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THE TRIGEMINAL NERVE AND IT'S CLINICAL RELEVANCE

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ABSTRACT

Of all cranial nerves, the trigeminal nerve is the largest and the most widely distributed in the supra-hyoid neck. It provides sensory input from the face and motor innervation to the muscles of mastication. (“Imaging the trigeminal nerve - PubMed”)

Management of trigeminal nerve injuries continues to challenge oral and maxillofacial surgeons. The purpose of this review article is to apply the anatomy and its clinical relevance towards the prevention and management of Trigemianal nerve injuries. The authors used PUBMED and Google Scholar to find relevant English-language literature published in the period 1995 to 2021. The authors used combinations of the search terms “trigeminal”, “nerve”, “neuralgia”, abstract and also full text articles to identify studies

Key Words; Trigeminal nerve, mandibular, maxillary, motor, sensory

INTRODUCTION

Largest cranial nerve, fifth cranial nerve, associated with derivatives of the 1st pharyngeal arch. Mixed nerve (sensory and motor), sensory to – skin of the face, mucous membranes and sinuses of the face. Motor to Muscles of Mastication, Tensor veli palatini, Tensor tympani Anterior belly of digastric, Mylohyoid. (“Trigeminal nerve - SlideShare”) "The post-ganglionic neurones of parasympathetic ganglia travel with branches of the

trigeminal nerve." (“NV Trigeminal nerve - NeurologyNeeds.com”) Parasympathetic Supply: Submandibular, Sublingual, Parotid, lacrimal and nasal glands.[1]

ANATOMICAL COURSE

"The trigeminal nerve originates from three sensory nuclei (mesencephalic, principal sensory, spinal nuclei of trigeminal nerve) and one motor nucleus (motor nucleus of the trigeminal nerve) extending from the midbrain to the medulla." (“The Trigeminal Nerve (CN V) - Course - TeachMeAnatomy”) [2]

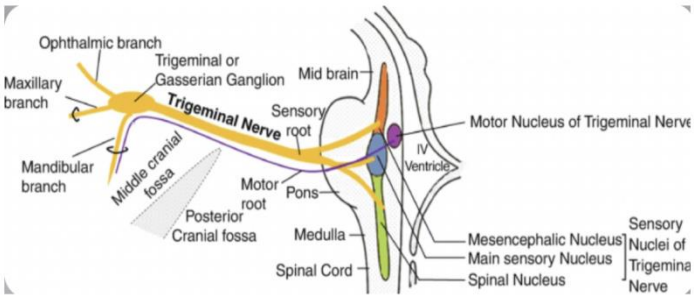

Fig. 1 illustrating the anatomical course of the trigeminal nerve

At the level of the pons, the sensory nuclei merge to form a sensory root. The motor nucleus continues to form a motor root. In the middle cranial fossa, the sensory root expands into the trigeminal ganglion. The trigeminal ganglion is located lateral to the cavernous sinus, in a depression of the temporal bone. This depression is known as the trigeminal cave. [1]

The peripheral aspect of the trigeminal ganglion gives rise to 3 divisions: ophthalmic (V1), maxillary (V2) and mandibular (V3). "The ophthalmic nerve and maxillary nerve travel lateral to the cavernous sinus exiting the cranium via the superior orbital fissure and foramen rotundum respectively." (“CRANIAL NERVES Flashcards | Quizlet”) The mandibular nerve exits via the foramen ovale entering the infra-temporal fossa.[3]

DIVISIONS OF TRIGEMINAL NERVE

1. Ophthalmic nerve
2. Maxillary nerve
3. Mandibular nerve

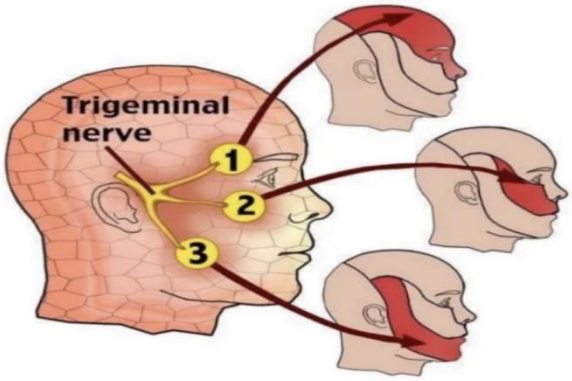

Fig. 2 shows the division of the trigeminal nerve

OPHTHALMIC NERVE

• Superior division of the V nerve

• Entirely Sensory

• Has 3 branches. All 3 of them pass through the sup. orbital fissure into the orbit. They are; Lacrimal nerve, frontal nerve, nasocilliary nerve [3,4]

COURSE

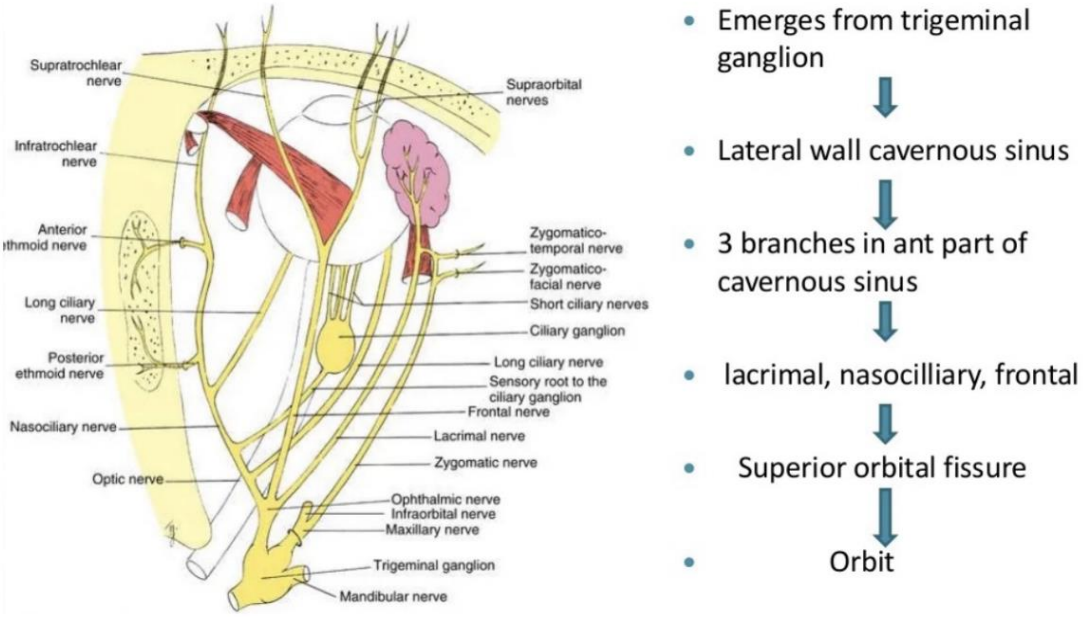

Fig. 3 illustrating the anatomical course of the ophthalmic division of the trigeminal nerve

BRANCHES

1. Lacrimal nerve: Smallest Sensory Supplies: lacrimal gland and the conjunctiva, skin of the upper eyelid.

"**2) Frontal nerve:** largest branch It enters the orbit through the superior orbital fissure divides into 2 branches." (“Trigeminal nerve 1 - SlideShare”)

i. The supra orbital branch: It is larger, arises from the orbit through the supraorbital foramen. (“Trigeminal nerve 1 - SlideShare”)

Supplies: skin of the forehead and scalp and the mucous membrane of the frontal sinus (“Trigeminal Nerve - Lecture notes 1 - StuDocu”)

ii. The supra trochlear branch: It is smaller and from the orbit above the trochlea.

Supplies: skin of the upper eyelid, lower part of the forehead.[3]

3) Nasocilliary nerve: It enters the orbit through middle of superior orbital fissure and ends in anterior ethmoidal foramen

Branches:

I. Communicating branch to cilliary ganglion: sensory

II. Long ciliary nerve: Iris and Cornea. [2,4]

"III. Posterior ethmoidal nerve: mucous membrane lining of the Post." (“Trigeminal nerve 1 - SlideShare”) etmoidal and Sphenoidal paranasal sinus.

IV. Anterior ethmoidal nerve: Anterior ethmoidal and frontal paranasal air cells.

In the upper part of the nasal cavity, further divides: (“Trigeminal nerve 1 - SlideShare”)

a. Internal nasal branches: medial and lateral

mucosa of nose.

b. External nasal branches: lower border of the

nasal bone.

V. Infra trochlear nerve: medial end of eyelid, conjunctiva, lacrimal sacs and upper half of nose. (“Trigeminal nerve 1 - SlideShare”) [2,5]

MAXILLARY NERVE

• Second division of trigeminal nerve

• Pure sensory

• Supplies: derivatives of maxillary process and frontonasal process

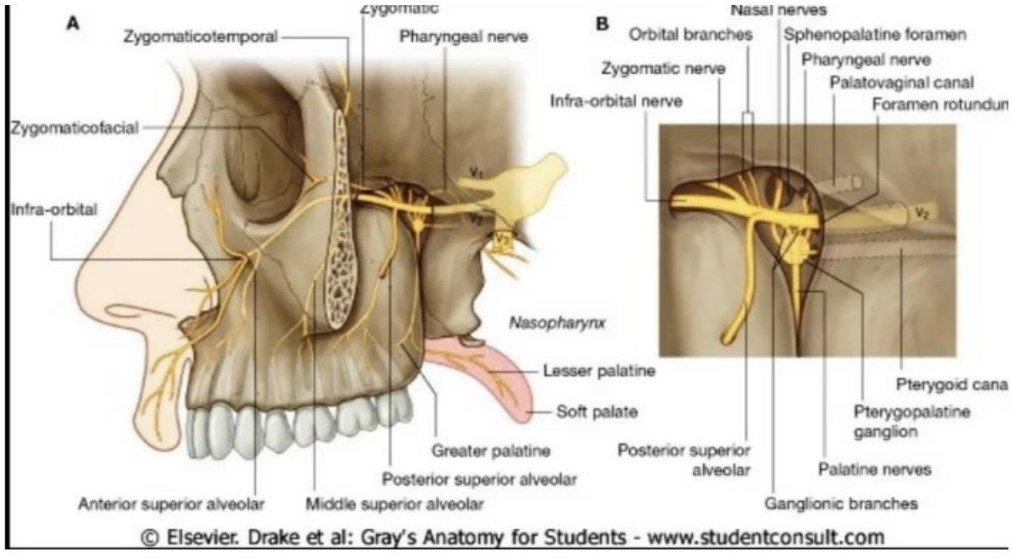

Fig. 4 shows the branches of the maxillary division of the trigeminal nerve

BRANCHES

1) In the cranium: Meningeal

2) In the pterygopalatine fossa: Ganglionic, Zygomatic, Posterior superior alveolar

3) In the infra orbital canal: Middle sup. alveolar, Anterior superior/ Greater alveolar

4) On the face: Palpebral, nasal, superior labial [1,5]

I. In the cranium:

"**Meningeal branch:** It is given off near the foramen rotundum." ("Trigeminal nerve - SlideShare")

Supplies: dura mater of the anterior and middle cranial fossae.

II. In the pterygopalatine fossa.

"**1.The ganglionic branches:** Connect the maxillary nerve to the pterygopalatine ganglion." ("Trigeminal nerve 1 - SlideShare") Contain secretomotor fibres to the lacrimal gland. **Supplies:** sensory fibres to the orbital periosteum and mucous membrane of the nose, palate and pharynx. ("Seminar cranial nerves - SlideShare") [2,3]

2. The zygomatic nerve:

"In the Inferior orbital fissure it divides into 2 branches." ("Trigeminal nerve 1 - SlideShare")

a. The Zygomaticofacial nerve: the skin over the zygomatic bone.

b. The Zygomaticotemporal nerve: the skin over the anterior temporal fossa region.[4]

3. Posterior superior alveolar nerve:

Two branches enter the posterior wall of the maxilla above the tuberosity, supply the molar teeth (except the mesiobuccal root of first molar). ("TRIGEMINAL NERVE / Orthodontic Courses by Indian Dental Academy") The 3rd branch pierces the buccinator, Supplies adjoining part of the gingiva and cheek along the buccal side of the upper molar teeth. [3,6]

III. Branches in the Infraorbital canals

1. Middle superior alveolar nerve:

Runs downwards and forwards along the infraorbital groove along the lateral wall of the maxillary sinus. Supply the maxillary premolars and mesiobuccal root of the first molar teeth. ("Trigeminal Nerve and Applied Anatomy - slideshare.net") [3]

2.Anterior superior alveolar nerve:

"It runs in the anterior wall of the maxillary antrum." ("Trigeminal nerve - SlideShare") It runs inferiorly and divides into the branches, which supply the canine and incisors. A nasal branch from this nerve, given off from the superior dental plexus supplies the mucous membrane of the anterior part of the lateral

wall and floor of the nasal cavity. (“Trigeminal nerve 1 - SlideShare”) It ends in the nasal septum [3,6]

IV. Branches given on the face:

1. The palpebral branches: They arise deep to the orbicularis oculi and pierce the muscle, supplying the skin over the lower eyelid and lateral angle of the eye along with the Zygomaticofacial and Facial nerves.

2. The nasal branches: They supply the skin of the nose and tip of the nasal septum and join the External nasal branch of the anterior ethmoidal nerve (“Trigeminal nerve - SlideShare”)

3. The superior labial branches: These are large and numerous. They supply the skin over the anterior part of the cheek and upper lip including the mucous membrane and labial glands. (“Trigeminal nerve - SlideShare”) They are joined by the facial nerve and form the infraorbital plexus. [2-4,6]

MANDIBULAR NERVE

- Third and largest division
- large sensory root - foramen ovale
- Small motor root which passes deep to the ganglion, and unites with the sensory root in the infratemporal fossa [5,7]

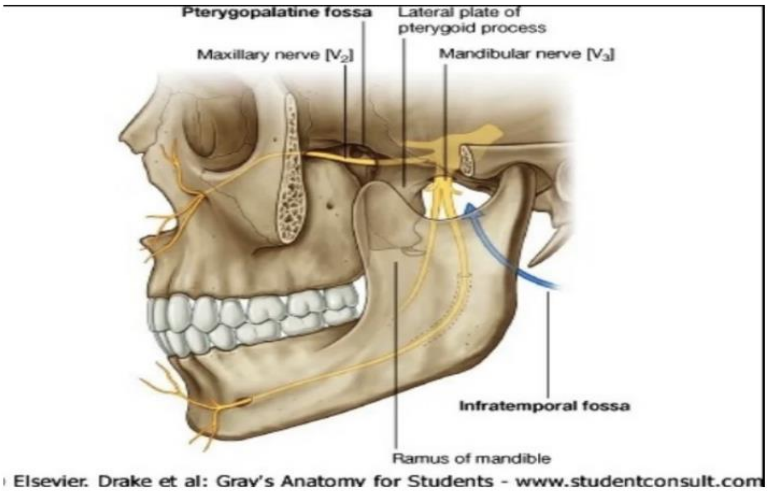

Fig. 5 shows the branches of the mandibular division of the trigeminal nerve

BRANCHES FROM THE UNDIVIDED BRANCH:

1. **Nervous spinosus or Meningeal branch of Mandibular nerve:**

• Enters cranial cavity through foramen spinosus along with middle meningeal artery (“Trigeminal nerve 1 - SlideShare”)

• Supplies the Dura matter of middle cranial fossa

2. **Nerve to medial Pterygoid:**

•Supplies medial pterygoid through Otic ganglion. [5,7]

BRANCHES OF THE DIVIDED NERVE

1.The buccal nerve:

• It passes between the 2 heads of the lateral pterygoid ("Trigeminal nerve 1 - SlideShare")

• It gives a sensory supply to the buccinator muscle. [7]

2. **The massetric nerve:**

• Arises from the upper border lateral pterygoid muscle

• It supplies the masseter muscle.

• It gives a branch to the TMJ

3. **The deep temporal nerves:**

• Supply the temporalis muscle.

4. Nerve to the lateral pterygoid.

• Supplying each muscle head. [3,6]

BRANCHES OF THE POSTERIOR DIVISION

1. Auriculotemporal nerve-

• Arises from 2 roots which run backwards and encircle the middle meningeal artery and form single trunk ("Trigeminal Nerve Anatomy - SlideShare")

• The trunk passes backward to lateral pterygoid between neck of mandible and sphenomandibular ligament. ("Trigeminal nerve 1 - SlideShare")

- Lies behind the TMJ close to the parotid gland
- Gives rise to two branches-auricular and temporal branches. [4,6]

Branches Of Auriculotemporal Nerve

1. Auricular branches- supply tragus, tympanic membrane and the pinna ("Trigeminal nerve 1 - SlideShare")

2. Superficial temporal branches-supply parotid gland, TMJ and skin of the temple. ("Trigeminal nerve 1 - SlideShare")

3. Lingual nerve

• It lies between the ramus of the mandible and the muscle in the pterygomandibular space

• It then passes deep to reach the side of the tongue. Here it lies in the lateral lingual sulcus against the deep surface of the mandible on the medial side of the roots of the third molar tooth ("Trigeminal nerve - SlideShare")

• From here it passes on to the side of the tongue where it is crosses the styloglossus and runs on the lateral surface of the hyoglossus & deep to the mylohyoid in close relation to the deep part of the submandibular gland and its duct ("Trigeminal Nerve and Applied Anatomy - slideshare.net")

• It gives off sensory fibres to the tonsil and the mucous membrane of the posterior part of the oral cavity. [3-7]

Communication of the facial nerve (Chorda tympani) with the lingual nerve.

As the lingual nerve passes 2cm below the skull it is joined from behind by the chorda tympani. This nerve conveys secretory fibres from the facial nerve. The parasympathetic secretory fibres control the submandibular and sublingual salivary glands. ("Trigeminal nerve 1 - SlideShare") [4,6]

3. Inferior alveolar nerve

• It is the largest terminal branch of the posterior division of the mandibular nerve.

• The nerve descends deep to the lateral pterygoid muscle at the lower border of the muscle, it passes between the sphenomandibular ligament and the ramus to enter the mandibular foramen ("Trigeminal nerve final - SlideShare")

• In the canal the nerve runs alongside the inferior alveolar artery as far as the mental foramen where it emerges out and gives off the mental and incisive branches. ("Trigeminal Nerve and Applied Anatomy - slideshare.net") [2,6,7]

Inferior alveolar nerve

From here the nerve runs in the canal giving off branches to the mandibular teeth as apical fibres and enters the apical foramena of the teeth to supply mainly the pulp as well as the periodontium. ("Trigeminal Nerve and Applied Anatomy - slideshare.net") [3,5]

Branches

1. Mental nerve: it supplies the skin of the chin and the mucous membrane as well as the skin of the lower lip.

2. Incisive branch: Supplies the canine and incisors.

3. Mylohyoid nerve: Supplies the mylohyoid muscle as well as the anterior belly of the digastric. [2-5]

CLINICAL CORRELATES

CORNEAL REFLEX

• Is the involuntary blinking of the eyelids – stimulated by tactile, thermal or painful stimulation of the cornea. ("Cranial nerves and pathologies Flashcards | Quizlet")

• Absence of this, is a sign of damage to the trigeminal/ ophthalmic nerve, or the facial nerve. [5,7]

HERPES ZOSTER OPHTHALMICUS

• Recurrent neuro-cutaneous inf.

• In ophthalmic Division of trigeminal dermatome, most freq. affecting nasociliary branch. ("Trigeminal nerve 1 - SlideShare")

• HHV3 / varicella zoster [5,7]

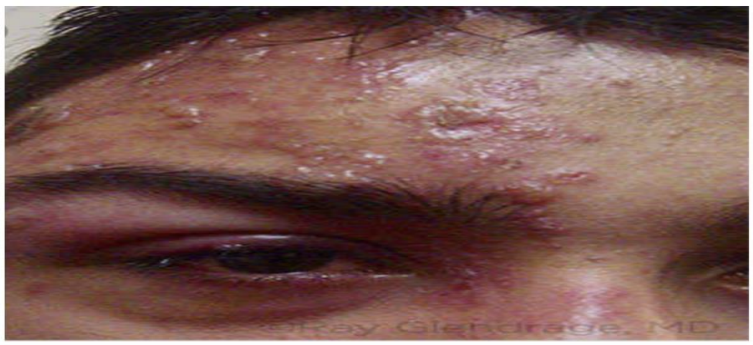

Fig. 6 shows herpes zoster ophthalmicus

MAXILLARY NERVE BLOCK/INFILTRATION

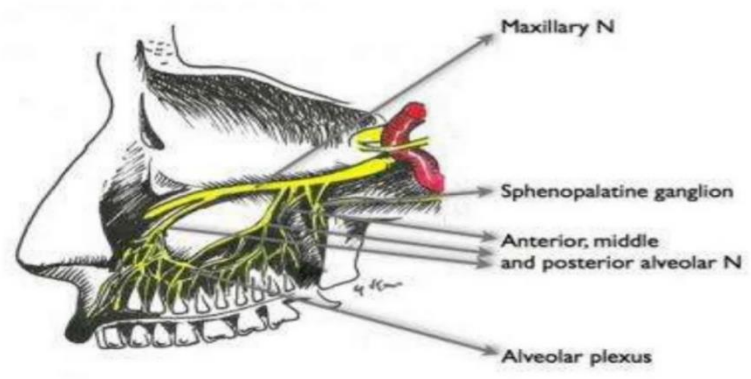

Fig. 7 shows maxillary nerve block

INFERIOR ALVEOLAR NERVE BLOCK

• The inferior alveolar nerve, travels through the mandibular foramen and mandibular canal. (“Embryology and Anatomy of the Jaw and Dentition - ScienceDirect”)

• Within the mandibular canal, it forms the inferior dental plexus, which innervates the lower teeth. (“trigeminal nerve : anatomy , course , branches & function”)

"• A major branch of this plexus, the mental nerve, supplies the skin and mucous membranes of the lower lip, skin of the chin, and the gingiva of the lower teeth." (“Trigeminal nerve - SlideShare”)

• In some dental procedures which require a local anaesthesia, the inferior alveolar nerve is blocked before it gives rise to the plexus. [5,7]

INFERIOR ALVEOLAR NERVE INJURY

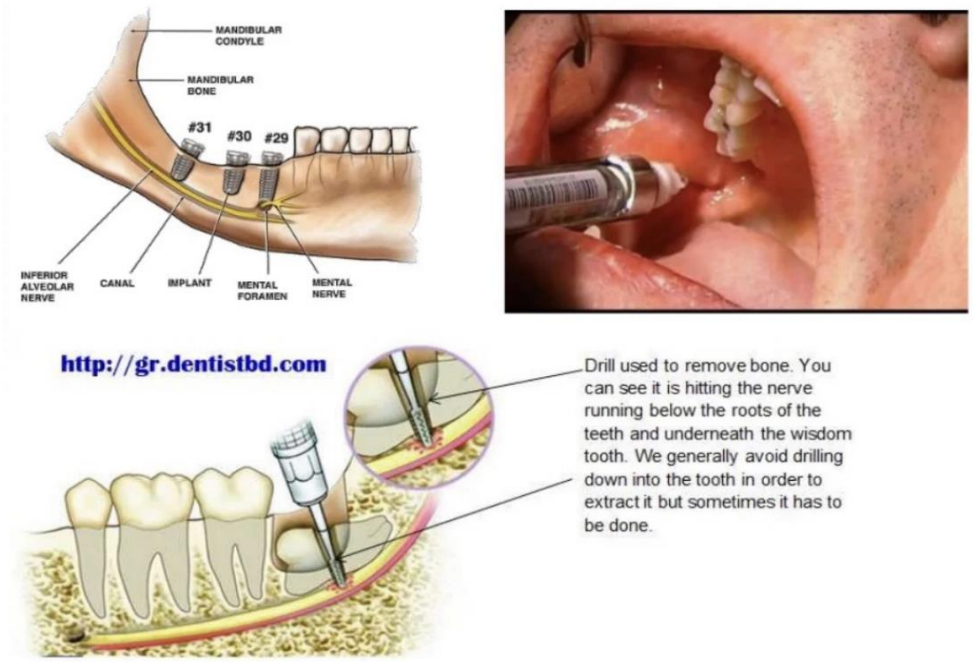

Fig. 8 illustrating inferior alveolar nerve block

MENTAL NERVE INJURY

• Improper Mental Nerve Block

• Incision extending to the mental foramen and lingual vestibular fold. (“Trigeminal nerve 1 - SlideShare”)

LINGUAL NERVE INJURY

• Occurs as a result of pressure against the mandible and the stretching of the pterygoid muscles, which results in compression of the nerve. (“Lingual Nerve - an overview | ScienceDirect Topics”)

• Numbing of the tongue

• Loss/ altered taste sensation

• Tingling sensation in the tongue. [5,6]

TRIGEMINAL NEURALGIA

• Sharp, shooting, paroxysmal pain

• Characteristics: unilateral, presence of trigger zones, presence of refractory period. Restricted to the areas supplied by the trigeminal nerve. (“Trigeminal nerve 1 - SlideShare”)

• Etiology: Usually Idiopathic

• Suggested causes: Demyelination of the nerves, tumour in the cerebellopontine angle, grooving of the nerve root. (“Trigeminal nerve 1 - SlideShare”)

• Diagnosis: Based on Clinical features and diagnostic test block on the trigger zones.[8]

POST HEPATIC NEURALGIA

An unpredictable complication of varicella zoster virus- (VZV-) induced herpes zoster (HZ) which often occurs in elderly and immunocompromised persons[8]

EXAMINATION OF THE TRIGEMINAL NERVE

Testing sensory supply: The patient is told to close his/her eyes and introduce a cotton wisp to areas of the face supplied by the three divisions of the trigeminal nerve to detect tactile sensory competence. ("trigeminal nerve : anatomy , course , branches & function")

Testing motor supply: The patient is told to clench their jaw as you palpate superior to the zygomatic arch to feel for contraction of the temporalis and then repeat palpating inferiorly for the masseter. Ask the patient to open their mouth and deviate their mandible to the right and left to check for competence of the medial and lateral pterygoid muscles. ("trigeminal nerve : anatomy , course , branches & function") [4,6]

CONCLUSION

Trigeminal nerve, its anatomic course and branches are very important from a dentist point of view as inadvertent surgical procedure may lead to trigeminal nerve

injury. Disorders of Trigeminal nerve are not rare, knowing about it will help in formulating appropriate diagnosis and treatment thus achieving the best possible recovery of Trigeminal nerve function. Nerve blocks given for varying various dental procedures involves the various branches of trigeminal nerve, hence to avoid any complications, one needs to have a knowledge about the course and branches of the nerve. **("Trigeminal Nerve | PDF | Neuroanatomy | Human Head And Neck - Scribd")**

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