



Trigeminal Ganglion Block, Trigeminal Ganglion Radiofrequency Ablation and Percutaneous Balloon Compression

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Equipment and Monitoring

- Standard ASA monitoring
- CPR equipment and medications available
- Fluoroscopy
- Sterile prep, and drape
- Local anesthesia prior to any needle larger than 25G (unless sedation is used)
- Coaxial view is always used to advance needle, unless otherwise specified
- Moderate sedation
- 22–25G, 3.5 inch (90 mm) needle, tip curved to facilitate steering
- Nonionic contrast
- Preservative-free local anesthetic
- Extension tubing
- 22G, 100–145 mm, 2–5 mm active tip radiofrequency cannula for radiofrequency ablation (RFA)
 - Grounding pad
 - RF generator with capacity for unipolar and bipolar lesions
- 14G, 100 mm needle and Fogarty catheter (4 French) for percutaneous balloon compression

Anatomy

- Trigeminal (Gasserian) ganglion is located in a dural pouch that contains cerebral spinal fluid (Meckel's cave). The ganglion is bounded medially by the cavernous sinus and the optic and trochlear nerves, superiorly by the inferior surface of the temporal lobe of the brain; and posteriorly by the brain stem
- In order to access the ganglion, the needle should pass through the foramen ovale
- The foramen ovale is situated in the posterior part of the sphenoid bone, posterolateral to the foramen rotundum. The mandibular and lesser petrosal nerves and the accessory meningeal artery pass through the foramen ovale
- There are three divisions of the trigeminal ganglion: the ophthalmic (sensory), maxillary (sensory), and mandibular (mixed motor and sensory) nerves
- Ophthalmic nerve (V1):
 - cranium exit point: superior orbital fissure
 - sensory innervation: the anterior scalp, forehead, eyebrow, eyelid, cornea, conjunctiva, ciliary body, the iris, the lacrimal gland, and nasal mucosa
 - motor innervation: none
- Maxillary nerve (V2):
 - cranium exit point: foramen rotundum
 - sensory innervation: upper lip, cheek, lower eyelid, area of the temple and zygomatic region, the side of the nose, upper jaw, teeth, gums, hard and soft palate, mucosa of the maxillary sinus, and dura matter of the middle cranial fossa
 - motor innervation: none
- Mandibular nerve (V3):
 - cranium exit point: foramen ovale
 - sensory innervation: the chin, lower lip, lower jaw, and anterior two-thirds of the tongue, anterosuperior ear, external auditory meatus, temporomandibular joint
 - motor innervation: muscles of mastication

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Structures to Keep in Mind and Possible Complications

- Brainstem anesthesia (signs: nausea can be the first sign, profuse sweating, vomiting, horizontal nystagmus, vertigo, ataxia, respiratory arrest)
- Carotid artery, accessory meningeal artery → intracerebral hematoma
- Clivus and petrous ridge of the temporal bone → cerebral cortex injury
- Lesser petrosal nerve → nerve injury resulting in Crocodile tears syndrome
- Retrobulbar hematoma
- Meningitis
- Adjacent cranial nerve palsies [oculomotor nerve (III), trochlear nerve (IV) and abducens nerve (VI)]
- Masseter weakness
- Keratitis
- Corneal anesthesia
- Anesthesia dolorosa
- Dural arteriovenous fistulae
- Local puncture pain and hematoma of the cheek for a few days
- Infection
- Bleeding
- Postprocedure pain
- Vasovagal reaction
- Allergic reaction

Fluoroscopy Technique, Target Localization

- Patient position – supine, head taped
- Posteroanterior (PA) view
- C-arm is angled caudally (the amount of caudad tilt depends on the patient's head position, but enough to obtain a submental view)
- Oblique (not much, about 15 degrees) to the desired side permits to visualize the foramen ovale medially to the mandibular process
- Coaxial view approach to the foramen ovale (Fig. 8.1a–c)
- Lateral view to confirm depth of needle

Procedure Steps for Trigeminal Ganglion Block

Disclaimer: Diagnostic block of the Gasserian ganglion is controversial, as the diagnosis of trigeminal neuralgia is a clinical diagnosis. Older publications describe successful

phenol injection and (also glycerol injection in seated position).

- Needle entry 2–3 cm lateral to the corner of the mouth
- Placing a finger in the mouth of the patient permits detection of an oral mucosal penetration
- Advance the needle in submental, oblique view until needle is engaged (or has touched the edge of the foramen) (Fig. 8.2a, b)
- Control the depth in the lateral view (Fig. 8.3a–c)
- Inject 1cc of contrast to confirm the lack of vascular uptake

Procedure Steps for Trigeminal Ganglion RFA

- Radiofrequency ablation (RFA) cannula is placed as described above for trigeminal ganglion block (Fig. 8.4a, b)
- Once the needle passed the base of the opening at the foramen ovale, it is engaged in the ganglion, at 2Hz stimulation masseter twitches (V3) are visible (Fig. 8.5a)
- Advance the needle until paresthesia is reached at the desired branch (50Hz, up to 1V setting). Masseter twitch fades as V2 reached (Fig. 8.5b)
- Lesioning at 60 °C for 60 seconds, then 65 °C for 60 seconds and 70 °C for 60 seconds. Do not use temperatures higher than 70 °C
- Stimulate the nerve again to compare the level of motor response and the level of paresthesia
- If the ophthalmic nerve (V1) branch is affected, evaluate the corneal reflex after each lesioning
- Observe the patient after the procedure
- Pulsed radio frequency (PRF) not higher than 42°C does not require local anesthetic

Procedure Steps for Trigeminal Ganglion Percutaneous Balloon Compression

- 14G needle is placed as above for trigeminal ganglion block
- Do not advance beyond the entrance of the foramen ovale
- Next, introduce and advance the tip of the Fogarty catheter (4 French) through the needle into the foramen ovale in the lateral view (Fig. 8.6a, b)
- Inflate the balloon of the Fogarty catheter by injecting 1 ml of nonionic contrast material. In the lateral fluoroscopic view, the balloon should resemble a pear, with the stem end pointing posteriorly. Verify this view in both lateral and posteroanterior (PA) fluoroscope images

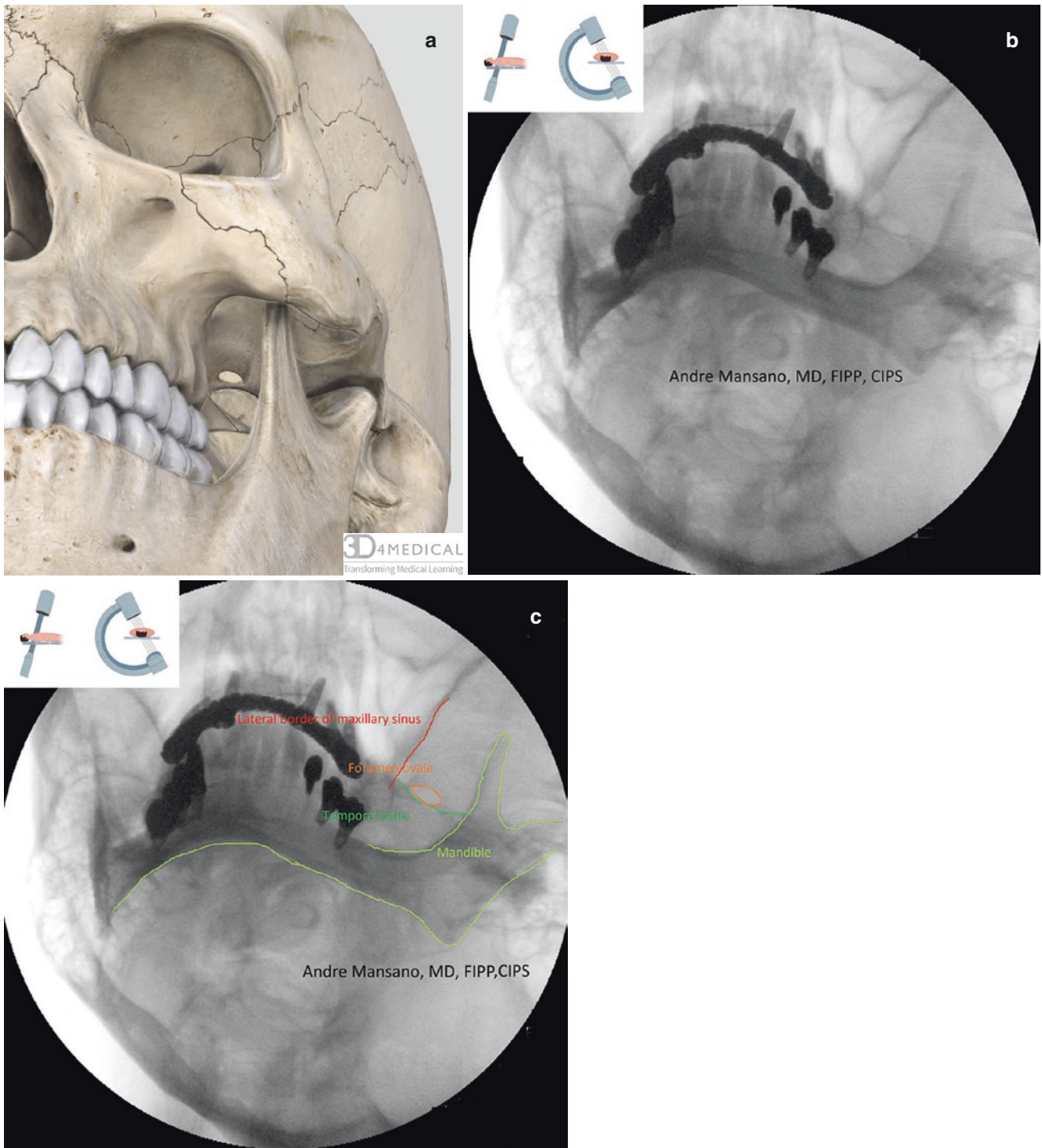


Fig. 8.1 Foramen ovale (orange) is visualized at the base of the skull in generous caudad and slight ipsilateral tilt. Image is not magnified. Mandible = yellow; maxillary sinus = red; petrosal bone = green. Notice the main landmarks that are always reliably identifiable (marked with

red, green and yellow) form a letter “H”. The foramen ovale is always found “sitting on the crossbar” of the “H”. Complete Anatomy image (a), native (b), and edited fluoroscopy image (c)

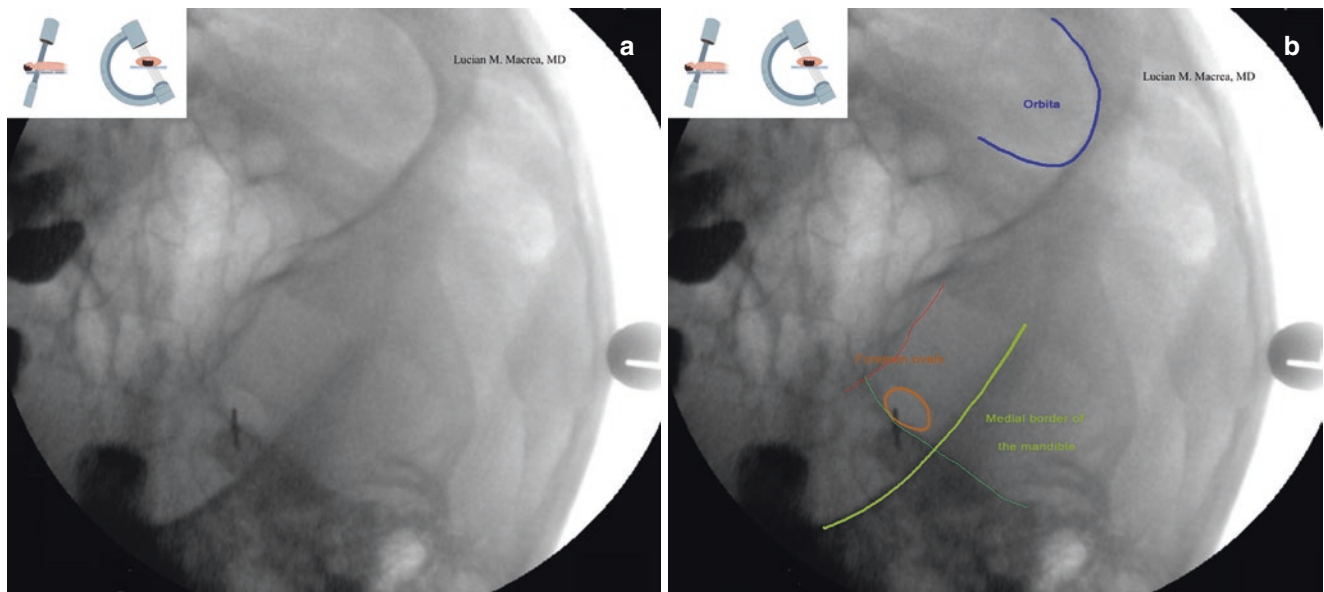


Fig. 8.2 Trigeminal ganglion block, submental view (C-arm in caudad and ipsilateral tilt), magnified image. Foramen ovale is visualized by fluoroscopy between the radiographic shadow of the mandibular ramus (lateral) and the maxillary sinus (medial), cephalad to the petrosal bone.

Needle is placed on the inferior margin of the foramen ovale. Orange = foramen ovale; yellow = mandible; green = petrosal bone; red = lateral wall of the maxillary sinus; blue = orbital margin. Native (a) and edited fluoroscopy images (b)

- Inflate the balloon and maintain it for 60 seconds. Analgesia is usually immediate (Fig. 8.6c)
- After completing the desired time for inflation, aspirate the contrast solution and confirm that the balloon appears to be deflated
- Then, withdraw the catheter together with the needle as one unit
- Observe the patient for at least 2 hours confirming lack of hematoma and intact corneal reflex

Clinical Pearls

- Puncture of the oral cavity increases the risk of meningitis
- Meticulous exclusion of intravascular injection is necessary. Contrast agent should be injected under real-time fluoroscopy. Utilization of digital subtraction angiography (DSA) is recommended
- When the needle enters the Gasserian ganglion, it can be quite painful

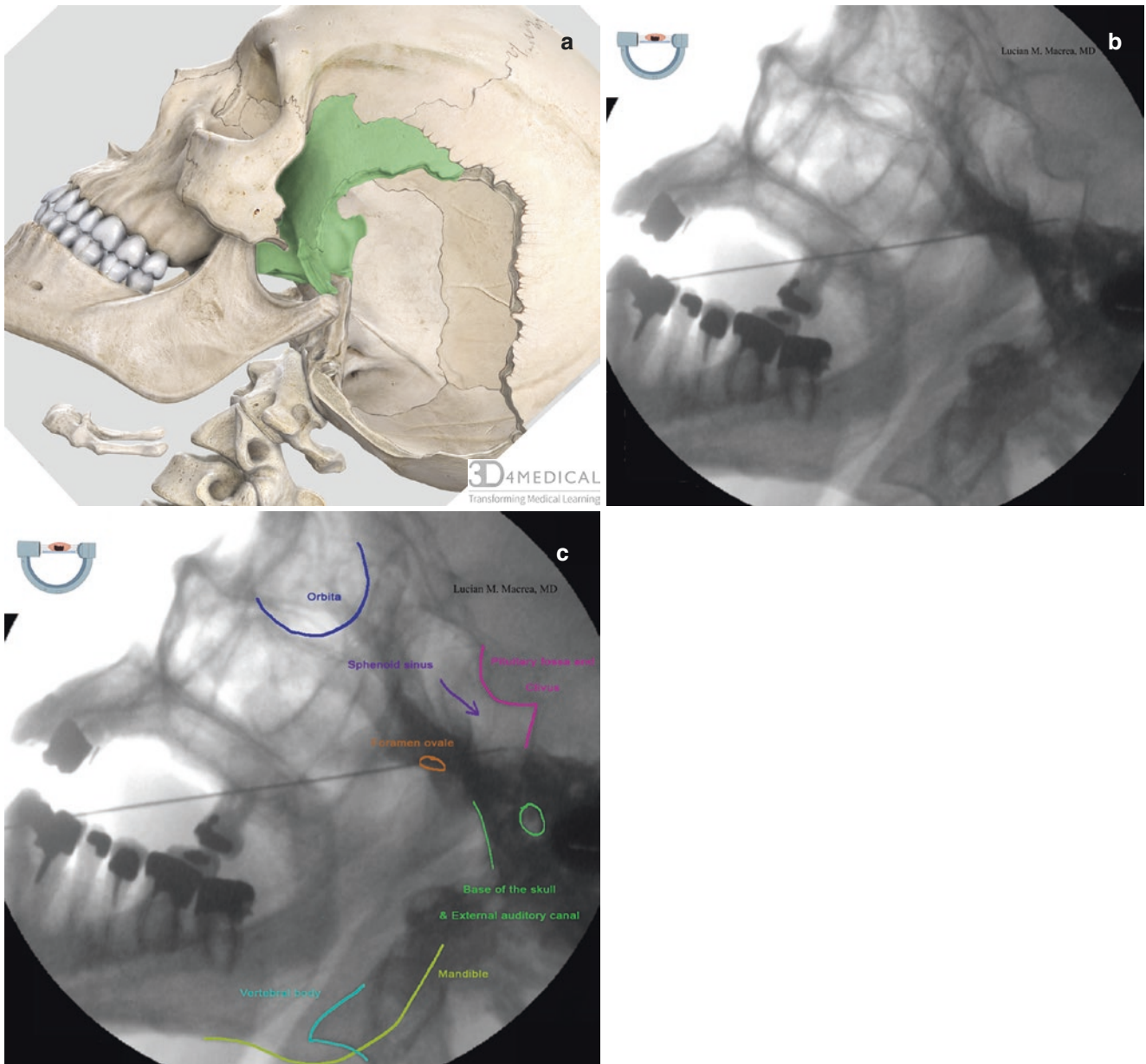


Fig. 8.3 Lateral view of the skull. Temporal bone removed, sphenoid highlighted in green. Complete Anatomy image (a). Needle inside the Meckel's cave. Orange = foramen ovale; yellow = mandible; green = petrosal bone; blue = orbital margin; pink = clivus and pituitary fossa. Native (b) and edited fluoroscopy image (c)

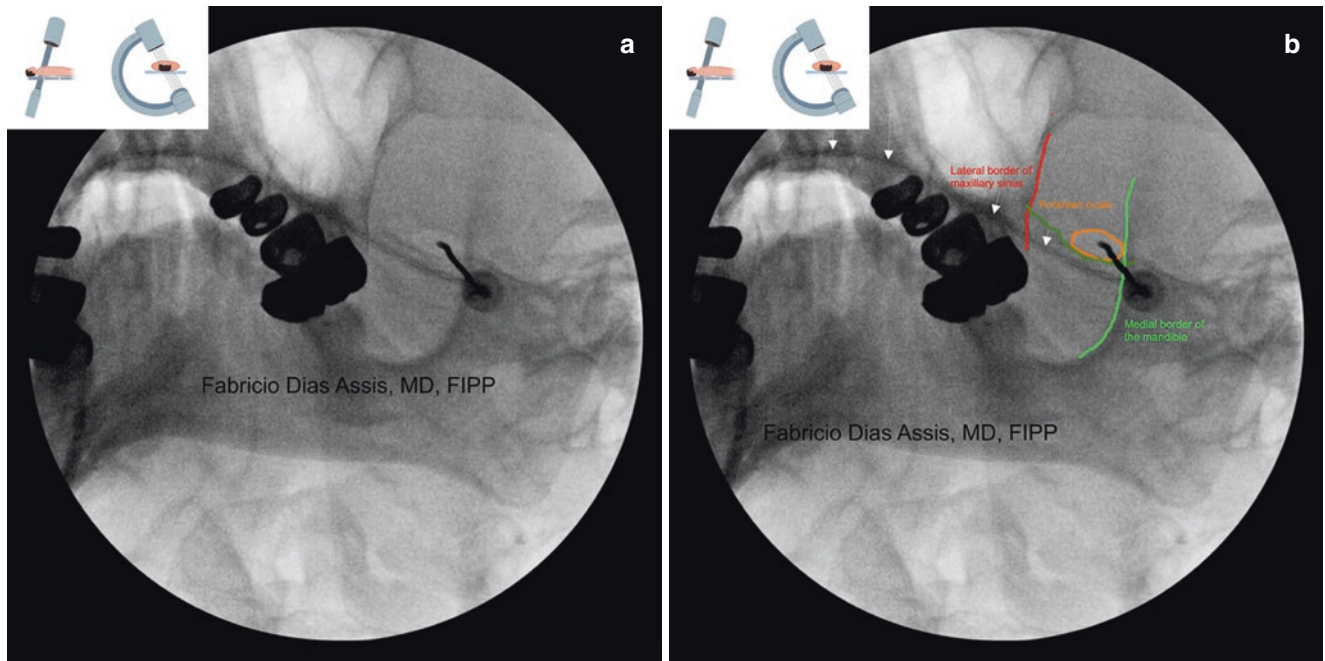


Fig. 8.4 Submental view showing RF needle in place. Foramen ovale = orange; maxillary sinus = red; petrosal bone = dark green, white arrows point at RF catheter. Native (a) and edited fluoroscopy image (b)

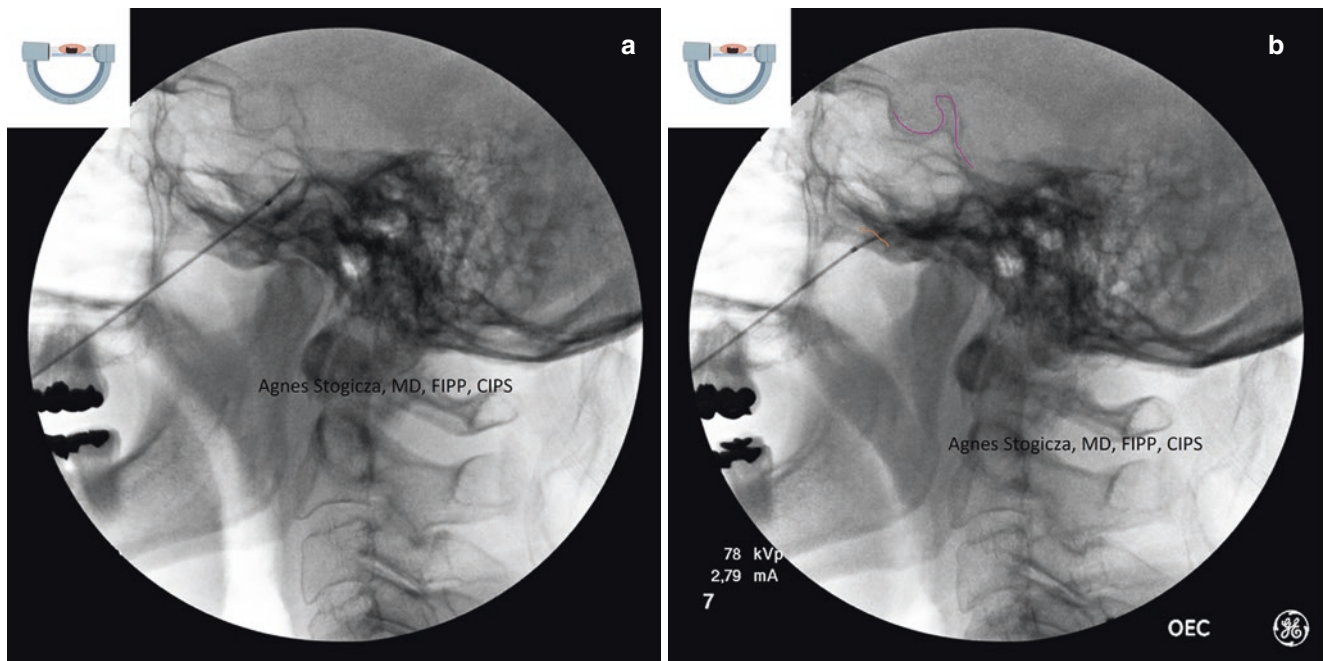


Fig. 8.5 RF needle passing through the foramen ovale. Location to start motor stimulation (a). RF needle inside the Meckel cave, final position for V2 lesion. Stimulation confirms needle position.

Orange = Foramen ovale; pink = clivus. Native (a) and edited (b) fluoroscopy image

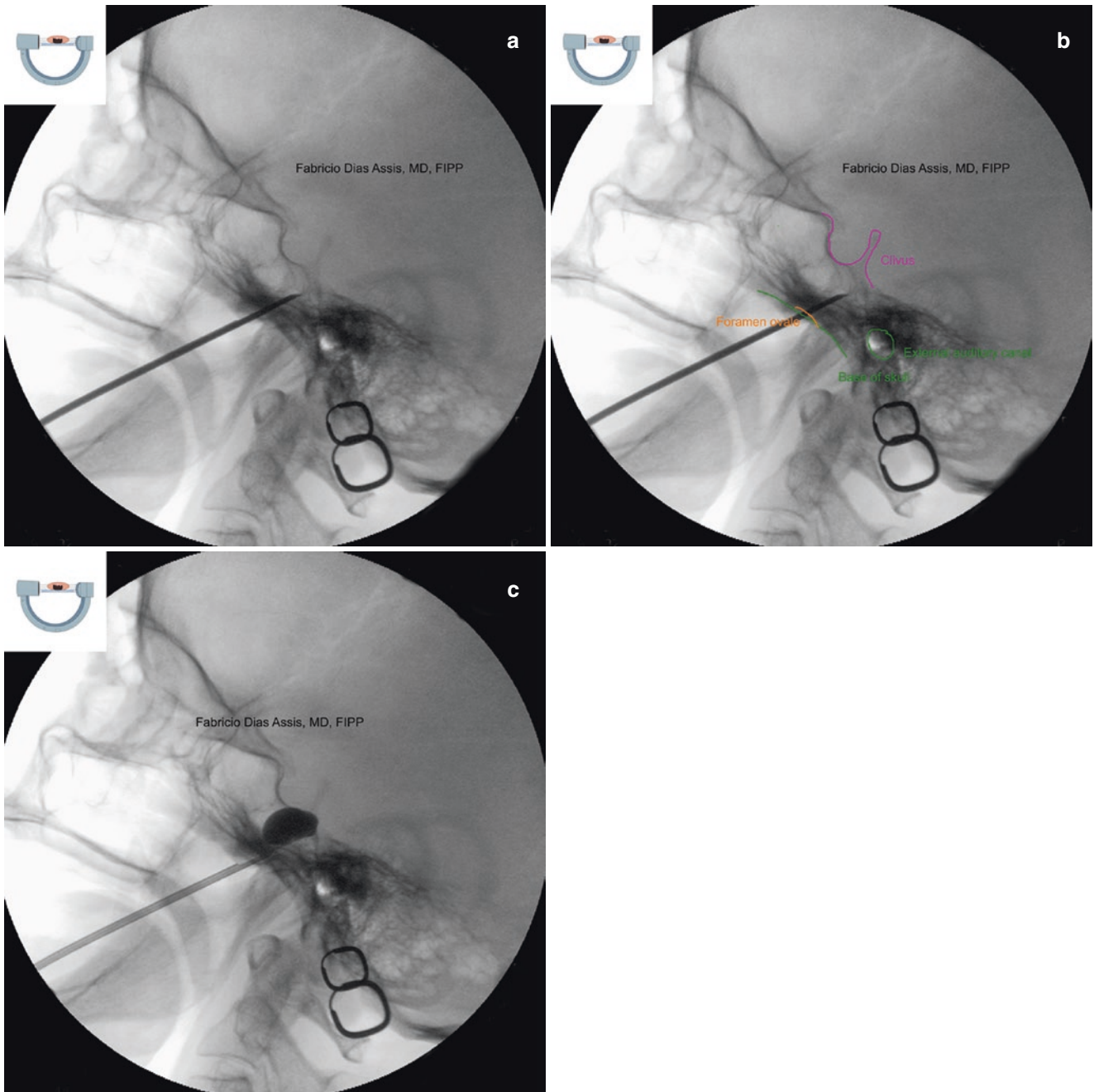


Fig. 8.6 Gasserian ganglion balloon compression. Needle inside the Meckel cave. Native (a) and edited (b) fluoroscopy image. Fogarty balloon inflated. Desired pear shape visible (c)

- First, the needle reaches the V3, then the V2, then the V1 branches
- V1 is often, V2 is occasionally intrathecal, which is shown by cerebrospinal fluid (CSF) return
- Any proof of lack of understanding of cranio-facial anatomy, for example targeting various oval shaped structures at the wrong area

Unacceptable, Potentially Harmful Needle Placement on Exam

- Failing to check lateral view
- Needle tip passed the clivus on the lateral view. Placing the needle in the brainstem
- Rough manipulation of the needle

Unacceptable, But Not Harmful Needle Placement on Exam

- The procedure was abandoned after unsuccessful attempts, but it was clear that the examinee was cognizant of the safety aspects of the procedure, the needle did not compromise vital structures, did not reach the brainstem, the orbit etc.
- Unable to identify foramen ovale on either side

Evidence

Table 8.1 Level of evidence and recommendations by the Benelux section of the World Institute of Pain

These recommendations are based on both a review of the literature in 2015 by an independent third party (Kleijnen Systematic Reviews LTD) and the previous published guidelines published in Pain Practice. The recent literature, the potential risk for complications, and the grade of invasiveness were considered when deciding to upgrade or downgrade the recommendation.

Indication	Procedure	Recommendation 2009 ¹	Grade 2015 ²	Recommendation 2018 ^{3,4}
Trigeminal neuralgia	Radiofrequency treatment (ablation) of the Gasser ganglion (Gasseri)	2B+	Low	Weak
Trigeminal neuralgia	Pulsed radiofrequency treatment of the Gasser ganglion (Gasseri)	2B–	Very low	Very weak

¹van Kleef M, van Genderen WE, Narouze S, Nurmikko TJ, van Zundert J, Geurts JW, et al. 1. Trigeminal neuralgia. *Pain Pract.* 2009;9:252–9

²Kleijnen Systematic Reviews Ltd.: Search and evaluation of the literature. 2015.

³Huygen F, Kallewaard JW, van Tulder M, Van Boxem K, Vissers K, van Kleef M, et al. Evidence-based interventional pain medicine according to clinical diagnoses: update 2018. *Pain Pract.* 2019;19:664–75

⁴<https://www.anesthesiologie.nl/publicaties/praktische-richtlijnen-anesthesiologische-pijnbestrijding>

Table 8.2 Level of evidence based on the American Society of Interventional Pain Physicians (ASIPP) review of the literature

Trigeminal nerve blocks and neurolysis ¹	Evidence
Trigeminal nerve blocks	Level III
Trigeminal nerve thermal radiofrequency	Level III
Trigeminal nerve pulsed radiofrequency	Level III

¹Lin C.-S, Cheng J. Trigeminal nerve blocks and neurolysis. In: Manchikanti L, Kaye AD, Falco FJE, Hirsch JA, editors. *Essentials of interventional techniques in managing chronic pain.* Springer International Publishing; 2018. p. 451–461.

Suggested Reading

- Henderson WR. The anatomy of the gasserian ganglion and the distribution of pain in relation to injections and operations for trigeminal neuralgia. *Ann R Coll Surg Engl.* 1965;37:346–73.
- Hong T, Ding Y, Yao P. Long-term efficacy and complications of radiofrequency thermocoagulation at different temperatures for the treatment of trigeminal neuralgia. *Biochem Res Int.* 2020;2020.

Jain A. Comparative analysis of balloon compression and radiofrequency ablation in idiopathic trigeminal neuralgia: a retrospective study with a 24-month follow-up. *Turkish J Anaesthesiol Reanim.* 2019;47(2):146–50.

Raj PP, et al. *Interventional pain management: image-guided procedures.* Philadelphia, PA: Saunders/Elsevier; 2008.

Unal TC, Unal OF, Barlas O, Heggul K, Ali A, Aydoseli A, et al. Factors determining the outcome in trigeminal neuralgia treated with percutaneous balloon compression. *World Neurosurg.* 2017;107:69–74.

Van Kleef M, Van Genderen WE, Narouze S, Nurmikko TJ, Van Zundert J, Geurts JW, et al. Trigeminal neuralgia. *Pain Pract.* 2009;9:252–9.

Wu H, Zhou J, Chen J, Gu Y, Shi L, Ni H. Therapeutic efficacy and safety of radiofrequency ablation for the treatment of trigeminal neuralgia: A systematic review and meta-analysis. *J Pain Res.* 2019;12:423–41.

The Trigeminal Diagnostic Block chapter was reviewed by Miles Day; Matthew Rupert; Maarten Van Kleef; Serdar Erdine; Javier De Andres Ares; Andrea M. Trescot; Milan Stojanovic; Peter S. Staats; Agnes R. Stogicza; Andre M. Mansano.