Local Anesthetic Blocks of the Head and Neck 2

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2.1 Introduction

If there were an award for the most important advance of the last millennium it would be in the author's opinion, hands down, the discovery of local anesthesia. Although it is almost impossible for us in the civilized world to contemplate, it was a cruel world out there. Owing to the inability to obtund severe pain, medicine and dentistry stayed in the "dark ages" way past the renaissance. A simple tooth extraction or a laceration repair would be an extremely traumatic experience, and in fact just several generations ago.

In the head and neck there is some of the most intensely innervated real estate in the body. Our major sensory organs are located there and are well protected and endowed with sensory innervation. Innervation to the teeth conveys only a single stimulus: pain! The ability to master local anesthetic techniques of the head and neck is one of the most useful and appreciated skills a physician can master. Neuroanatomy of the head and neck can be boring and complex and it was not that fun to learn back in medical or dental school. Relearning it now may seem laborious but if you pay attention to the pictures of sensory dermatomes in this chapter, it is really not that hard and actually can be fun.

The ability to predictably administer successful facial nerve blocks can provide many benefits. Many of us become somewhat callous when performing procedures and even may admonish patients for "hurting" during a procedure. Remember how we would want our own family treated if they went somewhere. We would want treatment to be painless and we should all strive for this same level of excellence. The second advantage of adequate local anesthesia is the ability to perform better work. No physician can argue that they can do superior work on a patient who is numb. No patient will argue that they can appreciate better work when they are numb! A hidden and sometimes unappreciated benefit of "being good with the needle" is positive marketing. The absence of pain is a superior marketing strategy. Never forget this and if you have not been practicing like this, tomorrow is the first day of the rest of your practice!

Alcohol was widely used for pain control, but as we are well aware and the ancients were also aware, even the drunkest drunk still feels pain. Cocaine was the first local anesthetic to be widely used in surgical applications. In the nineteenth century it was reported that the Indians of the Peruvian highlands chewed the leaves of the coca leaf (*Erythroxylon coca*) for its stimulating and exhilarating effects [1–3]. It was also observed that these Indians observed numbness in the areas around the lips. In 1859, Albert Niemann, a German chemist, was given credit for being the first to extract the isolate cocaine from the coca shrub in a purified form [4]. When Niemann tasted the substance, his tongue became numb. This property led to one of the most humane discoveries in all of medicine and surgery. Over two decades later, Sigmund Freud began treating patients with cocaine for its physiologic and psychological effects. While he was treating a colleague for morphine dependence, the patient developed cocaine dependence [4].

Koller demonstrated the topical anesthetic activity of cocaine on the cornea in animal models and on himself. In an operation for glaucoma, Koller used cocaine for local anesthesia in 1894 [2–5].

William Halsted was a prominent American surgeon who investigated the principles of nerve block using cocaine. In November 1884, Halsted performed infraor-

Fig. 2.1 Cocaine use in early dentistry

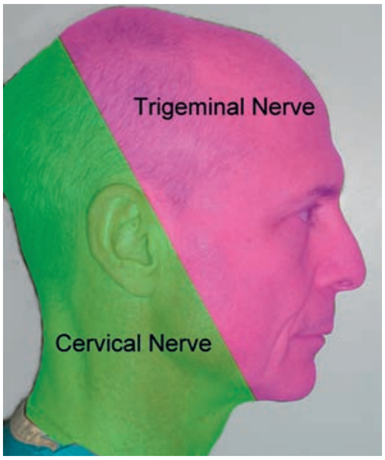

Fig. 2.2 The sensory innervation of the head and neck is derived from the trigeminal and upper cervical nerves

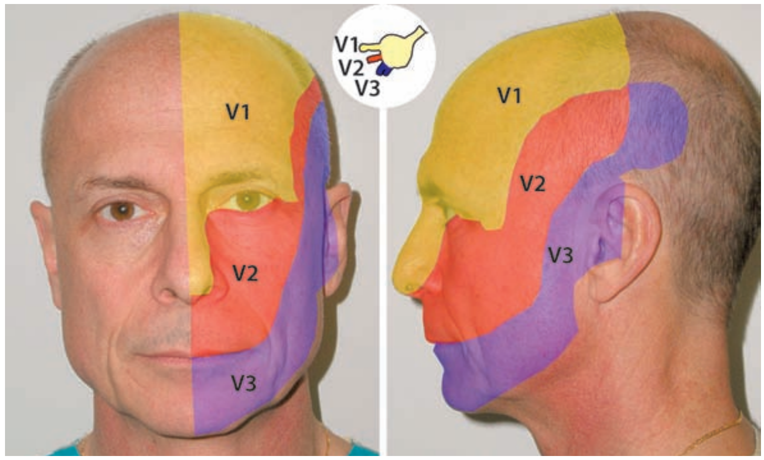

Fig. 2.3 The main branches of the trigeminal nerve supplying sensation to the respective facial areas. The *inset* shows the trigeminal ganglion with the three main nerve branches

bital and inferior alveolar (mandibular dental block) as well as demonstrated various other regional anesthetic techniques [4]. Halsted's self-experimentation with cocaine caused an addiction and it required 2 years to resolve and regain his eminent position in surgery and teaching [4].

Early dentists dissolved cocaine hydrochloride pills in water and drew this mixture into a syringe to perform nerve infiltrations and blocks. The extreme vasoconstrictive effects of cocaine often caused tissue necrosis, but nonetheless provided profound local anesthesia that revolutionized dentistry and medicine forever. Many proprietary preparations of that time period contained cocaine (Fig. 2.1).

By the early 1900s cocaine's adverse effects became well recognized. These deleterious effects included profound cardiac stimulation and vasoconstriction. Cocaine blocks the neuronal reuptake of norepinephrine in the peripheral nervous system, and myocardial stimulation in combination with coronary artery vasoconstriction has proven lethal in sensitive individuals, central nervous system stimulation and mood-altering euphoric effect [6, 7]. These effects coupled with the severe physical and psychological dependence proved to be significant drawbacks to cocaine use for local anesthesia.

In 1904 Einhorn, searching for a safer and less toxic local anesthetic, synthesized procaine (Novocain) [4, 8]. Novocain was the gold standard of topical anesthetics for almost 40 years until Lofgren synthesized lidocaine (Xylocaine), the first amide group of local anesthetics [4]. Lidocaine provided advantages over the ester group (procaine) in terms of greater potency, less allergic potential and a more rapid onset of anesthesia [1, 2, 9, 10].

2.2 Mechanism of Action of Local Anesthetics

Local anesthetics block the sensation of pain by interfering with the propagation of impulses along peripheral nerve fibers without significantly altering normal resting membrane potentials [11]. Local anesthetics depolarize the nerve membranes and prevent achievement of a threshold potential. A propagated action potential fails to develop and a conduction blockade is achieved. This occurs by the interference of nerve transmission by blocking the influx of sodium through the excitable nerve membrane [12].

2.3 Sensory Anatomy of the Head and Neck

The main sensory innervation of the face is derived from cranial nerve V (trigeminal nerve) and the upper cervical nerves (Fig. 2.2).

2.3.1 Trigeminal Nerve

The trigeminal nerve is the fifth of the 12 cranial nerves. Its branches originate at the semilunar ganglion (Gasserian ganglion) located in a cavity (Meckel's cave) near the apex of the petrous part of the temporal bone. Three large nerves, the ophthalmic, maxillary, and mandibular, proceed from the ganglion to supply sensory innervation to the face (Fig. 2.3).

Often referred to as “the great sensory nerve of the head and neck”, the trigeminal nerve is named for its three major sensory branches. The ophthalmic nerve (V1), maxillary nerve (V2), and mandibular nerve (V3) are literally “three twins” (trigeminal) carrying sensory information of light touch, temperature, pain, and proprioception from the face and scalp to the brainstem. The commonly used terms “V1,” “V2,” and “V3” are shorthand notation for cranial nerve five, branches one, two, and three, respectively. In addition to nerves carrying incoming sensory information, certain branches of the trigeminal nerve also contain nerve motor components (the ophthalmic and maxillary nerves consist exclusively of sensory fibers; the mandibular nerve is joined outside the cranium by the motor root). These outgoing motor components include branchial motor nerves (nerves innervating muscles derived embryologically from the branchial arches) as well as “hitchhiking” visceral motor nerves (nerves innervating viscera, including smooth muscle and glands). The trigeminal nerve exits the trigeminal ganglion and courses “backward” to enter the mid-lateral aspect of the pons at the brainstem [13].[1]

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The ophthalmic nerve (V1) leaves the semilunar ganglion through the superior orbital fissure. The maxillary nerve (V2) leaves the semilunar ganglion through the foramen rotundum at the skull base and the mandibular nerve (V3) leaves the semilunar ganglion through the foramen ovale at the skull base (Fig. 2.3) [13]. The remainder of this chapter will only discuss the sensory components of this nerve system as they relate to local anesthetic blocking techniques for cosmetic facial procedures.

2.3.2 Ophthalmic Nerve (V1)

The ophthalmic nerve, or first division of the trigeminal nerve, is a sensory nerve. It supplies branches to the cornea, ciliary body, and iris; to the lacrimal gland and conjunctiva; to the part of the mucous membrane of the nasal cavity; and to the skin of the eyelids, eyebrow, forehead, and upper lateral nose (Fig 2.3). It is the smallest of the three divisions of the trigeminal nerve and divides into three branches, the frontal, nasociliary, and lacrimal [13]. The frontal nerve divides into the supraorbital and supratrochlear nerves providing sensation to the forehead and anterior scalp.

The nasociliary nerve divides into four branches, two of which supply sensory innervation to the face. These two branches are the infratrochlear nerve, which supplies sensation to the skin of the medial eyelids and side of the nose, and the ethmoidal nerve, which gives of a terminal branch called the external (or dorsal) nasal nerve and innervates the skin of the nasal dorsum and tip. The lacrimal nerve innervates the skin of the upper eyelid.

2.3.3 Maxillary Nerve (V2)

The maxillary nerve, or second division of the trigeminal nerve, is a sensory nerve that crosses the pterygopalatine fossa then traverses the orbit in the infraorbital groove and canal in the floor of the orbit, and appears upon the face at the infraorbital foramen as the infraorbital nerve [13]. At its termination, the nerve divides into branches which spread out upon the side of the nose, the lower eyelid, and the upper lip, joining with filaments of the facial nerve [13].

The zygomatic nerve arises in the pterygopalatine fossa, enters the orbit by the inferior orbital fissure, and divides at the back of that cavity into two terminal branches, the zygomaticotemporal and zygomaticofacial nerves.

The zygomaticotemporal branch runs along the lateral wall of the orbit in a groove in the zygomatic bone then passes through a foramen in the zygomatic bone and enters the temporal fossa. It ascends between the bone and substance of the temporalis muscle and pierces the temporal fascia about 2.5 cm above the zygomatic arch, where it is distributed to the skin of the side of the forehead (Fig. 2.3) [13].

The zygomaticofacial branch passes along the inferolateral angle of the orbit, emerges upon the face through a foramen in the zygomatic bone, and, perforates the orbicularis oculi and supplies the skin on the prominence of the cheek (Fig. 2.3).

As the maxillary nerve traverses the orbital floor and exits the infraorbital foramen, it branches into a plexus of nerves, which has the following terminal branches:

1. The inferior palpebral branches ascend behind the orbicularis oculi muscle and supply the skin and conjunctiva of the lower eyelid (Fig. 2.3).
2. The lateral nasal branches (rami nasales externi) supply the skin of the side of the nose (Fig. 2.3).
3. The superior labial branches are distributed to the skin of the upper lip, the mucous membrane of the mouth, and labial glands (Fig. 2.3) [13].

2.3.4 Mandibular Nerve (V3)

The mandibular nerve supplies the teeth and gums of the mandible, the skin of the temporal region, part of the auricle, the lower lip, and the lower part of the face (Fig. 2.3). The mandibular nerve also supplies the muscles of mastication and the mucous membrane of the anterior two thirds of the tongue. It is the largest of the three divisions of the fifth cranial nerve and is made up of a motor and sensory root [13].

Sensory branches of the mandibular nerve include:

1. The auriculotemporal nerve supplies sensation to the skin covering the front of the helix and tragus (Fig. 2.3).

2. The inferior alveolar nerve is the largest branch of the mandibular nerve. It descends with the inferior alveolar artery and exits the ramus of the mandible to the mandibular foramen. It then passes forward in the mandibular canal, beneath the teeth, as far as the mental foramen, where it divides into two terminal branches, incisive and mental nerves. The mental nerve emerges at the mental foramen, and divides into three branches: one descends to the skin of the chin, and two ascend to the skin and mucous membrane of the lower lip [13].
3. The buccal nerve which supplies sensation to the skin over the buccinator muscle.

2.4 Local Anesthetic Techniques

2.4.1 Infiltrative Peripheral Anesthesia Versus Regional Nerve Block Anesthesia

Local anesthesia can be effectively obtained by infiltrations and nerve blocks. Infiltrative local anesthesia applies to the injection of the local anesthesia solution in the area of the peripheral innervation distant from the site of the main nerve. An advantage of infiltrative anesthesia is that no specific skill is necessary, only the selected area of innervation is involved and vasoconstrictors can improve local hemostasis. A drawback of infiltrative local anesthesia is the distortion of the tissue at or around the site of injection that may obscure or hamper cosmetic procedures.

A nerve block involves placing the local anesthetic solution in a specific location at or around the main nerve trunk that will effectively depolarize that nerve and obtund sensation distal to that area. Advantages of nerve blocks include the fact that a single accurately placed injection can obtund large areas of sensation without tissue distortion at the operative site. Disadvantages of peripheral nerve block include the sensation of numbness in areas other than the operative site and the lack of hemostasis at the operative site from a vasoconstrictor.

Individual anatomic variances in patients are responsible for the sometimes unpredictable effect of peripheral nerve block. Foraminal position, nerves crossing the midline, accessory innervation, and nerve bifurcation are just some factors that affect the predictability and success of failure of local anesthetic nerve blocks. Nerves that innervate areas close to the midline may receive innervation from the contralateral side and require bilateral blocks. For the multiple, aforementioned reasons, some nerve blocks may require augmentative infiltrative local anesthesia to obtain adequate pain control.

Since many nerves are accompanied by corresponding veins and arteries, aspiration should always be performed to prevent intravascular injection.

2.4.2 The Use of Topical Preanesthesia

Any person who has pain-free dental treatment more than likely receives topical mucosal anesthesia prior to having a dental block. Although some of the effects of topical anesthesia may be psychological, all patients appreciate the extra pain control effort. Although topical anesthetic techniques are more effective and faster acting on mucosal surfaces, patients still appreciate the extra care for pain control. The use of a topical anesthetic agent on the lip mucosa will definitely augment injections in that area regardless of the blocking techniques used. In the author’s practice, when a patient is seated for lip augmentation injections, the assistant immediately applies a thick coating of a topical anesthetic preparation to the lips, which will be in contact with the mucosa for at least 10 min before injection. This topical anesthetic is a custom mixture of benzocaine, lidocaine, and tetracaine (Bayview Pharmacy, Baltimore, MD, USA). This produces profound anesthesia in many patients and negates the need for further blocking techniques. Some patients will still require blocks, but topical anesthesia will assist by both psychological and physiological means. Many cosmetic surgeons also use topical agents for cutaneous anesthesia.

2.4.3 Local Anesthetic Techniques for Blocking the Main Sensory Nerves of the Head and Neck

A rudimentary knowledge of the neuroanatomy of the head and neck can enable the cosmetic surgeon to perform painless surgical procedures in this area. In addition, when used concomitantly with general anesthesia or intravenous sedation, local anesthetic blocks can decrease the amount of intravenous or inhalation agents needed. Finally, using local anesthetic blocks with intravenous or inhalation agents can provide excellent postanesthetic pain control.

2.4.3.1 Scalp and Forehead

The supraorbital nerve exits through a notch (in some cases a foramen) on the superior orbital rim approximately 27 mm lateral to the glabellar midline (Fig. 2.4). This supraorbital notch is readily palpable in most patients. After exiting the notch or foramen, the nerve traverses the corrugator supercilii muscles and branches into a medial and lateral portion. The lateral branches supply the lateral forehead and the medial branches supply the scalp. The supratrochlear nerve exits a foramen approximately 17 mm form the glabellar midline (Fig. 2.4) and supplies sensation to the middle portion of the forehead. The infratrochlear nerve exits a foramen

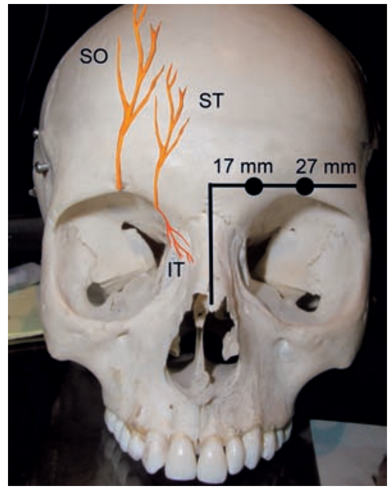

Fig. 2.4 The supraorbital nerve (*SO*) exits about 27 mm from the glabellar midline and the supratrochlear nerve (*ST*) is located approximately 17 mm from the glabellar midline. The infratrochlear nerve (*IT*) exits below the trochlea

Fig. 2.5 The forehead and scalp are blocked by a series of injections form the central to the medial brow

below the trochlea and provides sensation to the medial upper eyelid, canthus, medial nasal skin, conjunctiva, and lacrimal apparatus (Fig. 2.4) [14].

When injecting this area it is prudent to always use the free hand to palpate the orbital rim to prevent inadvertent injection into the globe! To anesthetize this area, the supratrochlear nerve is measured 17 mm from the glabellar midline and 1–2 ml of 2% lidocaine with 1:100,000 epinephrine is injected (Fig. 2.5). The supraorbital nerve is blocked by palpating the notch (and or measuring 27 mm from the glabellar midline) and injecting 2 ml of local anesthetic solution (Fig. 2.6). The infratrochlear nerve is blocked by injecting 1–2 ml of local anesthetic solution at the junction of the orbit and the nasal bones (Fig. 2.6). In reality, one can block all three of these nerves by simply injecting 2–4 ml of local anesthetic solution from the central brow proceeding to the medial brow. Figure 2.6 shows the regions anesthetized by the aforementioned blocks.

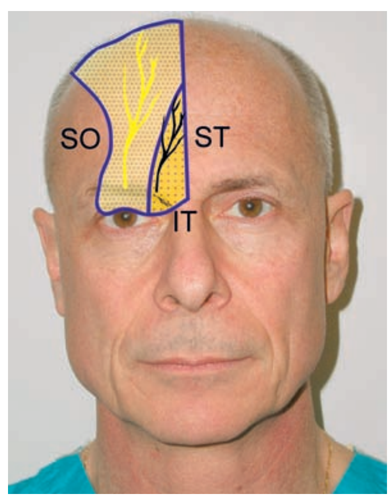

Fig. 2.6 The *shaded areas* indicate the anesthetized areas from supraorbital nerve (*SO*) and supratrochlear nerve (*ST*) and infratrochlear nerve (*IT*) blocks

2.4.3.2 *Infraorbital Nerve Block*

The infraorbital nerve exits the infraorbital foramen 4–7 mm below the orbital rim in an imaginary line dropped from the medial limbus of the iris [14] or the pupillary midline. The anterior-superior alveolar nerve branches from the infraorbital nerve before it exits the foramen and thus some patients will manifest anesthesia of the anterior teeth and gingiva if the branching is close to the foramen. Areas anesthetized include the lateral nose, anterior cheek, lower eyelid, and upper lip on the injected side. This nerve can be blocked by intraoral or extraoral routes. To perform an infraorbital nerve block from an intraoral approach, topical anesthetic is placed on the oral mucosa at the vestibular sulcus just under the canine fossa (between the canine and first premolar tooth) and left for several minutes. The lip is then elevated and a 1.5-in. 27-gauge needle is inserted in the sulcus and directed superiorly toward the infraorbital foramen (Fig. 2.7). The needle does not need to enter the foramen for a successful block. The anesthetic solution needs only to contact the vast branching around the foramen to be effective. It is imperative to use the other hand to palpate the inferior orbital rim to avoid injecting the orbit. Between 2 and 4 ml of 2% lidocaine with 1:100,000 epinephrine is injected in this area for the infraorbital block.

The infraorbital nerve can also be very easily blocked by a facial approach and this is the preferred route of the author. This may also be the preferred route in dental phobic patients. A 0.5-in. 27-gauge needle is used and is placed through the skin and aimed at the foramen in a perpendicular direction. Between 2 and 4 ml of local anesthetic solution is injected at or close to the foramen (Fig. 2.8). Again, the other hand must constantly palpate the inferior orbital rim to prevent inadvertent injection into the orbit.

A successful infraorbital nerve block will anesthetize the infraorbital cheek, the lower palpebral area, the lateral nasal area, and superior labial regions (Fig. 2.9).

The aforementioned techniques provide anesthesia to the lateral nasal skin but do not provide anesthesia to the central portion of the nose. A dorsal (external) nasal nerve block will supplement nasal anesthesia by providing anesthesia over the area of the cartilaginous nasal dorsum and tip. This supplementary nasal block is accomplished by palpating the inferior rim of the nasal bones at the osseous cartilaginous junction. The dorsal nerve (anterior ethmoid branch of the nasociliary nerve) emerges 5–10 mm from the nasal midline at the osseous junction of the inferior portion of the nasal bones (the distal edge of the nasal bones) (Fig. 2.10). The dotted line in Fig. 2.10 shows the course of this nerve under the nasal bones before emerging.

2.4.3.3 *Augmentive Lip Anesthesia*

Although in theory a bilateral infraorbital block should anesthetize the entire upper lip, some patients may still perceive pain for various anatomic (or sometimes psy-

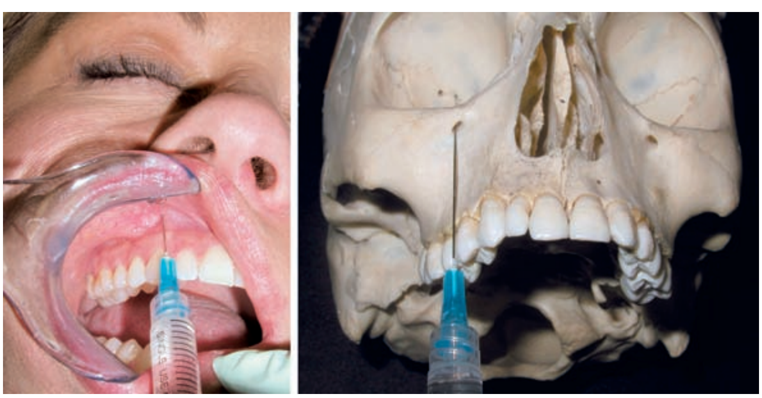

Fig. 2.7 The intraoral approach for local anesthetic block of the infraorbital nerve

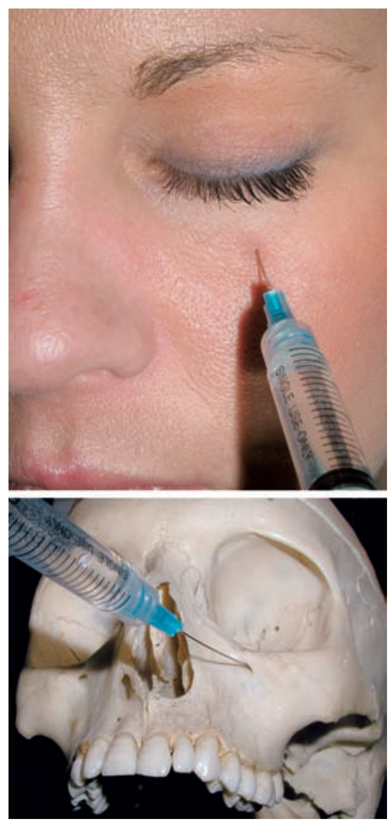

Fig. 2.8 The facial approach for local anesthetic block of the infraorbital nerve

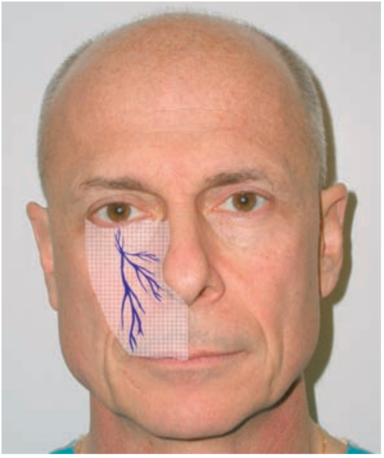

Fig. 2.9 Area of anesthesia from unilateral infraorbital nerve block

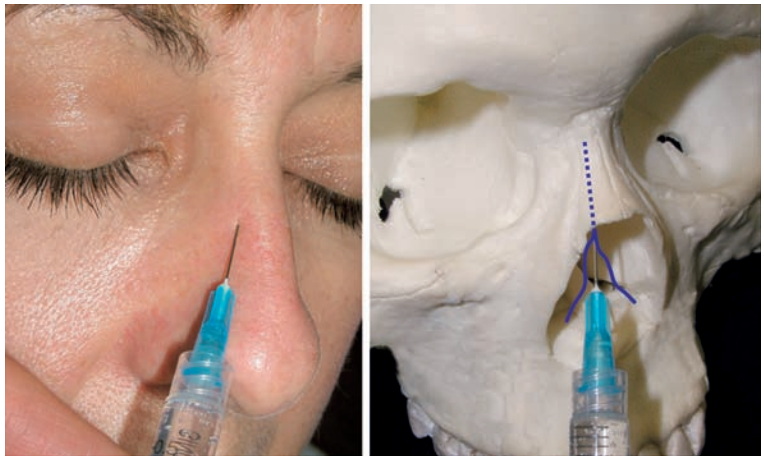

Fig. 2.10 The dorsal (external) nasal nerve is blocked subcutaneously at the osseous-cartilaginous junction of the distal nasal bones

chological) reasons detailed earlier in this chapter. Anecdotally, the author injects 0.5 ml of local anesthetic solution in the maxillary labial frenum (Fig. 2.11). Whether the effect is psychological or physiological, this seems to provide additional anesthesia. This can also be performed in the lower-lip labial frenum area to augment bilateral mental blocks as will be discussed later in this chapter. The combination of bilateral infraorbital and mental blocks and the just-described infiltrative augmentation (when necessary) is an ideal technique for anesthetizing the lips for filler injection or implant placement.

Two often overlooked nerves in facial local anesthetic blocks are the zygomaticotemporal and zygomaticofacial nerves. These nerves represent terminal branches of the zygomatic nerve. The zygomaticotemporal nerve emerges through a foramen located on the anterior wall of the temporal fossa. This foramen is actually behind the lateral orbital rim posterior to the zygoma at the approximate level of the lateral canthus (Fig. 2.12).

Fig. 2.11 An augmentative injection of local anesthetic in the maxillary frenum can assist subtotal anesthesia from infraorbital blocks when the upper lips are anesthetized

Injection technique involves sliding a 1.5-in. needle behind the concave portion of the lateral orbital rim. It is suggested that one closely examine this area on a model skull prior to attempting this injection as it will make the technique simpler. To orient for this injection, the physician needs to palpate the lateral orbital rim at the level of the frontozygomatic suture (which is frequently palpable). With the index finger in the depression of the posterior lateral aspect of the lateral orbital rim (inferior and posterior to the frontozygomatic suture), the operator places the needle just behind the palpating finger (which is about 1 cm poster to the frontozygomatic suture) (Fig. 2.12). The needle is then “walked” down the concave posterior wall of the lateral orbital rim to the approximate level of the lateral canthus. After aspirating, 1–2 ml of 2% lidocaine with 1:100,000 epinephrine is injected in this area with a slight pumping action to ensure deposition of the local anesthetic solution at or about the foramen. Again, it is important to hug the back concave wall of the lateral orbital rim with the needle when injecting.

Blocking the zygomaticotemporal nerve causes anesthesia in the area superior to the nerve, including the lateral orbital rim and the skin of the temple from above the zygomatic arch to the temporal fusion line (Fig. 2.13).

The zygomavaticofacial nerve exits through a foramen (or foramina in some patients) in the inferior lateral portion of the orbital rim at the zygoma. If the

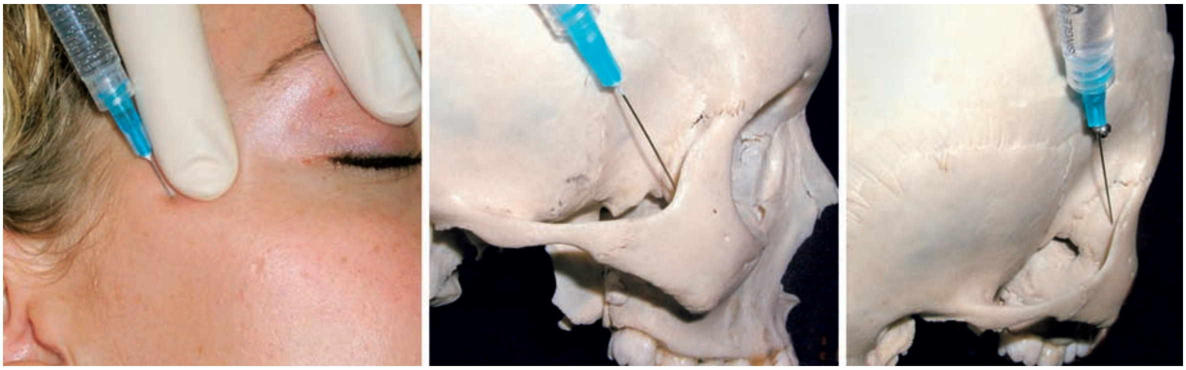

Fig. 2.12 The zygomaticotemporal nerve is blocked by placing the needle on the concave surface of the posterior lateral orbital rim

surgeon palpates the junction of the inferior lateral (the most southwest portion of the right orbit, if you will) portion of the lateral orbital rim, the nerve emerges several millimeters lateral to this point. By palpating this area and injecting just lateral to the finger, one successfully blocks this nerve with 1–2 ml of local anesthetic (Fig. 2.14). Blocking this nerve will result in anesthesia of a triangular area from the lateral canthus and the malar region along the zygomatic arch and some skin inferior to this area (Fig. 2.13) [14].

2.4.3.4
Total Second-Division Nerve Block

An efficient and simple technique to obtain hemi-midfacial local anesthesia is to block the entire second division or maxillary nerve. This will anesthetize the entire hemimaxilla and the unilateral maxillary sinus by blocking the pterygopalatine, infraorbital, and zygomatic nerves and their terminal branches. This is an easily learned technique and involves an intraoral approach at the posterior lateral palate (Fig. 2.15).

The maxillary nerve block via the greater palatine canal was first described in 1917 by Mendel [15]. The greater palatine foramen is located anterior to the junction of the hard palate and the soft palate medial to the second molar tooth (Fig. 2.15). The foramen is usually found about 7 mm anterior to the junction of the hard and soft palates. This junction is seen as a color change such that the tissue overlying the soft palate is darker pink than the tissue overlying the hard palate. The key to this block is to place a 1.5-in. needle through the greater palatine foramen. It sometimes takes multiple needle sticks to localize the foramen. Owing to the need for multiple sticks, the palatal mucosa in this area is first infiltrated with 0.5 ml of lidocaine to facilitate painless location of the greater palatine foramen. A 1.5-in. 25- or 27-gauge needle is bent to 45° and will usually easily negotiate the pterygopalatine canal, thereby placing the local anesthetic solution into the pterygopalatine fossa. The course of the maxillary division of the trigeminal nerve (V2) is as follows. The second division of the trigeminal nerve arises from the Gasserian ganglion in the medial cranial fossa and exits the skull via the foramen rotundum (Fig. 2.15). The nerve then traverses the superior aspect of the pterygopalatine fossa, where it divides into three major branches: the pterygopalatine

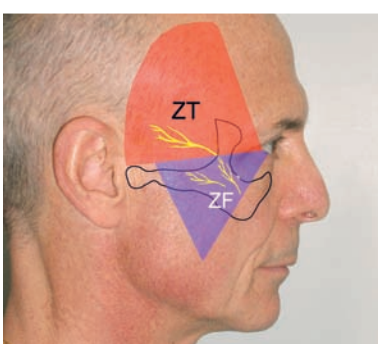

Fig. 2.13 The anesthetized areas from the zygomaticotemporal nerve (*ZT*) and the zygomaticofacial nerve (*ZF*)

Fig. 2.14 The zygomaticofacial nerve(s) are blocked by injecting the inferior lateral portion of the orbital rim

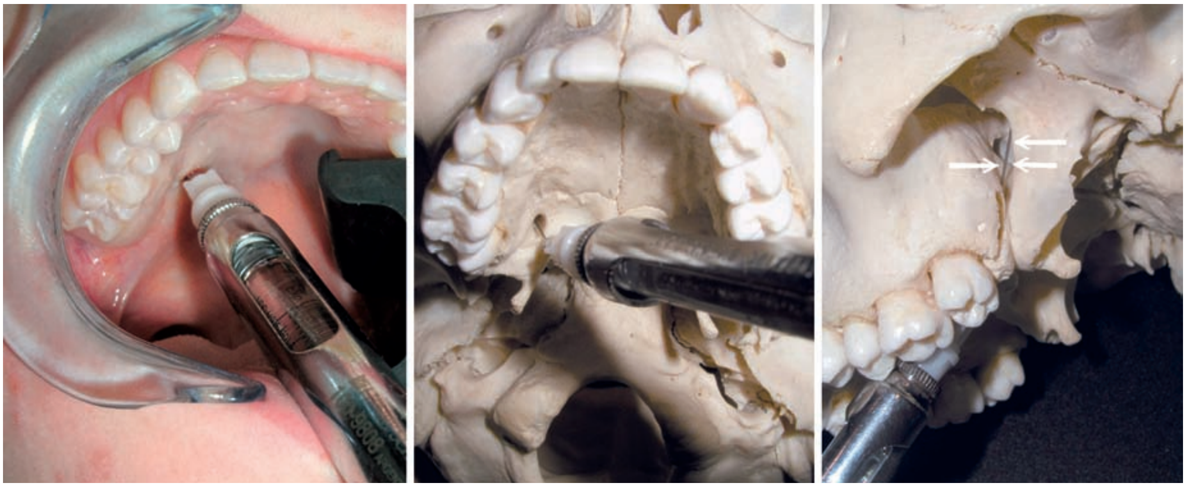

Fig. 2.15 The maxillary nerve block is performed by locating the greater palatine foramen (*left*) and inserting a bent needle up the pterygopalatine canal (*center*) to inject local anesthetic into the pterygopalatine fossa (*right*). Notice the needle tip in the pterygopalatine fossa in the *right* image. As the second division traverses this area it is blocked at the main trunk

nerve, the infraorbital nerve, and the zygomatic nerve [16]. It is these nerves that targeted in this block.

When the foramen is located, the needle should be gently advanced. If significant resistance is encountered, the needle should be withdrawn and redirected. Approximately 5% of the population has been shown to have tortuous canals that impede the needle tip and in some patients this technique is not possible [17]. It is also important to aspirate before injecting to prevent intravascular injection. When the needle is properly positioned (usually at a depth of 25–30 mm), the injection (2–4 ml) should proceed over 30–45 s.

Transient diplopia of the ipsolateral eye may occur [18]. This results from the local anesthetic diffusing superiorly and medially to anesthetize the orbital nerves. The patient must be assured that if this phenomenon occurs, it is transient.

Again, this technique will anesthetize all the terminal branches of the maxillary nerve with a single injection.

2.4.3.5 Mental Nerve Block

The mental nerve exits the mental foramen on the hemimandible at the base of the root of the second premolar (many patients may be missing a premolar owing to orthodontic extractions). The mental foramen is on average 11 mm inferior to the gum line (Fig. 2.16). There is variability with this foramen (like all foramina), but by injecting 2–4 ml of local anesthetic solution about 10 mm inferior to the gum line or 15 mm inferior to the top of the crown of the second premolar tooth the block is usually successful. In a patient without teeth, the foramen is often located much higher on the jaw and can sometimes be palpated. This block is performed more superiorly in the denture patient. As stated earlier, the foramen does not need to be entered as a sufficient volume of local anesthetic solution in the general area will be effective. By placing traction on the lip and pulling

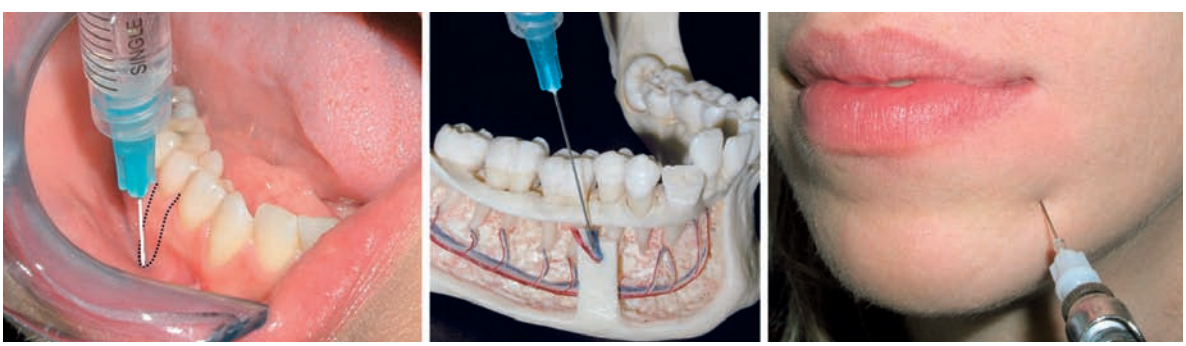

Fig. 2.16 The mental foramen is approached intraorally below the root tip of the lower second premolar (*left*) or from a facial approach (*right*)

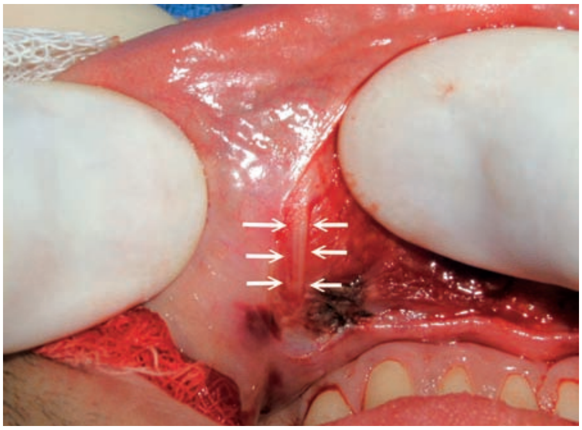

Fig. 2.17 By stretching the lower-lip mucosa, the underlying labial branches of the mental nerve are sometimes visible. This image shows the very superficial labial sensory nerve exposed with mucosal incision for a chin implant

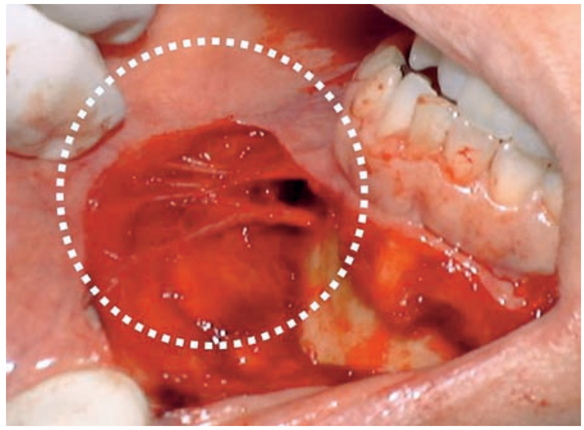

Fig. 2.18 The vast arborization of the distal branches of the mental nerve (*circled*) is visualized intraoperatively in a genioplasty incision

it away from the jaw, one can sometimes see the labial branches of the mental nerve traversing through the thin mucosa (Fig. 2.17). The mental nerve gives off labial branches to the lip and chin (Fig. 2.18).

Alternatively, the mental nerve may be blocked with a facial approach aiming for the same target (Fig. 2.16).

When anesthetized, the distribution of numbness will be the unilateral lip down to the mentolabial fold but many times the anterior chin and cheek depending on the individual furcating anatomy of that patient's nerve (Fig. 2.19). The inferior alveolar nerve also supplies sensory innervation to the chin pad. The mylohyoid nerve may also innervate this area. To augment or extend the area of local anesthesia on the chin, an inferior alveolar nerve (mandibular dental block) block can be performed instead of or with the mental nerve block. Additionally, local skin infiltration in that area may assist.

Sometimes patients may perceive pain despite bilateral nerve block in the upper or lower lips. When injecting fillers in the lower lip and bilateral mental nerve blocks are not totally effective, a supplemental infiltration of local anesthetic into the mandibular labial frenum can assist the blocks (Fig. 2.20).

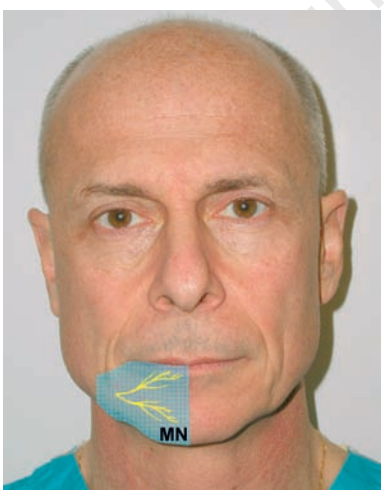

Fig. 2.19 The anesthetized areas from a unilateral mental nerve (*MN*) block. Owing to various anatomic factors, the area below the mentolabial fold or at the midline may share other innervation

Fig. 2.20 Supplemental anesthetic infiltration of the lower labial frenum area can be used to augment bilateral mental blocks when the patient still perceives pain

Fig. 2.21 Submucosal lip infiltration can be used to augment or in place of bilateral mental nerve block to treat the lower lip. Very small volumes will create adequate anesthesia. The solution is injected across the entire lip. The same technique can be used on the upper lip as well

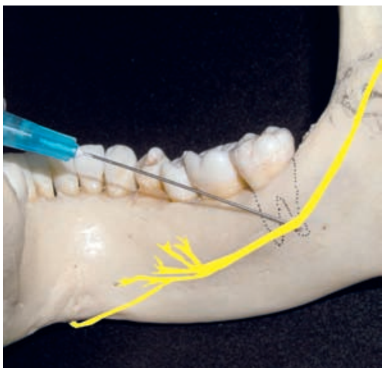

Fig. 2.22 The mylohyoid nerve may innervate portions of the chin, thus rendering a mental nerve block ineffective. The mylohyoid nerve can be blocked by injecting local anesthetic solution at the base of the roots of the second molar

Fig. 2.23 The target of the needle in the intraoral inferior alveolar nerve block is at the entrance of the nerve in the mandibular foramen on the medial ramus. The needle can be slightly bent with a medial angle to negotiate the flaring anatomy of the ramus. The mylohyoid nerve (inferior to needle) may or may not be blocked by this technique depending upon its level of branching

In the case of a “missed” or incomplete block, the lips may also be anesthetized by small amounts of submucosal local anesthetic infiltration (Fig. 2.21). This infiltration technique may be performed to assist or in place of mental nerve block, but a very small volume of local solution is used so as not to distort the lip. This is especially important when injecting fillers. Applying topical anesthesia prior to the injections will assist patient comfort.

The mental nerve block may fail to anesthetize the entire chin or area lateral to it owing to innervation from the mylohyoid nerve. Although infiltrative augmentation techniques may be used, complete anesthesia may be obtained by performing an inferior alveolar nerve block or blocking the mylohyoid nerve. The mylohyoid nerve branches off from the mandibular nerve and travels along the mylohyoid grove just below the apices of the mandibular second molars. This nerve is blocked by placing a 1.5-in. 27-gauge needle at the bottom of the roots of the lower second molar and depositing 2 ml of local anesthetic solution (Fig. 2.22).

2.4.3.6
Inferior Alveolar Nerve Block (Intraoral)

Almost every person who has ever been to a dentist has had this block and is aware of its effects, distribution, and duration. This block is technically more difficult to master, but is easily learned. The basis of this technique involves the deposition of local anesthetic solution at or about the mandibular foramen on the medial mandibular ramus where the inferior alveolar nerve enters the mandible (Fig. 2.23).

Detailed description of this technique is beyond the scope of this review but will be outlined as follows. The patient is seated upright and the surgeon places the index finger on the posterior ramus and the thumb in the coronoid notch on the anterior mandibular ramus (Fig. 2.23).

A 1.5-in. 27-gauge needle is then directed to the medial mandibular ramus at the level of the cusps of the upper second molar and the needle is advanced halfway between the thumb and index finger of the other hand that is grasping the mandible (Fig. 2.23). Two milliliters of 2% lidocaine with 1:100,000 epinephrine is then injected in a pumping motion to better the chances of anesthetic solution contacting the nerve and foramen. The needle can be slightly bent as shown in Fig. 2.23 to negotiate the sometimes outward curvature of the mandibular ramus. The surgeon should first aspirate to avoid intravascular injection. Anesthesia from this block sometimes takes 5–10 min to ensue. Proficiency in this blocking technique requires practice, but is very useful in cosmetic facial procedures. In addition, the ipsolateral tongue is usually anesthetized with this block. The area anesthetized includes the lower teeth and gums, the chin, and skin on the lateral chin. The inferior alveolar nerve block frequently includes the mylohyoid nerve. In some patients the mylohyoid nerve braches above the area of inferior alveolar injection and in this case needs a specific mylohyoid nerve block as outlined previously.

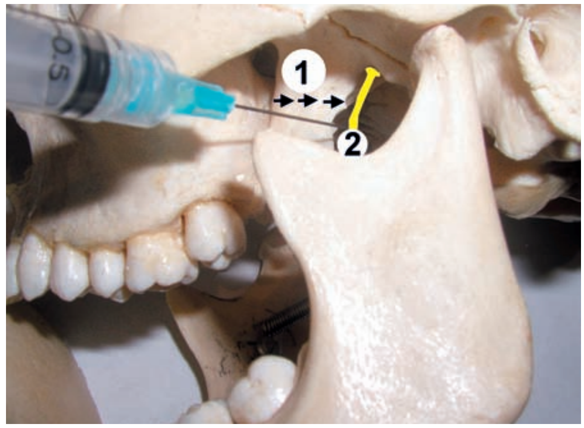

Fig. 2.24 The mandibular nerve (V3) block places the local anesthetic just posterior to the lateral pterygoid plate where the third division of the trigeminal nerve exits the foramen ovale. The needle is walked off the pterygoid plate (*1*) and the local anesthetic solution is deposited in the region of the third division of the trigeminal nerve (*2*)

2.4.3.7 Mandibular Nerve (V3) Block (Facial Approach)

The mandibular nerve can also be blocked from a deep injection as the nerve exits the foramen ovale, posterior to the pterygoid plate (Fig. 2.24). This technique requires more experience and has more potential complications than the intraoral approach.

The technique for performing this block begins with the patient in supine position with the head and neck turned away from the side to be blocked. The patient is asked to open and close the mouth gently so that the operator can identify and palpate the sigmoid notch [19]. This is the area between the mandibular condyle and the coronoid process (Fig. 2.24). This notch is located about 25 mm anterior to the tragus. If one places a finger 25 mm anterior to the tragus and opens and closes the jaw, the mandibular condyle can be palpated with the jaw open. When the jaw is closed, the finger will be over the sigmoid notch. An 8-cm 22-gauge needle is inserted in the midpoint of the notch and directed at aslightly cephalic and medial angle through the notch until the lateral pterygoid plate is contacted (Fig. 2.24) [19]. This is usually at a depth of approximately 4.5–5.0 cm. Spinal needles frequently have measuring stops that can be adjusted to the position of original contact of the pterygoid plate. The needle is then withdrawn to a subcutaneous position and carefully "walked off" the posterior border of the pterygoid plate (Fig. 2.24) in a horizontal plane until the needle no longer touches the plate and is posterior to it. The needle depth should be the same as the distance on the needle stop marker when the pterygoid plate was originally contacted. The needle should not be advanced more than 0.5 cm past the depth of the pterygoid plate because the superior constrictor muscle of the pharynx can be pierced easily [19]. When the needle is in the appropriate position, 5 ml of local anesthetic solution can be administered. The area anesthetized is shown as "V3" in Fig. 2.3. Complications include hematoma formation and subarachnoid injection [20]. This block should be learned in a proctored situation and should not be attempted by novice injectors.

2.4.3.8 Blocking the Scalp

As outlined earlier in this chapter, the anterior scalp is anesthetized by injecting the branches of V1 (supraorbital and supratrochlear nerves) and V2 (the zygomaticotemporal nerve). The posterior scalp is innervated by the greater and lesser occipital nerves and the greater auricular nerve supplies the lateral scalp (Fig. 2.25).

By performing the "brow blocks" (Fig. 2.6), the cervical plexus block (Fig. 2.27), and the zygomaticotemporal block (Fig. 2.12), one anesthetizes most of the scalp, with the exception of the posterior area. This is anesthetized by blocking the greater occipital nerve. On can also perform a ring block where wheals of local anesthetic are injected every several centimeters around the entire scalp at about the level of the eyebrows. About 30 ml of local anesthetic is required to perform a scalp ring block.

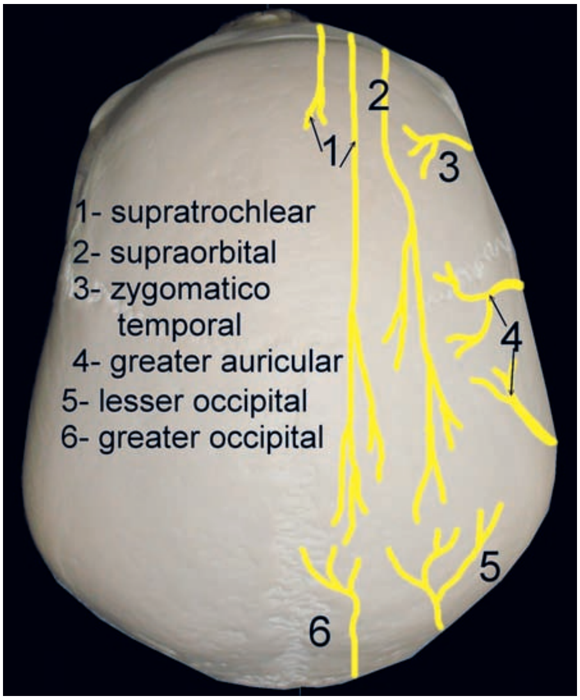

Fig. 2.25 Innervation of the scalp. *1* supratrochlear nerve, *2* supraorbital nerve(s), *3* zygomaticotemporal nerve, *4* greater auricular nerve, *5* lesser occipital nerve, *6* greater occipital nerve. (Innervation pattern adapted from Brown [19])

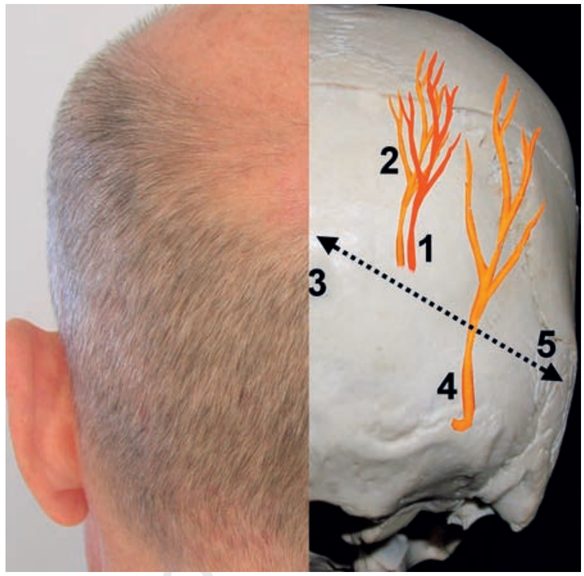

Fig. 2.26 The greater occipital nerve is in close approximation to the artery of the same name (*1*). The nerve can be located by palpating the artery and injecting just medial to it (*2*). Another landmark is injecting on the nuchal line, one third to half the distance between the mastoid prominence and occipital protuberence (*3*, *5*). *4* the lesser occipital nerve

2.4.3.9 Greater Occipital Nerve Block Technique for Posterior Scalp Anesthesia

The greater occipital nerve arises from the dorsal rami of the second cervical nerve and travels deep to the cervical musculature until it becomes subcutaneous slightly inferior to the superior nuchal line [21]. It emerges on this line in association with the occipital artery, and the artery is the most useful landmark for locating the greater occipital nerve (Fig. 2.26). The most efficient patient position is sitting upright with the chin flexed to the sternum [20].

The nerve is identified at its point of entry to the scalp, along the superior nuchal line two thirds to half the distance between the mastoid process and the occipital protuberance in the midline (Fig. 2.26). Another measurement for locating the artery is 2.5–3.0 cm lateral to the occipital protrubence [22]. The patient will report pain upon compression of the nerve: the point at which maximal tenderness is elicited can be used as the injection site. A 0.625-in. 25-gauge needle is used for the block. The occipital artery is just lateral to the greater occipital nerve and can be used as a pulsitile landmark. Between 2 and 4 ml of local anesthetic solution can be infiltrated on either side of the artery to ensure proximity to the nerve. Figure 2.29 shows the dermatomes anesthetized by blocking the greater occipital nerve.

2.4.3.10 Local Anesthesia of the Neck

Innervation of the Cervical Plexus

The cervical plexus is formed from the ventral rami of the upper four cervical nerves (Fig. 2.27). Their dorsal and ventral roots combine to form spinal nerves as they exit through the intervertebral foramen. The anterior rami of C2 through C4 form the cervical plexus [13]. The cervical plexus lies just behind the posterior border of the sternocleidomastoid muscle, giving off both superficial (superficial cervical plexus) and deep branches (deep cervical plexus). The branches of the superficial cervical plexus supply the skin and superficial structures of the head, neck, and shoulder. The deep branches of the cervical plexus innervate the deeper structures of the neck, including the muscles of the anterior neck and the diaphragm (phrenic nerve), and are not blocked for local anesthetic procedures.

Superficial Branches of the Cervical Plexus

The lesser occipital nerve arises from the second (and sometimes third) cervical nerve and emerges from the deep fascia on the posterior lateral portion of the head behind the auricle, supplying the skin and communicating with the greater occipital nerve, the greater auricular nerve, and the posterior auricular branch of the facial nerve [13].

The greater auricular nerve arises from the second and third cervical nerves and divides into an anterior and a posterior branch. The anterior branch is distributed to the skin of the face over the parotid gland, and communicates in the substance of the gland with the facial nerve.

The posterior branch supplies the skin over the mastoid process and on the back of the auricle, except at its upper part; a filament pierces the auricle to reach its lateral surface, where it is distributed to the lobule and lower part of the concha. The posterior branch communicates with the lesser occipital nerve, the auricular branch of the vagus, and the posterior auricular branch of the facial nerve [13].

The cutaneous cervical nerve (cutaneous colli nerve, anterior cervical nerve) arises from the second and third cervical nerves and provides sensation to the anterolateral parts of the neck (Fig. 2.25).

Cervical Plexus Block

This technique is used in cosmetic facial surgery to block the superficial branches of the cervical plexus to anesthetize skin of the lateral or anterior neck, the posterior lateral scalp, and portions of the periauricular area (Fig. 2.3).

The technique involves laying the patient back with the sternocleidomastoid flexed. The line from the mastoid process to the transverse process of C6 (Chassaignac's tubercle) (approximate level of the cricoid cartilage) (Fig. 2.27) is divided in half at the posterior border of the sternocleidomastoid to determine the injection point [19, 23]. Another technique is to simply bisect the distance from the origin and insertion of the sternocleidomastoid without osseous landmarks. The success of this block involves a larger volume of local anesthetic diffusing and spreading out over a larger area rather than absolute accuracy of the nerve position. Between 3 and 5 ml of local anesthetic solution is injected subcutaneously with the needle perpendicular to the skin. The needle is then redirected superiorly and another 3–5 ml is injected. Finally, the needle is then directed inferiorly and another 3–5 ml is injected. Figure 2.27 shows the areas anesthetized by a cervical plexus block.

Phrenic nerve involvement is rare with superficial cervical plexus block (it is more common with deep cervical blocks) but is technically possible as C3, C4, and C5 innervate the diaphragm. Healthy patients can tolerate a hemiparalysis of the diaphragm but caution must be used in patients with cardiopulmonary problems as assisted ventilation may be required. It must be kept in mind that a bilateral block could potentially denervate the entire diaphragm. To prevent unwanted spread of local anesthetic solution, this injection is just subcutaneous in placement and is never done bilaterally.

2.4.3.11 Ear Block

Four nerve branches supply sensory innervation to the ear. The anterior half of the ear is supplied by the

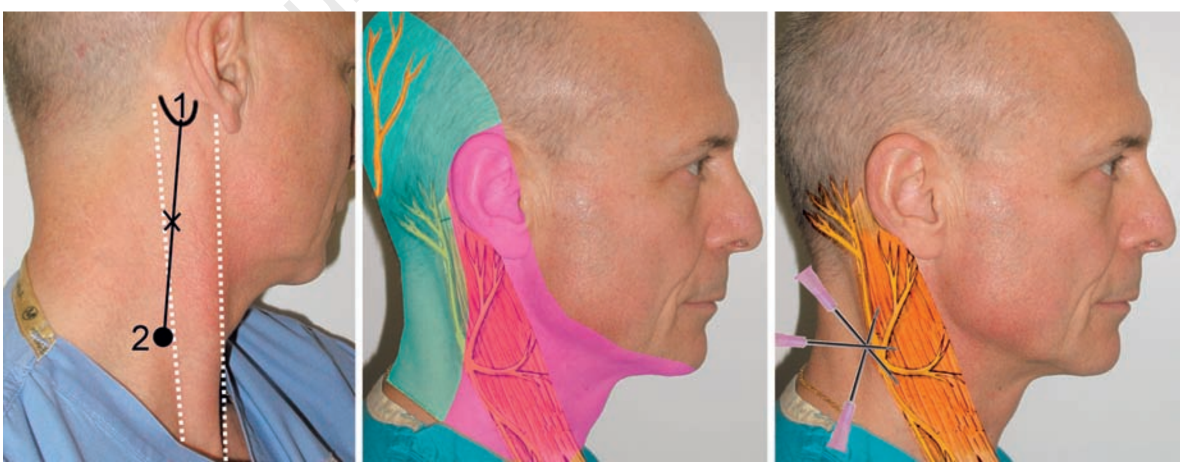

Fig. 2.27 The cervical plexus block is performed by making a line from the mastoid process (*1*) to the level of the transverse process of C6 (*2*) then finding the point halfway between these two marks (*X*) just posterior to the sternocleidomastoid (*dotted line*). Local anesthetic is then injected perpendicular, superiorly, and inferiorly in this region. The *middle picture* also shows the greater occipital nerve, which is not part of the cervical plexus

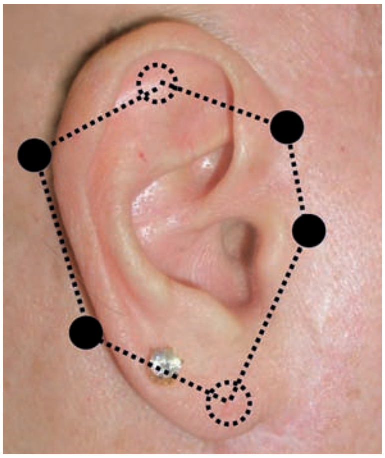

Fig. 2.28 Blocking the entire ear (with the exception of the area supplied by the vagus nerve) can be performed by inserting the needle at the *black dots* and infiltrating along the *dotted lines*. This will anesthetize the terminal branches of the auriculotemporal nerve, the lesser occipital nerve, and the anterior and posterior branches of the greater auricular nerve. The main trunks of these nerves could be blocked as detailed in the text, but this terminal infiltration technique may be more convenient

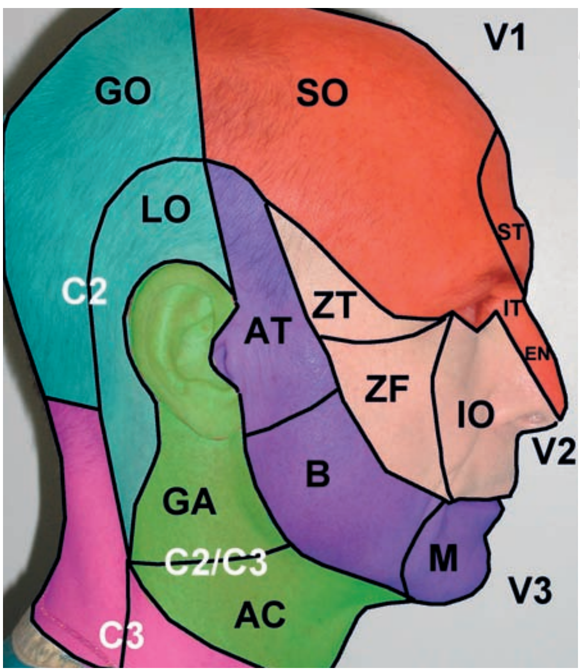

Fig. 2.29 The major sensory dermatomes of the head and neck. *AC* anterior cervical cutaneous colli, *AT* auriculotemporal nerve, *B* buccal nerve, *EN* external (dorsal) nasal nerve, *GA* greater auricular nerve, *GO* greater occipital nerve, *IO* infraorbital nerve, *IT* infratrochlear nerve, *LO* lesser occipital nerve, *M* mental nerve, *SO* supraorbital nerve, *ST* supratrochlear nerve, *ZF* zygomaticofacial nerve, *ZT* zygomaticotemporal nerve. (Adapted from Larrabee [24])

auriculotemporal nerve, which is a branch of the mandibular portion of the trigeminal nerve. The posterior half of the ear is innervated by two nerve branches derived from the cervical plexus: the great auricular nerve and the lesser occipital nerve (Fig. 2.27). The auditory branch of the vagus nerve innervates the concha and the external auditory canal.

Although these nerves can be individually targeted with blocks, a circumferential infiltration (ring block) will anesthetize the entire ear, except the concha and the external auditory canal, which are innervated by the vagus nerve. The needle is inserted into the skin at the junction where the earlobe attaches to the head. The anesthetic should be infiltrated while the needle is advanced to the subcutaneous plane. Infiltration is made in a hexagonal pattern around the entire periphery of the ear (Fig. 2.28). The chonal bowl and external auditory canal will need separate infiltration. One should aspirate (as with all injections) prior to injection to prevent intravascular injection.

2.5 Summary

A firm knowledge of the sensory neuroanatomy of the head and neck can benefit the practice of cosmetic facial surgery for both the surgeon and the patient. Although the pathways of sensation for the head and neck are complex, they can be easily and safely blocked by reviewing the basic innervation patterns.

The entire sensory apparatus of the face is supplied by the trigeminal nerve and several cervical branches. There exist many patterns of nerve distribution anomaly, cross-innervation, and individual patient variation; however, by following the basic techniques outlined in this chapter, the cosmetic surgeon should be able to achieve pain control of the major dermatomes of the head and neck. A basic dermatomal distribution is illustrated in Fig. 2.29 and can serve as road map to local anesthesia of the head and neck.

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