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Research Article

Obstructive Sleep Apnea Syndrome (OSAS) Treated with Orthodontic Appliances in Children: A New Feasible Approach

A.Balian, A.Malerba, L.Strohmenger
Clinica Odontoiatrica G.Vogel, ASST Santi Paolo e Carlo, University of Milan, Milan, Italy.

Abstract

Obstructive Sleep Apnea Syndrome (OSAS) affects up to 4% of the paediatric population and, due to the high risk of cardio-vascular and neurological complications and negative outcomes on the developmental process associated, represents the most serious type of Sleep Disordered Breathing (SDB) and the most challenging for public health.Although the most common treatment for OSAS in childhood is Adenotonsillectomy (AT), this approach is limited by its surgical risks and by a high prevalence of recurrence or partial success, with persistence of signs and symptoms of obstructive apnea.The presence of cranio-facial abnormalities and malocclusion is considered an important risk factor for paediatric OSAS and its recurrence after AT. Children affected by OSAS often present specific oro-facial features such asnarrow maxilla, mandibular retrusion, anterior openbite, bilateral/monolateral cross bite, that are frequently associated with dysfunctions such as oral breathing and atypical swallowing. Those alterations can represent an anatomical base which can contribute to the development of paediatric OSAS, especially in preschool child aged 3-6 years, when the hyperplasia of adenoids and tonsils is reported to be at its peak with a higher risk for obstruction. The purpose of the present research is to evaluate the possibility that an orthodontic treatment, primary aiming to the treatment of malocclusion and the related dysfunctions, can induce improvement or relief of respiratory nighttime distress, as a secondary effect. The sample consisted of 5 children affected by OSAS, 3 female and 2 male, average aged 4.5 years, who have never undergone AT or have had a recurrence of sign and symptoms 1 year after AT.All patients presented narrow maxilla, associated with monolateral/bilateral crossbite and or anterior openbite. The patients underwent orthodontic treatment performed with an elastodontic appliance, which is a removable oral device made of PVC and widely used in children aged less than 6 years. The following variables were evaluated in each patient at the beginning (T0) and after 1 year (T2) of orthodontic treatment:occlusal parameters; Sleep Clinical Score (SCS); Night time poligraphic parameters: Snoring, Apnea/Hypopnea Index (AHI) andOswestry Disability Index (ODI).Four out of 5 patients showed high compliance to the orthodontic treatment and improved their occlusal relationship. In those patients also AHI and ODI index improved as well as the SCS score, revealing a reduction of sign and symptoms of OSAS. The only patient who did not improve his occlusal and respiratory findings also showed poor compliance to the orthodontic treatment. The study suggest that the treatment of malocclusion might produce improvements in sign and symptoms of OSAS in children aged 3-6 years and that preformed elastodontc appliances are a feasible therapeutic tool for this purpose.

***Corresponding author:** Dr. A.Balian, G.Vogel Dental Clinic, ASST Santi Paolo and Carlo, University of Milan, Milan, Italy.

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Introduction

Sleep Disordered Breathing (SDB) is an umbrella term for several chronic conditions affecting the health and wellbeing of children. The SDB comprises various pathological conditions which can be classified on an increasing scale of symptoms,from primary snoring to Obstructive Sleep Apnea Syndrome (OSAS).They are caused by partial or complete obstruction and/or collapse of the Upper Aero-Digestive Tract (UADT) which occurs many times throughout the night andproducesthe reduction, or even the cessation, of breathing and impairment in the normal sleeping framework [1,2].

OSAS is the most threatening type of SDB and is characterized by sign and symptoms such as snoring, pauses in breathing, disturbed sleep,*Enuresis nocturna*, daytime sleepiness, hyperactivity and neuro-behavioural problems. If not properly and quickly treated, the neurological, cardiovascular and metabolic alterations often associated with OSAS lead to long-term adverse outcomes with unfavourable effects on a child's growth and developmental process [1,3].

In preschool children, hyperplasia of the adenoids and tonsils is reported to be the most common cause of OSAS in children aged 3-6 years and Adenotonsillectomy (AT) is currently the treatment of choice. This approach is nevertheless limited by its surgical risks and by a high rate of failure or partial success, with recurrences of signs and symptoms of obstruction [4,5].

Occlusion and jaw abnormalities are considered one of the main risk factors either for the onset or for the recurrence of OSAS, particularly in those associated with a certain oro-facial fenotype such as narrow maxilla, mandibular retrusion, bi-maxillary retrusion, openbite and/or functional alteration such as oral breathing, atypical swallowing and perioral muscle dysfunction [6,7]. Those alterations, isolated or together, may represent an anatomic and functional basis which increases the obstructive risk [6,7].

How much malocclusion might account for paediatricOSAS and whether an occlusal treatment might be useful in relief signs and symptoms of OSAS is still uncertain and solved case by case on the basis of personal, sometimes anecdotal, past experiences rather than on scientific proof. Few studies have investigated this topic and there is still a general lack of research and poor conclusive evidence [8-11].

Aim

The present study aims to investigate whether orthodontic treatment performed with elastodontic appliances is effective in relieving the signs and symptoms of OSAS in children aged 3-6 years, through the analysis and assessment of the pre-occlusal, respiratory and neuro-behavioural variables and the same post-variables obtained after the use of an oral removable appliance.

Material and Methods

Patients wereselected according to the following inclusion/

exclusion criteria: children aged between 3 and 6 years old; reported habitual snoring, breathing pause or efforts during night time; presence of malocclusion; lack of systemic disease; lack of congenital craniofacial syndromes; lack of obesity with a Body Mass Index (BMI) under the 85th percentile.

Eligible patients underwent orthodontic treatment. The protocol foresees the use of an oral preformed elastodontic appliance in PVC, to be worn at night and a few hours during the day and that the patients perform personalized muscular and respiratory exercises(Figure 1).

Patients were evaluated at baseline (T0) andafter 1 year (T1) of treatment.The following variables were assessed: Occlusal parameters; Sleep Clinical Score (SCS); Night-timepoligraphic parameters; Behavioural questionnaire scores.Occlusal findings were monitored during the periodic orthodontic check-ups.

Signs and symptoms of the respiratory impairment were evaluated by means of scores obtained from the Sleep Clinical Score (SCS), which is taken from the Sleep Clinical Record (SCR) data. The SCR is divided into three sections: ORL and orthodontic clinical examination, the Brouillette questionnaire to detect the weekly frequency of Apnea/Snoring/Disturbed sleep, the Attention-Deficit Hyperactivity Disorder (ADHD)-rating scale to detect eventual symptoms related to distraction and hyperactivity.

An objective quantification of the respiratory impairment was carried out through cardio-respiratory monitoring performed at the patient's home. In this study the following parameters were taken into consideration: Snoring, Apnea/Hypopnea Index (AHI)and number of desaturation greater than or equal to four of the base value Oswestry Disability Index (ODI). Thepoligraphic data were collected and evaluated according to the standards of the American Thoracic Society [12].

Results and Discussion

The sample consisted of 5 children, 3 female and 2 male, average aged 4.5 years, who have never undergone AT or have had a recurrence of sign and symptoms 1 year after AT.

At the beginning all patients presented narrow maxilla, associated with monolateral or bilateral posterior cross bite, oral breathing and atypical swallowing(Figure 2)and were diagnosed with mild OSAS (1<AHI<5).

Patients showed high cooperation to the therapy and found the prescribed oral appliance comfortable ad easy to use.Only one patient did not properly use the appliance and showed poor compliance. After 1 year of treatment, four patients out five reveal improvements in their occlusal relationships and a decrease in oral breathing and atypical swallowing (Figure 3).

The pre-treatmentSCS score of all patients was above the cut-off level of 6.25, which is considered to be positive associated with an increase AHI and the presence of OSAS. Even though the SCS score did not normalise, the SCS score of all patients improved in T1-T0(Table 1).A parent confirms that their child had a better night's sleep and a decrease of neurological and behavioural problems, such as daily sleepiness, hyperactivity disorders or attention deficit.

The nocturnal poligraphicfindingsconfirms this trend. Four out of five patients showed a decrease in snoring between T1-T0. AHI was above 1 and below 5 events per hour at T0, meaning the presence of mild OSASand it then decrease below 0.5 in four out of five patients at T1. Only one patients had a worsening AHI score at T1(Table 2). The average ODIwas 2.52 at T1 and decrease to 0.96 at T1(Table 3).

The patient who did not cooperate during the orthodontic treatment had a worsening in AHI and ODI indexes in T1-T0 and a pretty slight decrease of SCS score.

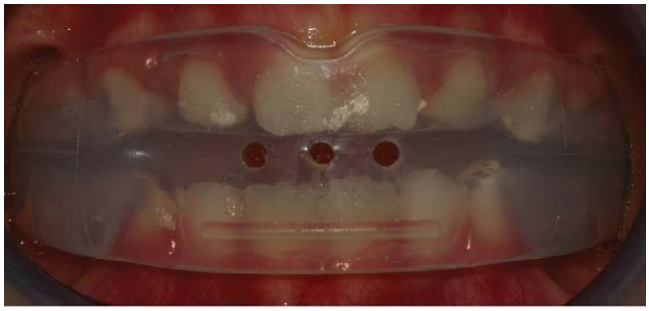

Figure 1: Patientwearing the elastodontic removable applications.

Figure 2: Patient at T0 before the orthodontic treatment revalling the presence of monolateral the presence of monolateral posterior cross bite.

Figure 3: Patient at T1 after 1 year of orthodontic treatment. Occlusal relationship improved with a complete resolution of posterior cross bite.

Patient	SCS	
	T0	T1
1	18:25	8
2	18:25	18
3	24	16:25
4	19	16
5	21	15

Table 1: Sleep Clinical Score (SCS) in T0 and T1.

Conclusion

The findings suggest that orthodontic treatment with elastodontic appliances can be successful inrelief sign and symptoms of OSAS in preschool children. The study highlights that correcting occlusal alteration might also have positive consequences on children's

Patient	AHI	
	T0	T1
1	1.5	0.5
2	2.2	4.3
3	2	0.4
4	1.4	0.5
5	1.2	0

Table 2: 2 Apnea/Hypopnea index (AHI) in T0 and T1.

Patient	ODI	
	T0	T1
1	5.8	1.2
2	3	3
3	1.2	0.4
4	1.9	0.2
5	1.6	0

Table 3: Desaturation index (ODI) in T0 and T1.

respiratory impairments during night time. Patients who did comply to the orthodontic treatment reached an improved occlusal relationship together with the reduction of habitual snoring and the decrease of AHI and ODI indexes in T1-T0. As a matter of fact,the only patient who reveals poor compliance to the occlusal therapy showed no improvements either of the malocclusion or of the sign and symptoms of OSAS. The adjustment of therapeutic tools is essential when dealing orthodontic treatment of malocclusion in very young children. Thanks to their comfortable and non-invasive structure and low cost, preformed elastodontic oral appliancescan be a good choicein child aged 3-6 years, since they are extremely comfortable, easy to use and safe.

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