

REVIEW ARTICLE**Open bite – a review**Nungshinaro Tzudir¹, Arun Chauhan², Soi Chakraborty¹, Susmita Majumder¹**Abstract:**

A review of open bite, which is defined as a malocclusion with no contact in the anterior region of the dental arches, and the posterior teeth in occlusion. The etiology of open bite is multifactorial and can be attributed to genetic and environmental traits, reflected in pathologic (muscular dystrophy) and cleft lip/palate and other developmental factors. The diagnosis and treatment planning of open bite must analyse in all three components of malocclusion – facial, dental and skeletal. Each component must be carefully studied and understood so that the correct diagnostic decisions are made to lead to an effective plan.

Keyword: Open bite, vertical dysplasia.**INTRODUCTION**

Open bite was defined by Subtelny and Sakuda, as open vertical dimension between the incisal edges of the maxillary and mandibular anterior teeth, although deficiency in vertical dental contact can occur between the anterior or the buccal segment.³

An open bite in a preadolescent child with normal vertical facial proportions is most likely cause by a habit such as thumb or finger sucking. Deviation from the usual pattern in transition from the primary to the permanent dentition may also be an etiologic, but this is less likely. A disproportionately large lower anterior face height with the severe anterior open bite indicates a skeletal problem. Open bites are more difficult to correct and are more unpredictable in their prognosis than deep bites. Open bites are ideally corrected dentally by intrusion of posterior teeth, thereby permitting counter clockwise rotation of the mandible. Extrusion of the anterior teeth represents a dental compensation and is achieved with vertical elastics or an extrusion arch wire. The lip-to-tooth and gingival displays on smiling are two factors that are important in the design of an appliance for correction of open bites. In some instances treatment cannot be accomplished by orthodontics alone, in which case a combined approach of orthodontics and surgery is necessary.²

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I) According to Rakosi, four varieties of open bite due to tongue posture may be differentiated as⁴

a) Anterior open bite - Open bite in a deciduous dentition, caused by tongue dysfunction as a residuum of a sucking habit.

b) Lateral open bite - Occlusion, in this type of open bite on both sides is supported only anteriorly and by first permanent molars.

c) Complex open bite - Severe vertical malocclusion. The teeth occlude only on second molars.

d) Tongue dysfunction and malocclusion - In mandibular prognathism, the downward forward displacement of tongue often causes an anterior tongue thrust habit.

II) A proper cephalometric analysis enables classification of open bite malocclusions⁴

a) Dentoalveolar open bite.

b) Skeletal open bite

i) Positional deviation.

ii) Dimensional deviation.

c) Skeletal Class II open bite.

d) Skeletal Class III open bite.

III) According to Proffit¹

a) Open bite (mm) > -4 extreme.

b) -3 to -4 severe.

c) 0 to -2 moderate.

IV) Open bite can be classified as⁴

a) Incomplete overbite.

b) Simple open bite.

c) Complex open bite.

d) Compound open bite

e) Iatrogenic open bite.

V) Open bite is classified as⁴

a) Anterior open bite - Anterior open bite is defined as no contact and vertical overlap between the maxillary and mandibular incisors.

b) Posterior open bite - When teeth are in occlusion there is a space between posterior teeth.

VI) Open bite is classified by Sassouni as (Criterion-Angle of mandibular plane)⁴

- a) Skeletal open bite.
- b) Dentoalveolar open bite.

VII) Open bite is classified as⁴

- a) Class I open bite.
- b) Class II open bite.
- c) Class III open bite.

VIII) The open bite can be the simple type, without abnormal measures to the vertical cephalometric analysis, and complex, when cephalometry shows disharmony in the skeletal components of the anterior facial height.⁴



Fig.4 Skeletal Anterior Open Bite



Fig.1 Anterior Open Bite

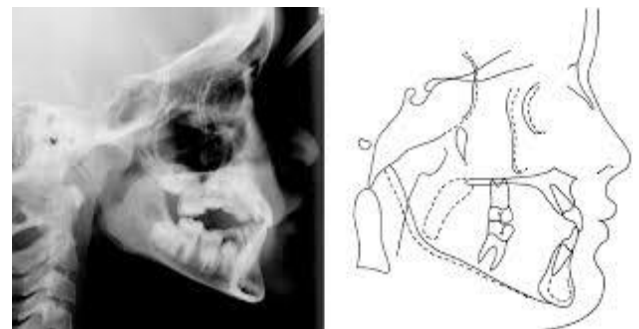


Fig.5 Skeletal Posterior Open Bite



Fig.2 Lateral Open Bite

ETIOLOGY OF OPEN BITE

I) ANTERIOR OPEN BITE

It is defined as a malocclusion with no contact in the anterior region of the dental arches, and the posterior teeth in occlusion. It is called combined open bite when malocclusion extends to the posterior segment.



Fig.3 Posterior Open Bite



Fig.6 Anterior Open Bite

ETIOLOGY:**A) Dental Open Bite⁶****a) Habits**

The effects of a habit depend upon its duration and intensity. If a persistent digit sucking habit continues into the mixed and permanent dentitions, this can result in an anterior open bite due to restriction of development of the incisors by the finger or thumb.

b) Localized failure of development

This is seen in patients with a cleft of the lip and alveolus, although rarely it may occur for no apparent reason.

c) Mouth breathing

It has been suggested that the open-mouth posture adopted by individuals who habitually mouth breathe, either due to nasal obstruction or habit, results in overdevelopment of the buccal segment teeth. This leads to an increase in the height of the lower third of the face and consequently a greater incidence of anterior open bite.

B) Skeletal Open Bite⁷**a) Airway obstruction**

Patients with skeletally disproportionately long faces are often suspected of having an airway obstruction. Linder-Aronson in 1970 demonstrated a statistically significant relationship between obstructing adenoid tissue and certain skeletal and dental patterns. These changes included rotation of the mandible in a clockwise manner so that the mandible was in a more vertical and backward direction, causing elongation of the lower anterior face height, open bite, and retrognathia.

b) Skeletal growth abnormalities

In 1931, Hellmans suggested that open bite is primarily due to skeletal deficiencies. In a study of 43 treated and untreated open bite cases, he found the percentage of successful treatments was equal to the percentage of self-correcting cases in the untreated group. Using anthropologic measurements, he found that subjects with open bite had shorter rami and greater total facial height. In another study by Schudy, clockwise rotation of the mandible (as viewed from the patient's right) was found to be a result of excessive vertical growth as it relates to horizontal growth. This kind of growth pattern occurs when vertical growth in the molar region is greater than growth at the condyle. Genetic and environmental influences that encourage vertical growth in the molar region, which are not compensated by growth at the condyle or posterior ramus, will result in anterior open bite. Similarly, forces that impede the eruption in the incisal region also result in anterior open bite.

II) POSTERIOR OPEN BITE

Posterior open bite can be defined as failure of contact between the posterior teeth when the teeth occlude in centric occlusion. In fig.7 we can see that there is no occlusion between the maxillary and mandibular premolars. The maxillary and mandibular molars have a slight contact. The anterior overjet and overbite are normal.⁵



Fig.7 Posterior Open Bite

It is seen rarely and can be because of ⁵

- i) Tongue interposition.
- ii) Disturbances in eruption (e.g., ankylosis).
- iii) Primary failure of eruption.

Posterior open bite occurs more rarely than anterior open bite and the aetiology is less well understood. In some cases, an increase in the vertical skeletal proportions is a factor, although this is more commonly associated with an anterior open bite which also extends posteriorly. A lateral open bite is occasionally seen in association with early extraction of first permanent molars possibly occurring as a result of lateral tongue spread.



Fig.8 Posterior open bite in a patient who had all four permanent first molars extracted in the mixed dentition

Posterior open bite is also seen in cases with submergence of buccal segment teeth. There are two rare conditions which affect the eruption of the permanent buccal segment teeth.⁶

Primary failure of eruption: This condition almost exclusively affects molar teeth and is of unknown aetiology. Although bone resorption above the unerupted tooth proceeds normally, the tooth itself appears to lack any eruptive potential. Extraction is the only treatment alternative. The aetiology is not understood.

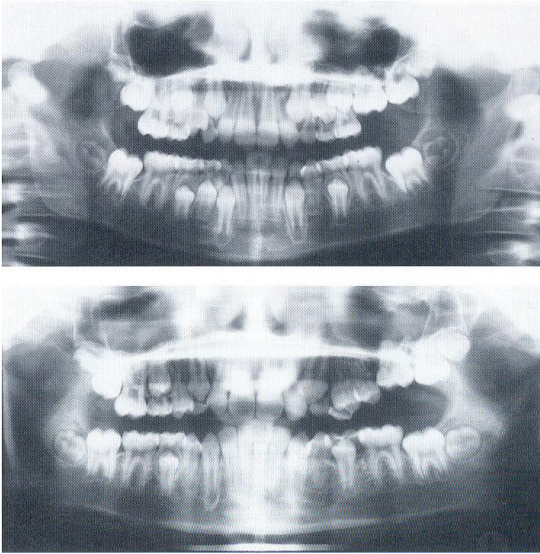


Fig.9 DPT radiographs showing failure of eruption of the upper left first permanent molar

Arrest of eruption: This also usually involves molar teeth. Affected teeth appear to erupt normally into occlusion, but then subsequently fail to keep pace with occlusal development. As growth of the rest of the dentition and alveolar processes continue, lack of movement of the affected tooth or teeth results in relative submergence.



Fig.10 DPT radiograph showing arrest eruption of the lower left first permanent molar

More rarely posterior open bite is seen in association with unilateral condylar hyperplasia which also results in facial asymmetry. If this problem is suspected, a bone scan will be required. If the scan indicates excessive cell division in the condylar head region, a condylectomy is usually necessary in addition to the deformity.

DIAGNOSIS OF OPEN BITE

I) Morphology of Skeletal Open Bite

A) Extra-oral⁸

a) Profile: A characteristic feature of skeletal open bite is the increased lower facial height. The lips at rest are incompetent and a conscious effort is required to hold the lips together with obvious evidence of muscle strain. During swallowing an active contraction of the orofacial musculature will be evident. There is a steep Frankfort mandibular plane angle and a marked antegonial notch is present.

b) Frontal: When viewing the patient from the front, increased length of the face will give the impression of a long thin face. The upper lip is short resulting in a high lip line and when smiling the patient shows an excess of upper teeth and gum.

B) Intra-oral⁸

As a result of the active pressure exerted by the lips during swallowing there is a tendency to mild crowding and flattening of both arches in the incisor region. In the severe skeletal open bite cases, the only dental contact between the upper and lower arches is in the region of the second permanent molar. During swallowing an anterior tongue thrust is evident as the tongue moves forward and laterally to fill the open inter-dental area and form a seal with the lips.

C) Cephalometric characteristics⁹

In case of skeletal open bite, the occlusal plane generally diverges from the first molar anteriorly.

The skeletal characteristics include: short ramus, obtuse gonial angle, excessive maxillary height, straight mandibular canal, thin and long symphysis, short posterior facial height, steep mandibular plane, divergent occlusal planes and anteriorly tipped-up palatal plane.

D) Maxilla⁸

There is some disagreement in the literature regarding the height of the maxilla. Subtelny and Sakuda (1964) and Sassouni and Nanda (1964) claimed that in anterior open bite cases the maxillary dental height was greater at both the incisor and molar levels; while Nahoum (1971) and Nahoum *et al.* (1972) found no significant difference in the measurement from maxillary molar cusp tips to palatal plane or to S-N plane.

E) Mandible⁸

There is general agreement on the features of the mandible in skeletal open bite patients. A short ramus is present together with an increased gonial angle and a marked antegonial notch. The dentoalveolar height in the molar region is reduced while in the incisor region it is increased.

F) In occlusion⁸

There is an increased total anterior facial height, measured from nasion to menton. This is due to an increase in lower facial height measured from anterior nasal spine to menton (Richardson, 1969; Hapak, 1964). The ratio of upper anterior facial height to lower anterior facial height (UFH/LFH) serves as one of the diagnostic criteria. The normal UFH/LFH ratio was given by Nahoum in 1975 as 0.8, open bite <0.7, and closed bite > 0.9.

II) Morphology of Dental Open Bite

A) Extra-oral⁸

There are no characteristic extra-oral features associated with this malocclusion. In the presence of an increased overjet there will be a convex profile with incompetent lips.

B) Intra-oral⁸

Maxillary arch: The shape of the maxillary arch will show characteristic features related to the etiology. If the malocclusion is due to a foreign body (pencil, pipe) being held passively between the incisor teeth, then the open bite is localized to the particular teeth involved; they will fail to erupt to the occlusal level of the other teeth in the arch. When the malocclusion is as a result of a thumbsucking habit, then the upper incisor teeth may be proclined resulting in a V-shaped upper arch. Due to the increased buccal pressure exerted on the molar teeth by the cheeks during sucking, there is a narrowing of the arch in the molar region (Moyers 1963).

C) In occlusion⁸

The anterior open bite has a characteristic appearance. The opposing molars and Premolars are in contact, the canines may or may not be in contact, the lateral and central incisors are in frank open bite. The mouth has the appearance of a 'fish mouth' (Fig. 3.2D). The open bite is limited to the incisor region as opposed to the skeletal open bite which extends to the molar region.

D) Cephalometric characteristics⁹

In case of dental open bite, the occlusal characteristics generally diverge from the first premolars anteriorly.

E) Maxilla⁹

In the maxilla there is no increase in height from the cusps tips of the molars to the palatal plane, but there may be a decrease in the vertical height measured from the mesial edge of the upper incisors to the palatal plane.

F) Mandible⁹

The mandible may show features related to dysplasias in the antero-posterior direction. However, the skeletal features related to the vertical dysplasia of the mandible described above will be absent. Retroclined and crowded lower incisors may result from a thumbsucking habit. The alveolar height in this region is not increased.

G) In occlusion⁹

As a pernicious thumbsucking habit is one of the commonest causes of this type of malocclusion, cephalometric analysis shows an increased incidence of skeletal Class II jaw relationship ($>ANB$ angle). This is related to the action of the thumb encouraging the forward movement of the maxilla while restraining the mandible.

TREATMENT OF OPEN BITE:**I) Treatment of open bite in the deciduous dentition¹⁰****A) Digit sucking**

Different intraoral appliances are available for behaviour modification. These consist of a stiff archwire with a series of loops that sit close to the anterior portion of the palate, and attach to two upper molar bands. The loops act as a mechanical obstruction/reminder of the pernicious habit.

B) Tongue thrust

Patients with tongue thrusts can be treated effectively in the same manner as digit suckers, although different appliances such as the habit appliance with lingual spurs have been suggested for these cases. Other devices aimed at retraining the tongue posture, known as myofunctional appliances, have also proven effective at treating tongue thrusts. Myofunctional therapy aids in muscle retraining by using a series of tongue exercises to correct the deleterious resting and functional posture.

II) Treatment of Open Bite in the Mixed Dentition**A) Activator¹¹**

The bite is opened 4 to 5 mm to develop a depressing force and load the molar that are in premature contact.

Properly constructed activators that follow this principle can influence the vertical growth pattern in these cases. To close the V between upper and lower dental arches by depressing the posterior maxillary segments with the activator in a manner analogous to that of orthognathic surgery

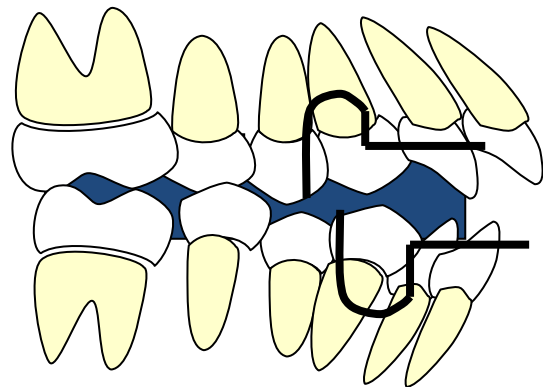


Fig.11 Activator

B) Bionator¹²

Use to inhibit abnormal posture and function of the tongue. The construction bite is as low as possible, but a slight opening allows the interposition of posterior acrylic bite blocks for the posterior teeth, to prevent their extrusion. To inhibit tongue movements, the acrylic portion of the lower lingual part extends into the upper incisor region as a lingual shield by closing the anterior space without touching the upper teeth. The palatal bar has the same configuration as the standard bionator, with the goal of moving the tongue into a more posterior or caudal position. The labial bow differs from the standard appliance that the wire runs approximately between the incisal edges of the upper and lower incisors. The labial part of the bow is placed at the height of correct lip closure thus stimulating the lips to achieve a competent seal and relationship. The vertical strain on the lips tends to encourage the extrusive movement of the incisors, after eliminating the adverse tongue pressures.

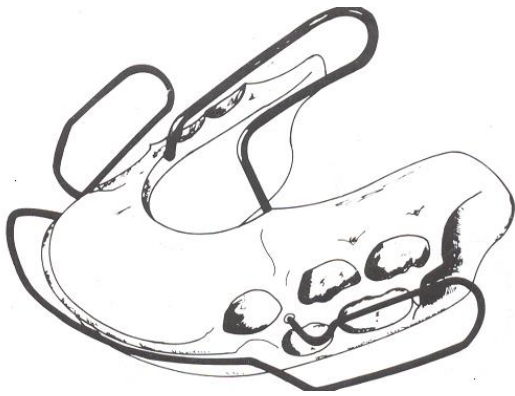


Fig.12 Bionator

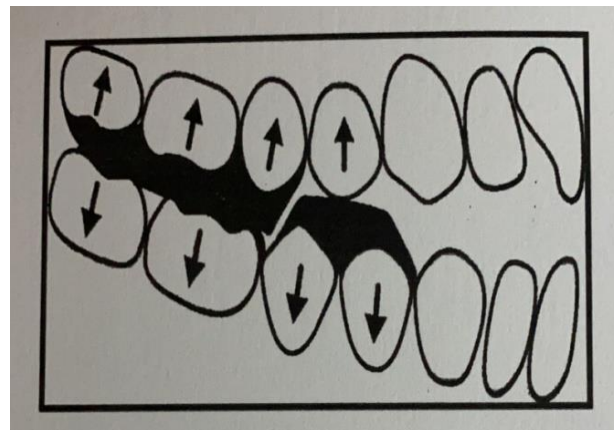


Fig.14 Twin Block

C) Frankel IV

Normally, anterior open bite problems show protracted tongue posture with incompetence of lips. The tongue tooth contact replaces the lip seal during deglutition to create negative atmospheric pressure.

FR IV along with lip exercises cause lip contact, reducing tongue protrusion and cause the tongue to move back into its normally raised position in proximity with palate, during deglutition.

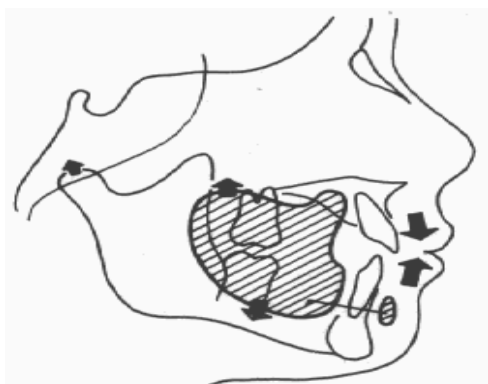


Fig.13 Frankel IV

D) Twin Block

Maintain occlusal contact to intrude the posterior teeth. Do not allow the second molars to over erupt. Extend occlusal cover or occlusal rests distally to second molars. Do not trim the upper block in open bite cases. This will allow the lower molars to erupt and again popping the bite open.

E. Headgear¹³

Centres of resistance in midfacial complex

- a) Alveolar process.
- b) Maxilla.

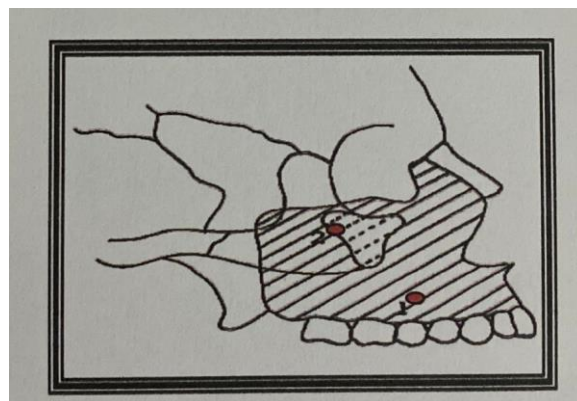


Fig.15 The two dots showing the center of resistance of maxilla



Fig.16 Direction of force passes behind both alveolar and skeletal centres of resistance, producing clockwise rotation of maxilla and maxillary dentition



Fig.17 Direction of force passes between alveolar and skeletal centers of resistance, producing a clockwise rotation of maxilla and counterclockwise rotation of maxillary dentition

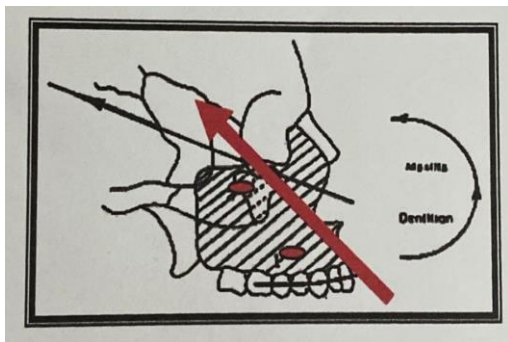


Fig.18 Direction of force passes above both the alveolar and skeletal centres of resistance, producing counter-clockwise rotation of maxilla and maxillary dentition

Occipital Headgear with chin cup

In the mixed dentition open-bite patient we could intrude the upper first permanent molars and then remove the remaining deciduous teeth, permitting open-bite closure.

Occipital headgear with a transpalatal arch to control the inclination of the molars as they are intruded.

After the molars have been intruded perhaps 3mm the deciduous teeth are removed, the mandible is hinged closed and the anterior open-bite is closed.

The lower molars will often tend to extrude in this type of situation. Unless mechanics are designed to control their eruption.

An addition of a vertical pull-chin cup to the occipital headgear and transpalatal arch would intrude the upper molars, while preventing the eruption of the lower molars.

As the open bite closes the mandible hinges upward, reducing the height of the lower face.

III. Treatment of Open Bite in the Permanent Dentition

Combined Orthodontic-Surgical Treatment of Skeletal Anterior Open Bite¹⁴

Contemporary orthognathic surgery is the actual expression of the interaction of orthodontics and oromaxillofacial surgery, where both professionals will conduct a complete patient evaluation regarding their requirements and needs to

perform a combined treatment planning. The interaction between orthodontics and orthognathic surgery expand the treatment possibilities to solve patient complaints and anxieties that could not be treated alone with Orthodontics. Manipulation of the apical bases in the three planes of space can provide a better esthetic improvement in the soft tissues than tooth movement within the apical bases.

Stages of combined orthodontic-surgical treatment¹⁴

The combined orthodontic-surgical treatment is divided into well-defined stages under responsibility of the orthodontist or oromaxillofacial surgeon. An effective communication among professionals is important for a perfect chronology of events and attainment of the best results. The stages are the following:

- i) Treatment planning.
- ii) Orthodontic treatment.
- iii) Presurgical impression and reevaluation of teeth positioning.
- iv) Presurgical records and definite treatment planning.
- v) Plaster model surgery and construction of an intermediary splint.
- vi) Orthognathic surgery.
- vii) Bracket rebonding, finishing procedures and appliance removal.
- viii) Retention and final records.

According to the protocol proposed by Arnett, Arnett and McLaughlin, and Arnett, Kreashko, and Jelic, the sequence of the steps for orthognathic surgical planning are performed based on the patient's digital tracing.

a) Maxillary positioning

The maxillary incisors are vertical and horizontally positioned through the LeFort I osteotomy, according to the clinical data and soft-tissue cephalometric analyses. In cases of vertical maxillary excess resulting in excessive exposure of the maxillary incisors and gingiva (gummy smile), the maxilla should be repositioned so that there is 3–5 mm exposure of the maxillary incisor crowns, below the relaxed upper lip. In cases of dental protrusion, maxillary impaction may compromise the projection of the upper lip and the nasolabial angle.

b) Correction of mandibular incisors inclination

The incisors should present adequate torque in relation to their skeletal bases. The maxillary incisors should present correct inclination in relation to the occlusal maxillary plane and the mandibular incisors in relation to the occlusal mandibular plane. The occlusal planes are used as reference because they are not modified with surgery, unlike the palatal and mandibular planes. This orthodontic decompensation is performed before the surgery during the presurgical orthodontic preparation by the orthodontist.

c) Overbite correction

After positioning the maxilla with a LeFort I osteotomy, an overbite of 3 mm may be obtained only with autorotation of the mandible, without surgical intervention in this apical base.

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d) Overjet correction

Although the overbite may be corrected with mandibular autorotation, a positive or negative overjet greater than 3 mm may not be corrected. In these circumstances, the mandible has to be surgically retruded or advanced.

e) Occlusal plane correction

After correction of the overbite and overjet, the position of the maxillary occlusal plane (from the incisal edge of the maxillary incisor to the mesiobuccal cusp tip of the maxillary first molar) in relation to the true vertical line has to be defined. Changes in the occlusal plane inclination affect the position of the chin and of the nasal base support, and consequently, facial convexity. A clockwise occlusal plane rotation produces a more convex and unattractive profile.

f) Genioplasty

The last stage of the surgical treatment is the horizontal and vertical chin positioning. This positioning may be performed through a sliding osteotomy (in height and length) of the chin or through inclination of the occlusal plane (fifth stage). The greater the inclination, the smaller is the chin projection and vice versa.

CONCLUSION:

Open bite malocclusion is difficult to treat in orthodontic practice. The diagnosis and treatment planning must be carefully studied and understood in all three components of malocclusion i.e., facial, dental and skeletal to lead to an effective plan. Treatment modalities include functional appliances in growing patients and surgeries in adults. Minor cases can be treated by fixed orthodontics along with some habit breaking appliance.

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