

# Genetic Influence on Open Bite: A Case Report

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**Abstract:** Open bite is one of the most serious malocclusions that can affect a patient's masticatory processes, it is also a condition that is poorly known and investigated. The majority of recorded instances are sporadic or idiosyncratic, with a wide range of etiologies that are still poorly understood. Although open bite has been linked to primary failure of eruption (PFE), lateral tongue push, and medical syndromes or temporomandibular joint dysfunction, the intricate interplay of environmental and genetic factors makes its etiopathogenesis a challenging issue to comprehend and explore. Further research into the gene(s) and mechanism(s) involved can not only help us better comprehend open bite and the complex muscular-occlusal link, but it can also help us figure out the best ways to treat these (and possibly other) malocclusions.

**Keywords:** Genetics, Open bite, Orthodontics, Malocclusion

## 1.Introduction

Malocclusion may be defined as a significant deviation from what is defined as normal or "ideal" occlusion (Andrews, 1972). Malocclusion can occur in three planes i.e. sagittal plane, vertical plane and transverse plane. In the past, though the importance has been given for the treatment of sagittal and transverse malocclusions, the malocclusion occurring in the vertical plane is of equal importance.

The vertical overlap of the anterior teeth are known as "overbite" (normally = 2-3 mm) and the horizontal overlap of the anterior teeth are known as "overjet" (normally = 2-3 mm). Any deviation from this normal occlusion will lead to malocclusion. When there is a lack of vertical overlap between the maxillary and mandibular dentition, is termed as "open bite" and if there is an increase in the overbite is termed as "deep bite".<sup>1</sup>

The term "open bite" was introduced by Carevelli in 1842 as a separate class from those already described by his predecessors, while J. Lefonlon in 1841 advanced the biological phenomenon and mentions that irregularities are due to:<sup>2</sup>

External muscular forces as the lips and cheeks

1. Internal muscular forces as the tongue
2. Occlusal forces

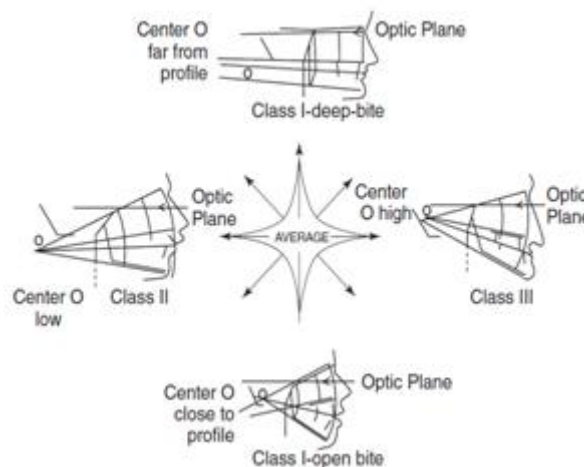


Fig. 1

Sassouni's major contribution to cephalometric analysis was his observation that the relative parallelness or convergence of the horizontal planes of the face (i.e., the anterior cranial base, palatal plane, occlusal plane, and mandibular plane) are related to anterior and posterior face height and frequently reflects a tendency toward deep bite or open bite, as seen in Sassouni's original diagram. The more parallel the planes, the greater is the deep bite tendency. This "Center O" (Figure 1) is the approximation of where the planes converge posteriorly. The theory is that the farther Center O is from the profile, the less convergent are the planes. This is seen most dramatically in the Class I deep bite and open bite representations.<sup>3</sup>

## 2. Classification

Open bites as a type of malocclusion and different authors have established that it occurs when the overbite is less than the normal overbite.

Open bite is classified into:

1. Anterior Open Bite
2. Posterior Open Bite

• Anterior Open Bite is further classified:

1) On the basis of whether it is due to epigenetic (or) environmental factors

1. Skeletal open bite
2. Dental open bite

2) On the basis of upper and lower first molar anterior-posterior relationship

1. Class I open bite
2. Class II open bite
3. Class III open bite

Anterior open bite (AOB) is defined by a lack of vertical overlap between the incisal edges of maxillary and mandibular anterior teeth.<sup>4</sup> If anterior teeth meet and posterior teeth do not, there is by definition a posterior open bite, which is almost always related to failure of dentoalveolar development in one or both arches. Evaluating vertical proportions relies on the convergence or parallelness of the mandibular plane, occlusal plane, and palatal plane (Fig. 1). If these three planes converge acutely and meet at a point close behind the face, posterior vertical dimensions are relatively smaller than anterior vertical ones. This produces a skeletal tendency toward anterior open bite, which is now routinely called "skeletal open bite."

Dental vertical problems refer to too much or too little eruption of teeth in relation to their own supporting bone. An open bite may be caused by infraeruption of incisors in either arch. This can be seen cephalometrically by a decrease in the distance from the incisor to the mandibular plane or palatal plane. Overall, proportion must be taken into account in judging these factors, because supraeruption of posterior teeth is also a factor in open bites. The relationship of the upper molar roots to the height of the palatal vault, which is easily observed cephalometrically, can be a great help in evaluation. The root apices of the upper molar in an adult should be at 2 to 3 mm below the height of the palatal vault.<sup>5</sup>

Worms, Meskin and Isaacson classified open bite as simple, compound and infantile.<sup>6</sup>

1. Simple OB: Open bite extends from canine to canine
2. Compound OB: Open bite extends from premolar to premolar
3. Infantile OB: Open bite extends from molar to molar.

## 3. Genetics

Heredity in the same way that horizontal skeletal dysplasias are inherited, so dysplasias in the vertical plane may also be inherited. These vertical dysplasias can be associated with a Class I, Class II or Class III skeletal relationship.<sup>7</sup> Innate growth potentials are regulated by genetic constitution of the body. For example controls of sagittal, transverse and vertical dimensions are usually inherited in the family such as Hapsburg jaw. Growth and growth rotations occurring in late maturation period are also attributed to the genetic pool of the patient. Facial types such as hyper and leptoprosopic allow the vertical eruption of molars, thus causing an excessive vertical skeletal pattern.<sup>8</sup> Relationship between the open bite and skeletal morphology have been extensively studied by Cangialosi.<sup>9</sup>

The differences are as follows:

1. Patients with open bite have a longer anterior facial height than the posterior facial height.
2. Proportion of lower facial height is more than the upper facial height in open bite patient.
3. The patient with open bite presents with large mandibular plane angle and gonial angle.

It is possible that the anterior open bite is influenced by genetic factors, since the genes that contribute to the growth and development of bones, teeth and soft tissues may be associated with the anterior open bite. Several data sources suggest that genetic factors contribute to the development of malocclusions. There may be a moderate to high proportion of inheritance (up to 60% contribution) for many dental and facial features. On the other hand, overbite has 53% and overjet 28% of genetic contribution, which suggests that environmental factors have a greater contribution than genetic factors.<sup>10</sup>

Genes involved:

- a) rs17576 polymorphism of the MMP9 gene
- b) genetic variant, R577X, in the gene coding for  $\alpha$ -actin
- c) AJUBA gene
- d) rs3826620 polymorphism of the RANK gene
- e) polymorphisms of Pro561Thr in the growth hormone receptor
- f) mutations in the PTHR1 gene

## 4. Case Report

A 13 year old girl reported to us with the chief complaint of inability of upper and lower teeth meet properly. On examination it was observed that patient had anterior open bite with contact only in the first molar region bilaterally in both the arches (Figure 2, 3 & 4.) On further investigation it was found that patient's father also suffered from the same malocclusion but to a lesser extent (Figure 5, 6 & 7).



Figure 2



Figure 3



Figure 4



Figure 5



Figure 6



Figure 7

## 5. Discussion

The current case report emphasises that skeletal jaw discrepancies and malocclusions of hereditary origin can be successfully treated orthodontically, with the exception of extreme cases requiring surgical intervention. Moss and Salentijn proposed in their study that orthodontic repair of malocclusion alters the phenotypic manifestation of a specific morphogenetic pattern.

In clinical orthodontics, it is important to recognise that each malocclusion has its own distinct slot on the genetic/environmental continuum, and hence the diagnostic goal is to ascertain the relative contribution of heredity and the environment.

## 6. Conclusion

The overall prevalence of anterior open bite among patients is less but challenging. Familial inheritance is observed in the above patients. Hence genetics plays an important role in anterior open bite malocclusion. Therefore, more studies are needed to decode the enigma of open bite and genetics.

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