CHAPTER II
LITERATURE REVIEW

Review of the age of adult samples

The age of adult samples among several studies in various races are different. Taranger and Hagg (1980), and Hagg and Taranger (1980) studied in the white Swedish, it was found that, the complete growth occurred in females at the mean age of 17 and of 19 in males. Ricketts (1960,1972) revealed that the mean age of complete growth in white people in general was 19 years, especially in males. Burstone (1963) stated that the complete body growth in American white females occured ahead of that of males with a difference in the beginning of the maximum growth spurt for about 2 years. Growth in height in the adolescent period in females ranged from 9.5 to 14.5 years of age, and in males from 10.5 to 16 years. Bjork and Helm (1967) reported that, for the white Danish, the maximum body growth in adolescents happened in females ahead of males for about 18±3 months.

Nabangxang et al. (1978) studied Thai children in Chiang Mai province from birth until 18 years of age, found that growth in adolescent period in females occured from 10.75 to 13.5 years of age and from 12 to 15 years of age in males. From the growth curve it was found that growth in height of most children ended at the age of approximately 12.75 years and 14.5 years in females and males respectively.

Points A, B and soft tissue profile changes in growing patients

In 1956 Holdaway evaluated the pretreatment and posttreatment of SNA, SNB, and ANB and found that angular change in SNA was a combination of inhibited maxillary alveolar growth and a change in point A following retraction of upper incisors. He also found that the changes of point A and B were influenced by the type of treatment. In addition, patients who were treated during a period of active growth responded with better apical base changes than non growing patients.

Linquist (1958) also found that point A can be moved more posteriorly by remodelling associated with lingual movement of the maxillary incisors.

Neger (1959) stated that proportional change of the soft tissue profile did not necessarily accompany extensive dentition changes and that one could no longer rely entirely on a dentoskeletal analysis for accurate information about the soft tissue facial profile change which occur during orthodontic treatment.

King (1960), in a study of 103 patients 8-15 year of age with class II division 1 malocclusion who were treated with extraoral anchorage reported that besides teeth, orthodontic treatment could influence most, the area around point A, which seemed most amenable to change during growth. Changes in Point A decreased with age. Finally, the points opposite the nasion and pogonion closely followed skeletal changes.

Subtelny (1961) presented five patients who showed changes in lip position due to treatment and growth and concluded that soft tissue change that could be anticipated during treatment centered around the lips and occured primarily in the vermilion area. Lip posture was found to be correlated closely with the posture of underlying dental and alveolar structure.

Bloom (1961) reported a statistically significant relationship between upper and lower incisor changes and soft tissue changes. It was found possible to predict the perioral soft tissue profile changes related to expected anterior tooth movement.

Rudee (1964) found that the ratio of upper incisor to upper lip change was 2.93:1.0, lower incisor to lower lip was 0.59:1.0, and upper incisor to lower lip was 1.1:1.0.

Meach (1966) compared the effect of extraoral traction using functional appliances and found that point A could be moved backward by extraoral traction. Hard skeletal tissue was highly adaptive to environmental influences, and extrinsic habits.

Taylor (1969) evaluated changes in points A, N and B of 225 patients as a result of orthodontic treatment. He suggested the elimination of the nasion as

a registration point and showed that the angles SNA, SNB and ANB should not be used because as the nasion moved forward, SNA and SNB became smaller, even though points A and B did not change or moved forward. He advocated the use of linear measurements and found that after orthodontic treatment, point A moved backward 1.1 mm. and point B moved forward 2.5 mm. (calculated as percent of change).

Anderson and associates (1973) studied profile change in orthodontically treated patients 10 years out of retention. Soft tissue profile was found to be closely related and depended on underlying dentoskeletal framework and continued to flatten during maturation after completion of orthodontic treatment.

Roos (1977) studied profile change in orthodontically treated patients with Edgewise appliances and a mean age twelve years. Points A and B moved 2.23 mm. and 1.28 mm. posteriorly respectively. He found good correlation of the subspinale, incision inferior, and supramentale to the corresponding soft tissue points, but poor correlation of the incision superior to the labrale superior or the labrale inferior. The points studied by Roos were shown in Figure 1.

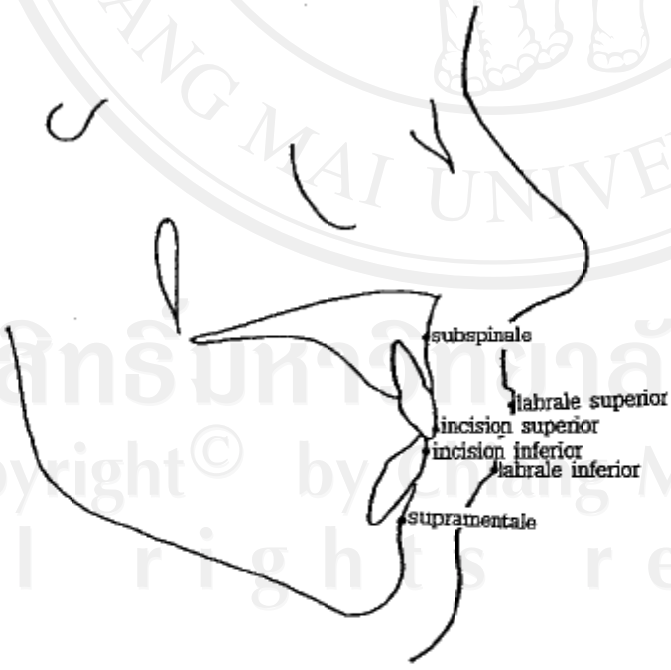


Figure 1 Points studied by Roos (1977).

LaMastra (1981) reported that in a sample of forty, points A and B moved backward 2.34 mm. and 1.89 mm. respectively. The ratio of mean change of the subspinale to the superior labial sulcus was 1.4:1.00 and of the supramentale to the inferior labial sulcus, 1.09:1.00 with a statistically significant relationship between changes of the subspinale and superior labial sulcus (r=0.812) and also between changes of the supramentale and inferior labial sulcus (r=0.96). The points studied by LaMastra were shown in Figure 2.

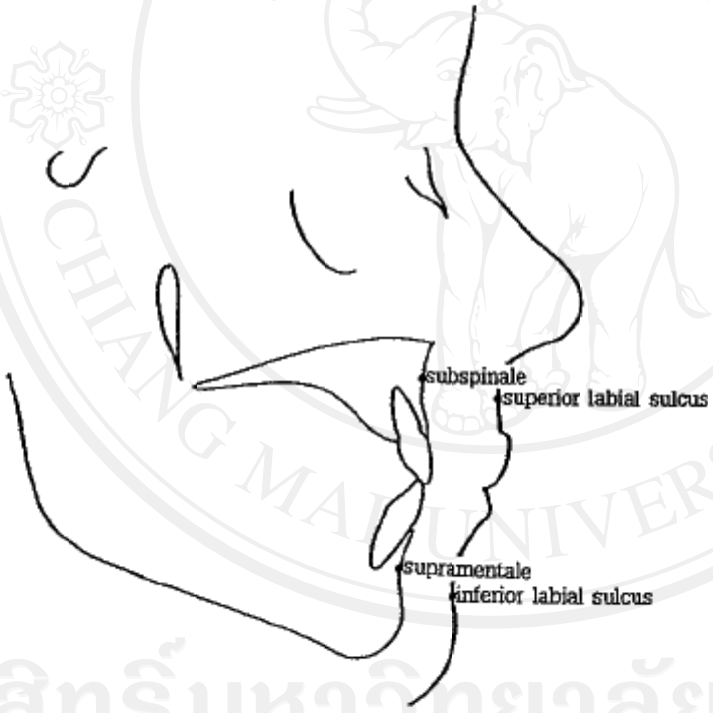


Figure 2 Points studied by LaMastra (1981).

Loois and Mills (1986) found that there was a great variation in individual responses of the soft tissue to change in the underlying hard tissue and that it was not possible to predict the effect on the lips of a given movement of the teeth.

Battagel (1990) studied 62 children with class II division 1 malocclusion who were treated with Edgewise and extraoral traction. He found no change in point A but forward movement of point B after treatment; in addition, there was no statistically significant correlation between soft tissue profile change and the underlying dentoskeletal tissue change except between the labrale superioris and incisor tip position, and point A and the upper incisor apex. Points studied by Battagel were shown in Figure 3.

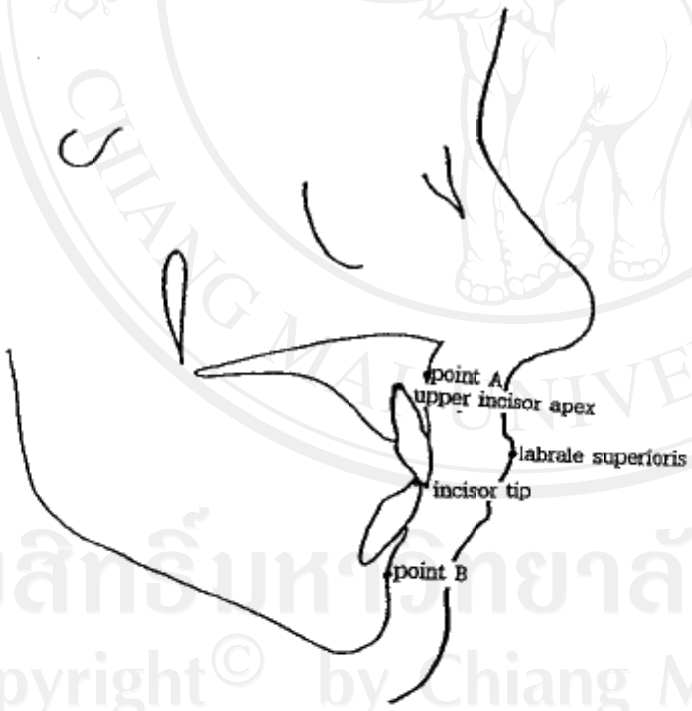


Figure 3 Points studied by Battagel (1990).

Points A, B and soft tissue profile changes in adult patients

The vast majority of the subjects studied were children whose hard and soft tissue changes resulted from the combination of their growth and orthodontic treatment. For adults whose changes resulted from only orthodontic treatment in a study of profile change in 36 female Caucasian adults with class I and class II malocclusion, Hershey (1972) reported that there was no change in point A at 0.01 the significant level but there was a change at the 0.05 level. There was a posterior change in point B of 1.3 mm.. For the superior labial sulcus, the labrale superius, the labrale inferius, and the inferior labial sulcus, there were multiple correlation coefficients of 0.71, 0.82, 0.58, and 0.78 respectively with underlying hard tissue. The lower lip was apparently less dependent than the other profile points upon the underlying skeleton for its position in space. Finally, he concluded that neither simple nor multiple correlation coefficients obtained were useful clinically in predicting soft tissue response to incisor tooth movement. The response of the soft tissue profile to incisor retraction did not differ significantly for class I and II subjects. Soft tissue points studied by Hershey were shown in Figure 4.

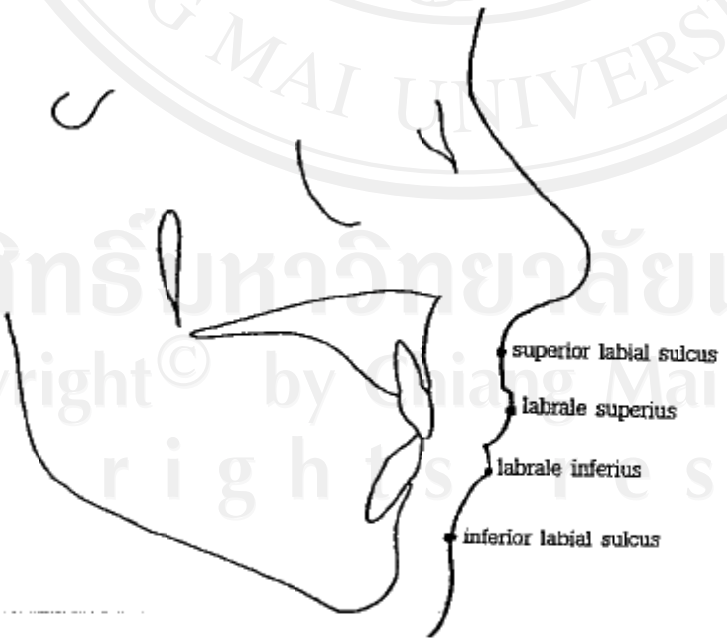


Figure 4 Soft tissue points studied by Hershey (1972).

Rains and Nanda (1982) in a study of 30 late adolescent and early adult Caucasian females proposed equations to predict soft tissue response to incisor retraction. They found no significant change of points A and B, no significant correlation between lower incisor movement and the response of the lower lip, and that the upper lip response was related to both upper and lower incisor movement, mandibular rotation and the lower lip. Finally, they concluded that the lower incisor was not a good predictor for changes of the lips related to treatment.

Lew (1989) reported soft tissue profile change in 32 Chinese adults treated with Begg appliances. He concluded that the changes in points A, B, and upper and lower incisor apices were not statistically significant, but there was a high correlation between incisor change and lip change with an average ratio of upper lip to upper incisor retraction of 1:2.2 and a ratio of lower lip to lower incisor retraction of 1:1.4.

Assuncao et al. (1994), in a study of white Brazilian adolescents reported a high correlation between absolute change in the upper lip and upper incisor and also between absolute change in the lower lip and lower incisor. Furthermore, the depth of the lower lip sulcus was highly correlated with the position of the lower incisor and point B. There was no statistically significant change in point A but posterior change in point B.

Bravo (1994) found that upper and lower lips moved back an average of 3.4 and 3.8 mm. from the E-line after orthodontic treatment by premolar extraction.

Racial and sex differences in profile changes

Most of the research was on white-Caucasian population; other races were studied to a lesser extent.

Garner (1974) in a study of soft tissue change in Negroes found that the extent of lip change was not always predictable.

Lew (1989) studied Chinese treated with Begg appliances and found high correlations between upper incisor change and upper lip change (r=0.72) and lower incisor change and lower lip change (r=0.80). In another group of Chinese, after treatment with esthetic appliances (Lew, 1992), the ratio of upper lip change to upper incisor change was 1:2.1 (r=0.91).

Yokosawa (1989) in a study of soft tissue profile change in 100 Japanese adults reported that upper lip change was about 40 percent of upper incisor change, and that lower lip change was about 70 percent of lower incisor change. He also found that upper incisor change has a stronger influence on the lower lip change than lower incisor change has on the lower lip change.

Assuncao et al. (1994) also found a high correlation between hard and soft tissue change in white Brazilians.

Regarding sex, Baum (1961) reported that when orthodontic treatment was complete before or during the period of growth, in males the facial structures moved further forward relative to dentition than in females of similar age.

Garner (1974) found that the change in lip posture was not the same in boys and girls.

Lundstrom and Cooke (1991) found that the horizontal measurements of the soft tissue profile of males were greater than those of females.

Review of reference lines in cephalometric analysis

Various lines have been proposed as references.

Linquist (1958) used S-N line, Frankfort Horizontal plane (FH line) and Nasion-Pogonion line as reference lines to study subsequent profile changes with orthodontic tooth movement as shown in Figure 5.

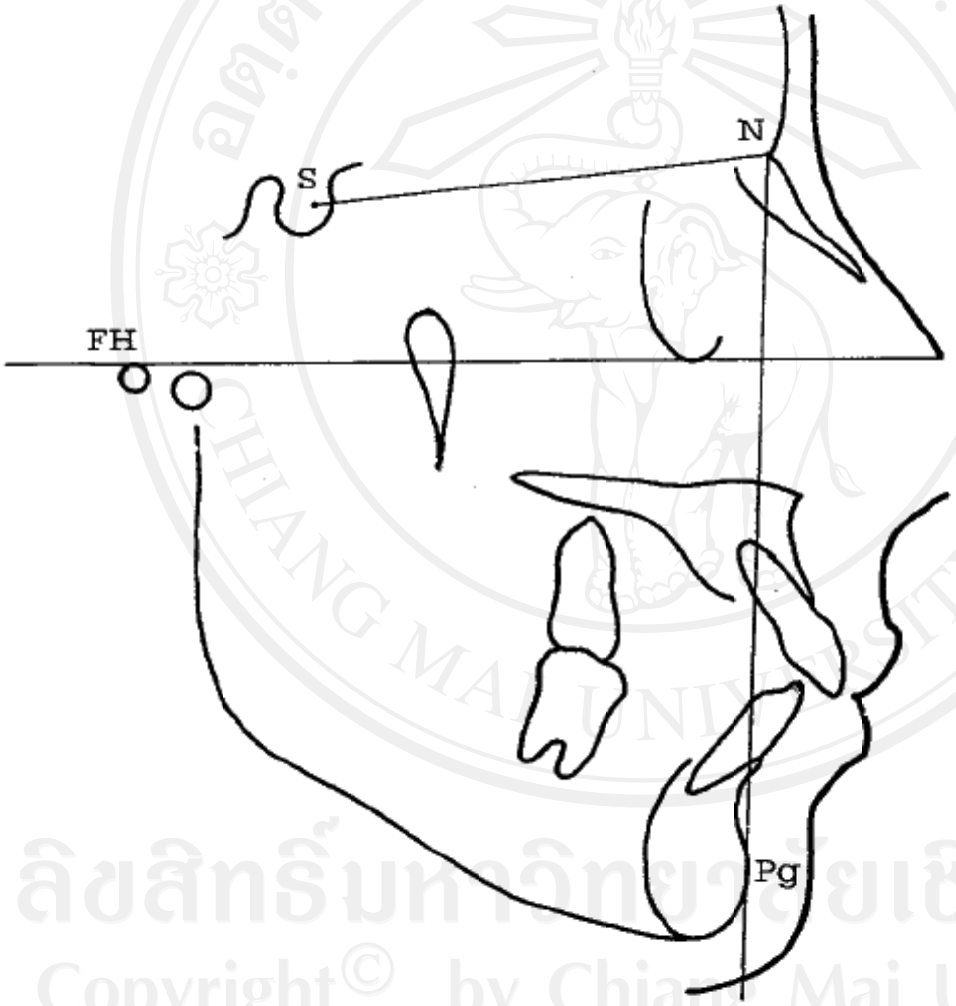


Figure 5 Reference lines used by Linquist (1958).

Neger (1959) used FH plane as a reference line and measured angles between Nasion and points desired to study (S, I, Pg) for the purpose of evaluating the soft tissue profile. Angular relationships are established between upper lip, lower lip, and chin as shown in Figure 6.

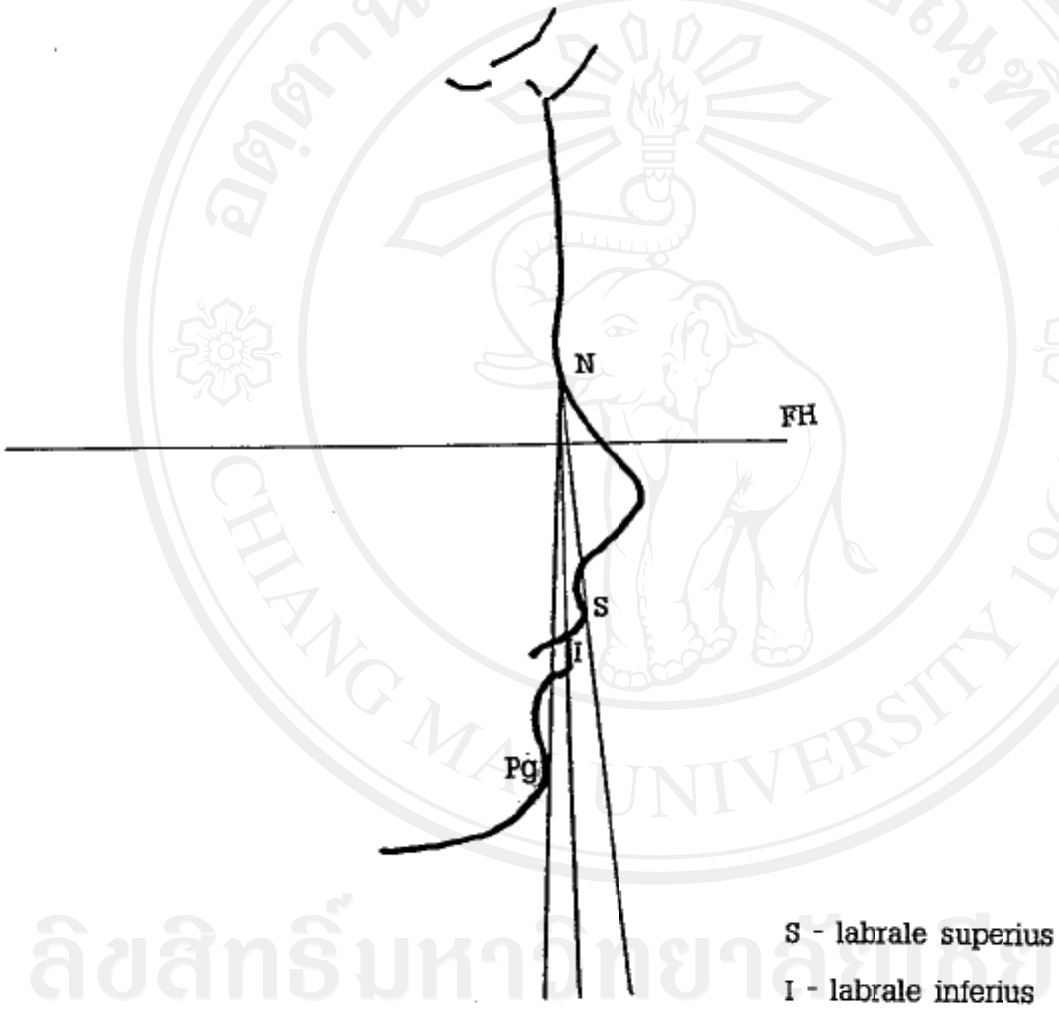


Figure 6 Reference line and points used by Neger (1959).

King (1960) used S-N line, FH plane and a line drawn from Nasion perpendicular to FH plane as reference lines as shown in Figure 7 to study hard tissue changes (Nasion, point A, and pogonion) and soft tissue changes (soft tissue opposite to nasion, upper lip, and soft tissue opposite to pogonion) after orthodontic treatment.

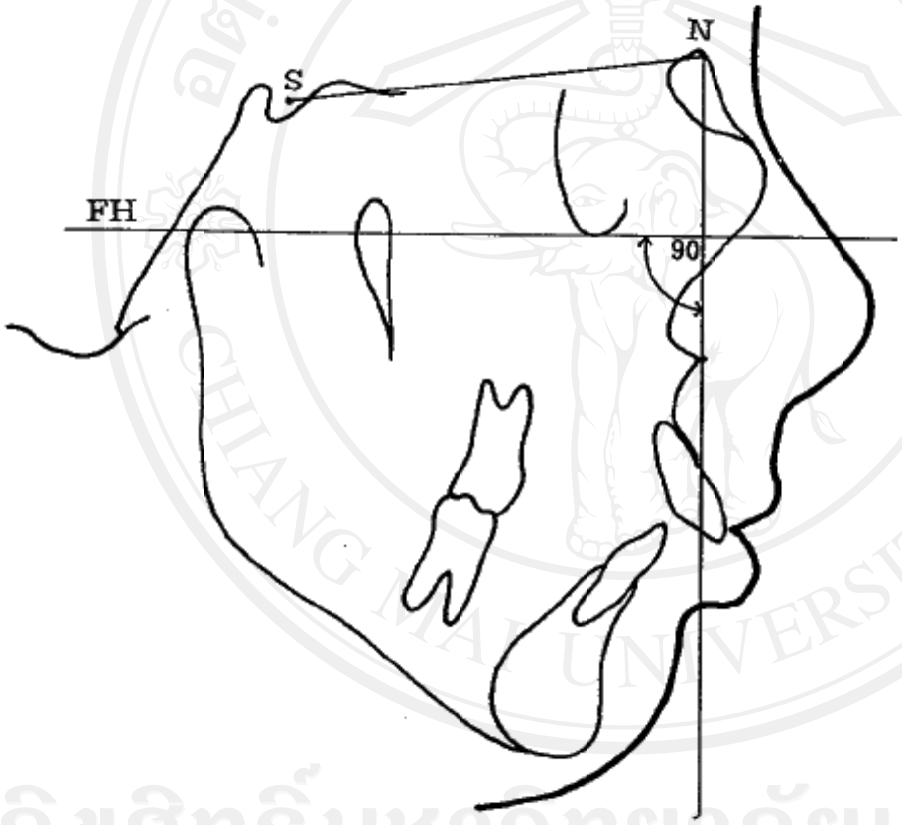


Figure 7 Reference lines used by King (1960).

Rudee (1964), Hershey (1972) and Garner (1974) used S-N line and N-Pg line as reference lines to study soft tissue changes concurrent with orthodontic treatment. Soft tissue points that were measured were nose, upper lip protrusion, lower lip protrusion and chin thickness as shown in Figure 8.

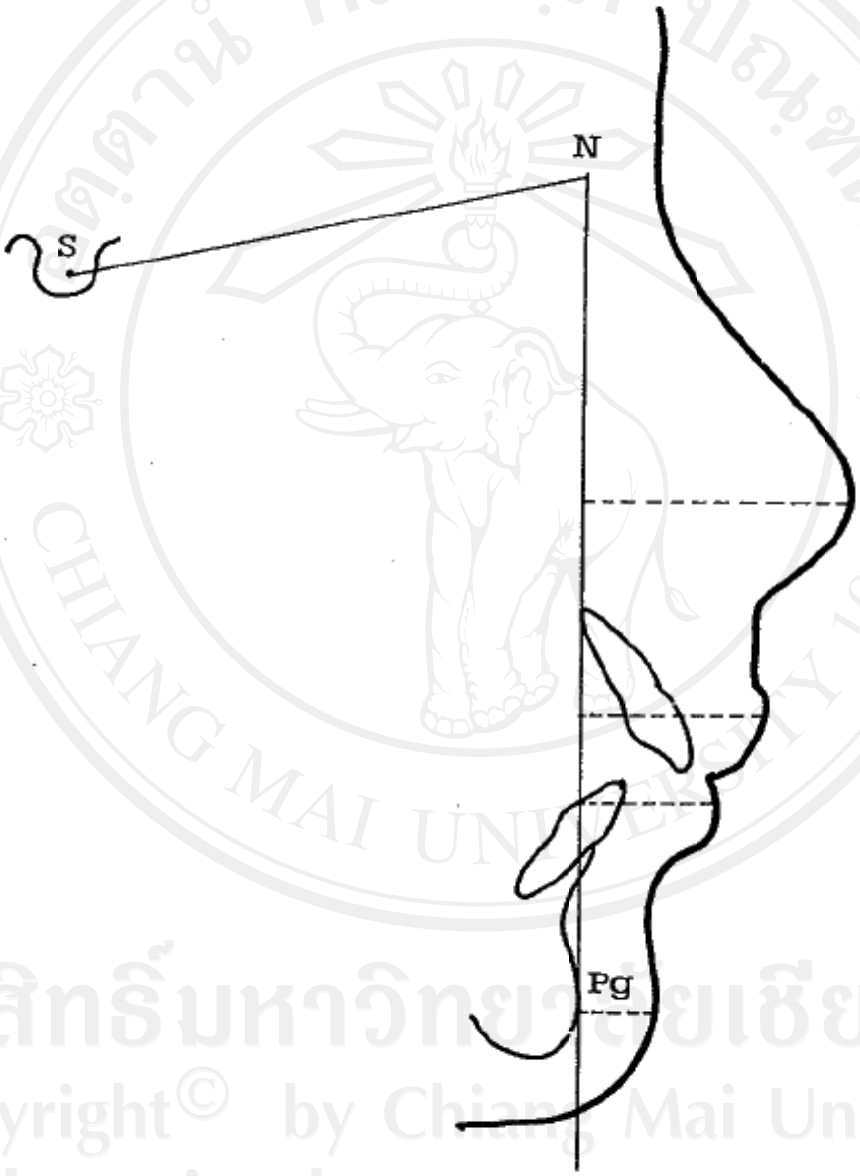


Figure 8 S-N line and N-Pg line used by Rudee (1964), Hershey (1972) and Garner (1974).

Anderson et al. (1973) and Hillesund (1978) used N-Pg line as reference line to study profile change after orthodontic treatment as shown in Figure 9 to study lip thickness over A (TSS), lip thickness over B (TSM), labrale superius (TLS), and labrale inferius (TLI).

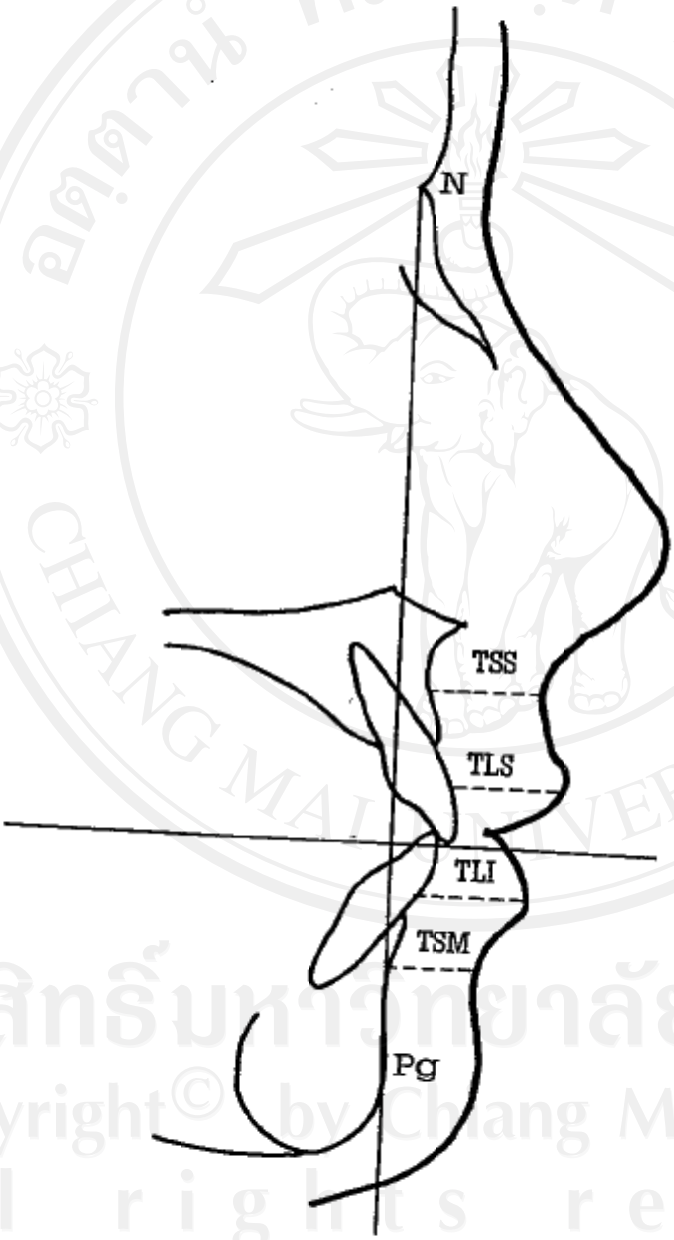


Figure 9 N-Pg line used by Anderson et al. (1973) and Hillesund (1978).

Roos (1977) used S-N line and a line drawn from point S perpendicular to SN line (SNP) as reference lines as shown in Figure 10 to study hard tissue (point A, point B) and soft tissue (nose, lips, chin) changes after orthodontic treatment. The distances from hard tissue and soft tissue points perpendicular to SNP were measured.

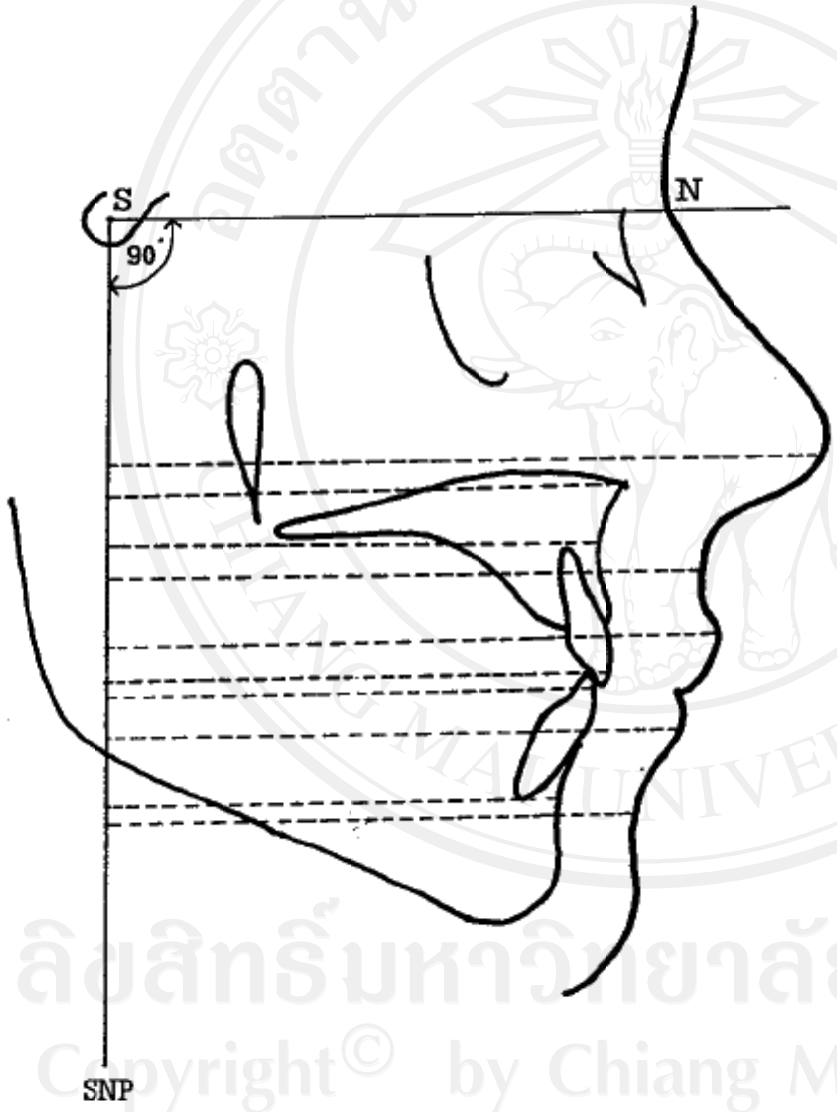
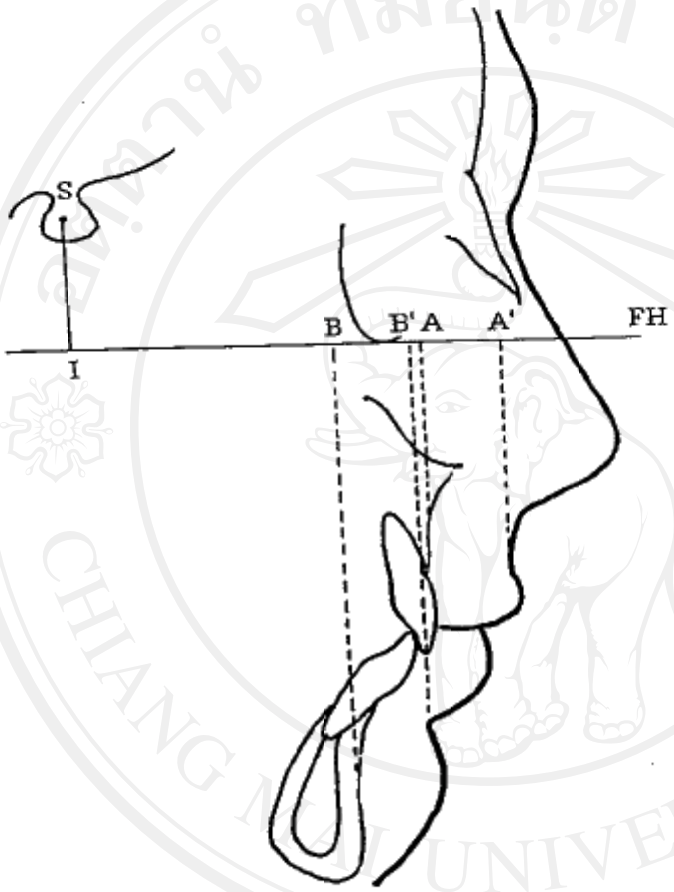


Figure 10 Reference lines used by Roos (1977).

LaMastra (1981) used FH plane as a reference line as shown in Figure 11 to study the changes of skeletal and integumental points A and B following orthodontic treatment. Linear measurements before and after treatment were made between point I and A, point I and B, point I and A', point I and B'.



I- a point drawn from sella perpendicular to the FH plane

A- a point drawn from osseous point A perpendicular to the FH plane

B- a point drawn from osseous point B perpendicular to the FH plane

A'- a point drawn from integumental A' perpendicular to the FH plane

B'- a point drawn from integumental B' perpendicular to the FH plane

Figure 11 Analysis studied by LaMastra (1981).

Bloom (1961) used palatal plane as a reference line as shown in Figure 12 to evaluate the correlation between the movement of teeth and the changes in the perioral soft tissue profile. Perpendicular distances from the palatal plane to the hard tissue points (A, B) and soft tissue points (upper lip, lower lip) were measured before and after orthodontic treatment.

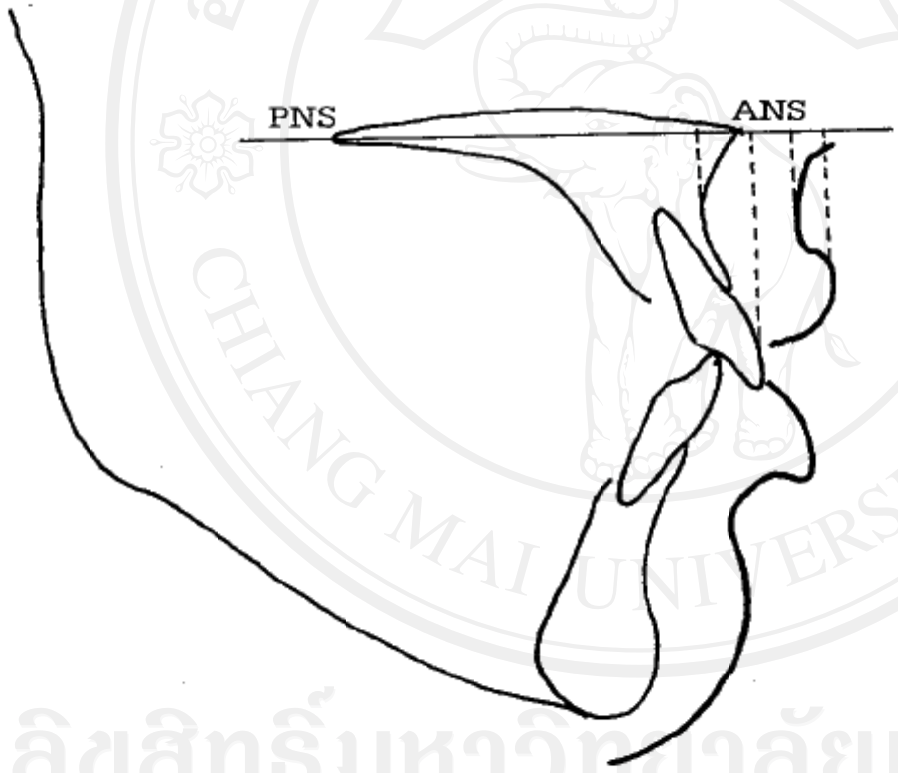


Figure 12 Reference line studied by Bloom (1961).

Rains and Nanda (1982), Loois and Mills (1986), Talass et al. (1987) and Assuncao et al. (1994) used 2 reference lines as shown in Figure 13 in order to study skeletal changes (point A, point B) and soft tissue changes (lips, lip sulcus, chin) associated with incisor retraction. Perpendicular distances from skeletal and soft tissue points to VRL were measured before and after treatment. Both reference lines were :

- X-axis (CFH) was a line drawn from the landmark sella at 7 degrees inferior to the original SN line.

- Y-axis (VRL) was a line drawn from the landmark sella perpendicular to X-axis.

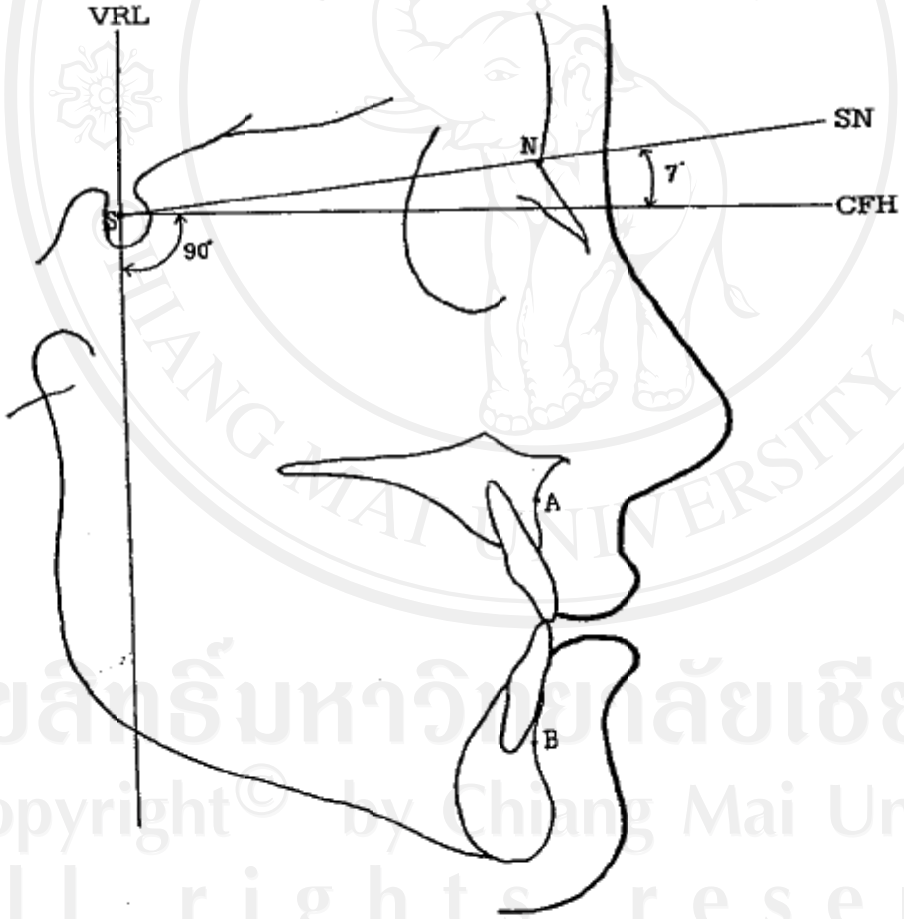


Figure 13 Reference lines used by Rains and Nanda (1982), Loois and Mills (1986), Talass et al. (1987), and Assuncao et al. (1994).

The SN line (Linquist, 1958; Rudee, 1964; Hershey, 1972; Garner, 1974; Roos, 1977) and FH plane (Neger, 1959; King, 1960; LaMastra, 1981; Zylinski et al., 1992) have often been used. However, both have some disadvantages.

The SN line, although easily located and stable after growth, is not a true horizontal line; thus it is unsuitable for comparison of the changes in distance. The FH plane has often been accepted as an indication of the patient's natural head position. However, there are problems with replication (Cooke and Wei, 1991).

Other lines, such as the Facial plane (Linquist, 1958; Anderson et al., 1973; Hillesund et al., 1978), the Nasion line (King, 1960), the palatal plane (Bloom, 1961, Oliver, 19820) are not parallel with the X or Y axes. Burstone et al. (1978) first recommened the use of CFH as a true Horizontal plane and The University of Connecticut has recommended a Cartesian coordinate system which used this plane for computerized analysis. This system uses the Constructed Frankfort Horizontal plane (CFH), which is a horizontal reference line constructed at an angle of 7 degrees from the SN line inferiorly to be used as the X axis. The line through S and perpendicular to CFH is used as the Y axis (Rains and Nanda, 1982; Loois and Mills, 1986; Talass et al., 1987; Assuncao et al., 1994).

Review of other aspects of soft tissue profile change analysis

For lip position, Hillesund et al. (1978) found that cephalograms taken while the lips relaxed and the teeth in occlusion seemed to provide the most accurate image of lip position and morphology.

Oliver (1982) showed the effect of lip strain on the relationship between incisor changes and vermilion border changes.

Zylinski et al. (1992) have suggested a range of values, rather than means. Michiels and Sather (1994) recommended using patients' photographs to evaluate esthetic profiles.

Young and Smith (1993) stated that when comparing extraction cases with non extraction cases, variability of changes in non extraction cases were as great as in premolar extraction cases, so it was incorrect to blame undesirable facial esthetics after orthodontic treatment on the extraction of premolars.