

## Atypical Swallowing, Open Bite and Musculo-Postural Consequences

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In this review, the author wants to highlight the possible musculopostural consequences in people who have atypical swallowing. Altered swallowing is often related to dental malocclusion, specifically to open bite. This combination of atypical swallowing with open bite leads to hypotonia of the masticatory muscles, which is confirmed by various authors by EMG examination. This muscular hypotonia has consequences both at the level of the temporomandibular joint and at the postural level. It is common that the individual suffers from specific symptoms that must make the practitioner reflect on the possible cause at the level of the swallowing mechanism.

**Keywords:** Atypical Swallowing; Posture; Postural Dysfunction; Open Bite**Introduction**

Swallowing is a complex physiological function of the human body, which allows the food bolus, saliva and liquids to be transported from the oral cavity to the stomach. This essential function is mediated by a neuromuscular mechanism where nerve receptors are involved both at the level of the tongue and lips [1-4].

During development, this mechanism involves the interposition of the tongue between the bone structures, while in an adult, it is positioned against the upper- retroincisive papilla.

The transition to the adult phase occurs in 12-15 months along with dental eruption [5-8]. When the transition to the adult phase does not occur with the consequent continuation of the infantile phase, it is a pathological condition called atypical swallowing, where the altered tongue posture leads the tip of the tongue to position itself against the palatal face of the central incisors or between the dental arches. The back of the tongue runs caudally and the base of the tongue touches the back of the palate and the

front of the pharyngeal wall. This situation causes hypotonia of the jaw's elevator muscles, while the perioral muscles are hypertonic [8]. This condition is also related to a dysfunction of the maxillary vertical growth, causing an open bite [9].

In addition to occlusal problems, postural dysfunction can also occur. Computerised tests show that in all patients this condition leads to an altered centre of gravity, as well as to a high number of oscillations in the standing position [9]. Studies by Scoppa and others also confirm that there is a significant relationship between the position of the tongue and the posture of the body, which has come to be known as Glosso-Postural Syndrome [10].

In this article, the author wants to underline the importance of also evaluating the possible postural consequences in individuals with atypical swallowing and open bite.

**Atypical swallowing**

When visceral swallowing persists beyond four years of age, it means that the child is suffering from atypical swallowing and it

is a dysfunctional or abnormal condition, as it is associated with forms of dental malocclusion [11]. Recent studies have shown that, at three years of age, half of children show signs of visceral swallowing (and it is quite normal, as many are still in the transition phase). However, at 12 years of age, 25% of children still have this altered swallowing [12]. These children do not always show all the characteristics of visceral swallowing, but they show at least one of the signs that are attributable to swallowing from the infantile phase [13]. Atypical swallowing is a much more frequent dysfunction than one would think. In a 2001 study, Profit [14] found that only 85% of the population swallowed properly. Therefore, it seems that, in those cases that show a delayed development of the swallowing mechanism, a certain percentage tend to develop a maturation of the process over time. For a number of reasons that are not yet fully explainable, visceral swallowing sometimes also persists due to the change of the dentition and then it is called atypical swallowing [13].

Atypical swallowing is often associated with non-nutritive sucking, bottle use, mouth breathing, central nervous system and anatomical abnormalities [15].

Atypical swallowing will mainly manifest itself in two ways:

- **Deviate with simple thrust:** clear contraction of the orofacial muscles (orbicular, mental, mandibular elevators), anterior tongue thrust and narrow dental arches.
- **Deviate with complex thrust:** clear contraction of the orbicular and of the chin, no contraction of the mandibular elevator muscles, anterior tongue thrust, wide dental arches with tongue and/or lower lip interposed [16].

Among the anatomical anomalies that occur in association with atypical swallowing, we also find the modified position of the hyoid bone due to the numerous insertions on it of many muscles involved in the swallowing mechanism. Numerous authors have tried to establish what the correct position of the hyoid bone in relation to the skull is [17-19] and the final position that this bone assumes in subjects affected by dental malocclusion [20-22] in subjects with mouth breathing [23,24] and in people suffering from obstructive sleep apnea [25,26].

In this context, the hyoid bone assumes a key position between the jaw and the rest of the body. It is a suspended bone, which has no real joints with other bone surfaces, only "distant connections", of a muscular, tendon and fascial nature [27].

### Atypical swallowing and mouth breathing

There are different forms of atypical swallowing and, from an aetiological point of view, there are two types

- **Primary Atypical Swallowing:** this type is psychological in origin and manifested in infantile (visceral) swallowing. Generally, this type of atypical swallowing arises as a result of parental over-care and is often associated with a general infantile attitude, sleep, appetite, digestion and mood disorders [28].
- **Secondary Atypical Swallowing:** in most cases, this arises for one of the following factors:
  - Poor habits, such as thumb sucking or prolonged use of a dummy [30].
  - Artificial breastfeeding [30].
  - Delayed weaning [31].
  - Macroglossia [29].
  - Adenoid and tonsillar hypertrophy, with a tendency to mouth breathing [29].
  - Turbinate hypertrophy [29].

Adults can also return to swallowing in an infantile manner following a temporary nasal obstruction, or when they have prolonged pain of the teeth every time they come into contact. In these conditions, the person is forced to keep their mouth open, favouring the onset of secondary atypical swallowing [32].

However, mouth breathing represents one of the fundamental aetiological factors in this topic.

It is a pathological condition [33] where the exclusive or partial passage of air is through the mouth and not through the nose and this condition is often accompanied by dental malocclusion [34] and atypical swallowing [35].

We classify the causes of mouth breathing into congenital and acquired and it can manifest itself due to an obstruction of the upper airways, sagging facial muscles or habits [36]. All individuals who exhibit mouth breathing for a period of no less than six months should be considered mouth breathers [37].

The most evident consequences are represented by alterations to the craniomaxillofacial development, principally caused by an anomalous positioning of the mandible and consequent dysmorphism of the oral structures. The tongue is placed downwards and

this allows the air to pass through the oral route. If, in addition, as is often the case, there is tonsillar hypertrophy, the tongue further anteriorises since its base is forced to move away from the posterior pharyngeal wall due to space problems. The most frequent dysgnathia is dental class 2 and, among these, open bite is frequent among mouth breathers [38]. It should be pointed out that malocclusion may not be a consequence, but a cause of mouth breathing due to the wrong mandibular and tongue position that derives from dysmorphosis [39].

Atypical swallowing begins to manifest itself as a delay in the maturation process from the infantile swallowing phase to that of mixed swallowing, which, if it does not clearly occur, causes a failure to further develop towards the adult swallowing phase [40].

### Atypical swallowing and dental malocclusion

The pressure exerted by the tongue in atypical swallowing on both dental arches is able to modify their development and to cause a series of alterations, among which the most frequent is anterior open bite. However, there are many dental malocclusions that can be a result of atypical swallowing.

Much interesting research has been published on this relationship: in 1946 Rix [41] studied a sample of 93 children aged between 7 and 12 years of age. 61 of these children had atypical swallowing and 36% of them also had dental malocclusion. Also interesting is the research carried out by Rogers [42] who in 1961 compared a group of pediatric orthodontic patients with a sample of public school children (some of whom had orthodontic problems) and noted that the incidence of atypical swallowing was high in both groups: 56.9% in public school children and 62.8% in orthodontic children. The percentage rose significantly among children with deep bite, 79.7% and 62.8%, respectively, and even more among those who had open bite (98.2% and 92.8%).

Dental malocclusions that can be a consequence of atypical swallowing are as follows [43]

- Anterior Open Bite.
- Uni or Bilateral Open Bite.
- Total Open Bite (with contacts only on the most distal parts of the arches).
- Uni or Bilateral Crossbite.
- Anterior Crossbite.
- Total Crossbite.
- Increased Overjet.
- Increased Overbite.
- Diastemas.

Malocclusion does not necessarily always result from atypical swallowing. Rogers [42] and others affirm: “the relationship between dental malocclusion and atypical swallowing varies from one case to another and lingual dyskinesia can be the cause, contributing cause or consequence of dentoalveolar alteration”. However, in most cases, it is an interposition of the tongue between the teeth, which hinders their eruption or pushes against them, thus exerting a force that acts negatively on the morphogenesis of the dental arches. This is because the position of the teeth in the mouth depends on internal force, generated by the tongue, and external force, generated by the perioral muscles [44].

However, it is of fundamental importance to understand when swallowing is atypical due to the persistence of an infantile attitude or when it is a necessity due to local or general obstructing factors. In the first case, it is swallowing that can cause malformations of the stomatognathic system with neuromuscular alterations. In the second case, it is the reverse [45]. By excluding these factors, a precise diagnosis of primary or secondary atypical swallowing will be derived and, consequently, the need or not for rehabilitation therapy [45].

### Atypical swallowing and TMD

Studies performed by Marchesi A., *et al.* show that there is an increased risk of TMD (temporomandibular disorders) in patients with atypical swallowing [46].

Similarly, the study performed by Thoru I., *et al.* shows that there is a relationship between open bite and alterations of the temporomandibular joint [47]. This is also confirmed by Masato K. and collaborators [48].

The study performed by Alstergren., *et al.* [49] is interesting, when they combine open bite and TMD. They believe that there is a marked increase in interleukin 1 beta in the synovial fluid, with an increase in the sensitivity to compression of the TMJ and the presence of pain in this region. The presence of these interleukins appears to be an alarm bell for tissue destruction.

Without highlighting a causal link, Hoppenreijts T. J. M., *et al.* [50] associated a maxillary vertical hyperplasia with a mandibular hypoplasia and anterior open bite in a study with 259 patients. These patients were then analysed before and after treatment for joint noises in the TMJ, condylar remodelling and condylar resorption.

Hanefi K., *et al.* associate TMJ osteoarthritis with open bite in their study published in 2011 [51].

Finally, 30 female patients with anterior open bite were analysed by MRI of the TMJ on the anterior displacement of the disc within the joint with modifications of the mandibular condyle (erosion, osteophytosis and deformation). The conclusion was that anterior displacement of the articular disc without reduction and modifications of the mandibular condyle can be related to anterior open bite [52].

Therefore, it seems that open swallowing, which we have previously seen often causes anterior open bite, can be the cause of numerous alterations of the temporomandibular joint.

### Atypical swallowing, open bite and postural consequences

In this review, I wish to study open bite as it is definitely the most frequent type of malocclusion in those with atypical swallowing [42].

The term open bite was first coined by Carevelli [53] in 1842 and it is estimated that it occurs in about 0.6% of the population in the USA. This is an abnormal occlusal condition where the anterior teeth of the upper dental arch do not come close enough to the teeth of the lower dental arch. Once this gap is present between the upper and lower incisors, the tongue continues to position itself between them with each swallowing act, effectively increasing this gap. Open bite does not manifest itself in those people who have masseters that play an active role in the swallowing mechanism. The weaker the masseter muscles, the more likely the person is to suffer from atypical swallowing and open bite [54]. Indeed, when the dental malocclusion is subsequently corrected with an orthodontic treatment, there is a significant increase in the tone of the masseter muscles [55]. However, hypotonia does not only affect the masseters, but all the chewing muscles. This is indeed confirmed by Stormer, *et al.* [56] that reported that patients with as, during saliva or water swallowing, may have an increased electromyographic activity of perioral muscles and a decreased activity of the masticatory muscles, which was similar to the findings of other authors [57].

Hypotonia of the masseter and temporal muscles is also typical in mouth breathing [58], as confirmed by Ferla A. and others by means of electromyographic examinations.

In summary, in an atypical swallowing condition associated with open bite, there is, in most cases, a state of hypertonia at the level of the swallowing muscles and a muscular hypotonia at the level of the chewing muscles associated with mandibular retrusion and cervical hyperlordosis between C3 and C7 [59].

The outcome of Moya, Rocabado, *et al.* [60] at the University of Chile in 1994 is interesting. They used the bite (with consequent increase in the vertical dimension and elongation of the chewing muscles) in 15 subjects and drew two conclusions:

- A significant reduction in lordosis in the upper part of the cervical spine (the authors speak of C1-C2-C3).
- An increase in the extension in the remaining part of the cervical lordosis (C3-C7).

That there is a relation between the masticatory muscles and the neck muscles has been suggested by many authors. The main findings are that a plausible evidence between the masticatory and cervical muscles can be described [61]. The authors of this article didn't find specific studies where the electric activity of the upper trapezius was measured in patients with an open bite (OBM) or with an atypical deglutition or in oral breathing to confirm this. Despite that, a few studies give the possibility to confirm the assumption that there is a direct link between neck and atypical deglutition, oral breathing and open bite. Interesting in this regard is the conclusion of Ferraccioli: "As for the SCM, suboccipital and trapezius muscles, the studies found a significant reduction in the electrical activity of the muscles evaluated during the relaxed position, aligned posture and nasal breathing of mouth breathers after physical therapy treatment [62]. This means that before the treatment and with the oral breathing there was a higher electric activity in these muscles. Posnick and Agnihotri [63] confirmed the relationship between postural changes in mouth breathing patients with an open bite as well.

### Symptoms of atypical swallowing and postural dysfunction

The disorders that can occur with atypical swallowing that negatively affects posture are numerous and, for this reason, I decided to divide the symptoms into those related to atypical swallowing and those related to postural consequences.

Symptoms of atypical swallowing:

- Malformations of the facial skull, mainly due to an altered physiology of the orofacial muscles [65]
- Dyslalia [64].
- Hypoesthesia of the tongue [65].
- A feeling of suffocation [64].
- Infections of the auditory complex [66].
- Mouth breathing when open bite is also present [67].

Symptoms of postural consequences

- **Headache:** Broberg, *et al.* [68] conducted a study where they concluded that 41% of the subjects examined with open bite suffered from headaches.
- **Neck Pain:** Raggi states that atypical swallowing can trigger discomfort and pain in the cervical spine [69].
- **Tinnitus:** tinnitus and buzzing are always possible consequences of atypical swallowing [69].
- **Mandibular click:** joint noises are associated with open bite [50].

### Conclusion

Atypical swallowing is a widely studied phenomenon that should be addressed by various professions (dentistry, speech therapy and manual therapy). The consequences of this dysfunction are not only expressed in dental occlusion and in the musculature of the oral cavity, but also in respiration, in the mechanics of the temporomandibular joint and of the spine. Therefore, the symptoms that can derive from this alteration are varied and must be analysed carefully and not as a disorder in itself, but as a complex set of problems with a single cause. It is therefore not advisable to face this dysfunction from a single point of view, while the multidisciplinary approach seems to be the basis for a correct and complete evaluation.

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