9 Trigeminal Nerve: Deep Block

Antoun Nader, Louise Hillen, and Danilo Jankovic

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Ultrasound-Guided Blockade of the Trigeminal Nerve Divisions Through the Pterygopalatine Fossa

General Considerations

Patients presenting with facial pain due to trigeminal neuralgia or atypical facial pain often do not have adequate relief with medical therapy alone. Trigeminal neuralgia is a neuropathic pain syndrome that typically involves the maxillary branch (V2) of the fifth cranial nerve. Twenty-five percent of patients with trigeminal neuralgia are refractory to medical treatment, and 8% may develop tolerance to their pharmacologic regimen. Patients who fail medical management may have the option to undergo surgical or minimally invasive procedures in an attempt to provide pain relief. In patients who are not surgical candidates, have side effects from medical management, or would rather avoid invasive techniques, a trigeminal nerve block under ultrasound guidance is a reasonable alternative. Blockade of the trigeminal nerve may also be an effective diagnostic tool to determine whether further potential treatment options such as radiofrequency ablation or neurolysis with glycerol would be beneficial. The use of trigeminal nerve blocks have also been used to help with acute pain from surgical procedures, such as cleft lip and palate repair. The use of ultrasound guidance allows for real-time visualization of soft tissue and surrounding vasculature and can help to confirm that local anesthetic has spread to the intended target. There are multiple different approaches to ultrasound-guided blockade of the trigeminal divisions through the pterygopalatine

A. Nader (✉)
Acute Pain and Regional Anesthesiology, Northwestern Medicine, Chicago, IL, USA
e-mail: a-nader2@northwestern.edu

L. Hillen
P.A., Plymouth, MN, USA

D. Jankovic
Pain Management Centre DGS – Cologne – Huerth, Cologne-Hürth, Germany
e-mail: danilo@jankovic1.de

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fossa (PPF). The three main approaches include the infrazygomatic anterior-to-posterior in-plane approach, infrazygomatic posterior-to-anterior in-plane approach, and the suprazygomatic out-of-plane approach.

Indication (Patient Selection)

Injection of local anesthetic, steroids, or glycerol at the trigeminal nerve and its branches may be indicated in patients who have failed pharmacological management or surgical interventions or those who are not candidates for surgical procedures or balloon decompression. A block may also be used to decrease facial pain in patients waiting for balloon decompression or surgical intervention for pathologies such as acoustic neuroma or chiari malformation.

Contraindications

Patients should not undergo the nerve block if they have an allergy to local anesthetic, or if they have an active infection or coagulopathy.

Functional Anatomy

(See also Chap. 8, Trigeminal Nerve Anatomy and Peripheral Branches Block)

The trigeminal ganglion (also known as the Gasserian ganglion) is situated within Meckel's cave in the middle cranial fossa. The trigeminal nerve gives rise to three branches: the ophthalmic (V1), maxillary (V2), and mandibular (V3). These branches exit the skull through foramina, the superior orbital fissure, the foramen rotundum, and the foramen ovale, respectively. The foramen rotundum opens into the posterior part of the pterygopalatine fossa (PPF), which is medial to the lateral pterygoid plate. Due to the connection of the PPF and the middle cranial fossa via the foramen rotundum, spread at the upper part of the PPF causes blockade of the trigeminal nerve. Because the space within the PPF is small, placing just 2 ml of contrast results in a retrograde passage in order to reach the middle cranial fossa. The PPF is a pyramidal-shaped space that contains the maxillary nerve (V2), maxillary artery, and sphenopalatine ganglion, and it communicates with the infratemporal fossa via the pterygomaxillary fissure. The boundaries of the PPF are the lateral pterygoid plate posteriorly, the maxillary bone anteriorly, and the orbital apex superiorly. The maxillary artery is tortuous and enters from the infratemporal fossa into the PPF from a posterior-anterior and lateral-medial course. It can be visualized on ultrasound as a deep structure within the PPF. Other contents of the PPF that will be blocked via this approach include the maxillary nerve and the afferent and efferent branches of the sphenopalatine ganglion. The PPF communicates with the foramen rotundum, supraorbital fissure, and vidian canal, which may account for the success of these blocks by way of local anesthetic spreading to the various branches of the trigeminal nerve.

Technique

There are three main approaches to ultrasound-guided trigeminal nerve blocks via the pterygopalatine fossa. The three will be described in detail below.

- Infrazygomatic Posterior-to-Anterior (In-Plane Approach)

  This approach was first described by Nader et al. in a prospective case series involving 15 patients with refractory facial pain. The patient is positioned in the lateral decubitus position with standard ASA monitors applied. The face is prepped and draped in a sterile fashion. The ultrasound is placed below the zygomatic process, superior to the mandibular notch, and anterior to the mandibular condyle (Fig. 9.1a). The zygomatic bone, the lateral pterygoid muscle, the lateral pterygoid plate, and the maxillary bone are identified using ultrasound. The superficial branches of the maxillary artery can be visualized anterior to the mandible using color Doppler (Fig. 9.1c). A 21-gauge 70–100 mm echogenic needle is inserted in-plane parallel to the transducer probe and advanced in a lateral-to-medial and posterior-to-anterior direction toward the pterygopalatine fossa (Fig. 9.1b). The needle will advance in-plane through the lateral pterygoid muscle and stop at the pterygopalatine fissure, typically located 4–5 cm below the surface of the skin and just above the lateral pterygoid plate. While dosing can vary, for the typical adult, 4 ml of 0.25–0.5% bupivacaine with 4 mg (1 ml) of dexamethasone can be injected. The procedure itself typically takes less than 5 min to complete.
- Infrazygomatic Anterior-to-Posterior (In-Plane Approach)

  Kampitak et al. describes an ultrasound technique using a curved probe for a selective maxillary (V2) nerve block using the lateral pterygoid plate (LPP) by way of the PPF. The PPF communicates with the infratemporal fossa via the pterygomaxillary fissure (PMF). The boundary of the PMF, the maxilla, and the lateral pterygoid plate (LPP) are used as anatomical landmarks for orientation during this ultrasound-guided maxillary nerve block. The goal is to find the PMF, which is the narrow gap between the infratemporal surface of the maxilla and the LPP.

  The ultrasound probe is first placed transversely below the zygomatic arch with identification of the maxillary tuberosity and LPP. The patient's mouth should be open to avoid shadowing by the coracoid process and the

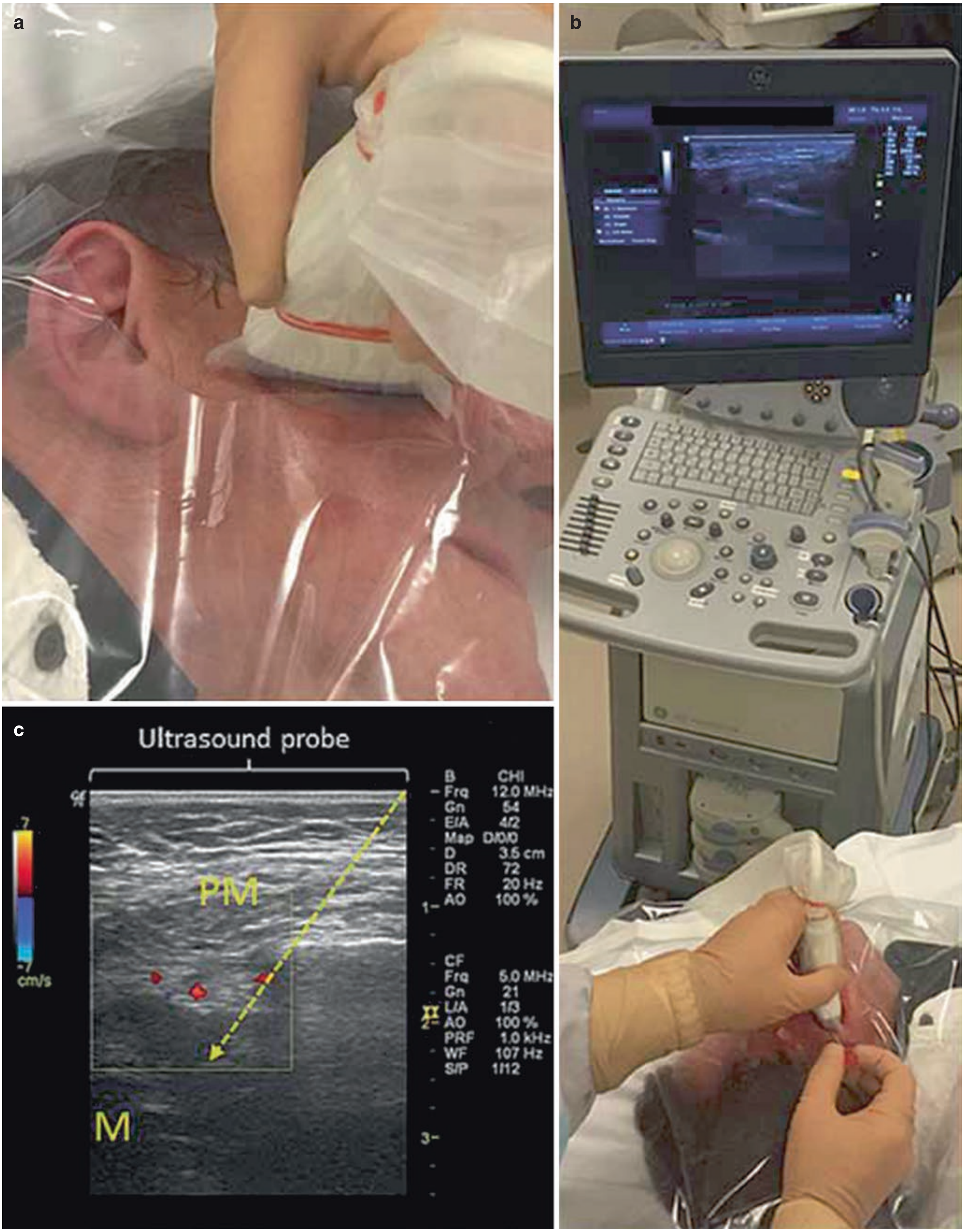

Fig. 9.1 (**a**) The ultrasound probe is positioned below the zygomatic arch with cephalad angulation in order to visualize the target area below the zygoma. (**b**) The needle is placed in-line with the transducer from lateral to medial. (**c**) The ultrasound image is a transverse view. Superficial branches of the maxillary and facial artery can be seen with Doppler. *Dashed line* needle trajectory, *PM* lateral pterygoid muscle, *M* Maxilla. (Reproduced with permission from Nader et al.)

mandible. The probe can be tilted from caudal to cranial direction to observe the boundary between the maxillary tuberosity and the LPP. At the bottom of the PMF, the LPP connects with the MT and appears to be a hyperechoic continuous line. By tilting the probe from caudal to cranial, one will see an interruption in this continuous line between the MT and LPP, which is the PPF or PMF opening. The needle injection point should be the uppermost part of the LPP.

The needle trajectory is anterior-to-posterior and lateral-to-medial, and in-plane with the ultrasound transducer. A 21-gauge 70–100 mm echogenic needle can be used and is advanced through the lateral pterygoid muscle until it contacts the anterior border of the lateral pterygoid plate. The needle is then withdrawn 1–2 mm and redirected medially into the PPF. Typically, just 3 ml of local anesthetic is needed for successful spread into the PPF.

- Suprazygomatic (Out-of-Plane)

Sola et al. describes a suprazygomatic out-of-plane approach, first utilized in children undergoing cleft palate repair. The ultrasound is placed below the zygomatic process over the maxilla at a 45° angle. A 21-gauge 70–100 mm echogenic needle is inserted perpendicular to the skin at the frontozygomatic angle above the zygomatic process, out-of-plane with the ultrasound. The needle is advanced until, typically around 20 mm in-depth, the needle tip contacts the great wing of the sphenoid (Figs. 9.2c and 9.3). The needle is withdrawn and directed caudally and posteriorly roughly 35–45 mm deep within the PPF. In Sola et al.'s study, 0.15 ml/kg of 0.2% ropivacaine was given, resulting in 70% of spread to the intermediate (anterior) part of the PPF and 22% deep in the PPF.

Complications

Each of the ultrasound-guided approaches has its limitations and potential complications. Both the anterior infrazygomatic and the suprazygomatic approaches involve making contact with the sphenoid bone, which can be particularly uncomfortable in an awake patient. Importantly, the parotid gland, facial nerve, and artery are superficial to the mandibular notch, and are in close proximity to the needle trajectory needed for the posterior infrazygomatic approach. In the suprazygomatic out-of-plane approach, the needle cannot be seen at the entry point and can only be seen once it passes below the zygoma. Without needle visualization at all times, injury to surrounding structures, including neurovascular structures, can occur. With all approaches, puncture of the maxillary artery is of concern. The risk of injury to the artery can be lessened by placing the needle tip beneath the lateral pterygoid muscle at the level of the pterygomaxillary fissure, which causes the muscle to indirectly force the spread of the injectate into the PPF.

The performance of the block may also be limited by patient comfort, and sedation may need to be given to the

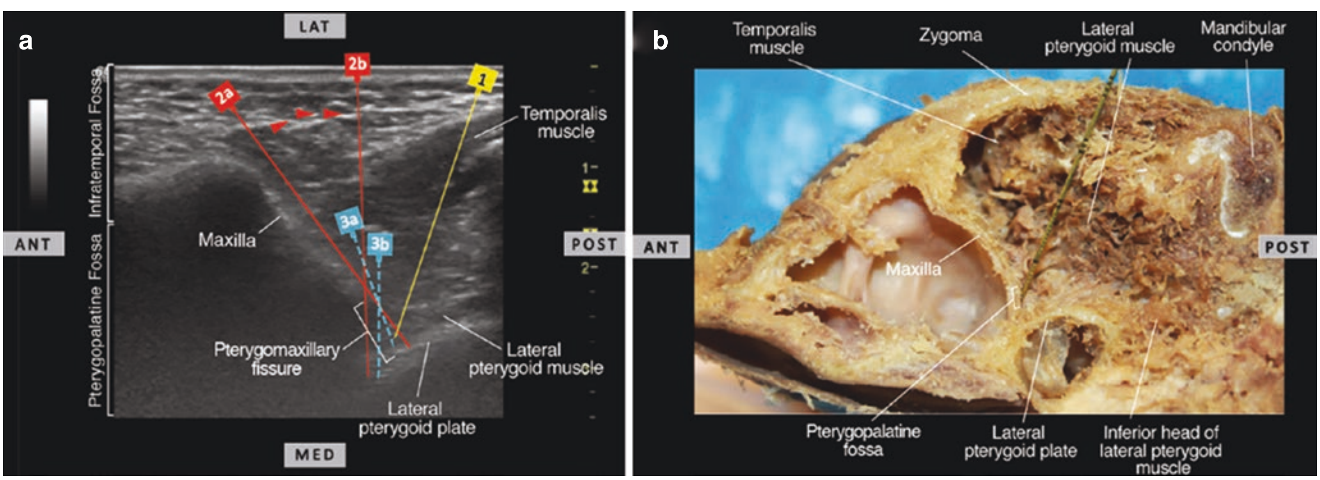

Fig. 9.2 (**a**) An ultrasound image comparing the three main approaches with anatomic landmarks. Yellow needle (1) is the posterior-to-anterior infrazygomatic approach, while the red needle (2) is the anterior infrazygomatic approach, with (2a) being the contact with the lateral pterygoid plate, followed by movement into the pterygopalatine fossa (2b). The blue needle represents the suprazygomatic approach, with (3a) representing the initial contact with the lateral pterygoid plate, followed by redirection towards the pterygopalatine fossa through the fissure (3b). (**b**) is an image of a cadaver skull with a needle demonstrating placement through the pterygoid muscle towards the pterygopalatine fossa. (Reproduced with permission from Nader et al.)

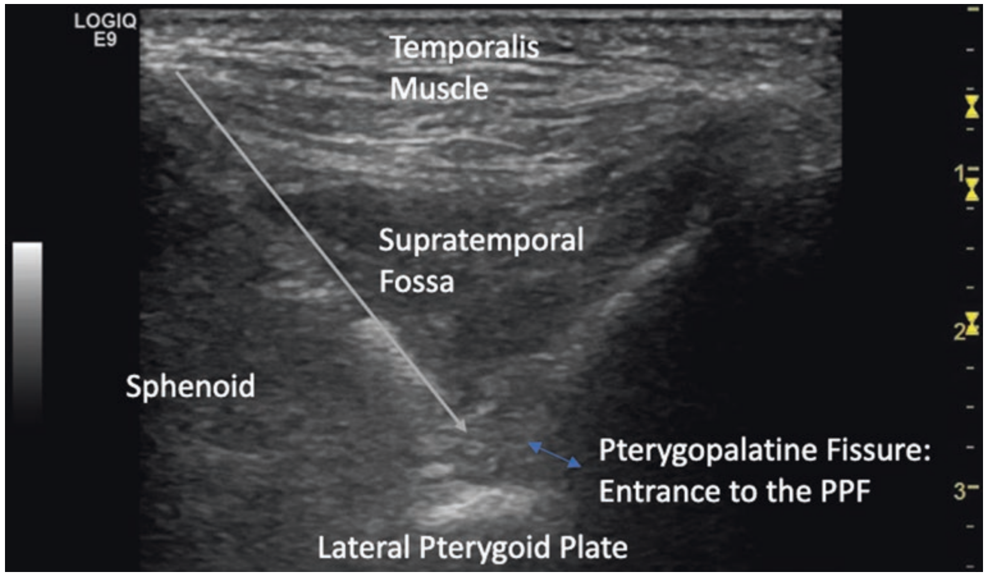

Fig. 9.3 Demonstrates a suprazygomatic approach to maxillary nerve block, with the needle (represented by the gray arrow) directed toward the pterygopalatine fissure, which is the entrance to the PPF. The maxillary nerve rests deep in the PPF

patient in order to tolerate the procedure. Furthermore, the procedure should be completed while monitoring the patient's heart rate, blood pressure, and pulse oximetry, as the procedure may induce an autonomic response of the trigeminal-vagal nerve reflex.

Practical Tips (How to Improve Success and Avoid Complications)

In order to improve the angle of insonation, the transducer probe can be placed closer (just anterior) to the mandibular condyle. Additionally, to avoid the acoustic shadow of the coronoid process, you can ask the subject to slightly open their mouth while directing the transducer probe in a slightly superior direction.

Literature Review

Trigeminal neuralgia is typically a neuropathic chronic pain syndrome that affects the maxillary branch (V2) of the trigeminal nerve. Patients typically describe a unilateral, electric shock-like, sensation that is often provoked by light touch. Medical therapy with antiepileptics drugs (such as carbamazepine) can be ineffective in up to 10% of patients. For refractory trigeminal neuralgia or atypical facial pain, workup by a neurologist to rule out brain tumors, multiple sclerosis, vascular anomalies, or other secondary causes of pain is important. Evidence suggests that vascular compression of the trigeminal nerve root is associated with symptoms in roughly 95% of patients, and microvascular decompression by a neurosurgeon may be helpful in relieving symptoms. While the exact pathophysiology of vascular compression of the trigeminal nerve leading to symptoms is unknown, the "ignition hypothesis" suggests that the neuropathic pain is due to abnormalities or injury of trigeminal afferent neurons in the trigeminal root that leaves the axons hyperexcitable and leads to synchronized electrical activity manifesting as pain.

The traditional approach to maxillary (V2) blockade of the trigeminal nerve was via a landmark approach by entering the PPF and advancing until paresthesia in the V2 distribution was felt by the patient. Alternative non-ultrasound approaches include using fluoroscopic guidance to target the LPP and redirecting off the bone, confirming that the spread of injectate did not spread intravascularly. This approach is limited by the use of bony landmarks that are often difficult to visualize and difficulty avoiding vascular structures. The use of ultrasound guidance for trigeminal nerve block includes better visualization of soft tissues, vasculature, needle placement, and direct observation of injectate spread. A review of the literature supporting each of the different block approaches is included below:

- Infrazygomatic Posterior-to-Anterior (In-Plane Approach)

  Literature supporting the infrazygomatic posterior-to-anterior approach stems largely from a prospective case series from Nader et al. in which 15 patients (14 of which had pain symptoms refractory to medical or surgical treatment) underwent a nerve block using the infrazygomatic posterior-to-anterior approach using 5 ml of 0.25% bupivacaine and steroid. All of the patients achieved complete sensory analgesia to pinprick sensation in the V2 distribution, while 80% achieved complete sensory analgesia in all three distributions of the trigeminal nerve within 15 min of the injection. Two-thirds of the patients reported good or excellent pain relief throughout the duration of the 3-month study. There were no reports of local anesthetic toxicity or new neurologic sequelae. Of the 15 patients, 14 required repeated injections, with three blocks as the median number of injections necessary to provide sustained relief.

- Infrazygomatic Anterior-to-Posterior (In-Plane Approach)

  This approach is intended for targeted maxillary nerve (V2) blockade. The maxillary nerve is a sensory branch of the trigeminal nerve that gives rise to multiple branches, including the palatine, zygomatic, nasopalatine, superior alveolar, and pharyngeal nerves. An alternative approach to a selective V2 nerve blockade via ultrasound includes an entry point within the oral cavity, which can make direct visualization of the block needle very difficult and is associated with serious complications, such as intravascular injection and infraorbital nerve injury. Some would argue that the using the anterior-to-posterior trajectory rather than the posterior-to-anterior approach previously described helps to avoid the needle pathway going through branches of the facial nerve and the parotid gland. Limitations of using this approach may include sparing of the infraorbital nerve, which in dye studies failed to be stained in 20% of cadavers.

- Suprazygomatic (Out-of-Plane Approach)

  The suprazygomatic out-of-plane approach has typically been described in pediatric patients undergoing cleft lip repair. A prospective randomized double-blind study of pediatric patients receiving bilateral suprazygomatic maxillary nerve block for cleft palate repair showed reduced total consumption of morphine at 48 h postoperatively. Furthermore, completing the block was considered easy by the anesthesiologist in 94% of cases with median time to completion at 56 s. This suggests that this allows good visualization of the pterygopalatine fossa and of the local spread. Ultrasound images obtained during this approach showed that 70% of the local anesthetic solution spread into the intermediate part of the pterygopalatine fossa. Additionally, because the maxillary artery is located in the anterior part of the pterygopalatine fossa while the needle trajectory has a more caudal inclination, vascular puncture risk is low.

Conclusion

The use of ultrasound-guided trigeminal nerve blocks provides a safe alternative for patients with trigeminal neuralgia or atypical facial pain who have failed surgical or medical management. This chapter aimed to identify three main techniques in order to achieve trigeminal nerve blockade using ultrasound visualization. Ultrasound use is relatively simple, free of radiation, and generally safe. The use of ultrasound imaging can assist with delineating surrounding bony structures, the PPF, and vascular structures, even though the identification of actual nerves is not possible. Therefore, understanding of anatomical landmarks under ultrasound is important for safe use in clinical practice.

Traditional Techniques

Block of the Main Trunk of Maxillary Nerve and Pterygopalatine Ganglion in the Pterygopalatine Fossa (PPF)

Functional Anatomy

The maxillary nerve emerges from the skull through the round foramen. It connects with the pterygopalatine (sphenopalatine) ganglion (PPG) in the pterygopalatine fossa (PPF) (see Chap. 8; Trigeminal Nerve Anatomy and Peripheral Branches Block, Figs. 8.4 and 8.5). The nerve and ganglion are responsible for sensory and autonomic supply to the central area of the face and head. The PPG, which lies in the PPF, is triangular in shape; extending to ca. 5 mm; it is the largest neuronal conglomerate outside of the brain. The ganglion has three types of nerve fibers and is connected to the trigeminal nerve via sensory fibers. It is linked to the facial nerve, internal carotid plexus, and superior cervical ganglion via sympathetic fibers; the motor fibers have parasympathetic (visceromotor) connections. There is also direct contact between the anterior horn of the spinal cord and the neurohumoral axis (adenohypophysis).

Indications

Diagnostic

1. Differential diagnosis of facial pain.

Therapeutic

1. Trigeminal neuralgia in the second branch, post-herpetic neuralgia.
2. Cluster headache, histamine headache, Sluder's neuralgia
3. Facial pain in the area of supply.
4. Pain in the eye region (iritis, keratitis, corneal ulcer), root of the nose, upper jaw and gums.
5. Postoperative pain in the area of the maxillary sinus and teeth.
6. Pain after dental extraction.

Neural Therapy

1. Allergic coryza.
2. Diseases of the oral mucosa.
3. Localized paresthesias.

Contraindications

Anticoagulant treatment (see Chap. 1), local infection and skin disease.

Procedure

These blocks should only be carried out only with appropriate experience. It is absolutely necessary to have a detailed discussion with the patient before the procedure.

Preparations and Materials

Check that the emergency equipment is complete and in working order. Sterile precautions.

Intravenous access. 22-G needle (4 cm) for the intraoral technique, 23-G needle (5–6 cm) for the extraoral technique. Disinfectant, spatula for the intraoral technique, compresses, cooling element available, emergency drugs.

Intraoral Technique

Patient Positioning and Landmarks

The patient should be sitting, leaning back slightly and with the head tilted back.

Posterior edge of the *upper seventh tooth (second maxillary molar)* (Fig. 9.4).

Technique

Using a 22-G needle (4 cm), the puncture is made medial to the posterior edge of the upper seventh tooth (second maxillary molar) through the greater palatine foramen. The needle is introduced at an angle of about 60°. The vicinity of the ganglion is reached at a depth of 3.5–4 cm. The greater palatine canal is about 3.4 cm long in adults. After careful aspiration at various levels, the local anesthetic is injected (Fig. 9.5).

Fig. 9.4 Intraoral technique: orientation. (Reproduced with permission from Danilo Jankovic)

Fig. 9.5 Intraoral block of the pterygopalatine ganglion. (Reproduced with permission from Danilo Jankovic)

Dosage

1–2 ml local anesthetic—e.g., 0.75% ropivacaine, 0.5% bupivacaine (0.5% levobupivacaine).

Extraoral Technique

- Suprazygomatic Technique

  Injection above the zygomatic arch is more comfortable for the patient.

Patient Positioning and Landmarks

Sitting, with face to the side and with the mouth slightly opened. Alternative: supine.

Center of the upper margin of the zygomatic arch.

Technique

A skin injection is made directly above the middle of the zygomatic arch. A 23-G, 5–6 cm long needle is introduced at an angle of ca. 45° in the direction of the pterygopalatine fossa (*contralateral molar teeth*) (Fig. 9.6). After the weak paresthesias have been elicited in the area of the nostril, the upper lip, and the cheek, the needle is withdrawn slightly and aspirated carefully at various levels, and the local anesthetic is administered slowly in several small doses. Repeated aspiration at various levels must be carried out during this procedure.

Fig. 9.6 Orientation for injections above the zygomatic arch. (Reproduced with permission from Danilo Jankovic)

Separate blocking of the maxillary nerve and pterygopalatine region is rarely possible with this method.

- Infrazygomatic Technique

Patient Positioning and Landmarks

Supine or sitting, face to the side with the mouth slightly open. *Mandibular fossa.*

Technique

The most important requirement for carrying out this block successfully is accurate location of the mandibular fossa between the condylar and coronoid processes of the mandible. It is helpful for the patient to open and close the mouth. After skin infiltration, a 23-G, 5–6 cm needle is introduced at an angle of 45° in the direction of the back of the eyeball (Fig. 9.7). After ca. 4–4.5 cm, the lateral part of the pterygoid process is reached and the needle is withdrawn slightly and lowered into the pterygopalatine fossa (about 0.5 cm medial to the pterygoid). After the weak paresthesias described above have been elicited and after careful aspiration at various levels, the local anesthetic is carefully injected in several small doses. If pain occurs in the region of the orbit, the procedure should be stopped.

The area supplied by the maxillary nerve is shown in Fig. 9.19.

Dosage

Diagnostic

3 ml local anesthetic—e.g., 0.5% prilocaine, mepivacaine, lidocaine.

Fig. 9.7 Extraoral technique beneath the zygomatic arch (mandibular fossa). (Reproduced with permission from Danilo Jankovic)

Therapeutic

Extraorally: 3–5 ml local anesthetic—e.g., 0.2–0.5% ropivacaine, 0.25–0.5% bupivacaine (0.25–0.5% levobupivacaine). In acute conditions, with corticosteroids added.

Surgical

Extraorally: 5–7 ml local anesthetic—e.g., 0.5–0.75% ropivacaine, 0.5% bupivacaine (0.5% levobupivacaine), 1% prilocaine, 1% mepivacaine.

Block Series

A sequence of six to eight blocks is recommended for the extraoral technique.

Side Effects

- Transient visual weakness (extremely rare).
- Horner's syndrome, extremely rare and usually with higher doses. There are connections with the superior cervical ganglion via the pterygoid canal, deep petrosal nerve, and greater superficial petrosal nerve (see Chap. 12, Superior Cervical Ganglion Block).
- Hematoma in the cheek or orbital cavity due to blood vessel puncture. Immediate outpatient treatment: alternating ice pack and heparin ointment, depending on the spread

of the hematoma, for ca. 1 h. This can be continued at home, with the patient also taking coated Reparil® tablets (sodium aescinate) if appropriate. Resorption of the hematoma, which is harmless but visually uncomfortable for the patient, occurs within 2 weeks at the most.

Complications

- Intravascular injection (maxillary artery and maxillary vein) (See Chap. 8, Figs. 8.4 and 8.5); Chaps. 1 and 5 (Local Anesthetic Systemic Toxicity)
- Epidural or subarachnoid injection

Both of these complications are extremely rare. Immediate treatment: (See Chap. 41, Neuraxial Blocks: Spinal and Epidural Anesthesia; Complications, p. 604.)

Nasal Block of the Pterygopalatine Ganglion

Indications

Greenfield Sluder drew attention to the significance of this ganglion as long ago as 1903. In 1918, he described a number of symptoms capable of being treated by injection or topical application of a local anesthetic or cocaine, with the associated anesthesia of the pterygopalatine ganglion: headache; pain in the eyes, mouth, or ears; lumbosacral pain, arthritis, glaucoma, and hypertension. Similar observations were reported by Ruskin, Byrd and Amster. More recent studies have shown that nasal local anesthesia of the ganglion can be used with good success rates in the treatment of:

1. Acute migraine.
2. Acute or chronic cluster headache.
3. Various types of facial neuralgia.
4. Tumor pain in the nasal and pharyngeal area.
5. Post-dural puncture headaches.

Procedure

Materials (Fig. 9.8)

2 ml syringe, plastic part of a plastic indwelling catheter (for self-administration in tumor pain), nasal speculum, applicators (cotton buds).

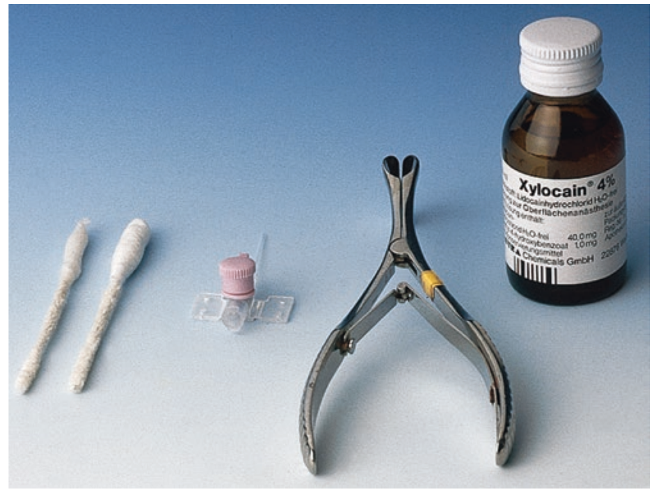

Fig. 9.8 Materials. (Reproduced with permission from Danilo Jankovic)

Fig. 9.9 Nasal application. (Reproduced with permission from Danilo Jankovic)

Patient Positioning

Supine or sitting, with head tilted back.

Application

An applicator, preferably a cotton bud, soaked in local anesthetic—e.g., 2% lidocaine gel or a 4% aqueous lidocaine solution—is carefully advanced along the inferior nasal concha as far as the posterior wall of the nasopharynx (Fig. 9.9) and left in place for 20–30 min (Fig. 9.10). In patients with cancer pain, the plastic part of a plastic indwelling catheter can be advanced as far as possible into the nasal cavity, and the local anesthetic—e.g., 0.5% bupivacaine—can be instilled with a 2 ml syringe. The block can be carried out bilaterally.

To prevent trauma, the applicator should not be advanced forcefully if resistance is encountered.

Dosage

- Local anesthetics: 2% lidocaine gel, 1.5–2 ml 4% lidocaine (aqueous solution) or 1.5–2 ml 0.5% bupivacaine (0.5% ropivacaine). Disadvantage: the onset of effect is slightly slower.

Fig. 9.10 The anesthetic should be allowed 20–30 min to take effect. (Reproduced with permission from Danilo Jankovic)

- 10% cocaine: at a dosage of 0.2–0.4 ml, there is no reason to fear adverse CNS effects. Advantage: very fast onset of effect.

If the recommended doses are used, there is no difference between these substances with regard to effectiveness and resorption.

Block Series

In acute pain, one or two applications are recommended. In chronic conditions, one to three applications can be given over a period of up to 3 weeks. In cancer pain, applications may be indicated three times per day over a longer period.

Side Effects

The method is not very invasive and has minimal side effects. Effects that may occur include: a sense of pressure in the nose, sneezing, short-term lacrimation due to irritation of branches of the lacrimal gland, a bitter taste, and slight numbness in the oral and pharyngeal cavity.

Complications

Very occasionally, toxic effects may occur as a result of absorption of the local anesthetic into very well-vascularized tumor tissue. In long-term treatments, erosions may sometimes lead to spinal absorption of the local anesthetic. To prevent this, periodic rinsing with a physiological saline solution can be carried out.

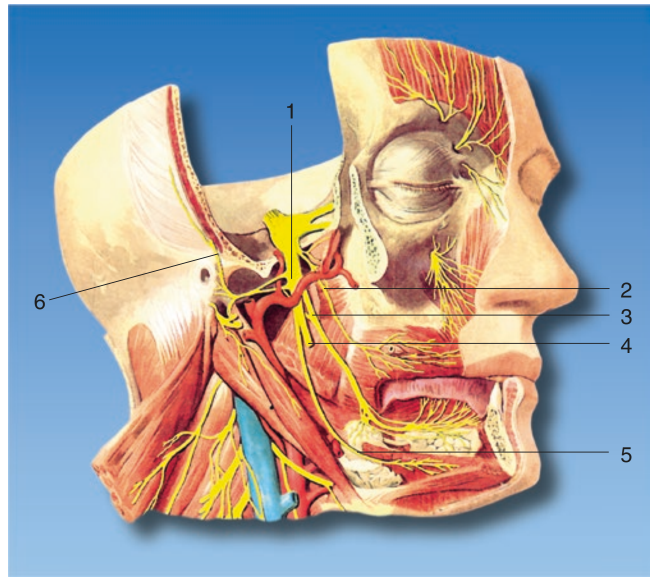

Fig. 9.11 Distribution areas of: (*1*) mandibular nerve; (*2*) buccal nerve; (*3*) lingual nerve; (*4*) inferior alveolar nerve; (*5*) mental nerve; (*6*) auriculotemporal nerve. (Reproduced with permission from Danilo Jankovic)

Block of the Mandibular Nerve and Otic Ganglion in the Infratemporal Fossa

Functional Anatomy

After passing through the oval foramen, the mandibular nerve forms a short, thick nerve trunk, with the otic ganglion lying on the medial side of it. Its most important branches are the buccal nerve, lingual nerve, inferior alveolar nerve, mental nerve, and auriculotemporal nerve (Fig. 9.11). See also Chap. 8; Trigeminal Nerve Anatomy and Peripheral Branches Block.

Indications

Diagnostic

1. Differential diagnosis of trigeminal neuralgia (anterior two-thirds of the tongue) and glossopharyngeal neuralgia (posterior third of the tongue).

Therapeutic

1. Tinnitus (the otic ganglion has connections with the chorda tympani, the nerves of the pterygoid canal, and the medial pterygoid nerve).
2. Trigeminal neuralgia in the third branch.
3. Trismus after dental extraction.

4. Dental surgery and maxillary surgery (higher dosages required).
5. Temporomandibular joint dysfunction syndrome (in collaboration with an orthodontist), if infiltration of the trigger points of the temporalis muscle, lateral pterygoid muscle and masseter muscle is unsuccessful.

Contraindications

Anticoagulant treatment (see Chap. 1), local infection, and skin disease in area of injection.

Procedure

This block should only be carried out only with appropriate experience. It is absolutely necessary to have a detailed discussion with the patient before the procedure.

Preparation and Materials

Check that the emergency equipment is complete and in working order. Sterile precautions.

Intravenous access. 23-G needle (5–6 cm), compresses, cooling element available, emergency drugs.

Patient Positioning and Landmarks

Supine, with face to the side. *Mandibular fossa, zygomatic arch, tragus* (the needle insertion point lies ca. 2 cm laterally (Fig. 9.12).

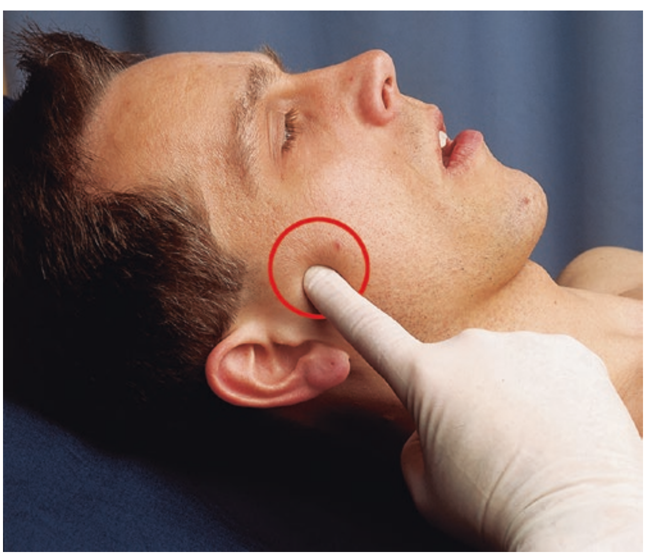

Fig. 9.12 The most important requirement is that the mandibular fossa should be identified precisely. It lies between the condylar process and the coronoid process of the mandible and is easiest to localize when the patient opens and closes his or her mouth. (Reproduced with permission from Danilo Jankovic)

Fig. 9.13 Needle insertion technique: the needle is directed at an angle of 90°. (Reproduced with permission from Danilo Jankovic)

Technique (Fig. 9.13)

Paresthesias in the lower jaw region, lower lip and lower incisors occur when the needle reaches a depth of ca. 4–4.5 cm. After paresthesias have clearly developed, the needle is withdrawn slightly, aspirated carefully at various levels and the local anesthetic is slowly injected in several small doses. Aspiration should be repeated several times at different levels as this is done. There is a delayed onset of the desired effect in the area of the auriculotemporal nerve.

Practical Tips

If contact is made with the pterygoid process when the needle is being introduced, withdraw the needle 0.5–1 cm and redirect dorsally.

Distribution of the Block

The area supplied by the mandibular nerve is shown in Fig. 9.21. The otic ganglion which lies directly under the oval foramen, is always anesthetized along with the nerve. (See Chap. 8, Trigeminal Nerve Anatomy and Peripheral Branches Block, Fig. 8.6),

Dosage

Diagnostic

3 ml local anesthetic—e.g., 5% prilocaine, mepivacaine, lidocaine.

Therapeutic

3–5 ml local anesthetic—e.g., 0.5% ropivacaine, 0.25% bupivacaine (0.25% levobupivacaine). In acute conditions, with corticosteroids added.

Surgical

5–7 ml local anesthetic—e.g., 0.75% ropivacaine, 0.5 bupivacaine (0.5% levobupivacaine), 1% prilocaine, 1% mepivacaine, 1% lidocaine.

Block Series

A series of six to eight blocks is recommended. When there is evidence of symptomatic improvement, further blocks can also be carried out.

Side Effects

- Transient facial paralysis caused by injecting too superficially.
- Hematoma in the cheek due to vascular puncture. These harmless hematomas can take up to 2 weeks to resolve. Immediate treatment: see the section on blocks of the maxillary nerve and pterygopalatine ganglion.

Complications

- Intravascular injection (middle meningeal artery and maxillary artery) (see Chap. 8; Figs. 8.4 and 8.5; Chaps. 1 and 5 Local Anesthetic Systemic Toxicity)
- Epidural or subarachnoid injection. Immediate treatment: see Chap. 41 Neuraxial Blocks: Spinal and Epidural Anesthesia; Complications, p. 604.

Gasserian Ganglion Block (Fluoroscopic or CT-Guided)

Functional Anatomy

The trigeminal ganglion (semilunar ganglion, Gasserian ganglion) lies on the dorsal surface of the petrous bone. The intracranial Gasserian ganglion lies medially in the middle cranial fossa, lateral to the cavernous sinus, internal carotid artery and cranial nerves III–VI, and posterior and superior to the oval foramen, through which the mandibular nerve exits from the intracranial cavity Fig. 9.14; See also Chap. 8, Figs. 8.1 and 8.2). All of these structures can be injured when the ganglion is blocked. The average size of the ganglion is ca. 1–2 cm. Part of the ganglion (the posterior two-thirds) is located within the trigeminal cave (Meckel cavity), a duplication of the dura that encloses the ganglion. The oval foramen is a channel ca. 5 mm long and its largest diameter is ca. 8 mm.

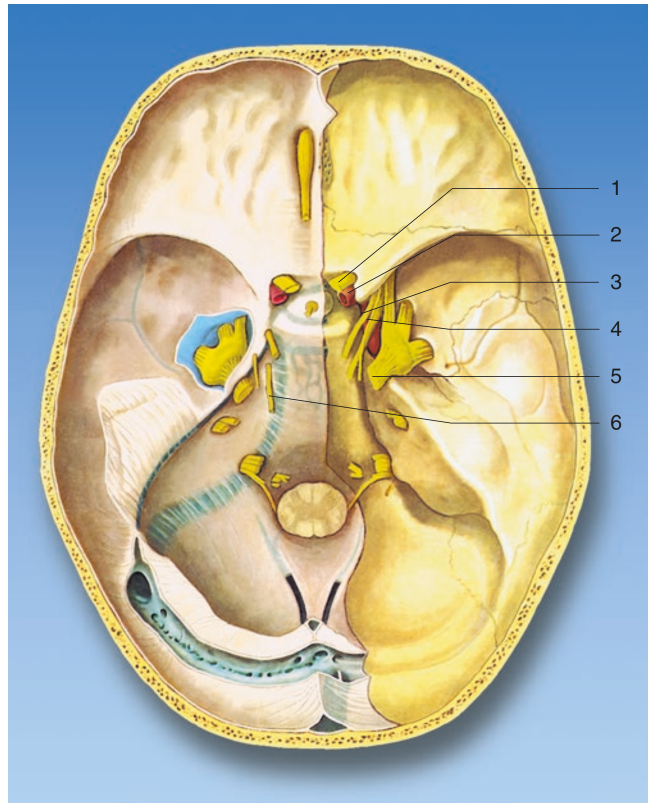

Fig. 9.14 The trigeminal ganglion and the neighboring cranial nerves and internal carotid artery. (*1*) Optic nerve, (*2*) internal carotid artery, (*3*) oculomotor nerve, (*4*) trochlear nerve, (*5*) trigeminal nerve, (*6*) abducent nerve. (Reproduced with permission from Danilo Jankovic)

Indications

1. Local Anesthetics.
   Diagnostic, before neurodestructive procedures.
2. Neurodestructive Procedures.

Neurodestructive methods—particularly radiofrequency lesions of the ganglion, and more rarely glycerol rhizolysis, alcohol injection, corticosteroid injection, or balloon compression of the ganglion—are used in pain conditions that are unbearable and cannot be influenced using other conservative measures:

1. Cancer pain.
2. Trigeminal neuralgia.
3. Cluster headache.

4. Intractable pain in the eye region.
5. Postherpetic neuralgia.

Contraindications
Local infection, sepsis, hemorrhagic diathesis, anticoagulation treatment (see Chap. 1) significantly increased intracranial pressure.

Procedure
This block should only be carried out by highly experienced specialists. A very good knowledge of anatomy, manual skill, radiographic guidance when conducting the procedure, and strictly aseptic conditions are required. It is necessary to have a detailed discussion with the patient before the procedure.

Premedication
This method is painful, and preoperative administration of 0.05 mg fentanyl is therefore recommended.

Preparations
The completeness and functioning of the emergency equipment should be checked. Sterile precautions. Intravenous access, ECG monitoring, ventilation facilities, pulse oximetry.

Materials
Sterile precautions. A fine 22-G spinal needle 8 cm long, 2-ml and 5-ml syringes,

disinfectant, sterile compresses, emergency medication, intubation kit, and cooling element should be ready to hand.

Patient Positioning
Supine; the head is raised with a cushion.

Landmarks (Figs. 9.15a, b)
- Medial edge of the masseter muscle, ca. 3 cm lateral from the angle of the mouth at the level of the second molar tooth.
- Ipsilateral pupil.
- Center of the zygomatic arch and articular tubercle (external acoustic meatus).

Procedure
The following should be noted during puncture:

- The operator should stand on the side on which the block is being carried out.
- Fluoroscopic (or CT) guidance for the puncture is indispensable.
- An intraoral location should be excluded after introduction of the needle (risk of contamination).

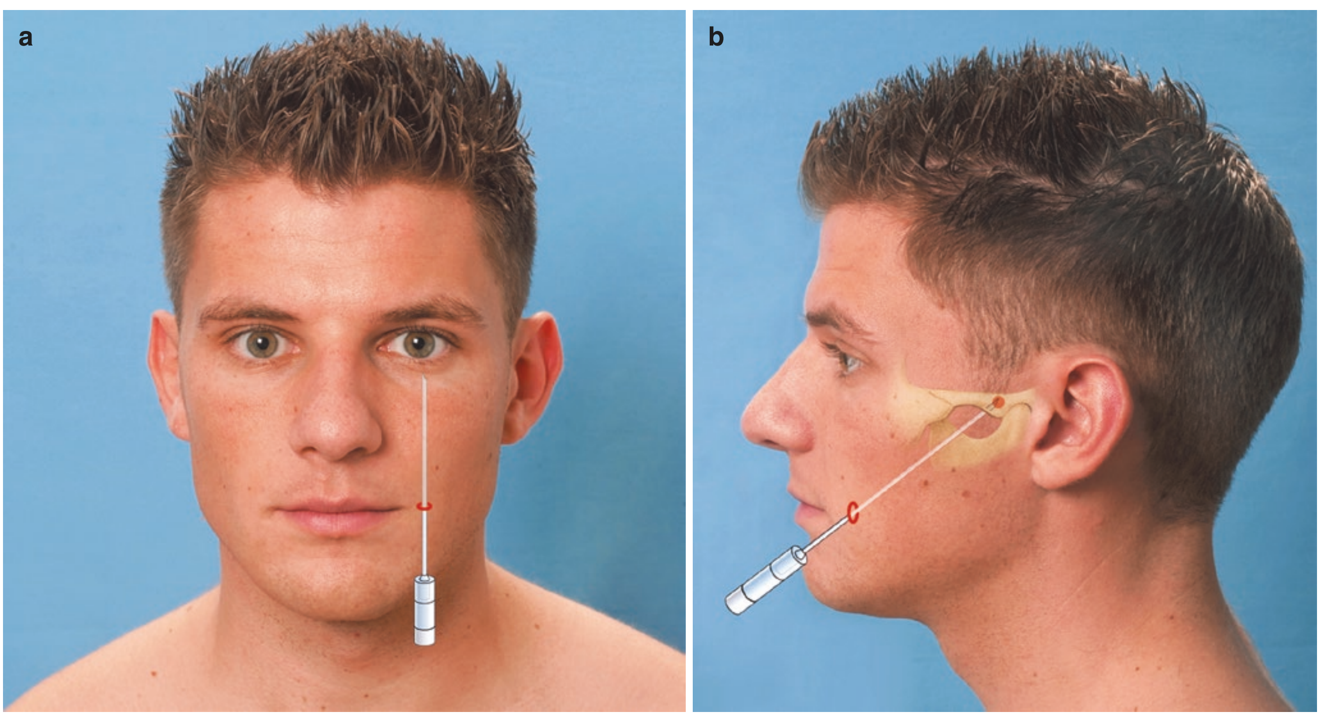

Fig. 9.15 (**a**, **b**) Landmarks: medial edge of the masseter muscle, ipsilateral pupil, center of the zygomatic arch. (Reproduced with permission from Danilo Jankovic)

- There is a risk of perforating the dural cuff (subarachnoid injection).
- Frequent aspiration and fractionated injection of the smallest possible fractions (blood, CSF?).

Technique

Local anesthesia at the needle insertion site is carried out ca. 3 cm from the angle of the mouth (medial edge of the masseter muscle). The patient is asked to gaze straight ahead and focus on a marked point on the wall. The needle should be directed toward the forward-gazing pupil when seen from the front and toward the articular tubercle of the zygomatic arch or external acoustic meatus when viewed from the side (Fig. 9.15a, b).

The needle is then introduced at the level of the second molar tooth, through the previous skin injection in the direction indicated. An intraoral location of the needle must be excluded (risk of contamination). After 4.5–6 cm, bone contact should be made (infratemporal surface of the large wing of the sphenoid bone, directly in front of the upper boundary of the oval foramen; (Fig. 9.16)). The needle is now withdrawn slightly, and the path to the oval foramen ca. 1–1.5 cm away from the first bone contact is probed millimeter by millimeter by advancing and withdrawing the needle. If the tip of the needle is located in the oval foramen, the patient will report pain and paresthesias in the area of distribution of the mandibular nerve (mandible). The needle is now slowly advanced for a further 0.5–1 cm. A small test dose of 0.1–0.2 ml local anesthetic is carefully administered. The remaining dose of 1–1.5 ml is injected in small fractions with constant aspiration. Particular attention should be given to possible subarachnoid or intravascular positioning of the needle. The sensory distribution of the block is shown in Fig. 9.17.

Dosage

1–2 ml local anesthetic—e.g., 1% lidocaine, 0.5–0.75% ropivacaine, or 0.5% bupivacaine.

Complications

1. Subarachnoid injection (total spinal anesthesia)
   Immediate measures: See Chap. 41, Neuraxial Blocks: Spinal and Epidural Anesthesia; Complications, p. 604.
   Important prophylactic measures:
   - Very good knowledge of anatomy
   - Precise execution of the procedure (radiographic guidance)
   - Careful dosage

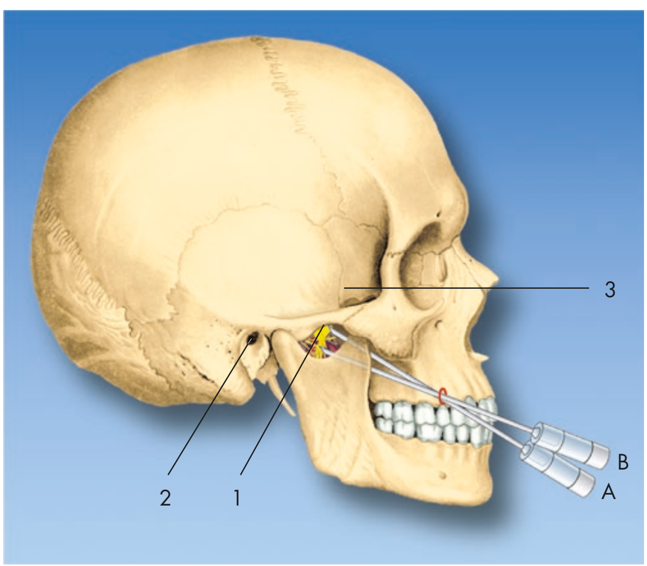

Fig. 9.16 Injection point (level of the second molar tooth). Needle position *A*: bone contact—infratemporal. Needle position *B*: entrance into the oval foramen. (*1*) Zygomatic arch, (*2*) external acoustic pore, (*3*) temporal fossa. (Reproduced with permission from Danilo Jankovic)

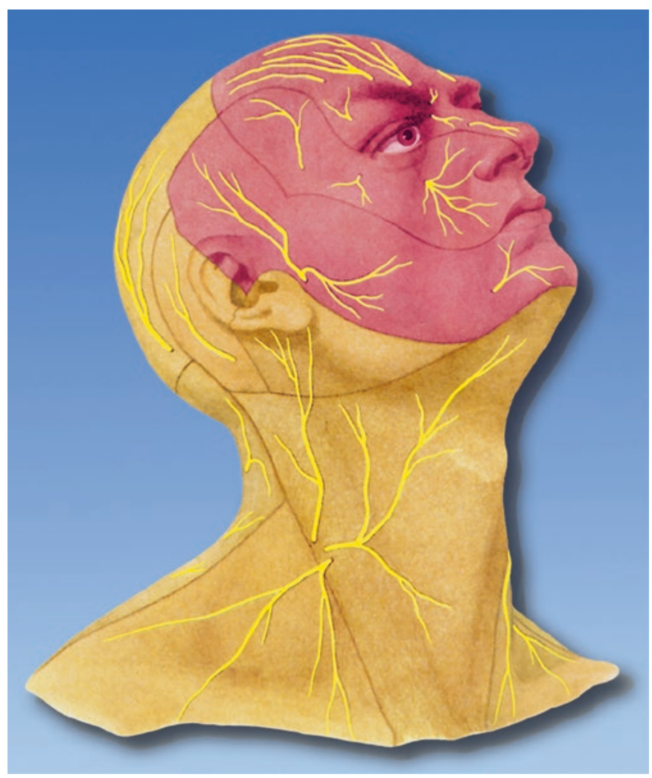

Fig. 9.17 Sensory deficit after blocking of the trigeminal ganglion. (Reproduced with permission from Danilo Jankovic)

- Constant aspiration and injection in the tiniest fractions of 0.1 ml local anesthetic (several test doses)
- No time pressure

2. Intravascular injection.
   Intravascular injection (middle meningeal artery) is always possible (in this highly vascularized region).
3. Hematoma in the cheek or orbit due to vascular puncture.
4. Transient visual weakness or blindness.
   Optic nerve; extremely rare.

Trigeminal Nerve: Comparison of Analgesia Zones

Figures 9.17, 9.18, 9.19, 9.20, 9.21, and 9.22 provide schematic illustrations of the areas supplied by the individual nerves. During blocks, the anesthetic spread may overlap.

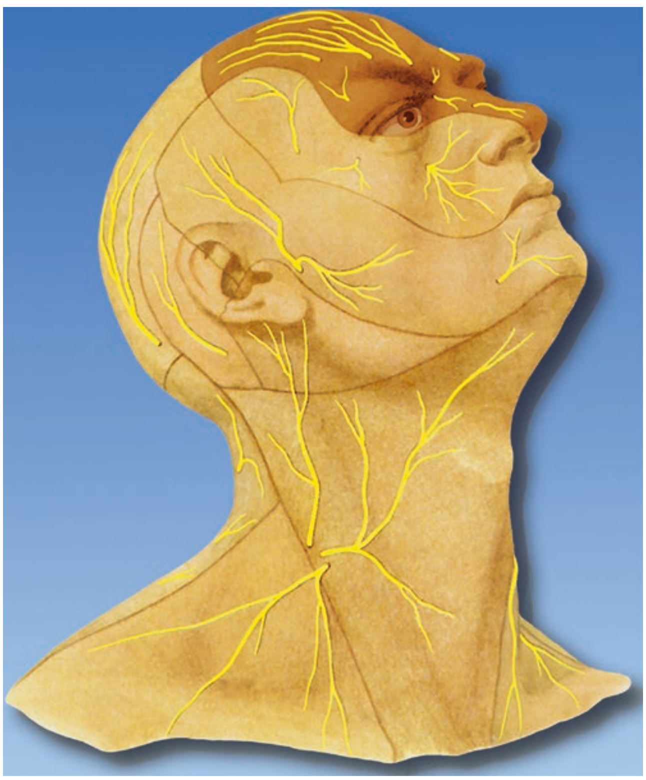

Fig. 9.18 Ophthalmic nerve. (Reproduced with permission from Danilo Jankovic)

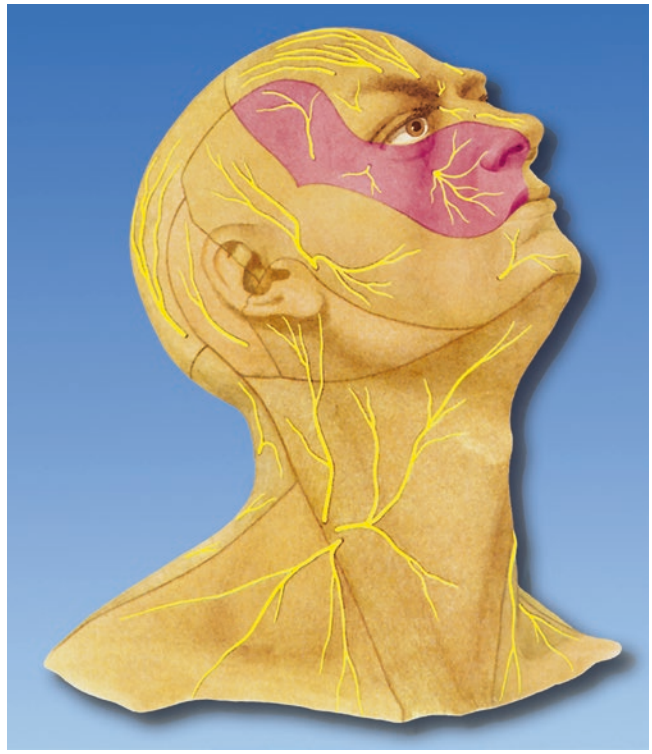

Fig. 9.19 Maxillary nerve. (Reproduced with permission from Danilo Jankovic)

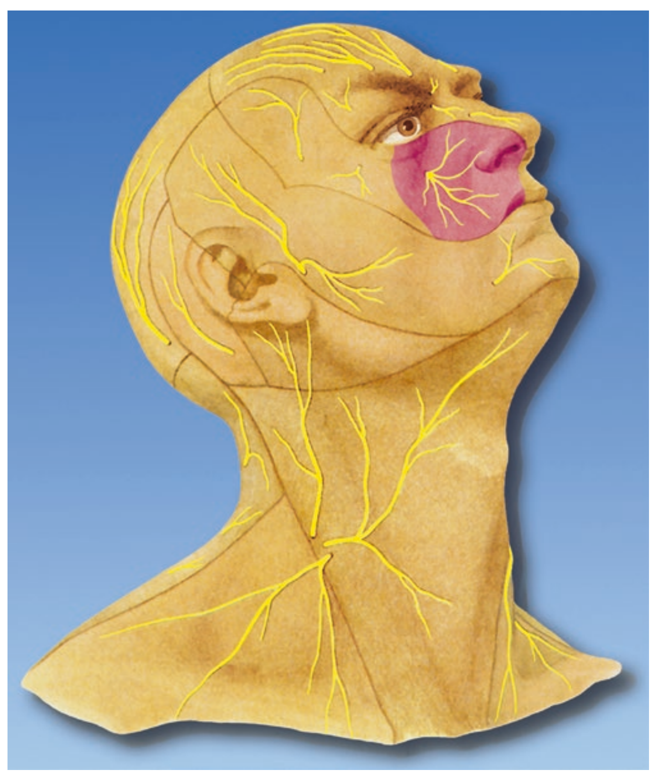

Fig. 9.20 Infraorbital nerve. (Reproduced with permission from Danilo Jankovic)

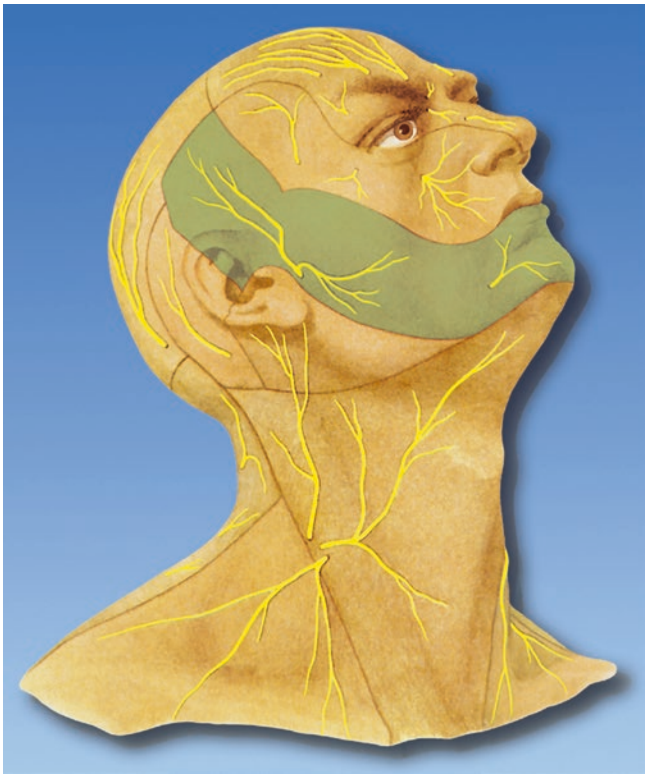

Fig. 9.21 Mandibular nerve. (Reproduced with permission from Danilo Jankovic)

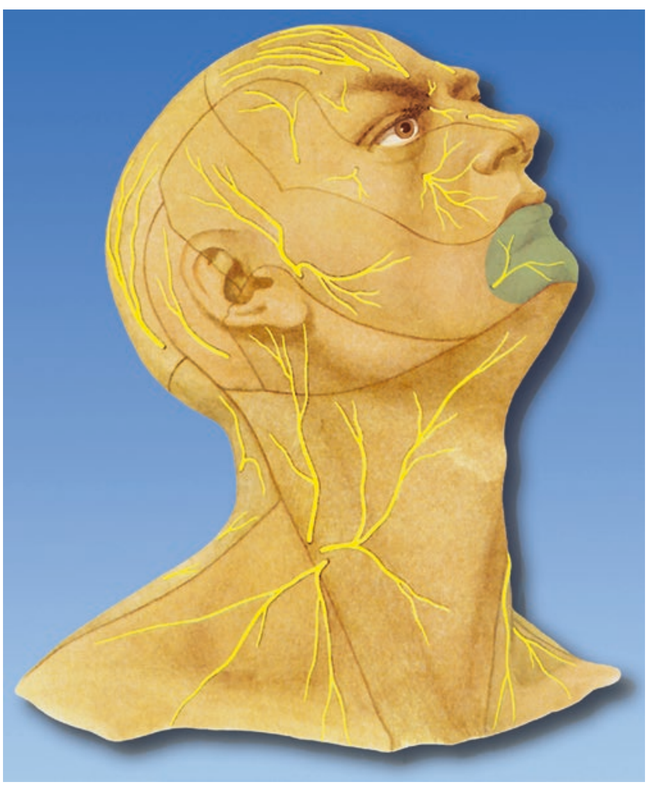

Fig. 9.22 Mental nerve. (Reproduced with permission from Danilo Jankovic)

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