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The relationship between occlusion and posture: a systematic review

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Abstract

The relationship between stomatognatic and postural system has longtime been investigated among practitioners in healthcare.

Since the last half of the twentieth century, the relationship between the subjects of orthodontics and orthopedics has been debated and, as a result of that, some scientifically validated studies and numerous case reports were published. In the medical world, however, the validity of many of these studies has been discussed, as they do not seem to meet the criteria of the "evidence-based medicine".

The physiological continuum that links occlusion and posture, in fact, does not seem to be a unique and linear relation but rather a complex set of many contributing factors.

The aim of this review is to try to understand this intriguing neurophysiological web through the analysis of the already achieved knowledge in order to find out the gaps that still don't allow to say whether a postural approach should be used during the orthodonthic treatment or not.

Introduction

The physiological continuum that links occlusion and posture does not seem to be a unique and linear relation but rather a complex set of many contributing factors. Basic and clinical research projects should be pursued in order to eventually identify the cause-effect relationship between occlusion and posture and only if there is an evident link between them, the postural approach during the orthodontic treatment will be evidence-based. [1,2]

Even Huggare [3] highlighted the fact that, despite the strong awareness in studying this correlation, only a few founded studies have been performed so far.

In 1964, Balters [4] stated that a purely localized disease of the teeth and jaws does not exist and that, during the therapy, all the structures and symptoms close to the stomatognatic system should be considered.

According to him, orthodontists should pay more attention on the posture of their patients: apart from using mechano-therapy to obtain a correct position of teeth and jaws, they should also be aware of the strong correlation present between occlusion and posture not only cephalic but of the whole body, taking into account the physiological variation of the cranio-cervical positions during orthodontic therapy.

Occlusion and posture

In literature a high prevalence of orthopedic pathological findings is reported in patients who need an orthodontic treatment: 74% of the group investigated by Dubler et al. and 91% in the one examined by Hirschfelder & Hirschfelder. Prager observed a normal appearance and shape of the jaws in only 13% of its orthopedic patients. 83% of 420 patients with orthopedic disorders of Muller-Wachendorf had malpositioned teeth and/or jaws.

Recent studies emphasized the potential role of the mandibular posture in the maintenance of postural control. Since the posture and the mandibular function are strongly influenced by the position of the teeth, it is thought that different dental occlusion may influence body posture.

Bracco et al. [5] observed that in patients without malocclusion, different intermaxillary relationships can influence the posture of the body. In particular, the myocentric relationship reduces the body sway and improves the distribution of the weight on the area of the feet.

Even Gangloff et al. [6] [7] carried out a study similar to the previous one in order to assess the postural control by keeping the jaw in four different positions using interocclusal splints (centric relation, intercuspal, lateral right and left). Postural control and the ability to stare get worse going from the centric relation to intercuspal and to lateral occlusion suggesting a role of occlusion in maintaining postural stability. In addition, the same study showed a possible role of occlusion in the proprioception and the stabilization of the look.

The relationship between different types of malocclusion and the spinal curvatures in the various planes of the space was the subject of several studies showing significant associations. The hypothesis underlying this association is that the position and the contact between maxillary and mandibular teeth can not only affect the muscles close to the jaws (and thus affect the structure of the cervical spine) but also the distal muscles (so liaising with thoracic, lumbar and pelvic curvatures).

Malocclusion and cervical spine

Talking about proximal musculature, different authors highlighted the relationship between occlusion and the posture of the cervical spine. Especially if observed on the sagittal plane, they found a connection between the sagittal relationship of the jaws, the mandibular length and the increased cervical lordosis. In particular, it seems that the skeletal class II is more often associated with a greater extension of the head on the spine compared to classes I and III.

Gadotti et al. [8] analyzed the posture of the head and the electromyographic activity of the anterior part of the temporal and masseter muscles bilaterally in subjects in different classes of Angle, showing a change in the electromyographic responses in subjects in class II, who more frequently had a forward position of the head.

Nobles et al. [9] deepened this topic in a study with fifty patients belonging to all of Angle classes who were asked to position themselves on a stabilometric platform and perform various tests. The results confirmed that patients in class II have more often a forward body position while those in class III a backward position. A possible explanation for this association is provided by Solow & Sandham [10] who speak of "soft tissue stretching": this hypothesis tries to explain how the cranio-cervical posture can influence the development and the function of dentofacial structures. Various studies showed that subjects with a very inclined mandibular plane and a long-face morphology have an extended posture of the head and a cervical spine tilted forward while subjects with a short face have a lowered position of the head and a much more accentuated cervical lordosis. In addition, some cephalometric studies showed that people with a small cranio-cervical angle usually have a reduced anterior facial height, increased mandibular prognathism and a less inclined mandibular plane while subjects with an increased cranio-cervical angle have an increased anterior facial height, maxillary and mandibular retrognathia and a more inclined mandibular plane. Another longitudinal study showed that bending the head (reduced cranium-cervical angle) leads to a growth with forward rotation of the mandible while the extension induces a vertical growth without forward rotation. It therefore seems that there are correlations between postural changes and changes in the craniofacial morphology and these changes seems to be coordinated by the mandible.

There is an association between head posture and craniofacial morphology and, as a result of that, cranio-cervical posture influences craniofacial growth. This mechanism is called "soft tissue stretching": the differences in the craniofacial morphology can be explained in terms of strength that the soft tissues (skin and facial muscles) exert on the facial skeleton.

When the head is extended on the column this layer is stretched, the forces on the skeletal structures are increased and so they block the forward growth of the jaws directing it more backward.

Von Treuenfels & Torklus [11] showed a correlation between the radiographic atlas position and the different types of malocclusion. The authors noted an higher atlas position in patients in class III and a lower one in patients in Class II, division 1. The patients in Class II, division 1 showed a higher head posture compared to those in class III. Patients with anterior open bite seem to have an atlas position similar to the one of patients with increased overjet. These results can be explained by the fact that a reclined head posture is assumed in case of persistent mouth breathing.

The relationship observed between the position of the atlas and the Angle classes is not confirmed by Hirschfelder & Hirschfelder studies [12] [13] [14] According to them, patients with class III showed a more dorsally extended head posture dorsally and an increased incidence of skeletal pathologies of the first cervical vertebrae.

Even if the literature often affirmed the contrary, the X-ray analysis showed several times some specific relationships between the cervical spine and the different Angle's classes. In particular, both Gresham & Smithells [15] and Balters [4], saw a radiographically increased cervical lordosis in subjects with class II and a tendency to a kyphotic position in patients with class III; such data were also confirmed by Noble [16].

On the contrary, other interdisciplinary studies rejected the hypothesis of a direct correlation between Angle's classes and orthopedic findings: among these, Hirschfelder & Hirschfelder affirmed, thanks to a clinical study on 118 orthopedic patients, that poor posture and sagittal jaws relationship are two independent disorders and that, therefore, they require different approaches.

Malocclusion and lower spine

Talking about the relationship between malocclusion and the thoracic, lumbar and sacrococcygeal spine, most of the literature focuses on the analysis of scoliosis patients, mainly analyzing the postural parameters on the frontal plane.

Scoliosis seems to be the more frequently found disease in interdisciplinary studies as it may be indirectly connected to some forms of facial asymmetry and dental malposition in the transverse plane.

Idiopathic scoliosis, whose etiology is unknown but whose base seems to be a genetic multifactorial alteration, is also called developmental or juvenile scoliosis because of its typical appearance in the pre-pubertal period and its potential worsening during the growth peak.

This dysmorphism macroscopically occurs as a deviation of the spine which loses its verticality on the lateral plane leaning laterally in one or more curves. In most cases the main curve (or primitive) is only one. Less frequently there are two main curves. The curves can be cervical, dorsal-cervical, dorsal-lumbar or lumbar depending on the affected segment; right- or left-convex considering the curve's side of convexity.

However, in order to maintain a proper center of gravity, the spinal column changes above and below the main curve as a natural defense mechanism producing the so-called "compensation curves". Idiopathic scoliosis implies therefore an anatomical alteration of the vertebral bodies in the three dimensions of space; it's "structured". This means that the spine, under the deforming effect of the vertebrae, twists itself causing obvious negative effects on muscles, tendons, joints and often on the internal organs as a consequence of the deformation of the rib cage. The scoliotic spine contains atrophic muscles on one side and hypertrophic muscles on the other and is often associated with kyphosis and lordosis.

Scoliosis should be absolutely distinguished from the "scoliotic attitude" which is not a dimorphism but a paramorphism. The latter condition is much less severe and occurs, for example, in the frequent case in which the two lower limbs have a different length causing a leg length discrepancy that is transmitted through the pelvis to the spine. The scoliotic attitude is easily corrected by removing the cause (for example by the use of an insole to match the length discrepancy of the lower limbs) and with a constant physical activity.

Ben-Bassat et al. [17] studied the potential correlation between scoliosis and different occlusal patterns through a study involving 96 patients with idiopathic scoliosis and 705 boys in the control group (not suffering from scoliosis). The distribution of Angle's classes was significantly different in the two groups with a prevalence of II classes in the orthopedic group. In addition, in the same group they found evidence of asymmetric malocclusion with deviations of the upper and lower median lines and a high frequency of anterior and posterior crossbites. They couldn't however find a correlation between site, side and severity of scoliosis and appearance and the site of malocclusion. They thus concluded that patients with idiopathic scoliosis have an asymmetric malocclusion more frequently than the healthy population.

This and other studies let us think that the kind of malocclusion that can potentially affect the scoliosis and the leg's length is unilateral posterior crossbite. This kind of malocclusion is the most common in early mixed dentition (7-23%) and has a strong impact on the functioning of the masticatory system.

In this respect, the experimental study of D'Attilio et al. [18] is interesting as they used some bites to produce an unilateral malocclusion in fifteen laboratory mice and then compared the occurred postural changes with fifteen mice belonging to the control group. After a week all the mice who wore the bite developed a scoliosis curve. Then, the same mice wore another bite on the opposite side to restore normal occlusion and in 83% of mice scoliosis disappeared. The alignment of the spinal column seems to be affected by occlusion in mice: alterations of occlusion and jaws position can indeed cause changes in the position of the vertebrae and reactions of the motor system and the autonomic nervous system.

Huggare [19] clinically and radiographically analyzed the head posture and the dental-facial structure of sixteen females and six males aged 12 to 34 who used a Boston brace for the treatment of scoliosis during adolescence. He observed an increased craniocervical angle (especially in frontal view), a rotation of the orbital, maxillary and mandibular planes, a deviation of the lower midline and a flattening of the atlas dorsal arch with an elongation of the atlas axis. Among scoliotic patients there also was a high prevalence of unilateral malocclusion and of missing premolars.

In the early stages the posterior crossbite is often associated with a functional deviation of the maxilla that can induce an asymmetric growth of the mandible, especially in the condylar region, leading to asymmetric condylar heights.

Kilic et al. [20] observed that patients with unilateral posterior crossbite more often present asymmetrical condyles compared to the control group and that the heights of the condyle, ramus and ramus-and-condyle on the crossbite side are lower than the ones on the side not affected by crossbite. Even Sato et al. analyzed the condylar asymmetry related to crossbite through an experimental study on mice in order to observe the effects of functional deviation of the mandible on the condylar cartilage during growth: the cartilage thickness is increased in the central region on the opposite side of the crossbite and reduced on the ipsilateral side.

It's been suggested that the crossbite is a compensation curve in the splanchnocranium due to the transmission of the body asymmetry to the skull.

According to the hypothesis that occlusion can affect the entire body posture, disorders of the masticatory muscles can be transmitted to the distal muscles through so-called "muscle chains". It's also been suggested that this chain of events can be folded and that an orthopedic problem such as scoliosis or different legs length can be considered either the cause and the consequence of a stomatognatic disorder or a risk factor for a chewing disorder. [21]

Michelotti [22] investigated the potential association between the legs length discrepancy and the posterior crossbite in a large group of boys from secondary school without finding a significant correlation between the two data (odds ratio very close to 1). This study disagree with Korbmacher's one [23] who noticed a significant but not mandatory correlation between the unilateral crossbite and orthopedic disorders such as oblique shoulder ($P = 0.004$), oblique pelvis ($P = 0.007$), scoliosis ($P = 0.04$) and a functional leg length discrepancy ($P = 0.002$).

Lippold [24] beyond confirming the fact that the mandible should be put in a postural relationship not only with the cervical spine but also with the lower part of the column, highlighted how this relationship must be analyzed not only on the frontal plane but also on the sagittal and vertical ones. In his researches based on the analysis of cephalometric and rasterstereographic data he found a correlation between the angles that determine the verticality of the craniofacial pattern (facial axis, internal gonial angle and mandibular plane angle) and the pelvic tilt and the lordotic angle. The mandible vertical pattern is related to the vertical pattern of the lower thoracic and lumbar spine and the inclination of the pelvis: subjects with more horizontal craniofacial features showed a reduced upper chest, lumbar and pelvic inclination while those with a more vertical pattern had the same inclinations increased.

Lippold also found a positive correlation between the sagittal position of the mandible and the pelvic tilt in the sagittal plane: subjects with a mesially positioned mandible seem to have less pronounced pelvic inclination compared to those with a distally positioned mandible.

According to the results of this study Lippold distinguishes two different models of "back shape profiles": a more distal and vertical craniofacial pattern with upper thoracic, lumbar and pelvic inclinations increased; a more mesial and horizontal pattern with the same inclinations reduced.

This study agrees with Solow and Huggare's ones as the results can potentially be explained by the "soft tissue stretching" hypothesis that, in this case, would not only be limited to the craniofacial structures growth in relation to the head inclination (cervical spine) but would be extended to the whole spine.

These results seem to disagree with a critical review of the literature by Michelotti et al. [25] who confirmed the existence of a relationship between the jaws sagittal position and neck posture but contradicted the relationship with the rest of the body.

Conclusion(s)

The difference of opinions resulting from the various studies seems to be partly due to the paucity of research in this area but also to the use of not totally correct diagnostic techniques. Just think of the latero-lateral teleradiography. This important radiographic technique used for orthodontic diagnosis allows to analyze the spine posture, the cervical vertebrae position in the sagittal plane and the intersegmental relationship between occiput, atlas and axis. However, the posture adopted in the cephalostat does not coincide with the natural head posture. Hirschfelder & Hirschfelder reported that the cephalometric study is not adequate to analize the cranio-vertical and cervical parameters as the head is hyperextended on the column. To determine the natural position of the head they recommend the recording in sitting position like orthopedic surgeons do. This technique is however not indicated for orthodontic diagnosis as the head can rotate so, if you need both an orthodonthic and a postural diagnosis both radiographic techniques are required.

Lippold also highlighted the importance of techniques such as rasterstereography because, according to him, not only it's easily repeatable and minimally invasive (saving the patient high doses of radiations) but it's also the technique that provides more accurate information about the posterior and sagittal profile of the examined patients.

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