Background/purpose: Myofunctional therapy is one of the recommended treatments for obstructive sleep apnea, but the level of compliance has often been low in children. This study aims to investigate the therapeutic effect of passive myofunctional therapy using an oral appliance during sleep in children suffering from obstructive sleep apnea.

Methods: Twenty-nine children who suffered from obstructive sleep apnea were divided into two groups: premature children and full-term children. All children wore an oral device to induce their tongue muscle activity during sleep for 6 months. Polysomnography during sleep was performed before and 1 week after the end of 6-month treatment.

Results: Both groups showed positive polysomnographic changes. Full-term children had a significant decrease in the apnea-hypopnea index, hypopnea index, and percentage of arousals. Prematurely born children had a significant decrease in the apnea-hypopnea index during rapid eye movement sleep and in the mean heart rate during sleep.

Conclusion: Using a specialized oral device to perform myofunctional therapy during sleep may improve the breathing during sleep of children with obstructive sleep apnea.

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Introduction

A high and narrow hard palate and obstructive sleep apnea (OSA) and/or hypopnea are found in a very high percentage (>80%) of children with premature birth. These children also have a high prevalence of malocclusion and often need orthodontic treatment. Although most premature infants will catch up with their peers developmentally later on (particularly during adolescence), they often have a lower weight, shorter height, and smaller head circumference by the age of 10 years, compared with full-term children. They also tend to have a shorter anterior cranial base, less convex skeletal profile, and shorter maxillary length.

Villa et al. studied a mandibular advancement device (MAD) for the treatment of OSA in children and reported that wearing a MAD for 6 months could reduce the apnea–hypopnea index (AHI) from 7.1 to 2.6 and improve the clinical respiratory symptoms. Myofunctional therapy (MFT) has been administered to adults and children with OSA to improve their breathing during sleep, and it has decreased the AHI by approximately 50% in adults and 62% in children. The therapy aims to improve the tongue muscle, particularly in hypotonic premature infants. However, the level of compliance for MFT has often been low in children. Economic and social conditions could also impact the performance of daily oral–facial exercises. The oral appliance studied in the current research is designed by one of the authors to help children perform oral exercises at bedtime and during sleep. Figure 1 shows the device with a bead placed close to the tip of the tongue. Moving along an axis, the bead is supported by a light frame mounted on the lower teeth, similar to other oral appliances. The device is designed on the basis that intrusion of a foreign object close to the tip of the tongue stimulates tongue activity at least during light stages of sleep. Better tongue functioning means better overall tongue position at rest, which is important for normal oral cavity growth and maxillary arch expansion. Proper positioning of the tongue through MFT has been demonstrated to improve nasal breathing, mandibular growth, and facial appearance.

This report presents the results of an objective study using polysomnography (PSG) to evaluate the short-term effect of passive MFT during nocturnal sleep by inserting an oral appliance in the mouth of children with OSA, including those who were prematurely born.

Methods

Patient recruitment and procedures

The study protocol was approved by the Institutional Review Board of the Human Investigation Committee of the Chang Gung Memorial Hospital. Informed consent from the legal guardian of each participant was obtained prior to investigation.

As shown in Table 1, 29 patients (23 boys and 6 girls; mean age: 9.76 ± 3.54 years; range: 3–15 years) with a diagnosis of pediatric OSA based on the International Classification of Sleep Disorders-Third Edition participated in the study. The inclusion criteria for this study, based on the results of PSG, were as follows: (1) AHI ≥ 1 event/h and (2) Respiratory Disturbance Index ≥ 5 events/h. The following demographic and clinical information of all participants was collected during their initial visit to the sleep laboratory: age, sex, body mass index (BMI), body weight and height, gestational age, and birth body weight. All children had been diagnosed with OSA based on their clinical complaints/symptoms and the results of PSG at the Sleep Center of the Chang Gung Memorial Hospital. Children were divided into two groups, based on their gestational age: “premature” (<37 weeks) and “full term”. The exclusion criteria for the study were as follows: epilepsy, head injury, severe developmental delay and mental retardation, autism, schizophrenia, severe depression, or inability to cooperate for the measurement of PSG or for the fabrication of oral devices.

Pediatric OSA is different from the adult type as most cases of pediatric OSA are mild to moderate. Most of the participants had undergone adenotonsillectomy before the study and had a residual AHI when the study began. The rest did not have adenotonsilar hypertrophy, so they could be included in the study.

All participants underwent PSG before treatment with the oral appliance and after 6 months of wearing the device nightly.

PSG during sleep

A Compumedics sleep system was used to monitor the following: electroencephalography (C4/A1, C3/A2, Fp1/T3, T3/O1, Fp2/T4, T4/O2, Fp1/C3, Fp2/C4), electrooculogram, chin and leg electromyography, electrocardiography with a modified V2 lead, body-position sensor, nasal cannula/pressure transducer, mouth thermistor, thoracoabdominal and plethysmographic bands, neck microphone, and finger pulse oximetry. Scoring was performed by an individual who was not involved in the study and was blind to the settings (i.e., pre- or post-treatment).

Oral appliance

The appliance is a one-piece, custom-made adjustable oral device for advancing the mandible. A bead is mounted on the lower part of the frame for the tip of the tongue to roll, which in turn places the tongue in a forward position so as to open the airway (Figure 1). The amount of mandibular advancement associated with the wearing of the device was 50% of the maximum mandibular advancement. Patients were instructed to wear their appliances and use their tongue to roll the bead (i.e., passive MFT) during sleep every night. Parents kept sleep logs to record the nightly wear by all children for 6 months. The study participants did not receive active MFT.

Statistical analysis

Data were analyzed using a statistical software package (SPSS Inc. Released 2009. PASW Statistics for Windows, Version 18.0. Chicago: SPSS Inc.). Descriptive statistics were presented as means and standard deviations.
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