

The Vertical Dimension – An Orthodontist Perspective

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ABSTRACT: Deepbite and open bite presents an orthodontist with challenge in any of its much form. Diagnosis, treatment planning and appropriate mechanics form a backbone of successful orthodontic treatment of these kinds of vertical problems. Patients with this kind of malocclusion can be diagnosed clinically and cephalometrically, however, diagnosis should be viewed in the context of the skeletal and dental structure. Vertical growth is the last dimension to be completed, therefore treatment may appear to be successful one point and fail later. Some treatment may be prolonged if begun early. This article reviews diagnosis, control of vertical dimension which aims at striking a balance between the soft- tissues and the dento - alveolar and skeletal structures. So far various techniques have been tried both successfully and unsuccessfully, both surgically and orthodontically (Even a combination of both).

KEYWORDS: Vertical dimension, Deepbite, Openbite.

INTRODUCTION

Vertical dysplasias often are among the most difficult dentofacial problems to treat. It seems obvious that inherited facial proportions and habits, functional adaptations and other environment factors may contribute to the etiology. Vertical problems arise in the end from a discrepancy between mandibular ramus growth and tooth eruption. The amount of tooth eruption must be coordinated with ramus growth is determined by the orientation of the jaws. During the examination of vertical dysplasia case three major questions must be considered: 1) What determines the orientation of the jaws? 2) What controls the amount of tooth eruption? and 3) How do these factors interact?.

INFLUENCES ON JAW ORIENTATION : Bjork's implant studies show that rotation of the maxilla occurs during growth and although the internal rotation of the maxillary core usually is concealed by surface remodeling that maintains the orientation of the palatal plane, this rotation does not always occur in patients with vertical dysplasias [1]. If the maxilla is rotated down posteriorly, or up anteriorly ,the amount of space for eruption of posterior teeth is reduced , space for eruption of anterior teeth increases and there is a tendency toward anterior open bite. Another influence on jaw orientation is the length of the ramus. The shorter the ramus, the smaller the space available for eruption of posterior teeth and the greater the chance that the mandible will rotate downward and backward. The longer the ramus, the greater the chance of mandibular rotation in the other direction.

INFLUENCES ON TOOTH ERUPTION : Based on the observations at frequent intervals , showed that active eruption occurred during the early evening but not during the day and was facilitated by having the child resting and quiet during the evening through initial video microscope studies [2]-[3].

A flexible fiber optic cable to bring the image of the rulings to the video microscope has allowed continuous observation of an erupting premolar for 12-hour periods [4]. These studies confirm that essentially all net eruptions occurs during a few critical hours in the evening, usually from about 8 pm until midnight [4]. This period of active eruption is remarkably similar to the time of major release of human growth hormone which suggests that adequate HGH levels may be necessary for eruption.

The path of eruption of the maxillary teeth is downward and somewhat forward. In normal growth the maxilla usually rotates a few degrees forward but frequently rotates slightly backward. The eruption path of mandibular teeth is upward and somewhat forward. When excessive rotation occurs in the short face type of development, the incisors tend to be carried into an overlapping position even if they erupt very little; hence the tendencies for deep bite malocclusion in short face individuals. In the long face growth pattern, an anterior open bite will develop as anterior face height increases unless the incisors erupt for an extreme distance.

CHARACTERISTICS OF VERTICAL DYSPLASIA: The most common types of vertical dyasplasia generally are referred to as hyperdivergent and hypodivergent. Sassouni [5], Schudy [6] have described the former type of dysplasia as long face syndrome. Opedebeeck [7] referred to the later as Short face syndrome.

- i. *Dimensional Deviations:* The total anterior facial height is relatively large in persons with open bite faces when compared to the average according to the investigations done by Hellan [8], Johnson [9]. The morphological basis of an open bite is associated with a large gonial angle, lack of compensating curve of spee, large vertical posterior maxillary dimension, anteroposterior rotation of maxilla and midcranial fossa and long mandibular corpus [10]. In the deepbite subjects (Fig.1) the deviations essentially are opposite to the openbite subjects (Fig.2).

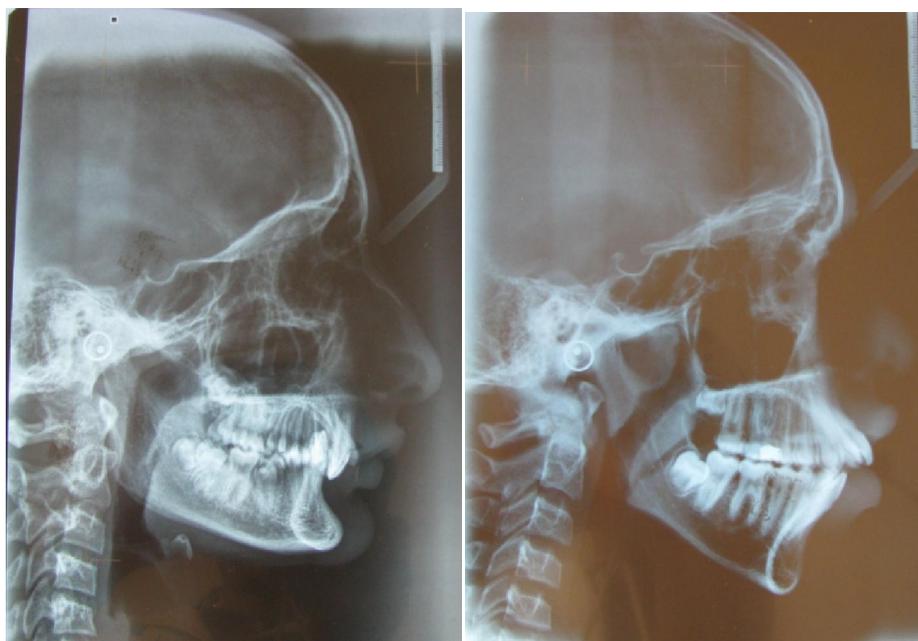


Fig. 1

Fig. 2

Many investigators have confirmed that there is a strong influence of lower anterior facial height on the formation of vertical facial proportions [11]-[13]. Open bite subjects are characterized by larger lower vertical facial heights in comparison with deepbite subjects.

- ii. *Positional deviations:* The four basic horizontal planes (palatal plane, mandibular plane, occlusal plane, anterior cranial base) tend to be steeper and more divergent in persons with large lower face height than in deepbite subjects whose facial planes are more parallel [14].

Several investigators have noted that the posterior half of the palate tends to be tipped downward in persons with open bite [10]. Carrying the molars downwards with posterior teeth acting as a fulcrum, there is a concomitant backward rotation of the mandible and consequently lower anterior face height and palatomandibular angle increase.

Several investigators have confirmed that the increase angle of the mandibular plane commonly found in persons with long faces is associated with a backward rotational growth pattern that can affect the vertical proportions of the anterior component of the face [15].

- iii. *Soft tissue characteristics:* A large interlabial gap is almost evident on clinical examination of a skeletal open bite patient (Fig.3) [16].



Fig.3

The lips are incompetent at rest and when the lips are closed, the mentalis muscle is strained and displaced to the level of the alveolar bone, giving the patient a chinless appearance. The distance between the posterior border of the palate and gonion is extremely small and the tongue and soft palate are crowded within a narrow pharyngeal space. Tongue position and incompetent lips leading to mandibular rotation and a high and narrow palatal vault leading to maxillary lingual crossbite.

- iv. *Breathing behavior and posture:* Ricketts [17] used the term “respiratory obstruction syndrome” to describe the constellation of features seen in mouth breathers. Quinn has assigned nasal airway obstruction as the major cause of mandibular prognathism, facial asymmetries and vertical dysplasias [18]. Mouthbreathing may cause habitual mouth agape posture; this is the proximate cause of the condition known as long face syndrome. Posterior crossbite occurs because the tongue is lowered, leaving the contracting effect of the buccinator muscles unopposed. Vertical posterior alveolar growth and dental eruption are enhanced because the forces restraining these changes are diminished because of jaw agape posture. Reduced facial height has been reported in patients who wore Milwaukee braces with chin rests for spinal scoliosis [19]. The weight of the head was expressed between the dental arches, simulating overactive elevators of the mandible.

DIAGNOSIS OF OPENBITE AND DEEBITE PROBLEMS: The Openbite Depth Indicator and Anteroposterior Dysplasia Index (APDI) are cephalometric measurements that serve as the “gold standard” for assessment of certain problems that are clinically significant [20]-[21].

The Overbite depth indicator (ODI) is an excellent guide to vertical problems that unfortunately cannot be modified significantly by routine orthodontic treatment. The ODI is determined by measuring the angle formed by the A-B plane and the mandibular plane, relating the anterior limits of the maxilla and mandible to the mandibular plane. Second, the relationship between the palatal plane and Frankfort horizontal plane is considered. If the palatal plane slopes anteriorly the difference is added to the AB/MP angle; conversely if the palatal plane slopes down posteriorly the difference between the palatal plane and FH is subtracted from the AB/MP angle. No change in the AB/MP angle is required if the palatal plane and FH are parallel.

An ODI of 65 degree or below strongly warns of the potential for an openbite to develop. A low ODI also indicates that teeth will move rapidly within the alveolar process: therefore, extra care must be taken not to lose anchorage in an extraction case. A high ODI of 80 degree or above indicates a deepbite skeletal pattern. Extraction of permanent teeth should be avoided, if possible because of the strong potential for deepbite relapse.

APDI is determined by measuring the angle formed by the AB Plane to the palatal plane, relating the anterior limits of the bony bases to the palatal plane and reflecting the horizontal discrepancies of a malocclusion. A class I skeletal pattern with an APDI of 81 indicates that the maxilla and mandible are in balance. An APDI of 75% or less indicates a Class II skeletal pattern, whereas a score of 90 degree or more indicates a Class III skeletal pattern.

Combination Factor (CF) is simply the ODI and APDI added together. This value gives an indication of the skeletal volume that is available to hold the dentition indicating the potential to treat with or without extractions. A CF of 151 degrees or below indicates that extraction of some teeth is probable. A low CF of 145 degrees indicates that the anterior teeth cannot be shifted back into insufficient vertical space. A CF of 155 degree and above indicates skeletal pattern that has the potential to accommodate all of the teeth. A CF of 165 degrees indicates good skeletal volume that will allow movement of the dentition.

CONTROL OF VERTICAL DIMENSION:

- i. Long face / Open bite: Unfortunately, vertical facial growth continues through adolescence and into the post adolescent year which means that even if growth can be modified successfully in the mixed dentition, active retention is likely to be necessary for a number of years. Several approaches to the long face pattern of growth in preadolescent children. They are :

High pull headgear to the molars: One approach to vertical excess problems is to maintain the vertical position of the maxilla and inhibit eruption of the maxillary posterior teeth. The appliance has to be worn for 14 hours a day with a force greater than 12 ounces per side. Lower molar eruption may contribute to the vertical facial change and outstrip changes made by controlling the upper molar with the headgear.

High pull headgear to a maxillary splint: This allows vertical force to be directed against all the maxillary teeth not just the molars and appears to have a substantial maxillary dental and skeletal effect with good vertical control. An appliance of this type would be most useful in a child with excessive vertical dimension of the entire maxillary arch and too much exposure of the maxillary incisors from beneath the lip.

Functional appliance with bite blocks: A more effective alternative is the use of a functional appliance that includes posterior bite blocks, with this appliance is to inhibit eruption of posterior teeth and vertical descent of the maxilla. The appliance can be designed with or without positioning the mandible anteriorly. This type of functional appliance is effective in controlling maxillary vertical skeletal and dental growth [22].

High pull headgear to a Functional Appliance with bite blocks: The most suitable approach to maxillary vertical excess and Class II is a combination of high pull headgear and a functional appliance with posterior bite blocks to anteriorly reposition the mandible and control eruption.

- ii. Short Face / Deep bite: the challenge in correcting these problems is to increase eruption of posterior teeth and influence the mandible to rotate downward without decreasing chin prominence too much. In these circumstances, it can be corrected taking advantage of cervical headgear with an extrusive tendency of extra oral force directed below the centre

of resistance of the teeth and the maxilla. This effect and eruption of the lower molar can be accomplished using a headgear and a biteplate to open the bite, a method used in the Florida prospective clinical trial [23].

CONCLUSION

Vertical Dysplasias to some extent are the result of growth that was programmed in that direction, but their expression is influenced by form-function interactions. The orthodontic clinician must make a careful differential diagnosis for each patient who seeks his or her care. The diagnosis must analyze all three components of malocclusion- facial, dental and skeletal. Each component must be carefully studied and understood so that the proper questions are asked and the correct diagnostic decisions are made to lead to an effective treatment plan.

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