Sleep Medicine 14 (2013) 518–525

Contents lists available at SciVerse ScienceDirect

Sleep Medicine

journal homepage: www.elsevier.com/locate/sleep

Critical role of myofascial reeducation in pediatric sleep-disordered breathing

C. Guilleminault [a,*], Y.S. Huang [b], P.J. Monteyrol [d], R. Sato [a], S. Quo [e], C.H. Lin [c]

[a] Stanford University, Sleep Medicine Division, United States
[b] Pediatric Sleep Medicine, Taiwan
[c] Cranio-Facial Center, Chang-Gung University and Memorial, Taiwan
[d] Clinique Oto-Laryngologique, Bordeaux, France
[e] Orthodontic Department, University of California, San Francisco Dental School, United States

ARTICLE INFO

Article history:
Received 25 September 2012
Received in revised form 16 December 2012
Accepted 25 January 2013
Available online 21 March 2013

Keywords:
Pediatric sleep-disordered breathing
Adenotonsillectomy
Orthodontics
Myofunctional therapy
Retrospective study
Long-term recurrence

ABSTRACT

Background: Limited studies suggest that pubertal development may lead to a recurrence of sleep-disordered breathing (SDB) despite previous curative surgery. Our study evaluates the impact of myofunctional reeducation in children with SDB referred for adenotonsillectomy, orthodontia, and myofunctional treatment in three different geographic areas.

Methods: A retrospective investigation of children with polysomnographic analysis following adenotonsillectomy were referred for orthodontic treatment and were considered for myofunctional therapy. Clinical information was obtained during pediatric and orthodontic follow-up. Polysomnography (PSG) at the time of diagnosis, following adenotonsillectomy, and at long-term follow-up, were compared. The PSG obtained at long-term follow-up was scored by a single-blinded investigator.

Results: Complete charts providing the necessary medical information for long-term follow-up were limited. A subgroup of 24 subjects (14 boys) with normal PSG following adenotonsillectomy and orthodontia were referred for myofunctional therapy, with only 11 subjects receiving treatment. Follow-up evaluation was performed between the 22nd and 50th month after termination of myofunctional reeducation or orthodontic treatment if reeducation was not received. Thirteen out of 24 subjects who did not receive myofunctional reeducation developed recurrence of symptoms with a mean apnea–hypopnea index (AHI) = 5.3 ± 1.5 and mean minimum oxygen saturation = 91 ± 1.8%. All 11 subjects who completed myofunctional reeducation for 24 months revealed healthy results.

Conclusion: Despite experimental and orthodontic data supporting the connection between orofacial muscle activity and oropharyngeal development as well as the demonstration of abnormal muscle contraction of upper airway muscles during sleep in patients with SDB, myofunctional therapy rarely is considered in the treatment of pediatric SDB. Absence of myofascial treatment is associated with a recurrence of SDB.

1. Introduction

Obstructive sleep apnea (OSA) has become increasingly recognized as a notable health concern in children given its consequences on behavior, function, and quality of life. The importance of early recognition and treatment in children is paramount to maximizing resolution of symptoms and potential avoidance of OSA syndrome during adulthood. Adenotonsillectomy and palatal expansion have established their roles in the treatment of OSA after demonstrating considerable improvement related to adenoid or tonsillar hypertrophy, maxillary or mandibular deficiency, and orthodontic or craniofacial abnormalities. However, the implementation of other treatment modalities such as myofascial reeducation also may play a role in the optimization of sleep-disordered breathing (SDB).

Functional myofascial reeducation in children has been well-established in the treatment of abnormal orofacial development for more than 40 years [1]. However, few studies have been published supporting the benefits of orofacial reeducation compared to the numerous studies reinforcing the utility of surgical and orthodontic treatments in SDB [2]. Although the role of orofacial education remains largely variable between institutions, the most notable results have been described when myofunctional therapists and orthodontists worked in collaboration to manage orofacial weakness. Although promising, the efficacy of myofunctional therapy in combination with surgical and orthodontic treatment is unclear. The purpose of our study was to evaluate the impact of myofunctional reeducation protocols on orofacial muscle weakness and the treatment of SDB in children following surgical and orthodontic optimization.

* Corresponding author. Tel.: +1 650 723 6601; fax: +1 650 725 8910.
E-mail address: cguil@stanford.edu (C. Guilleminault).

1389-9457/$ - see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.sleep.2013.01.013

2. Methods

Our retrospective analysis involving prepubertal children diagnosed with OSA, who were referred for orthodontic treatment after presenting with residual symptoms of abnormal breathing following adenotonsillectomy, could only draw a small number of subjects.

Data collection was performed in three different regions of the world, including the San Francisco Bay area, Taiwan, and France. Our analysis involved three different pediatric sleep centers working with otolaryngologists, orthodontists, and functional therapists. The three sleep centers performed all sleep monitoring and were referral centers for large geographic areas. The participating sleep clinics and the orthodontic practices had a collaborative working relationship spanning from 6 to 14 years.

Retrieval of health information for children was variable but targeted those initially seen between the ages of 3 and 6 years preceding confirmation of SBD by nocturnal polysomnography (PSG). If a child was confirmed to have OSA by PSG, the second step was to determine the presence of adequate follow-up and appropriate documentation including subsequent PSGs and documentation from other specialists. Most charts did not fulfill these criteria and were excluded from our study. Charts that had systematic PSG at different phases of follow-up were those of children seen by orthodontists either postadenotonsillectomy or without otolaryngologic intervention. Children often were referred to both a functional reeducation specialist and to an orthodontist in an effort to perform the investigation where myofunctional therapy was practiced. Children were followed in sleep medicine and orthodontic clinics with variable schedules.

Despite being followed in these clinics, postorthodontic treatment PSG records often were unavailable and complete documentation often was absent, excluding a large number of cases. Once the necessary clinical data and PSG reports were confirmed, identifiers were removed and data were extracted (Fig. 1). Anonymous analyses of clinical and polysomnographic data were performed. Retrospective analyses of unidentified PSG and of clinical information were approved by the internal review boards.

All surveyed subjects were prepubertal children between the ages of 3.6 and 6.6 years at the time of their initial visit. Initial assessment of each child included clinical interview, pediatric and sleep clinical evaluation, completion of the pediatric sleep questionnaire (PSQ), a questionnaire validated in different languages [3,4], and nocturnal PSG. Following clinical and PSG evaluation, all children diagnosed with OSA were referred to otolaryngology for surgical evaluation. All subjects except for one had adenotonsillectomy performed and all were followed up after surgery with repeat clinical evaluation and PSG. Subjects with residual OSA detected on postsurgery PSG were sent for orthodontic evaluation [5]. Once the decision regarding orthodontic treatment was made (i.e., rapid maxillary expansion or bimaxillary expansion), recommended myofunctional reeducation also was performed [1].

Subjects were followed at an orthodontic practice during the application of orthodontic treatment and also were followed at their sleep clinics 6 to10 months following initiation of their orthodontic treatment. Concomitant use of myofunctional reeducation was documented as being implemented or as recommendation not followed. Repeat PSG was performed following orthodontic treatment with or without functional reeducation. Data from myofunctional reeducation clinics were used solely to monitor compliance with follow-up appointments and to monitor duration of treatment. Subjects were most often seen during their scheduled orthodontic follow-up. Less frequently they were seen several years after initiation of orthodontic treatment due to planned follow-up visits or due to recurrence of sleep-related symptoms; in this case, they were referred back to sleep clinics. During long-term follow-up visits, the reassessment always involved clinical interviews, PSQ, clinical pediatric evaluation and sleep evaluation, determination of height and weight based on body mass index, sleep medicine examination, myofunctional orofacial status, and nocturnal PSG.

All long-term follow-up PSGs (i.e., last investigation performed) were transferred to new compact discs with recordings formatted in European Data Format. This transfer allowed analysis of all PSGs performed on various sleep programs to be anonymously rescored by a single scorer. PSG rescoring could not be performed on the initial PSGs in the same fashion. However, all centers used the same atlases and guidelines for scoring sleep and breathing variables.

All subjects were evaluated by full-night PSG performed in a sleep laboratory and included the following electrophysiologic parameters, electroencephalogram (EEG) (three channels), electrooculogram (two channels), electrocardiogram, chin electromyogram (EMG), leg EMG (one channel), nasal pressure cannula, oral thermistor, thoracic and abdominal belts, snoring sensor, pulse oximetry, position sensor, and video recording. Variations to the montage included an additional second leg EMG, a fourth EEG, transcutaneous CO_2 or end-tidal CO_2, and the thoracic and abdominal belts were either piezoelectric or inductive plethysmography. All recordings lasted a minimum of 7.5 hours. Individuals were assigned corresponding identification numbers and their data were compiled using the Microsoft Excel program to perform statistical analyses of the results.

Myofunctional reeducation specialists were trained in various countries and were divided into two categories of either speech therapists or specialists in muscle reeducation. Speech therapists were trained in the United States, whereas muscle reeducation specialists were trained outside of the United States. Myofunctional specialists obtained university degrees in functional reeducation with a subspecialty in myofunctional reeducation and practiced validated therapeutic protocols. Treatment protocols are similar in different countries [1]. In the United States, if not sanctioned by a diploma, courses are administered (particularly in California) by trained individuals often trained in other countries. The myofunctional re-educators involved in the three participating sleep centers had similar myofunctional reeducation training, including several years of experience with treatment modalities and use of the same type of report forms. Similar exercise regimens and daily durations of treatment were recommended to parents. Frequency of visits varied not with the sleep center but with the individual and were based on the needs of each case. Visits were more frequent at the initiation of treatment and less frequent as time passed. Daily exercise performance was recorded by parents in a log and reviewed by re-educators at visits. Reeducation programs were completed after 2 years.

3. Reeducation

Myofunctional reeducation involves strengthening of the tongue and orofacial muscles by teaching individuals how to reposition muscles to the appropriate position. The tongue should be kept in a high position during sleep with its dorsal-terminal end in constant contact with the palatine striae located on the anterior aspect of the palate. Reeducation typically is easier in children ages 6 years and older, but it is largely related to the degree of effort parents make in reinforcing a subject to perform his or her exercises. Exercises are initially repeated several times per day with a quick initial increase in frequency during the earliest phase of treatment. This phase requires the subject and one parent to frequently follow-up with a specialist during the first 6 months and less frequently thereafter. The amount of follow-up depends on the duration of therapy needed, but once the subject has gained the desired tongue position along with appropriate strength the