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THE ESSENTIAL ROLE OF THE COM IN THE MANAGEMENT OF SLEEP-DISORDERED BREATHING: A LITERATURE REVIEW AND DISCUSSION

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ABSTRACT

The origins of Orofacial Myofunctional Therapy began in the early 1960's by orthodontists who recognized the importance of functional nasal breathing, proper swallowing, and more ideal oral rest postures. Re-patterning these functions through myofunctional therapy assisted with better orthodontic outcomes and improved stability. Experts in orofacial myology have concluded that improper oral rest postures and tongue thrusting may be the result of hypertrophy of the lymphatic tissues in the upper airway. Orthodontists are aware of the deleterious effects these habits have on the developing face and dentition.

Sleep disordered breathing is a major health concern that affects people from infancy into adulthood. Physicians who treat sleep disorders are now referring patients for orofacial myofunctional therapy. Researchers have concluded that removal of tonsils and adenoids, along with expansion orthodontics, may not fully resolve the upper airway issues that continue to plague patients' health. Sleep researchers report that the presence of mouth breathing, along with hypotonia of the orofacial muscular complex, has been a persistent problem in the treatment of sleep disordered breathing. Orofacial myofunctional disorders (OMDs) coexist in a large population of people with sleep disordered breathing and sleep apnea. Advances in 3D Cone Beam Computed Tomography (CBCT) imaging offer the dental and medical communities the opportunity to identify, assess, and treat patients with abnormal growth patterns. These undesirable changes in oral structures can involve the upper airway, as well as functional breathing, chewing and swallowing. Leading researchers have advocated a multidisciplinary team approach. Sleep physicians, otolaryngologists, dentists, myofunctional therapists, and other healthcare professionals are working together to achieve these goals. The authors have compiled research articles that support incorporating the necessary education on sleep disordered breathing for healthcare professionals seeking education in orofacial myology.

KEYWORDS: orofacial myology, orofacial myofunctional therapy, sleep disordered breathing

INTRODUCTION

This article is a review of research related to Airway and Sleep Disordered Breathing and areas that may overlap with the identification of orofacial myofunctional disorders. Three questions were formulated that served to guide the collection of information.

1. How does the research related to airway and sleep disordered breathing relate to orofacial myology?
2. What compelling evidence is presented that would support Airway and Sleep Disordered Breathing as an important criteria for the orofacial myologist to include in assessing patient needs?
3. Orofacial myology recognizes and supports the need to assess functional breathing. What correlation/s can be made between functional breathing assessment and Airway/Sleep Disordered Breathing assessment?

These preliminary questions aim to establish if there is sound basis for the inclusion of Airway and Sleep Disordered Breathing in the realm of orofacial myology. In light of the new and emerging evidence, a comprehensive review has been compiled of the most current and compelling research available, thus far.

What is Sleep Disordered Breathing?

Several resources were examined in an attempt to define what Sleep Disordered Breathing is. The following are definitions from the American Thoracic Society and American Academy of Otolaryngology-Head and Neck Surgery.

According to the American Thoracic Society:

> Sleep-disordered breathing is an umbrella term for several chronic conditions in which partial or complete cessation of breathing occurs many times throughout the night, resulting in daytime sleepiness or fatigue that interferes with a person's ability to function and reduces quality of life. Symptoms may include snoring, pauses in breathing described by bed partners, and disturbed sleep. Obstructive sleep apnea (OSA), which is by far the most common form of sleep-disordered breathing, is associated with many other adverse health consequences, including an increased risk of death (Breathing in America: diseases, progress, and hope, 2010).

According to the American Academy of Otolaryngology-Head and Neck Surgery:

> Sleep-Disordered Breathing (SDB) is a general term for breathing difficulties occurring during sleep. SDB can range from frequent loud snoring to Obstructive Sleep Apnea (OSA) a condition involving repeated episodes of partial or complete blockage of the airway during sleep. When a child's breathing is disrupted during sleep, the body perceives this as a choking phenomenon. The heart rate slows, blood pressure rises, the brain is aroused, and sleep is disrupted. Oxygen levels in the blood can also drop. Approximately 10 percent of children snore regularly and about 2-4% of the pediatric population has OSA. Recent studies indicate that mild SDB or snoring may cause many of the same problems as OSA in children (Pediatric sleep disordered breathing/obstructive sleep apnea, 2011).

METHODS

Orofacial myologists are trained to evaluate and treat patients with a variety of oral and facial muscle dysfunctions. The authors used the existing Scope of Practice as defined on the International Association of Orofacial Myology website (www.iaom.com), as their framework to explore whether orofacial myologists can, and should be, part of a team to identify patients of all ages who may be in need of an evaluation for Sleep Disordered Breathing (SDB) and Upper Airway Respiratory Syndrome (UARS) difficulties. Areas that are included in a typical orofacial myofunctional assessment and for which treatment is provided include:

1.) Abnormal non-nutritive sucking habits (thumb, finger, pacifier etc.)
2.) Other detrimental orofacial habits
3.) Abnormal orofacial rest posture problems
4.) Abnormal neuromuscular muscle patterns associated with inappropriate mastication, bolus formation and deglutition
5.) Abnormal functional breathing patterns
6.) Abnormal swallowing patterns
7.) Abnormal speech patterns (only if the COM has the speech-language pathology credentials required by his/her State, Province or Country) (www.iaom.com).

Terms used to search the literature included: arch width, presence of enlarged tonsils and adenoids, collapsed airway, forward head posture, orofacial hypotonia, missing premolars, scalloped tongue, sleep disordered breathing, obstructive sleep apnea, upper airway respiratory syndrome, nasal polyps, deviated septum, low lying palate or redundant soft palatal tissue, narrow hypopharynx, inappropriate tongue position, inappropriate orofacial growth and development, recurrence of malocclusion post-orthodontically (orthodontic relapse), disruption of sleep breathing patterns, improper oropharyngeal development, snoring, daytime sleepiness,

cognitive impairment, attention deficit and hyperactivity disorder, mouthbreathing, lip hypotonia, lip seal, Mallampati score.

DISCUSSION

In March, 2014, the authors of this article, all of whom are Certified Orofacial Myologists, were in attendance at the American Academy of Physiologic Medicine and Dentistry meeting in Chicago. In discussion, it became evident that there was a need to explore the possible role that the orofacial myologist could play in the comprehensive treatment of the sleep disordered patient. The authors have compiled this literature review in accordance with how the information applies to the seven areas in the Scope of Practice.

Capua, Ahmadi and Shapiro (2009) stated that SDB can affect both adults and children. OSA in adults is diagnosed when repeated episodes of airway obstruction are present for more than 10 seconds during sleep, resulting in pauses, lapses, or disruption of breathing. OSA is the most common condition among a group of disorders, called sleep-disordered breathing that can affect both adults and children. It occurs in about 2% of children and typically appears between 2-7 years of age. It affects approximately 2.5-6% of the adolescent population. Males are more likely than females to present with this disorder. A possible link of ADD hyperactivity in children may be linked to SDB, as well.

Capua et al. (2009) continue that adenotonsillar hypertrophy is a risk factor that can lead to narrowing of the airway or obstruction, the most common contributing factor to SDB. Adenotonsillar hypertrophy also decreases muscle tone, especially during REM sleep, which can contribute to the blockage of the airway. OSA occurring in childhood may eventually manifest in adulthood, predisposing adults to an increase in blood pressure and arrhythmias from the effects of SDB on the cardiovascular system. Loud snorers have twice the risk of developing hyperglycemia and 92% are more likely to have low levels of HDL. 80% of men and 90% of women remained undiagnosed.

Scope of Practice #1, 2, & 3

Articles presented in this section are related to Scope of Practice #1 – Abnormal non-nutritive sucking habits (thumb, finger, pacifier, etc.), Scope of Practice #2 – Other detrimental orofacial habits, and Scope of Practice #3 – Abnormal orofacial rest posture problems.

Trained orofacial myologists understand and appreciate the importance of proper tongue placement within the oral cavity to encourage appropriate dentofacial development. Schmidt, Carlson, Usery and Quevedo (2009) demonstrated the negative effect that a dysfunctional, low resting tongue posture had on the muscles and the sympathetic nervous system and, in particular, the heart, in relationship to TMD. The research indicated that the tongue rest posture, in conjunction with tongue muscle elevation to the palate, actually revealed an increase in electromyographic activity in the temporalis and the suprahyoid muscles, compared with low tongue rest posture.

Tang, Wang, Qing, Jiang, Lu, Yao, Ahang, Ye, Shang and Huang (2013) discussed how exercising the larynx and genioglossus muscle could play a role in the management of OSA. They found it especially helpful in patients who were advanced in their years and who were unable to undergo surgery and/or could not tolerate CPAP. They concluded that exercise involving the larynx and the genioglossus muscle can be considered a remedial protocol for OSA and other therapy.

Erik (2010) indicates that the common anatomical factors of OSA include nasal septal deviation, polyps, a low-lying palate or redundant soft palatal tissue, a thickened tongue base, or a narrow hypopharynx. Orofacial myologists can support appropriate oral rest postures of the lips and tongue that are specifically designed to pull the tongue out from the base of the posterior oral cavity, which may increase posterior oral volume.

Weiss, Atanasov and Calhoun (2005) found tongue scalloping to be predictive of sleep pathology in high risk patients. They described the presence and severity of tongue scalloping and demonstrated positive

correlation with increasing Mallampati and modified Mallampati airway classification. Tongue scalloping was also associated with pathologic polysomnography data and abnormal Mallampati grades. The study of 61 subjects revealed the following:

> Presence of tongue scalloping was 71% specific for abnormal sleep efficiency (<85%), 70% specific for abnormal AHI (>5), and 86% specific for nocturnal desaturation >4% below baseline. Presence of tongue scalloping also showed PPV of 67% for abnormal AHI, 89% for apnea or hypopnea, and 89% for nocturnal desaturation (page 969).

Tongue scalloping is a useful clinical indicator of sleep pathology, and its presence should prompt the physician and the orofacial myologist to inquire about snoring history. Many orofacial myologists currently evaluate intra-oral structures, which include the size and shape of the tongue and description of the oropharynx, relative to the Mallampati score. This research reveals that the tongue scalloping and abnormal Mallampati score may be predictive of sleep pathology.

Cooper (2010) explored the role of orofacial myologists in the management of patients with sleep breathing disorders. Many of these signs are found in patients who are at risk of sleep apnea or have sleep-related breathing disorders. This article also points out that poor positioning of the tongue affects breathing and allows a series of events to occur that can negatively affect the orofacial complex. A review of tongue muscle physiology shows the effects of negative pharyngeal pressure in the airway is associated with sleep related breathing disorders, and that this same adverse effect on tongue posture is the same basis of rationale for myofunctional therapy.

Scope of Practice #4

Articles presented in this section are related to Scope of Practice #4 - Abnormal neuromuscular muscle patterns associated with inappropriate mastication, bolus formation and deglutition.

Guilleminault, Huang, Monteyrol, Sato, Quo, and Lin (2013) studied the effectiveness of orofacial myofunctional therapy in preventing a recurrence of sleep disordered breathing post orthodontically and postsurgically (adenotonsillectomy) in pre-pubescent males. Specifically, the study concludes that young children should be treated with myofunctional therapy in order to ensure proper growth and development and muscular tonus. It stresses that sleep disordered breathing in its primary form is not a syndrome but, rather the result of, inappropriate orofacial growth and development. They state that SDB is a disruption of facial growth patterns that ultimately result in a secondary disruption of sleep breathing patterns. These authors report that orofacial myofunctional therapy (OMT) should be considered a necessary part of a comprehensive pediatric SDB protocol to assist in proper oropharyngeal development.

Guilleminault (2013) found a clear difference between subjects who received valid orofacial myofunctional reeducation and those who did not. The Apnea Hypopnea Index (AHI) was significantly different between the two groups. None of the subjects with orofacial myofunctional reeducation showed any evidence of breathing abnormalities during sleep in their post treatment PSG (polysomnography) studies. Those without myofunctional reeducation reported persistent daytime concerns such as inattention in school and fatigue, as well as sleep concerns including snoring and agitated sleep. All subjects without reeducation displayed mouth-breathing during sleep. Abnormal head posture and orthodontic relapse, as confirmed by an orthodontist, were found in those who did not receive myofunctional reeducation. These anatomic presentations were not found in those subjects with normal breathing during sleep. The study found that OMT is beneficial to young children, as it helps encourage proper muscular tonus of the upper airway during the process of sleep.

Guimaraes, Drager, Genta, Marcondes and Lorenzi-Filho (2009) indicated that upper airway muscle function plays a major role in the maintenance of the upper airway patency and contributes to the genesis of OSA. The authors studied the efficacy of oropharyngeal exercises derived from the orofacial myofunctional literature as performed by

speech therapists in their country of Brazil. These exercises were done to determine if they provided an effective treatment option for patients with moderate OSA. Results indicated that patients experienced neck circumference decrease, snoring decrease in intensity and frequency, improved sleep quality, and reduced daytime sleepiness. O2 saturation rates increased. Oropharyngeal exercises significantly reduced OSA severity and symptoms and represent a promising treatment for moderate OSA.

Desplan, Mercier, Sabate, Ninot, Prefaut and Dauvilliers (2014) conducted a randomized control pilot study consisting of sedentary adult patients diagnosed with OSA against a control group. Significant positive changes occurred in all active subjects in AHI, neck circumference, arousal index, oxygen desaturation, weight loss/BMI, sleep latency, glucose levels and blood pressure. The researchers concluded that a comprehensive exercise rehabilitation program could be considered as an adjunctive or alternative treatment for moderate to severe OSA. This study demonstrates that the medical community is researching and supporting gross motor exercise activities as a valid means of improving OSA.

The emerging research in the dental community addresses oral exercise programs administered by trained orofacial myofunctional therapists, in a supportive professional setting, as a means of improving symptoms in OSA patients. Continuing to explore this path of adjunctive therapies, fine motor or gross motor, within a team approach in OSA, is becoming a strongly supported global concept by the therapeutic, dental, and medical research communities.

Scope of Practice #5

Articles presented in this section are related to Scope of Practice #5 – Abnormal functional breathing patterns.

Capua et al. (2009) lists several risk factors including family history of snoring or OSA, physical abnormalities, cerebral palsy, MS, Down syndrome, mouth breathing, and any condition that may lead to narrowing of the airway. They indicate that, in the case of tonsillar enlargement, the removal of the tonsillar tissues serves as an ultimate treatment of OSA. They further state that dentists, who often look into children's mouths, play an active role in identifying those with enlarged tonsils and are referring them for a sleep assessment. Since orofacial myologists play a similar role, it makes sense that they would also refer children with enlarged tonsillar tissue to other allied health professionals.

Guilleminault et al. (2013), concluded that young children treated with myofunctional therapy be encouraged to habituate appropriate breathing patterns that, in turn, can assist in improving breathing patterns during sleep and support adequate nasal flow. They further state that, by providing myofunctional therapy exercises as well as screening for airflow and nasal resistance, much sleep disordered breathing can be prevented in the young population.

Pia Villa, Brasili, Ferretti, Vitelli, Rabasco, Mazzotta, Pietropaoli and Martella (2014) evaluated the efficacy of oropharyngeal exercises in children with symptoms of OSA after adenotonsillectomy. They indicated that untreated pediatric OSA may result in various problems such as cognitive impairment, attention and hyperactivity disorder, poor academic achievement, and cardiovascular and metabolic complications. The authors identified that mouth breathing and lip hypotonia seldom change after surgical and/or medical treatment and may be a residual behavior related to OSA.

The oropharyngeal exercises included in the Pia Villa et.al. (2014) study were nasal breathing rehabilitation, labial seal and lip tone exercises, and tongue posture exercises performed three times daily with ten to twenty repetitions. This study indicated that oropharyngeal exercises led to a significant decrease in nasal obstruction which, in turn, reduced the proportion of positive Glatzel and Rosenthal tests and improved nasal patency, thereby allowing patients to regain nasal breathing, and that lip seal exercises designed to strengthen the lips also allowed children to regain correct labial seal.

Orofacial myologists assess nasal breathing, lip seal, and lip tone. The exercises used in the Pia Villa et.al. (2014) study were very

similar to the exercises presented in an introductory orofacial myofunctional therapy training course. Orofacial myologists understand the importance of nasal breathing. Therefore, it is prudent to include the quality of breathing a patient experiences during sleep as part of a routine assessment in an orofacial myofunctional therapy program. The study by Pia Via et.al. (2014) demonstrates the possibility that OMT may improve breathing function for children. With more research and ongoing studies, OMT may prove to be a very important aspect in the treatment and management of OSA.

Bonuck, Freeman, Chervin and Xu (2012) examined the effects of snoring, mouth breathing and apnea on behavior, from infancy through 7 years of age, in more than 11,000 children over a 6 year period. This is the largest cohort study on SDB in children to date. The study describes the combined trajectory of 3 hallmark SDB symptoms (snoring, mouth breathing, and witnessed apnea) and their longitudinal statistical effects on behavior. The study indicated a strong and persistent association between SDB symptoms in early life and behavior. The researchers indicated that children whose sleep-disordered breathing peaked at 6 or 18 months of age were between 40 and 100 percent more likely to develop behavioral problems by age 7 when compared with children who breathe normally during sleep. Most noticeably, children who had the worst behavioral problems had breathing problems throughout their infancy, which peaked when the child was 30 months old. This research is the strongest evidence to date that snoring, mouth breathing, and apnea can have serious behavioral and social-emotional consequences for children. The findings provide epidemiologic evidence that early childhood SDB effects may only become apparent years later. It appears that the clinical implications for early screening and treatment exist.

Functional breathing is within the realm of the orofacial myologist. Therefore the orofacial myologist must collect information on the individual's breathing patterns, both while they are awake and as they sleep. The breathing patterns during sleep are usually reported to the orofacial myologist by a parent, sleep partner, or other residing with the patient. Any altered breathing, such as oral predominant breathing, regardless of when it occurs (whether awake or asleep), has the potential for negative impact with corresponding harmful and detrimental effects. The findings from the Bonuck (2012) study support the need for SDB screening. Functional breathing assessment should be included in every OMT patient evaluation and the orofacial myologist should make appropriate referrals accordingly.

Marcus, Brooks, Draper, Gorzal, Halbower, Jones, Schechter, Sheldon, Spruyt, Ward, Lehmann and Shiffman (2012) revised clinical practice guidelines intended for primary care clinicians and provided recommendations for the diagnosis and management of OSA in children and adults. This article demonstrates the relevance of following a detailed history and examination to determine whether further evaluation for OSA is needed, and provides a format for taking a thorough history relevant to OSA. In summary, it states that any dysfunctional breathing, regardless of whether awake or asleep, has negative impact on the growth and development of children. Based on this research, the orofacial myologist should consider incorporating a comprehensive screening tool in assessing functional breathing patterns when the client is awake and also collect information related to breathing while asleep.

Crabtree, Varni and Gozal (2004) studied a group of children with snoring and suspected SDB. They found impairments in quality of life and depressive symptoms, compared to children who did not snore. Orofacial myologists motivate their patients to participate in orofacial myofunctional therapy programs; however, if the patient has underlying issues of depression, it may impact the success of therapy. In promoting a multi-disciplinary approach, referral to other appropriate specialists should be made that extends past the evaluation of the airway, and should include psychologically-based support if indicated.

Guilleminault, Huang, Quo, Monteyrol and Lin, (2013) investigated why OSA in some children appears to resolve following orthodontia and adenotonsillectomy, and why some fail to resolve these issues and relapse into inappropriate sleep patterns later in life. They found that, not only did OSA relapse occur

frequently, despite early intervention with orthodontic expansion and adenotonsillectomy, but a sequela of common observations were found to coexist in these relapsing patients. Altered facial growth and aesthetic changes were prevalent, in addition to the recurrence of the OSA.

Guilleminault et.al. (2013) determined, through an orofacial myofunctional evaluation, that all of the teens included in the study who reported sleep symptom relapse were found to present with abnormal facial muscle tone. This is the first study that shows long-term evolution of sleep disordered breathing in children after recording adequate treatment in early childhood for this malady. It suggests that the reappearance of SDB can occur several years after receiving what is considered the appropriate and aggressive current standard of care.

The orthodontic community has long associated mouth breathing and hypotonia of the orofacial muscular complex with facial structural changes. This was confirmed in the Guilleminault et.al. (2013) study by the presence of abnormal myofunctional patterns in these relapsing teenagers. Muscular hypotonia is considered to be a driving force in the maxillary and mandibular deficiencies, as noted in many sleep disordered children. Simply removing the adenoids and tonsils in the pre-pubertal years and providing maxillary/mandibular expansion does not necessarily guarantee a long-term resolution of the responsible cause of both factors over time, nor does it guarantee that a relapse will not occur, according to the research by Guilleminault (2013). What it does demonstrate is that if nasal breathing is established vs mouth breathing, and oral facial muscular tone is normalized, the chance of OSA recurrence in teens is significantly reduced. If muscular facial tonus concerns and mouth breathing are allowed to persist, a progression of altered facial structure may result, causing the potential for a cascade of issues to occur which are documented to coexist with OSA. Mouth breathing was considered a significant factor in the sustenance of OSA in these myofunctional evaluations. Therefore, the researchers concluded that myofunctional evaluations are warranted as a necessary component of a team approach to the treatment of childhood and teenage OSA (Guilleminault et.al., 2013).

Meltzer, Plaufcan, Thomas and Mindell (2010) conducted a comprehensive review of documented treatment recommendations provided for sleep disorders and sleep problems in pediatric primary care patients. Their study revealed that sleep disorders and sleep problems were found to be highly persistent for up to a third of the 750 pediatric charts they reviewed, yet only 5.2% of those children received a treatment recommendation. Given their findings that very few children receive referrals and/or treatment recommendations for diagnosed sleep disorders or sleep problems, they concluded that it is essential to provide health care providers with more education and support on sleep disorders and sleep problems in the pediatric primary care population.

A study by Mann, Burnett, Cornell and Ludlow (2002) suggested that, by increasing muscle tone of the upper airway through the process of electrical stimulation to the tongue, positive effects to patients with sleep apnea can be observed. Electrical stimulation to the genioglossus muscle resulted in an increased hypopharyngeal airway. Individuals in the population who already receive this form of tongue training are musicians who play a double reed instrument. In particular, the demands of the respiratory muscles during sound production of a double reed instrument are significant, compared to other musical instruments.

Nine hundred and eighty six collegiate and professional musicians were recruited for the target group in the Mann et.al. (2002) study. Health and sleep histories, risk assessments, and the Epworth Sleepiness Scale were administered to all participants. Those determined to be at high risk (dry mouth in morning, tossing and turning, obesity, etc.) were categorized as such. Of those in this high risk group, approximately 9% were diagnosed with OSA. It was determined that playing a double reed instrument was predictive of a lower risk for OSA than playing a non-wind instrument. It was theorized that the upper airway stimulation that occurred with double reed playing may provide an effective alternative method of OSA treatment, and particularly in those individuals with a mild to

moderate form who cannot tolerate, nor gain benefit from, CPAP treatment. Both electrical stimulation (Mann et al., 2002) and exercise, i.e., physical stimulation that has been described earlier in this paper (Guimares et al., 2009), may be beneficial in contributing to upper airway patency.

These particular instruments, English Horn, Oboe, and Bassoon, require significant pressure through a small aperture, or double reed, in order to produce sound. This is associated with high air resistive strength during the act of instrumentation. Each instrument has a distinct muscular pattern which contributes uniquely to airway resistance. However, for musicians who play a double reed instrument, the particular requirements and demands of a double reed dictate a high degree of pressure, resulting in increased airway resistance, and possibly contributing to this decreased OSA risk factor (Mann et al., 2002).

Clients frequently request instrument recommendations (Green & Green, 1998) that would be beneficial for their particular lip, tongue, or jaw morphology and muscle patterns. Helping individuals make the proper choice to encourage proper tongue pattern activity was described in the International Journal of Orofacial Myology over a decade ago. Given this previous involvement of the orofacial myologist in musical instrument selection, would it be beneficial for clinicians to take this one step further into the present, given this new research? Can a young child seeking to play a musical instrument be assisted in make the 'right choice' if they appear to be at risk for OSA? And would these educated choices influence the prevention or improvement of SDB risk factors? The researchers of this article feel that this is the case. It appears that making the 'right choice' of a musical instrument may influence improved airway patency.

In the Principles and Practice of Pediatric Sleep Medicine, Boyd and Sheldon (2012) discuss the relationship between epigenetics, evolution, and modern disease. Boyd and Sheldon report that anthropological skeletal and skull observations over the past several decades have suggested that the facial, oral, craniofacial, mandibular, and airway structures are changing in modern man, particularly in this generation of children, and not in a positive way.

These epigenetic and resultant structural evolutionary changes, often impacted by modern man's environment, challenge the entire homeostasis in the developing child. This often leads to a cascade of medically compromising conditions over the lifespan of the individual. Causative factors implicated in this chain of events include a decreased incidence of breastfeeding, a change from early man's coarse textured diet to soft, overly processed textures, and other environmental factors. As a result, a narrowed oral and facial structure is now becoming the norm. This narrowing vertical growth propensity correlates to an increased incidence of airway, sleep, and decreased respiratory functional concerns (Boyd & Sheldon, 2012).

Boyd and Sheldon (2012) indicate that cranial structures reduced in size often lead to airway disorders, SDB, OSA, and other related systemic concerns that may ultimately result from altered nocturnal breathing patterns such as cardiovascular disease, obesity, neurological disorders, diabetes, and ADHD. They suggest that, because of these altered genetic expressions over the last 300 years, pediatric dental care should also evolve to an airway supportive model. In each generation, these epigenetic alterations or genetic expressions, such as narrowing cranial morphology, can further disrupt and negatively impact the evolutionary process for future generations of children (Boyd & Sheldon, 2012).

The first study that the authors of this review were able to find on the topic of epigenetics and airway and facial development was conducted in 2010 by the Mayo Clinic researcher Dr. Theodore Belfor. He determined that oral function and an epigenetic response, which could alter facial and airway development, could be encouraged through a functional orthodontic appliance. Belfor concludes that the results could only be attributed to a genetic expression.

The application and relationship of this topic of structural epigenetic evolution to the field of orofacial myology is relevant. Early recognition of tongue or lip tie through

screening in the infant to insure breastfeeding, which encourages healthy structural development and oral patterns, elimination of digit sucking habits and pacifier or other non-nutritive sucking education, and the education of parents in the benefits of healthy food choices, i.e., a firm textured diet, encompass the first leg of this journey. As the child matures, screening, appropriate referral, and/or treatment to help establish proper nasal breathing and 'functional breathing patterns' are well within the Scope of Practice of the Certified Orofacial Myologist. Poor mastication, delayed and/or challenged tooth eruption and caries, poor digestion, and altered nutritional status are all possible ramifications of decreased tongue space and inappropriate lingual and orofacial muscular patterns, as well. Many concerns may be prevented if recognized in infancy and early childhood through early awareness, intervention and supportive care by a comprehensive team of interdisciplinary professionals. Comprehensive efforts could be directed to help improve and maximize a child's genetically predetermined maxillary and craniofacial growth trajectory to its fullest, thus supporting healthy future generations and the epigenetic model.

This orofacial myofunctional treatment model may encourage optimum palatal and structural growth for current and future generations. It could also help identify those children at risk for future airway concerns and respiratory disease. Certified Orofacial Myologists are highly trained health care providers with proven expertise and established competency in the field of early recognition of functional breathing concerns from a developmental standpoint.

This shifts the focus of childhood orofacial growth and development to a more preventive and interceptive model of practice. Marcus, Brooks, Draper, Gozal, Halbower, Jones, Schechter, Sheldon, Spruyt, Ward, Lehman, and Shiffman, (2012) were involved in establishing recommendations for the diagnosis and management of OSA in children and adolescents. These clinical guidelines were intended for use by primary care clinicians. Several recommendations were made on the basis of their research including: (1) All children/adolescents should be screened for snoring; (2) Polysomnography should be performed in children/adolescents with snoring and symptoms/signs of OSAS; if polysomnography is not available, then alternative diagnostic tests or referral to a specialist for more extensive evaluation may be considered; (3) Adenotonsillectomy is recommended as a first-line treatment of patients with adenotonsillar hypertrophy.

Owens, Spirito, McGuinn and Nobile (2000) examined a variety of common sleep behaviors of almost five hundred elementary school children, from kindergarten through fourth grade, using a battery of sleep questionnaires. Their study revealed that approximately 10% of those examined were identified as having significant problems with daytime sleepiness. The results of this study emphasize the importance of focused screening for sleep disorders in this age group in the clinical setting, and recommends it as the first-line treatment of patients with adenotonsillar hypertrophy.

Diiulio (2013) interviewed one of the most prominent researchers in pediatric sleep medicine and one of a few physicians who have dedicated their careers to the field, Stephen Sheldon, DO, professor of Pediatrics at Northwestern University, Feinberg School of Medicine, and Director of the Sleep Medicine Center of Ann and Robert H. Lurie Children's Hospital of Chicago, who explains that clinicians need to know how to assess a sleep disorder.Sheldon indicates that "The identification of disordered sleep really rests on asking the right questions and being able to interpret the answers, and that really begins with all child healthcare professionals" (p 1).

As the fields of Pediatric Medicine and Dentistry evolve to meet the needs of future generations, this new emerging knowledge base can also be used as a building block for the growth and advancement of the practice of orofacial myology. Perhaps this is our legacy for the next generation in orofacial myofunctional therapy.

Sharma, Shrivastav, Hotwani and Murrell (2014) state that patients with sleep-disordered breathing and airway problems are subjects of concern for the orthodontist, as well as the otolaryngologist. Imaging of the upper airway forms an essential tool in the field of orthodontics, as it has allowed us to

begin to understand the biomechanical basis for OSA and mouth breathing. Consequently, treatments prescribed by the orthodontist and otolaryngologist require a multidisciplinary approach for a successful result. Sharma et al. (2014) detail how different methods of measuring the upper airway can be utilized to evaluate growth of the craniofacial structures and assist with treatment planning.

It is recognized that nasorespiratory function and it's relation to craniofacial growth is of great interest not only for orthodontists, but also for pediatricians, otolaryngologists, speech pathologists, and other members of the healthcare community. Nasal airway function has been implicated as an etiological factor in dentofacial development. Craniofacial form and function should be managed closely, particularly during early growth and development. In cases of an impeded airway, it is important to recognize the facial alterations and take adequate steps to achieve occlusal harmony and facial balance in conjunction with the restoration of physiologic functions.

Diaferia, Truksinas, Haddad, Santos-Silva, Bommarito, Gregorio, Tufik and Bittencourt (2011) demonstrated that patients being studied, who presented with OSA, commonly displayed decreased neuromuscular tension of the tongue and cheeks, inadequate resting posture of the tongue, inefficient mastication, tongue thrust swallow, and overactive mentalis muscle during swallowing. They found these issues to be crucial to the assessment of patients with OSA. They also indicated that patients' symptoms could be improved with a therapeutic approach. Findings showed changes in the orofacial musculature which may worsen during sleep and aggravate OSA. They noted select cases where snoring improved. They concluded that clinical assessments of orofacial motricity in OSA patients should be considered as alternative or adjunctive treatment. Orofacial myofunctional assessments included swallowing alterations, which worsened during sleep and aggravated the OSA condition. Disordered breathing was present day and night.

Capua et al., (2009) state that adenotonsillar hypertrophy is a risk factor which can lead to narrowing of the airway or airway obstruction-which is the most common contributing factor to SDB – as it is found to decrease muscle tone, especially during REM sleep. It is recommended that orofacial myologists should refer to ENT's for further assessment.

Orthodontists whose lives were personally affected by OSA collaborated to create the Orthodontic Sleep Apnea Clinical Advisory Team. In "Orthodontic Strategies for Sleep Apnea," one of the authors describes how, through an imaging Cone Beam Computed Tomography (CBCT), his 8 year old son was diagnosed with severe airway obstruction. The original medical team involved missed the etiology. The combined treatment of ENT surgery and orthodontic treatment greatly improved his upper airway volume. Carlyle, Churma, Damon, Diers, Paquette, Quintero (2014) developed a comprehensive educational course that provides an evidence-based system to implement sleep apnea treatment in the orthodontic practice. The educational goal is to broaden the scope of the orthodontic practice to screen effectively, and to test and treat patients for OSA.

Scope of Practice #6 & 7

Articles presented in this section are related to Scope of Practice #6-Abnormal swallowing patterns and Scope of Practice #7–Abnormal speech patterns.

Singh and Olmos (2007) stated that when using sibilant phonetic sounds, the position of the mandible is assessed by using a round separating device used as a fulcrum on the anterior teeth to capture resting position between 'S' sounds counting from 66 to 77, providing a registration of 'phonetic bite'. Establishing proper freeway space may improve TMJ/muscle dysfunction, as well as airway patency. They state that it is thought that the 'S' sound produces a patent airway and that, when the mandible is in this forward posture, there is a reduction in nociceptive ascending input from the posterior joint space. Evaluation of jaw thrust habits during speech and at rest may assist in improving rest position of the jaws.

Another meta-analysis highlighting recent literature on orofacial myofunctional exercises as they relate to sleep disordered breathing has been compiled by Camacho, Certal, Abdullatif, Zaghi, Ruoff, Capasso and Kushida (2014). This analysis included many of the

previously mentioned studies in the present article. They concluded that, "Current literature demonstrate that myofunctional therapy decreases AHI by approximately 50% in adults and 62% in children. Lowest oxygen saturation, snoring and sleepiness outcomes improve in adults. Myofunctional therapy could serve as an adjunct to other OSA treatments." (p. 14, epub ahead of print)

CONCLUSION

While reviewing the literature, it became evident that orofacial myology directly applies to those individuals who display symptoms of sleep disordered breathing (SDB), which includes obstructive sleep apnea (OSA) and upper airway resistance syndrome (UARS). It is the consensus of the authors of this article that the present treatment protocols may fall short in the comprehensive orofacial myofunctional evaluation and subsequent referral for a SDB evaluation by an appropriate sleep study center, and a team approach to management. Most orofacial myofunctional therapy patients demonstrate many observable indicators mentioned in the research above. These criteria are routinely utilized by clinicians to determine the existence of an orofacial myofunctional disorder. They also appear to be identified in the literature presented above. In an article depicting a typical patient intake form, Green (2012) asks the following questions, "Does the client have a history of current or previous tonsil or adenoid enlargement or difficulty per his MD?", "Does the client breathe through their mouth at night?" and "If so, is there excessive snoring associated with mouth breathing, or tiredness upon awakening?" It appears interesting that the very questions the authors of the cited research above are also asking, and should be included in a comprehensive orofacial myofunctional assessment.

Presently accepted orofacial myofunctional health histories routinely contain questions regarding mouth/nasal breathing etiologies, asthma, allergies, tonsils/adenoids, snoring, deviated septum, airway patency, and a host of other airway-related areas of concern. Recent studies suggest that these symptoms and others may be directly associated with, and/or play a part in, the development of sleep disordered breathing issues. The management of orofacial myofunctional disorders is dependent upon a patent airway from the nasal cavity to the oropharynx. Without acknowledgement of this physiological aspect of the client, can one anticipate that a positive therapy outcome will result? The authors feel this is a question worthy of exploration.

Much of the research previously discussed acknowledge that oral hypotonia and poor rest posture of the tongue, lips, and mandible can contribute to malformations of the maxilla and mandible. Orofacial myofunctional therapists must be knowledgeable and well-versed in the research in order to be considered a part of the comprehensive treatment team. They must know the pertinent questions to ask.

Orofacial myofunctional therapy is dedicated to the promotion of optimal health and well-being and the enhancement of the quality of one's life. In reviewing the research, it additionally becomes clear that airway related issues are the growing focus of many disease etiologies and treatments. As specialized health care providers, the authors of this article believe that it would be beneficial for orofacial myofunctional therapists to utilize this new research to help further define their role as an evolving profession and as members of an interdisciplinary healthcare team.

Should orofacial myologists begin to think about SDB as a condition secondary to growth and development abnormalities, which are already present in the orofacial complex? Orofacial myologists are in a unique position to be able to recognize these potential concerns and, through specific exercises, may be able to help establish proper functional breathing patterns, thus improving muscular tonus and encouraging the proper growth trajectory in regard to the oral structural complex.

By establishing proper freeway space, improving nasal breathing in the capable patient with a patent nasal airway, and eliminating noxious habits, the growth and development of oral facial structures can be maximized and the potential for beneficial structural growth can be established early on. These authors believe that, by preventing these structural concerns early in life, via

establishing good oral muscular and functional breathing patterns through OMT exercises, the potential for proper orofacial growth and development, the potential for improved sleep, and an optimally established nocturnal airway, will most likely result.

In conclusion, the authors of this article are hopeful that the natural progression of this process could result in the formal incorporation of screening and assessment of sleep-disordered breathing into the practice of orofacial myology. The ultimate goal is the formal incorporation of the Certified Orofacial Myologist as a valued member of the team whose task is to comprehensively co-manage the patient with sleep-disordered breathing.

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