Neurologic Anatomy of the Nose

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2.1 Introduction

The external nose and nasal cavity receive a rich sensory innervation through branches of the first and second divisions of the trigeminal nerve (Fig. 2.1). Autonomic nervous supply to the nose arises from the superior salivatory nucleus in the brain stem (parasympathetic) and superior cervical ganglion (sympathetic) via the pterygopalatine ganglion. Knowledge of the neurologic anatomy of the nose is important for the facial and rhinoplasty surgeon who must place incisions strategically to avoid inadvertent injury to sensory nerves. Regional nerve blocks also require a detailed knowledge of the sensory innervation of the nose and the locations of the foramina from which they emerge.

The soft tissues and skin of the external nose are innervated by the infratrochlear and external nasal nerves. These are branches of the ophthalmic division of the trigeminal nerve. Nasal branches of the infraorbital and anterior superior alveolar nerves, both terminal branches of the maxillary nerve, provide further sensory innervation to the sides and part of the tip and columella (Fig. 2.2).

Within the nasal cavity, special sensory innervation relating to olfaction is provided by the first cranial nerve. General sensation in the nasal cavity is relayed through branches of the ophthalmic and maxillary nerves. These include the anterior ethmoidal, infraorbital, and posterior superior alveolar nerves. Further innervation is provided indirectly through the pterygopalatine ganglion by the posterior superior nasal, greater palatine, and nasopalatine nerves (Fig. 2.3).

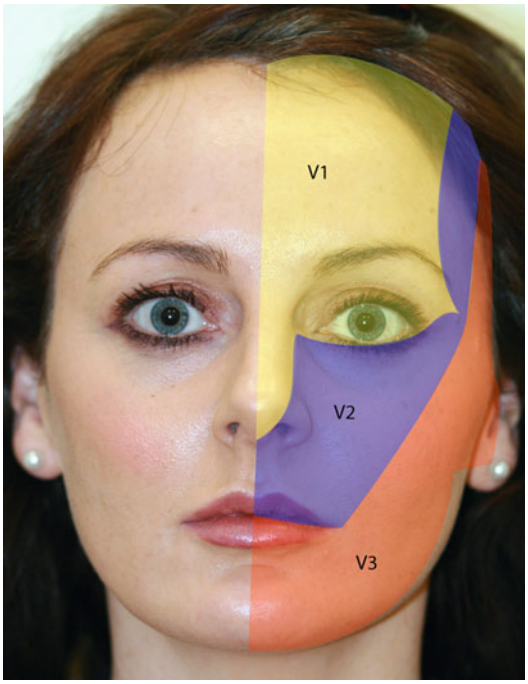

Fig. 2.1 Sensory innervation of the face. The nose is supplied by branches of the first (V1 ophthalmic), second (V2 maxillary), and third (V3 mandibular) divisions of the trigeminal nerve

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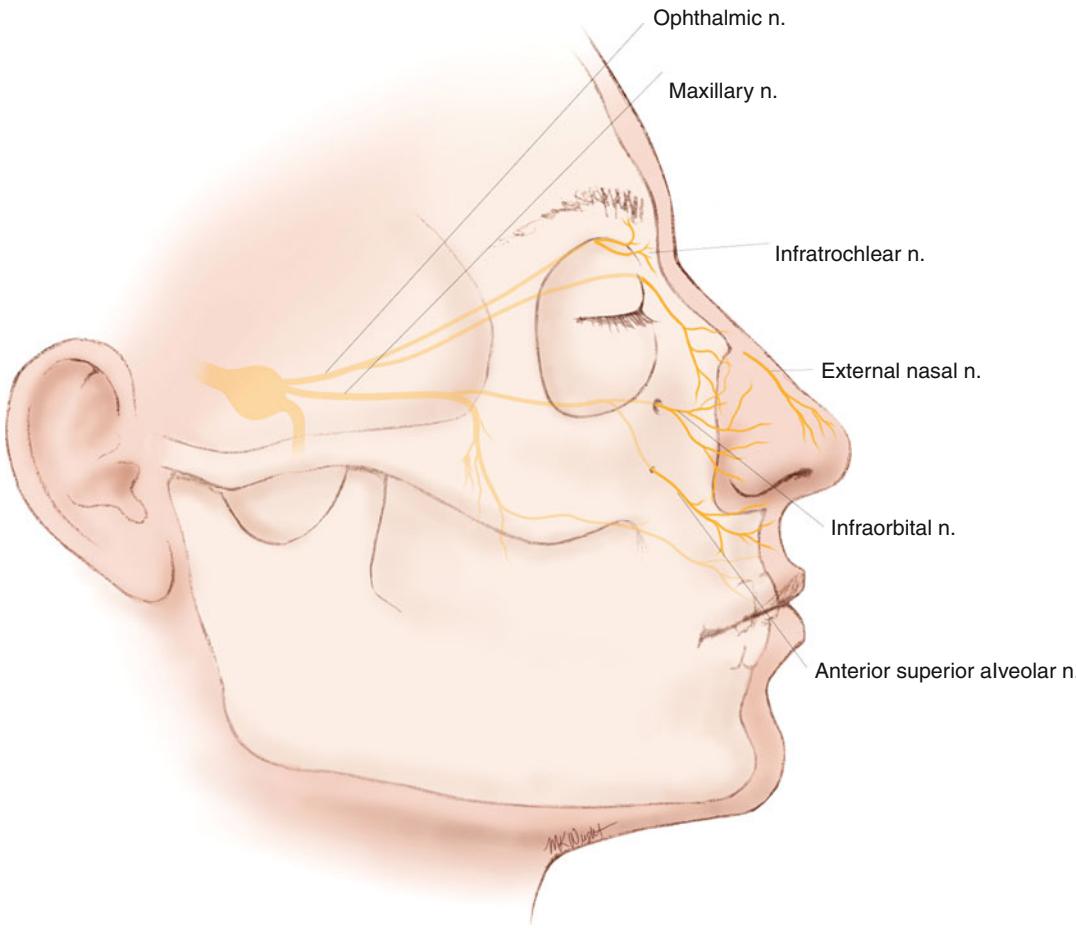

Fig. 2.2 Nerves to the external nose

2.2 Olfactory Nerves

The olfactory nerves transmit the special sense of smell and arise from olfactory cells that lie in the mucosa of the superior conchae and superior part of the nasal septum. From the neural plexus that lies in the nasal mucosa arise about 20 branches of unmyelinated nerves. These branches are ensheathed in dura, pia, and arachnoid mater and pass through the cribriform plate to reach the olfactory bulb in the anterior cranial fossa. The extension of the meningeal layers from the brain to the nasal cavity is a potential avenue for the transmission of infection through the subarachnoid space to the intracranial cavity.

2.3 Sensory Nerves

2.3.1 Anterior Ethmoidal Nerve

The anterior ethmoidal nerve is a direct continuation of the nasociliary nerve when the latter arrives at the medial orbital wall after crossing the optic nerve and running below the superior rectus and superior oblique muscles. After traversing the anterior ethmoidal foramen and canal, the anterior ethmoidal nerve runs along the cribriform plate before passing through a slit lateral to the crista galli to enter the nasal cavity. Medial and lateral branches supply the mucosa of the nasal septum and lateral nasal wall, respectively. At the caudal end of the nasal bone, the nasociliary nerve

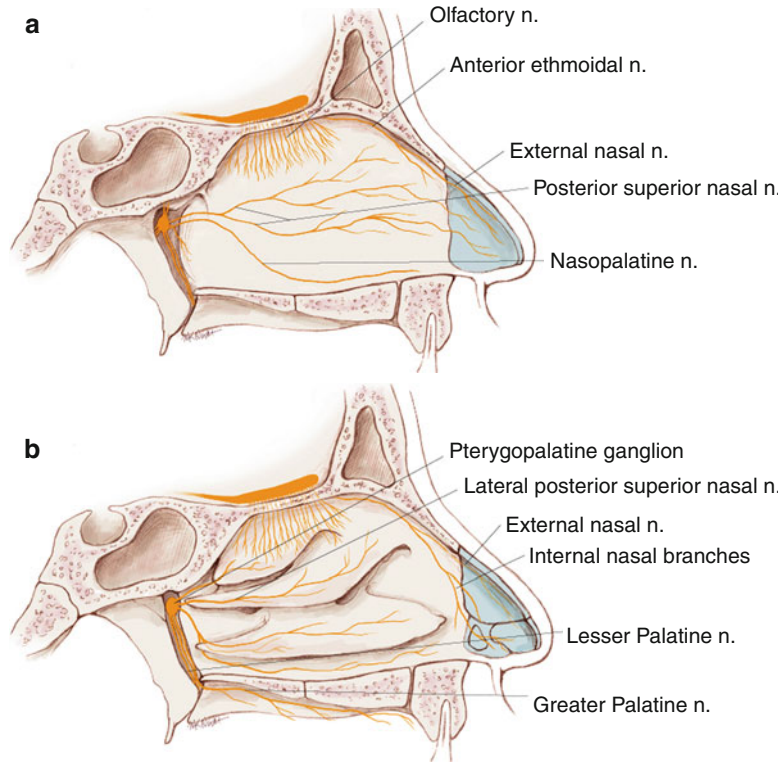

Fig. 2.3 Innervation of the nasal cavity. (**a**) Medial branches supply the septum. (**b**) Lateral branches supply the lateral walls and conchae

appears 6.5–8.5 mm from the midline as the external nasal nerve. From this position between the nasal bone and the upper lateral cartilage, it runs parallel to the midline toward the nasal tip. Variations in the external nasal nerve exist [1]. The nerve may appear as two branches superiorly, branch as it approaches the apex of the nose, or remain as a single branch along its course. The external nasal nerve passes deep to the nasalis and superficial musculoaponeurotic layer of the nose, through the deep fatty layer, to the alar cartilages. The nerve supplies sensation to the distal aspect of the nasal dorsum and tip of the nose, as well as the skin of the nasal ala. Injudicious endonasal incisions or dissection during rhinoplasty surgery can easily lead to transection of the external nasal nerve resulting in nasal tip dysesthesias. Nerve injuries may be minimized by avoiding deep intercartilaginous or intracartilaginous incisions, restricting the dissection to within 6.5 mm of the midline, and limiting dorsal nasal onlay grafts to 13 mm at the rhinion [1].

2.3.2 Infratrochlear Nerve

The infratrochlear nerve, a branch of the nasociliary nerve, arises near the anterior ethmoidal foramen and runs along the medial wall of the orbit before exiting above the medial canthus. The nerve runs inferiorly and supplies sensation to the medial eyelid, lateral part of the nose above the medial canthus, medial conjunctiva, and lacrimal apparatus. The infratrochlear nerve also receives a branch from the supratrochlear nerve lateral to it.

2.3.3 Infraorbital Nerve

The infraorbital nerve is the largest terminal branch of the maxillary nerve. The latter arises between the first and third divisions of the trigeminal nerve as a broad band, passes through the foramen rotundum, and becomes more cord-like as it enters the pterygopalatine fossa. It sends two ganglionic branches to the pterygopalatine ganglion

before continuing anteriorly to give off its sensory branches that innervate the midface. Nasal sensory nerves arise from both the anterior superior alveolar nerve and the larger infraorbital nerve. The anterior superior alveolar nerve arises in the infraorbital canal and traverses the canalis sinuosus, passes below the infraorbital foramen on the maxilla, and then turns inferiorly lateral to the nose before sending branches to the central lip, incisors, columella, and tip of the nose. The infraorbital nerve traverses the infraorbital canal in the floor of the orbit. It emerges as five branches at the infraorbital foramen about 6–8 mm below the inferior orbital rim in line vertically with the pupil. These sensory branches consist of the inferior palpebral, external, and internal nasal branches and medial and lateral subbranches of the superior labial branch of the infraorbital nerve [2]. The infraorbital nerve branches emerge into the infraorbital space over the maxilla, where they are amenable to nerve block or susceptible to both traumatic and iatrogenic injuries. This space is bounded superiorly by the origin of levator labii superioris, laterally by levator anguli oris, medially by levator labii superioris alaeque nasi, and inferiorly by orbicularis oris. Hu [2] describes four branching patterns of the infraorbital nerve as it appears from its foramen (excluding the inferior palpebral branch): type I, where all four branches are separated; type II, where the two nasal branches are separated but the superior labial branches are fused; type III, where the superior labial branches are separated but the nasal branches are merged; and type IV, where the two nasal branches and the two labial branches are fused. The external nasal branch of the infraorbital nerve innervates the lateral part of the nose and ala. The internal nasal nerve arises from the lateral part of the infraorbital foramen and runs down along the nose and around the ala to innervate the nasal septum and vestibule.

2.3.4 Anterior Superior Alveolar Nerve

This branch of the infraorbital nerve arises before the latter reaches the infraorbital foramen. It supplies a small part of the external nose at the tip and columella (Fig. 2.2).

2.3.5 Posterior Superior Nasal Nerves

These branches of the maxillary nerve innervate the nasal cavity through a number of smaller medial and lateral branches. Lateral branches supply the mucosa of the superior and middle nasal conchae, whereas medial branches send fibers to the nasal septum (Fig. 2.3). The nasopalatine nerve represents the largest of the medial posterior superior nasal nerves. It passes anteroinferiorly in a groove on the vomer to reach the floor of the nasal cavity. From here, it passes through the incisive fossa of the hard palate and communicates with the greater palatine nerve to supply the mucosa of the hard palate. The posterior superior nasal nerves pass through the pterygopalatine ganglion without synapsing and onto the maxillary nerve via its ganglionic branches.

2.3.6 Palatine Nerves

The greater and lesser palatine nerves are also sensory branches of the maxillary nerve, via the pterygopalatine ganglion. From the ganglion, they pass inferiorly through the greater palatine canal. In the canal, the larger greater palatine nerve gives off branches that perforate the perpendicular plate of the palatine bone to enter the nasal cavity. These posterior inferior branches supply sensation to the mucosa over the inferior nasal concha and the inferior and middle meatuses. The greater palatine nerve emerges from its canal through the greater palatine foramen and passes anteriorly in the roof of the palate, innervating the mucosa and gingivae and communicating with the nasopalatine nerve anteriorly. The lesser palatine nerve runs with the greater palatine nerve, emerging through the lesser palatine foramen to send sensory fibers to the tonsils, uvula, and soft palate. It does not contribute to the innervation of the nose or nasal cavity.

2.4 Regional Anesthesia of the Nose

Nerve blocks are valuable techniques that facilitate outpatient nasal surgery, including rhinoplasty, and obviate the need for general anesthesia and even sedation in selected cases [3]. The tip of the nose is anesthetized by blocking the external nasal nerve with an injection over the periosteum at the junction of the nasal and cartilaginous parts of the nose on either side of the midline. Anesthesia of the bridge of the nose requires a block of the infratrochlear nerve. Since the nasociliary nerve gives off the infratrochlear nerve and continues as the anterior ethmoidal nerve, blocking this nerve achieves anesthesia of the root, dorsum, and tip of the nose. To block the nasociliary nerve, a 30-mm 25-gauge needle is inserted 1 cm above the medial canthus and passed posterolaterally along the bone to a depth of 1.5 cm. At this point, 2 mL anesthetic is placed to block the anterior ethmoidal nerve. The needle is advanced 1 cm further to reach the posterior ethmoidal foramen and a further 1.5-mL solution is placed. Pressure should be applied immediately on withdrawing the needle to prevent ecchymosis. To block the infraorbital nerve, about 2 mL anesthetic solution is placed around the infraorbital foramen. The foramen appears on the maxilla in line with the pupil, about 6–8 mm inferior to the inferior rim of the orbit. It can be reached by a percutaneous or intraoral injection, with the needle directed superolaterally toward the foramen. The noninjecting hand protects the orbit as the needle approaches the foramen below the eye. For complete anesthesia of the columella and nasal tip, an additional injection in the upper labial frenulum may be required to block fibers of the anterior superior alveolar nerve that arise separately from the infraorbital nerve. For anesthesia of the mucous membrane of the superior and middle conchae and the posterior nasal septum, topical anesthesia is used to block the sensory nerves arising from the pterygopalatine ganglion. Gauze soaked in local anesthetic with vasoconstrictor is passed along the middle concha until it rests over the pterygopalatine ganglion posterior to the middle meatus. After 10 min, adequate anesthesia and vasoconstriction are achieved.

2.5 Autonomic Nerves

Autonomic control of the vessels and glands of the nose and nasal cavity occurs through both parasympathetic and sympathetic pathways (Fig. 2.4). Postganglionic sympathetic fibers pass from the superior cervical ganglion to the internal and external carotid artery plexuses. Sympathetic fibers continue as the deep petrosal nerve toward the pterygopalatine fossa. The parasympathetic nerves arise in the superior salivatory nucleus in the brain stem. Preganglionic parasympathetic fibers then pass via the sensory root of the facial nerve to the greater petrosal branch. The deep petrosal and greater petrosal nerves merge to form the nerve of the pterygoid canal or vidian nerve. Upon exiting the canal, it enters the pterygopalatine ganglion. Parasympathetic fibers synapse in the ganglion, and postganglionic secretomotor fibers are transmitted to the nasal cavity with the posterior superior, nasopalatine, posterior inferior, and greater palatine nerves. Sympathetic fibers pass through the pterygopalatine ganglion without synapsing, reaching their targets in the nasal cavity by running with the sensory nerves. A second sympathetic pathway exists, represented by fibers that pass from the vidian nerve to periarterial plexuses associated with the maxillary and descending palatine arteries [4].

2.6 Motor Nerves

The small nasal muscles include procerus, nasalis, and depressor septi (Fig. 2.5). Nasalis consists of compressor naris and dilator naris. The motor nerves to these muscles arise from the buccal branch of the facial nerve. Superficial branches supply procerus, whereas lower zygomatic or upper deep buccal branches supply the two parts of nasalis and depressor septi.

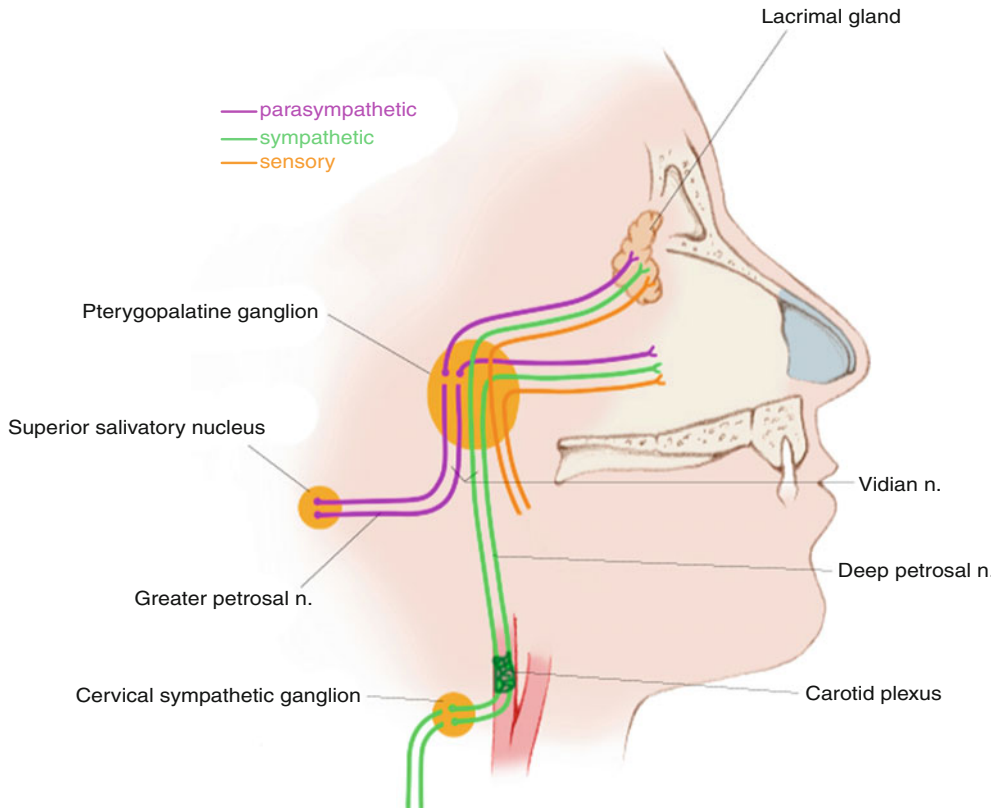

Fig. 2.4 Autonomic nerve supply to the nose. Sympathetic fibers pass through the pterygopalatine ganglion without synapsing, whereas parasympathetic fibers synapse in the ganglion. Sympathetic and parasympathetic secretomotor and vasomotor fibers pass with the sensory nerves to the tissues of the nasal cavity and to the lacrimal gland

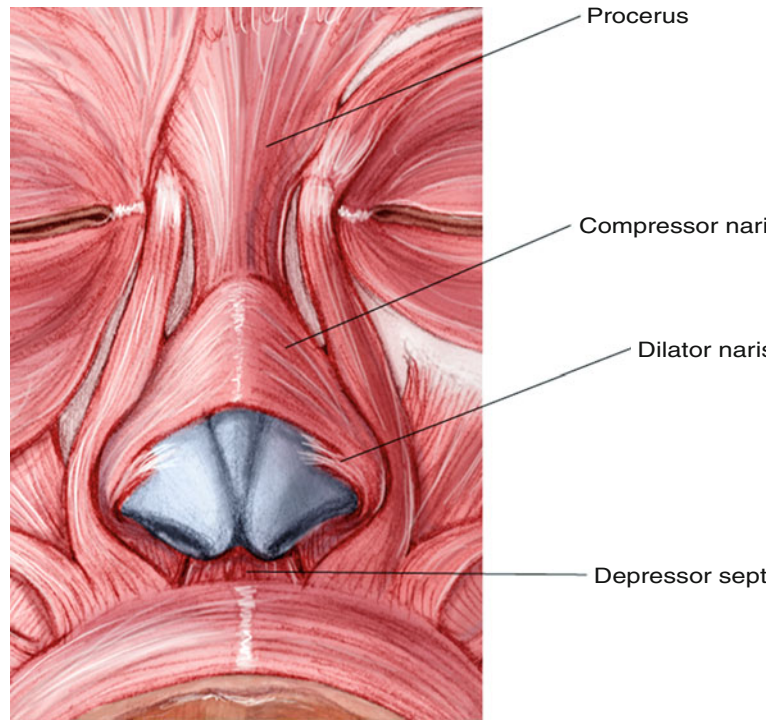

Fig. 2.5 Muscles of the nose

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