CLINICAL RESEARCH SUMMARY · MARCH 1996

Treatment of epilepsy through the trigeminal nerve

Clinical research summary

Dwight Jennings, DDS, MICCMO · Alameda, California

Originally published March 1996 in *The Journal* of the American Academy of Gnathologic Orthopedics, p. 7.
Transcribed from the original scan; minor OCR artifacts corrected.

Abstract

Multiple clinical experiences suggested that prolonged hyperactivity of the trigeminal nerve could precipitate a seizure. The purpose of this study was to see if reducing trigeminal nociceptive input, by way of orthopedic alignment of the mandible, could reduce seizures. Eight patients, who presented both seizures and cranio-mandibular dysfunction, were treated by jaw orthopedics so that speech and chewing were on the same trajectory. In all cases (except one in which jaw stability was never achieved), the patients either had no subsequent seizures or a dramatically reduced seizure rate.

During my 20+ years' experience, I have had many encounters with seizures that I suspected were related to dental procedures. Approximately three years ago, I had a patient who reported that she had not had a seizure in over a year, which paralleled the amount of time that she had been under my treatment for cranio-mandibular dysfunction. This was quite significant as she had previously had approximately six grand-mal seizures a year for over thirty years.

I then began to solicit and treat a number of patients with both seizures and cranio-mandibular dysfunction. I was curious whether this patient's response was just coincidental, unique, or whether her response could be replicated in other patients.

After eight cases of various types of seizures and three years' experience, my data indicates that jaw orthopedics is extremely effective. In all cases except one, there was a dramatic improvement in seizure rate and associated pathologies. In nearly all cases, there were no subsequent seizures once the jaw alignment was corrected and maintained.

Pathology

Seizures are a common neurological disorder characterized by paroxysmal, involuntary disturbances in brain function. They occur in 5.7% of the population. In over 70% of seizure patients, a cause is never found. Seizures can cause severe disruptions in quality of life. Of the patients taking medications, over 50% continue to have seizures, and over 50% have serious side effects from their medications.

Rationale — Anatomy of the trigeminal nerve

Peripheral anatomy. The trigeminal nerve is the largest nerve in the body, with representation in 28% of the sensory cortex. Other than the special sensory nerves (hearing, smell, sight, and taste), it is the principal sensory nerve for the head. Seldom is its broad range of sensory input recognized. Besides the more commonly known innervations of face, teeth pulp, oral cavity, and gingiva, it also innervates the sinus membranes, front and back surface of the eye ball, anterior and middle meninges, and most of the scalp. It is unique in that it has an extremely high density of nerve endings. It is known to mediate the sense of smell, and to influence hearing and blood flow to the brain.

Central nervous system anatomy. The three branches of the trigeminal nerve converge at the bilateral trigeminal ganglion, where most sensory cell bodies are clustered, and then enter the brainstem at the mid-pons region. The insertion location is such that it has a profound effect on the level of brain activity by way of its large representation and its direct connections with the reticular activating system. (It is these connections that you use to wake up in the morning by rubbing your eyes or washing your face.)

When the trigeminal nerve enters the brainstem, the neurons split, going in different directions depending on their type. The afferent fibers, which carry tactile information, are large-diameter axons that branch into two nuclei: principal sensory nuclei and spinal nuclei. Pain and temperature afferents descend to the trigeminal spinal nucleus, which also receives input from cranial nerves VII, IX, X and spinal nerves C1 to C3. Proprioceptive neurons ascend to the mesencephalic nucleus, where the cell bodies are located (the only primary sensory cell bodies located within the brain). The cell bodies of the motor neurons are in the pons.

The trigeminal system of motor and sensory nuclei are direct rostral extensions of the sensory and motor systems in the spinal cord. The principal sensory nucleus and its major thalamic projections are both functionally and anatomically identical to the dorsal-column / medial lemniscal system of the spinal cord.

Trigeminal nerve projections

Neurons of the spinal trigeminal nucleus (pain and temperature sensations) project to the ventral posterior medial and intralaminar nuclei of the thalamus. These axons also send collaterals to the reticular formation.

Most fibers of the principal sensory nucleus (tactile information) travel to the contralateral ventral posterior nucleus of the thalamus — a decussating pathway that joins the ascending spinal dorsal-column / medial lemniscus. These project to the somatosensory cortex.

The mesencephalic trigeminal nucleus (proprioceptive, mechanoreceptors) consists of a column of primary sensory neurons that develop from the neural crest cells and can therefore be considered equivalent to a peripheral sensory ganglion. The majority of peripheral fibers of the mesencephalic nucleus appear to travel with the mandibular branch of the trigeminal nerve. This nucleus has a strong influence on posture and hence can affect spinal input.

Possible trigeminal influences on seizure activity

The trigeminal nerve effects CNS function through a large quantity of neural connections, extensive projections, and a strategic input into the reticular activating system. The reticular activating system is an area in the brainstem that stimulates the brain — and not only keeps us conscious, but can have a profound effect on brain activity level (for example, hyperactivity and sleep disorders associated with TMD). With excessive input from trigeminal nociceptive and proprioceptive sensory nerves, the brain might be predisposed to seizures. Clinical experience indicates that it often takes a number of days of excessive input (conditioning) before a seizure is precipitated.

Neurochemistry

The trigeminal nerve is known to have a predominant influence on substance P levels in the cerebrospinal fluid. Substance P is known to depolarize nerve cells, affect smooth muscles (blood vessels), and act as a neurotransmitter in many regions of the brain. Elevated levels of substance P have been shown to correspond with seizure activity in rats.

Neuropharmacology

Tegretol is one of the primary drugs of choice for many types of seizures. It has two accepted clinical uses: trigeminal neuralgia and seizures. I find it surprising that no one has ever sought to discover why it works for both disorders.

Influence on the cerebrovascular system

The trigeminal nerve innervates the Circle of Willis and has been shown to affect blood flow to the brain. This mechanism might account for the primary pathology found occasionally in severe epilepsy, which is an atrophying of the amygdala / hippocampal region.

Methods

After a medical history was taken, all patients were subjected to the following diagnostics: (1) temporomandibular joint imaging, (2) kinesiographic examination of jaw motion, (3) models of teeth, and (4) intra-oral pictures. Precision Block Appliances[1] were fabricated to stabilize the mandible so that speech and biting were performed on, or very near, the same trajectory in the sagittal and frontal planes. The rationale: speech is a muscular phenomenon and biting is a skeletal phenomenon, and in order to eliminate any musculoskeletal discrepancy these should be coincidental. The appliances were worn at all times in the daytime, including during eating. A Nocturnal Orthopedic Positioner[2] was fabricated to wear at night.

The occlusal interfaces of the appliances were modified over a 6–9 month period to correct for changes that occurred in functioning and resting positions. Final adjustments were done with ultra-low-frequency TENS and monitored with surface electromyography.

Results

Of the eight patients treated, four never had any subsequent seizures over an average 24-month follow-up. Stability was never achieved in one patient due to excessive missing teeth; she continued to have petit-mal seizures. Three patients reported significant increase in stability with rare seizures, during subsequent orthodontic stabilization when occlusal stability was lost due to tooth movement.

Discussion

When orthopedic dysfunction occurs within the cranio-mandibular apparatus, it elicits an intense barrage of nociceptive and proprioceptive input — as anyone who has ever experienced TMJ pain or tic douloureux will attest. This nociceptive input can manifest as pain, not only locally but frequently as pain and dysfunction in other distribution regions of the same nerve (i.e., headaches, neck aches, sinus pain, etc.). This study would indicate that it can even cause major dysfunction within the CNS.

It is not clear whether a large number of seizures are caused primarily by conditioning of the CNS from trigeminal hyperactivity, or whether jaw orthopedics is just an effective therapy. If trigeminal hyperactivity is the cause, that would explain why no cause is found in such a large percentage of seizure patients (70%). Only a very small percentage of the medical and dental community recognize jaw dysfunction and/or trigeminal hyperactivity. The high degree of success in this study may also be attributable to the refined treatment methods.

Summary

Jaw orthopedic therapy proved to be extremely effective in the treatment of multiple types of epilepsy. The mechanism of action might possibly be by way of effecting brain chemistry (e.g., substance P levels) and/or the reticular activating system. Other research that stimulated the vagus nerve, and hence the RAS, has also shown some success in reducing seizures. It would be desirable to follow up this study with a larger sample, physician support, and better monitoring of CNS electrophysiology.

Notes

[1] Precision Appliance — similar to Twin Block Crozats but with multiple different design parameters.

[2] Nocturnal Orthopedic Positioner — similar to a neutral-bite Bionator but with different requirements on construction bite.