

The role of dentistry in the field of sleep medicine...are we respecting the physiology?

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Dentistry plays an extremely important role in sleep medicine, not only in treatment, but also in first-line recognition of the clinical signs, and screening for, sleep disordered breathing. Along with obesity, the incidence of sleep apnea is on the rise, yet it is both under-diagnosed and under-treated.¹ Much of the healthcare budget and resources are spent managing the comorbidities associated with sleep apnea, yet the underlying problem remains undiagnosed.² Thankfully, awareness is increasing among the medical and dental professions and the public alike, and one day the future may not equal the past.

There is no higher priority for the body than to breathe. We can survive days without food or water, but only minutes without oxygen. The state of sleep, although an active process, relies entirely on physiological autonomic processes to survive. One of the fundamental drivers underlying the pathophysiology of obstructive sleep apnea is the upregulation of the sympathetic nervous system that occurs in response to the struggle to maintain a patent airway.³ The physiology cannot be escaped. The autonomic nervous system, that fine balancing act between the sympathetic (stress response) nervous system and the parasympathetic (rest and recovery) nervous system, hums away in the background, working hard to maintain homeostasis, the status quo. There are tight physiologic boundaries⁴ within which the body must remain to maintain health, and the autonomic nervous system is constantly monitoring afferent sensory input from a myriad of sources to conserve that balance. A reasonable analogy would be all the micro-adjustments a tight-rope walker needs to be constantly making in order to successfully reach the other side. A failure to maintain balance (homeostasis) has dire consequences.

The rules that guide the scoring of events throughout a sleep study can tend to sugarcoat the

underlying complexity of what is actually happening during frank apnea events and increased upper airway resistance. Somers has shown that even momentary micro-arousals, ones that would not register on the scoring of a sleep study, result in an autonomic response that causes a transient elevation in blood pressure and an upregulation of sympathetic nerve activity.⁵ The stress response is critical to survival. Its role is to respond to a challenge, then switch off.⁶ The problem is when the sensory input becomes barraged with challenges, as occurs with sleep disordered breathing, the switch is on more than it is off and the sympathetic nervous system becomes upregulated.⁷ In this process, the tight physiological boundaries become re-set to maintain a new homeostasis, albeit a pathological one. The baroreceptors accept higher blood pressure as being the new norm,⁸ the chemoreceptors accept elevated carbon dioxide levels,⁹ and even the muscles fibers that support the pharyngeal airway undergo plastic change from the slow to fatigue Type I fibers, to fast to respond but also fast to fatigue Type II fibers.¹⁰ Everything changes because of the need for physiological economy and homeostasis.

So what does this have to do with dentistry? Everything. Our role is not only to provide jaw support to help maintain a patent airway, but just as importantly, to turn down the sympathetic nervous system, which is fundamental to the pathophysiology underlying the health consequences associated with sleep apnea. It may sound confronting, but it is actually quite a basic principle. The autonomic nervous system, like gravity, is pervasive. We may not think about it, but it's still there, and there will be a physiological response, good or bad, to whatever treatment we provide.

Sir Charles Sherrington, 1932 recipient of the Nobel Prize in physiology and medicine, first described the avoidance reflexes to flex away from an aberrant input, which lead to postural compensatory adjustments throughout the entire musculoskeletal system.¹¹ Dr.

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Norman Thomas later used these principles to describe the postural reflexes associated with a noxious input to the proprioception from the occlusion, the cervical, the airway, or even distant sites that can lead to fatigue in the muscles and ultimately the experience of pain in temporomandibular disorder patients.¹² The autonomic nervous system drives the response, but the muscles have to do the work to sustain the compensated position. Huxley and Gordon clearly demonstrated in their Nobel Prize winning research, that muscle fibers have to rest at their resting length of 2–2.25 mm per sarcomere for optimum physiological function.¹³ Chronic foreshortening or chronic lengthening will lead to fatigue, and fatigue not only compromises function, but also increases the experience of pain.

Orthogonal postural alignment is essential to avoid the chronic contraction and elongation of muscle fibers described above. This allows aerobic physiological muscle metabolism and health. Studies have shown that as little as a 10–25% muscle contraction is enough to compress the blood flow to a muscle, and lead to fatigue.¹⁴ Understanding this, it is easy to recognize that it is imperative that the postural balance of the muscles of the head and neck be optimized in our oral appliances, which are there to support the airway when the person is most vulnerable — lying down and asleep. Opening the airway, but creating postural compensations between the jaw and the cervical complex may reduce the Apnea Hypopnea Index, but fail to turn down the sympathetic nervous system. So how can we be sure the neuromuscular system is in balance? By measuring the physiology.

Dentists have worked in isolation from medicine for far too long. What we do to patients is largely mechanical in nature, yet we are dealing with a physiological human being who will have a physiological response to our treatment, and yet we fail to consider, let alone measure, that physiological response. They measure everything in medicine. Physiological parameters and the physiological response to treatment is the measure of successful treatment. Surface EMGs are one of the three cardinal measures in polysomnography.¹⁵ Muscle tone as identified on EMG is integral to determining not only sleep state, but also sleep events and arousals. Arousals are associated with increased sympathetic nerve activity and higher EMG activity.⁵ By measuring the EMG activity across pairs of muscles from the temporalis to the cervical region, the physiological balance and response of the

neuromuscular system to the bite taken for the oral appliance therapy, can be identified. It can also be compared to the state of balance both at rest and when the patient lightly rests on their natural dentition. Aberrancies and compensations are readily identified, in real time, allowing the practitioner to ascertain whether the bite they have taken is assisting in turning down the sympathetic nervous system response or inadvertently upregulating it. This is a powerful starting position to optimizing the physiology for the compromised sleep apnea patient along with maintaining a patent airway.

Medicine has long measured physiology. It is time dentistry caught up. There are many tools and treatment protocols available to optimize the physiology; the technology is available, the education is available, and the patient is worth it.

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