Diagnosis and Management of Head and Face Pain

A Practical Approach

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To our residents, nurses, and assistants who work with me—without their help, I could not do what I do to help patients.
And to my family: Karen, Brent and Constance, Tiffany, Bradley and Jessica, Brennan, and to my wonderful grandchildren, Sophia, Vivian, and Ethan James. They are my joy outside of work!

James Y. Suen

To my husband, Shane Estep, my partner and love.
To my son Ethan, who teaches me to look at the puzzles of life with fresh curiosity.
To my sister, Aili, and my father, Karl, and all my family for all their support and love.
In loving memory of Elisabeth Saranec Petersen, who launched me on the way.

Erika Petersen

Preface

Millions of people throughout the world suffer with pain of the face and head. The costs of these problems are tremendous and include medical treatment, lost wages, and lost productivity. Problems with opioid addiction and the emotional distress existing in patients and their families are often under-recognized in these patients.

Many physicians do not like dealing with patients who have facial and head pain, because they feel they have little to offer them except medications. With the opioid crisis in the United States, physicians are becoming reluctant to prescribe narcotics, even when many times these may be the only drugs that help patients tolerate their pain. Patients with uncontrolled facial and head pain are desperate and feel helpless, and often the clinicians treating them are limited in the possible treatment options to consider.

We accepted the task of editing this textbook on the treatment of facial and head pain because we know there are many options for treating these patients besides medications, such as narcotics. As a head and neck surgeon, I have seen many patients with severe pain from cancer or trauma. Rather than sending these patients to other physicians, I would think of ways to try to stop pain in these patients. Dr. Petersen, in her neurosurgical practice, has also seen patients whose options required exploring less familiar alternatives to address refractory symptoms. With this experience, we have seen and operated on most nerves innervating the head and neck. This has proven to be an advantage in knowing where the cranial and cervical nerves are located and what areas they innervate. We have found that doing nerve blocks and/or removing the peripheral nerves has helped many patients with face and head pain. In some instances, the appropriate neurosurgical, neuromodulation, or dental procedure has been the key.

Because of this success in helping patients with face and head pain, we have had many referrals from neurologists, neurosurgeons, pain specialists, and dentists. This has given us a major learning experience over the past 10 years, and sharing this experience can give guidance to other clinicians on how to manage patients with face and head pain.

The treatment of head and face pain benefits from a multidisciplinary approach. Similarly, we have gathered a group of experts from multiple specialties—neurology,

neurosurgery, anesthesiology, interventional pain, psychiatry, psychology, dentistry, otolaryngology, plastic surgery, neuroradiology, radiation oncology—to contribute to this textbook. We have tried to make this as comprehensive as possible and as practical as possible.

From our experience, we feel that the majority of face and head pain is the result of problems with the peripheral nerves of the trigeminal nerve and the cervical nerves. Most of these nerves are accessible for nerve blocks, or for decompression or resection, when indicated. Diagnosis depends on a good knowledge of anatomy of the nerves innervating the head and face, and on the understanding of the differential diagnosis based on obtaining a good history. The key to treatment is arriving at the correct diagnosis.

This textbook is divided into four parts. The first part covers the clinical fundamentals: etiology, pathophysiology, anatomy, and nomenclature. The second part covers evaluation and diagnosis, where diagnostic nerve blocks are discussed in detail. These blocks should be considered a crucial part of the evaluation. The third part discusses management and treatment options, and the fourth part presents representative clinical cases and the management. Overall there are 42 chapters which give a comprehensive overview of face and head pain.

We hope this textbook gives clinicians a systematic approach to treating face and head pain. It reviews the more standard methods of treatment and introduces some newer methods.

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Little Rock, AR, USA Erika Petersen

Acknowledgments

We wish to thank all the contributors who took time from their busy practices to write chapters. This group of contributors, who are each considered experts in their field, helped to make this a comprehensive textbook on facial and head pain. This was a team effort that we hope will provide the reader with new insights to the diagnosis and treatment of face and head pain.

Also we want to thank Leslie Norris who did the medical illustrations for our chapters. Our special thanks goes to Joni Fraser, Development Editor at Springer Publishers, who provided wonderful assistance throughout this effort.

We would like to thank all those clinicians who have influenced our practice and specifically our approach to head and facial pain.

Finally, we offer our gratitude to patients that we have treated over the years who suffer with head and face pain. Thank you for trusting us to find treatments for you. We hope this textbook will offer hope and treatment to all patients who suffer from similar conditions.

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Part I
Clinical Fundamentals

Chapter 1
Applied Neuroanatomy of the Face and Head

Chelsey Smith and James Y. Suen

Introduction

Comprehensive knowledge of the neuroanatomy of the head, neck, and face is paramount to the treatment of pain located in these areas. In the arenas of both otolaryngology and neurosurgery, we encounter these nerves and their landmarks daily just by the nature of our surgical expertise, and this becomes a valuable tool when evaluating and treating the facial and head pain patient. When facial and head pain is seen through the lens of anatomy rather than the serpentine tunnel of conditions of chronicity, the assessments and plans become more efficient and concise. It can even eliminate the use of imaging modalities, including ultrasound (often used to aid in finding peripheral nerves for nerve injections). Knowing the nerve anatomy can help the physician determine the nerves which may be triggering the patient's pain or headache on the initial visit.

Overview of the Head, Face, and Neck Dermatomes

Three specific nerve groups are the treatment focus for facial and head pain: the trigeminal nerve, the upper cervical plexus, and the greater occipital nerve. Comprehension of these three neuroanatomical structures allows for diagnostic and

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potentially therapeutic pain relief in all head and face dermatome distributions. Knowing the dermatomes will aid in determining a patient's "trigger" point(s) and localizes pain distribution so that a specific nerve(s) can be targeted for therapy. It is simple mapping that both the patient and the physician can refer.

Figure 1.1 depicts the dermatomes of the head and neck. The three anterior zones correlate with the distal sensory nerve innervations of the three trigeminal nerve divisions. The upper cervical plexus dermatome is depicted by the region from the upper anterior neck around the lower earlobe and over the parotid and angle of jaw areas. Lastly, the greater occipital nerve supplies the posterior scalp from the vertex of the skull down to the upper posterior neck.

Each of these three anatomical positions will be described in the following text.

It is important to understand that pain in one nerve dermatome distribution can cause pain in the other branches of that division and even into the other divisions. Also pain in the trigeminal nerve branches can trigger pain in the lesser or greater occipital nerves through a connection in the brain stem called the trigeminocervical complex, and vice versa, the occipital nerve pain can trigger trigeminal nerve pain.

Trigeminal Nerve

The trigeminal nerve arises from the Pons and goes into Meckel's cave in the cavernous sinus where the trigeminal ganglion is located. This ganglion contains the cell bodies for the afferent sensory nerve fibers of the trigeminal nerve's three divisions, the ophthalmic, the maxillary, and the mandibular divisions, commonly referred to as V1, V2, and V3 [1].

It is important to know the branches of each of these three divisions and where they innervate the face and head (Fig. 1.2).

The first division, V1, is the ophthalmic branch. It enters the orbit through the superior orbital fissure and has several nerves to eye structures, to the internal upper nose, and then further divides into the supraorbital, supratrochlear, and infratrochlear nerve branches as it exits the orbit. *The supraorbital nerve* exits the orbit through the supraorbital notch or foramen, and it supplies the upper eyelid and the ipsilateral forehead to the vertex of the scalp. The notch or foramen can be a place where the supraorbital nerve can be compressed. A notch occurs about 83% of the time and is usually encircled by a ligamentous fascial band which encircles the nerve [2]. The *supratrochlear nerve* exits at the superior-medial part of the orbit near the bridge of the nose and supplies the skin of the forehead near the midline (Fig. 1.3). Pain in V1 can be in the eyelid, the forehead, or the top of the head and can trigger headaches, commonly diagnosed as migraine headaches.

The *infratrochlear nerve* supplies the skin over the bridge of the nose and the medial part of the lower eyelid.

The second division, V2, is the maxillary branch, and it is primarily sensory in function. It is more complex and takes more study to understand the innervation and where pain from V2 can elicit. The main nerve of V2 is the *infraorbital nerve* which

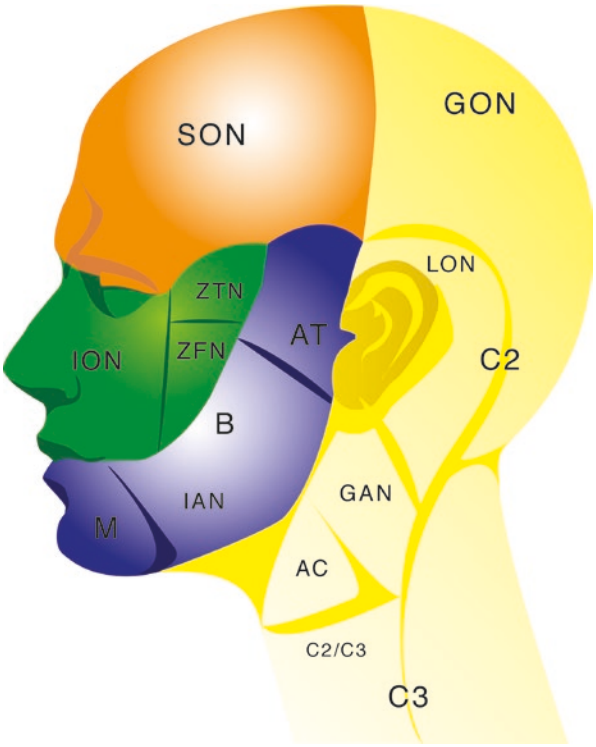

Fig. 1.1 Dermatomes of the trigeminal nerves to the face and of the upper cervical plexus and greater occipital nerves to the back of the head and upper neck. Orange ophthalmic division of trigeminal; green maxillary division of trigeminal; purple mandibular division; yellow upper cervical plexus and greater occipital nerves

goes in a groove in the floor of the orbit and exits through the infraorbital foramen and supplies the midface. There are two other branches of this nerve which are important to know. One is the *posterior superior alveolar nerve* (Fig. 1.2) which comes off the V2 after it exits the foramen rotundum and wraps around the posterior-lateral wall of the maxilla where it enters the underlying bone and innervates the posterior upper teeth. It is common for pain in this nerve to be diagnosed as dental pain and result in dental extractions with no pain relief.

The second important branch is the *zygomaticotemporal nerve* (ZTN) which leaves the infraorbital nerve in the floor of the orbit and goes into the zygoma bone and exits just lateral to or through the bone of the lateral orbital rim and goes to the anterior temporalis muscle area (Fig. 1.3). The foramen where the ZTN exits the zygoma is about 7 mm lateral to the lateral orbital rim and about 8 mm cranial to the lateral canthus. It goes into the temporalis muscle or just superficial to it. Sometimes the ZTN comes out just lateral to the lateral orbital rim. Pain in this nerve is quite common and can cause temporal headaches which are commonly called migraine headaches.

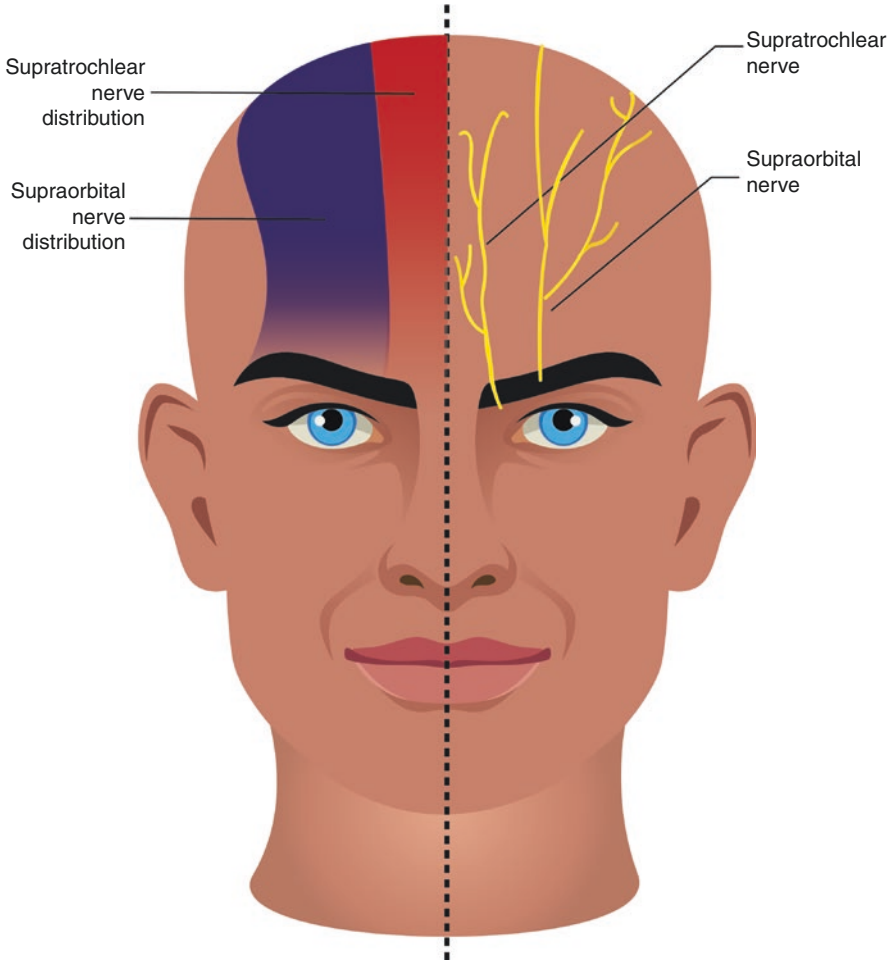

Fig. 1.2 The trigeminal nerve ganglion with the three major divisions: ophthalmic, maxillary, and mandibular

The third division, V3, is called the mandibular branch (Fig. 1.2), and it has both sensory and motor function. The motor part supplies the muscles of mastication. The sensory branches go to three main areas: *the lingual nerve* to the tongue, the *inferior alveolar nerve* into the mandible in the ascending ramus and supplying the lower jaw teeth and exiting the mental foramen to supply the chin and lower lip, and the third branch, the *auriculotemporal nerve* (*ATN*), which exits just posterior to the mandibular condyle and goes superiorly to the area of the temple and above the ear (Fig. 1.1). Pain can occur in one or all of these branches. We feel the auriculotemporal nerve can also trigger migraine headaches.

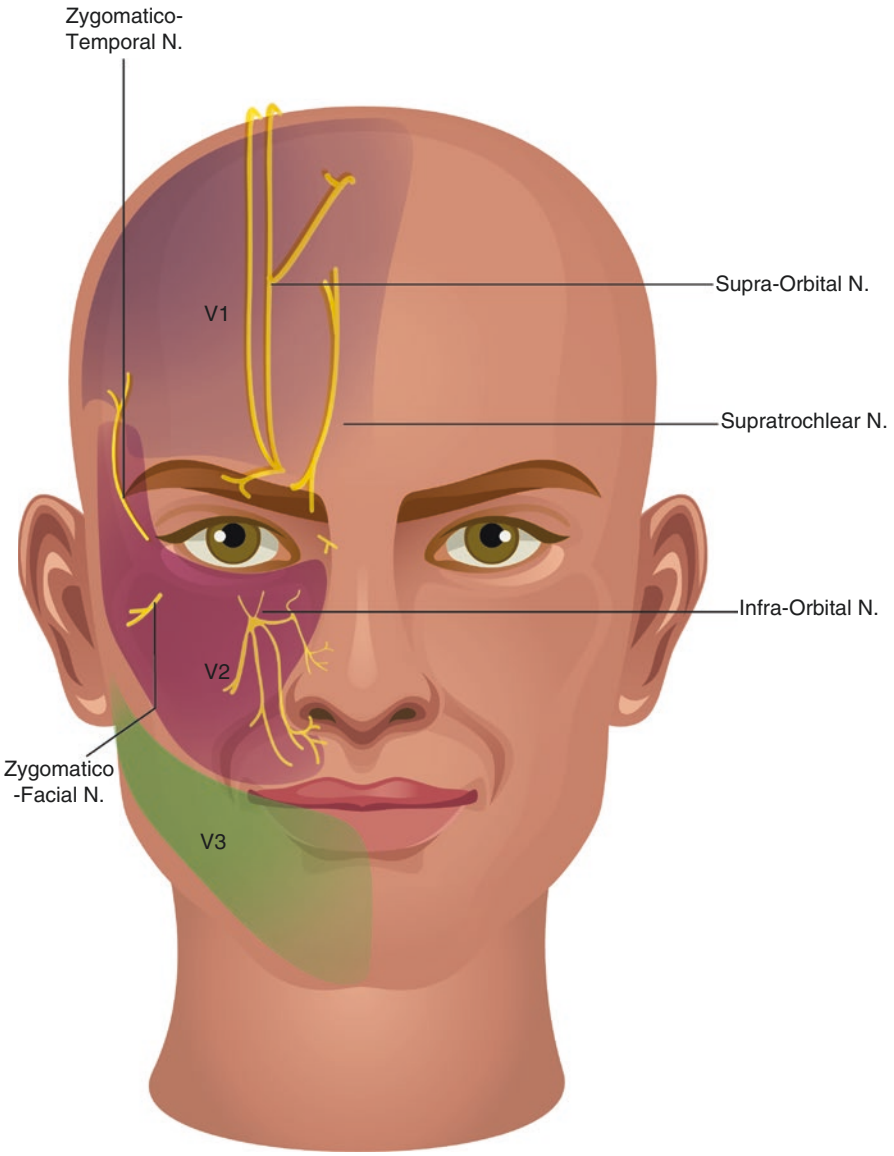

Fig. 1.3 The supraorbital and supratrochlear nerves innervate the forehead to the vertex of the scalp. This also illustrates the location of the zygomaticotemporal nerve branch of the maxillary division of the trigeminal nerve

Upper Cervical Plexus

Neuritis originating from the upper cervical plexus is commonly encountered during the work-up of the head and neck pain patient. Consisting of both motor (ansa cervicalis) and sensory components, its distal reaches are wide and disperse. For the purposes

of this chapter, the focus will be on the sensory portions only [2]. Origins for the cervical plexus begin deep to the sternocleidomastoid muscle (SCM) formed by the ventral rami of C2, C3, and C4. After emanating from deep to the SCM, the sensory branches route just above the midpoint of the posterior border of the SCM and then scatter to their distal destinations. *Branches of the upper cervical plexus nerves include the lesser occipital, greater auricular, and the transverse cervical nerves* (Fig. 1.4).

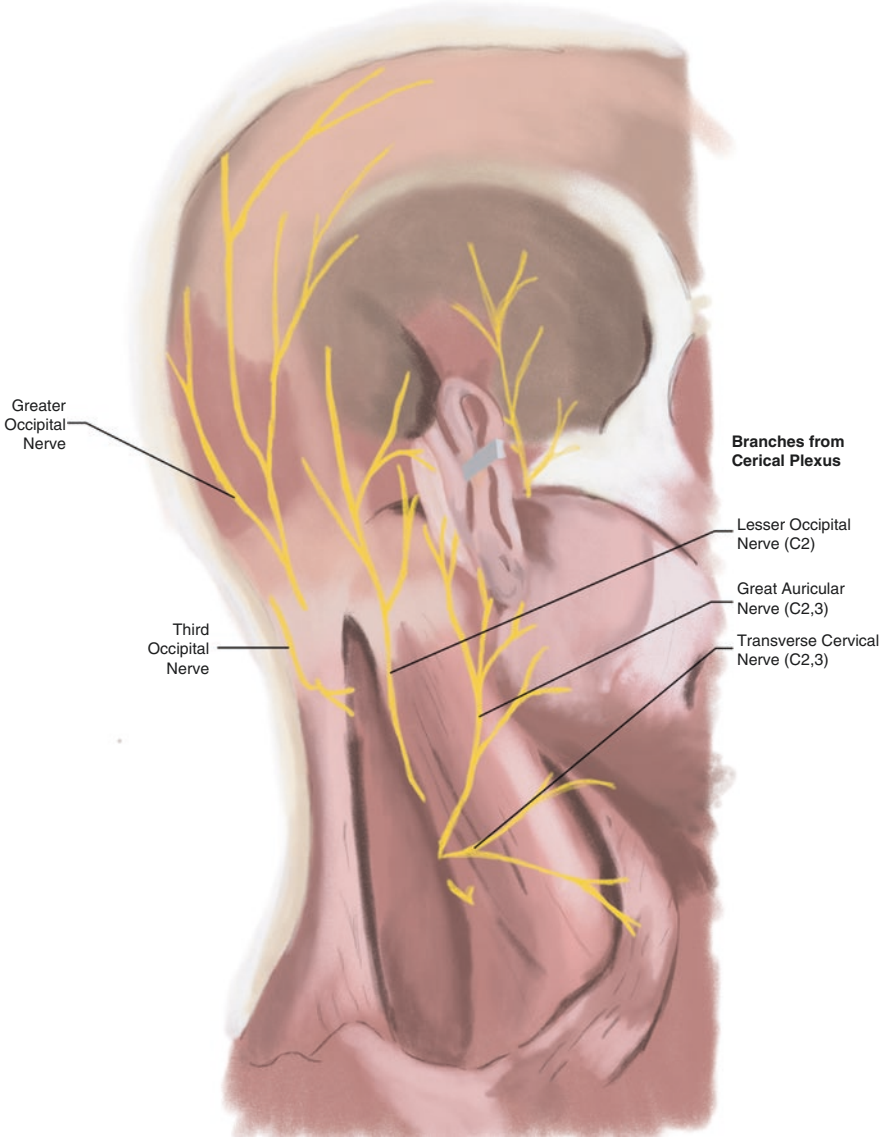

Fig. 1.4 Upper cervical plexus nerves include the lesser occipital, greater auricular, and transverse cervical nerves from C2 to C3

It is important to understand the anatomical location at which the nerves emerge from the posterior border of the SCM as this is the location for insertion of the needle for clinical nerve blocks. We use the definition of "Erb's point" to aid in localizing the site of emergence as being approximately halfway between the mastoid process and the clavicle along the posterior edge of the SCM. From this point, 1–2 cm superior to this location along the posterior border of the SCM is considered Erb's point. This is considered the "sweet spot" for cervical plexus nerve blocks and is where the main branches of the upper cervical plexus are in close proximity before they separate and go to different areas (Fig. 1.4).

Lesser Occipital Nerve: the lesser occipital nerve is a sensory nerve that is derived from the ventral rami of C2 and C3. After passing over the posterior border of the SCM muscle, it usually ascends along the posterior border of the SCM but may go deep to the muscle and surface over the mastoid process and supplies sensory innervation posterior to the ear, and up to the temple area above the ear. This is important to know because pain above the ear can be related to the lesser occipital nerve.

Greater Auricular Nerve: ventral rami C2 and C3 also give rise to the greater auricular nerve fibers. Exiting the posterior border of the SCM, this nerve proceeds toward the lower earlobe as it crosses the SCM. It innervates the lower part of the ear, the skin overlying the tail of the parotid gland and over the angle of the mandible (Fig.1.4).

Transverse Cervical Nerve: similar to the lesser occipital and greater auricular nerves, the transverse cervical nerve also arises from the C2 and C3 ventral rami. After passing over the posterior border of the SCM, it continues anteriorly in a horizontal fashion and innervates the skin along the jaw line.

Greater Occipital Nerve

The greater occipital nerve can be a common source for severe head and neck pain, frequently described as "tension headaches" [3]. Fortunately, it is easily accessible for clinical treatment. The dorsal ramus of C2 is the source of this nerve. It pierces the suboccipital triangle between the obliquus capitis inferior muscle and the semispinalis capitis muscle. As it ascends superficial to the semispinalis and deep to the trapezius, it eventually pierces through the superior portion of the trapezius at the level of the nuchal line [4] (Fig. 1.4). The nuchal line is an excellent landmark for finding the appropriate latitude of the greater occipital nerve and where it begins its course into the subcutaneous scalp. Other helpful landmarks include the posterior midline sulcus of the neck and the occipital protuberance (Fig. 1.5). From this midline site, the occipital nerves can be found approximately 1.5–2.5 cm laterally. Once the greater occipital nerve commences its subcutaneous course, it ascends and innervates the skin of the posterior scalp to the level of the vertex.

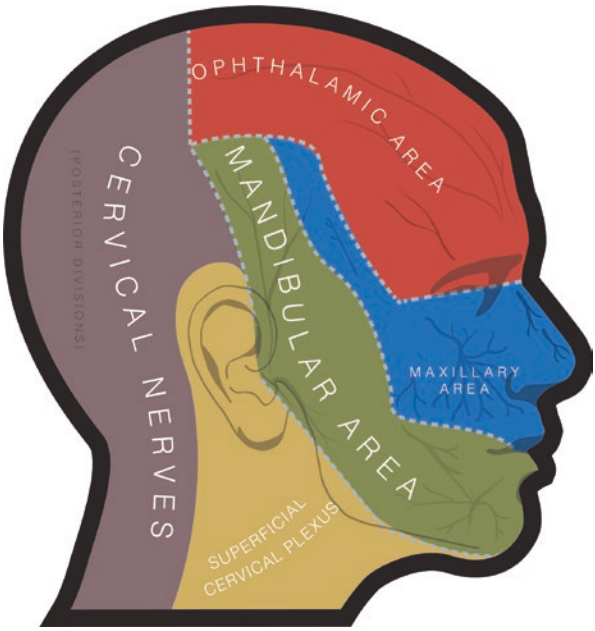

Fig. 1.5 The terminal branches of the greater occipital nerves and the lesser occipital nerves in relationship to the occipital protuberance and mastoid landmarks

Conclusion

The trigeminal nerve, the upper cervical plexus nerves, and the greater occipital nerves are the primary nerves which causes head and face pain. It is important to learn the dermatomes that these nerves innervate. All these nerves are accessible in multiple ways for pain treatment modalities. This will be the focus of the remaining portions of this text.

The sensory neuroanatomy of the head and neck is unparalleled in its detail and elegance, but when dissected down to its fundamentals, it can be a straightforward way to think about the diagnosis and treatment of facial pain. Concise medical comprehension of these nerves and dermatomes can be the intersection between physician assessment and patient understanding, leading to satisfying clinical encounters concerning head and face pain. Anatomic knowledge is a pillar of punctual and accurate diagnosis in this arena.

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