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Our Responsibility: The Trigeminal Nerve

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INTRODUCTION

As dentists of every type of specialty, we are charged with evaluating patients who present to our offices and clinics with all types of craniofacial pain complaints. These complaints may be periodontal, odontogenic, myogenic, infectious and neurological in nature. But lest we forget or even neglect, the temporomandibular joints are very often the source of misdiagnoses by dentists and physicians alike. Patients seek treatment for facial and head pain from the primary care physician, otolaryngologists, neurologists, and maybe a dental specialist when oftentimes, the patient presents with clicking and locking temporomandibular joints and frequently, not one of these doctors considers the joints as a source of the patient's pain. Even dentists neglect these joints even though their health contributes greatly to most dental therapeutic modalities.

A thorough knowledge of the trigeminal nerve is a must if one expects to be successful in the diagnosis and possible treatment of any type of orofacial or temporomandibular joint pain. In this short article, a much abbreviated summary of the trigeminal nerve will be presented in order to refresh the reader's mind of the anatomy of the trigeminal nerve.

ORIGIN OF THE TRIGEMINAL NERVE

The trigeminal, or fifth cranial nerve, is comprised of three major divisions: the ophthalmic, the maxillary and the mandibular. This largest of the cranial nerves conveys sensory information from the teeth, gingiva, mucous membranes of the head, the jaws, the muscles of mastication, the skin and the temporomandibular joints. The third division also is responsible for efferent or motor activity of the muscles of mastication as well as the tenor veli palatine and the tenor tympani muscles.

The trigeminal nerve originates from the lateral border of the pons as two roots: a large sensory and smaller motor. Most of the sensory fibers have the cell bodies of origin in the Gassarian (trigeminal or semilunar) ganglion, located in recess in the petrous portion of the temporal bone in the middle cranial fossa. Leaving the trigeminal ganglion, the ophthalmic division enters the orbit via the superior orbital fissure; the maxillary division passes through the foramen rotundum of the sphenoid bone, enters into the pterygopalatine (sphenopalatine)

fossa, and has its distribution into the maxilla; the mandibular division passes through the foramen ovale, enters into the infratemporal fossa, and then divides itself into three large branches and innervates mostly mandibular structures and conveys motor nerves to the muscles of mastication.

OPHTHALMIC DIVISION

Providing the least influence to the dental practitioner, the ophthalmic division of the trigeminal nerve is the smallest of the three divisions. It supplies sensory innervation to the ciliary body, cornea and iris. This division also provides innervation to the lacrimal gland, the conjunctiva and nasal and various sinuses (frontal and sphenoidal), skin of the upper eyelid, nose and forehead. Lastly, the ophthalmic nerve provides sensory innervation to several intracranial structures. Sympathetic fibers from the carotid plexus also join the ophthalmic nerve.

After entering the orbit through the superior orbital fissure of the sphenoid bone, the ophthalmic division divides into three branches: the nasociliary, the frontal and the lacrimal (Fig. 1). The largest and most significant branch to dentistry, the frontal nerve, exits the orbit through the supraorbital notch or in some cases, a foramen, divides into a medial and lateral branch and travels superiorly to provide sensory innervation to the forehead and scalp, the upper eyelid, the frontal sinus and portions of the conjunctiva.

It is not uncommon for a patient, who has received blunt trauma to the forehead, to have chronic and constant pain along the distribution of the frontal nerve.

MAXILLARY DIVISION

The maxillary or second division of the trigeminal nerve is intermediate in size in compared to the ophthalmic and mandibular divisions and provides sensory innervation to all structures in and around the maxillary bone, the skin of the midface and lower eyelid, the side of the nose and upper lip, the maxillary sinus, soft palate, roof of the mouth, the maxillary teeth and gingivae (Fig. 2). The vast complex of nerves formed from the maxillary nerve is so frequently involved in the development and conveyance of orofacial pain, often mimicking maxillary sinus pain. This problem in itself is the cause for the very common misdiagnosis of maxillary sinusitis simply because a patient presents with maxillary pain of unknown origin.

Perhaps the most important branch of the maxillary nerve considering dentistry is the infraorbital. The maxillary nerve leaves the pterygopalatine fossa, enters the inferior orbital fissure of the sphenoid bone, travels anteriorly through the maxilla and maxillary sinus and exits the maxilla through the infraorbital fissure as the infraorbital nerve. This large nerve ultimately divides as the inferior palpebral, lateral nasal and superior labial nerves. Infection in the maxilla or trauma to the midface may very well produce pain through the distribution of the infraorbital nerve.

Two smaller branches of the maxillary nerve, the zygomaticofacial and zygomaticotemporal nerves are also important to dentistry. These tiny nerves supply sensory innervation to the lateral orbital area, the skin of the lateral face and even lateral forehead. A blow to the lateral facial region can damage either of these nerves, producing chronic lateral facial and anterior temporal pain.

MANDIBULAR DIVISON

The mandibular or third division of the trigeminal nerve is the largest of the three divisions. It is a mixed nerve; namely, it conveys both sensory innervation and motor innervation. The motor fibers of this nerve transmit efferent fibers to the muscles of mastication, the zygomandibularis muscle, the mylohyoid and anterior digastric muscles, the tensor veli palatine and the tensor tympani muscles. The mandibular division provides sensory

innervation to the teeth and gingivae of the mandible; the skin of the temporal region and lower one-third of the face, ear and lower lip; mucous membranes of the anterior two-thirds of the tongue, the cheek and floor of mouth; and feeling to the muscles of mastication (Fig. 3).

The main truck of the mandibular division, after exiting the foramen ovale into the infratemporal fossa, subdivides into three branches. The anterior branch gives rise to the buccal nerve, the masseteric nerve, the nerve to the lateral pterygoid muscle, the anterior deep temporal nerves, the zygomandibularis nerve and the posterior deep temporal nerves.

The posterior branch of the mandibular nerve gives rise to the auriculotemporal nerve, which itself, divides into at least five smaller branches. The nerve provides approximately 75% of sensory innervation to the temporomandibular joint. In addition, the lingual nerve is a major nerve originating from this posterior branch of the mandibular nerve. The chorda tympani nerve, which brings parasympathetic fibers from the seventh or facial cranial nerve, joins the lingual nerve to innervate the anterior two-thirds of the tongue.

The inferior alveolar nerve is the largest branch of the mandibular nerve and arises from this posterior branch. It enters the mandible, along with the inferior alveolar artery and vein, through the mandibular foramen, which is guarded by the lingula of the mandible.

PAIN PERCEPTION

Understandably, all types of information from the periphery needs to be transmitted into the central nervous system and then to higher centres in the brain. The first neuron carrying information, regardless of the area of the body, is termed the primary afferent neuron or first order neuron. For most areas of the body, information carried by the first order neuron is relayed into the central nervous system by initially synapsing in the dorsal root ganglion of the spinal cord. In the orofacial region, pain impulses are carried by the trigeminal nerve and synapse directly in the central nervous system in the spinal trigeminal tract, which is located in the pons. From this area, second order neurons transmit pain impulses in the anterior trigeminothalamic tract, with most fibers crossing the midline and terminating in the ventral posterior media thalamus. On the way to the thalamus, fibers pass through an area in the medulla termed the reticular formation, where pain impulses are filtered and either attenuated or accentuated and then on to the thalamus. From the thalamus, ascending fibers terminate in somatosensory areas in the cerebral cortex where they are interpreted. There is so much more to pain interpretation than has been presented here, but this information is sufficient for a very basic and clinical understanding of pain perception.

It is extremely important for clinicians to understand that pain perception in the trigeminal area of influence is not just as simple as conduction of a painful or noxious impulse to the cerebral cortex where the information is sensed and actions are directed concerning pain. In addition to the complex neuroanatomical interactions and connects, pain perception of our patients is greatly influenced by:

- The patient’s age
- The patient’s ethnic or cultural background
- Prior experiences
- The patient’s sex
- The doctor-patient relationship
- Family influences
- Religious beliefs
- Fear and anxiety

- Genetic factors
- Sleeping difficulties

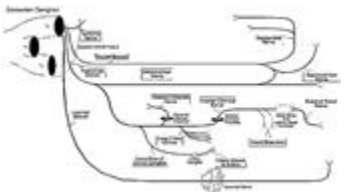
These emotional influences, all of which serve to modulate the anatomical complexities of the processing of painful stimuli, make each and every patient unique and thus, complicate the process of diagnosis, not to mention recommended treatment.

With the understanding of this much abbreviated review of the trigeminal nerve, the clinician can greatly begin to appreciate that what may appear to be a simple diagnosis of a painful problem can oftentimes be complicated and frustrating. As dental clinicians, it is our responsibility within the medical community to thoroughly understand the anatomy of the trigeminal nerve so that we may be affective diagnosticians first and hopefully, effective managers of the pain complaints of our patients. **OH**

Dr. Shankland has a practice devoted to the treatment of Craniofacial and TMJ disorders and General Dentistry in Columbus, Ohio. He has studied, authored and spoken extensively in the areas of neurobiology, anatomy and human biology with a special focus on the trigeminal nerve. He can be reached at ***drwes@drshankland.com****.*

Oral Health welcomes this original article.

Photos



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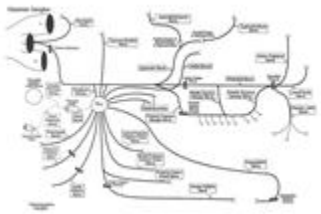
Caption: Figure 1. Ophthalmic division of the trigeminal nerve. ...



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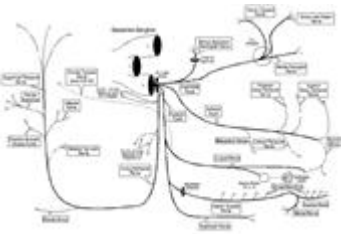
Caption: Figure 2. Maxillary division of the trigeminal nerve. F...



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Caption: Figure 3. Mandibular division of the trigeminal nerve. ...

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