

CHAPTER III MATERIALS AND METHODS

Materials

Before conducting this study, a pilot study has been undertaken to obtain a reasonable estimate of sample size. TRUE EPISTAT program (Epistat Services, Texas, 1991) was used to calculate the findings (see in Appendix A). The number of the anterior open bite and the control groups required were 50 and 67 respectively. Since this procedure was aimed at a minimum sample size, it was assumed that the sample size for this study was 70 for each group.

In this study, the sample was comprised of the centric occluded lateral cephalograms of 140 adult Northern Thais: 57 males and 83 females. They were selected by purposely sampling according to the following criteria:

- 1) There was no agenesia or missing teeth exception of third molar.
- 2) There was no craniofacial syndrome.
- 3) All subjects had never received any previous orthodontic treatment or orthognathic surgery and had no history of any facial injury.

Table 1 Age distribution of the normal and open bite groups

Group	No. of subject	Age (years)		Mean age (years)	SD	SE mean
		Min	Max			
Normal						
male	35	16.3	25.7	20.97	1.83	0.31
female	35	15.8	28.8	19.17	2.48	0.42
Open bite						
male	22	16.0	29.0	19.86	3.34	0.71
female	48	15.0	38.0	20.10	4.86	0.70

The subjects were separated into two sample groups: an anterior open bite group and a control or normal group. The average ages for the male and female subjects in both groups in this study were presented in Table 1. The

normal group consisted of lateral cephalograms of 70 (35 males and 35 females) Northern Thai adults ranging in age from 16.3 to 25.7 years in males and from 15.8 to 28.8 years in females from the collection of the Orthodontic Department of the Faculty of Dentistry, Chiang Mai University. Each subject should have a good or an excellent occlusion, normal overbite and overjet, and good or pleasing soft tissue profile. The overbite was the distance from incisal edge of maxillary incisor to incisal edge of mandibular incisor, measured perpendicular to functional occlusal plane (Figure 4A). For all of normal group, a minimum overbite was 0.5 millimeter and a maximum overbite was 5 millimeters..

The anterior open bite group consisted of pretreatment lateral cephalograms of 70 (22 males and 48 females) Northern Thais ranging in age from 16.0 to 29.0 years in males and from 15.0 to 38.0 years in females obtained from the Orthodontic Department of the Faculty of Dentistry, Chiang Mai University, several private orthodontic clinics in Chiang Mai Province and Lampang Hospital in Lampang Province. The anterior open bite samples were selected by the condition of negative overbite which were measured perpendicular to the functional occlusal planes in centric occlusion from the lateral cephalograms (Figure 4B). For all of anterior open bite group, a minimum negative overbite was - 0.5 millimeter and a maximum negative overbite was - 8 millimeters.

Since the anterior open bite group was comprised of several skeletal patterns, therefore the ANB angle was employed to classify the anterior open bite group into skeletal Class I, Class II and Class III subgroups. The mean and standard deviation of ANB angle for the normal occlusion of Northern Thai sample were determined 1.386 ± 1.516 degrees. Thus skeletal Class I would have the range of ANB angle between minus and plus one standard deviation from mean of normal occlusion: 0 - 2.9 degrees. Skeletal Class II would have the ANB value over 2.9 degrees and ANB value for skeletal Class III was under 0 degree. These criteria were provided for combined genders because of small sample size in each subgroup.

Methods

To evaluate the errors in the cephalometric measurements, 15 lateral cephalograms were selected randomly. These lateral cephalograms were traced and measured by an investigator and an experienced orthodontist. After one month, these were retraced and remeasured by the same investigator and the experienced orthodontist. The repeated measurements by the same investigator (intrainvestigator) were tested with a paired t-test, while the repeated measurements between the investigator and the experienced orthodontist (interinvestigator) were tested with an unpaired t-test. The reliability of repeated measurements by the intrainvestigator and the interinvestigator were assessed by Pearson's product-moment correlation. There were no significant differences between the first and second measurements and there were high correlations ($r = 0.9-1.0$) between the first and second measurements by intrainvestigator and interinvestigator (see in Appendix B).

All lateral cephalograms were traced on 8 inches by 10 inches acetate paper over an illuminated viewbox in a dark room with a 0.3 millimeter 2B pencil. When bilateral images were not coincident, the midline between both images was traced. All lateral cephalograms were traced and measured by an investigator. The 20 cephalometric landmarks of hard and soft tissues, the 12 planes/lines, 14 angular measurements and 20 linear measurements were identified in Figure 1 to Figure 5. The cephalometric analyses in this investigation were adopted from Steiner Analysis (1960), Burstone (1967), Jacobson (1975) and Karlson (1994).

The following landmarks and planes/lines were defined:

Skeletal, dental and soft tissue landmarks (Figure 1)

1. Sella (S)
: The center of the pituitary fossa of the sphenoid bone.
2. Nasion (N)
: The most anterior point of the fronto-nasal suture in the midsagittal plane.
3. Basion (Ba)
: The lowest and most anterior point of the foramen magnum.
4. Articulare (Ar)
: The intersection of the basisphenoid and the posterior border of the condyle of the mandible.
5. Subspinale (Point A)
: The deepest point on the anterior contour of the maxillary alveolar process in the midsagittal plane.
6. Supramentale (Point B)
: The deepest point on the anterior contour of the mandibular process in the midsagittal plane.
7. Gonion (Go)
: The point on the curvature of the angle of the mandible located by bisecting the angle formed by the lines tangent to the posterior ramus and the inferior border of the mandible.
8. Gnathion (Gn)
: The point on the bony chin located by bisecting the angle formed by the N-Pg line and the inferior border of the mandible.
9. Menton (Me)
: The lowest point on the bony chin in the midsagittal plane.
10. Pogonion (Pg)
: The most anterior point on the bony chin in the midsagittal plane.

11. Anterior nasal spine (ANS)
: The most anterior point of the nasal floor i.e. the tip of the premaxilla in the the midsagittal plane.
12. Posterior nasal spine (PNS)
: The most posterior point on the contour of the bony palate.
13. UI
: The incisal edge of the most anterior maxillary central incisor.
14. LI
: The incisal edge of the most anterior mandibular central incisor.
15. UA
: The root apex of the most anterior maxillary central incisor.
16. LA
: The root apex of the most anterior mandibular central incisor.
17. AO
: The point of contact of perpendicular dropped from point A onto the functional occlusal plane.
18. BO
: The point of contact of perpendicular dropped from point B onto the functional occlusal plane.
19. Subnasale (Sn)
: The point at which the nasal septum merges with the upper cutaneous lip in the midsagittal plane.
20. Stomion superius (Stm_s)
: The lowermost point of the vermilion border of the upper lip.

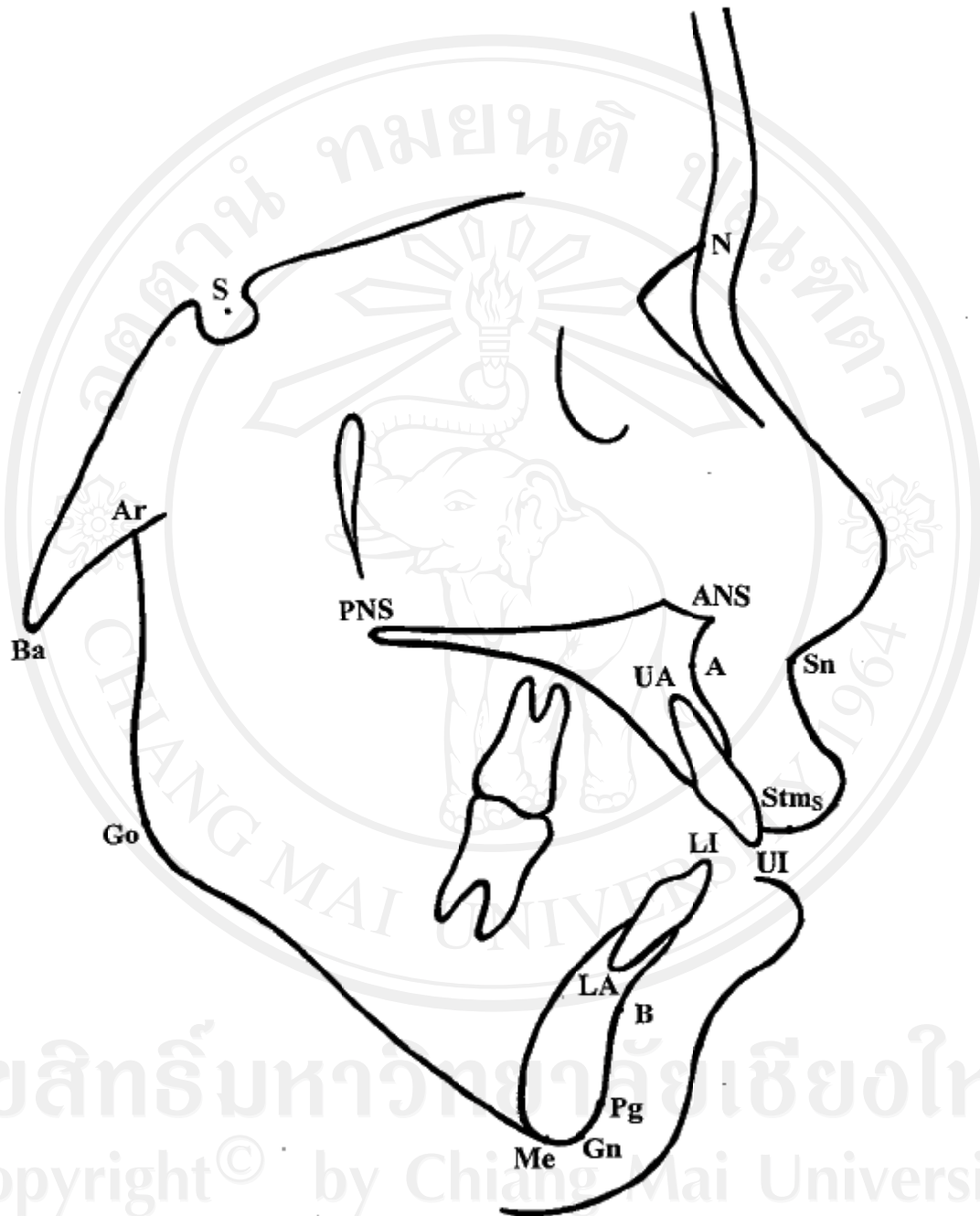


Figure 1 Skeletal, dental and soft tissue landmarks

Lines/Planes

1. SN plane
: The line from Sella to Nasion.
2. SN' plane
: The sagittal axis constructed through Sella at an angle of 8 degrees to the SN and referred to as SN prime, using as the average horizontal reference plane.
3. SNP' plane
: The vertical axis perpendicular to SN' through Nasion and referred to as SNP prime. The vertical linear measurements were measured along this vertical axis.
4. NA line
: The line from Nasion to point A.
5. NB line
: The line from Nasion to point B.
6. S-Ba line
: The line from Sella to Basion.
7. S-Gn line
: The line from Sella to Gnathion.
8. Palatal plane (PP)
: The line constructed by joining ANS and PNS.
9. Functional occlusal plane (FOP)
: The plane bisecting the overbite of molars and first premolars.
10. Mandibular plane (MP)
: The plane tangent to the inferior border of the mandible.
11. Go-Gn line
: The line from Gonion to Gnathion.
12. Ar-Go line
: The line from Articulare to Gonion.

Then the 14 angular measurements, 15 linear measurements and 5 ratios of the skeletal, dental and soft tissue parts will be done by using a standard cephalometric protractor (ORMCO) which could measure differences as small as 0.5 millimeter and 0.5 degree.

A. Skeletal variables

A.1. Angular measurements (Figure 2)

1. NSBa

: The angle between SN plane and S-Ba line, to evaluate configuration of cranial base.

2. SNA

: The angle between SN plane and N-A line, to evaluate anteroposterior position of maxilla.

3. SNB

: The angle between SN plane and N-B line, to evaluate anteroposterior position of mandible.

4. ANB

: The angle between N-A line and N-B line, to evaluate the anteroposterior relationship between maxilla and mandible.

5. SN-PP

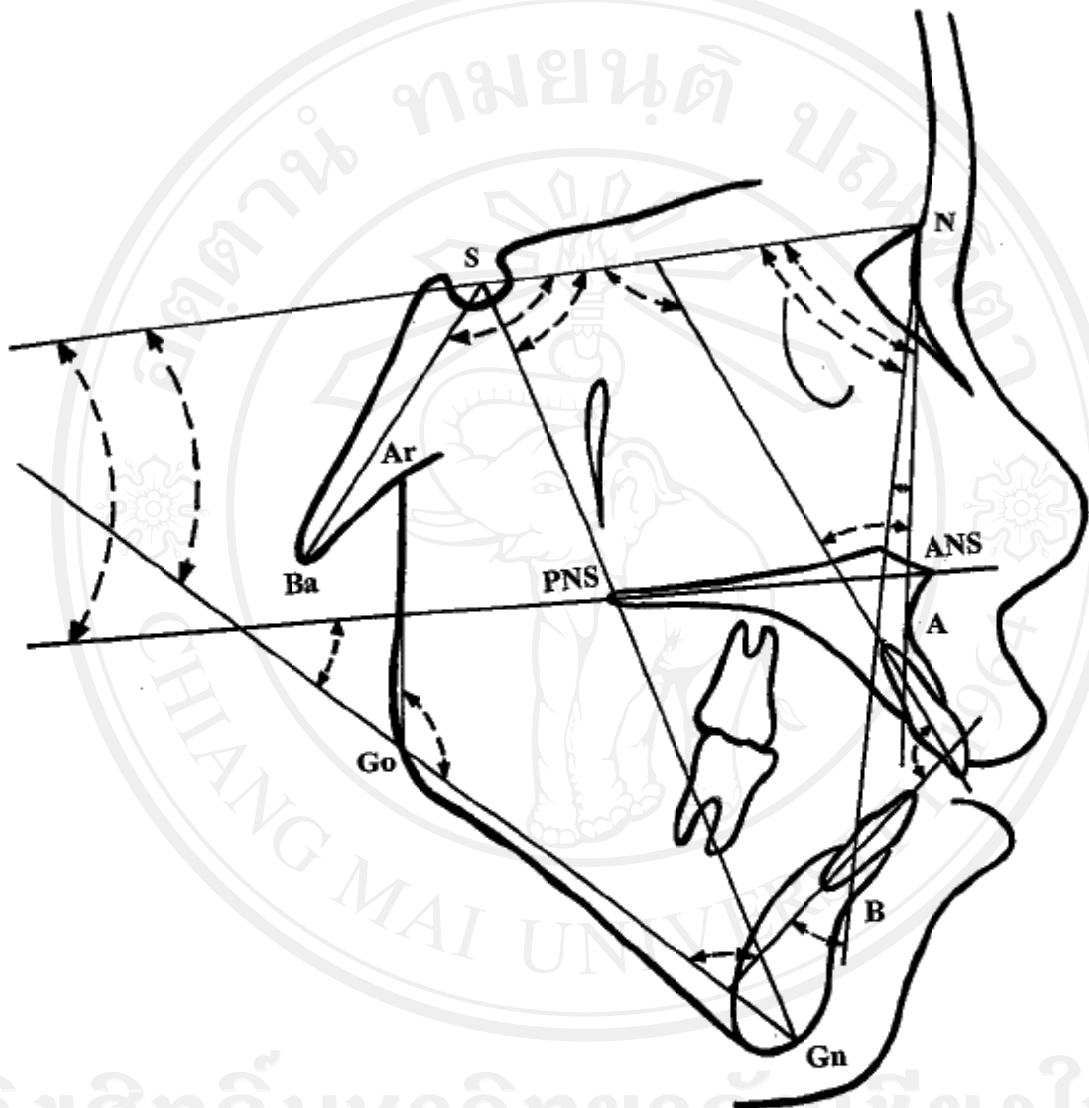
: The angle between SN plane and palatal plane, to evaluate the vertical relationship between anterior cranial base and maxilla.

6. SN-GoGn

: The angle between SN plane and Go-Gn line, to evaluate the vertical relationship between anterior cranial base and mandible.

7. PP-GoGn

: The angle between palatal plane and Go-Gn line, to evaluate the vertical relationship between maxilla and mandible.



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่
 Copyright© by Chiang Mai University
 All rights reserved

Figure 2 Skeletal and dental angular measurements

8. Ar-GoGn

: The angle between Ar-Go line and Go-Gn line (Gonial angle),
to evaluate morphology of mandible.

9. NSGn

: The angle between SN plane and S-Gn line shows growth direction
of mandible.

A.2. Vertical linear measurements (Figure 3)

1. Total anterior facial height (TAFH)

: The distance between N and Me, measured along the SNP' plane.

2. Upper anterior facial height (UAFH)

: The distance between N and ANS, measured along the SNP' plane.

3. Lower anterior facial height (LAFH)

: The distance between ANS and Me, measured along the SNP' plane.

4. Total posterior facial height (TPFH)

: The distance between S and Go, measured along the SNP' plane.

5. Upper posterior facial height (UPFH)

: The distance between S and PNS, measured along the SNP' plane.

6. Lower posterior facial height (LPFH)

: The distance between PNS and Go, measured along the SNP' plane.

7. Ramus height (RH)

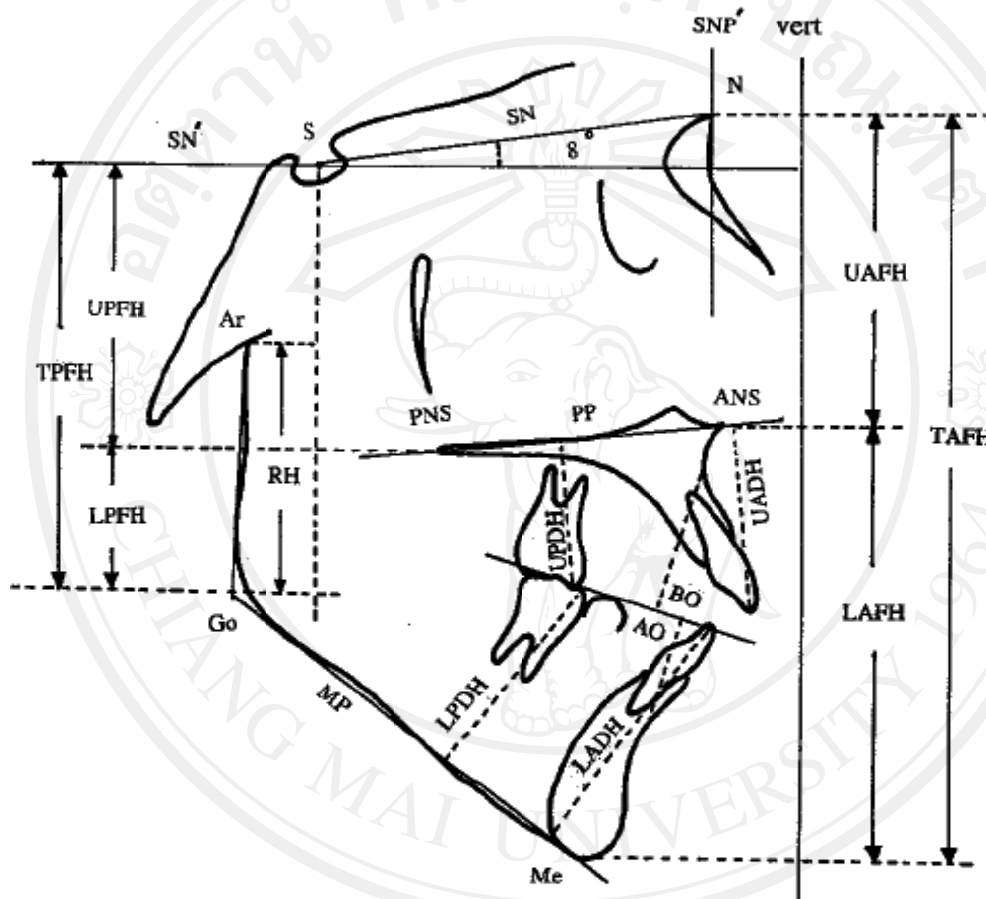
: The distance between Ar and Go, measured along the SNP' plane.

8. UAFH/LAFH ratio

: The ratio of upper anterior facial height to lower anterior facial
height.

9. UPFH/LPFH ratio

: The ratio of upper posterior facial height to lower posterior facial
height.



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่
 Copyright © by Chiang Mai University
 All rights reserved

Figure 3 Skeletal and dental linear measurements

10. TPFH/TAFH ratio (Jarabak quotient)

: The ratio of total posterior facial height to total anterior facial height. (Jarabak and Fizzell, 1972)

11. Wits appraisal (AO-BO)

: The distance between the perpendicular lines drawn from point A and point B onto the functional occlusal plane, to identify antero-posterior jaw disharmony.

B. Dental variables**B.1. Angular measurements (Figure 2)**

1. UI-NA

: The angle between long axis of maxillary incisor and N-A line, to evaluate inclination of maxillary incisor in relation to N-A line.

2. LI-NB

: The angle between long axis of mandibular incisor and N-B line, to evaluate inclination of mandibular incisor in relation to N-B line.

3. UI-SN

: The angle between long axis of maxillary incisor and SN plane, to evaluate inclination of maxillary incisor in relation to anterior cranial base.

4. LI-GoGn

: The angle between long axis of mandibular incisor and Go-Gn line, to evaluate inclination of mandibular incisor in relation to Go-Gn line.

5. UI-LI

: The angle between long axis of maxillary incisor and long axis of mandibular incisor represents the interincisal angle.

B.2. Vertical dental : linear measurements (Figure 3)

1. Upper anterior dentoalveolar height (UADH)
 - : The perpendicular length of a line dropped from the incisal edge of the maxillary central incisor to the palatal plane.
2. Lower anterior dentoalveolar height (LADH)
 - : The perpendicular length of a line dropped from the incisal edge of the mandibular central incisor to the mandibular plane.
3. Upper posterior dentoalveolar height (UPDH)
 - : The perpendicular length of a line dropped from the mesiobuccal cusp tip of the maxillary first molar to the palatal plane.
4. Lower posterior dentoalveolar height (LPDH)
 - : The perpendicular length of a line dropped from the mesiobuccal cusp tip of the mandibular first molar to the mandibular plane
5. UPDH/UADH ratio
 - : The ratio of upper posterior dentoalveolar height to upper anterior dentoalveolar height.
6. LPDH/LADH ratio
 - : The ratio of lower posterior dentoalveolar height to lower anterior dentoalveolar height.
7. Overbite
 - : The distance from incisal edge of maxillary incisor to incisal edge of mandibular incisor, measured perpendicular to functional occlusal plane (Figure 4A).
8. Anterior open bite
 - : A negative incisal overbite (Figure 4B)

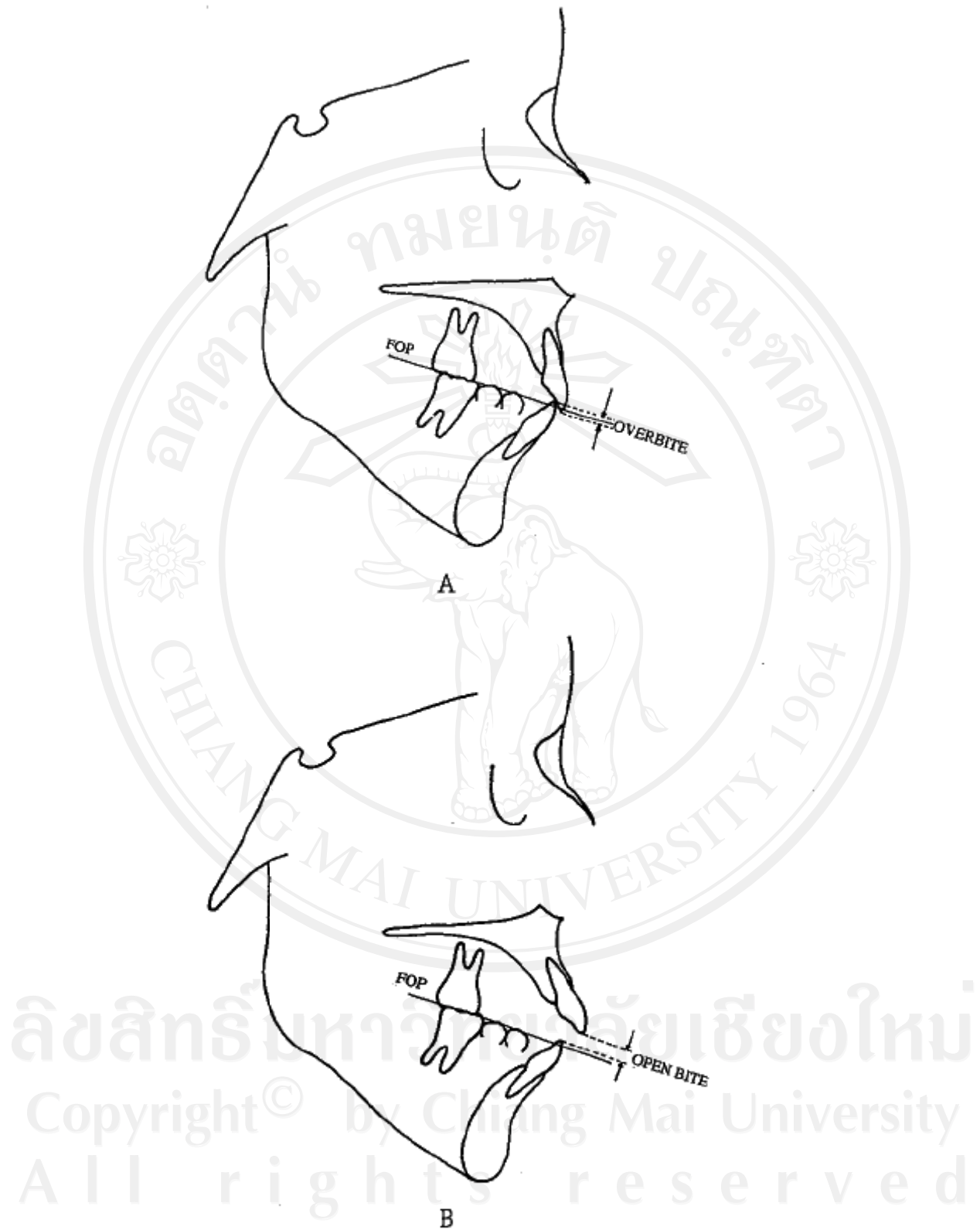


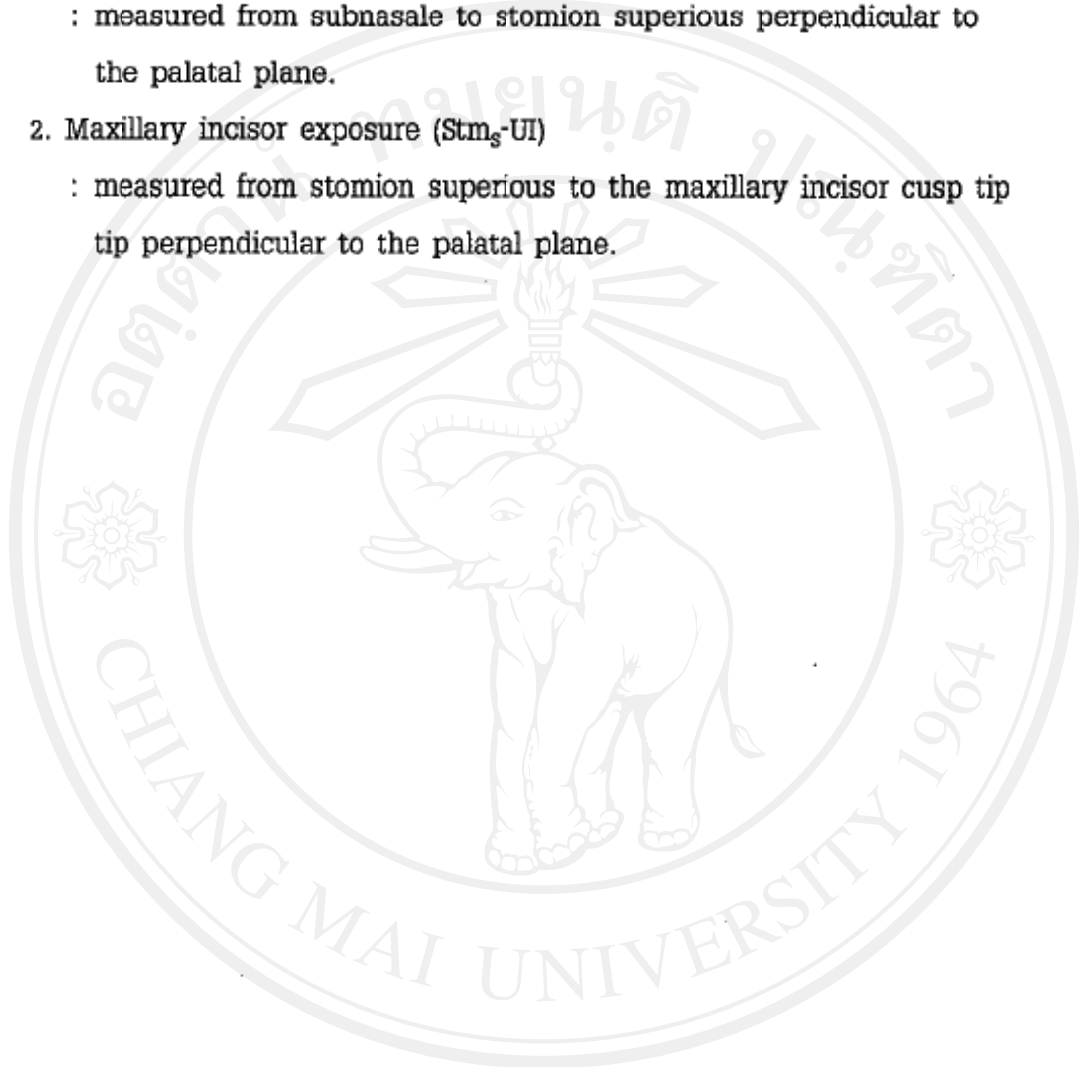
Figure 4 (A) Overbite measurement using the functional occlusal plane as a reference plane (B) A negative incisal overbite is defined as an open bite

C. Soft tissue variables : linear measurements (Figure 5)1. Upper lip length ($Sn-Stm_s$)

: measured from subnasale to stomion superious perpendicular to the palatal plane.

2. Maxillary incisor exposure (Stm_s-UI)

: measured from stomion superious to the maxillary incisor cusp tip tip perpendicular to the palatal plane.



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

Copyright© by Chiang Mai University
All rights reserved

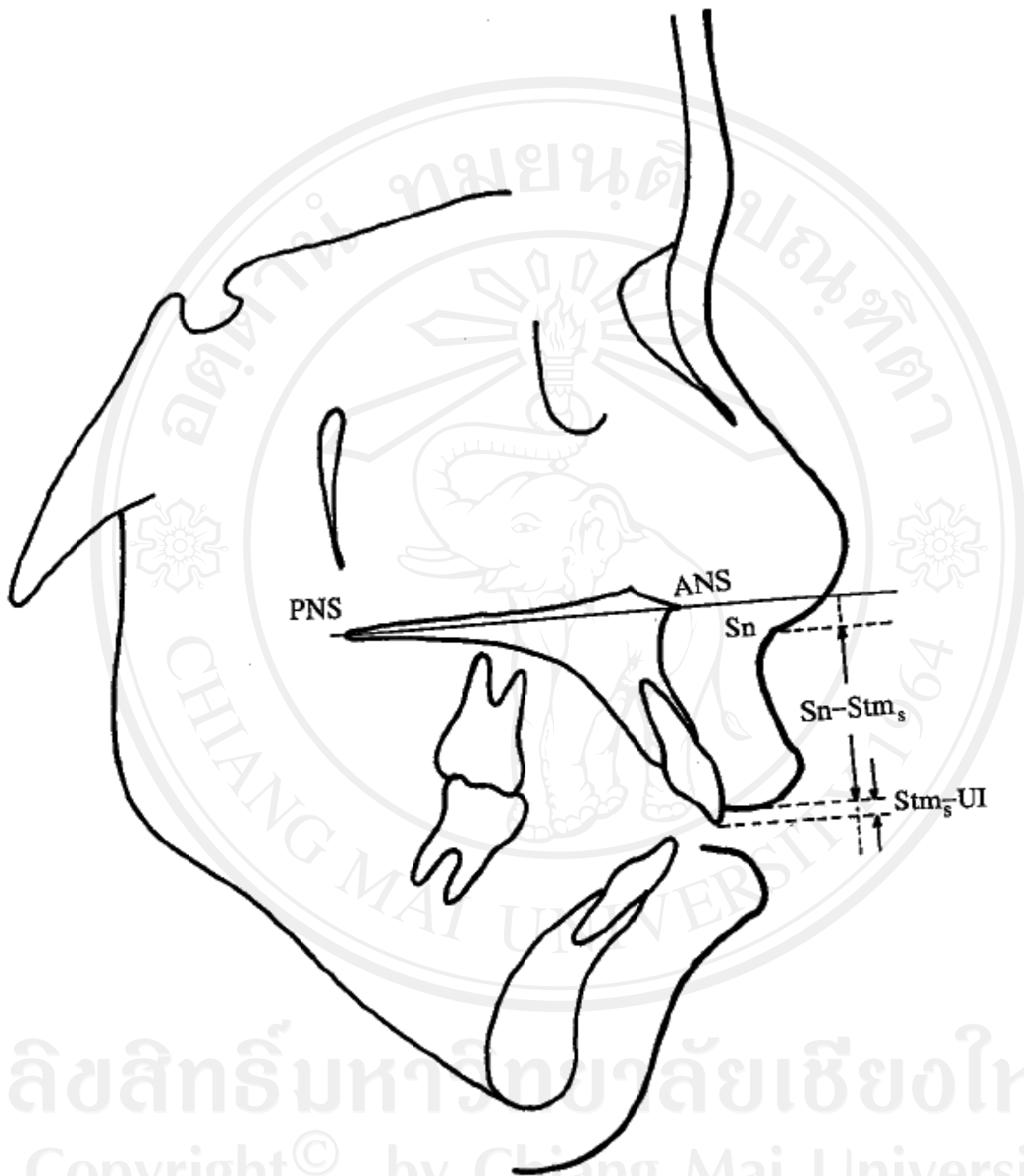


Figure 5 Soft tissue vertical linear measurements

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่
 Copyright © by Chiang Mai University
 All rights reserved

Statistical analyses

The SPSS for Window Release 6.0 program (SPSS Inc., Chicago, 1989-1993) was used to calculate the followings :

1. Descriptive analysis.
2. Two-way analysis of variance (two-way ANOVA) were performed to assess the differences between the means of cephalometric measurements in the anterior open bite and the normal groups in both sexes.
3. One-way analysis of variance (one-way ANOVA) were performed to assess the differences among the means of cephalometric measurements in skeletal Class I, Class II and Class III anterior open bite subjects.
4. Scheffe test was employed:
 - 4.1. to identify which groups were significantly different, when there was significant interaction effect between sexes and types of occlusion on any mean of cephalometric measurement from two-way ANOVA, and
 - 4.2. to identify which of the several possible differences between means of cephalometric measurements in skeletal Class I, Class II and Class III anterior open bite subjects, when there was any significance from one-way ANOVA.
5. Student t-test was used to test the mean differences of cephalometric measurements between the male and female in the normal and the anterior open bite groups.
6. Pearson' s product - moment correlations were analysed to test the relationships between each of cephalometric measurements in the normal and the anterior open bite groups.
7. Stepwise multiple linear regression analysis was used to predict the anterior open bite.

The probability of significance was denoted as * for $p < 0.05$, as ** for $p < 0.01$ and as *** for $p < 0.001$.