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Research Article

Correction of Nocturnal Bruxism After Nasal Airway Surgery in Adults and Children

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Abstract

Background: Nocturnal bruxism is a common dental problem in adults and children that has recently been shown to result from nasal obstruction. In this study we investigated whether nasal airway surgery to correct nasal obstruction can reduce or eliminate nocturnal bruxism (NB).

Methods: 25 adults (19-67 years; 9M/16F) and 25 children (aged 4-15 years; 9M/16 F) with NB diagnosed by their dentist were studied prospectively. Nine of the children had already undergone sutural palatal expansion. Nasal airway obstruction was evaluated by history, physical exam, CT scan and NOSE scores preoperatively and 3 months post-operatively. Changes in NB were carefully assessed using a VAS scale by the patient, their bed partner or parent, and a repeat exam by their dentist.

Results: The NOSE scores in children went from 11.2 pre-op to 2 post-op ($p<.05$); and in adults went from 11.3 pre-op to 5.5 post-op ($p<.05$). NB completely resolved in 15/25 children, improved in another 8 children, and was unchanged in 2. NB resolved in all children who had also previously undergone sutural palatal expansion. In adults, NB completely resolved in 5/25 patients, improved in another 15, and was unchanged in 5 patients. Overall, NB improved in 92% of children and 80% of adults. Patients with the smallest change in NOSE scores had the least improvement in NB. There were no adverse events.

Conclusion: When compared to adults, children had greater improvement in NOSE scores and were more likely to either improve or completely resolve their NB. Better NOSE scores correlated highly with a reduction in symptoms.

Keywords: Nocturnal Bruxism (NB); Sleep; Temporomandibular Joint (TMJ)

Introduction

Sleep or nocturnal bruxism (NB), also known as teeth grinding and/or jaw clenching, is a relatively common problem in adults and children, with a prevalence of about 26% in young children and 15% in adolescents [1]. NB is a distinct diagnosis and is different from awake bruxism. The latter is associated with stress and anxiety whereas NB is associated with sleep disordered breathing and low serum oxygen levels [2]. Bruxism is a condition of the masticatory muscles, used for chewing and is comprised of the masseter, temporalis, and medial and lateral pterygoid muscles. Normal chewing will create a force on the teeth of between 50-200 pounds, however this force is increased to 250 pounds during NB [3]. Most NB occurs during sleep stages 1 and 2, with patients unaware of their jaw motion [4]. Bed partners or parents can often hear the grinding and alert the patient of the condition. Signs and symptoms of NB are jaw, face or neck pain, headache, fractured or chipped teeth, temporomandibular joint (TMJ) pain and/or dysfunction, flattened teeth, earaches, reduced jaw opening (trismus), and locking of the jaw. A dentist will notice flattened tooth surfaces and worn dental enamel.

TMJ symptoms develop from NB because of a loss of dental height secondary to grinding of the upper and lower teeth against each other. As the dental or tooth height is reduced, the mandibular condyle is forced vertically into the glenoid fossa thereby diminish-

ing the joint space and compressing or dislocating the joint disc. Without the protective function of the joint disc, the bone of the condyle rubs directly on the bone of the glenoid fossa leading to bone erosion, pain, and joint instability (lock jaw, clicking, and dislocations). A night-time dental appliance is often prescribed for this condition and designed to not only protect the teeth from further wear but to also restore the space between the condylar head and the glenoid fossa of the TMJ, providing pain relief and an opportunity for the bone surfaces to heal. The latter is not always possible depending upon the degree of erosion, patient age, and medical history. This is best accomplished by an experienced dentist who makes a custom appliance because an improperly fit or OTC mouth guard can worsen the condition of the TMJ once it is injured, as well as worsen any apnea that is present [5,6].

Recent research has shown that the masticatory muscles, especially the masseters, are very sensitive to serum carbon dioxide levels [7]. As carbon dioxide levels fall during sleep disordered breathing (SDB), this introduces a perceived stress environment for the body. In response, the masseter and submental muscles develop increased muscle tone and muscle activity to prevent airway collapse during sleep thus trying to reduce the stress state [8]. Therefore, it is now known that NB is a protective mechanism against an obstructed airway during sleep and is a sign that SDB is present. This phenomenon was first observed and reported by E. Harvold [9], a Norwegian orthodontist, in 1978 during his landmark study on baby primates. In this study, Harvold purposely obstructed the nares of baby monkeys using silicone plugs sewn into their nares. He observed the behavior and growth of these monkeys over the next 6 months, comparing them to a control group of similar baby monkeys with normal nasal breathing. He noted that the nasally obstructed monkeys developed adenoid facies akin to that seen in children with obstructed nasal breathing. He also noted that a subset of nasally obstructed monkeys would develop rhythmic jaw movements that were visible and subsequently measured by EMG needles placed in their masseter muscles during sleep. It was not known at the time that this observed jaw activity was equivalent to NB and related to the fact that he had artificially created SDB in these baby monkeys.

With the prevailing evidence strongly supporting the view that the majority of NB is related to SDB and nasal obstruction during sleep, the question posed by this study is whether correction of the nasal airway in patients with SDB and NB can reduce or eliminate their NB. This is a novel study with no comparable literature previously reported.

Study design

Children and adults diagnosed with SDB and having NB witnessed by a bed partner or parent and confirmed by their dentist were enrolled. The patients were evaluated and treated in an otolaryngology clinic in a major metropolitan area by the same physician. The dental exam required evidence of flattened teeth surfaces and/or worn dental enamel. All patients underwent a physical exam, including an endoscopic nasal exam, non-contrast sinus CT scan, and skin allergy testing when indicated by their history and exam. Eight of the children were previously treated with palatal expansion for a narrow palatal arch, which is another hallmark finding of SDB in children. To further assess their degree of nasal obstruction, every patient completed a NOSE score at baseline and 3 months after surgery. The NOSE or Nasal Obstruction Symptom Evaluation [10] score is a validated outcome metric for children and adults used to assess nasal patency with scores ranging from 5 (mild to no obstruction) to 100 (extreme obstruction). All patients underwent intra-nasal surgery using total intravenous anesthesia in our hospital. The range of procedures included some combination of septoplasty, inferior turbinate reduction, swell body reduction, uncinectomy, anterior ethmoidectomy, and adenoidectomy. There were no surgical complications during the study. Patients were seen in follow-up during postoperative weeks 3 and 12. The patient's bed partner or parent also reported the frequency and/or loudness of NB using a VAS scale graded from 1-10, with 1 being "none present" and 10 being "severe". The follow-up dental exam at 3 months after surgery was to identify any changes in dental architecture (newly cracked teeth or increase in worn enamel) or associated jaw symptoms.

Results

Twenty-five children and twenty-five adults were enrolled and completed the study. The age range for children was 5 to 16 years (mean = 9) and for adults was 18 to 75 years (mean = 43). There were 11 boys and 14 girls, and 9 men and 16 women enrolled. The NOSE scores in children went from 15.2 pre-op to 2.0 post-op ($p<.05$) and in adults went from 16.3 pre-op to 5.5 post-op ($p<.05$). The average pre-op VAS score in children went from 7.1 at baseline to 2.5 after 3 months, and in adults it went from a baseline of 6.9 to

3.0 at 3 months. The dental exams at 3 months showed no obvious worsening of the dental condition compared to baseline.

NB completely resolved in 15/25 children, improved in another 8 children, and was unchanged in 2. NB resolved in all children who had also previously undergone sutural palatal expansion. In adults, NB completely resolved in 5/25 patients, improved in another 15, and was unchanged in 5 patients. Overall, NB improved in 92% of children and 80% of adults and was more likely to be curative in children versus adults. Patients with the smallest change in NOSE scores had the least improvement in NB. There were no adverse events.

Discussion

NB is an interesting phenomenon because it is invoked as a protective mechanism to help relieve body stress from oxygen deprivation yet when activated can cause serious damage to one's teeth and jaws resulting in disabling symptoms for some. Previously, bruxism was a diagnosis associated with anxiety or emotional stress. However, more recent research has identified two distinct forms of bruxism – daytime and nocturnal. The latter is now associated with SDB, nocturnal oxygen desaturations, elevated serum carbon dioxide, and a physical stress condition called sympathetic dystrophy [11]. This is a similar mechanism to adrenaline release during SDB that leads to hypertension, cardiac events, dysrhythmias, stroke, and more [10]. NB has also been shown to correlate well with patients diagnosed with obstructive sleep apnea, part of the spectrum of SDB [4].

The sensitivity of the masseter muscles to serum carbon dioxide levels was known since the 1980's but was not connected to SDB until 2008 [2,6]. Similarly, Harvold's primate study or oral respirations was reported in 1981 but not appreciated for what it had discovered with respect to craniofacial development in children, the importance of nasal breathing in developing humans, and the observance of NB because of nasal obstruction until the 21st century. Our contemporary understanding of these relationships and their physiologic interactions has made us better able to diagnose and treat NB by addressing its underlying cause – nasal obstruction during sleep.

In this study, we wanted to evaluate this theory in children and adults and therefore included 2 groups of patients diagnosed with SDB and NB. During our consultations with these patients, the majority were unaware of any relationship between NB and their SDB. While this was not part of the study outcomes, about 25% of the patient had serious dental and TMJ damage from their NB, including broken teeth and facial/jaw pain. The relief of jaw and face pain, trismus, and jaw tightness during the day were frequent symptoms that allowed the patients to use a VAS scale to evaluate their NB. In addition, we made sure a bed partner or parent were also involved in use of the VAS scale at baseline and 3 months after surgery. The dental evaluation was to confirm the presence of NB and to determine if any progression had occurred during the study.

Our results confirm that relief of nasal obstruction, as determined by the NOSE score, was directly related to a reduction in NB and its symptoms. However, not every patient was cured. Persistent NB was more likely in the adult population compared to children where 5 adults had no improvement versus only 2 children, and 15 adults were improved (not cured) versus 8 children. This is not surprising because the NOSE scores in children improved more than the NOSE scores in adults and the degree to which the nasal airway can be improved in a critical factor in better outcomes. Adults can be challenging because they have a mature or long-standing nasal situation resulting in an abnormal nasal airway that has become more dysfunctional with time. Most of our body systems have some degree of reserve capacity and reversibility from a diseased state unless you reach an end-stage situation. Such as an arthritic knee requiring replacement vs physical therapy. Thus, the adult nose is less forgiving and the problems, such as hypertrophic tissues and diseased mucosal surfaces are less likely to reverse than in children.

Conclusion

Our results are very promising and add additional support to the current theory regarding the etiology of NB and its relationship to SDB. We have shown that targeted minimally invasive nasal surgery for the correction of NB is safe and effective in all ages, but with a greater rate of success in children than in adults.

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