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Original Article

Sleep bruxism, snoring, and headaches in adolescents: short-term effects of a mandibular advancement appliance

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ABSTRACT

Objectives: Sleep bruxism (SB) frequently is associated with other sleep disorders and pain concerns. Our study assesses the efficacy of a mandibular advancement appliance (MAA) for SB management in adolescents reporting snoring and headache (HA).
Methods: Sixteen adolescents (mean age, 14.9 ± 0.5) reporting SB, HA (>1 d/wk), or snoring underwent four ambulatory polysomnographies for baseline (BSL) and while wearing MAA during sleep. MAA was worn in three positions (free splints [FS], neutral position [NP], and advanced to 50% of maximum protrusion [A50]) for 1 week each in random order (FS–NP–A50 or NP–A50–FS; titration order, NP–A50). Reports of HA were assessed with pain questionnaires.
Results: Overall, sleep variables did not differ across the four nights. SB index decreased up to 60% with MAA in A50 ($P = .004$; analysis of variance). Snoring was measured as the percentage of sleep time spent snoring. The subgroup of snorers ($n = 8$) showed significant improvement with MAA (−93%; $P = .002$). Initial HA intensity was reported at 42.7 ± 5/100 mm, showing a decreasing trend with MAA (−21% to −51%; $P = .07$).
Conclusion: Short-term use of an MAA appears to reduce SB, snoring, and reports of HA. However, interactions between SB, breathing during sleep, and HA as well as the long-term effectiveness and safety of MAA in adolescents need further investigation.

1. Introduction

Sleep bruxism (SB) is a sleep-related movement disorder characterized by teeth grinding and clenching. It is frequently observed in pediatrics, and recent epidemiologic studies have reported SB prevalence ranging from 13% to 38% in children and adolescents [1–3]. The etiology of SB is still under investigation. Genetic, physiologic, neurologic, and psychosocial factors may be involved in the genesis of the rhythmic masticatory muscle activity (RMMA) that frequently occurs (⩾2 episodes/h of sleep) in patients with SB [4].

Repeated and sustained masticatory muscle activity during sleep may have a number of clinical consequences, such as tooth wear, tooth damage, muscle fatigue, orofacial pain, and headache (HA) [1,4–6]. SB also may be concomitant with other sleep disorders, including parasomnias (e.g., sleepwalking, sleep talking, enuresis), periodic limb movements during sleep, restless legs syndrome, and sleep-disordered breathing (SDB) [7–9]. All of these conditions may share common pathophysiologic factors. In particular, it has been hypothesized that coactivation of the jaw-opening and jaw-closing muscles during RMMA may reopen the upper airway in response to an obstructive respiratory event such as obstructive sleep apnea [4,10,11]. Subjects reporting SB in association with pain, HA, or sleep concerns may need further clinical investigation and treatment usually is required. Our study assesses the effectiveness of a mandibular advancement appliance (MAA), previously used to separately manage SB, HA, and SDB [12–14] in adolescents reporting SB, HA, and snoring. We hypothesized that the MAA could improve breathing during sleep to the benefit of all concomitant concerns that may share common pathophysiologic substrates.

2. Material and methods

A randomized, controlled, crossover design was used. The protocol was approved by the Ethics Review Board of the Hôpital du Sacré-Coeur de Montréal. All participants and at least one of their parents signed a written consent form and received compensation for participating in the study.

2.1. Study sample

Participants were recruited through announcements (approved by the Ethics Review Board) posted from winter 2009 to summer 2011. Volunteer candidates were initially screened in phone interviews conducted by research staff, either directly or through

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their parents. Candidates with a history of SB with HA or snoring were invited to come to the university research laboratory for a clinical examination and an initial ambulatory polysomnographic (PSG) assessment. Reports of SB and snoring were then confirmed in the first PSG recording. SB diagnosis was based on an RMMA index (number of episodes/h of sleep) $\geqslant 2$ [15,16].

Inclusion criteria were age from 12 to 19 years, PSG-diagnosed SB, presence of snoring, or reports of frequent HA (>1/wk). HA intensity was assessed with a questionnaire using a 0- to 100-mm visual analog scale (VAS). HA was self-reported with no clinical diagnosis. HA criteria were based on the definition of probable episodic tension-type HA (International Classification of Headache Disorders, The International Headache Society [17]). Exclusion criteria were diagnosed migraine, cluster HA, orthodontic treatment, severe medical diseases, and regular use of medications.

2.2. Study protocol

At first visit, candidates filled out questionnaires to assess reports general health, sleep quality, pain, HA, and SB. Clinical examination, performed by MCC, included an assessment of dental, temporomandibular joint, and masticatory muscle status. The first ambulatory PSG usually was performed on the day of the clinical examination to both confirm the SB diagnosis and to establish a baseline (BSL) night. Because the ambulatory PSG system allowed participants to sleep in their own bed at home, a habituation night was not required. Candidates who met the inclusion criteria were invited to come to the dental clinic for dental impressions and radiograms. X rays including a panoramic view and a lateral cephalogram were performed to rule out contraindications to MAA use and to assess craniofacial features. The MAA was manufactured by a specialized dental laboratory (Dentec Laboratory, Quebec City, Canada) and was graciously provided with no obligation by ResMed (Narval O.R.M.™ CC, USA and France). It consisted of an optimized mandibular retainer device comprising upper and lower custom-made semirigid splints linked by a tractable and adjustable flexible joint (Fig. 1). Once the individually fitted MAA was customized, it was given to the participant who was instructed to wear it during sleep only. The MAA was worn in three different positions (for 1 wk each) in random order: free splints (FS), neutral position (NP), and advanced to 50% of maximum protrusion (A50). FS position was obtained by removing the connectors between the upper and lower splints so that only the dental surfaces were covered, allowing a full range of jaw movement. In NP the mandible was retained in maximum intercuspidation (set as the participant's normal occlusion). Although no advancement is obtained, this setting prevents the jaw from moving backward during sleep. The A50 position was obtained by shortening the connectors to retain the mandible at 50% of the previously measured maximum protrusion. Each MAA position was tested for one week followed by a washout period (5–7 d) to avoid a potential carryover effect. The three positions were randomized into two sequences: (1) FS, NP, A50; or (2) NP, A50, FS, in compliance with a titration paradigm (NP–A50). Participants were randomly allocated to either sequence. Appliance compliance was monitored using self-report questionnaires. After each week with the MAA, participants underwent PSG recordings while wearing the device during sleep.

2.3. Ambulatory PSG

An ambulatory PSG system (Siesta, Compumedics, Australia) was used at the participant's home (level 2). This system ensured high participation and compliance, especially in adolescents; only 25% of our sample (i.e., four participants, all aged >16 y) would have participated if the study had been conducted in a hospital-based sleep center instead of at home. Participants and their parents were instructed on how to start and stop PSG recording in the evening and on awakening. If any technical concern had compromised the data, sleep recording was repeated the following day. The overall success rate of the ambulatory PSG recordings was 86%.

The following channels were recorded: electroencephalogram (F_3M_2, F_4M_1, C_3M_2, C_4M_1, O_1M_2, O_2M_1, electrooculogram (right and left), electrocardiogram, and electromyogram from the suprahyoid muscles and the right and left masseter and temporalis muscles (essential for RMMA scoring). Respiratory parameters were assessed by recording abdominal and thoracic respiratory effort, airflow (oronasal cannula), and oximetry. A microphone was placed at the center of the participant's forehead to measure snoring. Data were visually scored according to the American Academy of Sleep Medicine criteria [18] for offline analysis. Despite the absence of audio–video recordings, RMMA was scored according to standard published rules [19]. Breathing events were scored according to the American Academy of Sleep Medicine criteria for children [18,20]. All nights were scored by the same examiner who was blind to the presence or absence and position (i.e., FS, NP, A50) of the MAA.

Sleepiness and sleep quality were assessed with the validated French versions, adapted for adolescents, of the Epworth sleepiness scale and the Pittsburg Sleep Quality Index.

2.4. Statistical analysis

Based on Landry-Schönbeck et al. [13], a sample size of 16 participants is sufficient to detect a 40% decrease in RMMA index from BSL under NP (effect size, 0.77) with a power of 0.80 and at 0.05 α level. BSL, FS, NP, and A50 data were statistically compared using repeated measures analysis of variance and pairwise tests (significant at $P \leqslant .05$). Abnormally distributed data (Shapiro–Wilk normality statistic, <0.05) were normalized by applying Log_{10}. In the case of randomly missing data, a mixed model analysis was applied

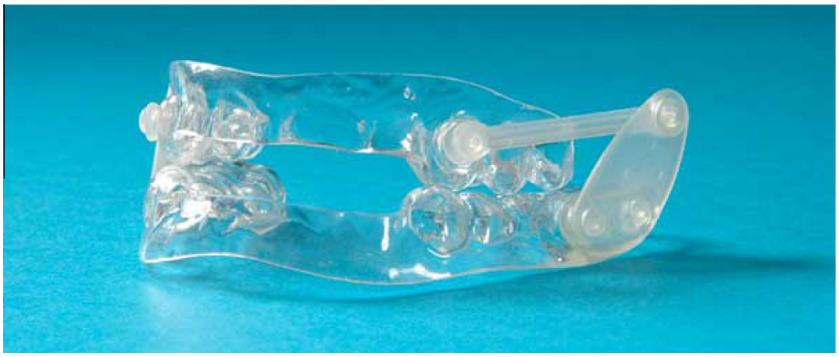

Fig. 1. The mandibular advancement appliance used in our study. Picture from ResMed Narval O.R.M® CC (www.resmed.com).