uniformly, whereas, the total female sample did not show any significant increase in the thickness of the soft tissue chin.

2. The overall distance between the hard and soft tissue chin around the symphysis should be greater for the brachyfacial group of patients before, after and at 5 years post-treatment.

<u>Before Treatment</u> (T_1): The overall chin thickness around the symphysis in the brachyfacial group was not found to be greater than the mesofacial or dolichofacial patterns (Tables 1B, 2). Chin thickness in the brachyfacial pattern was statistically the same as the mesofacial patterns except for the points "B" and "b"

where the soft tissue chin thickness was less in the brachyfacial group. The pretreatment brachyfacial group had a smaller soft tissue chin thickness than the pretreatment dolichofacial group at point "B", but the thickness at points "c", "d" and "e" was greater. At no point around the symphysis was the overall soft tissue distance for the brachyfacial group thicker than the mesofacial group.

After Treatment (T_2): The overall soft tissue chin thickness was greater in the brachyfacial group than the dolichofacial group at points "c", "d" and "e". However, the overall soft tissue distance around the symphysis in the brachyfacial group was equal to, or less than, the mesofacial group.

Five Years After Treatment (T_5): Only at 5 years after treatment were the soft tissue distances at points "b", "c" and "e" larger in the brachyfacial group than in the mesofacial group. The points "b, "c", "d" and "e" points had larger distances in the brachyfacial group as compared to the dolichofacial group.

It is apparent that the mentalis muscle is usually not strained in the brachyfacial pattern unless a severe overjet is present. Thus, the soft tissue thickness around the symphysis should be greater in this facial pattern. The dolichofacial patterns have a long lower facial height and a degree of lip and mentalis strain, thus the brachyfacial group had a larger soft tissue chin thickness than the dolichofacial group. This soft tissue thickness was particularly apparent around the lower border of the symphysis.

3. The pre-treatment dolichofacial type patterns should have smaller measurements for the total distance between the hard and soft tissue chin than the patients with mesofacial and brachyfacial type patterns.

Facial pattern significantly influences "B", "c", and "d" points, after adjusting for sex and age (Table 6). The total (male and female) dolichofacial sample measurements before treatment (T_1) from the hard to soft tissue chin measures as much as 2 mm less than the mesofacial and brachyfacial groups, especially at points "c", "d", and "e" (Tables 1, 2).

The soft tissue distances from hard to soft tissue chin are as follows:

<u>Males</u>

"B", "a", "b" points - No statistically significant differences in soft tissue chin thickness between the three facial patterns at T_1.

"c" point - No statistically significant difference in the mesofacial and brachyfacial groups: average of 1.7 mm less in the dolichofacial group at T_1.

"d" point - No statistically significant difference in the mesofacial and brachyfacial groups; average of 1.1 mm less in the dolichofacial group at T_1.

"e" point - No statistically significant difference in the mesofacial and brachyfacial groups; average 0.7 mm less in the dolichofacial group at T_1.

Females

"B" point - No statistically significant difference in the mesofacial and dolichofacial groups; average 1.6 mm less in the brachyfacial group.

"a" point - No statistically significant difference in the brachyfacial and dolichofacial groups; average of 1.1 mm larger in the mesofacial group. Brachyfacial and dolichofacial groups have a smaller soft-tissue chin thickness at point "a" than the mesofacial group.

"b" point - No statistically significant difference in the brachyfacial and dolichofacial groups. Brachyfacial and dolichofacial groups have a smaller soft-tissue chin thickness than the mesofacial group.

"c", "d", "e" points - the dolichofacial pattern has statistically the smallest soft tissue chin thickness.

4. The patients with the dolichofacial patterns will not have an even soft tissue chin thickness distribution

over the symphysis of the chin before treatment.

None of the groups had close to the same distances from the soft tissue to the hard tissue chin at the points "B" - "e" (Table 4). The results seem to show that there are certain points, especially "B", "a" and "d", "e", respectively, that have similar hard tissue to soft tissue distances. Females have more points with similar distances showing that the soft tissue over the chin is more evenly distributed than in males. None of the groups seemed to have hard tissue to soft tissue distances that were similar at all points "B" - "e".

5. After treatment (T_2), the soft tissue chin should have a fairly even thickness distribution over the symphysis of the chin.

This hypothesis could not be proven. All points on the symphysis of the chin have different distances from hard to soft tissue chin after treatment except "d" and "e" points in males and "B", "a" and "d", "e" points, respectively, in females, which have similar hard to soft tissue chin distances (Figure 3).

After treatment, the mesofacial and brachyfacial groups had more points with similar hard to soft tissue chin distances, especially in females, as compared with the dolichofacial group.

The principal points with statistically similar measurements from hard tissue to soft tissue chin were points "d" and "e" (Table 4).

6. The horizontal increase in the total distance between the hard and the soft tissue chin after treatment should be less in the dolichofacial group than in the mesofacial and brachyfacial groups. This should occur as the mentalis muscle is more likely to be strained in the pretreatment dolichofacial group and orthodontic treatment should even out the distance around the symphysis from points "B" - "e".

The results demonstrated that this did not occur. The dolichofacial group showed a consistent increase in the distances from the hard to the soft tissue chin, especially at points "a", "b", and "c". At some points, namely "a", "b", "c", "d" the dolichofacial group had a greater increase in the distances between the soft and hard tissue chin than the mesofacial and dolichofacial groups. Males showed a greater increase at the points "B" - "e" around the symphysis in all groups.

Post-Treatment (T_2) to Pretreatment (T_1)
Increase in MM of Soft Tissue Chin Thickness
Taken From Table 3

Points on the Chin	Mesofacial	Brachyfacial	Dolichofacial
B	.58	.78	.98
a	.32	.87	1.08
b	.08	.85	1.20
c	-0.05	.26	1.04
d	.16	.52	.88
e	.24	.84	.68

7. In cases of maxillary dental protrusion, after the upper incisors are retracted during orthodontic treatment, the total chin thickness over the symphysis increases.

Neither the statistical tests, nor the scatter diagrams for the total sample showed statistical significance. In the total group, and the mesofacial group, no pattern of correlation could be determined from the statistical analysis between the upper incisor position and the soft tissue chin over the symphysis.

For the brachyfacial group, there were highly positive ($p<.01$) correlations between the change in the upper incisor position and points "B" and "a". As the upper incisor to APog position decreased after treatment, the thickness of the soft tissue at points "B and "a" also decreased. Furthermore, there was a negative correlation between the change in the upper incisor position and point "e". As the upper incisor to APog position increased after treatment, the thickness of the soft tissue at point "e", decreased. In the dolichofacial group, there was a negative correlation between the change in the upper incisor position and point "b" on the soft tissue chin. The brachyfacial group was the only group where there was a highly significant correlation between the change in the upper incisor position and the thickness of the soft tissue chin after treatment. These correlations may be the result of perioral muscular differences between the facial types.

Posen[15] measured the perioral musculature and found that the strength of the musculature was correlated with the position of the incisors. Class II, division 2 malocclusions had the strongest perioral musculature and Class I bimaxillary protrusion malocclusions the weakest. He also observed that during treatment a change in the oral environment, due to a more normal denture position, was accompanied by a change in the perioral musculature toward more normal readings. Hillesund et al.[7] also found that the thickness over "B" point was significantly ($P<0.05$) greater in a normal group of patients than in a group of patients with excessive overjet.

8. Changes in the thickness of the soft-tissue chin after treatment will be smaller in patients with a dolichofacial pattern.

The patients who had a more dolicofacial pattern had no significant difference in the soft tissue chin thickness before and after treatment when compared to the mesofacial and brachyfacial patterns.

In Table 3 we see that, in general, the dolichofacial group shows a greater increase in the soft tissue chin thickness at point "B" - "e" after treatment than the mesofacial or brachyfacial groups. The latter groups showed very few extremes in the amount of change after treatment.

9. The point of the deepest concavity on the symphysis of the mandible, "B" point, will change after orthodontic treatment alters the position of the lower incisors. This will bring about a change in the soft tissue "B" point, since the soft tissue chin has been found to closely approximate the hard tissue chin.

Few correlations were deduced after orthodontic treatment, since this study did not consist of a population with a protrusive mandibular incisor position. In all mesofacial, brachyfacial and dolichofacial patients, the average lower incisor position to the APog plane was at Ricketts normal of +1 mm + 2 mm, or less than normal, position (See data below which was taken from Table 2).

Total Sample	Means (mm)		
	T_1	T_2	T_5
Lower incisor to APog Plane			
Females	1.2	1.6	1.8
Males	0.6	1.4	1.2
Upper incisor to APog Plane			
Females	7.6	5.0	5.0
Males	7.1	4.5	4.3

The results of the correlation analysis were as follows:

Total Group

The change in the lower incisor to APog plane in the total sample after treatment was positively correlated to points

"B" and "a" on the symphysis. Since this change was mostly a negative figure (highest lower incisor to APog at T_1 is 1.8 mm) in this study; as the lower incisor was retracted, points "B" and "a" increased. Points "d" and "e" on the chin, were negatively correlated to the change in the lower incisor position after treatment.

The mesofacial and dolichofacial patients showed no correlation between the change in the lower incisor position, relative to APog after treatment and the thickness of the soft tissue chin. The brachyfacial group, however, showed significant correlations. Positive correlations occurred on point "B", "a" and "b" and negative correlations occurred on points "d" and "e". The points in parentheses are highly significant ($p<.01$).

Stoner et al.[23] evaluated 57 consecutive cases treated by Dr. Charles H. Tweed. On the soft tissue it was found that point B exhibited no change in the Class I cases, whereas, in Class II cases it moved anteriorly 0.5 mm. After measuring the antero-posterior changes in the soft tissue chin at pogonion, Stoner found that the chin came forward an average of 1.1 mm at the pogonion point. There was roughly three times as much anterior positioning in the Class II type cases (average 2.0 mm) as was found in the Class I type (average 0.75 mm). The present study had a sample size consisting of mostly Class II type of cases (Table 1). Point "B" moved anteriorly in all of the cases.

Ricketts[16,17] stated that in the sublabial area the lip tissue closely follows the positional change of the lower incisor root and the maintenance of the lower lip thickness. Ricketts also explains that, as lip strain is lost and the mentalis muscle relaxes, an increase in the tissue thickness occurs over the chin. In some long faces, due to the shortness of the lips, this change does not occur even with denture and lip retraction. The results in this study showed that the soft tissue follows the bony contour in females more than in males and in the mesofacial group more than in the other two groups.

Wylie [27] analyzed 29 treated cases and correlated the esthetics of tooth position to profile changes. He concluded that the modification of the facial profile by orthodontic means does not depend upon the inclination of the anterior teeth as much as it does upon the mandibular growth. However, Lindquist[9] stated that the chin and the lower incisor are directly related to each other. Riedel[21] also stressed that the relationship of the anterior teeth to the face and to their respective apical bases have a marked influence on the soft tissue profile outline.

10. The thickness of the distance between the hard and the soft tissue chin will not increase after pubertal growth; i.e., 15 years of age in females and 18 years in

males.

The t-tests were performed on both female and male samples. Out of the 31 individuals in the male sample there were only two males over 18 years of age. This left too small a sample size from which to draw any valid conclusions.

Out of the 29 in the female sample, there were 19 females less than, or equal to, 15 years of age and 10 females of ages greater than 15 years. The t-test, on females, shows that, at age 15 years and older, there is no significant difference between the post-treatment and 5 year post-treatment times at the various points "B" - "e" on the chin.

The amount of growth change will be greater in the soft tissue structures of children 7 or 8 years of age than they will be in teenagers.[6] The face that appears somewhat full at 7 years of age may lose a large amount of this procumbency as the maxillary bone appears to recede. The lips grow longer, the nose grows forward and the chin becomes more prominent. It is very possible to produce an unfavorable result in the profile by disregarding these factors.

11. Patients who are less than 9 years of age have a smaller total soft tissue chin thickness than patients older.

At T_1 there were 22 patients less, or equal to, 9 years of age and 38 patients greater than 9 years of age. A t-test was run with a critical value of 0.05, or less. The only point that changed significantly after age 9 years of age was "B" point. Patients who were less than, or equal to, 9 years of age had a significantly smaller "B" point distance than the patients older than 9 years of age. The group less than, or equal to, 9 years of age also had a slightly significant "a" point value that was less than the rest of the group.

Bowker and Meredith[1] stated that children at age 5 years and 14 years with smaller overall soft tissue measurements of the face and that were of a smaller physique than the average, had a smaller distance measurement from the pogonion to the soft tissue pogonion.

Subtelny,[24] during growth studies, found that with an increase in age there seemed to be an uprighting of the mandibular alveolar process and the incisors. Consequently, the mandibular alveolar process, including the area of point "B", becomes more retruded in relationship to the underlying supporting bone. The chin soft tissue point "B" becomes more retruded in relationship to the position of the lower lip from the age of 10 to 16 years. Soft tissue gnathion in all cases, except for Class II females, seemed to be retruded. Similar soft tissue results were obtained by Chaconas and Bartroff.[4]

A normal soft tissue profile is dependent on the relationship of the mandible to the maxilla.[6] However, is no positive correlation between an excellent occlusion and an ideal, straight profile. A proportionate change, or an improvement in the soft-tissue profile, does not necessarily accompany extensive dentition changes. Neger,[13] in 1959 did soft tissue profile analyses on photographs of people with excellent occlusions and found many with deficient chins. Subtelny[24] also noted that changes resulting from mechanotherapy directly affecting the maxilla and incisors do not always produce the desired soft tissue results. Upon studying the analyses of 30 patients taken from the Bolton study, Subtelny concluded that the nose, chin, lips and teeth all coordinate to produce an acceptable facial profile.

The data indicates that the soft tissue chin thickness varies in different individual facial types, as well as in males and females (Tables 3 and 4). After adjusting for sex and age, the facial type is the primary determinant in the amount of change that takes place in the soft tissue chin after orthodontic treatment (Table 6).

The extreme variation in the soft tissue chin has been particularly discussed by Holdaway[8] (Figure 5). He stressed that one of the fundamental similarities associated with facial beauty includes a soft tissue chin nicely positioned in the facial profile. Holdaway recorded the horizontal measurement of the soft tissue chin thickness (supra-pogonion-soft-tissue supra-pogonion) and determined the average to be 10-12 mm. A direct quote of his statement is cited below:

> Large variations, such as 19 mm of thickness need to be recognized, and in such cases it is essential to leave the lower incisors and hence the upper incisors in a more anterior position and to avoid the tendency to take away needed lip support (Figure 4).

There has been virtually no discussion of the soft tissue on the chin covering the entire symphysis. In previous studies, the horizontal thickness of the soft tissue on the chin have been measured only from the points pogonion, Ricketts' suprapogonion point and the B point on the chin. The distance measurements were made from the bony points to the soft tissue of the chin.

Soft tissue chin changes with growth

During growth, the skeletal and the integumental chins assume a more forward relationship to the cranial base.[6] Based on previous studies by Hillesund et al.,[7] Lines et al.,[10] and Midtgard et al.,[12] the soft tissue covering the mandible and the chin follows the dentoskeletal growth and comes forward accordingly. Bowker and Meredith[1], Sarnäs and Solow[22] and Subtelny[24,25] have noted sex differences in the integumental extension. Areas inferior to the nose in the male, in general had a greater horizontal extension of the soft tissue. These areas also showed a greater degree of mandibular skeletal prognathism.

Merrifield[11] stated that, from his measurements, adult males have 2.4 mm more "total chin" than females. He measured this "total chin" between the line NB and the soft tissue pogonion. Subtelny[25] found the increase in the soft tissue thickness overlying the bony pogonion from 3 to 18 years of age to be on an average 2.4 mm in males and 1.0 mm in females. The results of the present study (Table 3) show that the soft tissue thickness overlying the bony pogonion increased an average of 1 mm for the total sample at 5 years post-treatment. There was an average increase in the soft tissue chin thickness of 1.6 mm for males and 0.4 mm for females.

Sarnäs and Solow,[22] in 1980 found that, from 21 to 26 years of age, the thickness of the soft tissue chin increased by 0.7 mm in males, but was unchanged in females. They found that the age changes in the vertical soft tissue dimensions reflected those observed for the skeletal dimensions. The present study also showed that females who have finished growing, i.e., after 15 years of age, do not show a change in the chin thickness. There were only 2 males over 18 years of age, so no valid conclusions were made for adult males.

Bowker and Meredith[1] measured the convexity of the chin by a line perpendicular to the nasion-pogonion line from the point pogonion. At age 5 years, in both sexes this measurement is 11.3 mm. The average measurement of the thickness of the soft tissue chin at pogonion, i.e.; "b" point, in this study was found to be 10.7 mm before treatment (the average age of the sample was 10 years and 1 month) Table 1B. Stoner et al.[23] found the soft tissue to move vertically downward to the same degree as the hard tissue chin.

Error of Measurement

Sources of measurement errors are likely to be greater for the cephalometric soft tissue than for the hard tissue landmarks.[7] Uncertainties on the part of the observer in locating the landmarks is probably the greatest source of error for the skeletal reference points.[12] This is enhanced by the fact that the identification may be more difficult because of less well defined anatomic structures and additional variations in facial expressions. According to Midtgard et al.,[12] for skeletal tissues only, slight differences occur between double registrations of landmarks on the same film and the registrations on two films of the same patient exposed within a short time interval.[12] In studies done by the same author, the differences were greatest for the soft tissue "B" point and the soft tissue pogonion reference point. Hillesund et al.,[7] stated that the reproducibility of the soft tissue landmarks was quite acceptable in the horizontal plane. The soft tissue "B" point, and particularly the soft tissue pogonion, had rather poor reproducibility in the vertical plane.[7]

In the present study, however, the only measurement used on a vertical plane was "e" point. A source of data unreliability could be introduced during a chance variation in measuring between the points registered on the radiographs. Additional chance measurement variation could be associated with the positioning of the subject, radiographic processing, drawing the various lines for measurement and registering the measurement landmarks. Measurements were made with a millimeter ruler to the nearest 0.5 mm. This could have been measured to the nearest 0.25 mm for further accuracy.

CONCLUSIONS

1. After orthodontic treatment, the soft tissue chin thickness increased at all the points measured around the symphysis of the chin in both males and females. The thickness of the soft tissue chin increased with a range of 1.0 - 1.2 mm points "B" - "e" five years post treatment.
2. Males showed a greater increase than the females in the thickness of the soft tissue chin at all points "B" - "e" at T_2 and T_5.
3. The soft tissue chin thickness increased the most in the dolichofacial group of male patients after T_2 and T_5. The mesofacial females showed the least amount of increase in the soft tissue chin thickness at T_2 and T_5.
4. The brachyfacial pattern has a larger soft tissue chin thickness than the dolichofacial pattern at points "c","d" and "e" (Figure 3) at T_1, T_2 and T_5.
5. No group seemed to have an even thickness of soft tissue chin around the symphysis before treatment. After treatment and 5 years post treatment, the soft tissue did not seem to follow the hard tissue contour evenly around the symphysis in any given group. Mesofacial and brachyfacial females, however, had chins

with a soft tissue thickness that was more evenly distributed around the symphysis than the dolichofacial females and the total sample of males.

6. The brachyfacial group was the only group with highly significant correlations between the changes in the upper incisor position and the thickness of the soft tissue chin at T_2 and T_5 on points "B","a" (positive correlation) and point "e" (negative correlation).
7. The brachyfacial group was also the only group with significant correlations between the changes in the lower incisor position and the thickness of the soft tissue chin at T_2 and T_5 on points "B", "a" (positive correlation) and points "d", "e" (negative correlation).
8. The soft tissue chin thickness did not seem to increase after the age of 15 years in females.
9. Patients who were less than, or equal to, 9 years of age had a significantly smaller B point thickness of the soft tissue than the older patients.

If the lip and chin thickness is recognized at the outset of treatment, to be excessively thin or heavy, it may mean the difference between the success and failure of the soft tissue treatment esthetics. It must be emphasized that changes in the basic position of the soft tissue nose and tissue chin occur primarily as a function of growth[24] and there is little that an orthodontist can do to alter them. Within reason, the clinician could possibly exert some control over only one of these structures; that being the position of the soft tissue chin. This can be accomplished only if the mandible is repositioned during treatment, or if orthodontic appliances can be effectively used to alter the growth of the skeletal mandible.[25]

SUMMARY

This study was performed to cephalometrically assess the soft tissue chin changes from orthodontic treatment and after 5 years post-treatment. Variability in the soft tissue chin structure between the different facial types and between the sexes was also evaluated.

Sixty patients, treated by Dr Ricketts, were selected from the Rocky Mountain Data system files. Pretreatment, post-treatment and 5 year post-treatment cephalograms were taken on each patient and the soft tissue chin thickness was measured at six points around the symphysis. Means and standard deviations were calculated for each point on the symphysis by sex and facial type.

The post-treatment data indicated an overall mean increase in the soft tissue chin thickness in the total sample with a range of 0.4 - 0.8 mm over the six measured points around the symphysis. Five years post-treatment data showed an increase in the soft tissue chin thickness with a range of 1.0 - 1.2 mm around the symphysis. The male sample demonstrated a greater increase in the soft tissue chin thickness than the female sample. The total female sample did not show a significant increase in the soft tissue chin thickness; however, the dolichofacial female group showed a thickness increase with a range of

0.9 - 1.3 mm after treatment and a range of 1.0 - 1.3 mm 5 years after treatment.

The male dolichofacial group showed the greatest amount of increase in the soft tissue chin thickness with a range of 0.8 - 1.4 mm after treatment and 1.6 - 2.5 mm 5 years post-treatment.

The soft tissue chin thickness was found to vary at all points around the symphysis except for the two points at, and closest to, menton. The mesofacial female sample showed a more even thickness around the chin after treatment.

Females, after 15 years of age, showed no increase in the soft tissue chin thickness. Patients younger than 9 years of age showed a smaller "B" point thickness than the rest of the group.

It was concluded that the soft tissue chin thickness does not increase uniformly around the symphysis and that the thickness varies between the facial types. This study demonstrates the importance of evaluating the soft tissue chin thickness before treatment and of considering the changes that occur after treatment.

LITERATURE CITED

1. Bowker, W.D & Meredith, H. V.: A Metric Analysis of the Facial Profile. Am. J. Orthodontics. 29:149-160, 1959.

2. Burstone, C.J.: The Integumental Profile. Am. J. Orthodontics. 44:1-25, 1958.

3. Burstone, C.J.: Integumental contour and Extension Patterns. Angle Orthodontist. 29:93-104, 1959.

4. Chaconas, S.J., Bartroff, J.D.: Prediction of Normal Soft Tissue Facial Changes. Angle Orthodontist. 45:12-26, 1975.

5. Garner, L.D.: Soft-tissue changes concurrent with Orthodontic tooth movement. Am. J. Orthodontics. 66:367-377, 1974.

6. Hambleton, R.S.: The Soft-Tissue covering of the Skeletal Face as related to Orthodontic problems. Am. J. Orthodontics. 50:405-420, 1964.

7. Hillesund, E., Fjeld, D., Zachrisson B.U.: Reliability of Soft Tissue Profile in Cephalometrics. Am J. Orthodontics. 74:537-550, 1978.

8. Holdaway, R.H.: Soft Tissue Cephalometric Analysis and its Use in Orthodontic Treatment Planning. Am. J. Orthodontics. 84:1-36, 1983

9. Lindquist, J.T.: The Lower Incisor - Its Effect on Treatment and Esthetics. Am. J. Orthodontics. 44:112-128, 1958.

10. Lines, P., Lines, R., Lines, C.: Profilemetrics and Facial Esthetics. Am. J. Orthodontics. 73:648-657, 1978.

11. Merrifield, L.L.: The Profile Line as an Aid in Critically Evaluating Facial Esthetics. Am. J. Orthodontics. 52:804-821, 1966.

12. Midtgard, J., Bjork, G., and Linder-Aronsen, S.: Reproducibility of Cephalometric Landmarks and Errors of Measurement of Cephalometric Cranial Distances. Angle Orthod. 44:56-61, 1974.

13. Neger, M.: A Quantitative Method for the Evaluation of the Soft Tissue Facial Profile. Am. J. Orthodontics. 45:738-751, 1959.

14. Peck, H., and Peck S.: A Concept of Facial Esthetics. Angle Orthod. 40:284-318, 1970.

15. Posen, A.L.: The Application of Quantitative Perioral Assessment to Orthodontic Case Analysis and Treatment Planning. Angle Orthod. 46:118 - 143, 1976

16. Ricketts, R.M.: A Foundation for Cephalometric Communication. Am. J. Orthodontics. 46: 330-357, 1960.

17. Ricketts, R.M.: Cephalometric Synthesis. Am. J. Orthodontics. 46:647-847, 1960.

18. Ricketts, R.M.: The Influence of Orthodontic Treatment on Facial Growth and Development. Am. J. Orthodontics. 30:103-133, 1960.

19. Ricketts, R.M. : Esthetics, Environment and the Law of Lip Relation. Am. J. Orthodontics. 54: 272-289, 1968.

20. Riedel, R.A.: Esthetics and Its Relation to Orthodontic Therapy. Angle Orthodontist. 22: 168-178, 1950.

21. Riedel, R.A.: An Analysis of Dentofacial Relationships. Am. J. Orthodontics. 43:103-119, 1957.

22. Sarnäs, K.V. and Solow, B.: Early Adult Changes in the Skeletal and Soft-tissue Profile. European J. Orthod. 2:1-12, 1980.

23. Stoner, M., Lindquist, J.T., Vorhies, J.M., Hanes, R.A., Hapak, F.M., Haynes, E.T: A Cephalometric Evaluation of 57 Consecutive Cases Treated by Dr. Charles H. Tweed. Angle Orthodontist. 26:68-98, 1961.

24. Subtelny, J.D.: A Longitudinal Study of Soft Tissue Facial Structures and their Profile Characterstics, defined in relation to underlying skeletal structures. Am. J. Orthodontics. 45:481-507, 1959.

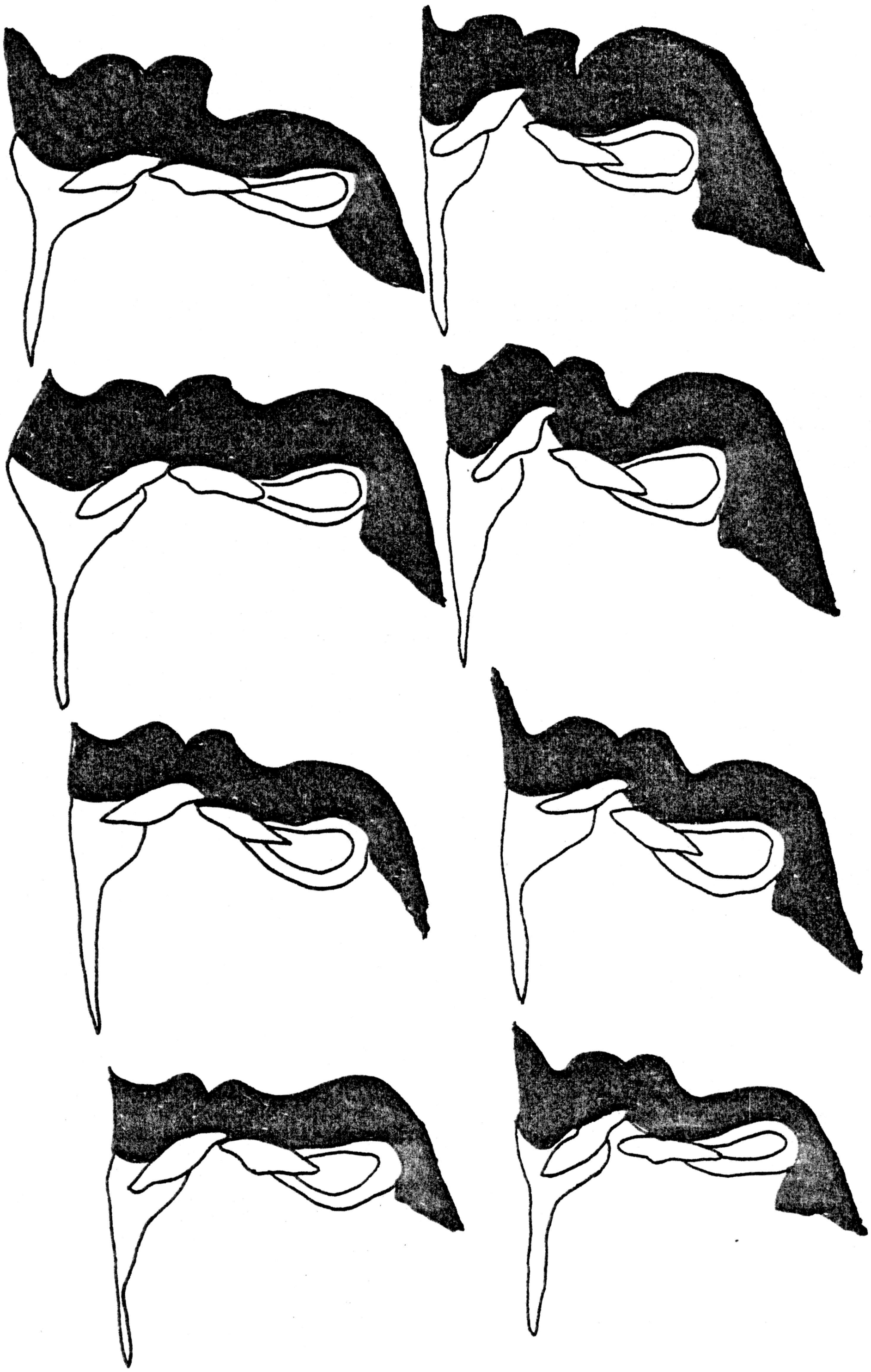
25. Subtelny, J.D.: The Soft Tissue Profile, Growth and Treatment Change. Angle Orthod. 31:103-122, 1961.

26. Wuerpel, E.H.: On Facial Balance and Harmony. Angle Orthod. 7:81-89, 1937.

27. Wylie, W.: Mandibular Incisor - Its Role in Facial Esthetics. Angle Orthodontist. 25:32, 1955.

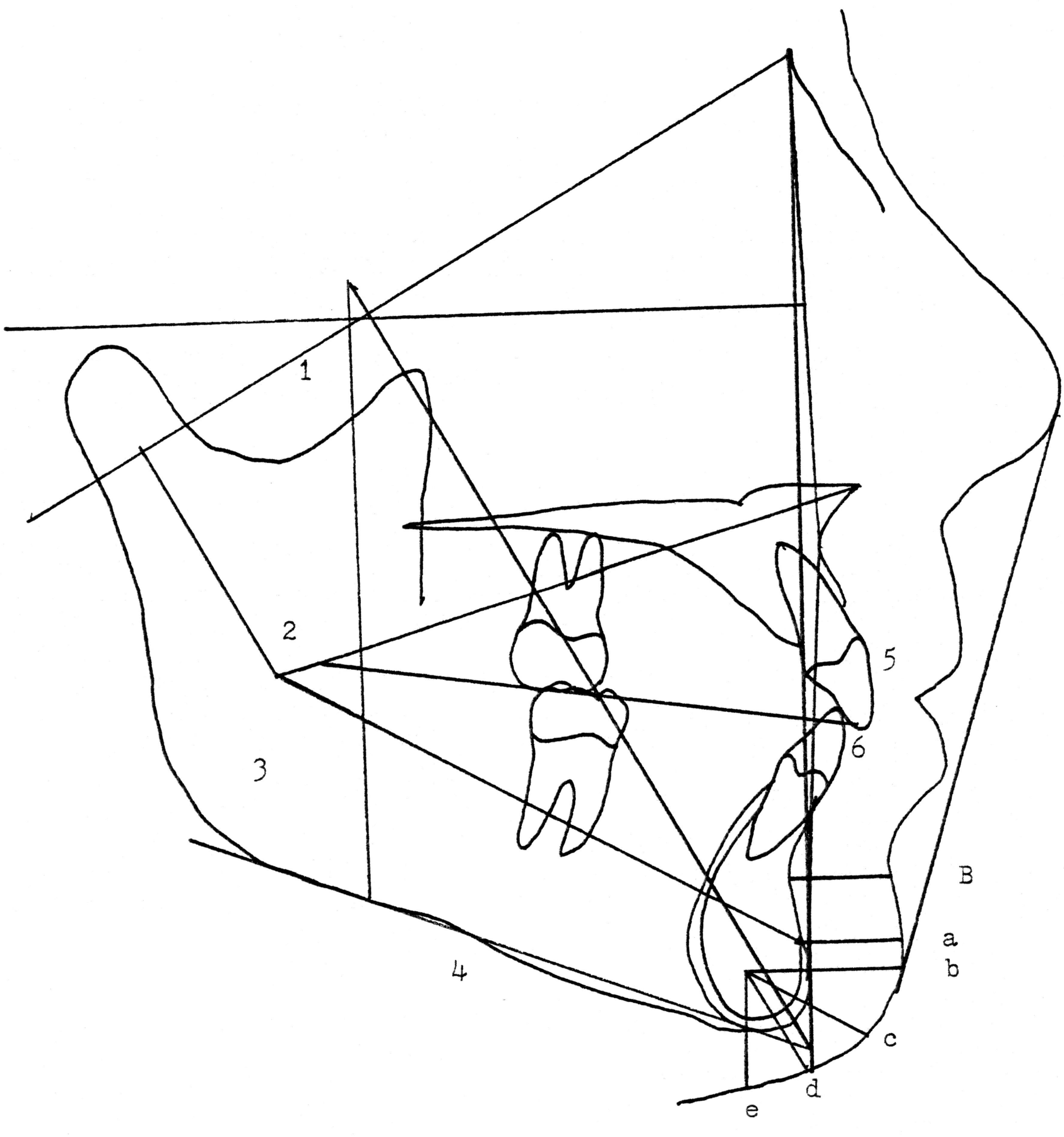
28. Zwemer, T.J., Lorber, R.M.: An Annotated Atlas of Facial Analysis. Dental Clinics of N. America. 20:40, 641-660, 1976.

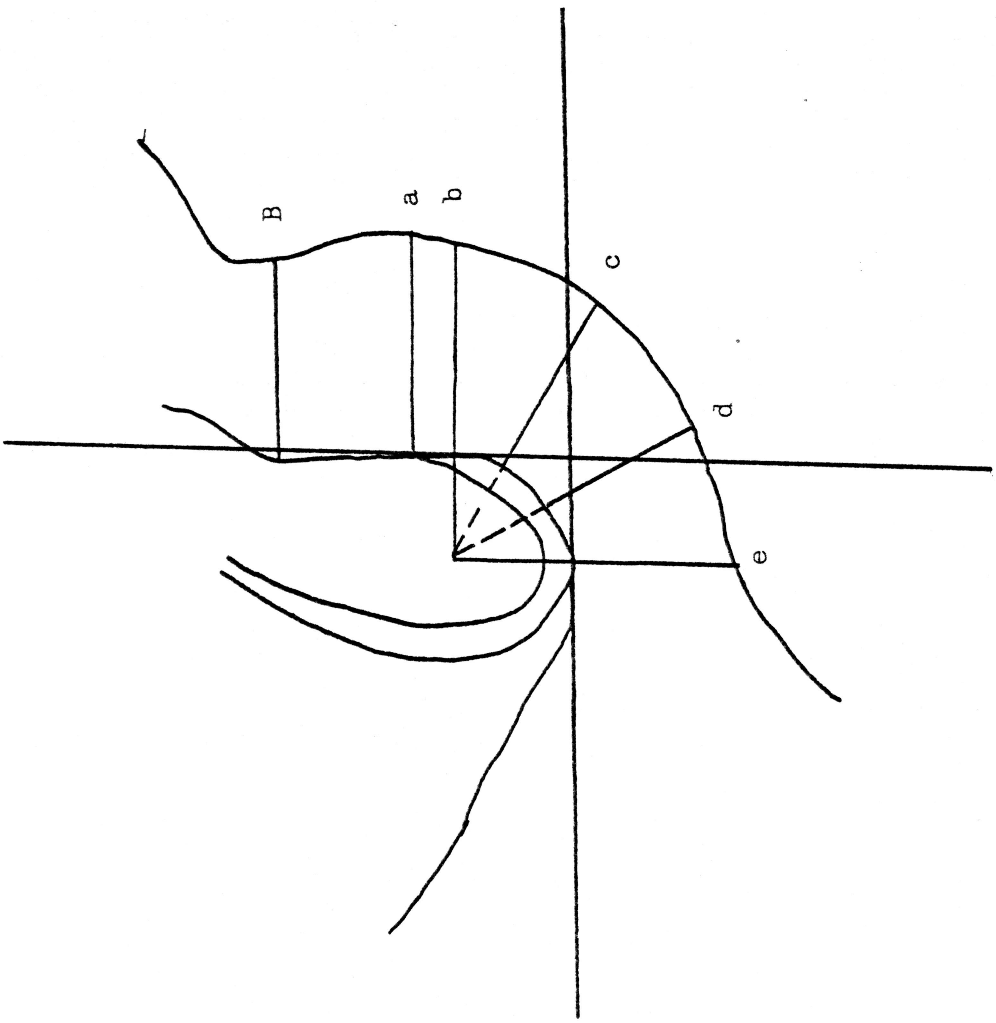
APPENDIX



A

B


1
2
3
4
5
6
B
a
b
c
d
e


B
a
b
c
d
e

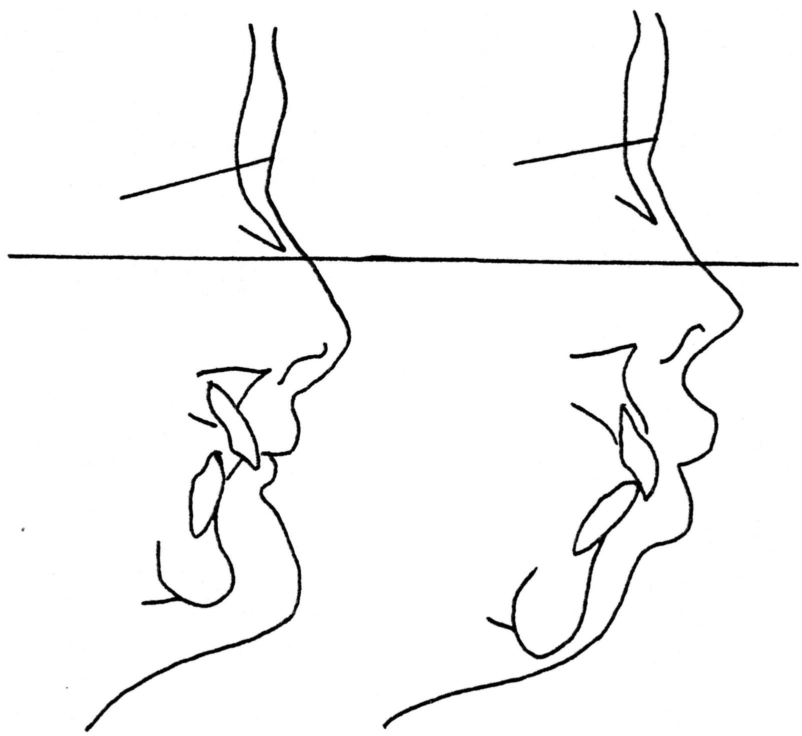


Table 1A

Number of Patients

	Mesofacial 1- 20	Brachyfacial 20 - 40	Dolichofacial 40 - 60	Total
Male	11	10	10	31
Female	9	10	10	29
NE (M+F)	15	15	7	37
EXT (M+F)	5	5	13	23
Class I (M+F)	2	2	0	4
Class II,Dl (M+F)	16	16	19	51
Class II, D2 (M+F)	2	2	1	5

NE - Non extraction
EXT - Extraction
$\overline{1}$ - Lower Incisor
$\underline{1}$ - Upper incisor
M - Male
F - Female

T_1 - Pretreatment

T_2 - Post-treatment

T_5 - 5 years post-treatment

For Table 1B and 2A, B & C standard deviations are in parentheses.

1. B point to e point - mean measurements of the distances from the hard tissue chin to their soft tissue extensions for each group at these points are in millimeters.
2. The various mean measurements are used to determine the facial type.

SOFT TISSUE THICKNESS
(Arranged by Facial Type)
TABLE 1B
MEANS (MM) WITH STANDARD DEVIATIONS

	MESOFACIAL			BRACHYFACIAL			DOLICHOFACIAL			TOTAL		
	T_1	T_2	T_5	T_1	T_2	T_5	T_1	T_2	T_5	T_1	T_2	T_5
B point	12.4	13.0	13.4	11.5	12.3	12.8	12.8	13.7	14.0	12.2	13.0	13.4
	(1.7)	(1.5)	(1.4)	(1.7)	(1.6)	(1.8)	(2.1)	(2.3)	(2.4)	(1.9)	(1.9)	(1.9)
a point	12.0	12.3	12.7	11.4	12.3	12.7	11.7	12.7	13.1	11.7	12.4	12.9
	(1.9)	(1.8)	(2.2)	(1.5)	(1.9)	(1.5)	(1.9)	(1.6)	(2.0)	(1.8)	(1.8)	(1.9)
b point	11.4	11.5	11.6	10.5	11.3	12.0	10.3	11.5	11.7	10.7	11.4	11.8
	(2.0)	(2.2)	(2.0)	(1.5)	(1.7)	(1.5)	(2.2)	(1.5)	(2.0)	(2.0)	(1.8)	(1.9)
c point	9.5	9.4	9.7	9.0	9.1	10.3	7.5	8.6	9.2	8.7	9.1	9.8
	(2.1)	(2.4)	(1.8)	(1.3)	(1.1)	(1.3)	(2.1)	(1.4)	(1.7)	(2.0)	(1.7)	(1.7)
d point	7.6	7.8	8.1	7.1	7.6	8.4	5.9	6.8	7.6	6.9	7.4	8.0
	(2.1)	(1.9)	(1.7)	(0.9)	(0.9)	(1.1)	(1.3)	(1.1)	(1.5)	(1.6)	(1.4)	(1.4)
e point	7.3	7.6	7.9	6.8	7.6	8.2	6.1	6.7	7.9	6.7	7.3	8.0
	(2.2)	(1.9)	(2.0)	(1.2)	(1.1)	(1.4)	(1.4)	(1.4)	(2.0)	(1.7)	(1.5)	(1.8)
Mand Plane	24.9	25.2	22.6	20.6	20.3	17.6	30.1	30.1	27.3	25.4	25.2	22.5
	(3.6)	(5.2)	(6.3)	(2.1)	(4.2)	(4.1)	(2.6)	(4.3)	(5.5)	(5.1)	(6.0)	(6.6)
Mand Arc	26.8	28.1	28.6	30.7	32.2	34.0	22.6	25.3	27.2	26.7	28.6	30.0
	(4.5)	(4.5)	(5.3)	(3.9)	(3.9)	(4.2)	(4.1)	(3.8)	(4.1)	(5.3)	(4.9)	(5.4)
Lower Face	46.4	47.3	47.3	42.5	43.5	42.5	50.5	50.5	51.7	46.5	47.1	47.2
Height	(3.7)	(3.9)	(4.2)	(3.5)	(2.7)	(4.0)	(3.6)	(3.1)	(3.8)	(4.8)	(4.3)	(5.4)
Facial Axis	89.2	88.8	89.3	92.7	92.2	92.9	85.0	84.4	85.3	89.0	88.5	89.2
	(3.2)	(4.2)	(4.1)	(2.6)	(2.2)	(3.0)	(3.8)	(3.6)	(4.3)	(4.5)	(4.7)	(4.9)
1 APog	0.8	1.4	1.1	0.4	1.1	1.3	1.5	1.9	2.0	0.9	1.5	1.5
	(2.2)	(1.8)	(2.4)	(2.7)	(1.9)	(2.1)	(2.6)	(2.1)	(2.1)	(2.5)	(1.9)	(2.2)
$\underline{1}$ APog	7.1	5.0	4.3	6.4	4.2	4.3	8.5	5.0	5.2	7.3	4.7	4.6
	(3.1)	(2.1)	(2.6)	(2.6)	(2.5)	(2.1)	(2.7)	(2.2)	(2.7)	(2.9)	(2.3)	(2.5)
Age (Mo)	120.9	192.0	260.5	121.3	185.1	263.9	120.2	169.3	251.8	120.8	175.5	258.8
	(19.5)	(28.4)	(43.2)	(27.3)	(26.8)	(45.0)	(30.3)	(15.3)	(39.9)	(25.7)	(24.8)	(42.3)

SOFT TISSUE THICKNESS
(Arranged by Facial Type and Sex)
TABLE 2-A
PRE-TREATMENT (T_1) MEANS (S.D.) IN MM BY GROUP AND SEX

	MESO (GRP 1)		BRACHY (GRP 2)		DOLICHO (GRP 3)		TOTAL	
	F	M	F	M	F	M	F	M
B	12.8	12.0	11.2	11.8	12.8	12.7	12.2	12.2
STD	(1.4)	(1.8)	(1.5)	(1.9)	(2.6)	(1.5)	(2.0)	(1.7)
a	12.8	11.3	11.6	11.2	11.5	11.8	12.0	11.4
STD	(2.0)	(1.6)	(1.0)	(1.9)	(2.3)	(1.6)	(1.9)	(1.6)
b	12.4	10.6	10.8	10.1	10.5	10.1	11.2	10.3
STD	(2.1)	(1.6)	(1.4)	(1.6)	(2.4)	(2.1)	(2.1)	(1.7)
c	10.4	8.7	9.2	8.8	7.9	7.1	9.1	8.2
STD	(2.4)	(1.6)	(1.3)	(1.3)	(2.5)	(1.5)	(2.3)	(1.6)
d	8.6	6.8	7.3	6.9	6.1	5.7	7.3	6.5
STD	(2.6)	(1.2)	(0.9)	(1.0)	(1.7)	(0.9)	(2.0)	(1.3)
e	7.9	7.0	6.8	6.7	6.0	6.1	6.9	6.6
STD	(3.0)	(1.3)	(1.7)	(1.2)	(1.8)	(1.0)	(2.1)	(1.2)
Mand Plane	25.0	24.9	21.3	20.0	31.6	30.0	26.0	24.9
STD	(4.5)	(2.9)	(1.5)	(2.5)	(2.8)	(2.3)	(5.4)	(4.8)
Mand Arc	25.2	28.2	29.2	32.2	21.5	23.7	25.3	28.0
STD	(3.9)	(4.7)	(3.5)	(3.9)	(3.9)	(4.3)	(4.9)	(5.4)
LFH	46.2	46.5	43.7	41.3	51.0	50.1	47.0	46.0
STD	(3.4)	(4.0)	(3.4)	(3.2)	(4.4)	(2.6)	(4.8)	(4.9)
Fac. Axis	89.7	88.9	92.5	93.0	84.7	85.3	89.0	89.0
STD	(4.1)	(2.2)	(2.7)	(2.7)	(4.0)	(3.7)	(4.8)	(4.2)
1 APog	1.3	0.4	1.4	-0.6	0.8	2.2	1.2	0.6
STD	(2.6)	(1.8)	(2.3)	(2.7)	(1.8)	(3.1)	(2.2)	(2.8)
1̲ APog	8.1	6.3	7.2	5.5	7.5	9.5	7.6	7.1
STD	(2.0)	(3.8)	(1.7)	(3.1)	(2.5)	(2.6)	(2.0)	(3.5)
Age	116.2	124.8	109.2	133.4	125.3	115.1	116.9	124.4
Months	(18.2)	(20.1)	(21.0)	(28.4)	(26.0)	(34.8)	(22.5)	(28.2)

SOFT TISSUE THICKNESS
TABLE 2-B
POST-TREATMENT (T_2) MEANS (S.D.) IN MM BY FACIAL TYPE AND SEX

	MESO (GRP 1)		BRACHY (GRP 2)		DOLICHO (GRP 3)		TOTAL	
	F	M	F	M	F	M	F	M
B	12.6	13.3	11.7	12.9	13.7	13.8	12.7	13.3
STD	(1.3)	(1.6)	(1.5)	(2.5)	(2.9)	(1.7)	(2.1)	(1.6)
a	13.0	11.7	11.8	11.7	12.8	12.7	12.5	12.3
STD	(1.8)	(1.6)	(1.0)	(2.2)	(1.6)	(1.6)	(1.5)	(1.9)
b	12.5	10.6	11.0	9.4	11.7	11.3	11.7	11.2
STD	(2.2)	(1.8)	(0.8)	(1.3)	(1.4)	(1.6)	(1.6)	(1.9)
c	10.9	8.3	9.1	9.4	8.6	8.5	9.5	8.7
STD	(2.4)	(1.7)	(0.8)	(1.3)	(1.4)	(1.4)	(1.9)	(1.5)
d	9.0	6.8	7.7	7.6	6.6	7.0	7.7	7.1
STD	(2.2)	(0.9)	(0.6)	(1.2)	(1.3)	(1.0)	(1.7)	(1.0)
e	8.4	7.0	7.7	7.5	6.6	6.9	7.6	7.1
STD	(2.5)	(1.0)	(1.2)	(1.1)	(1.7)	(1.0)	(1.9)	(1.0)
Mand Plane	24.8	25.6	20.0	20.6	31.4	28.7	25.4	25.0
STD	(6.8)	(3.9)	(3.9)	(4.7)	(4.6)	(3.8)	(6.9)	(5.2)
Mand Arc	26.5	29.4	32.2	32.3	25.2	25.3	28.0	29.0
STD	(4.0)	(4.7)	(4.6)	(3.3)	(2.8)	(4.7)	(4.8)	(5.0)
LFH	47.4	47.1	42.7	44.2	50.7	50.2	46.9	47.2
STD	(3.4)	(4.3)	(2.4)	(2.9)	(3.3)	(3.1)	(4.5)	(4.2)
Fac. Axis	91.5	86.5	92.1	92.4	83.9	85.0	89.1	87.9
STD	(4.4)	(2.5)	(2.1)	(2.5)	(3.9)	(3.4)	(5.1)	(4.2)
1 APog	1.8	1.1	1.2	1.0	1.9	2.1	1.6	1.4
STD	(2.3)	(1.4)	(2.4)	(1.5)	(1.8)	(2.4)	(2.1)	(1.8)
$\underline{1}$ APog	5.9	4.3	4.3	4.1	4.8	5.3	5.0	4.5
STD	(2.4)	(1.4)	(2.9)	(2.2)	(1.9)	(2.6)	(2.4)	(2.1)
Age	181.7	164.2	179.7	190.6	169.9	168.7	176.9	174.2
Months	(29.5)	(11.4)	(21.0)	(31.8)	(12.4)	(18.5)	(21.6)	(2.2)

SOFT TISSUE THICKNESS
TABLE 2-C
5 YEAR POST-TREATMENT (T_5) MEANS (S.D.) IN MM BY FACIAL TYPE AND SEX

	MESO (GRP 1)		BRACHY (GRP 2)		DOLICHO (GRP 3)		TOTAL	
	F	M	F	M	F	M	F	M
B	13.1	13.6	12.2	13.4	13.4	14.6	12.9	13.8
STD	(1.8)	(0.9)	(1.7)	(1.6)	(12.9)	(2.0)	(2.2)	(1.6)
a	13.5	12.1	11.9	13.6	12.9	13.4	12.7	13.0
STD	(2.7)	(1.6)	(1.1)	(1.5)	(2.0)	(2.0)	(2.0)	(1.8)
b	12.2	11.1	11.4	12.6	11.3	12.0	11.6	11.9
STD	(2.3)	(1.8)	(1.2)	(1.6)	(2.2)	(2.0)	(1.9)	(1.8)
c	9.9	9.6	9.7	11.0	8.9	9.5	9.5	10.0
STD	(2.1)	(1.7)	(1.2)	(1.2)	(2.0)	(1.2)	(1.8)	(1.5)
d	7.8	8.3	8.0	8.7	7.1	8.2	7.6	8.4
STD	(1.4)	(1.9)	(0.8)	(1.3)	(1.5)	(1.3)	(1.3)	(1.5)
e	7.2	8.5	7.6	8.8	7.1	8.7	7.3	8.6
STD	(1.0)	(2.5)	(1.6)	(1.0)	(2.0)	(1.6)	(1.6)	(1.8)
Man Plane	23.7	21.8	18.2	16.9	29.2	25.4	23.7	21.4
STD	(5.3)	(7.1)	(3.8)	(4.4)	(5.3)	(5.2)	(6.6)	(6.6)
Man Arc	24.9	31.6	33.9	34.1	25.7	28.8	28.3	31.5
STD	(3.3)	(4.8)	(4.7)	(3.9)	(4.4)	(3.2)	(5.8)	(4.5)
LFH	47.6	47.0	41.7	43.4	51.9	51.5	47.1	47.3
STD	(2.9)	(5.1)	(4.6)	(3.3)	(4.3)	(3.4)	(5.8)	(5.2)
Fac. Axis	89.8	88.9	92.8	93.1	83.9	86.7	88.8	89.5
STD	(4.0)	(4.3)	(2.7)	(3.5)	(4.7)	(3.5)	(5.4)	(4.5)
1 APog	2.1	0.3	1.3	1.2	1.9	2.1	1.8	1.2
STD	(2.5)	(2.1)	(2.0)	(2.3)	(1.8)	(2.5)	(2.1)	(2.3)
$\underline{1}$ APog	5.2	3.6	4.3	4.4	5.4	5.0	5.0	4.3
STD	(2.7)	(2.4)	(2.3)	(2.1)	(3.3)	(2.0)	(2.7)	(2.2)
Age	260.3	260.6	270.7	257.2	248.2	255.5	259.7	257.9
Months	(44.9)	(43.9)	(30.3)	(57.1)	(43.8)	(37.5)	(39.7)	(45.3)

STD or S.D.= Standard Deviations
LFH = Lower Face Height
Fac. Axis = Facial Axis
1 APo = Upper Incisor to APo Line
$\underline{1}$ APo = Lower Incisor to APo Line
F = Female
M = Male

MM DIFFERENCE IN SOFT TISSUE THICKNESS AND STANDARD DEVIATIONS

	TABLE 3(i) TOTAL			TABLE 3(ii) MESOFACIAL (GROUP 1)		
	T(M&F)	M	F	T(M&F)	M	F
B2-1	0.8(1.5)	1.1(1.2)	0.4(1.6)	0.6(1.6)	1.3(1.5)	-0.3(1.3)
B5-1	1.2(1.7)	1.7(1.6)	0.6(1.7)	1.0(1.9)	1.6(1.5)	0.3(2.1)
B5-2	0.4(1.3)	0.5(1.2)	0.2(1.4)	0.4(1.6)	0.3(1.2)	0.6(2.0)
a2-1	0.7(1.5)	0.9(1.6)	0.6(1.4)	0.3(1.3)	0.4(1.2)	0.2(1.4)
a5-1	1.2(1.8)	1.6(1.5)	0.8(2.0)	0.7(2.3)	0.8(1.5)	0.7(3.2)
a5-2	0.4(1.6)	0.7(1.6)	0.1(1.7)	0.4(2.3)	0.4(2.0)	0.5(2.6)
b2-1	0.7(1.6)	0.9(1.7)	0.5(1.4)	0.1(1.3)	0.1(1.2)	0.1(0.6)
b5-1	1.0(2.0)	1.6(1.8)	0.4(2.0)	0.2(2.0)	0.5(1.8)	-0.2(2.1)
b5-2	0.3(1.5)	0.7(1.4)	-0.1(1.4)	0.1(1.5)	0.5(1.7)	-0.3(1.3)
c2-1	0.4(1.6)	0.5(1.6)	0.4(1.6)	0(1.5)	-0.5(1.5)	0.5(1.5)
c5-1	1.1(2.2)	1.8(1.8)	0.3(2.4)	0.2(2.4)	0.9(2.0)	-0.5(2.8)
c5-2	0.7(1.6)	1.3(1.3)	-0.2(1.7)	0.3(2.0)	1.3(1.4)	-1.0(1.7)
d2-1	0.5(1.2)	0.6(1.3)	0.4(1.1)	0.2(1.2)	0(1.2)	0.4(1.1)
d5-1	1.1(1.8)	1.9(1.5)	0.3(1.8)	0.5(2.2)	1.5(1.3)	-0.7(2.6)
d5-2	0.6(1.6)	1.3(1.5)	-0.8(1.5)	0.3(2.2)	1.5(1.6)	-1.2(2.0)
e2-1	0.6(1.5)	0.5(1.4)	0.7(1.5)	0.2(1.8)	0(1.8)	0.5(2.0)
e5-1	1.2(2.1)	2.0(1.9)	0.4(2.0)	0.5(2.7)	1.5(2.3)	-0.7(2.8)
e5-2	0.7(2.0)	1.5(1.9)	-0.2(1.8)	0.3(2.8)	1.5(2.6)	-1.2(2.2)
Ages						
Mos	54.7	49.7	60.0	51.1	39.4	65.4
2-1	(28.2)	(22.7)	(32.7)	(30.4)	(19.4)	(36.1)
	137.9	133.4	142.8	139.5	135.8	144.1
5-1	(40.7)	(41.1)	(40.5)	(41)	(44.2)	(38.7)
	83.3	83.7	82.8	88.4	96.4	78.7
5-2	(43.3)	(46.2)	(40.8)	(46.6)	(50.6)	(41.8)

MM DIFFERENCE IN SOFT TISSUE THICKNESS AND STANDARD DEVIATIONS

	TABLE 3(iii) BRACHYFACIAL (GROUP 2)			TABLE 3(iv) DOLICHOFACIAL (GROUP 3)		
	T(M&F)	M	F	T(M&F)	M	F
B2-1	0.8(1.6)	1.1(1.2)	0.5(1.9)	1.0(1.2)	1.1(1.1)	0.9(1.3)
B5-1	1.3(1.6)	1.6(1.7)	1.0(1.6)	1.2(1.8)	1.9(1.8)	0.6(1.6)
B5-2	0.5(1.0)	0.5(1.2)	0.5(0.9)	0.2(1.2)	0.8(1.1)	-0.3(1.1)
a2-1	0.9(1.6)	1.5(1.8)	0.2(1.1)	1.1(1.6)	0.8(1.6)	1.3(1.6)
a5-1	1.4(1.6)	2.4(1.5)	0.3(1.0)	1.4(1.1)	1.6(1.1)	1.3(1.2)
a5-2	0.5(1.2)	0.9(1.5)	0.1(0.7)	0.4(1.4)	0.7(1.3)	0(1.4)
b2-1	0.8(1.5)	1.6(1.5)	0.1(1.1)	1.2(1.8)	1.2(2.1)	1.2(1.5)
b5-1	1.5(1.7)	2.6(1.5)	0.5(1.2)	1.4(2.0)	1.9(1.5)	0.8(2.4)
b5-2	0.7(1.2)	1.0(1.4)	0.4(0.9)	0.2(1.7)	0.7(1.3)	-0.4(1.9)
c2-1	0.3(1.5)	0.6(1.3)	-0.1(1.6)	1.0(1.7)	1.4(1.7)	0.7(1.8)
c5-1	1.3(1.6)	2.1(1.2)	0.5(1.7)	1.7(2.4)	2.4(1.8)	1.0(2.7)
c5-2	1.1(1.4)	1.5(1.3)	0.6(1.3)	0.6(1.5)	1.0(1.3)	0.3(1.7)
d2-1	0.5(1.2)	0.7(1.3)	0.4(1.1)	0.9(1.3)	1.3(1.2)	0.4(1.3)
d5-1	1.2(1.3)	1.8(1.5)	0.7(0.8)	1.7(1.7)	2.5(1.7)	0.9(1.4)
d5-2	0.7(1.5)	1.1(1.8)	0.3((1.0)	0.8(1.1)	1.2(1.2)	0.5(1.0)
e2-1	0.8(1.3)	0.8(1.4)	0.9(1.3)	0.7(1.1)	0.8(1.0)	0.5(1.3)
e5-1	1.4(1.8)	2.0(1.9)	0.8(1.5)	1.8(1.6)	2.6(1.4)	1.0(1.4)
e5-2	0.6(1.8)	1.2(1.6)	-0.1(1.8)	1.1(1.3)	1.7(1.5)	0.5(0.9)
Ages						
Mos	63.8	57.2	70.5	49.1	53.6	44.6
2-1	(27.1)	(21.7)	(31.3)	(26.0)	(25.0)	(27.7)
	142.6	123.8	161.5	131.6	140.4	122.9
5-1	(46.1)	(48.6)	(36.5)	(35.9)	(30.6)	(40.1)
	78.8	66.6	91.0	82.5	86.8	78.3
5-2	(45.7)	(48.6)	(41.4)	(38.9)	(36.9)	(42.3)

Underlined Numbers - The differences between the points are statistically greater than 0, i.e., the distances increased at these points.

If the STD are high and the differences are small, there is no significance in the measurement differences, i.e., the same as 0.

2-1 mm difference between Post-Treatment (T_2) - Pretreatment (T_1) soft tissue chin thickness

5-1 mm difference between 5 yrs Post-Treatment (T_5) - Pretreatment (T_1) soft tissue chin thickness

5-2 mm difference between 5 yrs Post-Treatment (T_5) - Post-Treatment (T_2) soft tissue chin thickness

T = Total, M = Male, F = Female

TABLE 4 (Cont)

GROUP III - DOLICHOFACIAL
(P value in parentheses)

Males			Females		
T_1	T_2	T_5	T_1	T_2	T_5
B,a (.05)			Ba (.119)	B,a (.192)	B,a (.547)
c,e (.062)		c,e (.129)	B,b (.065)		B,b (0.059)
d,e (.302)	d,e (.766)	d,e (.211)	d,e (.876)	d,e (1.0)	d,e (0.898)

B,a,b,c,d,e - Points on the soft tissue chin symphysis representing extensions from the hard tissue to the soft tissue chin.

Points, where P values <.05 are significantly dissimilar. The points listed together (above) have similar distances between the hard and soft tissue chin at the given times. (T_1, T_2 and T_5 respectively)

TABLE 4

Statistically similar hard tissue to soft tissue chin distances around the symphysis at the given points during T_1, T_2 and T_5 respectively.

GROUP I - MESOFACIAL
(P values in parentheses)

Males			Females		
T_1	T_2	T_5	T_1	T_2	T_5
B,a (.057)			B,a (.920)	B,a (.485)	B,a (.506)
			B,b (.355)	B,b (.953)	B,b (.228)
			a,b (.187)	a,b (.077)	a,b (.186)
d,e (.684)	d,e, (.620)	d,e (.682)	d,e (.376)	d,e (.166)	d,e (0.101)

GROUP II - BRACHYFACIAL
(P values in parentheses)

Males			Females		
T_1	T_2	T_5	T_1	T_2	T_5
B,a (.151)	B,a (.812)	B,a (.604)	B,a (0.248)	B,a (0.589)	B,a (.314)
	B,b (.149)	B,b (.228)	B,b (0.520)	B,b (0.119)	B,b (.120)
					a,b (.083)
d,e (.621)	d,e (.767)	d,e (.843)	d,e (0.159)	d,e (.860)	d,e (.433)

TABLE 5
REGRESSION ANALYSES ON TOTAL 60 PATIENTS
Variables affecting the thickness of the soft tissue chin

Points On Symphysis	Time	1st	2nd	3rd	4th	5th
B	2-1 R^2%	Sex 0.36	MA 0.08	MA 0.04	1-APog 0.02	1-Apog 0.02
B	5-1 R^2%	Sex 0.3	Age 0.1	1-APog 0.06	1-APog 0.06	MA 0.03
B	5-2 R^2%	FAS 0.29	MP 0.09	FA 0.05	1-APog 0.07	Sex 0.03
a	2-1 R^2%	Age 0.38	1-APog 0.07	Age 0.05	Group 0.04	NE/EXT 0.03
a	5-1 R^2%	1-APog 0.30	Sex 0.08	Age 0.04	1-APog 0.03	NE/EXT 0.03
a	5-2 R^2%	Age 0.26	1-APog 0.08	Sex 0.04	1-APog 0.03	1-APog 0.02
b	2-1 R^2%	Age 0.39	Group 0.07	LFH 0.08	1-APog 0.03	LFH 0.02
b	5-1 R^2%	Sex 0.3	Group 0.07	LFH 0.12	MP 0.07	MP 0.03
b	5-2 R^2%	MA 0.28	1-APog 0.07	Sex 0.05	MP 0.04	1-APog 0.03
c	2-1 R^2%	Group 0.27	Age 0.05	1-APog 0.03	MA 0.04	MA 0.07
c	5-1 R^2%	Sex 0.32	Group 0.08	1-APog 0.09	1-APog 0.06	MA 0.03
c	5-2 R^2%	Sex 0.4	1-APog 0.06	1-APog 0.06	MA 0.02	MA 0.05
d	2-1 R^2%	NE/EXT 0.34	FA 0.03	MP 0.06	MP 0.03	LFH 0.03
d	5-1 R^2%	Sex 0.42	Group 0.08	1-APog 0.09	AgeMo 0.06	FA 0.05

TABLE 5(Continued)
REGRESSION ANALYSES ON TOTAL 60 PATIENTS
Variables affecting the thickness of the soft tissue chin

Points On Symphysis	Time	1st	2nd	3rd	4th	5th
d	5-2	Sex	LFH	MP	MA	MA
	R^2%	0.41	0.05	0.06	0.05	0.03
e	2-1	1-APog	AgeMo	NE/EXT	$\bar{1}$-APog	MA
	R^2%	0.30	0.06	0.04	0.04	0.02
e	5-1	Sex	Group	FA	$\bar{1}$-APog	MP
	R^2%	0.38	0.07	0.03	0.02	0.02
e	5-2	Sex	AgeMo	Group	LFH	$\bar{1}$-APog
	R^2%	0.43	0.04	0.03	0.06	0.03

The following variables, age, sex, group (facial type), 1 - APog, $\bar{1}$ - APog, MP (mandibular plane), MA (mandibular arc), NE/EXT (Nonextraction/Extraction), FA (facial axis) and LFH (lower face height) affect the thickness of points "B" - "e" at times T_1, T_2 or T_5 (2-1, 5-1, 5-2 are explained in Table 3i-iv).

R^2 = Proportion of variability in the dependant variable (change in soft tissue thickness at the points "B" - "e") explained by knowing the values of the other variables.

1st and 5th, in order of significance, are the variables which affect the soft tissue thickness at points "B" - "e" at the times shown.

The table showed that age, sex and facial type were the only variables that influenced soft tissue chin thickness at points "B" - "e".

TABLE 6
ANALYSIS OF VARIANCE
Significance of Facial Type After Adjusting for Age and Sex

	Age	Sex	Group
BT_1	.001	N.S.	.048
aT_1	.005	.079	N.S.
bT_1	.073	.019	N.S.
cT_1	N.S.	.028	.002
dT_1	N.S.	.021	.002
eT_1	N.S.	N.S.	.054
BT_2-T_1	N.S.	.03	N.S.
aT_2-T_1	.008	N.S.	N.S.
bT_2-T_1	.029	N.S.	.041
cT_2-T_1	.05	N.S.	.08
dT_2-T_1	.073	N.S.	N.S.
eT_2-T_1	N.S.	N.S.	N.S.
BT_2-T_1	.028	.006	N.S.
aT_5-T_1	N.S.	.028	N.S.
bT_5-T_1	N.S.	.005	.0327
cT_5-T_1	N.S.	.008	.071
dT_5-T_1	N.S.	0.00	.042
eT_5-T_1	N.S.	.002	.089
BT_2	N.S.	N.S.	.033
aT_2	N.S.	N.S.	N.S.
bT_2	N.S.	N.S.	N.S.
cT_2	N.S.	.05	N.S.
dT_2	N.S.	.077	.046
eT_2	N.S.	N.S.	N.S.
BT_5-T_2	N.S.	N.S.	N.S.
aT_5-T_2	N.S.	N.S.	N.S.
bT_5-T_2	N.S.	.038	N.S.
cT_5-T_2	N.S.	.001	N.S.
dT_5-T_2	.046	.001	N.S.
eT_5-T_2	.006	.001	N.S.
BT_5	N.S.	.058	N.S.
aT_5	N.S.	N.S.	N.S.
bT_5	N.S.	N.S.	N.S.
cT_5	N.S.	N.S.	N.S.
dT_5	N.S.	.036	N.S.
eT_5	N.S.	.005	N.S.

$p <.05$ = variables are statistically significant
N.S. = not significant

TABLE 6 SUMMARY
ANALYSIS OF VARIANCE
Significance of Facial Type After Adjusting for Age and Sex

Points on the Chin	T_1	T_2	T_5	T_1-T_2	T_5-T_2	T_1-T_5
B	(-)	(-)				
a						
b				(-)		(-)
c	(-)			(-)		
d	(-)	(-)				(-)
e						

(-) = Facial pattern is significant at (-) points after adjusting for age and sex on point "B" - "e".