Apertognathia- A review

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Abstract
An anterior open bite is considered to be one of the most dentofacial deformities to treat in orthodontics. The complexity of this malocclusion is attributed to a combination of skeletal, dentoalveolar, functional and habit related factors. There is common agreement amongst orthodontists that patients with anterior open bites are difficult to treat and relapse is common after treatment with orthodontics alone or with orthognathic surgery.

Keywords: Open bite, Bimax, Protrusion.

Introduction
Caravelli (1842) was the first to introduce the term "open bite" as a separate class of dentofacial deformity.[1] Kim (1974) introduced the overbite depth indicator (ODI) evaluated the nature and skeletal pattern of open bite with the help of ODI analysis and concluded that the incidence of open bite is greatest when the ODI value is below the mean 74.5.[2] The clinical definition of open bite, diagnostic criteria, appraisal of etiologic factors and treatment of open bite was given by Subtelny and Sakuda (1964).[3] An anterior open bite has been defined by various authors;

According to Graber It is defined as a condition where a space exists between the occlusal or incisal surfaces of maxillary and mandibular teeth in the buccal or anterior segments when the mandible is brought into habitual or centric occlusion.[4] According to Moyers, It is defined as the absence of incisal overlap, and/or the absence of an occlusal stop or contact. True open-bite can occur with Class I, Class II division 1, and Class III malocclusions.[5] Subtelney and Sakuda states that an open bite exists when there is an open vertical dimension between the incisal edges of the maxillary and mandibular anterior teeth although loss of vertical dental contact can occur between the anterior or the buccal segment.[6] According to Chase Defined open bite as a condition characterized by space discrepancies between the occlusal and incisal surfaces of the maxillary and mandibular teeth when the mandible is brought into habitual or centric occlusion.[7]

In the Glossary of Orthodontic Terms, an open bite is a developmental or acquired malocclusion whereby no vertical overlap exists between maxillary and mandibular anterior or posterior teeth.[8]

Incidence: The incidence of anterior open bite varies among races and with dental age. In African Americans incidence is reported to be 6.6%, than in Caucasians it is reported 2.9% and Hispanics 2.1% incidence was reported. Chronologically, as children develop dentally, anterior open bite incidence decreases, because it tends to self-correct through the mixed dentition phase.[9]

Classification: Moyers classified open bite as:

1. Simple or Dentoalveolar and
2. Complex or Skeletal.

Simple Open Bite: When the basal skeleton is normal and the open bite is confined to the teeth and an alveolar process, the condition is called a simple open bite.

Simple open bite can be subdivided into anterior and posterior according to the location.

Anterior simple open bite (Fig. 1): It usually results from digital sucking or abnormal tongue behavior. It is more common in children than adolescents, because by adolescence many simple tongue thrusts are lost. By adolescence, too, some vertical effects on the facial skeleton must have occurred and what was an earlier simple anterior open bite becomes more complex.

Posterior simple open bite (Fig. 2): It is rarer than simple anterior open bite and frequently is the result of a lateral spreading of the tongue at rest. The abnormal tongue posture usually begins when it is necessary to secure a posterior seal during the swallow because ankylosed primary molars are present or their early loss creates a vertical open space. The persistence of the spreading tongue posture impedes eruption and full vertical development of succedaneous permanent teeth. This condition is sometimes confused with "idiopathic failure to erupt." Maxillary apical base insufficiency also may necessitate an abnormal posterior spreading of the tongue.

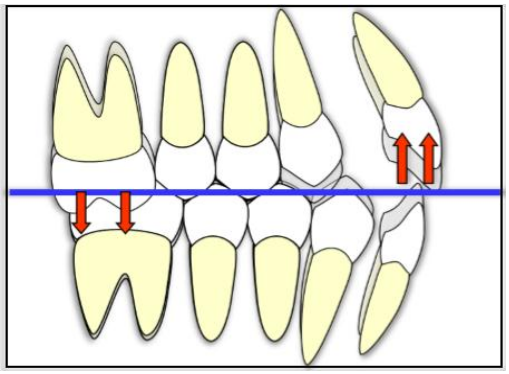

Fig. 1: Anterior simple open bite (Dentoalveolar)

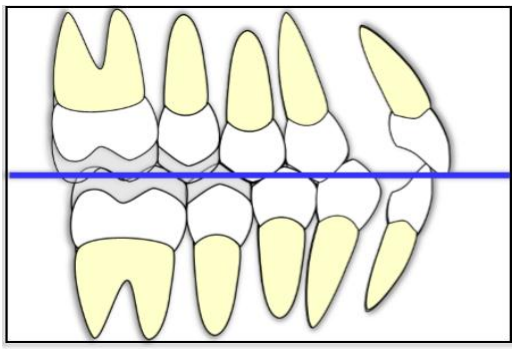

Fig. 2: Posterior simple open bite

Complex or Skeletal Open Bite: Complex or Skeletal open bite is the result of a vertical dysplasia so severe that compensatory alveolar growth cannot cope. The abnormal lip and tongue functioning observed with a complex open bite is usually adaptive in coping with the skeletal dysplasia, though the condition is held by many to be associated with "mouthbreathing" and chronic nasorespiratory dysfunction.[6]

Subtelny and Sakuda (1964)

Classified open bite based on etiologic origin.

Generally, three etiologic factors have been considered to be associated with open-bite:

1. Vertical growth deficiencies in both the anterior and posterior region of the maxilla;
2. Disproportionate muscle growth or aberrant muscle function caused by enlarged, excessively fronted, or protrusive function of the tongue which is thought to prevent the full eruption of anterior dental units or to exert a disfiguring influence on the molding of the anterior dentoalveolar processes;
3. Thumb and finger sucking habits.[11]

Sassouni and Nanda (1964) classified skeletal open bite into:
Class I,
Class II and
Class III. (Fig. 3) [11]

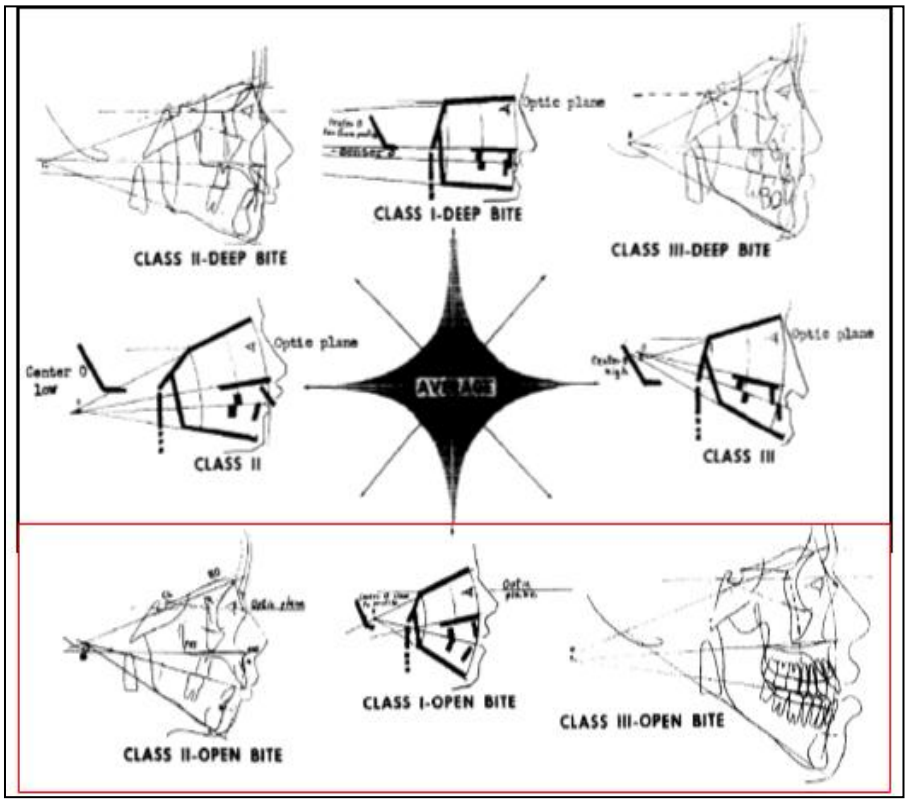

Fig. 3: Classification of skeletal malocclusion (Sassouni V, Nanda S. Analysis of dentofacial vertical proportions. Am J Orthod 1964;50(11):817.

Y. H. Kim (1974) classified open bite as mild, moderate and severe.[10]

Kamiyama and Takiguchi (1958) and Horowitz and Hixon (1966) in a similar manner, categorized open bite into the dentoalveolar type and the skeletal type.

Etiology

Table 1:

	Environmental Factors
1	Habits: Finger sucking Tongue thrusting Mouth breathing due to upper airway obstruction
2	Retained infantile swallow
3	Altered tongue posture
4	Macroglossia
5	Skeletofacial or dentoalveolar trauma
6	Degenerative disorders of the condyle like idiopathic condylar resorption and juvenile rheumatoid arthiritis
7	Neuromuscular deficiencies causing masticatory muscle atrophy
8	Craniofacial anamolies like cleft lip cleft palate, pierre robin syndrome

Genetic Factors: Inherited growth potential most commonly inherited increased anterior facial height

Diagnosis

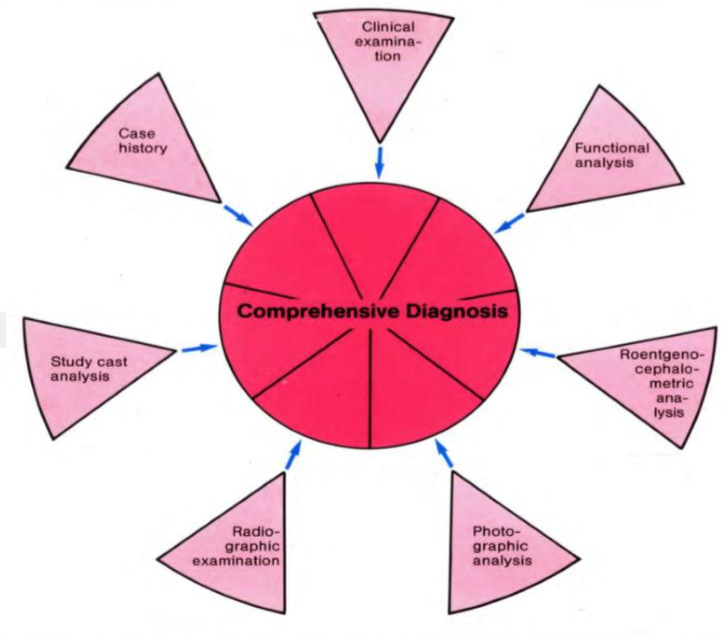

Fig. 4: Etiological factors of open bite

Clinical Findings:
According to Moyers,
In Anterior Open Bite: In patients with thumb or finger sucking habit, the maxillary arch is often narrow and there could be excessive height to the alveolar process, producing undesirable gingival display. Mandibular postural retraction may develop if the weight of the hand or arm continually forces the mandible to assume a retruded position in order to practice the habit.

Concomitantly, the mandibular incisors may be tipped lingually. When the maxillary incisors are tipped labially and an open bite has developed, it becomes obligatory for the tongue to thrust forward during swallowing in order to affect an anterior seal, therefore a simple tongue- thrust is essentially related to digital sucking habit.

This disturbance within the force system in and around the maxillary complex, it often is impracticable for the nasal floor to drop vertically to its expected position during growth. Therefore, thumb- suckers are found to own a narrower nasal floor and a high palatal

vault. The maxillary lip tends to be hypotonic and the mandibular lip becomes hyperactive, since it should be elevated by contractions of the orbicularis muscle to a position between the malposed incisors during swallowing. During sucking and swallowing these abnormal muscle contractions stabilize the deformation.

In Posterior Open Bite: Open bites in the posterior region are rare in young children and usually result from a lack of vertical alveolar development, either ankylosed primary molars or "idiopathic failure to erupt." Lateral "tongue-thrusts" are largely tongue postures adaptive to an open bite resulting from another cause. Ankylosed primary molars result in a localized cessation of alveolar development, creating a posterior open bite. The tongue must spread laterally to seal the open bite space during reflex swallowing. When the primary teeth are removed, the tongue continues its lateral swallowing movements that may impede the eruption of the bicuspids.[5]

According to Bjork: Most of the skeletal and dental characteristics commonly seen in open bite patients were initially described by Bjork. His paper discussed the morphologic characteristics associated with downward and backward mandibular rotation during growth. These skeletal and dental characteristics include: distal condylar inclination, short ramus, antegonial notching, obtuse gonial angle, excessive maxillary height, straight mandibular canal, thin and long symphysis, long anterior facial height, short posterior facial height, steep mandibular plane, divergent occlusal planes, acute intermolar and interincisal angulation, anteriorly tipped-up palatal plane, and extruded molars. Of all these characteristics, the steepness of the mandibular plane has been considered the key skeletal finding associated with a skeletal anterior open bite.[12]

Cephalometric Findings and Radiographic Examination: Nanda stated that the difference between skeletal and dental open bite is evident as excessive vertical growth of the dentoalveolar complex, especially in the posterior molar region in skeletal open bite.

And reduced incisor dentoalveolar vertical height is seen in dental openbite.[9]

Moyers stated that vertical analysis is a necessary part of cephalometric diagnosis. The features seen in open bite patients were: palatal plane tipped upward; mandibular plane steeper than normal; anterior face height excessive relative to posterior face height; the skeletal dysplasia may be confined to anterior lower face height; gonial angle may be obtuse and the ramus angled posteriorly; mandibular alveolar process height may be excessive anteriorly and the occlusal and mandibular lines divergent. The use of Vertical Analysis and the vertical growth measures provides localization of the problem in the craniofacial skeleton and makes possible monitoring of treatment during growth.[5]

Treatment Planning: After thorough evaluation of the etiology, clinical findings and radiographic assessment of the malocclusion, a definitive treatment plan is arrived at by following the following steps:

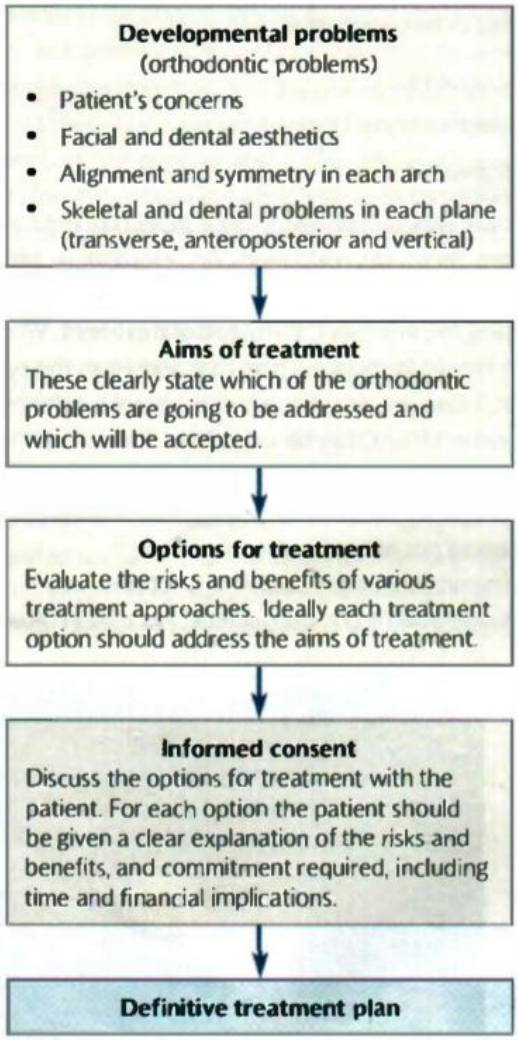

Fig. 5: Treatment planning in apertognathia

According to the Index of Treatment Needs (IOTN):

Grade 4 (severe/need treatment) – extreme lateral or anterior open bites greater than 4mm.

Grade 3 (Moderate/Borderline need) – lateral or anterior open bite greater than 2mm but less than or equal to 4mm

Grade 2 (Mild/Little need) – anterior or posterior open bite greater than 1mm but less than or equal to 2mm.

Grade 1 (No treatment needed) – no open bite[7]

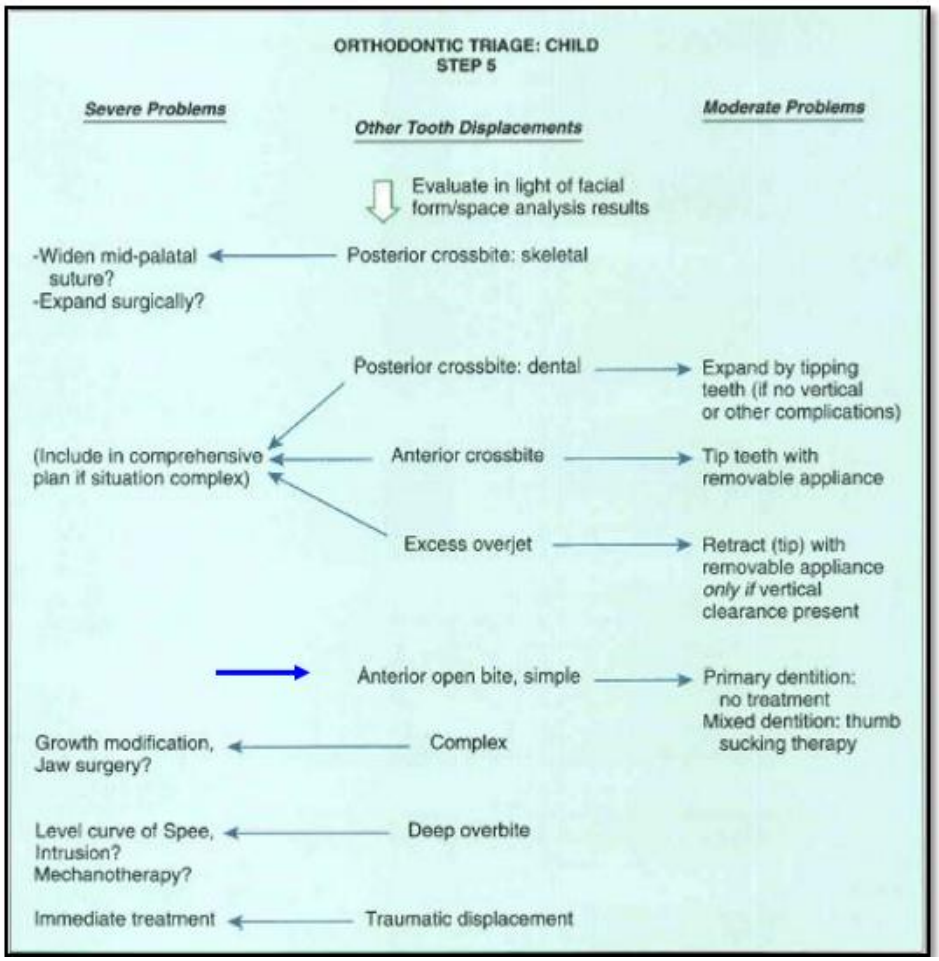

Fig. 6: Orthodontic triage

According to Moyers, it is necessary to note the relationship of the osseous bases to the dentition while planning the treatment. Always suspect a habit of some sort when an open bite is first seen in a child, since the majority of simple anterior open bites are caused by digital sucking habits or abnormal tongue posture, If, during eruption, the teeth repeatedly encounter a finger, thumb, or tongue, eruption is impeded and an open bite results.

The complex or skeletal open bite is a symptom of a variety of serious skeletal dysplasias including varied morphologies such as Class II, vertical type 1 (steep mandibular plane, or excessive anterior total face height), mandibular prognathism, and several of the craniofacial syndromes (e.g. Downs' syndrome). The most frequently encountered skeletal open bite is that seen in vertical type 3 (upward tipped palatal line and inadequate development of anterior upper face height). Skeletal contributions to open bite are often overlooked in young children and then they are more difficult to treat later. A few guidelines and principles for early treatment of complex or skeletal open bite are:

1. The earliest possible diagnosis is essential because the condition is not self-correcting and usually worsens with time;
2. Removal of all possible etiologic factors as soon as diagnosed is important. Consultation with the pediatrician or otolaryngologist may be important. When referring the patient to the physician, the cephalogram and a summary of cephalometric findings should be sent along;
3. Since these cases may be very difficult and require prolonged and varied appliance therapy, they challenge the experience and skills of the best orthodontists.

Early mistakes in treatment can compound the problem. [5] According to Proffit, anterior open bite in a young child with good facial proportions usually needs no treatment, because there is a good chance of spontaneous correction, especially if the open bite is related to an oral habit like finger sucking. A complex open bite (one withskeletal involvement or posterior manifestations), or any open bite in an older patient, is a severe problem. Excessive growth of the maxilla in children with Class II malocclusion often shows more of a vertical than an anteroposterior component (i.e., there is excessive growth downward than forward). Both components can contribute to skeletal Class II malocclusion, because if the maxilla moves downward, the mandible rotates downward and backward. The effect is to prevent mandibular growth from being

expressed anteriorly. The goal of treatment is to restrict growth of the maxilla while the mandible grows into a more prominent and normal relationship with it. The application of extraoral force is the obvious approach but functional appliance treatment also can be helpful. Children with the long face growth pattern typically have a maxilla that is rotated down posteriorly and/or a short mandibular ramus, which accounts for the steep mandibular plane and the huge discrepancy between posterior and anterior face height. The ideal treatment for these patients would be to control all subsequent posterior vertical growth so that the mandible would rotate in an upward and forward direction. This could be accomplished by controlling all tooth eruption if there was adequate mandibular vertical ramus growth. Unfortunately, vertical facial growth continues through adolescence and into the post-adolescent years, 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. Although dramatic improvement can be demonstrated in selected patients, probably the most sensible use of any of the appliances to control vertical skeletal and dental development is to use them for the minor to moderate problems and intervene in adolescence toward the end of the growth period. That way, the problem is more manageable and treatment and retention are more circumscribed. Type of the appliance and duration of the treatment when started, retention would be critically necessary till growth is completed in the late teens or early 20's.[14] According to Graber (1959), in patients with thumb- and finger- sucking habit, a thorough oral examination is made on the first visit, but the case history is taken with the child out of the room. An attempt is made to get information on the etiology, intensity, frequency, duration, chronology, mental attributes, family environment, school and play environment, siblings, response under stress, associated abnormalities, parental attitude, previous habit- breaking attempts, psychic superstructure, etc. Children with behavior problems, in whom finger-sucking is only one of many symptoms, are referred for psychiatric guidance. Children from broken homes or environments of great tension or conflict are considered poor risks for interceptive appliances. They are carried on a "visit-and-talk" routine, in the hope of establishing a rapport and, thus, therapy through suggestion. Some of these children had become appliance cases later, but only after a better understanding of the child's actions and motivations had been gained.

Adolescents with Questionable Growth Potential: When evaluating orthodontic patients with primarily vertical problems, it is easy to dwell on antero-posterior problems because most long face patients will have a receding chin and Class II malocclusion. Frequently the chief complaint is that the upper incisors are very prominent. An astute patient may be perceptive enough to describe the gummy smile as a problem that should be corrected but most know only that they do not like the prominence of their upper incisors, without differentiating vertical and horizontal components. A camouflage treatment set up supported retraction of the upper incisors is also recommended if the orthodontist views the problem primarily as Class II malocclusion, without recognizing the involvement of the skeletal discrepancy. Correcting the overjet by retraction of incisors for long-face adolescents is extremely unattractive. Extraction of premolars to retract the upper incisors can cause them to elongate even further and increase the nasolabial angle. Because this correction is often accomplished through the use of Class II elastics, the mandible is likely to further rotate down and back, accentuating an already long- face pattern. Before the option of vertical maxillary impaction became available, the negative facial aesthetics that resulted were considered an inevitable consequence of improving the dental occlusion. The continuation of growth well into the late teens tends to worsen the deformity; however, the fact that there is remaining growth provides an opportunity for implementation of growth modification techniques. Growth modification after the adolescent growth spurt is theoretically possible but actually improbable because very few adolescents will wear a functional appliance with bite blocks or a headgear. Anterior open bite in adolescents (or adults) typically will be corrected with orthodontic treatment by intruding the posterior teeth; however that's virtually not possible without surgery. A multiloop edgewise appliance, in conjunction with anterior vertical elastics, claims to produce posterior intrusion and improvement of the skeletal problem. Recent reports show that the open bite correction happens virtually altogether by elongating the incisor teeth. Successful camouflage of a long-face problem is a function of both the patient's perception of the success of treatment and the soft-tissue adequacy (the fuller the lips, the better they can cover the teeth). If the chief complaint is excessive display of the teeth and a gummy smile, elongating the incisors will not correct it. However, if the patient's major concern is the open bite, an increased display of the anterior teeth may be tolerable. The orthodontist must be sure the patient understands the aesthetic implication of the latter decision. Patients who are treated with other extrusive, non-extraction orthodontic approaches may end up with their occlusion reasonably well corrected, but both facial aesthetics and long-term stability are questionable. In this particular situation, the lower incisors will remain too protrusive relative to the chin for good stability, the chin will still be deficient, and the lip incompetence will still be present. If the nonextraction treatment is considered unsuccessful and the patient is retreated with extractions, esthetics will be compromised even more. For borderline cases such as these, a lower border osteotomy of the mandible to bring the chin upward and forward can greatly improve

both dental and facial aesthetics because the lower lip relaxes and moves up as the chin is elevated. The lower border osteotomy is not a complicated procedure and may be accomplished in an ambulatory care setting.

Adults with Little or no Growth Potential: Long-face patients with no prospect for successful growth modification have no real alternative to surgery for a successful and stable outcome. Orthodontic camouflage is not a real option in long-face problems. It may be better not to treat a patient with a true vertical problem who refuses to consider surgical correction because aesthetics is likely to be severely compromised.[13]

Surgical Management: An accurate diagnosis and the variety of surgical techniques available should reduce complications and the degree of relapse following treatment. However, there are still some cases which are so severe that some compromise in treatment may be l1Davoidable, in the past, the majority of patients were treated by mandibular procedures. The most favorable surgical results are currently achieved through maxillary procedures, particularly the LeFort I osteotomy with adjunctive procedures. Various bi jaw procedures are explained in literature which are shown in the table below:

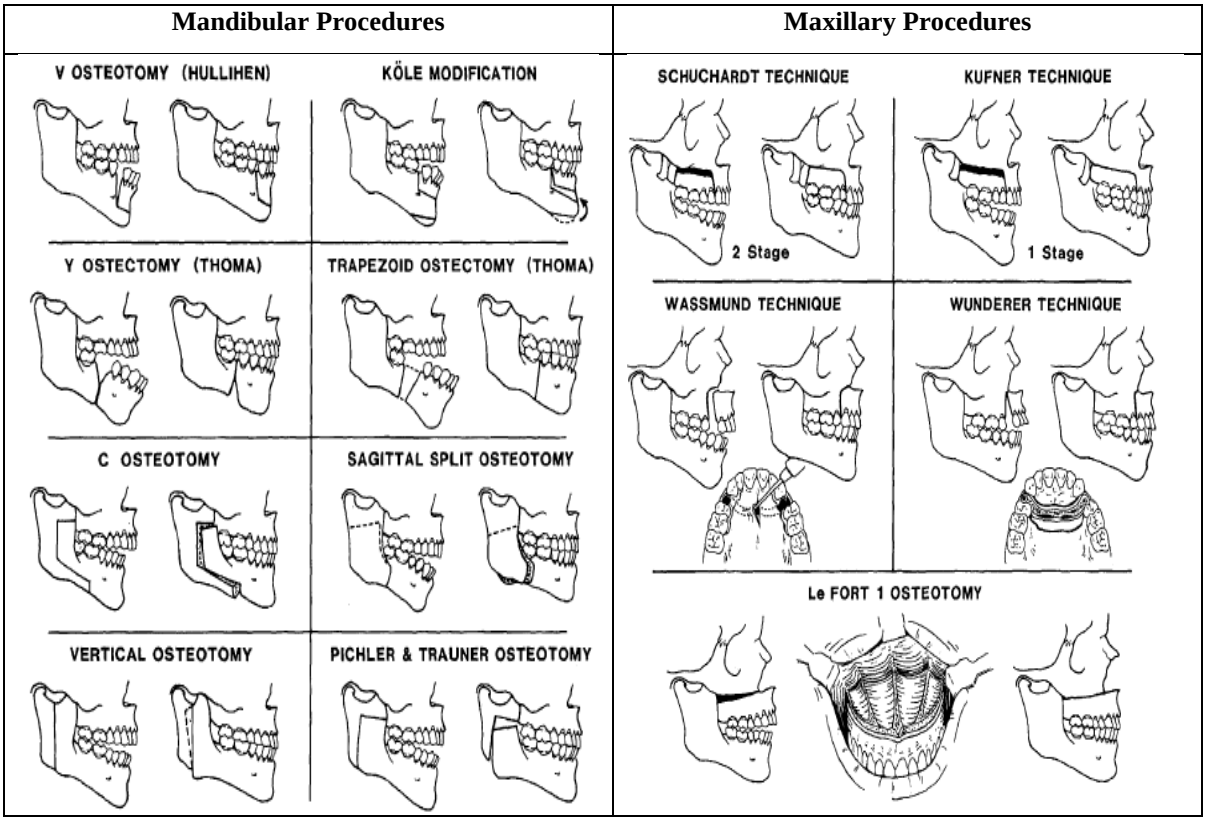

Fig. 7: Maxillary and mandibular procedures for treating apertognathia

Summary: An anterior open bite is one of the most difficult dentofacial deformities to treat in orthodontics. Etiology being multifactorial, a thorough clinical and cephalometric examination should be done while treating a patient with open bite. The difficulty of this malocclusion is accredited to a combination of skeletal, dentoalveolar, functional and habit related factors. It is characterized by a large anterior dentoalveolar height in both the jaws, increased total and lower anterior face height, a disproportionate ratio of upper to lower anterior face height, decreased posterior face height, an increased gonial angle, a high mandibular plane angle, a low posterior to anterior face height ratio and a short ramus. Till recently, the orthodontic treatment modalities included habit correction, extrusion of anterior teeth using intermaxillary elastics, uprighting of the molars and inhibition of molar eruption during growth. These methods were unsatisfactory due to the skeletal and esthetic compromises that ensued. However recently with the advent of clearaligners, patients with high esthetic demands and having a open bite malocclusion can also be treated in an effective manner. Another advancement is the use of skeletal anchorage, with absolute intrusion of the teeth using temporary anchorage devices, it is possible to auto-rotate the mandible in a closing counter clockwise direction and correcting the open bite without surgery. Miniimplants are used not only as a treatment option but also as an aid in retention. With numerous treatment modalities to correct open bite, the problem still exists with retention and stability of this malocclusion. However many retention protocols have been

documented to be effective, stable results are obtained only if a comprehensive assessment is done with regards to the age of the patient and the etiology of open bite. The treatment of open bite depends on the etiology, age and severity of the problem. Hence, treatment options may include habit correction, extraoral appliances with or without bite blocks in growing patients. Treatment options in non growing patients include intrusion of posteriors using temporary anchorage devices. In severe cases, orthognathic surgery (maxillary or mandibular or both) is indicated. Early and timely treatment of open bite could avoid use of fixed appliances and surgery and but however this requires patient compliance and co operation in a growing patient. However, when the deformity is severe in a non growing patient, orthognathic surgery is the treatment of choice. This may include maxillary expansion, impaction with or without mandibular advancement or setback along with advancement and reduction genioplasties as required. Different approaches have been advocated for retention after treatment of open bite. Day time wear of removable retainers and night time wear of either high pull headgear, or functional appliance with bite blocks (an open bite bionator). Others suggested retainers with occlusal coverage to control molar eruption. Prolonged retention is required in most cases. To summarize, openbite continues to be a challenging malocclusion to be treated by an orthodontist but comprehensive approach towards planning treatment and retention protocol can give successful results in most cases.

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