CHAPTER II
LITERATURE REVIEW

Since open bite malocclusions exhibited skeletal, dental, and soft tissue abnormalities, to categorize and to describe the typical open bite patients, this review would cover cephalometric analyses that deal with anterior open bite deformities.

Skeletal pattern

Anteroposterior relationship

Several analyses comparing normal subjects to open bite subjects exhibited no significant difference in the anterior cranial base length as measured from Sella to Nasion (Subtelny and Sakuda, 1964; Nahoum et al., 1972). Subtelny and Sakuda (1964) reported that there was no significant difference in the cranial base angle between the two groups. However, they found that the distance between Sella and Basion was less in the open bite group than the normal group, indicating the shortened posterior cranial base.

Ellis and McNamara (1984) identified the differences in the dental and skeletal components for adults with Class III malocclusion, both with and without open bite. They found no significant intergroup difference in the cranial base angle.

Nanda (1990) found that there was no significant difference in the cranial base angle (NSBa) between the skeletal open bite group and the skeletal deep bite group for males and females.

Hapak (1964) analyzed a group of fifty-two untreated cases with an age range of 10 to 16 years, all of which exhibited a lack of occlusion in the anterior area, the lateral areas, or both. He reported that these open bites occurred with a variety of skeletal patterns. His study showed that the samples had a Class II tendency and proved to be retrognathic on the Down facial diagram. Subtelny and Sakuda (1964) found that the SNA angle and SNB angle were smaller in the open bite subjects than in the normal subjects. The maxilla and

mandible were found to be significantly more retruded relative to the anterior cranial base. The ANB angle was greater in the open bite subjects than in the normal subjects.

However, Lopez-Gavito et al. (1985) suggested that the subjects with open bite, the mandibles were retrognathic with significantly smaller value for the SNB angle and higher values for the SNA and ANB angle than the normal subjects.

Vertical relationship

Subtelny and Sakuda (1964) and Cangialosi (1984) found no significant difference in the angle between the Sella-Nasion plane and the palatal plane (SN-PP) for open bite and normal subjects. Conversely, Nahoum (1971) and Lopez-Gavito et al. (1985) found that the SN-PP angle was significantly less in the open bite subjects than in the normal subjects.

In 1990, Nanda studied skeletal factors associated with the development of the vertical proportion of the skeletal open bite group and the skeletal deep bite group in males and females from the ages of 4 years through 18 years. He found that the palatal plane angle (SN-PP) was smaller in the skeletal open bite group than the skeletal deep bite group throughout development, regardless of sex.

Subtelny and Sakuda (1964), Nahoum (1971), Cangialosi (1984), and Lopez-Gavito et al. (1985) had studied open bite cases agreed that the mandibular plane angle (SN-MP) was consistently larger in the open bite subjects than in the normal subjects. Ellis and McNamara (1984) also found that Class III open bite malocclusion exhibited a larger mandibular plane angle compared to the Class III non open bite malocclusion.

Richardson (1969) stated that the jaw angle (Ar-Go-Me) and joint angle (S-Ar-Go) were also significantly larger in the open bite cases than in the deep overbite cases.

The palatomandibular plane angles in the open bite subjects were significantly greater than that in the normal subjects (Nahoum, 1971; Cangialosi,

1984; Lopez-Gavito et al., 1985). The gonial angles were greater in the open bite subjects than in the normal subjects (Subtelny and Sakuda, 1964; Nahoum, 1971; Cangialosi, 1984). Nanda (1990) concluded that palatomandibular plane angle (PP-MP) in the skeletal open bite group was greater than the skeletal deep bite group and might have been even masked any effects of sexual dimorphism. The magnitude of the gonial angle and the inclination of the mandibular plane were not significantly different in the two extreme vertical dysplasias.

The ramus height in the open bite subjects was shorter than in the normal subjects (Subtelny and Sakuda, 1964) and in the deep bite subjects (Sassouni and Nanda, 1964). This contrasted with the finding of Nanda (1988) that the ramus height did not significantly differ in the open bite and the deep bite subjects.

Facial height and vertical facial proportion

Wylie and Johnson (1952) measured the vertical proportions of face in normal subjects along the Nasion-Menton line employing the anterior nasal spine (ANS), as the separated point of the anterior upper face and the anterior lower face.

The upper and lower facial heights were measured along the Nasion-Gnathion line by Horowitz and Thompson (1964). They found that the male facial heights were generally larger than the female facial heights in the normal untreated postadolescent group. Similarly, Dechkunakorn et al. (1994) had studied the normal Thai adults and he reported that all linear measurements of anterior facial heights and posterior facial heights were significantly greater in the males than the females.

One of the most distinguishing features of the skeletal open bite population was that total anterior facial heights were greater than those of the normal population (Hapak, 1964; Nahoum, 1971; Cangialosi, 1984; Ellis and McNamara, 1984). However, Lopez-Gavito (1985) found that there was no

significant difference in the total anterior facial height between the open bite subjects and the normal subjects.

Most studies showed that the increase in the total anterior facial height occurred primarily in the lower anterior facial height or in the area below the anterior nasal spine (Hapak, 1964; Schudy, 1964; Subtelny and Sakuda, 1964; Nahoum, 1971; Frost et al., 1980; Cangialosi, 1984; Lopez-Gavito, 1985) but not in the upper anterior facial height, which remained normal (Hapak, 1964; Schudy, 1964; Subtelny and Sakuda, 1964; Cangialosi, 1984) or was shorter in the open bite subjects than in the normal subjects (Nahoum, 1971). This indicated that most of the deformity occurred below the level of the palate. However, Lopez-Gavito et al. (1985) found that the total anterior facial height did not show significant differences between the normal group and the open bite group. Their patients with open bite exhibited a significantly reduced upper anterior facial height, while a lower anterior facial height was increased.

Ligthelm-Bakker et al. (1992) suggested that the negative correlation between the average growth rate for the upper and the lower anterior facial heights showed a fast growth rate for the lower anterior facial height, and the result showed a tendency toward an open bite face.

The posterior facial height (S-Go) was usually shorter in the open bite subjects than in the normal subjects (Nahoum et al., 1972; Schendel et al., 1976; Frost et al., 1980; Cangialosi, 1984). Conversely, Lopez-Gavito et al. (1985) found that the posterior facial height was not significantly different between the Class I or Class II division 1 open bite subjects and the normal subjects. In several studies, comparing the open bite subjects to the deep bite subjects exhibited no significant difference in the posterior facial height between the two groups (Nanda, 1988; Ligthelm-Bakker et al., 1992). Ellis and McNamara (1984) reported that persons with Class III open bite had no significant difference in posterior facial height when being compared to persons with Class III non-open bite.

Schudy (1964) suggested that the vertical dimension was the most important dimension for the clinical orthodontists. The vertical dysplasias were

inseparably related to both the open bite and the deep bite subjects. A positive correlation was found between facial height and the SN-MP angle as well as the OP-MP angle in both the open bite and the deep bite subjects.

A correlation between the mandibular plane angle, the anterior facial height and the posterior facial height was described by Van der Beek et al. (1991). From this study of seventy two orthodontically untreated girls, 10 to 14 years of age from the Nijmegen Growth Study, the changes during growth with regard to the mandibular plane angle were more strongly related to the anterior facial height than to the posterior facial height.

Wylie and Johnson (1952) suggested that the ratio of the upper anterior facial height to the total anterior facial height (UAFH/TAFH) was 0.436 and 0.432 for normal adult male and female respectively.

The average upper anterior facial height to lower anterior facial height ratio (UAFH/LAFH) was 0.81 for the normal Thai adults and no sexual differences were found for this ratio (Suchato and Chaiwat, 1984; Dechkunakorn et al., 1994).

Brodie (1953) investigated 19 individuals during the period of life from 8 to 17 years old and found that a number of these patients did not maintain the facial proportions of their initial facial patterns.

Nahoum (1971) found that the ratio of the upper anterior facial height and the lower anterior facial height (UAFH/LAFH) was less in the open bite subjects than in the normal subjects and this ratio was quite constant at all ages. There was no significant difference in the UAFH/LAFH ratio between the males and the females in any of the open bite subjects. In 1972, Nahoum et al. reported that the mean UAFH/LAFH ratio as measured along the N-Me line for the subjects with normal dentition and good face was 0.810. The mean UAFH/LAFH ratio for patients with open bite malocclusion was 0.686 excluding subjects with mandibular prognathism. Subjects with deep overbite had the UAFH/LAFH ratio greater than 0.900. They also suggested that these ratios could be used to indicate the severity of vertical dysplasia and as a guide in predicting the treatment results.

Cangialosi (1984) agreed with the finding of Nahoum (1971) that the UAFH/LAFH ratio was smaller in the open bite group than that in the normal group, and remained relatively constant in both mixed and permanent dentition groups. In addition, the open bite group showed the decrease in the ratio of total posterior to total anterior facial height (TPFH/TAFH).

Dental pattern

Dechkunakorn et al. (1994) showed that there were significant differences between the males and the females for the upper anterior dentoalveolar height (UADH), upper posterior dentoalveolar height (UPDH), lower anterior dentoalveolar height (LADH), and lower posterior dentoalveolar height (LPDH). However, there were no significant sexual differences for the UPDH/UADH ratio and the LPDH/LADH ratio. The average ratios of UPDH/UADH and LPDH/LADH were 0.89 and 0.82, respectively.

Dentoalveolar height in open bite malocclusion has been thoroughly investigated. Hapak (1964) found that the alveolar height in the lower incisor was positively correlated with the Frankfort-Mandibular plane angle in the open bite cases. Isaacson et al. (1971) revealed that the backward-rotating high mandibular plane angle case had a tendency toward open bite in spite of the fact that the maxillary incisors were already markedly longer than the average or low mandibular plane angle cases.

Sassouni and Nanda (1964) reported that the anterior dentoalveolar height was greater in the persons with open bite, at both the upper and lower incisor levels than in the persons with deep bite. Conversely, Subtelny and Sakuda (1964), and Nahoum et al. (1972) found that in the open bite cases, the excessive eruption of the anterior dentoalveolar segments were not found in either the maxillary incisor or the mandibular incisor regions. However, Lopez-Gavito et al. (1985) concluded that the anterior dentoalveolar height in the maxillary incisor region was increased with dentoalveolar hyperplasia in the open bite subjects, but that in the mandibular incisor region was similar in both normal and open bite subjects. From these findings, it was deduced that the

undereruption of the incisors vertically was not a primary factor in the open bite. In addition, Lopez-Gavito et al. (1985) noted that the maxillary and mandibular incisors were more proclined in the open bite subjects than in the normal subjects, thus the interincisal angle was acute in the open bite subjects.

Schendel et al. (1976) found that the anterior maxillary and anterior mandibular dental heights were greater in the long-faced subjects with open bite than in the normal subjects. In 1984, Fields et al. noted that there was a tendency toward excessive eruption of all teeth in long-faced adults, but there were no statistically significant differences between the normal and the long-faced adults.

An increase in maxillary posterior dentoalveolar height was another commonly cited causal factor in the open bite cases (Subtelny and Sakuda, 1964; Sassouni and Nanda, 1964; Sassouni, 1969; Lopez-Gavito et al., 1985). Isaacson et al. (1971) noted that the amount of posterior alveolar maxillary development increased as the mandibular plane angle (MP-SN) increased in the high angle cases. However, Nahoum et al. (1972) did not find any significant difference in the posterior maxillary dentoalveolar heights of the open bite and normal samples.

Another factor that could contribute to an open bite was the overeruption of the mandibular molar teeth which could cause a clockwise rotation of the mandible. However, Subtelny and Sakuda (1964), as well as Lopez-Gavito et al. (1985) noted that there were no significant differences in either incisor or molar mandibular dentoalveolar heights between the open bite samples and the control samples. Sassouni and Nanda (1964) and Nahoum et al. (1972) noted a decrease in distance between the mandibular molar and the mandibular plane in the open bite subjects.

In 1970, Richardson suggested that a lack of vertical growth of dentoalveolar structures was also a cause of open bite. He believed that the delayed growth of the upper face would correct itself with the passage of time, but the vertical development of the dentoalveolar structure would never catch

up. Therefore, it seemed that anterior open bite might be attributed to both skeletal and dentoalveolar discrepancies. If the teeth and the alveolar bones compensated in any way for the variation in the vertical skeletal relationship, it was rather by passive eruption than by active eruption, so that the heights of the basal parts of the maxilla and mandible were large in open bite but relatively small in deep overbite.

Ellis and McNamara (1984) concluded that there were posterior maxillary and mandibular dentoalveolar hyperplasias and anterior maxillary dentoalveolar hyperplasia in Class III open bite.

Janson, Metaxas and Woodside (1994) studied in the subjects of 12 years of age which were classified into excessive, normal and short lower anterior facial height, using the upper anterior facial height to lower anterior facial height ratio (UAFH/LAFH). The results showed that the anterior and posterior dentoalveolar heights were significantly greater in excessive LAFH cases than in the normal LAFH cases. The maxillary and mandibular molar and incisor dentoalveolar heights were inversely correlated with the UAFH/LAFH ratio. The maxillary teeth had a higher correlation with the UAFH/LAFH ratio than the mandibular teeth.

Soft tissue pattern

In the study of Schendel (1976), lip measurements were compared to the Burstone norms (1967). There was no difference in the upper lip length between norms and both of the vertical maxillary excess groups (open bite and non-open bite groups). The length of the exposed portion of maxillary teeth, however, was greater in both the vertical maxillary excess groups.

Blanchette et al. (1996) studied the longitudinal growth and development of the soft tissue drape for boys and girls with long and short vertical patterns from 7 to 17 years of age. The subjects were selected on the basis of their percentage of lower anterior vertical facial height. They reported that the male and female subjects with long vertical patterns had longer upper lips than those

with short vertical patterns. The male long vertical pattern group showed a particularly long upper lip when being compared with the other groups.

Anterior open bite is recognized as an exceedingly complicated malocclusion. This kind of dental deformity appears in conjunction with various craniofacial malformations, which may appear singly or in combination.