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Dental Changes in Obstructive Sleep Apnea Patients under Oral Appliance Treatment are Progressive in Nature

Commentary on Pliska et al. Obstructive sleep apnea and mandibular advancement splints: occlusal effects and progression of changes associated with a decade of treatment. *J Clin Sleep Med* 2014;10:1285–1291.

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Mandibular advancement appliance (MAA) treatment is recommended as a primary treatment option in mild to moderate obstructive sleep apnea (OSA) patients and in severe OSA patients who do not tolerate continuous positive airway pressure (CPAP).[1,2] With the growing use of MAAs in the treatment of OSA, it is important to get more insight into the side effects of MAAs and their impact on the OSA condition.

Pliska et al. evaluated in a retrospective study the magnitude and progression of dental changes associated with MAA treatment in 77 OSA patients (mean age, 47.5 ± 10.2 years, 62 males) over an average period of 11 years (range, 8–19.3 years).[3] This research group is one of the pioneers in the field of dental side effects of oral appliance therapy in OSA patients. Therefore, they were able to study the longest observation period published to date. The series of dental casts of patients were analyzed with a digital caliper for changes in overbite, overjet, crowding, dental arch width, and inter-arch relationships. Their study showed that clinically significant changes in occlusion during an MAA treatment were progressive in nature. This means that the dental changes did not have a discernible end-point after this long period of observation. The authors observed the following significant dental changes: reductions in the overbite (2.3 ± 1.6 mm), overjet (1.9 ± 1.9 mm), and mandibular crowding (1.3 ± 1.8 mm); and increases in mandibular intercanine (0.7 ± 1.5 mm) and intermolar (1.1 ± 1.4 mm) width and in the frequency of anterior crossbite and posterior open bite. The speed of the changes in overbite and mandibular intermolar distance decreased with time, while the speed of the changes in overjet, mandibular intercanine distance, and lower arch crowding remained constant during the observation period.

The authors provide a nice explanation for the observed dental changes from a biomechanical point of view[3]: even very low applied forces, if applied for a considerable amount of time, such as several hours during nighttime wear of an oral appliance, will result in tooth movement. All MAAs position the mandible in a forward position and retain it in place by contacting the dentition. The force required to retain the mandible in an advanced position is transmitted to the dental arches. As the mandible attempts to return to its normal postural position during muscle relaxation, it transmits a labially directed force against the mandibular incisors and a lingually directed force against the upper incisors. This results in a significant labial tipping of the lower incisors and a lingual tipping of the upper incisors.[4] Besides a reduction in mandibular arch crowding, the labial tipping of the lower incisors may cause an occlusal interference with the upper anterior teeth. Consequently, the patient will not be able to close the posterior teeth completely due to this premature contact. Similarly, crossbites of the anterior teeth will occur as the mandibular arch moves forward and the overjet and overbite are reduced to a point where the lower teeth protrude beyond the upper ones. The development of a posterior open bite and an anterior crossbite are therefore common phenomena in OSA patients under MAA treatment.[3]

Pliska and colleagues also determined which initial dental characteristics act as predictors of the observed dental side effects of MAA treatment.[3] There was a considerable variability in the dental changes over time in their group of patients. Patients with a larger initial overjet tended to show larger reductions in both overjet and overbite. The authors explain this finding by the greater amount of freedom for forward movements of the lower dentition before the lower anterior teeth would contact the corresponding upper anterior teeth. Patients with a smaller initial overbite are therefore more likely to experience a crossbite of the anterior teeth with prolonged MAA treatment, while those with a larger initial overbite will likely show greater amounts of overbite reduction as the result of their treatment. Such interindividual variability in dental changes over time was also observed by Doff et al. and Marklund in their long-term follow-up studies on dental side effects.[5,6] Further, the presence of periodontal bone loss, dental implants, or conventional bridges in the dentition at the start of MAA treatment may influence the magnitude and progression of dental changes over time.[7] Therefore, the initial dental situation plays an important role in the magnitude and progression of the long-term dental changes. The amount of mandibular protrusion and the compliance have also been suggested as important factors in the magnitude and progression of dental changes.[5,6] Aarab et al. recommended a weighted compromise between efficacy and side effects by starting an MAA treatment in the 50% protrusion position.[8] This was corroborated by the findings of Cohen-Levy et al., who reported that the more the mandible is protruded in a forward position the greater the labially directed force against the mandibular incisors, so that the magnitude of the dental changes can be expected to be larger.[9] We ask our OSA patients to use their MAA on a nightly basis to control their sleep apnea condition optimally, but we also know that the longer they use their appliance the greater the effect of the forces transmitted to their dental arches by the MAA will be. Hence the need for the above-described weighted compromise.[8] The literature provides contradictory evidence about the effect

of MAA design on the long-term dental changes. Marklund suggested that orthodontic side effects might be predicted based on the design of MAAs.[6] A soft elastomeric monoblock device with full occlusal coverage produced less dental changes than a hard acrylic monoblock one. Further, Marklund and Legrell showed that a specific MAA design may be beneficial to OSA patients at risk of dental changes under MAA treatment.[10] On the other hand, Vezina et al. and Lawton et al. found no difference in orthodontic side effects between two different designs of MAAs (viz., Monoblock/Twinblock versus "Herbst" appliance).[11,12] More long-term prospective studies on the effect of MAA design on the magnitude and progression of dental side effects are thus needed. We agree with Plitska and colleagues[3] that insight in the predictors of orthodontic side effects of MAA treatment will help us in designing optimal treatment protocols that result in maximum treatment effect of the prescribed MAA.

In our current society, patients seek orthodontic treatment mainly because of concerns about their facial appearance. Psychosocial problems related to facial appearance can have major effects on an individual's quality of life.[7] In OSA patients under MAA treatment with an large initial overjet, a decrease in the overjet as a consequence of the MAA treatment may in most cases be considered as an improvement in facial appearance. However, those patients with a small initial overbite will more likely experience a crossbite of the anterior teeth with prolonged MAA treatment. This latter side effect may be experienced as a deterioration in facial appearance, especially in those patients in whom this orthodontic side effect is not camouflaged by their facial soft tissues. Studies on the impact of changes in facial appearance as a consequence of MAA treatment on an individual's quality of life are therefore also needed. The development of a posterior open bite results in a reduced number of occlusal contacts in the premolar and molar area. We hypothesize that patients with a fast development of their posterior open bite may experience more difficulties in chewing tough meat or vegetables than patients with a slow development of their posterior open bite. An impairment in chewing activities may negatively influence the quality of life and may also have an impact on the individual's general health status.[13] Insight in the associations between orthodontic side effects of MAA therapy on the one hand and quality of life and general health status on the other is therefore needed, especially because the experienced dental changes may influence the long-term MAA compliance of the patient.

In conclusion, dental side effects of MAA treatment observed in different studies show many similarities. This underlines the importance of the involvement of a dentist, orthodontist, or oral maxillofacial surgeon specialized in dental sleep medicine in the initial phase as well as in the follow-up phase of an MAA treatment. Further, OSA patients should be informed about these possible dental side effects prior to the start of an MAA treatment ("informed consent"). Knowing that the dental side effects are progressive in nature raises concerns about the long-term positive effects of an MAA treatment. An OSA patient who starts with an MAA treatment in his/her early thirties may have to use the MAA for several decades of his/her life. Therefore, insight in the associations between dental side effects, predictors of those effects, efficacy of an MAA therapy, quality of life, and general health status is therefore needed in order to aid the development of an optimal MAA treatment protocol for every individual OSA patient.

CITATION

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