Content available at: https://www.ipinnovative.com/open-access-journals

IP Indian Journal of Orthodontics and Dentofacial Research

Journal homepage: https://www.ijodr.com/

Review Article

# A review on open bite

**Anshul Munjal[1],*, Adeeba Ali[2], Sharon Ann Abraham[3], Bater Jini[4]**

[1]*Private Practitioner, Delhi, India*
[2]*Private Practitioner, Bareilly, Uttar Pradesh, India*
[3]*Private Practitioner, Bengaluru, Karnataka, India*
[4]*Private Practitioner, Itanagar, Arunachal Pradesh, India*

ARTICLE INFO

*Article history:*
Received 03-08-2021
Accepted 23-11-2021
Available online 24-01-2022

*Keywords:*
open bite
vertical dysplasia
anterior open bite
vertical control

ABSTRACT

Normal occlusion is analyzed in three dimensions- sagittal, vertical and transverse, and any deviation in these three parameters are further attributed to skeletal, dental, habitual or a combination of the three factors. Open bite characterized by insufficient or absence of contact between anterior and/or posterior teeth have been found to be one of the most complex vertical malocclusion to treat with high tendency for relapse in both surgical and non surgical intervention. The aim of the article is to arrive at a precise diagnosis and classify with early intervention using the most appropriate treatment and retention modalities to achieve long term functional and esthetic goals.



## 1. Introduction

Any increase or decrease in vertical dimension of face results to vertical dysplasia. The increased vertical dimension can lead to OPEN BITE. The term “open bite” was coined by Caravelli in 1842 as a distinct classification of malocclusion[1] and can be defined in different manners.

Subtelney and Sakuda[2] defined open bite as 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 posterior segment.

### *1.1. Prevalance*

An open bite of greater than 2 mm occurs in less than 1% of the population and has five times greater prevalence in the black population than in the white or Hispanic populations.[3] The incidence of anterior open bite ranges from 1.5% to 11%[4] and varies between races and with dental age.[5] In the mixed dentition the prevalence of the anterior open bite can reach up to 18.5%, decreasing with age.

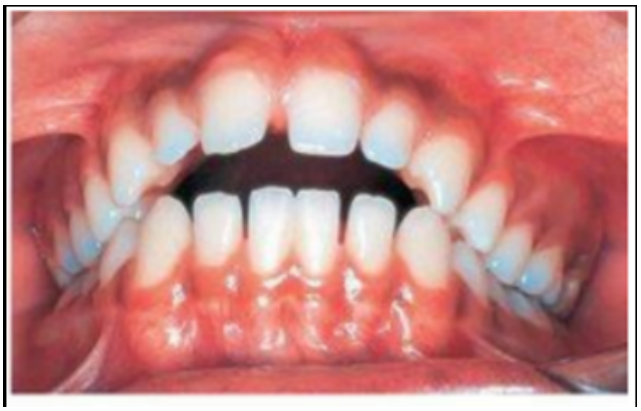

**Fig. 1:** Anterior open bite

Classification

* *Corresponding author*.
*E-mail address*: dranshulmunjal@gmail.com (A. Munjal).

https://doi.org/10.18231/j.ijodr.2021.046

1. Worms, Meskin and Isaacson[6] provided classification based upon clinical findings:
   Simple OB: from canine to canine
   Compound OB: from premolar to premolar
   Infantile OB: from molar to molar
2. According to Proffit,[7]
   Open bite (mm)
   >-4 extreme
   -3 to -4 severe
   0 to -2 moderate
3. Sassouni[8] classified open bite by taking mandibular plane angle into consideration as (Figure 2):
   (a) Skeletal open bite
   (b) Dentoalveolar open bite
4. Based on 1$^{st}$ molar antero-postero relationship
   (a) Class I
   (b) Class II
   (c) Class III
5. Rakosi[9] classified open bite based on tongue posture as (Figure 3):
   (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.

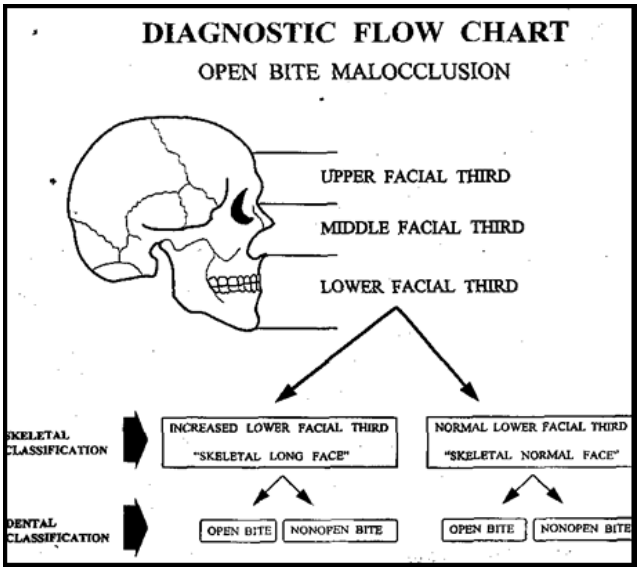


**Fig. 2:** Diagnostic flow chart for open bite malocclusion


**Fig. 3:** Rakosi classification of open bite

### *1.2. Etiology*

The etiologic factors of open bite can be broadly classified into

1. (a) Epigenetic factors
   (b) Environmental factors

### *1.3. Epigenetic factors*

1. Posture, morphology and size of the tongue,
2. Skeletal growth pattern of maxilla and Mandible
3. Vertical relationship of Jaw bases

These characteristics are genetically determined.

### *1.4. Environmental factors*

#### *1.4.1. Thumb and digit sucking habit*

The severity of malocclusion caused by thumb Sucking depends upon

1. (a) Duration
   (b) Frequency
   (c) Intensity

According to Freud's psychoanalytical theory,[10] all developmentally normal children possesses an inherent, biological drive for sucking. Rooting and placing reflexes are merely expressions of this drive. Environmental factors contribute transfer of this sucking habit to non-nutritive sources such as thumb or finger.

The effects of thumb sucking are;

1. Proclination of maxillary anteriors
2. Anterior open bite with supra-eruption of the buccal teeth
3. Leads to tongue thrust habit because of open bite
4. Upper lip is hypotonic and hyperactive mentalis activity.

*1.4.2. Tongue thrust habit*

According to Bahr and Holt,[11] the tongue thrust activity are classified into

1. Tongue thrust without deformation
2. Tongue thrust causing anterior deformation with an anterior open bite termed as simple open bite
3. Tongue thrust causing buccal segment deformation with a posterior open bite (Lateral tongue thrust activity)
4. Combined tongue thrust, causing both anterior and posterior open bite called complex open bite

Tulleysuggested tongue thrusting as an endogenous habit oris an adaptive behaviour based largely on facial morphology and swallowing activity.

According to Proffit and Mason**,** tongue thrust is more likely to be an adaptation to the open bite, and therapy aimed at changing the swallowing pattern is not indicated. Given the physiology of tooth movement, it is unlikely that tongue thrust, but rather resting tongue posture, plays a role in the etiology of open bite

Equilibrium theory[12] (Figure 4) suggests that light continuous forces are responsible for tooth movement and position. These forces can be external (digits) or internal (tongue posture or periodontal forces). Abrupt, intermittent forces (tongue forces due to swallowing) are much less likely to be a causative factor. Proffit and suggest that therapy for anterior tongue position is not warranted with or without malocclusion before adolescence. Further, tongue therapy is most effective when combined with orthodontic treatment. Speech therapy may be combined with orthodontic treatment and possibly myofunctional therapy in older children.

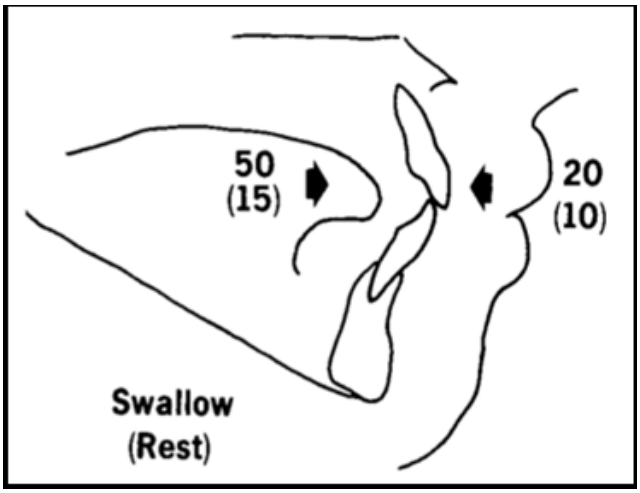


**Fig. 4:** Diagrammatic representation of tongue and lip pressure during swallowing and at rest.[12]

*1.4.3. Mouth breathing*

It is the pattern of breathing totally/partially though oral cavity due to anatomical or functional variation. It can be classified as: Obstructive, Habitual and Anatomical.

When a person breathe through mouth, the mandible and the tongue are lowered, and the head is extended, if these postural changes are to be maintained, the vertical equilibrium will be disrupted causing over eruption of the posterior teeth, increase in lower facial height and change in cranio-vertebral angle by 5 degrees, which further leads to backward rotation of mandible and thus open bite.[2]

Clinical features are:

1. Long and narrow face
2. Narrow nose and nasal passage
3. Short and flaccid upper lip
4. Contracted upper arch
5. Flaring of the Incisors
6. Anterior marginal gingivitis due to drying of the gingiva.

*1.5. Diagnosis*

The diagnosis and treatment planning for open bite continues to be one of the most challenging situations facing Orthodontists today.

*1.6. Clinically*[13]

1. Overjet combined with an open bite less than 1 mm - Pseudo open bite
2. Open bite more than 1mm between the incisors, and posterior teeth are in occlusion - simple open bite.
3. Open bite extending from premolars (or) deciduous molars on one side to the corresponding teeth on the other side - complex open bite.
4. Compound (or infantile open bite is completely open including molars
5. Iatrogenic open bite is the consequence of orthodontic therapy. In mixed dentition, various therapeutic measures may cause open-bite.

   (a) An open activator with a high construction bite causes tongue thrust habit and results in anterior open bite. Intrusion of posterior teeth creates posterior open bite especially in deciduous molar area.

   (b) Expansion treatment - buccal segments tip buccally with elongation of lingual cusps. This creates prematurity and opens the bite.

   (c) In distalization of maxillary first molar with extra-oral force the molars are often tipped down and back, elongating the mesial cusps. This creates open bite in downward, backward growing faces with already having excessive anterior face heights.

### *1.7. Cephalometrically*[13]

1. Dentaloalveolar open bite- Depends on the extent of the eruption of teeth. Supraocclusion of molars and infra-occlusion of incisors.
2. Lateral open bite- It is Purely dentoalveolar with infraocclusion of molars. Etiology can be cheek sucking, lateral tongue thrust or lateral tongue posture in postural rest position.
3. Skeletal open bite- There will be excessive anterior face height particularly lower third, posterior facial height will be short.

Mandibular base- is usually normal and antegonal notching is often present, symphysis is narrow and long, ramus is short, gonial angle is large and growth pattern is vertical.

Maxillary base- Vertical growth pattern:

1. Upward tipping of the forward end of the max base.
2. Downward tipping of the posterior end of the max base.
3. Horizontal growth patterns
4. Upward and forward tipping of the max base

**David a nd Richard Smith**, 1998, has described the cephalometric and clinical diagnosis of open-bite tendency.

1. Steep mandibular plane angle
2. SN: MP angle 40° (or) greater
3. OP: MP angle 22° (or) greater
4. PP: MP 32° (or) greater
5. PFH/AFH ratio 58% (or) less
6. UFH/LFH Ratio 0 700 (or) less

### *1.8. Sassouni analysis*

Sassouni[14] pointed out that the horizontal anatomic planes (Figure 5) -

1. The inclination of the anterior cranial base,
2. Frankfort plane,
3. Palatal plane,
4. Occlusal plane,
5. Mandibular plane-tend to converge toward a single point in well-proportioned faces.

The inclination of these planes to each other reflects the vertical proportionality of the face. If the planes intersect relatively close to the face and diverge quickly as they pass anteriorly, the facial proportions are long anteriorly and short posteriorly, which predisposes the individual to an open bite malocclusion (skeletal open bite).

If the planes are nearly parallel, so that they converge far behind the face and diverge only slowly as they pass anteriorly, there is a skeletal predisposition to anterior deep bite (skeletal deep bite).

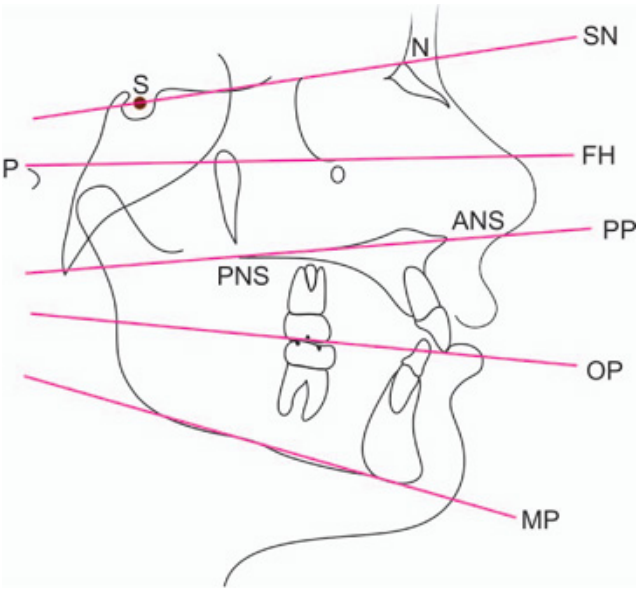


**Fig. 5:** Planes referred forSassouni Analysis

### *1.9. **Treatment plan***

#### *1.9.1. Treatment plan in deciduous dentition*

1. (a) No treatment up to 3 years of age
   (b) Dental type: Screening therapy
   (c) Skeletal type: habit control to reduce the increasing severity of dysplasia and the extra-oral orthopaedic appliances can be used effectively to redirect the growth (e.g.) chin caps

#### *1.9.2. Treatment plan in mixed dentition*

1. Early mixed dentition- Screening therapy
2. Late mixed dentition- Habit breaking appliance (Figure 6)
   -Orthopaedic approach
   -Orthodontic approach
   -Myotherapy

**surgical resection of mentalis muscle is done in mixed dentition stage to decrease the golf ball chin effect.

#### *1.9.3. Treatment plan in permanent dentition*

1. Functional appliances
2. Fixed mechanotherapy
3. Surgery

According to Issacson and Worms, spontaneous correction occurs in 80 percent of mixed dentition cases.[15] Parker and Johnson (1993) suggested interceptive treatment to be carried out in cases that do not self-correct.[16]

1. Altering mode of breathing
2. Myotherapy
3. Habit breaking appliances

**Fig. 6:** Habit breaking appliance

4. Functional orthopaedic appliances
5. Fixed mechanotherapy

*1.9.4. Treatment modalities*

1. Altering Mode of Breathing
   Linder and Arensen suggested adenoidectomy to be performed at an early age (6-8 years) to provide post-surgical growth.[17]
   Woodside confirmed that the change in mouth open breathing to mouth closed breathing reverses symptoms.
   (a) Tongue and mandible position raised
   (b) Increased width of maxillary arch
   (c) Increased depth of bony nasopharynx
   (d) Decreased lower facial height.

   Contraindicated in bifid uvula cases (indicate palatopharyngeal insufficiency)
   Side effect: can create hypernasality and cleft palate voice.
2. Myotherapy
   Purpose is to create normal facial muscular function to aid growth and development to normal occlusion

   Myotherapy exercises:
   (a) Ask the patient to hold the piece of paper between lips
   (b) Practice swallowing pattern: placing tip of tongue on the palate, close teeth, close lips, and swallow with tongue in that position.
   (c) Clenching exercises- 15 seconds- 5 times a day

   Myoappliances (Figure 7):
   i. Lingual pearl (JCO 1998)[18]
   ii. Scorpion appliance[19]
   iii. Blue grass appliance
3. Habit Breaking Appliances
   (a) Tongue Crib Appliance – inhibitory appliance. Restricts the tongue thrusting and thumb/ digit sucking habits.
   (b) Vestibular screens- It is effective in eliminating the mouth breathing habit, abnormal sucking habits and lip dysfunction to achieve a proper lip seal, which is of prime importance. This lip seal will indirectly influence the posture of the tongue and thereby leading to maturation of the deglutation cycle and creates a somatic swallowing pattern. The appliance is usually worn at night and 2 to 3 hours per day
4. Functional Appliances
   These appliances are designed to change the patient's pattern of function, alter the jaw relationship and reprogram the neuromusculature, thus altering the functional matrix of the face.
   (a) Activator- Stellzig et.al, 1999 has described about the ELASTICACTIVATOR for the treatment of open bite.[20] The intermaxillary acrylic of the lateral occlusal zones is replaced by elastic rubber tubes. By stimulating orthopaedic gymnastics (chewing gum effects) the elastic activator intrudes upper and lower posterior teeth. It also produces counter clock wise rotation of the mandible by decreasing the gonial angle (Figure 8).
   (b) Functional regulator 4 appliance (FR4): Rolf Fränkel believe that correction of the faulty postural activity of the orofacial musculature might help correct the associated skeletal deformity, so he used FR4 appliance (conjunction with lip seal training to achieve over bite correction and elimination of the skeletal dysplasia 1980) (Figure 9). A randomized clinical trial conducted by Erbay et al. (1995) reported that the growth direction of the mandible could be changed to an upward and forward direction by FR4 therapy
   (c) TWIN BLOCK - In treating the patients with vertical growth pattern associated with anterior open bite and increased lower facial height, the contact between the occlusal bite blocks and the posterior teeth should be maintained to prevent the eruption of the posterior teeth.
   If necessary, in certain patients, headgear tubes can be attached to the upper molar and high pull extra oral traction can be applied to a modified face bow worn at night to intrude the upper molars. If necessary, the concord face bow is also used along with this appliance, which is

best suited to produce intrusive force to the upper molars and protrusion effect to the lower dentition. This upward force is balanced by the horizontal elastic attached to the recurred labial hook and the vertical component of orthopaedic force is applied to the upper molars by cervical head cap (or) headgear.

(d) Modified Thurow appliance -: This modified appliance has acrylic occlusal splint and an expansion screw, which guides the vertical force against the posterior teeth and the alveolar process (Stuani, 2005).[21] An expansion screw in palate is incorporated to prevent and treat a posterior bilateral crossbite during the use of this appliance.

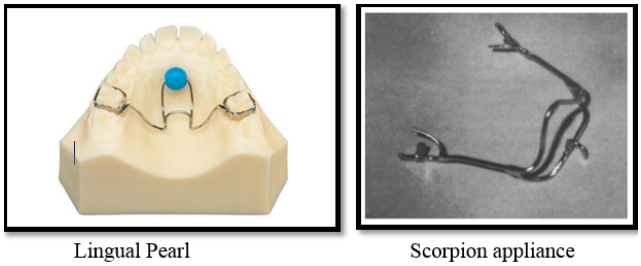


**Fig. 7:** Myoappliances

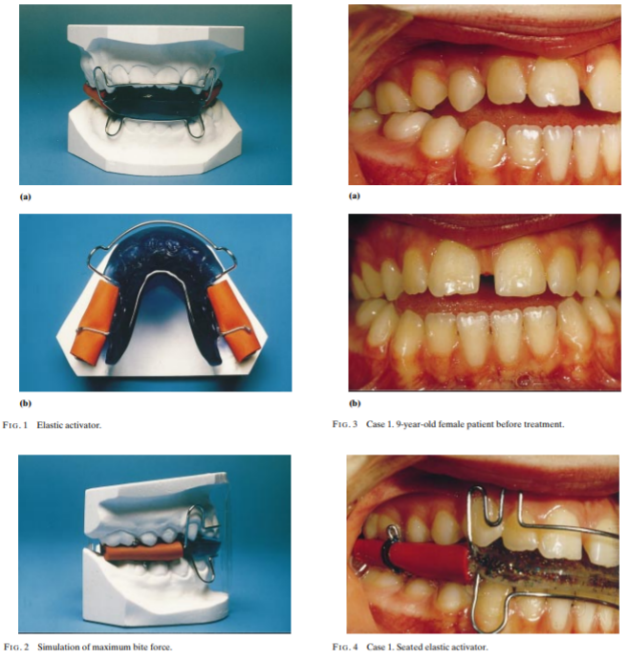


**Fig. 8:** Elasticactivator

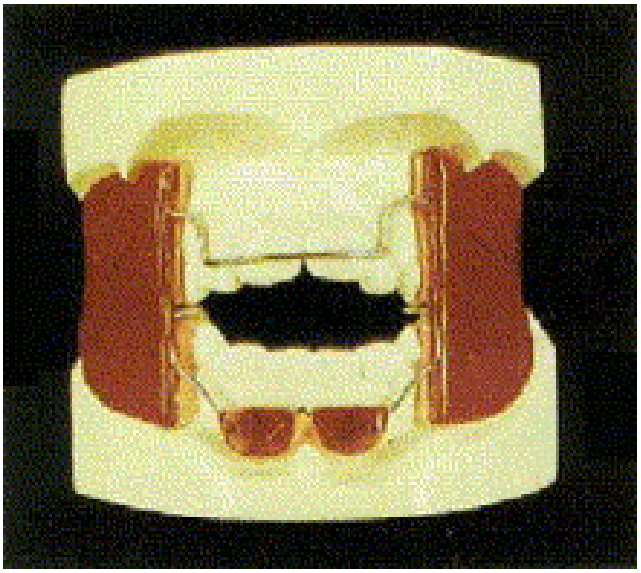

**Fig. 9:** FR4 appliance for Open Bite

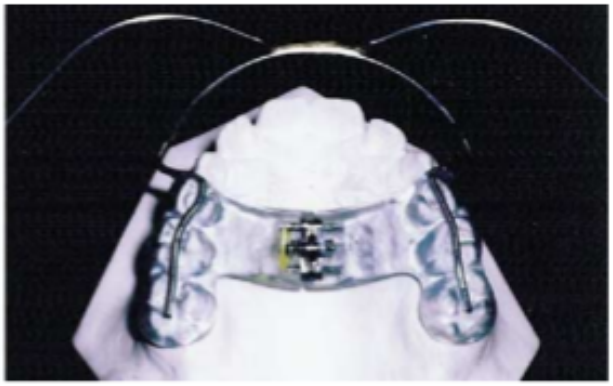

**Fig. 10:** ModifiedThurow appliance

### *1.9.5. **Fixed appliance treatment***

Correction of open bite by incisor extrusion:

1. Vertical elastics[22] (Nanda, 2012)

Indication:

(a) Complaint patients
(b) Patients with divergence of occlusal planes anteriorly.

Biomechanics: Vertical elastics from the lower incisors to the upper incisors results in a consistent force system of equal and opposite forces. Reduction of open bite occurs by extrusion of incisors (Figure 11).
Poor control of the force magnitude and degrees in compliance are main inherent problems.

2. Extrusion arches

Indications:

(a) Noncompliant patients who will not wear anterior vertical elastics
(b) When upper and lower occlusal planes that diverge anterior to the first premolars.
(c) When a constant extrusive force is desired in the anterior teeth with minimal posterior side effects Biomechanics:

3. Multiloop edgewise archwire (MEAW): Kim, (1987) developed MEAW consists of a 0.016"x0.022" stainless wire which contains a series of loops with both a horizontal and vertical component.[23]

**Fig. 11:** Application of elastics and an extrusion arch in the management of an open-bite malocclusion

**Fig. 12:** Multiloop edgewise archwire with vertical elastics

*1.9.6. Magnets*

The use of a magnetic appliance in the treatment of skeletal open bite malocclusion was first illustrated in the literature in 1986 by Dellinger. His 'Active Vertical Corrector' consists of TWO removable bite block appliances (maxillary and mandibular) containing four samarium cobalt magnets per arch (two on either side) which the author describes as an 'energized bite block' (Figure 13). The magnets produce a reciprocal repelling, intrusive force of 600*650g per side.[24]

**Fig. 13:** Active Vertical Corrector

1.9.6.1. Extractions for open bite closure: . Different types of extractions have been suggested to correct anterior open bite[22], including extracting the second molars, extracting the first molars, extracting the second premolars, and extracting the first premolars (Nanda, 2012).

1. Second molar extractions: The extraction of second molars has been suggested as a practical option in patients who have an anterior open bite with contact solely on these teeth and divergent occlusal planes (wedge effect).
2. First molar extraction: Typically, the first molar extracted only if they are compromised by extensive decay. If the second molar have not erupted and if the only contact is between the first molar, extraction of first molar would eliminate the increased vertical height
3. Premolar extractions: Extraction of second or first premolars are the most commonly considered alternatives for the treatment of anterior open bites associated with crowding and or overjet. In patients who has premolars extracted, extrusion of anterior segment rather than wedge effect aids in closing the open bite.

1.9.6.2. Temporary anchorage devices (tad): . TAD provides a source anchorage for intrusion of molars to correct the vertical dimension without the need for compliance of patient. A major advantage of molar intrusion with TADs is the favourable skeletal changes that enhance a patient's dentofacial aesthetics. The suggested magnitude of force for molar intrusion is about 50 to 200 g per tooth. For en mass intrusion of premolars and molars, a force of approximately 200 to 400 g has been

suggested. Usual time for intrusion of maxillary molars is 5-7 months for a mean intrusion of 2mm to 4mm. Sugawara et al. reported mean intrusion of 1.7mm and 2.8mm for mandibular first and second molars, respectively, when mini- plates were used. Molar intrusion can be accomplished with different types of TADs. The line of force for molar intrusion determines the number of mini-implants, buccal or palatal placement, direct anchorage or indirect anchorage, and anatomic location of TAD placement.

1.9.6.3. Skeletal anchorage system (SAS). Mikako umemorl et al., 1999 has described about the skeletal anchorage system for open-bite correction.[25] It consists of titanium miniplate that is temporally implanted in the maxilla (or) in the Mandible as an immobile anchorage. SAS - is used to intrude the Molars to correct the open-bite Malocclusion

*1.9.7. Surgical treatment*

Hulliten in 1849 was the first to surgically correct an anterior open bite. Since that time the operation was been termed as anterior mandibular sub-apical osteotomy and Trauner, Hofer, and Kole have modified it.

1. Anterior maxillary and mandibular sub apical osteotomy
   This surgery is mainly executed for the extrusion of the anterior segment of maxilla (or) mandible (or) both to close the anterior open bite.

   Indications for anterior maxillary sub-apical osteotomy:

   (a) A small open bite associated with the minimal tooth exposure (or) none, lip competence, a good nasolabial angle, and adequate lower anterior facial height
   (b) If the relationship between the upper lip and concealed maxillary incisors at rest, speech and smiling produces an unaesthetic edentulous appearance.

   Indication for Anterior Mandibular Sub – apical Osteotomy:
   If the open bite manifests in the anterior portion of the mandible as a reverse curve in the mandibular arch with transverse maxillo-mandibular harmony and good aesthetic balance between upper lip and maxillary anterior teeth.

2. “Kole” modification of mandibular sub-apical osteotomy

The main objective of this surgery is to c1ose the open-bite by elevating the lower anterior segment and reducing the chin height which includes horizontal sub-apical bone incision and vertical ostectomies in the premolar (or) molar extraction sites. The choice of extraction site depends on the magnitude of the anterior open bite and location of the reverse curve in the mandibular occlusal plane.

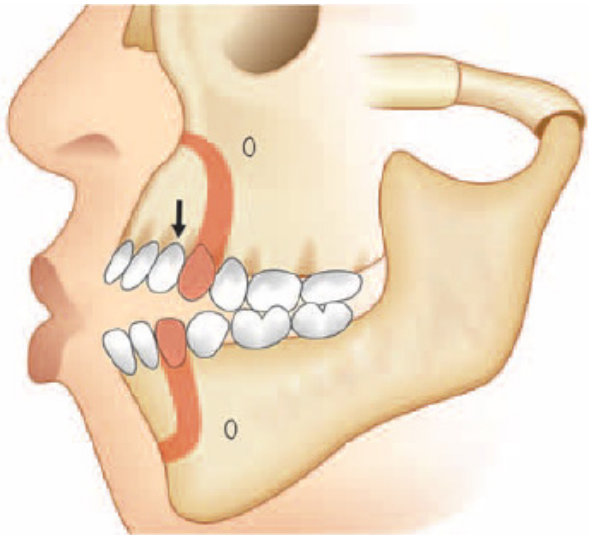

**Fig. 14:** Anterior maxillary and mandibular sub apical osteotomy

The other surgical procedures used for the correction of anterior open bites associated with mandibular prognathism and severe reverse curve with mandibular arch are

1. Mandibular Body ’step’ ostectomy
2. Mandibular body ’V “ostectomy
3. Mandibular body ’Y’ ostectomy.

Adjunctive surgical procedures
The ’v” excision for partial glossectomy
Keyhole procedure for partial glossectomy

**2. Stability a nd Retention**

Cessation of habits and removal of respiratory obstruction might decrease the rate and severity of relapse. Myofunctional therapy and placement of a tongue crib may improve stability in patients, especially with an anterior tongue posture (MillerAJODO 2020). Janson et al. in his study concluded that the long-term stability of corrected open-bite was higher in patient treated with extraction as compared to those who did not have extraction.

Long term studies indicated that orthognathic surgery is an effective method for the management of anterior open-bite. Superior re-positioning of maxilla by one piece Le fort 1 osteotomy is considered one of the most stable procedure in hierarchy of stability. According to a meta-analysis (Greenlee, 2011), correction of open-bite by a surgery is prone to some amount of relapse, although the long-term stability was greater than 75%, possible reason

for post-operative relapse is pre-operative orthodontic treatment, type of surgery, type of surgical fixation, condylar positioning during bimaxillary surgery, growth after surgery, and the soft tissue adaptation. Positioners are routinely suggested during retention phase. The elasticity of positioners between the molars applies an intrusive force through daily chewing exercise. Myofunctional therapy and placement of a tongue crib may improve stability in patients, especially with an anterior tongue posture. According to Nanda, masticatory muscle exercise involving a chewing gum or soft bite during retention might add in retaining the obtained result.

## 3. Summary

Open bite has a multifactorial aetiology. It is important to consider the growth status of the patient and to differentiate between a dentoalveolar and skeletal open bite. Treatment's strategies generally focus on the vertical control and/or extrusion of the anterior segments in the growing patient. With the introduction of TAD, skeletofacial changes can also be obtained with molar intrusion in non-growing patients. In patients with severe long face morphology, if aesthetic is the main concern of treatment, then surgical alternatives should be taken into consideration. Although all these treatments provide the possibility of attaining satisfactory outcomes, long term stability remains the major challenge for the orthodontist.

## 4. Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

## 5. Source of Funding

None.

## References

1. Parker JH. The interception of the open bite in the early growth period. *Angle Orthod*. 1971;41(1):24–44.
2. Subtelny HD, Sakuda M. Open bite: diagnosis and treatment. *Am J Orthod*. 1964;50(5):337–58.
3. Proffit WR. Contemporary Orthodontics. 3rd Edn. Mosby Publishing; 2000.
4. Zuroff JP, Chen SH, Shapiro PA, Little RM, Joondeph DR, Huang GJ, et al. Orthodontic treatment of anterior openbite malocclusion: stability 10 years postretention. *Am J Orthod Dentofacial Orthop*. 2010;137(3):302.e1–8.
5. Ng CS, Wong WK, Hagg U. Orthodontic treatment of anterior open bite. *Int J Paediatric Dent*. 2008;18(2):78–83. doi:10.1111/j.1365-263X.2007.00877.x.
6. Open-bite Frank W. Worms, D.D.S., M.S.D., Lawrence H. Meskin, and Robert J. Isaacson, AJODO June 1971.
7. Proffit WR, Fields HW, Sarver DM. The etiology of orthodontic problems. Contemporary Orthodontic. 3rd Edn. St. Louis: Mosby; 2000.
8. Sassouni V. A classification of skeletal facial types. *Amer J Orthod*. 1969;55(2):109–23. doi:10.1016/0002-9416(69)90122-5.
9. Rakosi T, Moyers RE, Jonas I. Orthodontic Diagnosis (Color Atlas of Dental Medicine). 1st Edn.; 1993.
10. Davidson L. Thumb and finger sucking. *Pediatr Rev*. 2008;29(6):207–8. doi:10.1542/pir.29-6-207.
11. Brauer JS, Holt TV. Tongue thrust classification. *Angle Orthod*. 1965;35:106–12. doi:10.1043/0003-3219(1965)035<0106:TTC>2.0.CO;2.
12. Proffit WR. Equilibrium theory revisited: factors influencing position of the teeth. *Angle Orthod*. 1978;48(3):175–86.
13. Dung DJ, Smith RJ. Cephalometric and clinical diagnoses of open bite tendency. *Am J Orthod Dentofac Orthop*. 1988;94(6):484–90. doi:10.1016/0889-5406(88)90006-6.
14. Sassouni V. A roentgenographic cephalometric analysis of cephalo-facio-dental relationships. *Am J Orthod*. 1955;41(10):735–64.
15. Isaacson JR, Isaacson RJ, Speidel TM, Worms FW. Extreme variation in vertical facial growth and associated variation in skeletal and dental relations. *Angle Orthod*. 1971;41(3):219–29.
16. Parker AM, Fischhoff B. Decision-making competence: External validation through an individual-differences approach. *J Behav Decision Making*. 2005;18(1):1–27.
17. Linder-Aronson S. Their effect on mode of breathing and nasal airflow and their relationship to characteristics of the facial skeleton and the denition. A biometric, rhino-manometric and cephalometro-radiographic study on children with and without adenoids. *Acta Otolaryngol Suppl*. 1970;265:1–132.
18. Ritto AK, Leitao P. The lingual pearl. *J Clin Orthod: JCO*. 1998;32(5):318–27.
19. Spolyar JL. A Physiologically Designed Habit Appliance. *J Clin Orthod: JCO*. 1974;8(7):406–7.
20. Stellzig A, Steegmayer-Gilde G, Basdra EK. Elastic activator for treatment of open bite. *Br J Orthod*. 2014;26(2):89–92. doi:10.1093/ortho/26.2.89.
21. Stuani MB, Stuani AS, Stuani AS. Modified Thurow appliance: a clinical alternative for correcting skeletal open bite. *Am J Orthod Dentofacial Orthop*. 2005;128(1):118–25. doi:10.1016/j.ajodo.2005.02.014.
22. Uribe FA, Janakiraman N, Nanda R. Management of Open Bite Malocclusion. Elsevier; 2015. p. 147–76. doi:0.1016/B978-0-7216-0196-0.50013-8.
23. Kim YH. Anterior openbite and its treatment with multiloop edgewise archwire. *Angle Orthod*. 1987;57(4):290–321.
24. Dellinger EL. A clinical assessment of the active vertical corrector-a nonsurgical alternative for skeletal open bite treatment. *Am J Orthod*. 1986;89(5):428–36.
25. Umemori M, Sugawara J, Mitani H, Nagasaka H, Kawamura H. Skeletal anchorage system for open-bite correction. *Am J Orthod Dentofac Orthop*. 1999;115(2):166–74.

## Author biography

**Anshul Munjal,** Private Practitioner

**Adeeba Ali,** Private Practitioner

**Sharon Ann Abraham,** Private Practitioner

**Bater Jini,** Private Practitioner

**Cite this article:** Munjal A, Ali A, Abraham SA, Jini B. A review on open bite. *IP Indian J Orthod Dentofacial Res* 2021;7(4):277-285.