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VERTICAL DISCREPANCIES IN ORTHODONTICS

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Abstract:
Vertical discrepancies, encompassing variations in the vertical dimensions of the face and jaws, present a significant challenge in orthodontic diagnosis and treatment. This review explores the etiology, diagnosis, and management of vertical discrepancies in orthodontics. The causes of vertical discrepancies are multifactorial, involving genetic predispositions, environmental factors, and functional habits that influence craniofacial growth. Accurate diagnosis is critical and typically involves a combination of clinical examination, cephalometric analysis, and three-dimensional imaging techniques. Various treatment modalities are discussed, including growth modification in younger patients, orthodontic camouflage, and surgical interventions in severe cases. The review highlights the importance of individualized treatment planning to address the unique needs of each patient. Additionally, it underscores the role of interdisciplinary collaboration in managing complex vertical discrepancies, particularly in cases requiring orthognathic surgery. Advances in technology, such as digital modeling and computer-assisted surgical planning, are also examined for their contributions to enhancing treatment outcomes. The article concludes by emphasizing the need for ongoing research to develop innovative approaches for the effective management of vertical discrepancies. By understanding and addressing vertical discrepancies, orthodontists can improve functional and aesthetic outcomes for patients, thereby enhancing their quality of life.

Keywords:

1. Vertical discrepancies
2. Orthodontics
3. Cephalometric analysis
4. Treatment planning
5. Orthognathic surgery

INTRODUCTION:

A malocclusion created due to a vertical discrepancy is of great interest in the field of orthodontics, because of its etiology, treatment planning and tendency to relapse in the post treatment period. An experienced orthodontist can possibly face a malocclusion with an anteroposterior discrepancy without doubt but a malocclusion with vertical discrepancy must be faced with caution, weighing the options for treatment. The two kinds of malocclusions present in a case of vertical discrepancy are- Openbite and Deep Bite or Deep Overbite.

According to Thomas Rakosi[(1)], there are various factors, which give importance to a malocclusion with a vertical discrepancy. While treating a case of Open bite or Deep bite, it is not only the vertical dimensions that need to be addressed, but also the sagittal relationship, i.e., anteroposteriorly, if it is a Class I, Class II, or Class III malocclusion. The direction & amount of growth completed, and growth expected in the patient during the course of the treatment and in the post-treatment period is to be considered as well.

The vertical dimension is unique in that the growth rate is highest and lasts the longest in this direction. Since growth tends to increase the vertical distance between the maxillary and mandibular jaw bases, performing treatment during this period is most advantageous, as stated by Rakosi [(1).]

However, he also states that vertical dimension is not stable. Even in adults who have never had any orthodontic treatment, significant changes can occur in the vertical dimension. Abrasion or loss of teeth can close down the vertical dimension leading to a deep bite. Tooth elongation or overeruption also can occur, increasing the vertical dimension and opening the bite. The stability of tooth position depends on the eruption or elongation tendency of the teeth and on the opposing forces. If the occlusal forces are altered, the equilibrium is disturbed and the teeth migrate in the direction of the occlusal plane.

Late growth of the mandible may increase an already existing increase in vertical dimension, accentuating the malocclusion thus occurring due to the discrepancy.

This work will reveal the review of literature the classification, diagnosis and management of the vertical discrepancies in Orthodontics.

CLASSIFICATION OF VERTICAL DISCREPENCY IN ORTHODONTICS :

1.CLASSIFICATION OF INCISOR RELATIONSHIPS IN THE VERTICAL DIMENSION.

Ballard and Wayman first gave a classification of the incisor occlusion in 1964[(3)], which in turn was based on the work of Backlund[(4).] With the help of lateral skull radiographs, in the Caucasian population, Backlund studied the relation between the part of the lingual surface of the upper incisors on which the lower incisors occluded. As a result, he divided the palatal or lingual surface of the upper incisors into three equal parts. Brook and Shaw [(5)] gave the British Standard Institute Classification of Malocclusion, considering incisor occlusion. This classification is considered superior to Angle's classification because the posterior teeth did not influence the occlusion on the incisors.
The BSI-classification is as follows:

Class I: the lower incisor edge precludes with or lies immediately below the cingulum plateau of the upper central incisors.

Class II: the lower edges lie cervical to the cingulum plateau (middle part Class II has two subdivisions:

Div 1: there is an increase in overjet and the upper central incisors are usually proclined.
Div 2: the upper central incisors are retroclined. The overjet is usually minimal, but may be increased.

Class III: the lower incisor edges lie coronal to the cingulum plateau of the upper incisors

II. CLASSIFICATION OF DEEP OVERBITE (DEEP BITE):

Developmental deep bite and Acquired deep bite. [(1)]

- Developmental deep bite, also known as Genetically

determined deep overbites is further classified as: 1. Skeletal deep overbite.

There is a horizontal growth pattern observed in cases of skeletal deep bite.
E.g. Class II Div1 malocclusion.

2. Dentoalveolar deep bite.
A dental deep bite is caused by supraocclusion of the incisors. In such cases, the interocclusal clearance is usually small. i.e., the overbite is functionally a pseudo over-bite.

- Acquired deepbite maybe caused by the following factors: 1.A lateral tongue thrust or the posture of the tongue.

This produces an infraocclusion of the posterior teeth, in turn leading to a deep overbite.Eg. Class II div 2 malocclusion.

2. Premature loss of deciduous molars or early loss of permanent posterior teeth, causing an acquired secondary deep overbite.
3. The wearing away of the occlusal surface or tooth abrasion can produce an acquired, secondary deep overbite.

II. CLASSIFICATION OF OPEN BITE

The classification of an open bite is based on the etiology of the malocclusion.

Thomas Rakosi[(1)], states two kinds of factors which are concerned with the etiology of an open bite. They are:

1. Epigenetic factors.
These are factors which are related to an underlying

cause. These include- posture of the tongue, morphology and size of the tongue, skeletal growth pattern of the maxilla and mandible, particularly the mandible and the vertical relationship of the jaw bases.

2. Environmental factors
These include- improper respiration, abnormal function,

etc. Rakosi's study showed that most children have an abnormal functional pattern or potentially deforming habit during the growth phase.Tongue dysfunction, disturbed or occluded nasal respiration can cause a change in the posture or function of both the tongue and the mandible, which can lead to an open bite. Andrew Richardson[(8)], proposed an etiology- related classification:

1. Transitional open bite.
2. Open bite, due to habits.
3. Open bite, due to the presence of :

- Local pathology.
- Skeletal pathology.

4. Non-pathological or skeletal open bite.

   a) Skeletal (ab initio)open bite

   - Open bite that is improving.
   - Open bite, which is deteriorating.
   - Improving but later deteriorating type of open

     bite.
     b) Skeletal (de novo) open bite

5. Open bite, due to the morphology and behavior of the tongue and lips.

I. Transitional Open bite

They occur when the permanent incisor teeth are erupting, and are due to incomplete growth of the dento- alveolar areas. Spontaneous correction is brought about by the continued dento-alveolar development.

II. Open bite, due to habits. (DIGIT SUCKING,TONGUE THRUST)

This type of open bite is a continuation and accentuation of the transitional open bite, where the eruption of the incisor teeth is impeded by the digit. When a thumb or finger is placed between the anterior teeth, the mandible has to be positioned downward to accommodate it. (fig-6) The interposed thumb, or digit directly hinders with incisor eruption. At the same time, the separation of the jaw alters the vertical dimension on the posterior teeth, and as a result, there is more eruption of posterior teeth. Due to the geometry of the jaws, 1mm of elongation posteriorly opens the bite about 2mm anteriorly, a powerful contributor to the development of anterior open bite. The effect is limited to the dento- alveolar processes.

III. Open bite, due to the presence of ϖLocal Pathology.

Supernumerary teeth , cysts, and dilacerations may obstruct eruption of incisors. Spontaneous correction is brought about by the continued dento-alveolar development

Skeletal Pathological Open bite.
Conditions such as cleft palate, which are recognizable

at an early stage, and other conditions which become apparent towards the end of the growth period, such as condylar hyperplasia and acromegaly.

Correction of the open bite can be achieved by gentle traction with conventional appliances. But often in the case of a skeletal pathology, the alveolar process may be a little deficient.

IV. Non pathological skeletal open bites

a. Skeletal (ab initio)open bite.
It is termed as ‘ab initio’ as it can be recognized very

early. This group consists of children in the pre-pubertal stage. Spontaneous correction is brought about by the continued dento-alveolar development. In the pre-pubertal and pubertal periods, closure of the open bite is brought about by dento-alveolar growth compensating for increased vertical facial growth present in a case of open bite, but in the post- pubertal period closure is most frequently brought about by increasing mandibular prognathism with forward rotation of

the mandible. When there is a spontaneous closure of the open bite in the pubertal stage of growth, it can be termed as an improving skeletal open bite. This might reassert itself in the post-pubertal stage due to an interplay between vertical facial growth and the simultaneous compensating dento-alveolar growth. This can be termed as a deteriorating skeletal open bite. In the pubertal stage, active dento-alveolar growth is sufficient to close the open bite but in the post-pubertal stage, continuing skeletal growth dominates, leading to an open bite at the end of the post-pubertal period. This is termed as an improving but later deteriorating open bite.

b. Skeletal (de novo).
It is termed as 'de novo' as they arise for the 1st time

about the middle of the pubertal stage and not in the beginning. Due to its late appearance, it presents as a difficult clinical orthodontic malocclusion.

V. Soft tissue abnormalities.
Open bite, due to the morphology and behavior of the tongue and lips.

It is commonly associated with abnormal tongue function, like in the case of a tongue thrust habit. When there is an anterior open bite, as often occurs from sucking habits, it is difficult to seal off the front of the mouth during swallowing to prevent food or liquids from escaping. Therefore, a tongue thrust swallow is a useful adaptation in a case of open bite, which is why an individual with an open bite also has a tongue thrust swallow, Profitt[(2)]. After a sucking habit stops, the anterior open bite tends to close spontaneously, but the position of the tongue between the anterior teeth persists for a while as the open bite closes. Until the open bite disappears, an anterior seal by the tongue tip remains necessary. However, more than one factor may operate in a patient. When a vertical discrepancy is combined with an anteroposterior discrepancy, there are 4 kinds of facial types described by Sassouni[(9)]:

1. Skeletal Class II open bite. 2. Skeletal Class II deep bite. 3. Skeletal Class III open bite. 4. Skeletal Class III deep bite.

TREATMENT PLANNING[1]

Problem-specific therapeutic measures can be taken,

depending on the skeletal or dentoalveolar nature of the deep overbite. (Fig-28)

- In skeletal problems, therapy should be directed toward enhancement of the divergent rotation of the jaw bases, using whatever appliances (fixed or removable) are available.

- In dentoalveolar problems, intrusion and labial inclination of the incisors are desirable, as are extrusion of the posterior segment teeth and leveling of the occlusal plane to reduce the curve of Spee.

TREATMENT OF DEEP OVERBITE DURING GROWTH

An important consideration is whether therapy should be performed during or after the growth period. During the growth period, tooth eruption can be stimulated in the posterior segments and inhibited in the anterior segments. The vertical growth component in the condylar and sutural areas also is amenable to favorable therapeutic influence.

Extrusion of the molars and premolars also implies a skeletal growth stimulus with vertical rotation of the mandible, rocking the mandible down and back. Such a maneuver, of course, can accentuate the sagittal discrepancy in a Class II malocclusion, increasing the angle of facial convexity. In the growing individual, growth stimulation is a valid treatment objective with functional appliances. In the true deep bite problem, with a large interocclusal clearance, lateral tongue posture and function, and infraocclusion of posterior teeth, functional appliances are valid tools.

In all other types of deep overbite, after the possibility of growth stimulation is gone, fixed or removable mechanical appliances are needed to achieve the optimal treatment response. Causal treatment is possible in the dentoalveolar type of problem through intrusion of the incisors and leveling of the curve of Spee. However, the skeletal discrepancy can be compensated for only by dentoalveolar orthodontic surgical methods.

TREATMENT OF SKELETAL DEEP OVERBITE

The treatment of a skeletal deep overbite requires consideration of the sagittal dimension.

Most skeletal deep overbites are combined with Class II sagittal intercuspation. The treatment of a deep overbite combined with a Class II sagittal malrelationship can be handled with several therapeutic approaches.

- • Growth inhibition of the upper jaw and growth promotion in the lower jaw combined with dentoalveolar changes should result in the improvement of a deep overbite.
- • Treatment can be performed using a headgear in combination with an activator.

Treatment may proceed as follows:
1. Distalization and elongation of the upper first

permanent molars is the first step.
A properly trimmed activator can then guide the eruption of the teeth in the posterior segments.

2. The unfavorable inclination of the jaw bases should be opened if possible in convergent growth rotation patterns. This can be achieved atleast partly with an activator of special design or by the use of extraoral force.
3. Dentoalveolar compensation for a deep overbite is required, especially in skeletal deep overbite treated after the growth period is completed. This compensation can be achieved by extrusion and distalization of the maxillary molars, sometimes aided by second molar extraction. Intrusion and labial tipping of the lower incisors with leveling of the curve

of Spee further benefit the dentoalveolar compensation.

Graber [(34)] states that controlling vertical dimension in borderline patients is one of the most important aspects of good treatment. Richard I. Levin [(15)] stated many biomechanical systems currently used to correct deep bite during orthodontic treatment.

The system of choice depends on the objectives of treatment: Incisor intrusion Incisor protrusion, and Molar eruption, or extrusion.

Incisor intrusion particularly of maxillary incisors is generally perceived to be the major biomechanical problem. Incisor intrusion can convincingly be demonstrated using fixed or removable appliances (Begg, 1965; Booy, 1966; Sims, 1971; Burstone, 1977; Ten Hoove et al., 1977; van Beek, 1985; Thompson, 1985; Dermaut and Vanden Bulcke, 1986; Levin, 1987). Molar extrusion or eruption induced by removable appliances, cervical headgear or intra oral elastics is an established clinical procedure. Molar extrusion resulting in a backward mandibular rotation(Williams, 1965; Bijlstra, 1970) and opening

of the bite is generally considered to be contra-indicated although recovery can be anticipated (Williams, 1965; Levin,1977; Van der Linden, 1988). Most investigations and clinical reports have considered initial bite opening procedures and have not addressed the implications of rotational mandibular growth as described by Björk (1969), and Björk and Skieller (1972). Due to vertical condylar growth in forward mandibular growth rotation, the mandible rotates around a fulcrum in the incisor or premolar region.

In response to this growth, compensatory differential eruption takes place with molars erupting more than incisors. Differential tooth eruption associated with mandibular growth, and the influence of treatment on this growth and eruption would seem to be an important consideration when assessing the factors involved in the treatment of deep bite.

INTRUSION ARCHES

The correction of a deep overbite can be accomplished in a number of ways, depending on the initial diagnosis and treatment objectives. A Combination of extrusion of posterior teeth with intrusion of anterior teeth can be considered. Intrusive mechanics include good control of the vertical dimension and forward rotation of the mandible.

1. K-SIR (Kalra-Simultaneous intrusion and retraction)
It has been named after its founder, Dr.Varun Kalra.

In the traditional method of retraction and intrusion, first the canines are pulled back and once these are done, the incisors are retracted. In Kalra's technique, the entire segment-incisors and the canines are pulled back simultaneously. The treatment time is reduced from as long as the traditional 18 months to as less as eight months. It is both time saving and aesthetically sound.

2. Connecticut intrusion arch [(57)]

This arch was developed by Nanda. Correction of deep overbite in conjunction with a Class II molar relationship may be accomplished by anterior intrusion, posterior extrusion, or a combination of both. The decision must be based on the ideal incisor position, considering lip-to-tooth relationships and the lower vertical dimension.

Although numerous methods have been described for incisor intrusion, Begg, Ricketts, and Burstone employ the same basic principle: tipback bends at the molars to provide an intrusive force at the incisors. The wire materials used for

intrusion in these techniques are diverse, but all recognize the need for a light, continuous force.

The intrusion arch, as described by Burstone[60] , is significantly different in its force delivery because it is not engaged in the incisor brackets. Properly designed and employed, an intrusion arch will tip the molars back while simultaneously intruding the incisors. A single design can correct multiple problems with no wire changes and minimal appliance adjustments.

4. Burstone's segmented arch.[60]
The technique, known as the segmented arch, used

different cross sections of wire within the same arch and wires that did not run continuously from one bracket to the adjacent bracket. Segmented arch procedures have a number of advantages in space closure in extraction cases and in producing tooth alignment with minimum side effects.5 In particular, segmentation allows for the genuine intrusive movement of the anterior teeth. One of the limitations of traditional continuous arch therapy has been its inability to produce genuine intrusion.

The basic mechanism for intrusion consists of three parts: (1) a posterior anchorage unit, (2) an anterior segment, and (3) an intrusive arch spring.

5. Mushroom Loop Archwire.
This was also introduced by Nanda.
Anchorage control is one of the major treatment goals

in patients with class II malocclusions undergoing premolar extractions. It is conventionally accomplished by increasing the number of teeth in the anchor segment, headgear, intermaxillary elastics and temporary anchorage devices. Retraction of canines by sliding mechanics is often associated with deepening of the overbite, distal tipping of the canine, and friction, which may result in anchorage loss. In last few years we have developed the concept of 'Smart" orthodontic wires. These wires have predetermined bends or and/or activations to deliver predictable orthodontic forces. One of the simplest methods used to simultaneously reinforce the anchorage and prevent the side effects often associated with the sliding retraction mechanics is the Connecticut Intrusion Arch(CIA)

ORTHOGNATHIC SURGERY

Short face problems in contrast to open bite, are treated most predictably and successfully by mandibular ramus surgery that allows the mandible to move downward only at the chin, increasing the mandibular plane angle by shortening

the ramus and opening the gonial angle further, than by rotating at the condyle. When vertical positions of the jaws are changed, it is often necessary to alter the anteroposterior relations as well.

CONCLUSION

The problem of a vertical discrepancy is multifactorial. Diagnosis is the key to the correct management of the dental and skeletal structures. Timely intervention improves the success of treating this malocclusion. On the basis of present results, and according to the methodology used to evaluate the success and stability of various management protocols, therapy for a malocclusion in the vertical dimension can be advocated. The source of the difficulty must be analyzed. In orthodontics, although the patient might feel that treatment is complete when the appliances are removed, the most important stage of retention lies ahead. Orthodontic control of tooth movement and tooth positions alongwith the occlusal relationship in a vertically challenged case poses an interesting yet confusing disciple of treatment of malocclusion.

Pattern, variability and timing of growth is an important concept. Malocclusion is a developmental condition. In most cases, malocclusion and dentofacial deformity are caused due to some amount of distortion in normal development. These problems result from a complex interaction among multiple factors that influence growth and development.

In diagnosing a malocclusion in the vertical dimension, it is important not to concentrate on one aspect of the patient’s overall condition to an extent that other significant features may be overlooked. Orthodontic malocclusions are almost always the culmination of a developmental process and not of a pathologic process. Classification has traditionally been an important tool in the diagnosis-treatment planning procedure. Early orthodontic treatment remains the ‘gold standard’ for contemporary care.

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