Awareness of sleep breathing disorders is growing amongst the medical profession, dentists, the media and the public. And it is just as well. It is estimated that OSA affects between 10 and 25% of the population, only 10% of those have been diagnosed and only 10% of those diagnosed are actually being treated and compliant.

Neuromuscular Dentistry and Obstructive Sleep Apnea

A Marriage of Mutual Advantage

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The table below shows the potential extent of the problem:

Country	Population	Estimated OSA 10%	Diagnosed OSA 10%	In Active Treatment 10%
USA	311,000,000	31M	3.1M	310,000
Canada	34,000,000	3.4M	340,000	34,000
Australia	22,000,000	2.2M	220,000	22,000

Figure 1: Potential OSA prevalence

Even if these estimates were 50% incorrect there is still a huge discrepancy between the prevalence, diagnosis and treatment of this profoundly life-threatening condition.

Dentists are in a position to be the number one group identifying these potential patients. Why? Because OSA is a disease of cranio-facial anatomy and who should be the experts in that field? Dentists.

The sad thing is that many dentists fail to recognize the signs and symptoms glaring at us in our patients while we go about repairing the damage that the OSA has done. The question is: Do we ever ask why? Why did that unrestored tooth split? Why did that restoration break? Why are there abfractions? Why is this patient struggling with treatment? Why do they gag when I take an impression? Why is their mandible retruded? Why is their tongue scalloped? Why is this child grinding their teeth away? Why are there bony exostoses around the ridges? Why are those tonsils so huge when there is no infection? Why have they got a deep overbite? Why are they developing into Class II or Class III? Why are there wear facets on their front teeth? Why is there erosion on the occlusal surface of the posterior teeth? Why have they got a narrow palate? Why are their posterior teeth lingually inclined? Why is this patient falling asleep during treatment? Why do they hate going to the dentist – are they frightened of you or are they protecting their airway?

The list could go on and on. To be a good diagnostician, you have to retain your child like curiosity and ask why. Except for blunt trauma, dental breakdown rarely occurs in isolation.

The study of neuromuscular dentistry and an interest in treating temporo-mandibular disorders once again reintroduces dentists to anatomy and physiology.

These dentists acquire a growing awareness of how a compromised airway is root cause to many of the developmental deficiencies witnessed in and contributing to the complexity of the TMD patient. Both TMD and OSA are diseases of a compromised cranio-facial anatomy. Cunali, 2009 showed that 75% of TMD patients also had OSA and 52% of OSA patients also had TMD. This high correlation makes it inevitable that the TMD treating dentist needs to recognize, refer appropriately for a diagnosis to be competent in treating OSA. Similarly dentists treating OSA will find themselves frequently dealing with TMD patients and require a deep understanding of the anatomy and physiology to deliver predictable and favourable outcomes for their patients.

Deficiencies in the cranio-facial anatomy result in cranio-cervical-mandibular relationships, which are compromised. Modern, Western diets and environmental pollutants frequently result in low grade allergies which cause proliferation of lymphoid (tonsils and adenoids) and nasal tissue inflammation and hypertrophy. The net result of this is poor nasal patency obligating the child to become a mouth breather. As soon as this happens, the tongue assumes a low posture in the mouth to enable mouth breathing. A tongue thrust develops to create a seal while swallowing and the tongue fails to take up its rest position within the palate where it would have acted to widen the arch to its genetic potential. Unfortunately the forces from the buccinator muscle continue to act upon the developing dentition in a compressing (narrowing) function. The arch then develops within the neutral zone but the neutral zone is compromised and the end result is a narrow V shaped arch, often with a high palatal vault instead of the optimal broad U shaped arch. And because the roof of the mouth is the floor of the nose, the nasal airway is compromised further.

A compromised airway affects the midface development and the mandible whose growth is predicated by the maxilla is then forced into a more retruded position to enable articulation of the teeth. The lower teeth often crowd and the posterior teeth hypo-erupt due to the pressure of the tongue lying on top of them as the child breathes through their mouth and this results in a deep overbite. As the mandible takes up its retruded position, the functional space of the airway becomes compromised so the body extends the neck forward to maintain the airway and causes a posterior cranial rotation to maintain the horizontal gaze. This is just one of the many adaptations the body will assume to overcome the compromised cranio-facial anatomy.

There is nothing more important to the body than maintaining the airway. We can go weeks without food, days without water but only minutes without air. This forward neck posture and retruded position of the mandible result in a compromised airway but it is an airway none the less and the best airway the body can assume given the compromise. The hierarchy of needs have dictated this posture. The postural reflexes involved in the maintenance of this posture are dictated by the central nervous system as first explained by Sherrington (recipient of the Nobel Prize in Physiology or Medicine 1932). These reflex postural compensations are dictated by the CNS but maintained by the peripheral neuromuscular system. This change from orthogonal (upright, correct and balanced) posture to reflex driven causes the muscles to be contracted or stretched all the way down the postural chain rather than be at their resting length.

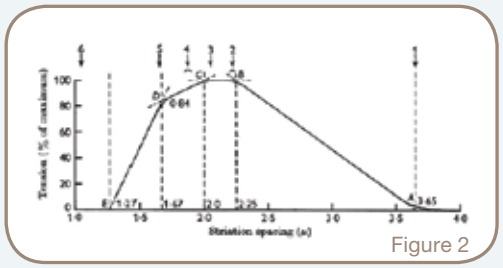
Figure 2

Huxley and Gordon (Nobel Prize for Physiology or Medicine 1963) demonstrated that the resting length of muscle is 2-2.25um per sarcomere and that shortening or lengthening beyond this arrangement will result in fatigue. (Figure 2) Studies have shown that a contraction between 10-25% will completely cut off the blood supply to a muscle (Rasmussen, 1977) (Thomas N. , 1999) - resulting in fatigue and pain. An assumed posture away from orthogonal is fine in the short term but not in the long term. Chronic postural compromise will eventually result in chronic pain as experienced by patients suffering from TMD. (Figure 3)


Figure 3

Neuromuscular dentistry recognizes this chronic fatigue as being instrumental to the presenting symptoms of the patient and addresses this compromise physiologically rather than mechanically. Orthotics are used to support and stabilize the cranio-cervical-mandibular system but the starting position is determined by first relaxing the neuromuscular system through the use of ultra low frequency TENS. Through the use of the J5 Myomonitor, cranial nerves V and VII and XI and C1/C2 receive an impulse every 1.5 seconds. Because the process is neurally mediated, every muscle innervated by these nerves is caused to fully contract for 0.2 of a second and for the remaining 1.3 seconds before the next stimulus, the muscles are allowed to relax because the opposite of contraction is relaxation – the releasing of tension. It is during this relaxation phase that the blood is allowed to once again pump through the blood vessels supplying the muscles bringing with it all the nutrients necessary for healthy normal muscle metabolism and carries away the waste products. Over the period of the TENS the muscles physiologically return to their resting length. This can be verified by various means using the K7 Evaluation system through EMG amplitude, frequency analysis and jaw tracking.

Neuromuscular dentistry thus simultaneously relaxes the cranio-mandibular and the cranio-cervical muscles allowing an improved posture which will be supported and stabilized through the use of a neuromuscular functional orthotic.

So what has this to do with dental sleep medicine and OSA? Well OSA too, is a disease of cranio-facial anatomy, and unfortunately that compromise continues day and night. A fatigued neuromuscular system will be less able to maintain a patent airway when the patient is in their most vulnerable position – lying down and asleep and even more vulnerable during REM sleep when the muscles, including those of the airway, are at their lowest tone. For many patients with TMD and sleep apnea, the wearing of a neuromuscular orthotic on one arch only may not provide adequate stabilization of the mandible to prevent it falling back through

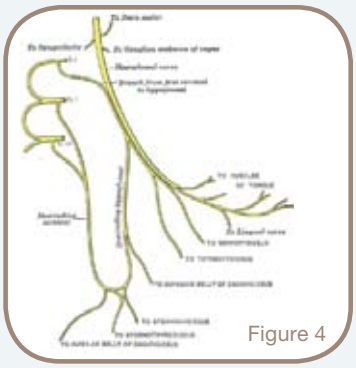

Figure 4

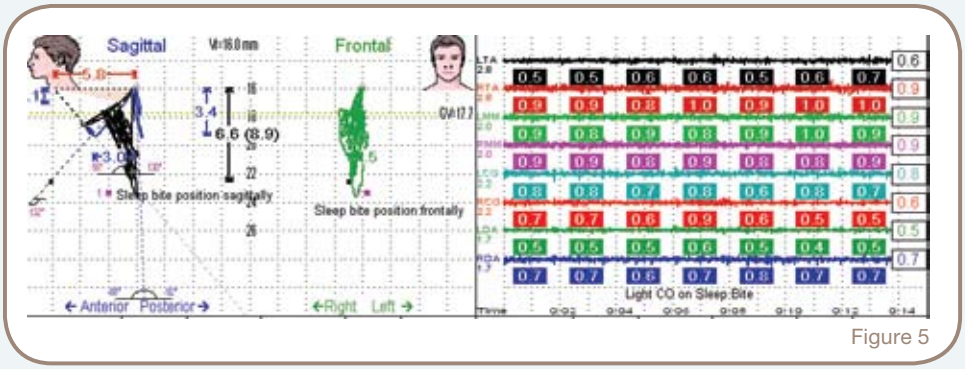

Figure 5

Figure 6

Has his sleep quality improved? His sleep quality has definitely improved

Is he snoring? No, no more snoring :).

Is he waking more refreshed in the morning? Yes, he does feel more refreshed in the mornings.

Is he getting headaches? No, he has never had any headaches, even prior to wearing Somnodent

Is he getting any TMJ pain? No, he has never had any TMJ pain.

Does he have any trouble getting his teeth back together in the morning? No, he has no problem getting his teeth back together.

Has he titrated the appliance? No, we have never needed to titrate it.

If yes, why did he decide to do that?

If yes, how far?

If no, did it feel right immediately? Yes, it felt good immediately, and I was really amazed that it did stop his snoring on the very first night without any titration or adjustments!

Figure 7

the effects of gravity and despite the physiologic jaw position during the daytime being optimal for the patient, additional support may be required during the night.

The question becomes how should one determine this appliance position to minimize apnea events while asleep? Does it make sense to simply protrude the jaw to 50-70% of maximum or some other patient determined position on a George gauge or does it make more sense to physiologically relax the muscles with the TENS, first, as described above? Ultra low frequency TENS of the cranial and cervical nerves mentioned earlier, either directly or indirectly, through the ansa cervicalis, also stimulates and allows relaxation of the muscles of the airway. (Figure 4) To detorque all these muscles, which have become posturally fatigued prior to determining the bite position to support the neuromuscular system during its most vulnerable time makes physiologic sense to this author. The ability to measure that physiologic response of the muscles in the determined position through the K7 Evaluation system gives the dentist great confidence and objective data to support the starting position. (Figure 5) A titratable appliance without compromise to the volume available to the tongue such as the LVI Lingual-less Somnodent further facilitates a positive and comfortable outcome to the patient and potentially decreases the amount of forward titration necessary for the mandible. (Figure 6)

An LVI Lingual-less Somnodent can be made as a stand-alone sleep apnea appliance for a patient or in conjunction with a daytime neuromuscular appliance for TMD patients. It has been the experience of this author that this approach to dental sleep medicine has been well accepted by the patients who have reported minimal jaw discomfort, a reduction in morning headaches and little trouble returning to their centric occlusion the following day. (Figure 7)

The beauty of neuromuscular dentistry is that it works with the physiology of the patient, not without regard to it. At a time when the physiology is most compromised, anything we can do as dentists to support the physiology, rather than take an already fatigued system and potentially fatigue it further without measuring the physiologic response, simply makes sense. Dentists, as a rule, fail to measure what they do. That is why the medical profession does not like to refer to us as a group. They measure everything in medicine. Now that we can too, it is time the dental profession caught up. What we do can be mechanical, or physiologic. I choose physiologic.