CHAPTER II

LITERATURE REVIEW

Studies of facial growth and development has usuallly performed on cephalometric roentgenographys (Isaacson *et al.*, 1971). The literature review consists of two main topics; the cephalometric variations and method errors.

1 CEPHALOMETRIC VARIATIONS

1.1 Skeletal Pattern

1.1.1 Sagittal Relationship

Richardson (1969) studied open bite and deepbite patients with age ranging from 7 to 27 years. He reported the longer anterior cranial base in the deepbite subjects compared to the open bite subjects. Nanda (1990) however found that there was no significant difference in cranial base angle (NSBa) value between subjects with those different vertical skeletal patterns. Karlsen (1994) also reported that there were no differences in values of cranial base flexure in the Class II div. 1 with or without deepbite, and the normal subjects. There were no significant changes in the saddle or articular angles in either gender during the growth period from children to young adult in Chinese normal samples (Chang, 1993).

Opdebeeck (1978) studied short face syndrome (SFS) subjects who were selected on the basis of clinical impression of short faces and found larger SNB angle and normal maxillary length (ANS-PNS) in the SFS group. However Karlsen (1994) claimed that the mandible in the Class II div. 1 deepbite was more prognatic than that in the Class II div. 1 normal overbite group.

1.1.2 Vertical Relationship

Several investigators indicated that the gonial angle (ArGoGn) was significantly smaller in deepbite than in open bite cases (Richardson, 1969, Opdebeeck and Bell, 1978, Trouten *et al.*, 1983) whereas Nanda (1990) postulated that the gonial angle was not different between various facial types.

Richardson (1969) additionally reported that the articulare angle (SArGo) was lesser in the deepbite than in the open bite cases. He claimed that the sizes of the ArGoGn and SArGo angles might be factors in the etiology of deepbite or open bite.

Sassouni and Nanda (1964) found that ramus height was more in the deepbites than in the open bites. Opdebeeck (1978) reported the reduced ramus height in the SFS group.

A longitudinal study was operated by Nanda (1990) in the samples with the age from 4 to 18 years to find out the skeletal features associated with the development of vertical facial disproportions. He stated that the sella-nasion to palatal plane angle (SN-PP) was more obtuse in the deepbites than in the open bites at each chronologic age in both genders. There were minimal changes in that angle in both the deepbite and the open bite samples after 10 years of age. The sella-nasion to mandibular plane angle (SN-MP) and the palatomandibular angle (PP-MP) were more acute in the deepbites than in the open bites. The SN-MP, PP-MP and gonial angles decreased progressively throughout the period of his study.

Opdebeeck (1978) reported that the SN-MP angle and sella-nasion to occlusal plane angle (SN-OP) were more acute in the SFS group compared to the normal group. Karlsen (1994) claimed that the SN-MP angle was larger in Class II div. 1 normal overbite cases than in Class II div. 1 deepbite cases.

McDowell and Barker (1991) reported that the SN-MP angle in deepbite adults was very stable, any alteration of this angle might account for the greater bite depth relapse tendency.

According to Karlsen (1995), between two groups of boys with low and high SN-MP angles, the dimensional change from 6 to 12 years was theoretically compatible with the fact that the mandibular rotation was clearly more forward in the low angle than in the high angle groups.

1.1.3 Facial Height and Vertical Facial Proportion

Isaacson *et al* (1971) and Opdebeeck and Bell (1978) reported that total anterior facial height (TAFH) was reduced in SFS group resulted from the reduction of lower anterior facial height (LAFH). This is confirmed with studies by others e.g. Richardson, 1969, Jiraviwatana *et al.*, 1998, Beckmann *et al.* 1998b, Richardson and Krayachich, 1980, Nanda, 1988, and Karlsen, 1994. Nanda (1988) claimed that the upper anterior facial height was increased in the deepbite subjects. Nevertheless Karlsen (1994) suggested that the UAFH was shorter in the Class II div. 1 deepbite group than in the normal.

Total posterior facial height (TPFH), as suggested by Opdebeeck (1978), was longer in the SFS group compared to the Bolton standards published by Broadbent *et al.*,1976. Jiraviwatana *et al.* (1998) also found that the facial height was long posteriorly in skeletal deepbite subjects. Sassouni (1969) reported that the TPFH was nearly equal to the TAFH in skeletal deepbite. However Nanda (1988) concluded that the posterior facial height did not significantly differ between the deepbite and the open bite subjects.

Dechkunakorn *et al* (1994) reported that the UAFH, LAFH, upper posterior facial height (UPFH) and lower posterior facial height (LPFH), in normal Thai samples, were greater in male than in female. However no sexual differences, in Thai normal subjects, were found for the UAFH/LAFH, UPFH/LPFH and TPFH/TAFH ratios. In the normal Chinese subjects, Chang (1993) also reported the greater of facial heights in male than in female. The UAFH/LAFH ratio in both sexes of his samples stayed constant around 81% from childhood to adulthood. The UPFH/LPFH ratio, as reported by McNamara (1984), showed a significant difference between males (1.03) and females (1.14) in Caucasians who were 20 years of age or older.

Hans *et al* (1994) reported the facial heights of deepbite samples were more increased by the cervical headgears than by the bionators. They suggested that patients with decreased lower vertical facial height would derive the greatest esthetic benefit from cervical headgear. The treatment with bionator resulted in correction of overbite by relative intrusion of the upper and lower incisors and increase in mandibular skeletal change.

For the ramus height, Isaacson *et al* (1971) reported the longer ramus height (58.75 mm.) in the skeletal deepbite samples compared to the normal (52.35 mm.). Karlsen (1994) raised that the ramus height in the Class II div. 1 deepbite subjects were not smaller than in the normal subjects but trended to be.

1.2 Dentofacial Pattern

Sassouni (1969) reported that upper and lower incisors, in the skeletal deepbites, had nearly parallel long axis. The incisors were vertically extruded while the molars were intruded.

Jiraviwatana *et al.* (1998) concluded that characteristics of the skeletal deepbite were the short upper posterior dentoalveolar height (UPDH), the upper anterior dentoalveolar height (UADH) and lower anterior dentoalveolar height (LADH). Janson *et al.* (1994) indicated that the dentoalveolar heights were significantly different between faces with excessive, normal and short lower anterior facial height but the lower posterior dentoalveolar height. Those variables were the shortest in the samples who had the short lower anterior face height. Opdebeeck (1978) also indicated that the upper and lower anterior dentoalveolar heights were reduced in the SFS group. He nevertheless found that the lower posterior dentoalveolar height was shorter in the SFS group than in Bolton standards (Broadbent 1976). The infraclusion of the upper molars was also reported by Sassouni and Nanda (1964)

Richardson (1970) reported that in anterior deepbite cases the upper and lower incisors were actually not only extruded but also upright. However Prakash and Margolis (1952) claimed that the deepbite subjects appeared to be associated with supraclusion of upper incisors and infraclusion of lower incisors, together with some infraclusion of upper molars. Lower incisors were not in supraclusion in cases exhibiting deepbite.

Opdebeeck (1978) found that the degree of overbite was larger in the SFS group. The overjet was more pronounced in the SFS group (5.33 mm) compared to normal values (2.0 mm). The lower incisors seemed to be in a more upright position in the SFS group. Nonetheless obvious difference was found in the interincisal angle.

Beckmann (1998a) postulated that the inclination of the maxillary central incisor might have an effect on the overbite. The maxillary central incisors, in subjects with anterior deepbite, were more steeply inclined. The mandibular central incisors were slightly more protruded in the deepbites than in the open bites.

The inclination of upper and lower anterior teeth did not change appreciably in either sex during growth period (Chang, 1993).

Karlsen (1994) found that children in Class II division 1 deepbite,compared to the normal , had a strong tendency toward under development of both the UPDH and LPDH. The UADH and LADH were smaller in the Class II div. 1 normal overbite than in the Class II div. 1 deepbite.

For the dentoalveolar heights of Thai adults with normal occlusion reported by Dechkunakorn (1994), there were greater UADH, UPDH, LADH and LPDH in male than female but the ratios of UPDH/UADH and LPDH/LADH were not different between them. In a longitudinal study in normal Chinese samples, the greater value of all the mean dentoalveolar heights in male were also reported by Chang (1993).

In a longitudinal study was undertaken by Bergersen (1988), There were no differences between the overbites of males and females at any age from 8 through 20 years. The overbite which was found greater than 3 millimetre at the age of 12 years still remain through adulthood for 81 % of cases.

1.3 Soft Tissue Pattern

Sassouni (1969) claimed that the skeletal deepbite cases usually had retrusive midface which created concave profile. The posterior chain of muscles were attached anteriorly on the mandible and stretched in nearly a straight line vertically.

The upper lip length in the normal adolescent samples, reported by Burstone (1967), were sinificantly longer in male (23.8+1.5 mm.) than in female (20.1+1.9 mm.). He suggested that in a typical sample of malocclusions,a considerably greater variation in lip length was usually to be expected. However this was not in normal and Class II division 1 samples.

Opdebeeck and Bell (1978) reported that the upper lip length in the study was found to be within normal limits in SFS subjects. Blanchette *et al* (1996), on the contrary, found that the SFS had shorter upper lip length and thinner upper lip compare to the long face subjects.

2 Method Errors

2.1 Errors of Measurement

Errors of the measurement could be systematic and/or random errors

Systematic errors or bias can happen when more than one observer is involved, but can also arise over a period of time if single observer practice changes with experience.

Random errors can arise as a result of variations in positioning of the patient in the cephalostat. In cross-sectional studies, it is not possible to exactly specify the acceptable limits of random errors, because this depends on differences between groups and the number of cases .

The greatest source of random errors comes from the difficulty in identifying particular landmark or precision in its definition (Houston, 1983).

2.2 Errors of Magnification Between Various X-ray Machines

The study was undertaken by Anuwongnukroh *et al* (1992) to evaluate and compare magnifications of lateral and posteroanterior cephalograms produced from 6 types of X-ray machines. They found that most of those machines did not have the significant differences on averaged magnifications.