The Face – A Neurosensory Perspective

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A literature review

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SUMMARY

The face is a unique part of the body with its individual anatomical characteristics. While the dental clinician is usually focused on the oral cavity, the physical examination should involve close attention to the neurosensory status of the facial skin. Furthermore, skin sensitivity should be assessed pre- and postoperatively in conjunction with dental interventions. The face can be divided into several functional units, such as the eyes, nose, mouth/lips, and cheeks. With regard to the neurosensory supply of the skin, various innervation territories of the face can be distinguished representing the three divisions of the trigeminal nerve. In addition, cutaneous branches of the cervical plexus provide sensitivity to the lower and lateral portions of the face. The objective of the present article is to provide the dental clinician with a literature update of the neurosensory innervation of the face.

Introduction

The face is a unique part of the body with its individual anatomical characteristics and can be defined as the anterior aspect of the head. Anatomically, the face extends superiorly to the hairline, inferiorly to the chin and base of the mandible, and laterally to the auricles (Marur et al. 2014).

The face plays an important role for human relationship including esthetics, emotions, communication, and social interaction. The face is also one of the most intriguing body parts regarding identity (Marur et al. 2014). In medicine, many specialties including dentistry manage orofacial disorders. Beautiful and natural teeth, or artfully restored or reconstructed teeth and dentitions, in harmony with the face, contribute to facial esthetics which in turn is, for many individuals, a key factor for self-esteem, attractiveness and health.

The face is also a highly specialized organ for receiving sensory information from the environment and for its transmission to the cortex (Siemionow et al. 2011). In the facial skin, there is a rich representation of sensory unmyelinated fibers in the epidermis as well as myelinated fibers mainly directed to hair follicles in the dermis (Nolano et al. 2013). This rich innervation may represent the morphological basis for the low threshold to thermal, noxious and tactile stimuli in facial skin compared to the rest of the body (Nolano et al. 2013). Facial sensation may differ across the face. Facial cutaneous sensibility increases from the lateral areas of the face to the midline with the vermilions being the most sensitive areas and the forehead being the least sensitive area (Costas et al. 1994; Siemionow et al. 2011).

Various dental procedures affect the cutaneous sensation of the face, in particular the application of local or block anesthesia. Dental interventions themselves may also result in temporary or permanent facial neurosensory disturbances including removal of impacted teeth, placement of dental implants, or endodontic treatment (Hillerup 2007; Deppe et al. 2015).

The face can be divided into several functional units, such as the eyes, nose, mouth/lips, and cheeks. With regard to the neurosensory supply of the skin, various innervation territories of the face can be distinguished. The objective of the present article is to provide the dental clinician with a literature update of the neurosensory innervation of the face.

Innervation territories

The primary source of cutaneous innervation of the face is the trigeminal nerve (cranial nerve CN V) with its three divisions, i.e. ophthalmic nerve (V1), maxillary nerve (V2), and mandibular nerve (V3) (Shankland 2000). The former two are purely sensory, whereas the latter is a mixed sensory and motor nerve (Siemionow et al. 2011). However, the inferior and posterior parts of the cheek, as well as parts of the ear, are innervated by the great auricular nerve derived from the cervical plexus of the spinal cord. Thus, four distinct innervation territories can be attributed to the respective nerves (Fig. 1).

Fig. 1 Illustration of the sensory territories of the skin of the face: green = territory of ophthalmic division of trigeminal nerve; blue = territory of maxillary division of trigeminal nerve; beige = territory of mandibular division of trigeminal nerve; red = territory of anterior branches of cervical plexus

The trigeminal nerve (CN V)

The trigeminal nerve is the largest and most complex of the cranial nerves (CN). It serves as a major conduit of sensory input from the face (Joo et al. 2014). The functional structures of the trigeminal nerve include somatic afferent (tactile, nociceptive, proprioceptive) and motor-related efferent components. The neurons of the tactile and nociceptive fibers are located in the trigeminal ganglion (Gasserian ganglion) and the afferent fibers terminate in the pons. In contrast, cell bodies of afferent proprioceptive fibers are located in the mesencephalon (midbrain) while efferent motor neurons are located in the motor nucleus of CN V within the pons. Further description will be limited to the somatosensory components of CN V providing cutaneous sensation of the face (Fig. 2).

The ophthalmic nerve (CN V1)

The first division of the trigeminal nerve is the ophthalmic nerve that leaves the trigeminal ganglion in a forward, lateral and slightly upward direction to pass through the cavernous sinus (Shankland 2001a). Then, the ophthalmic nerve enters the orbital cavity (orbit) through the superior orbital fissure

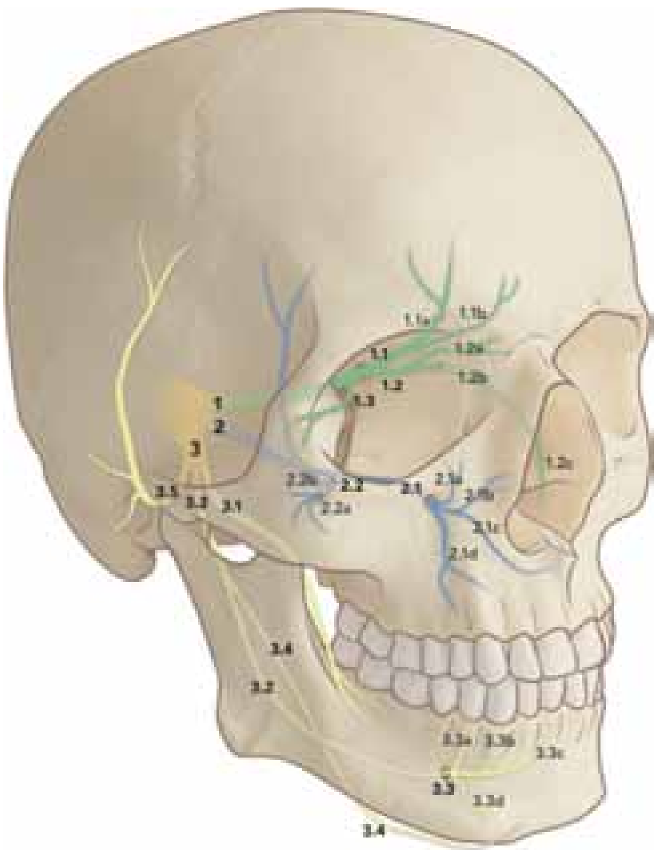

Fig. 2 Illustration depicting the trajectories of the cutaneous sensory branches of the trigeminal nerve (1 green = ophthalmic division, 2 blue = maxillary division, 3 yellow = mandibular division)
1.1 = frontal nerve (1.1a = supraorbital nerve, 1.1b = supratrochlear nerve); 1.2 = nasociliary nerve (1.2a = infratrochlear nerve, 1.2b = anterior ethmoidal nerve, 1.2c = external nasal nerve); 1.3 = lacrimal nerve; 2.1 = infraorbital nerve (2.1a = inferior palpebral branch; 2.1b = external nasal branch; 2.1c = internal nasal branch; 2.1d = superior labial branch); 2.2 = zygomatic nerve (2.2a = zygomaticofacial nerve, 2.2b = zygomaticotemporal nerve); 3.1 = buccal nerve; 3.2 = inferior alveolar nerve; 3.3 = mental nerve (3.3a = angular branch, 3.3b = lateral labial branch, 3.3c = medial labial branch, 3.3d = mental branch); 3.4 = mylohyoid nerve; 3.5 = auriculotemporal nerve

and divides into three major branches including the lacrimal, frontal, and nasociliary nerves. All of these three branches carry sensory fibers (but to a varying degree) to various parts of the forehead, scalp, eyelids, and nose, respectively.

The maxillary nerve (CN V2)

The maxillary nerve (second division of the trigeminal nerve) leaves the trigeminal ganglion in a forward, horizontal and slightly lateral direction (Shankland 2001b). The maxillary nerve also runs through the cavernous sinus. Subsequently, it passes slightly downwards to reach the foramen rotundum and enters the pterygopalatine fossa. There, the maxillary nerve distributes various branches including the infraorbital nerve, the zygomatic nerve, the sphenopalatine nerve, and the (greater and lesser) palatine nerves. The infraorbital and zygomatic nerves contribute sensory innervation to the midface (upper lip, cheek, nose and anterior temporal region).

The mandibular nerve (CN V3)

The mandibular nerve (third division of the trigeminal nerve) leaves the trigeminal ganglion in a downward direction (Shankland 2001c). The mandibular nerve is a mixed sensory-motoric nerve and it has the shortest intracranial portion of the three divisions of the trigeminal nerve. The mandibular nerve exits the middle cranial fossa through the foramen ovale to enter the infratemporal fossa where it immediately divides into two trunks (anterior and posterior). The anterior trunk includes the motoric branches to the masticatory muscles, but also the long buccal nerve that provides sensory innervation of the cheek and buccal mucosa. The larger posterior trunk includes the auriculotemporal nerve, the inferior alveolar nerve, and the lingual nerve. The latter is joined in the infratemporal fossa by the chorda tympani (secretomotor fibers and special sensory or "taste" afferents), a neural connection with the facial nerve. Regarding the skin of the face, the auriculotemporal nerve provides sensory innervation to the tragus, auricle, and posterior part of the temple. The inferior alveolar nerve supplies sensory innervation to the lower lip and chin along with mental and mylohyoid nerve branches.

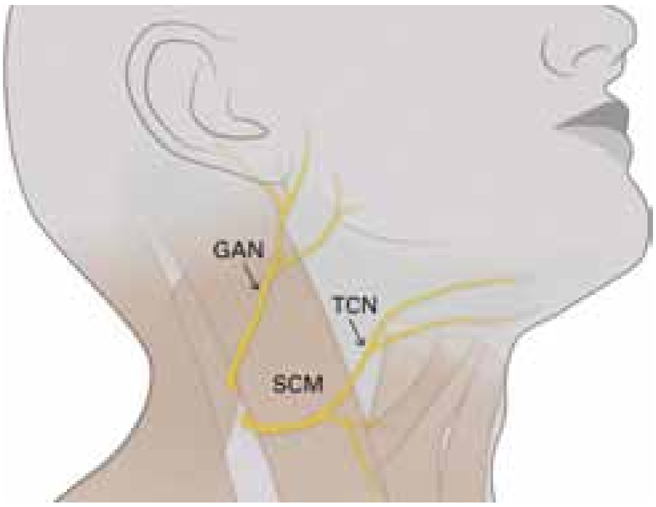

Fig. 3 Illustration showing the courses of the great auricular nerve (GAN) and of the transverse cervical nerve (TCN) emerging behind the sternocleidomastoid muscle (SCM).

The great auricular nerve

The great auricular nerve belongs to the cutaneous branches of the cervical plexus (Fig. 3). The cervical plexus arises from the spinal nerves C1 to C4. The cutaneous branches of the cervical plexus emerge from the posterior border of the sternocleidomastoid muscle at its middle third region and then travel to the respective skin areas of the neck and adjacent regions (Kim et al. 2002; Murphy et al. 2012; Lin et al. 2013). The great auricular nerve itself is composed of branches from C2 and C3, and it provides sensory innervation to the skin overlying the parotid gland, the mastoid process and part of the ear. Other cutaneous branches of the cervical plexus include the transverse cervical nerve (C2–C3), the lesser occipital nerve (C2), and the supraclavicular nerve (C3–C4).

Sensory innervation of the face by regions

The distribution of the sensory nerves in the human face is usually described as a branching pattern from the main trunk to the distal rami (Siemionow et al. 2011). However, from a clinical perspective, it is more valuable to discuss the cutaneous innervation of the face by its subunits. The topographical descriptions by subunits aids the clinician in understanding the neurosensory anatomy with often multiple/overlapping supply of a specific cutaneous region by different nerves (Pilsl et al. 2002). The central facial subunits include, from superior to inferior, the forehead, eyelids, nose, lips and chin, whereas the lateral subunits comprise the temples, cheeks and ears (Fig. 4 and 5).

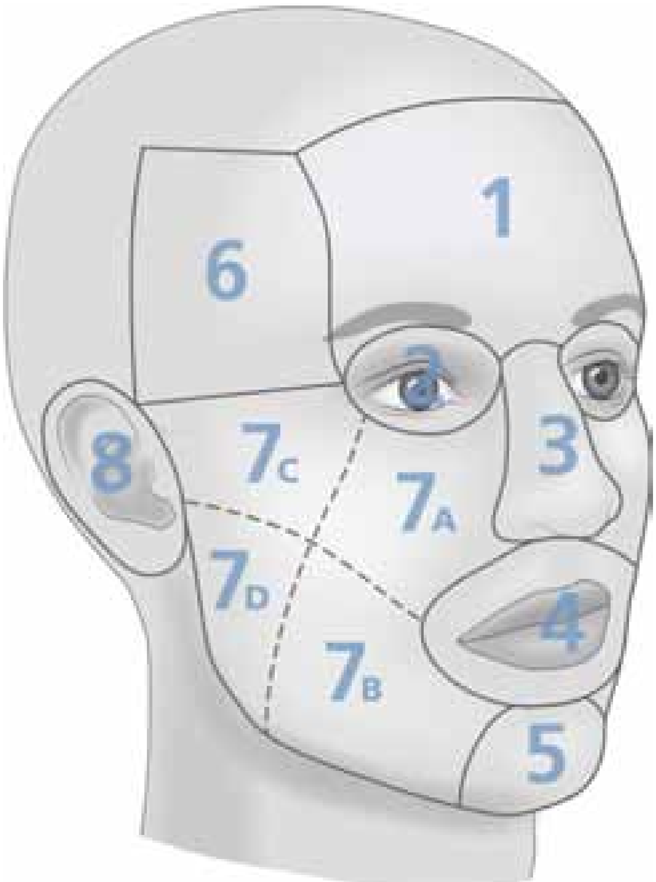

Fig. 4 Illustration of the central and lateral subunits of the face: (1) forehead, (2) eyelids, (3) nose, (4) lips, (5) chin, (6) temple, (7a) cheek: infraorbital region, (7b) cheek: buccal region, (7c) cheek: zygomatic region, (7d) cheek: parotid-masseteric region, and (8) ear.

Forehead

The sensory nerve supply to the forehead is from the frontal nerve that arises from the ophthalmic nerve (CN V2) within the superior orbital fissure. The frontal nerve usually divides inside the orbit at a variable distance from the orbital rim into two main branches, one lateral (known as the supraorbital nerve), and a medial branch (known as the supratrochlear nerve) (Fatah 1991) (Fig. 6). However, the frontal nerve can emerge from the orbit as a single nerve before dividing into multiple branches to supply the whole of the forehead and part of the scalp up to the vertex (Fatah et al. 1991). A recent dissection study described on average 7.7 branches (range 2–15) of the supraorbital nerve and 5.1 branches (range 2–7) of the supratrochlear nerve, respectively, emerging from the orbit (Yang et al. 2015a).

Generally, the skin of the lower forehead near the midline is supplied by the supratrochlear nerve while the larger upper and lateral parts of the forehead are innervated by the supraorbital nerve (Andersen et al. 2001; Joo et al. 2014). Knize (1995) studied the supraorbital nerve anatomically in detail. He described a superficial (medial) division supplying the forehead skin and a deep (lateral) division innervating the skin of the frontoparietal scalp (the latter not belonging to the face). Hwang et al. (2005b) consistently found a horizontal branch of the supraorbital nerve coursing laterally to the skin of the lateral end of the eyebrow.

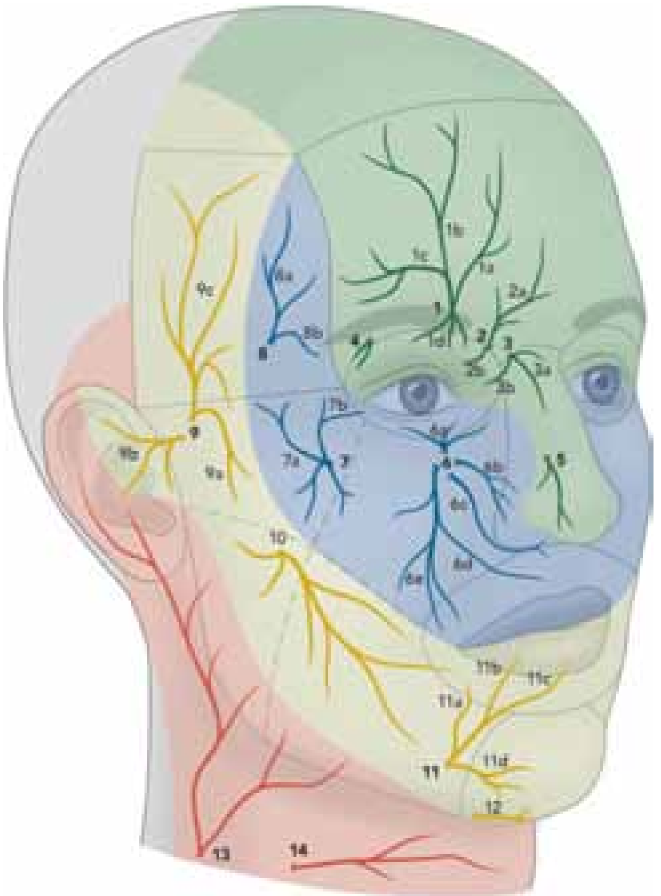

Fig. 5 Illustration of the cutaneous, sensory nerves of the face.
1 = supraorbital nerve (1a = medial branch, 1b = lateral branch, 1c = horizontal branch, 1d = palpebral branches); 2 = supratrochlear nerve (2a = forehead branches, 2b = palpebral branch); 3 = infratrochlear nerve (3a = nasal branches, 3b = palpebral branch); 4 = palpebral branches of lacrimal nerve; 5 = external nasal branch of anterior ethmoidal nerve; 6 = infraorbital nerve (6a = inferior palpebral branches, 6b = external nasal branch, 6c = internal nasal branch, 6d = medial branch of superior labial branch, 6e = lateral branch of superior labial branch); 7 = zygomaticofacial nerve (7a = zygomatic branches, 7b = palpebral branch); 8 = zygomaticotemporal nerve (8a = temporal branches, 8b = palpebral branch); 9 = auriculotemporal nerve (9a = zygomatic branches, 9b = auricular branches, 9c = temporal branches); 10 = long buccal nerve; 11 = mental nerve (11a = angular branch, 11b = lateral labial branch, 11c = medial labial branch, 11d = mental branch); 12 = mental branch of mylohyoid nerve; 13 = great auricular nerve; 14 = transverse cervical nerve

Eyelids

The upper eyelid receives sensory palpebral branches (in the order medial to lateral) from the infratrochlear, supratrochlear, supraorbital and lacrimal nerves, all originating from the ophthalmic nerve (Vestal et al. 1994; Joo et al. 2014). Even the zygomaticotemporal branch may supply a small area to the very lateral end of the upper eyelid (Shams et al. 2013).

The main sensory nerve of the lower eyelid is the inferior palpebral branch of the infraorbital nerve (ION) (Hu et al. 2006; 2007a). The inferior palpebral branch is the smallest branch of the ION and, after exiting the infraorbital foramen, runs in an upward course (in contrast to all other ION branches that leave the foramen in a downward direction). The inferior palpebral branch is often bifurcated with one sub-branch traveling medially and the other laterally (Hu et al. 2007a). Occasionally, the inferior palpebral branch only innervates the medial or the lateral part of the lower eyelid with other sensory nerves standing in. If the medial branch is absent, the external nasal branch may compensate for it. When the lateral branch is missing, the zygomaticofacial branch of the zygomatic nerve may innervate the area instead (Hu et al. 2007a; Hwang et al. 2008). A palpebral branch of the infratrochlear nerve may also reach the medial aspect of the lower eyelid (Shams et al. 2013).

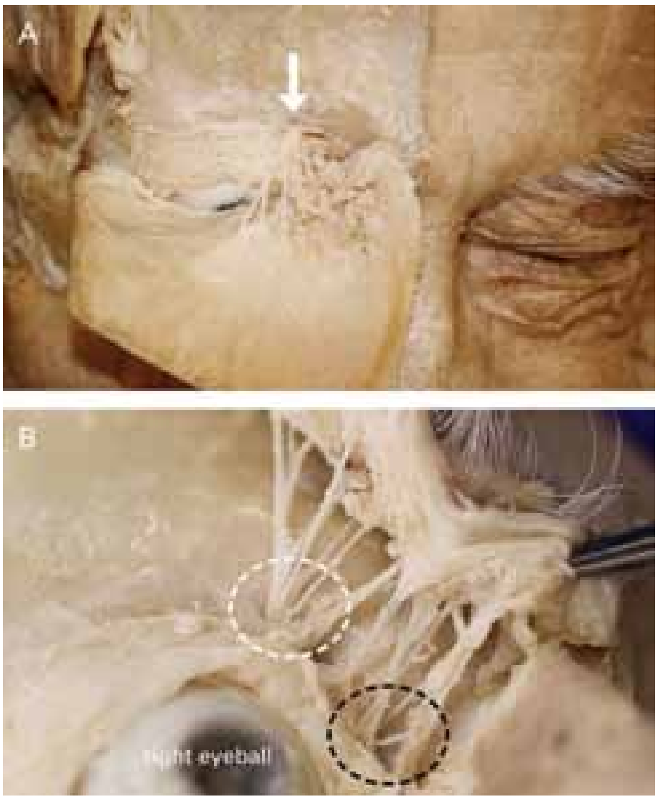

Fig. 6 (A) Cadaveric dissection of the right supraorbital nerve (arrow) innervating the skin of the forehead (folded downwards) with multiple branches. (B) Detailed view of the branches of the right supraorbital nerve (white dotted circle) and supratrochlear nerve (black dotted circle).

Nose

The skin of the nose is innervated by branches from the ophthalmic and maxillary divisions of CN V. The upper part of the nose is innervated by the infratrochlear nerve arising from the nasociliary nerve (one of the three major branches of the ophthalmic nerve CN V1). The skin of the lower and central part of the nose and the nasal tip are innervated by the external nasal nerve, the terminal portion of the anterior ethmoidal nerve that originates also from the nasociliary nerve. The external nasal nerve exits between the nasal bone and the upper lateral cartilage about 6.5 to 8.5 mm lateral to the nasal midline to reach the skin (Han et al. 2004). Then, the external nasal nerve courses downward almost straight and follows along the midline toward the nostril apex (Han et al. 2004).

The lateral parts of the nose (alae nasi) as well as the nasolabial fold receive sensory innervation from the external nasal branch of the ION (Hwang et al. 2004a). The area of the lateral nose supplied by the external nasal branch may reach from the root to the ala of the nose, but may also be limited to the lower portion of the nose (Hu et al. 2007a). In this situation, the medial branch of the inferior palpebral branch extends to the skin of the lateral root portion of the nose (Hu et al. 2007a).

The bridge of the nose is innervated by the infratrochlear nerve that is the terminal branch of the nasociliary nerve (Yang et al. 2013). However, the nasal root may also be innervated by a branch from the supratrochlear nerve (Siemionow et al. 2011).

Lips

The skin of the upper lip is innervated by branches of the ION (Fig. 7). The ION, an entirely sensory nerve, is the terminal branch of the maxillary nerve. After exiting the infraorbital foramen, the ION divides into different branches: inferior palpebral, internal nasal, external nasal, and superior labial (the latter is the largest of the ION branches). The main ION branch contributing sensory fibers to the upper lip is the superior labial with two sub-branches: the medial sub-branch of the superior labial branch supplies the center portion of the upper lip, whereas the lateral sub-branch innervates the lateral aspect of the upper lip (Hu et al. 2006). The superior labial branch exits the infraorbital foramen at the lateral aspect and then descends vertically toward the upper lip. Often, an additional lateral small branch of the lateral sub-branch communicates with the zygomaticofacial nerve (Hu et al. 2007a). A small area of the philtrum may be supplied by the internal nasal branch (Hu et al. 2007a). The internal nasal branch of the ION emerges in the medial portion of the infraorbital foramen, and then courses downward and around the ala of the nose (Hu et al. 2006). The area supplied by the superior labial branch may be overlapped by the area innervated by the external nasal branch, thus in the event of damage to one of these branches the other non-damaged branch may sustain sensory perception (Hwang et al. 2004a).

The cutaneous sensory innervation of the lower lip is provided by the mental nerve (Fig. 8), one of the two terminal branches of the inferior alveolar nerve (the other one being the mandibular incisive nerve). After exiting the mental foramen, the purely sensory mental nerve divides into three to four branches: medial inferior labial, lateral inferior labial, angular (corner of mouth), and mental (chin, see below) (Alsaad et al. 2003; Hu et al. 2007b; Won et al. 2014). However, the branching pattern of the mental nerve may vary with different combinations of fusion of its branches. Furthermore, the number of inferior labial branches originating from the mental nerve may range from one to four (Alantar et al. 2000). The same authors also reported midline crossover innervation of the ventral surface of the lower lip in 31%. The branches of the mental nerve to the lower lip

Fig. 7 Cadaveric dissection of the right infraorbital nerve (black dotted circle) leaving the infraorbital foramen and supplying the overlying skin.

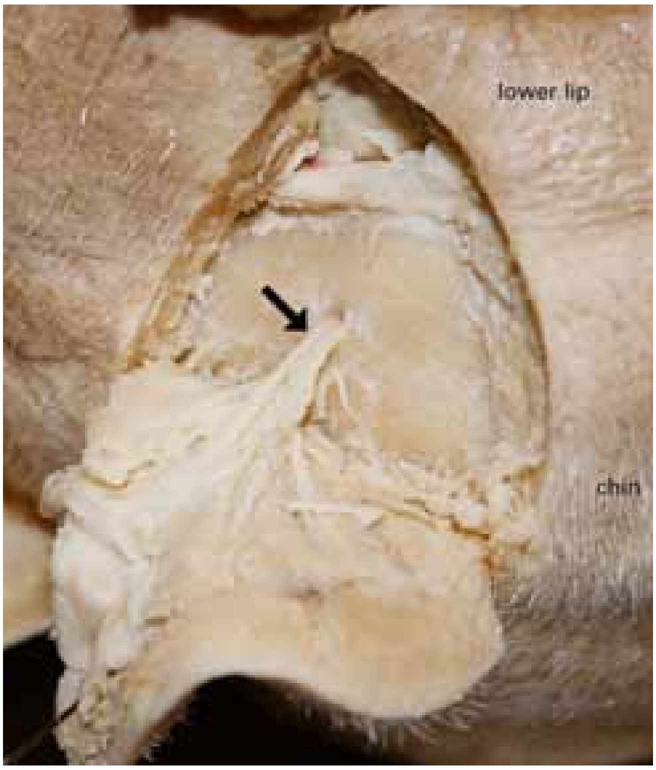

Fig. 8 Cadaveric dissection of the right mental nerve (arrow) leaving the mental foramen and arborizing to the skin of the lower lip and chin.

show an oblique direction whereas the angular branch to the corner of the mouth has a more or less vertical course. Even the mental branch of the mental nerve may contribute in some cases to the sensitivity of the lower lip (Won et al. 2014). The latter authors also showed that in 50% of studied cadaveric specimens, each branch of the mental nerve overlapped with adjacent branches.

The skin overlying the corner of the mouth may also receive sensory innervation from terminal rami of the long buccal nerve (Joo et al. 2014).

Chin

The chin is supplied by the mental branch of the mental nerve. The mental branch of the mental nerve exits the mental foramen and courses anteriorly in a horizontal direction (Alsaad et al. 2003; Hu et al. 2007b; Won et al. 2014). Subsequently, it arborizes to provide sensory innervation to the whole chin. Additional sensory supply by the mylohyoid nerve to the inferior chin area has also been documented (Guyot et al. 2002; Hwang et al. 2005a; Varol et al. 2009). The mylohyoid nerve arises from the inferior alveolar nerve well above the mandibular foramen and then travels along the medial aspect of the mandible below the mylohyoid muscle. This nerve provides motoric innervation to the mylohyoid muscle and the anterior belly of the digastric muscle, but also has cutaneous afferent fibers from below the chin. Hwang et al. (2005a) found a mean number of 2.3 terminal sensory fibers of the mylohyoid nerve innervating bilaterally a rhomboid zone of the skin, directly below the anterior mandibular border (submental area).

Temples

The largest area of the temple receives cutaneous sensory supply from the auriculotemporal nerve (Fig. 9). This nerve originates from the mandibular nerve immediately below the foramen ovale in the infratemporal fossa. The auriculotemporal nerve often has multiple roots, courses medially to the neck of the mandibular condyle where it turns upwards along the anterior border of the external auditory tube to the temporal region (Yang et al. 2015b). According to Lei et al. (2006), the emerging point of the auriculotemporal nerve can be located by feeling the pulse of the superficial temporal artery between the bony external acoustic meatus and the articular eminence of the temporomandibular joint. A vertical line drawn from the emerging point to the temporoparietal region corresponds to the body surface projection line of the main branch of the auriculotemporal nerve (for more specific information, see Lei et al. 2006 and description therein).

The skin of the anterior temple is innervated by the zygomaticotemporal nerve of the zygomatic nerve (Tubbs et al. 2012). The zygomaticotemporal nerve may have an additional posterolateral branch directed horizontally to join the auriculotemporal nerve (Totonchi et al. 2005). According to Hwang et al. (2004b), the skin territory innervated by the zygomaticotemporal nerve is a circular area with a diameter of 30 mm. Its center is located 10 mm superior to the top of the auriculocephalic sulcus and 30 mm lateral to the lateral canthus.

Cheeks

According to Pilsl et al. (2012), the cheek can be divided into four regions: infraorbital region, buccal region, zygomatic region, and parotid-masseteric region. The skin of the infraorbital region of the cheek is innervated by branches from the ION, mainly by twigs from the superior labial branch, but also from the other ION branches.

The main sensory nerve of the buccal region of the cheek is the (long) buccal nerve (Hendy et al. 1996; Tohma et al. 2004; Wongsirichat et al. 2011; Yang et al. 2012). It originates from the anterior root of the mandibular nerve within the infratemporal fossa. The long buccal nerve approaches the cheek from beneath the anterior border of the masseter muscle at approximately the level of the occlusal plane, normally piercing the posterior half of the buccinator muscle to arborize extensively within the buccal surface of the cheek (Hendy et al. 1996; Tubbs et al. 2010). The latter authors identified 4 to 8 (mean 6) major branches of the long buccal nerve in 20 dissections. Yang et al. 2012 demonstrated that branches of the long buccal nerve may also reach the anterior upper portion of the cheek above the lateral corner (cheilion) of the mouth.

The skin of the zygomatic region overlying the malar bone, i.e., the prominence of the cheek, is innervated by the zygomaticofacial nerve of the zygomatic nerve that originates from the maxillary nerve within the pterygopalatine fossa (Hwang et al. 2007). The zygomatic nerve passes to the orbit through the inferior orbital fissure, runs along the inferolateral angle of the orbit, and then enters the zygomatico-orbital foramen (Totonchi et al. 2005). Within the zygomatic bone, the zygomatic nerve divides into the zygomaticofacial and zygomaticotemporal nerves (Fig. 10); however, there is great variability with regard

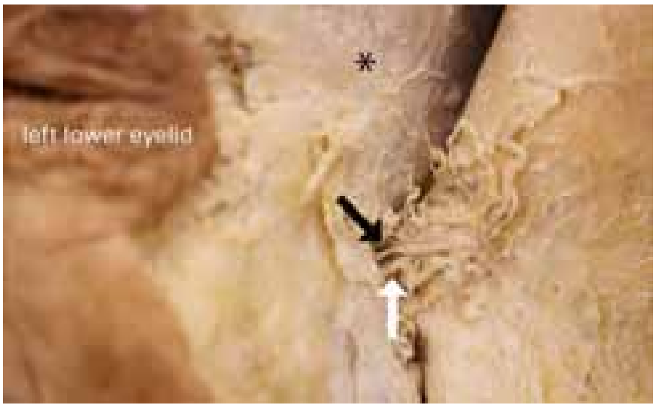

Fig. 9 Cadaveric dissection of the left auriculotemporal nerve (black arrow) that is accompanied by the superficial temporal artery (white arrow). The skin of the left temple region is retracted posteriorly. (* = left temporal bone)

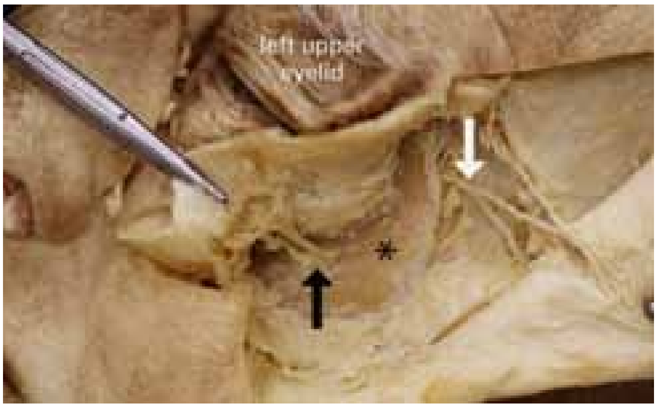

Fig. 10 Cadaveric dissection of the left zygomaticofacial (black arrow) and zygomaticotemporal (white arrow) nerves. (* = left zygomatic bone)

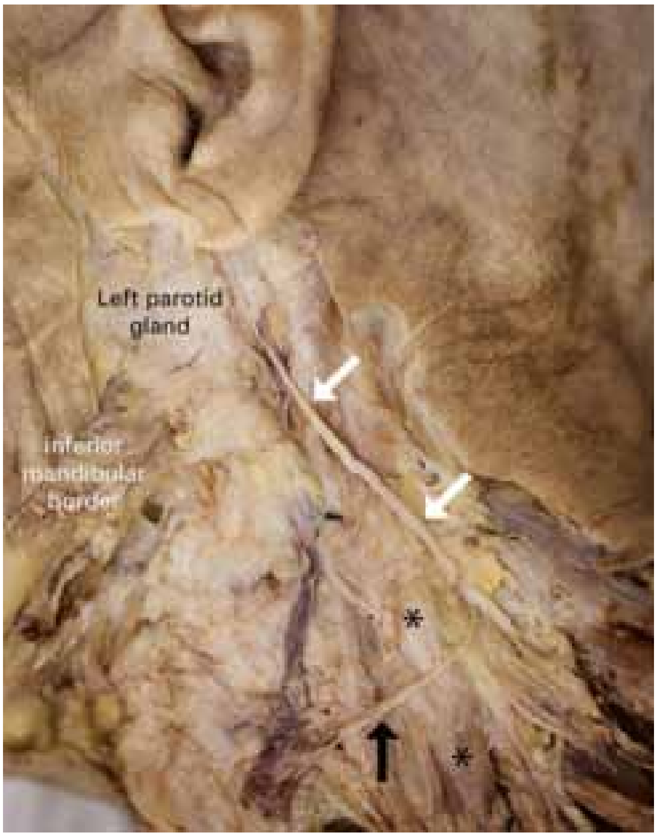

Fig. 11 Cadaveric dissection of the left great auricular nerve (white arrows) and of the transverse cervical nerve (black arrow). (* = sternocleidomastoid muscle)

to the site of nerve division outside/inside the zygomatic bone and the number of foramina/canals where nerves enter and leave the zygomatic bone (Kim et al. 2013). Twigs of the zygomaticofacial nerve may reach the skin lateral and below the lateral canthus (Hwang et al. 2008). The skin of the upper anterior part of the cheek is supplied by lateral rami of the large superior labial branch from the ION (Joo et al. 2014).

The lower and posterior skin of the cheek overlying the angle of the mandible and the parotid gland (parotid-masseteric region) is innervated by terminal branches from the great auricular nerve (Ella et al. 2015) (Fig. 11). Furthermore, the transverse cervical nerve (also forming part of the superficial cervical plexus) may contribute cutaneous sensory innervation to the skin of the inferior border of the lateral and anterior mandible (Lin et al. 2013; Ella et al. 2015).

Ears/Auricles

The cutaneous sensory innervation of the ear is rather complex with four contributing nerves: auriculotemporal nerve (CN V3), great auricular nerve, posterior auricular branch from facial nerve (CN VII), and auricular branch from vagus nerve (CN X), as well as minor contributions from the tympanic branch of the glossopharyngeal (CN IX) and possibly afferent fibers associated with the facial nerve (CN VII). The upper anterior part of the auricle and the external acoustic meatus receive somatic afferent fibers from the auriculotemporal nerve (Komarnitki et al. 2012). The posterior and lower parts of the auricle are innervated by the great auricular nerve. The posterior auricular branch of the facial nerve is a mixed motoric-sensory nerve contributing cutaneous innervation to the central part of the auricle (concha). The auricular branch from the vagus provides sensory innervation also to the external acoustic meatus and part of the auricle (Tekdemir et al. 1998; Kiyokawa et al. 2014). In general, the great auricular nerve and the auriculotemporal nerve supply the more superficial surfaces of the external ear whereas the posterior auricular branch from the facial nerve and the auricular branch from the vagus nerve contribute to the deeper parts of the auricle.

Discussion

The skin of the face is mainly innervated by sensory branches arising from the three trunks of the trigeminal nerve (CN V). In addition, other nerves provide cutaneous innervation to the posteroinferior areas of the cheeks (great auricular nerve, transverse cervical nerve) and the auricles (facial nerve CN VII, vagus nerve CN X, great auricular nerve). The latter variations may explain persistent sensitivity after block anesthesia of the trigeminal branches, and occasionally require additional, distant injections to obtain full anesthesia of the skin in the corresponding areas. In contrast, unexpected skin numbness may occur after administration of intraoral local anesthesia (Kim et al. 2003; Ngeow & Chai 2009).

Most of the anatomical studies on dissection of cutaneous sensory branches in the face emphasize the frequent presence of neural connections (anastomoses) among terminal rami of adjacent nerves. Furthermore, innervation territories of sensory nerves may overlap, i.e., a specific skin area may be supplied by two different nerves. In the event of damage to one nerve, its function may be supplanted by the other achieving partial or full recovery of skin sensation (Hwang et al. 2004a).

Many anatomical studies concerning nerve innervation of the face documented neural communications between sensory branches of the trigeminal nerve (CN V) and motoric branches of the facial nerve (CN VII) (Kwak et al. 2004; Tohma et al. 2004; Kim et al. 2009; Diamond et al. 2011). According to a recent extensive review of the literature, bilateral connections between the facial and trigeminal nerves cross the midline and may serve as afferent pathways for proprioceptive inputs of muscles of facial expression (Diamond et al. 2011). Some have even postulated that communicating trigeminal branches may explain spontaneous recovery of denervated facial muscles (DeLacure et al. 1990; Cheney et al. 1997; Tohma et al. 2004).

An evaluation of the neurosensory status of the three trigeminal branches should be performed by every dental practitioner when examining a patient. Furthermore, skin sensitivity should be assessed pre- and postoperatively in conjunction with dental interventions. In the absence of local, regional or systemic factors to account for facial sensory loss, the clinician should consider the possibility of sinister underlying pathology, possibly remote from the jaws (Schifter & Barrett 1993; Bridgman & Snape 1998; Boerman et al. 1999). The latter articles have documented cases with peripheral trigeminal neuropathy secondary to perineural invasion of malignancies. Other causes may include direct nerve compression by metastatic or primary tumors of the brain.

In conclusion, the clinical relevance of the facial sensitivity comprises the pre- and postoperative assessment of the cutaneous innervation of the face, the awareness of (sudden) changes with regard to the neurosensitivity, and the possible supplementary neural supply of specific skin territories by adjacent nerves.

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Conflict of interest
The authors declare that there are no conflicts of interest related to this review.

Résumé
Cet article fournit une revue de la littérature concernant l'innervation sensorielle de la peau du visage. Les interventions chez le dentiste, en particulier bien sûr l'administration de l'anesthésie locale ou régionale, ont une influence sur la sensibilité de la peau du visage. Pour cette raison, chaque clinicien devrait avoir une connaissance de l'innervation sensible dans la zone du visage, et examiner le patient avant et après les interventions dentaires en conséquence.

Le visage façonne plus que toute autre partie du corps le caractère individuel et l'apparence d'une personne. De belles dents naturelles ou reconstruites/restaurées sont essentielles pour l'esthétique du visage, et sont donc utiles à l'attrait, l'estime de soi et la santé en général.

Mais le visage est aussi un organe hautement spécialisé en ce qui concerne la sensibilité. Un réseau dense de fibres nerveuses sensibles non myélinisées (épiderme) et des fibres nerveuses myélinisées (follicules pileux du derme) constitue la base morphologique pour le seuil d'irritation de la peau du visage par rapport au reste de la peau en termes de stimuli thermiques, toxiques et tactiles.

L'innervation sensorielle de la peau du visage est principalement réalisée par les trois branches du nerf trijumeau (cinquième nerf crânien). Pendant que les nerfs ophtalmique (V1) et maxillaire (V2) sont purement des branches sensorielles, le nerf mandibulaire (V3) comporte également des fibres nerveuses motrices adjacentes aux sensorielles. Les branches du nerf ophtalmique innervent la peau dans la région du front, des paupières supérieures et le dos du nez jusqu'à la pointe du nez. Les branches du nerf maxillaire innervent la peau de la lèvre supérieure, des paupières inférieures, des joues dans la zone antéro-supérieure et dans la région antérieure des tempes. Le nerf mandibulaire innerve la peau de la lèvre inférieure et du menton, les parties inférieures des joues et, avec le nerf auriculotemporal, la zone arrière des tempes et l'avant ainsi que des parties supérieures du pavillon de l'oreille. Dans la littérature, il est également fait référence aux anastomoses fréquentes entre les branches sensorielles du nerf trijumeau et motrices du nerf facial (VII).

L'innervation de la peau dans la zone de l'angle de la mandibule et la portion basse de la joue sur le rebord de la mandibule est réalisée par les branches du plexus cervical (nerf auriculaire, nerf cervical transverse). Ce dernier est constitué des nerfs spinaux C1 à C4.

D'un point de vue clinique, il est logique de discuter l'innervation de la peau du visage par région. Les régions centrales de la face comprennent le front, les paupières, le nez, les lèvres et le menton, les régions latérales sont les tempes, les joues et les oreilles. Les deux branches principales qui innervent au niveau sensible le front sont le nerf supra-orbitaire (parties supérieure et latérale du front) et le nerf supra-trochléaire (milieu du front). Ces deux nerfs sont issus du nerf frontal (V1). L'innervation sensorielle des paupières supérieures est complexe avec des branches de quatre différents nerfs (du milieu vers l'extérieur: nerf infra-trochléaire, nerf supra-trochléaire, nerf lacrymal et nerf supra-orbitaire). L'innervation sensorielle de la paupière inférieure l'est principalement par le rameau palpébral du nerf infra-orbitaire. Le nez reçoit son innervation sensorielle des branches du nerf naso-ciliaire et du nerf infra-orbitaire. La lèvre supérieure est principalement innervée au niveau sensoriel par le rameau labial supérieur (nerf infra-orbitaire) et la lèvre inférieure par les branches labiales du nerf mentonnier. La peau du menton doit son innervation aux branches sensorielles du nerf mentonnier et du nerf mylohyoïdien.

Dans la région temporale, l'innervation sensorielle se distingue à l'avant par le rameau zygomatico-temporal (du nerf zygomatique, V2) et à l'arrière par le nerf auriculo-temporal (V3). L'innervation sensorielle de la joue est essentiellement divisée en quatre zones: infra-orbitaire (nerf infra-orbitaire), buccale antérieure (nerf buccal, basal év. nerf cervical transverse), buccale postérieure (nerf buccal et nerf grand auriculaire) et la région de la pommette (nerf zygomatico-facial, du nerf zygomatique, V2). L'innervation sensorielle de la peau des pavillons des oreilles est à son tour très complexe: nerf auriculo-temporal (V3), nerf grand auriculaire (plexus cervical) et de petites branches des nerfs vague et glossopharyngien.

Zusammenfassung
Die vorliegende Arbeit bietet eine Literaturübersicht bezüglich der sensiblen Innervation der Gesichtshaut. Interventionen beim Zahnarzt, vor allem natürlich das Legen lokaler oder regionaler Anästhesien, haben einen Einfluss auf die Sensibilität der Gesichtshaut. Aus diesem Grunde sollte jeder Kliniker Kenntnisse der sensiblen Versorgung im Gesichtsbereich haben, und die Patienten vor und nach zahnärztlichen Eingriffen entsprechend untersuchen.

Das Gesicht prägt wie kein anderer Körperteil den individuellen Charakter und das Aussehen eines Menschen. Schöne natürliche oder restaurierte/rekonstruierte Zähne tragen wesentlich zur Gesichtsästhetik bei und sind damit bedeutungsvoll für die Attraktivität, das Selbstgefühl und die Gesundheit im Allgemeinen.

Das Gesicht ist aber auch ein hochspezialisiertes Organ bezüglich Sensibilität. Ein dichtes Netz von sensiblen nicht myelinisierten Nervenfasern (Epidermis) wie auch von myelinisierten Nervenfasern (Haarfollikel der Dermis) bietet die morphologische Basis für die tiefe Reizschwelle der Gesichtshaut im Vergleich zur restlichen Haut bezüglich thermischer, noxischer sowie taktiler Reize.

Die sensible Innervation der Gesichtshaut erfolgt primär durch die drei Äste des N. trigeminus (fünfter Hirnnerv). Während der N. ophthalmicus (V1) und der N. maxillaris (V2) rein sensible Äste sind, führt der N. mandibularis (V3) neben sensiblen auch motorische Nervenfasern. Äste des N. ophthalmicus innervieren die Haut im Bereich der Stirn, der oberen Augenlider sowie des Nasenrückens bis zur Nasenspitze. Äste des N. maxillaris versorgen die Haut der Oberlippe, der unteren Augenlider, des vorderen oberen Wangengebietes sowie im vorderen Schläfenbereich. Der N. mandibularis innerviert die Haut im Unterlippen- und Kinnbereich, die unteren Anteile der Wange und mit dem N. auriculotemporalis den hinteren Schläfenbereich sowie die vorderen und oberen Anteile der Ohrmuschel. In der Literatur wird auch auf die häufigen Anastomosen zwischen sensiblen Ästen des N. trigeminus und motorischen Ästen des N. fazialis (VII) hingewiesen.

Die Haut im Bereich des Kieferwinkels und der untersten Wangenabschnitte über dem Unterkieferrand wird durch Äste (N. auricularis magnus, N. transversus colli) des Plexus zervikalis innerviert. Letzterer besteht aus den Spinalnerven C1 bis C4.

Aus klinischer Sicht macht es Sinn, die Innervation der Gesichtshaut nach Regionen zu diskutieren. Zentrale Gesichtsregionen umfassen Stirn, Augenlider, Nase, Lippen und Kinn, seitliche Regionen sind Schläfen, Wangen und Ohren. Die beiden sensiblen Hauptäste der Stirn sind der N. supraorbitalis (obere und laterale Stirnanteile) sowie der N. supratrochlearis (mittlere Stirnanteile), beide stammen aus dem N. frontalis (V1). Die sensible Innervation des oberen Augenlides ist komplex, mit Ästen von vier verschiedenen Nerven (von medial nach lateral: N. infratrochlearis, N. supratrochlearis, N. supraorbitalis und N. lacrimalis). Die sensible Versorgung des unteren Augenliedes erfolgt primär durch den R. palpebralis des N. infraorbitalis. Die Nase erhält sensible Äste vom N. nasociliaris sowie vom N. infraorbitalis. Die Oberlippe wird hauptsächlich vom R. labialis superior (N. infraorbitalis) und die Unterlippe von den labialen Ästen des N. mentalis sensibel versorgt. Die Haut im Kinnbereich erreichen sensible Äste des N. mentalis sowie des N. mylohyoideus.

Im Schläfenbereich unterscheidet man eine vordere sensible Innervation durch den R. zygomaticotemporalis (vom N. zygomaticus, V2) und eine hintere sensible Versorgung durch den N. auriculotemporalis (V3). Die Wange wird grundsätzlich in vier Gebiete unterteilt mit folgender sensibler Innervation: infraorbital (N. infraorbitalis), bukkal anterior (N. buccalis, basal evtl. N. transversus colli), bukkal posterior (N. buccalis und N. auricularis magnus) sowie Jochbein-Region (N. zygomaticofacialis, vom N. zygomaticus, V2). Die sensible Versorgung der Haut der Ohrmuscheln wiederum ist sehr komplex: N. auriculotemporalis (V3), N. auricularis magnus (Plexus zervikalis) sowie kleine Äste vom N. vagus und N. glossopharyngeus.

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