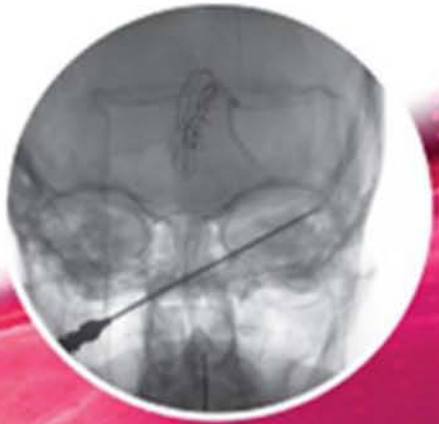
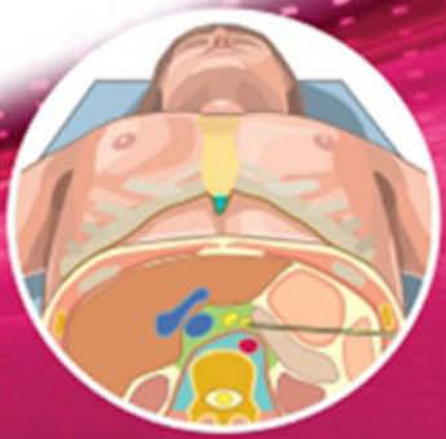
Steven D. Waldman

Atlas of INTERVENTIONAL PAIN MANAGEMENT

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Atlas of Interventional Pain Management

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FIFTH EDITION

Steven D. Waldman, MD, JD

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This book is dedicated to Dr. Steven Barag,
dear friend, mentor, philosopher, clinician, teacher, comedian,
and the only guy I know who can wear an ascot and actually pull it off.

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Preface

Milepost 40
First Interventional Pain Management Meeting
Nice, France—1992
Steven D. Waldman, MD, JD, Ronald Melzack, PhD, and Alon Winnie, MD (left to right)

For most who are currently practicing medicine, the specialty of interventional pain management has just always been there. Have a patient who needs an epidural? Just consult your friendly pain management specialist. It is almost impossible to remember a time when this wasn't so. In reality, our specialty of interventional pain management is one of medicine's youngest. The specialty of interventional pain management is a mere 40 years old. So, you may ask, "*Where do babies come from"?*

Well, it would seem that a little meeting of a couple of hundred physicians with an interest in using invasive techniques to treat pain that Alon Winnie and I organized in Nice, France, is hardly worth mentioning. But in fact, it was at this meeting that a new subspecialty of pain medicine was born…Interventional Pain Management. This specialty devoted its efforts to the use of neural blockade, implantable technologies, and neurodestructive procedures to treat pain. That is not to say that before this meeting physicians were not using invasive techniques to treat pain…it was simply that this was the first time that many of those physicians interested in using invasive pain treatment modalities got together in an organized fashion and begin to define the subspecialty that we now call Interventional Pain Management.

As I noted in the Preface to the third edition of *Atlas of Interventional Pain Management*, I came up with the name *interventional pain management* as a way to signal to potential meeting goers that this meeting was about invasive procedures rather than pills, hypnosis, biofeedback, and behavioral modalities that were *de rigueur* at the time. Truth be told, at the meeting, some suggested that a better name for our new subspecialty would be "invasive pain management." Fortunately or unfortunately, depending on how you look at it, that name didn't stick, so here were are today.

To put all of this ancient history in the proper context, it is useful to look at where the specialty of pain management was back in these dark ages…a time before cell phones, personal computers, Viagra, and PRP…a time when most of the discussion surrounding the treatment of the patient in pain centered on tricyclic antidepressants, major tranquilizers, anticonvulsants, biofeedback, and behavior modification.

Wait, you say…there was no specialty of pain management at that time…at least insofar as organized, mainstream medicine was concerned! Forty years ago, with the exception of a few unofficial and uncertified training programs that were run by a rather eccentric group of anesthesiologists including Raj, Racz, Winnie, and myself, there were no organized training programs for pain management, let alone any real fellowships. At that time, a very few of us devoted our practices solely to pain management. For most, pain management was a sideline; for many, pain management was an unwelcome interruption to their day. Practitioners would grudgingly do a nerve block or two in the recovery room after spending a day giving anesthesia in the operating room. You might ask, what about the PM & R docs and neurologists? They did not arrive on the pain management scene until much later.

You will remember that the first "official" examinations in pain management were not held until 1993. I remember flying to Chicago along with about 250 other "grandfathered" anesthesiologists to sit for a 3-hour written examination that was made up of primarily of questions written by those of us who were sitting for the

examination. Hard to believe that since we wrote most of our own questions, the pass rate for this first exam was only about 80%! Those of us who passed the examination were awarded the dubious distinction of having qualified for a *Certificate of Added Qualification in Pain Management* by the American Board of Anesthesiology. Truth be told, no one was really clear on what that really meant or whether it was even worth listing on your curriculum vitae.

Fast forward to 2020 and you will find that our specialty has really come up in the world. Pain Medicine (its name changed from Pain Management in 2002) is now recognized by the American Board of Medical Specialties as a specialty worthy of its own full subspecialty board certification…a Board Certification that can be reached only after completing a four-year residency in anesthesiology, physical medicine and rehabilitation, neurology, etc. and a one- to two-year fellowship in pain medicine, and then passing a rigorous written examination. We have traveled quite a distance in the past 40 years, but these years have not been without some growing pains…some good and some not so good.

As the body of knowledge of Interventional Pain Management began to become codified by the publishing of the first books in our specialty such as Raj's *Practical Management of Pain*, and my textbooks *Interventional Pain Management* and the *Atlas of Interventional Pain Management Techniques*, organized fellowships in pain management began appearing. As these training programs grew both in scope and stature, a critical mass of qualified interventional pain management specialists became available to care for the patient in pain. Interventional pain management procedures became the gold standard for the treatment of pain. As with most good things, some interventional pain management specialists, myself among them, adopted the mantra that *if a little was good, more was better.* To borrow a term from the former head of the Federal Reserve, Ben Bernenke, there was a *"frothy, irrational exuberance"* insofar as interventional pain management procedures were concerned. Many interventional pain management specialists bragged "there was no place in the body that they couldn't put a needle"! Fortunately, as the specialty evolved, so did its practitioners and with the help of new professional organizations such as the Society for Pain Practice Management, the American Society of Regional Anesthesia, and later the American Society of Interventional Pain Physicians under the tireless leadership of Lax Manchicanti, interventional pain specialists began to promulgate guidelines for best practices for our specialty and to the benefit of our patients.

But there was trouble in paradise. As a result of a paper based on just 38 patients published by Portenoy and Foley, many interventional pain management specialists (along with the rest of the medical community) were told that opioids…specifically Oxycontin and the like…were the panacea we were all looking for when treating the patient in pain. Interventional pain management specialists were admonished "How dare you stick a needle in a patient suffering from back pain." Portenoy and Foley concluded that *"opioid maintenance therapy can be a safe, salutary and more humane alternative to the options of surgery or no treatment in those patients with intractable non-malignant pain and no history of drug abuse."* After all, we were told, pain was the *Fifth Vital Sign,* and the medical community was roundly chastised that it was being grossly undertreated. Many in our specialty of interventional pain management drank the "*opioid for non-malignant pain Kool Aid"* and eschewed the time-proven beneficial interventional pain management procedures, choosing instead to reach for the prescription pad. For a time, a feeling of guilt pervaded our specialty…especially whenever one of us picked up a needle or scalpel…and a sort of Dark Ages descended on the specialty of interventional pain management. These guilt-ridden, dark years dragged on as a relentless campaign organized and funded by pharmaceutical companies to promote the use of opioids for chronic non-malignant pain gathered momentum. Physicians were told that "opioids were a gift from nature," and the few holdouts who refused to prescribe opioids in the setting of chronic non-malignant pain were accused of suffering from opiophobia. Even the State Federation of Medical Boards and the Joint Commission yielded to the pressure of this stealth program organized and financed by big pharma to sell opioids and jumped on the opioids for chronic non-malignant pain bandwagon. It seems that our specialty was at risk for obsolescence. It was indeed a dark time. To quote Thomas Paine, "*A long habit of not thinking a thing wrong gives it a superficial appearance of being right."* Although many knew deep down in their hearts that the use of opioids as a first line treatment for chronic non-malignant pain was wrong, few spoke up. This silence on the part of organized medicine, and our specialty in particular, led to a public health disaster that could only be likened to the Black Plague of the Middle Ages…a pandemic that ultimately harmed millions of people!

Fortunately, as in most times in the history of man, good triumphed over evil. As the deaths and ruined lives resulting from the inappropriate use of opioids mounted, a few voices within our specialty began to speak out against opioids, and once again interventional pain management specialists are putting away their prescription pads and again turning to interventional procedures to help their patients.

Helping fuel this renewed enthusiasm in the use of interventional pain management modalities has been the arrival on the scene of a totally unrelated development…the use of ultrasound guidance. Just as improvements in needle technology and implantable devises helped fuel the early growth of our specialty, huge improvements in ultrasound technology, both in terms of image resolution and ease of use, have made performing many interventional pain management procedures easier and safer for both the pain management specialist and the patient. Although time and experience will help define exactly where ultrasound fits within the practice of interventional pain management, I believe that most will agree that this imaging modality has been a great advancement for our specialty.

About this fifth edition of *Atlas of Interventional Pain Management*…a little information is in order. In its first four editions, the *Atlas of Interventional Pain Management* has enjoyed enormous success, becoming the largest selling pain management text currently in print. The various editions have been translated into more than 18 languages and have been a mainstay of education for a generation of interventional pain management physicians. My colleagues at Elsevier and I are very proud of these facts and have endeavored to make this fifth edition the best one yet. I have added 21 brand new chapters and more than 200 new full-color figures and have greatly expanded information on the use of ultrasound guidance. The addition of more than 100 how-to-do-it sections on ultrasound-guided interventional pain management techniques that are richly illustrated with full-color photographs showing transducer placement, patient positioning, and clearly marked ultrasound images should make this fifth edition of *Atlas of Interventional Pain Management* better than ever.

As always, I hope you enjoy reading and using this text as much as I enjoyed writing it!

Steven D. Waldman, MD, JD
Spring 2020

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1 Atlanto-Occipital Block Technique

CPT-2019 CODE	
First Joint	64490
Second Joint	64491
Third and Any Additional Joint	64492
Neurolytic First Level (Two Nerves)	64633

RELATIVE VALUE UNITS	
First Joint	12
Second Joint	12
Each Additional Joint	12
Neurolytic First Level (Two Nerves)	30

Indications

Atlanto-occipital block is useful in the diagnosis and treatment of painful conditions involving trauma or inflammation of the atlanto-occipital joint. These problems manifest clinically as neck pain, preauricular pain, and/or suboccipital headache pain and occasionally as suboccipital pain that radiates into the temporomandibular joint region. The patient may note an increase in pain when the joint is placed at extreme ranges of motion and may also experience associated nausea, difficulty concentrating, and sleep disturbance due to an inability to find a comfortable position when supine.

Clinically Relevant Anatomy

The atlanto-occipital joint is dissimilar to the functional units of the lower cervical spine. The joint is not a true facet joint because it lacks posterior articulations characteristic of a true zygapophyseal joint. The atlanto-occipital joint allows the head to nod forward and backward with an isolated range of motion of about 35 degrees. This joint is located anterior to the posterolateral columns of the spinal cord. Neither the atlas nor the axis has an intervertebral foramen to accommodate the first or second cervical nerves. These nerves are primarily sensory and, after leaving the spinal canal, travel through muscle and soft tissue laterally and then superiorly to contribute fibers to the greater and lesser occipital nerves.

The atlanto-occipital joint is susceptible to arthritic changes and trauma secondary to acceleration-deceleration injuries. Such damage to the joint results in pain secondary to synovial joint inflammation and adhesions.

Technique

Fluoroscopically Guided Technique

Atlanto-occipital block is usually done under fluoroscopic guidance because of the proximity of the joint to the spinal cord and vertebral artery, although some pain management specialists have gained sufficient familiarity with the procedure to perform it safely without fluoroscopy. The patient is placed in a prone position. Pillows are placed under the chest to allow moderate flexion of the cervical spine without discomfort to the patient. The forehead is allowed to rest on a folded blanket.

If fluoroscopy is used, the beam is rotated in a sagittal plane from an anterior to a posterior position, which allows identification and visualization of the foramen magnum. Just lateral to the foramen magnum is the atlanto-occipital joint. A total of 5 mL of contrast medium suitable for intrathecal use is drawn up in a sterile 12-mL syringe. Then 3 mL of preservative-free dilute local anesthetic is drawn up in a separate 5-mL sterile syringe. When the pain being treated is thought to be secondary to an inflammatory process, a total of 2.5 mg of non-particulate dexamethasone is added to the local anesthetic with the first block, and 1.5 mg of non-particulate dexamethasone is added with subsequent blocks.

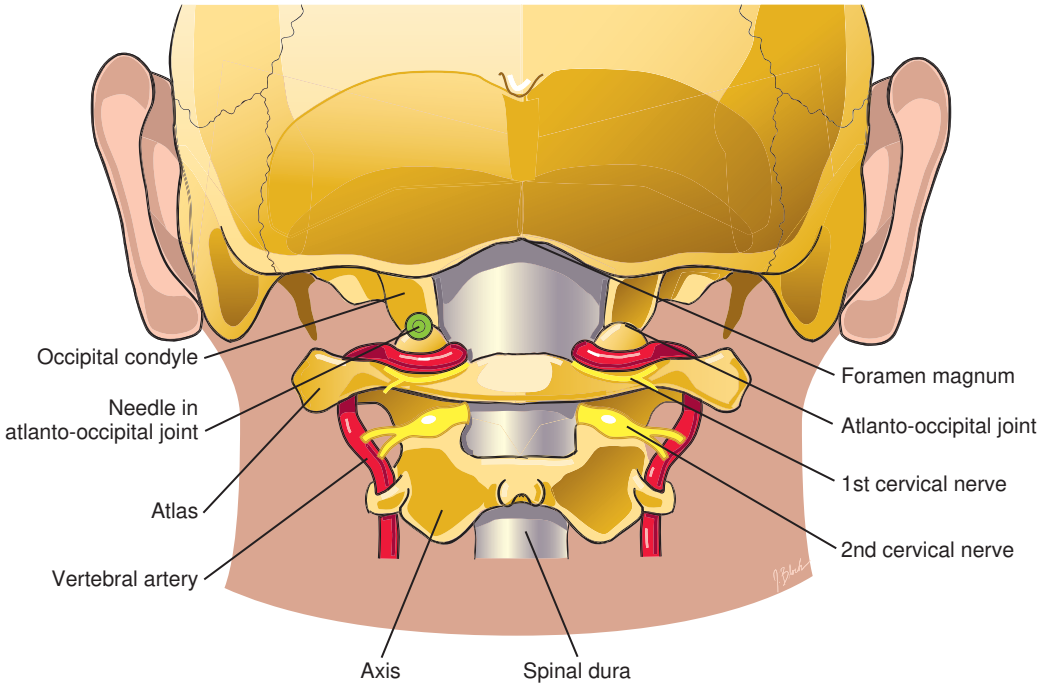
After preparation of the skin with antiseptic solution, a skin wheal of local anesthetic is raised at the site of needle insertion. An 18-gauge, 1-inch needle is inserted at the site to serve as an introducer. The fluoroscopy beam is aimed directly through the introducer needle, which appears as a small point on the fluoroscopy screen. The introducer needle is then repositioned under fluoroscopic guidance until this small point is visualized over the posterolateral aspect of the atlanto-occipital joint (Figs. 1.1 and 1.2). This lateral placement avoids trauma to the vertebral artery, which lies medial to the joint at this level.

Abstract

The atlanto-occipital joint is different from the functional units of the lower cervical spine in that the joint is not a true facet joint because it lacks posterior articulations characteristic of a true zygapophyseal joint. The atlanto-occipital joint is susceptible to arthritic changes and trauma secondary to acceleration-deceleration injuries. Atlanto-occipital block is useful in the diagnosis and treatment of painful conditions involving trauma or inflammation of the atlanto-occipital joint. These problems manifest clinically as neck pain, preauricular pain, and/or suboccipital headache pain and occasionally as suboccipital pain that radiates into the temporomandibular joint region.

Keywords

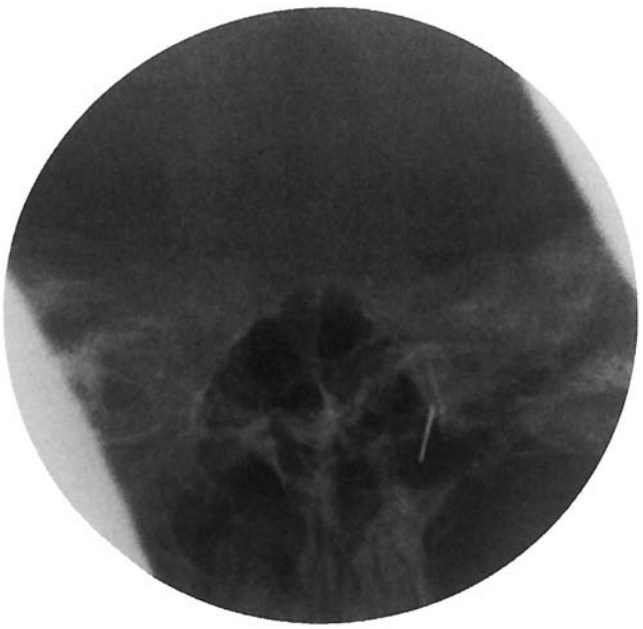
atlanto-occipital joint
atlanto-occipital block
cervical spine
headache
neck pain
osteoarthritis
temporomandibular joint
ultrasound-guided atlanto-occipital block
zygapophyseal joint



• **Fig. 1.1** Anatomy of the atlanto-occipital joint.

A 25-gauge, 3½-inch styletted spinal needle is then inserted through the 18-gauge introducer. If bony contact is made, the spinal needle is withdrawn and the introducer needle is repositioned over the lateral aspect of the joint. The 25-gauge spinal needle is then readvanced until a pop is felt, indicating placement within the atlanto-occipital joint. It is essential then to confirm that the needle is actually in the joint, which is anterior to the posterolateral aspect of the spinal cord (Fig. 1.3). This is accomplished by rotating the C-arm to the horizontal plane and confirming needle placement within the joint. If intra-articular placement cannot be confirmed, the needle should be withdrawn.

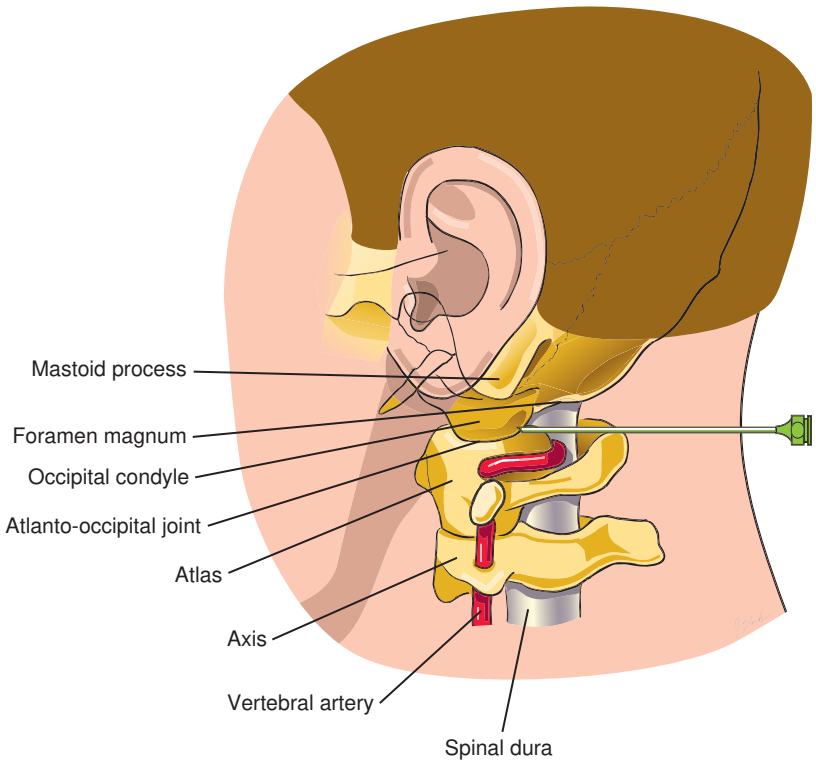
After confirmation of needle placement within the atlanto-occipital joint, the stylet is removed from the 25-gauge spinal needle, and the hub is observed for blood or cerebrospinal fluid. If neither is present, gentle aspiration of the needle is carried out, and if no blood or cerebrospinal fluid is seen, 1 mL of contrast medium is slowly injected under fluoroscopy. An arthrogram of the normal atlanto-occipital joint reveals a bilateral concavity representing the intact joint capsule. However, if the joint has been traumatized, it is not unusual to see contrast medium flow freely from the torn joint capsule into the cervical epidural space. If the contrast medium is seen to rapidly enter the venous plexus rather than outline the joint, the needle is almost always not within the joint space. If this occurs, the needle should be repositioned into the joint before injection. If the contrast medium remains within the joint or if it outlines the joint and a small amount leaks into the epidural space, 1 to 1.5 mL of the local anesthetic and steroid is slowly injected through the spinal needle.



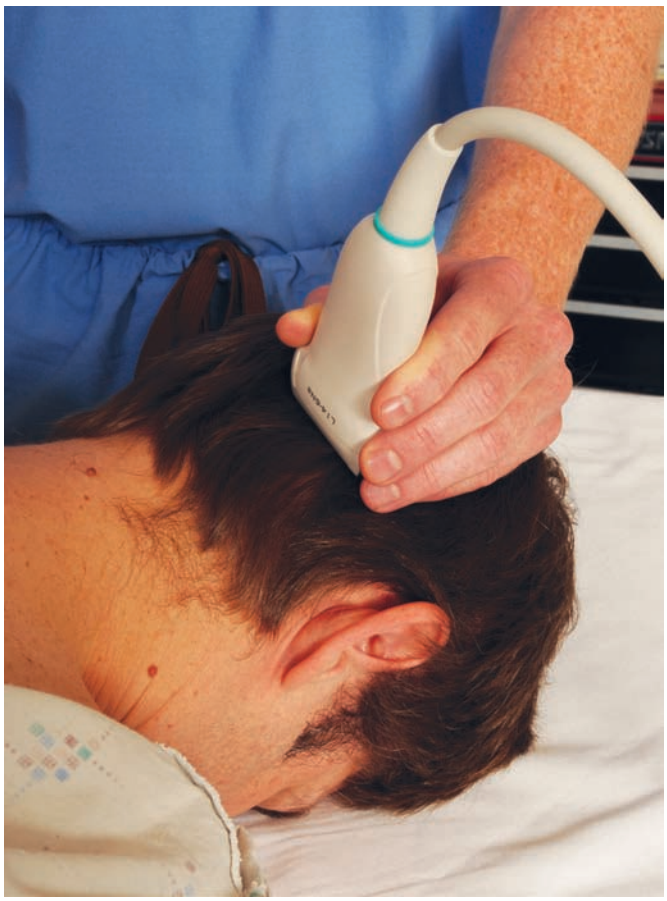
• **Fig. 1.2** Fluoroscopic view of the needle over the posterolateral aspect of the atlanto-occipital joint.

Ultrasound-Guided Technique

The patient is placed in a prone position. Pillows are placed under the chest to allow moderate flexion of the cervical spine without discomfort to the patient. The forehead is allowed to rest on a folded blanket. After preparation of the skin overlying the injection site with antiseptic solution, a high-frequency linear ultrasound transducer is placed slightly off the midline in a transverse position (Fig. 1.4). The vertebral artery is then identified as it passes through the transverse vertebral foramen. Color Doppler imaging may



• **Fig. 1.3** Lateral view of the placement of the needle into the atlanto-occipital joint.

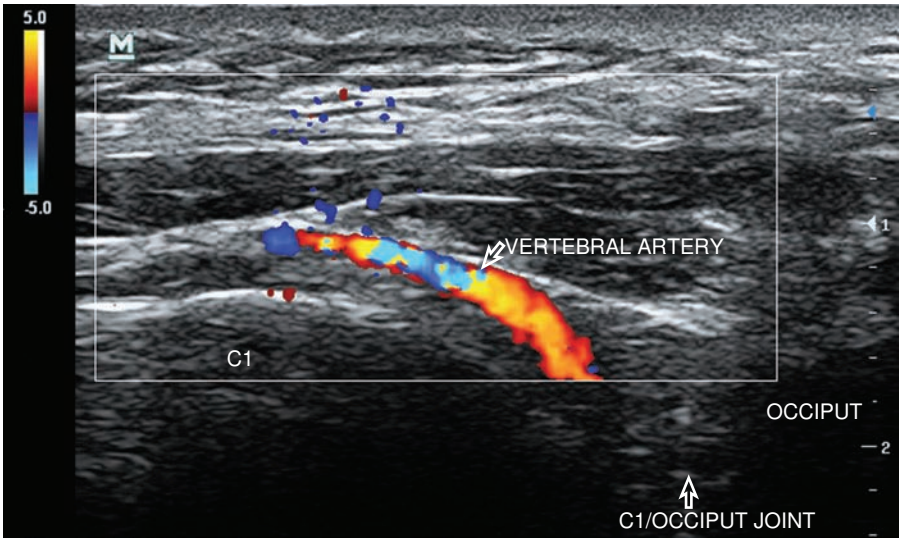


• **Fig. 1.4** The patient is placed in a prone position with the cervical spine slightly flexed and the forehead placed on a folded towel. A high-frequency linear ultrasound transducer is placed slightly off the midline in a transverse position.

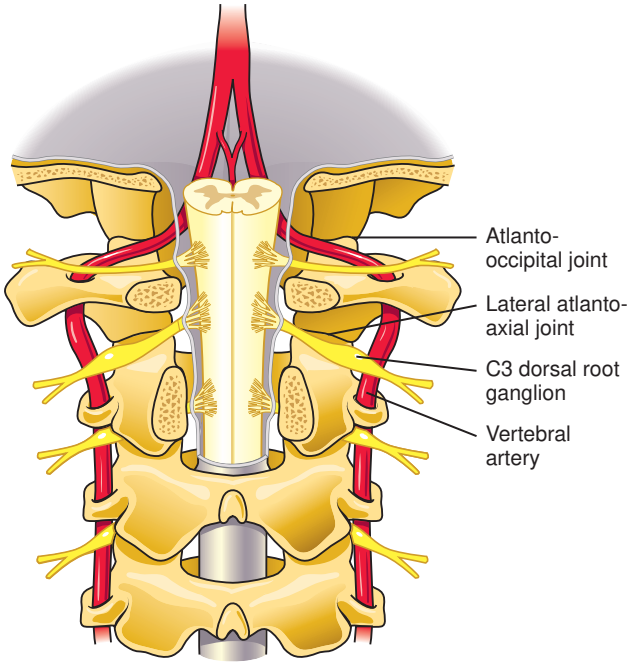
assist in identification (Fig. 1.5). After the artery is identified, it is traced cranially under real-time ultrasound imaging until the artery is seen to turn medially in front of the atlanto-occipital joint (Fig. 1.6). The atlanto-occipital joint is identified, and at a point just lateral to the angle of the turn of the vertebral artery, a 22-gauge, 3½-inch spinal needle is carefully advanced under real-time ultrasound guidance into the atlanto-occipital joint (Fig. 1.7). When the pain being treated is thought to be secondary to an inflammatory process, a total of 2.5 mg of non-particulate dexamethasone is added to the local anesthetic with the first block, and 1.5 mg of non-particulate dexamethasone is added with subsequent blocks.

Side Effects and Complications

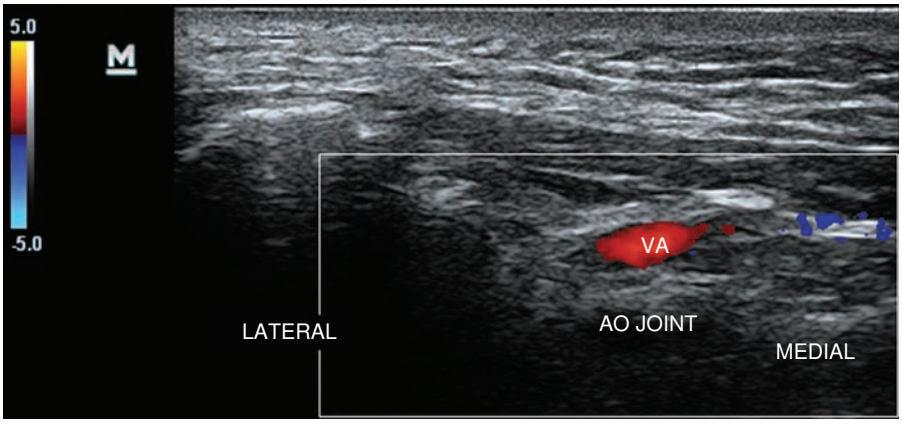
The proximity to the brain stem and spinal cord makes it imperative that this procedure be carried out only by those well versed in the regional anatomy and experienced in performing interventional pain management techniques. Fluoroscopic guidance is recommended for most practitioners because neural trauma is a possibility even in the most experienced hands. The proximity to the vertebral artery, combined with the vascular nature of this anatomic region, makes the potential for intravascular injection high. Even small amounts of local anesthetic injected into the vertebral arteries will result in seizures; therefore, it is recommended that dilute concentrations of preservative-free local anesthetics be used. Given the proximity of the brain and brain stem, ataxia after atlanto-occipital block due to vascular uptake of local anesthetic is not an uncommon occurrence. Non-particulate steroids such as dexamethasone are probably a safer option when compared with particulate-containing steroids such as depot methylprednisolone.



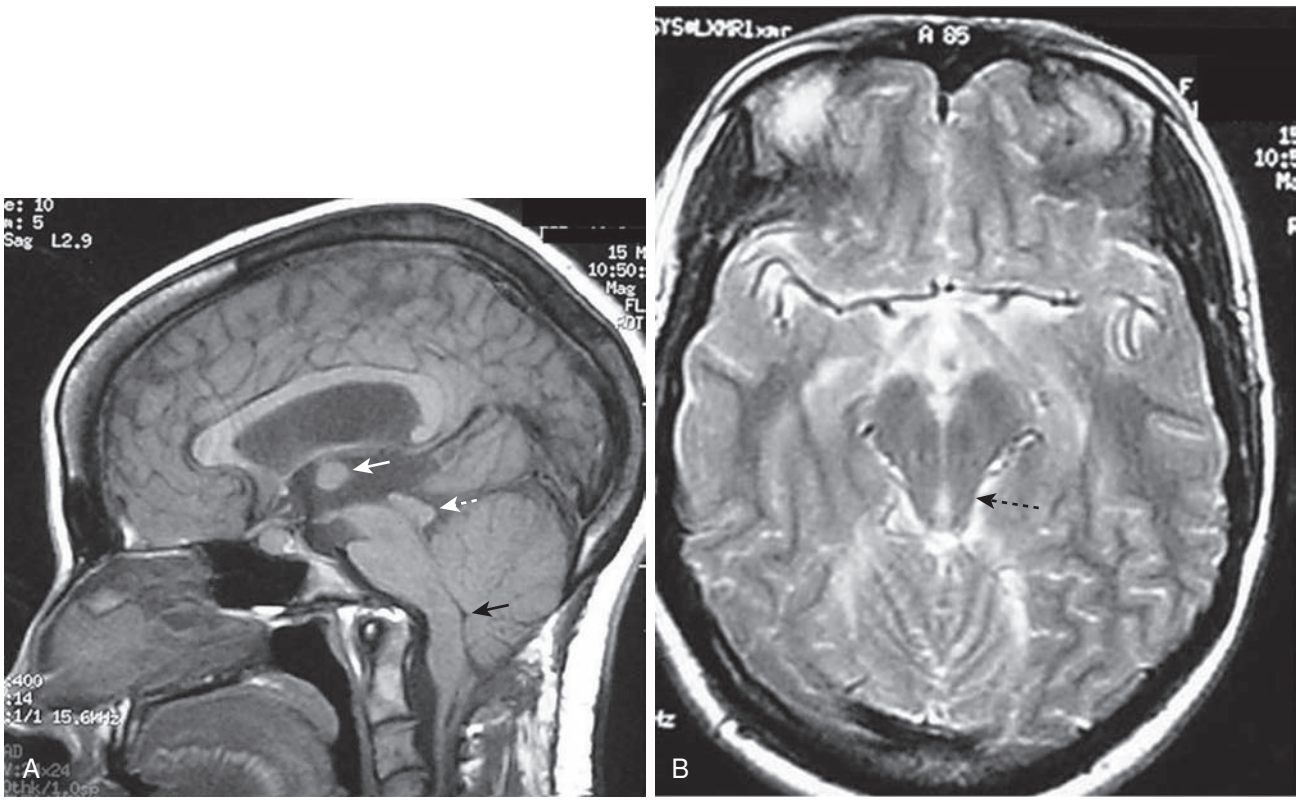
• **Fig. 1.5** Color Doppler image of the vertebral artery demonstrating how it turns medially in front of the atlanto-occipital joint.



• **Fig. 1.6** The vertebral artery passes cranially through the transverse vertebral foramen. It turns medially toward the midline. The atlanto-occipital joint lies just in front of the turning vertebral artery.



• **Fig. 1.7** Ultrasound image demonstrating the relationship of the vertebral artery *(VA)* to the atlanto-occipital *(AO)* joint.



• **Fig. 1.8** (A) Sagittal T1-weighted (T1W) magnetic resonance (MR) image of an adult patient with Arnold-Chiari type II deformity. The posterior fossa is small with a widened foramen magnum. There is inferior displacement of the cerebellum and medulla with elongation of the pons and fourth ventricle *(black arrow).* The brain stem is kinked as it passes over the back of the odontoid. There is an enlarged massa intermedia *(solid white arrow)* and beaking of the tectum *(dashed white arrow).* (B) Axial T2W MR image showing the small posterior fossa with beaking of the tectum *(dashed black arrow).* (From Waldman SD, Campbell RSD. Arnold-Chiari malformation type II. In: *Imaging of pain*. Philadelphia: Saunders; 2011:29–30.)

CLINICAL PEARLS

Atlanto-occipital block is often combined with atlantoaxial block when treating pain in the previously mentioned areas. Although neither joint is a true facet joint in the anatomic sense of the word, the block is analogous to the facet joint block technique used commonly by pain practitioners and may be viewed as such. Many pain management specialists believe that these techniques are currently underused in the treatment of so-called postwhiplash cervicalgia and cervicogenic headaches. These specialists believe that both techniques should be considered when cervical epidural nerve blocks and occipital nerve blocks fail to provide palliation of these headache and neck pain syndromes.

Any patient being considered for atlanto-occipital nerve block should undergo magnetic resonance imaging (MRI) of the head to rule out unsuspected intracranial and brain stem disease (Fig. 1.8). Furthermore, MRI of the cervical spine should be considered to rule out congenital abnormalities such as Arnold-Chiari malformations and atlanto-occipital instability associated with Down syndrome, as well as posterior fossa tumors that may be the hidden cause of the patient's headache symptoms.

It should be noted that in some patients, the course of the vertebral artery covers the entire atlanto-occipital joint, which makes needle placement impossible. In such patients, a trial of occipital nerve stimulation may be a reasonable consideration.

Suggested Readings

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2
Atlantoaxial Block Technique

CPT-2019 CODE	
First Joint	64490
Second Joint	64491
Third and Additional Joints	64492
Neurolytic First Level (Two Nerves)	64633

RELATIVE VALUE UNITS	
First Joint	12
Second Joint	12
Each Additional Joint	12
Neurolytic First Level (Two Nerves)	30

Indications

Atlantoaxial block is useful in the diagnosis and treatment of painful conditions involving trauma or inflammation of the atlantoaxial joint. These problems may manifest clinically as neck pain or suboccipital headache pain and occasionally as suboccipital pain that radiates into the temporomandibular joint region and is worsened with rotation of the joint. The patient may note an increase in pain when the joint is placed at extreme ranges of motion and may also experience associated nausea, difficulty concentrating, and sleep disturbance due to an inability to find a comfortable position when supine.

Clinically Relevant Anatomy

The atlantoaxial joint is dissimilar to the functional units of the lower cervical spine. The joint is not a true facet joint because it lacks posterior articulations characteristic of a true zygapophyseal joint. Furthermore, there is no true disk or intervertebral foramen between atlas and axis. The atlantoaxial joint allows the greatest degree of motion of all the joints of the neck: it not only allows the head to flex and extend about 10 degrees but also allows more than 60 degrees of rotation in the horizontal plane. The integrity and stability of the atlantoaxial joint are almost entirely ligamentous in nature. Even minor injury of the ligaments due to trauma can result in joint dysfunction and pain. Severe disruption of the ligaments has the same effect as a fracture of the odontoid process and can result in paralysis and death.

This joint is located lateral to the posterolateral columns of the spinal cord (Fig. 2.1). Neither the atlas nor the axis has an intervertebral foramen to accommodate the first or second cervical nerves. These nerves are primarily sensory, and after leaving the spinal canal, they travel through muscle and soft tissue laterally and then superiorly to contribute fibers to the greater and lesser occipital nerves. The vertebral artery is lateral to the joint compared with the medial position of the artery relative to the atlanto-occipital joint.

The atlantoaxial joint is susceptible to arthritic changes and trauma secondary to acceleration-deceleration injuries. Such damage to the joint results in pain secondary to synovial joint inflammation and adhesions. Rheumatoid arthritis may result in gradual erosion of the odontoid process that may present initially as occipital headaches. This erosion leads to instability of the atlantoaxial joint and ultimately may result in increased susceptibility to dislocation, paralysis, and death following seemingly minor trauma. In addition to rheumatoid arthritis, there are a number of other diseases associated with instability of the atlantoaxial joint, including Down syndrome, osteogenesis imperfecta, von Recklinghausen disease, congenital scoliosis, Larsen syndrome, Morquio syndrome, Kniest dysplasia, congenital spondyloepiphyseal dysplasia, and metatropic dysplasia.

Technique

Fluoroscopically Guided Technique

Atlantoaxial block is usually done under fluoroscopic guidance because of the proximity to the spinal cord and vertebral artery, although some pain management specialists have gained sufficient familiarity with the procedure to perform it safely without fluoroscopy. The patient is placed in a prone position. Pillows are placed under the chest to allow the cervical spine to be moderately flexed without discomfort to the patient. The forehead is allowed to rest on a folded blanket.

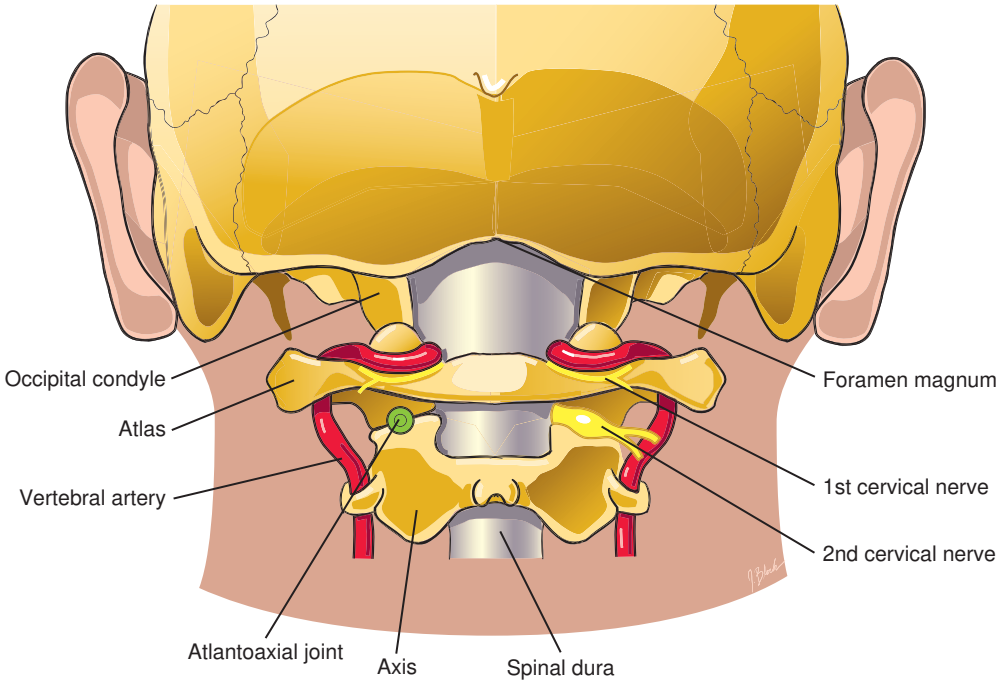
If fluoroscopy is used, the beam is rotated in a sagittal plane from an anterior to a posterior position, which allows identification and visualization of the foramen magnum and atlas. Just lateral and inferior to the atlas and to the foramen magnum is the atlantoaxial joint (see Fig. 2.1). A total of 5 mL of contrast medium suitable for intrathecal use is drawn up in a sterile 12-mL syringe. Then 3 mL of preservative-free local anesthetic is drawn up in a separate 5-mL sterile syringe. When the pain being treated is thought to be secondary to an inflammatory process, a total of 40 mg of

Abstract

The atlantoaxial joint is different from the functional units of the lower cervical spine in that the joint is not a true facet joint because it lacks posterior articulations characteristic of a true zygapophyseal joint. The atlantoaxial joint is susceptible to arthritic changes and trauma secondary to acceleration-deceleration injuries. Atlantoaxial block is useful in the diagnosis and treatment of painful conditions involving trauma or inflammation of the atlantoaxial joint. Furthermore, there is no true disk or intervertebral foramen between atlas and axis. The atlantoaxial joint allows the greatest degree of motion of all the joints of the neck: it not only allows the head to flex and extend about 10 degrees but also allows more than 60 degrees of rotation in the horizontal plane. The integrity and stability of the atlantoaxial joint are almost entirely ligamentous in nature.

Keywords

atlantoaxial joint
atlantoaxial block
cervical spine
headache
neck pain
osteoarthritis
rheumatoid arthritis
temporomandibular
joint ultrasound-guided atlantoaxial block
zygapophyseal joint



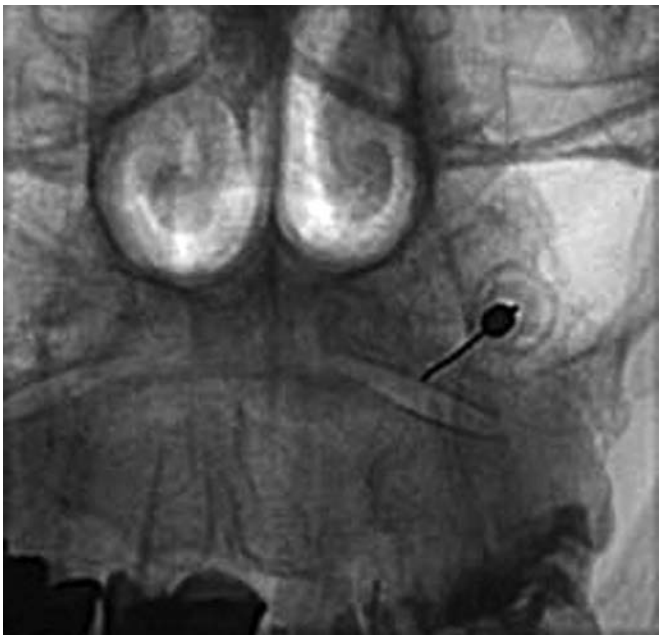
• **Fig. 2.1** Anatomy of the atlantoaxial joint.

depot-steroid is added to the local anesthetic with the first block, and 20 mg of depot-steroid is added with subsequent blocks.

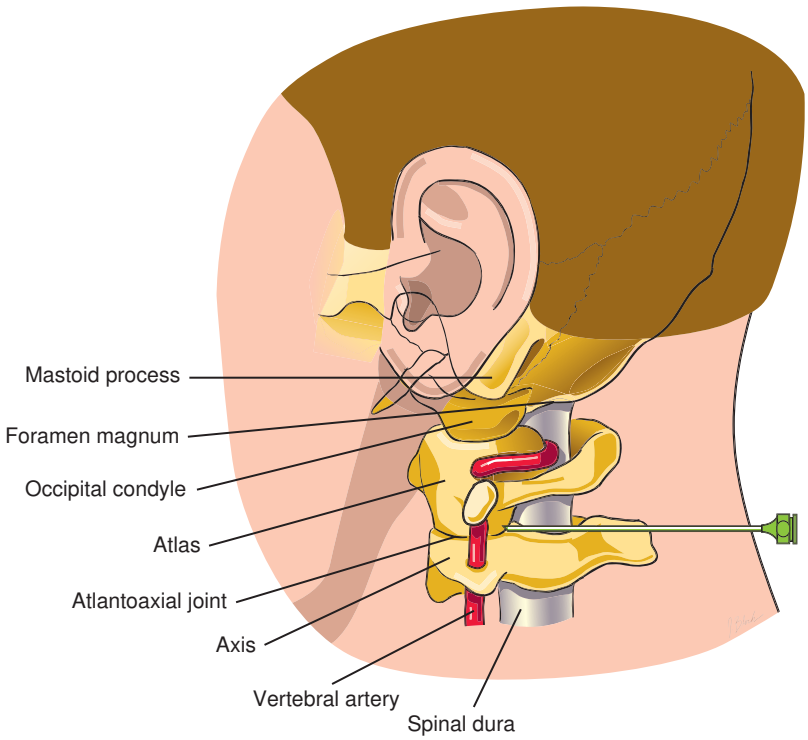
After preparation of the skin with antiseptic solution, a skin wheal of local anesthetic is raised at the site of needle insertion. An 18-gauge, 1-inch needle is placed at the insertion site to serve as an introducer. The fluoroscopy beam is aimed directly through the introducer needle, which appears as a small point on the fluoroscopy screen. The introducer needle is then repositioned under fluoroscopic guidance until this small point is visualized over the posterolateral aspect of the atlantoaxial joint (see Fig. 2.1). This lateral placement avoids trauma to the spinal cord, which lies medial to the joint at this level. It should be remembered that the vertebral artery is lateral to the atlantoaxial joint, and care must be taken to avoid arterial trauma or inadvertent intra-arterial injection.

A 25-gauge, 3½-inch styletted spinal needle is then inserted through the 18-gauge introducer. If bony contact is made, the spinal needle is withdrawn, and the introducer needle is repositioned over the lateral aspect of the joint. The 25-gauge spinal needle is then readvanced until a pop is felt, indicating placement within the atlantoaxial joint (Fig. 2.2). It is essential then to confirm that the needle is actually in the joint, which is anterior to the posterolateral aspect of the spinal cord. This is accomplished by rotating the C-arm to the horizontal plane and confirming needle placement within the joint (Figs. 2.3 and 2.4). If intra-articular placement cannot be confirmed, the needle should be withdrawn.

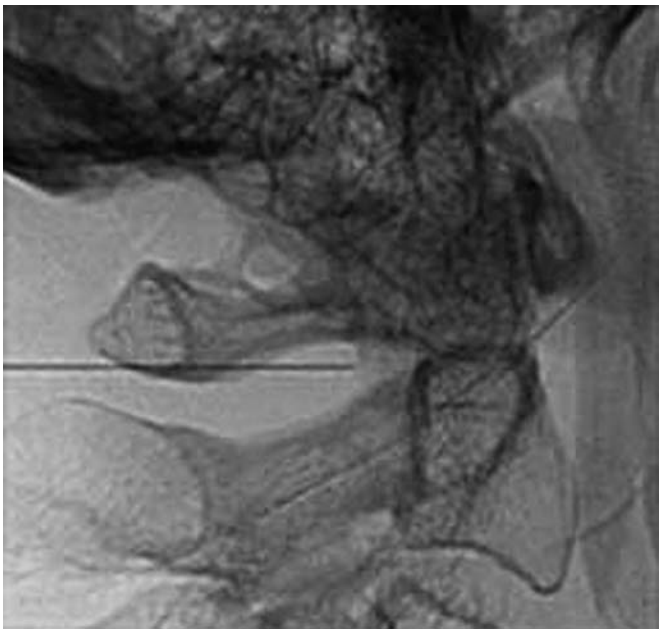
After confirmation of needle placement within the atlantoaxial joint, the stylet is removed from the 25-gauge spinal needle, and the hub is observed for blood or cerebrospinal fluid. If neither is present, gentle aspiration of the needle is carried out, and if no blood or cerebrospinal fluid is seen, 1 mL of contrast medium is slowly injected under fluoroscopy. An arthrogram of the normal atlantoaxial joint reveals a bilateral concavity representing the intact joint capsule (Figs. 2.5 and 2.6). However, if the joint has been traumatized, it is not unusual to see contrast medium flow freely from the torn joint capsule into the cervical epidural space. If the contrast medium is seen to rapidly enter the venous plexus rather than outline the joint, the needle is almost always not within the joint space. If this occurs, the needle should be repositioned into the joint before injection. If the contrast medium remains



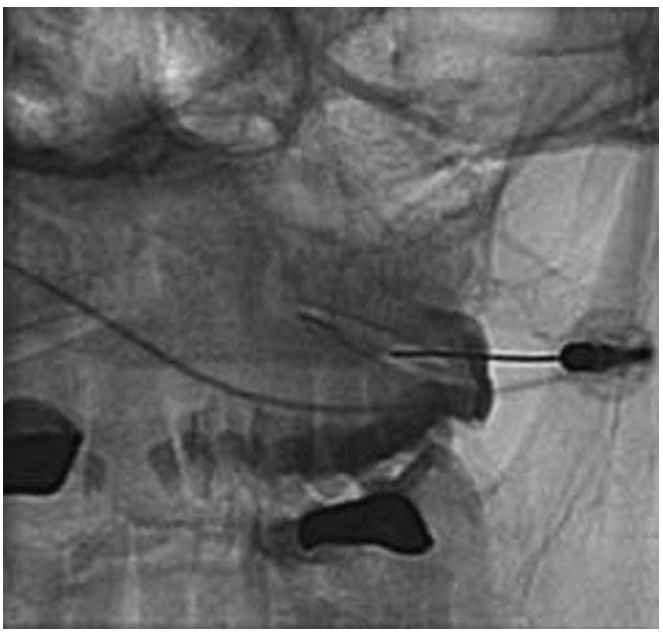
• **Fig. 2.2** Anteroposterior fluoroscopic view of the right lateral atlantoaxial joint with the needle tip on bone at the initial target point for an intra-articular block. (From King W, Borowczyk JM. Zygapophysial joint pain: procedures for diagnosis and treatment. In: Lennard TA, Walkowski SA, Singla AK, Vivian D, eds. *Pain Procedures in Clinical Practice*. 3rd ed. Philadelphia: Saunders; 2011:378.)



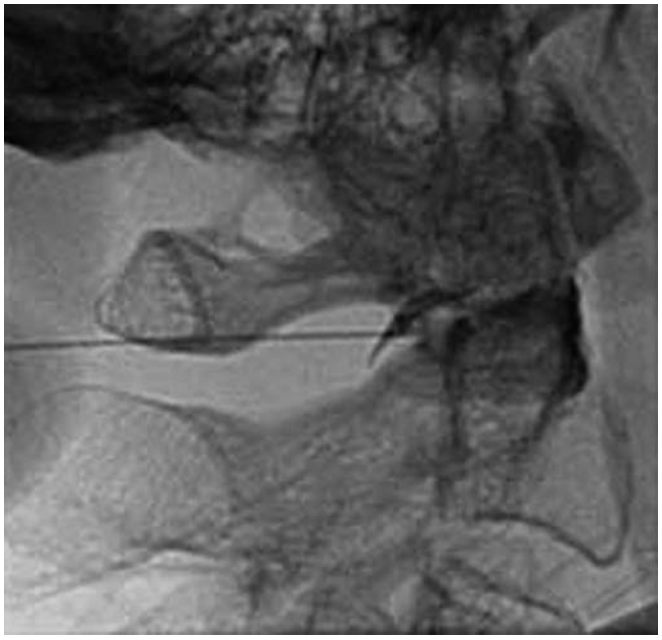
• **Fig. 2.3** Lateral view of the clinically relevant anatomy and proper needle placement for atlantoaxial block.



• **Fig. 2.4** Lateral fluoroscopic view of the right lateral atlantoaxial joint with the needle tip on bone at the initial target point for an intra-articular block. (From King W, Borowczyk JM. Zygapophysial joint pain: procedures for diagnosis and treatment. In: Lennard TA, Walkowski SA, Singla AK, Vivian D, eds. *Pain Procedures in Clinical Practice*. 3rd ed. Philadelphia: Saunders; 2011:378.)



• **Fig. 2.5** Anteroposterior fluoroscopic view of a right lateral atlantoaxial arthrogram recorded to confirm correct placement of the needle tip for an intra-articular block. (From King W, Borowczyk JM. Zygapophysial joint pain: procedures for diagnosis and treatment. In: Lennard TA, Walkowski SA, Singla AK, Vivian D, eds. *Pain Procedures in Clinical Practice*. 3rd ed. Philadelphia: Saunders; 2011:379.)



• **Fig. 2.6** Lateral fluoroscopic view of a right lateral atlantoaxial arthrogram recorded to confirm correct placement of the needle tip for an intra-articular block. (From King W, Borowczyk JM. Zygapophysial joint pain: procedures for diagnosis and treatment. In: Lennard TA, Walkowski SA, Singla AK, Vivian D, eds. *Pain Procedures in Clinical Practice*. 3rd ed. Philadelphia: Saunders; 2011:379.)

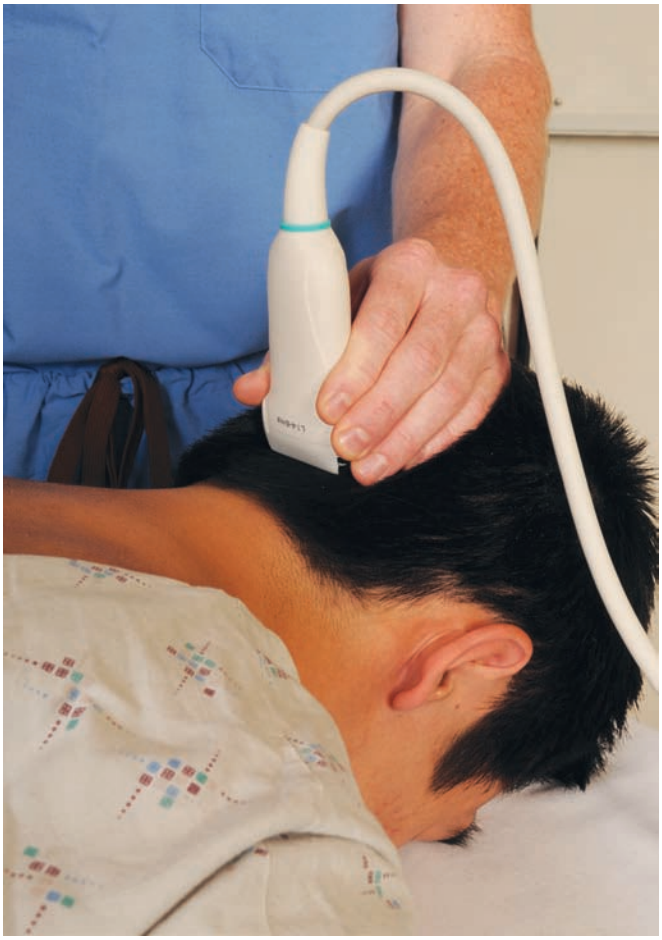
within the joint or if it outlines the joint and a small amount leaks into the epidural space, 1 to 1.5 mL of the local anesthetic and steroid is slowly injected through the spinal needle.

Ultrasound-Guided Technique

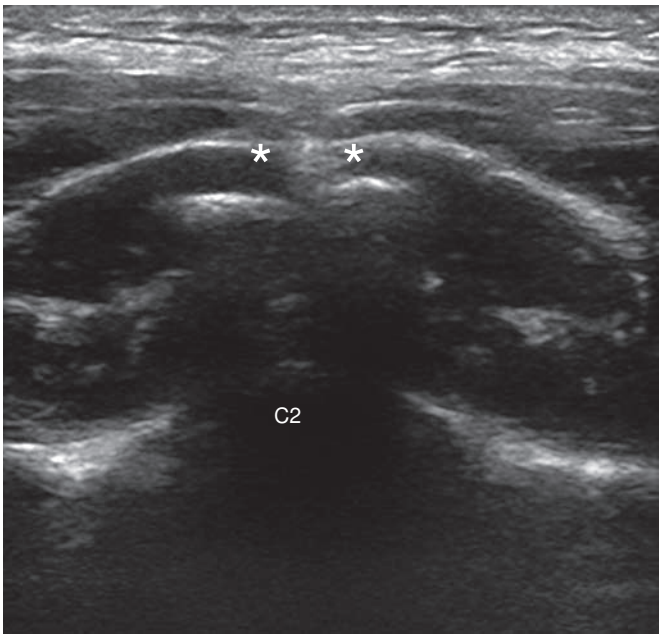
The patient is placed in a prone position. Pillows are placed under the chest to allow moderate flexion of the cervical spine without discomfort to the patient. The forehead is allowed to rest on a folded blanket. After preparation of the skin overlying the injection site with antiseptic solution, a high-frequency linear ultrasound transducer is placed in the transverse orientation at the level of the occiput (Fig. 2.7). The ultrasound transducer is then slowly moved in a caudad direction to identify the C1 and C2 vertebral bodies. The C2 vertebral body has a clearly visible bifid spinous process, whereas the spinous process on the C1 vertebral body is poorly seen because it is a vestigial structure (Fig. 2.8). After the C2 vertebra has been properly identified, the ultrasound transducer is slowly moved laterally until the vertebral artery is seen. Color Doppler may aid in the identification of the vertebral artery (Fig. 2.9). Lying between the exiting C2 nerve root and the vertebral artery is the atlantoaxial joint (Fig. 2.10). After the relative positions of the vertebral artery laterally, the C2 nerve root medially, and the atlantoaxial joint are identified, a 22-gauge, 3½-inch styletted spinal needle is then advanced into the atlantoaxial joint using an out-of-plane approach under real-time ultrasonography.

Side Effects and Complications

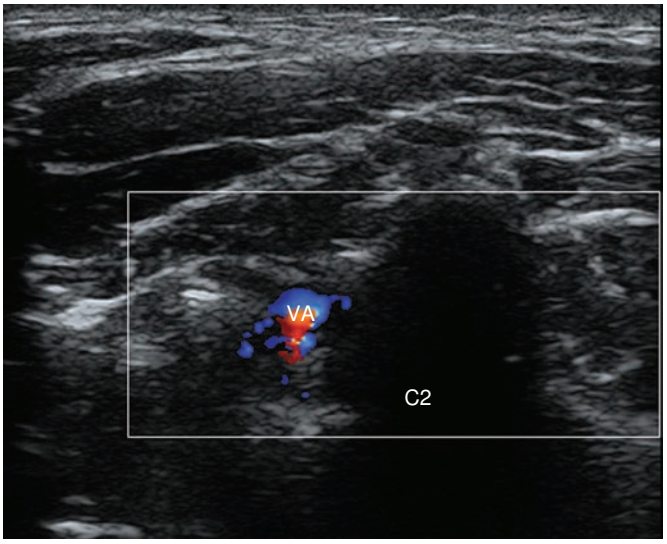
The proximity to the brain stem and spinal cord makes it imperative that this procedure be carried out only by those well versed in the



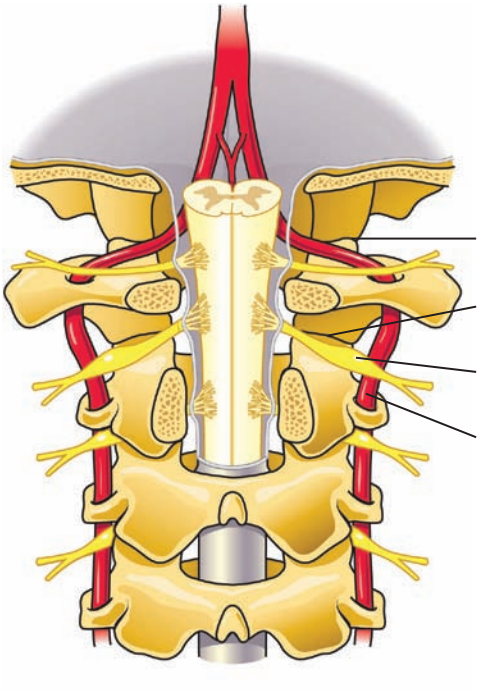
• **Fig. 2.7** Proper transverse placement of the high-frequency linear ultrasound transducer at the level of the occiput.



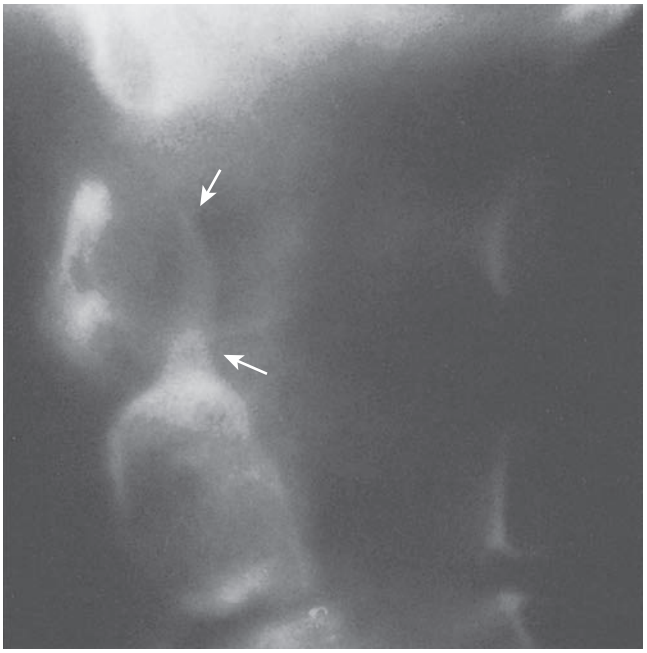
• **Fig. 2.8** Transverse ultrasound image demonstrating the bifid nature of the *C2* spinous process *(asterisks)*.



• **Fig. 2.9** Color Doppler image of the vertebral artery *(VA)*.



• **Fig. 2.10** Lying between the exiting C2 nerve root and the vertebral artery is the atlantoaxial joint.



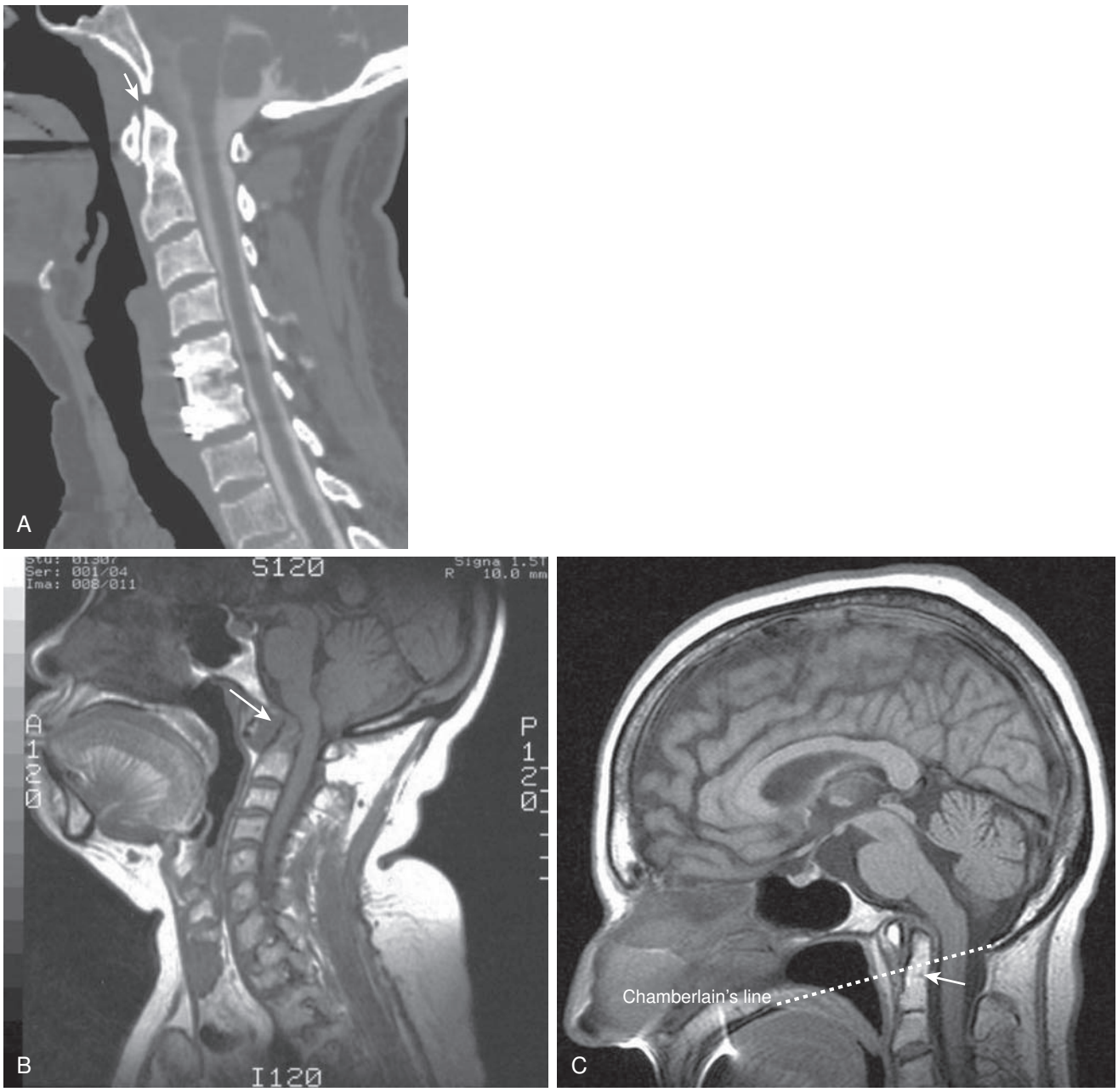
• **Fig. 2.11** Abnormalities of the cervical spine: odontoid process erosions. Lateral conventional tomogram reveals severe destruction of the odontoid process *(arrows),* which has been reduced to an irregular, pointed protuberance. (From Resnick D, Kransdorf MJ. *Bone and Joint Imaging*. 3rd ed. Philadelphia: Saunders; 2004:244.)

CLINICAL PEARLS

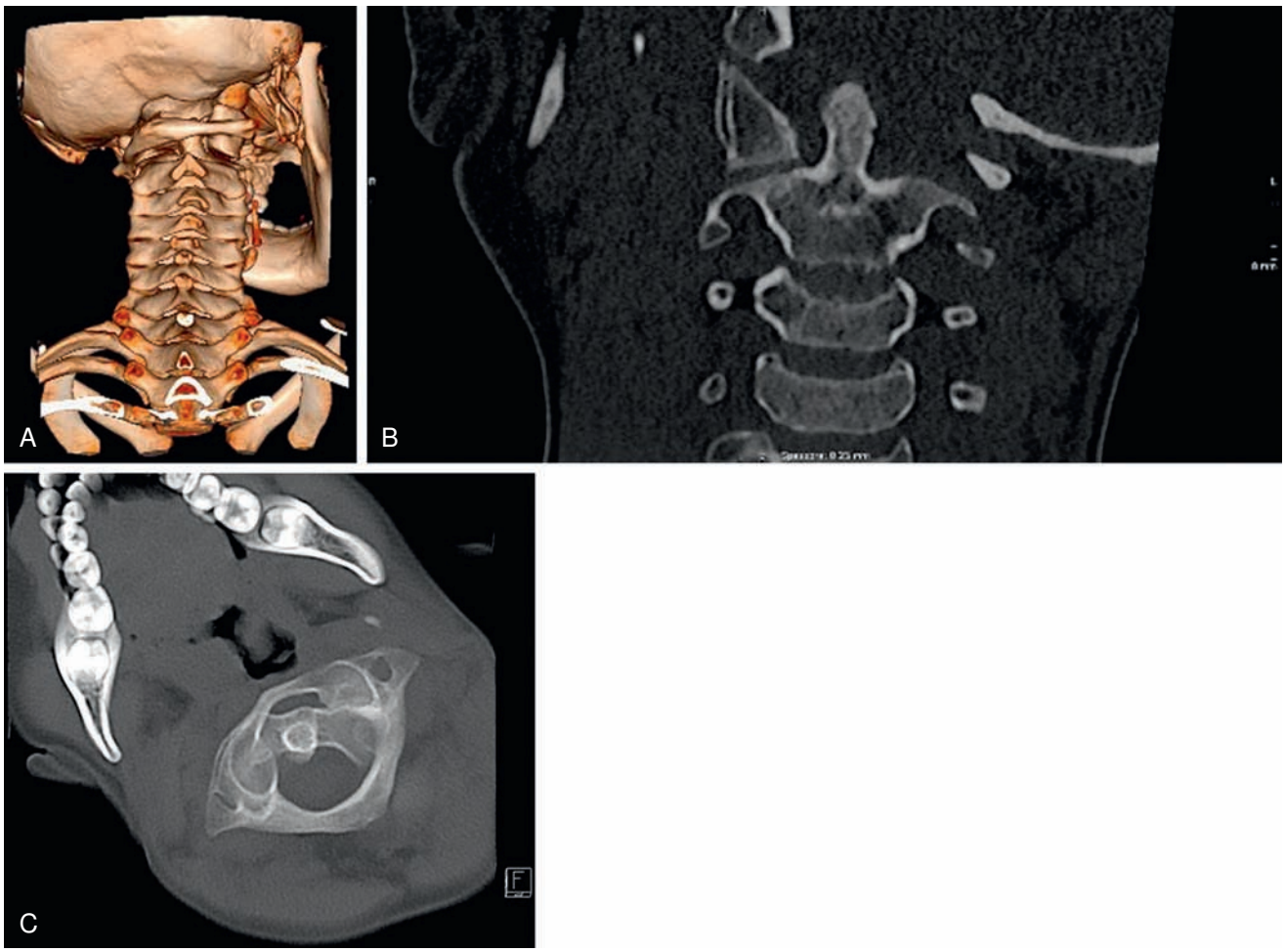
Atlantoaxial block is often combined with atlanto-occipital block when treating pain in the previously mentioned areas. Although neither joint is a true facet joint in the anatomic sense of the word, the block is analogous to the facet joint block technique used commonly by pain practitioners and may be viewed as such. Many pain management specialists believe that these techniques are currently underused in the treatment of so-called postwhiplash cervicalgia and cervicogenic headaches. These specialists believe that both techniques should be considered when cervical epidural nerve blocks and occipital nerve blocks fail to provide palliation of these headache and neck pain syndromes.

regional anatomy and experienced in performing interventional pain management techniques. Fluoroscopic guidance is recommended for most practitioners because neural trauma is a possibility even in the most experienced hands. The proximity to the vertebral artery, combined with the vascular nature of this anatomic region, makes the potential for intravascular injection high. Even small amounts of local anesthetic injected into the vertebral arteries will result in seizures. Given the proximity of the brain and brain stem, ataxia after atlantoaxial block due to vascular uptake of local anesthetic is not an uncommon occurrence. Many patients also complain of a transient increase in headache and cervicalgia after injection of the joint.

Any patient being considered for atlantoaxial nerve block should undergo magnetic resonance imaging (MRI) of the head to rule out unsuspected intracranial and brain stem disease (Fig. 2.11). Furthermore, cervical spine radiography and computerized tomography of the cervical spine should be considered to rule out congenital abnormalities such as Arnold-Chiari malformations that may be the hidden cause of the patient's headache symptoms as well as to identify erosion of the odontoid process in patients with rheumatoid arthritis (Fig. 2.12; see also Fig. 2.11). Grisel syndrome, or post-infectious nontraumatic rotary subluxation of the atlantoaxial joint with intact atlantoaxial ligaments, should be considered in any young patient with persistent severe neck pain and torticollis following a nasopharyngeal infection (Fig. 2.13).



• **Fig. 2.12** Position of the dens in a normal patient (A), in a rheumatoid patient (B), and in a nonrheumatoid patient with basilar invagination and platybasia (C). (A) Postmyelography computed tomogram with sagittal reformation demonstrates normal relationship of the dens with respect to the foramen magnum, brain stem, and anterior arch of C1. A normal atlantoaxial distance (AADI) is seen *(arrow).* (B) T1-weighted sagittal magnetic resonance (MR) study of the cervical spine in a rheumatoid patient reveals erosion and pannus formation at the atlantoaxial joint resulting in increased AADI *(arrow),* posterior subluxation of the dens, and brain stem compression. (C) Sagittal MR study of the brain in a nonrheumatoid patient shows normal AADI, but basilar invagination and platybasia have resulted in vertical subluxation of the dens and brain stem compression. The line drawn from the hard palate to the posterior lip of the foramen magnum is Chamberlain's line *(dotted line); basilar invagination* is defined as extension of the odontoid tip. Patient shows normal AADI. Also notice the fusion of the C2 and C3 vertebrae. The small, linear, dark line at the mid-C2 level is the subdental synchondrosis *(arrow).* (From Chi TL, Mirsky DM, Bello JA, Ferson DZ. Airway imaging: principles and practical guide. In: Habberg C, ed. *Benumof and Hagberg's Airway Management*. 3rd ed. Philadelphia: Saunders; 2013:32.)



• **Fig. 2.13** Grisel syndrome in a patient post-adenoidectomy. (A) Volume-rendering computerized tomographic reconstruction showing the typical position of the head (rotated on the right and tilted on the left), with increases in distance between C1 and C2 posterior elements and loss of alignment between right C1-C2 joints. (B) Coronal magnetic resonance imaging shows loss of alignment between right C1-C2 joints. (C) Maximum intensity projection axial reconstruction showing C1-C2 rotatory subluxation (about 45 degrees), with atlantodental space measuring 6.7 mm (Fielding type 3 atlantoaxial subluxation).

Suggested Readings

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Fath L, Cebula H, Santin MN, Coca A, Debry C, Proust F. The Grisel's syndrome: a non-traumatic subluxation of the atlantoaxial joint. *Neurochirurgie*. 2018;64(4):327–330.

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3

Sphenopalatine Ganglion Block: Transnasal Approach

CPT-2019 CODE	
Local Anesthetic	64999
Neurolytic	64999

RELATIVE VALUE UNITS	
Local Anesthetic	8
Neurolytic	20

Indications

Sphenopalatine ganglion block may be used in the treatment of acute migraine headache, acute cluster headache, and a variety of facial neuralgias including Sluder, Vail, and Gardner syndromes. This technique is also useful in the treatment of status migrainosus and chronic cluster headache. There is anecdotal evidence that sphenopalatine ganglion block may also be useful in the palliation of pain secondary to acute herpes zoster of the trigeminal nerve as well as postdural puncture headache and untreated essential hypertension.

Neurodestructive procedures of the sphenopalatine ganglion using neurolytic agents, radiofrequency lesioning, or freezing may be indicated for the palliation of cancer pain and rarely for headache and facial pain syndromes that fail to respond to conservative management. Recent experience with electrical stimulation of the sphenopalatine ganglion has shown promising early results.

Clinically Relevant Anatomy

The sphenopalatine ganglion (pterygopalatine, nasal, or Meckel ganglion) is in the pterygopalatine fossa, posterior to the middle nasal turbinate (Figs. 3.1 to 3.3). It is covered by a 1- to 1.5-mm layer of connective tissue and mucous membrane. This 5-mm triangular structure sends major branches to the gasserian ganglion, trigeminal nerves, carotid plexus, facial nerve, and superior cervical ganglion (see Fig. 3.2, Fig. 3.4). The sphenopalatine ganglion can be blocked by topical application of local anesthetic or by injection.

Technique

Sphenopalatine ganglion block through the transnasal approach is accomplished by the application of suitable local anesthetic to the mucous membrane overlying the ganglion. The patient is placed in the supine position, and the anterior nares are inspected for polyps, tumors, and foreign bodies. Three milliliters of either 2% viscous lidocaine or 10% cocaine is drawn up in a 5-mL sterile syringe. The tip of the patient's nose is then drawn upward as if to place a nasogastric tube, and 0.5 mL of local anesthetic is injected into each nostril. The patient is asked to sniff vigorously to draw the local anesthetic posteriorly, which serves the double function of lubricating the nasal mucosa and providing topical anesthesia.

Two 3½-inch cotton-tipped applicators are soaked in the local anesthetic chosen, and one applicator is advanced along the superior border of the middle turbinate of each nostril until the tip comes into contact with the mucosa overlying the sphenopalatine ganglion (Fig. 3.5). Then 1 mL of local anesthetic is instilled over each cotton-tipped applicator. The applicator acts as a tampon that allows the local anesthetic to remain in contact with the mucosa overlying the ganglion. The applicators are removed after 20 minutes. If anatomic considerations such as the presence of polyps preclude the use of cotton-tipped applicators, transnasal endoscopically guided insertion of a 22-gauge, 3½-inch needle may be considered (Fig. 3.6). The patient's blood pressure, pulse, and respirations are monitored for untoward side effects.

Side Effects and Complications

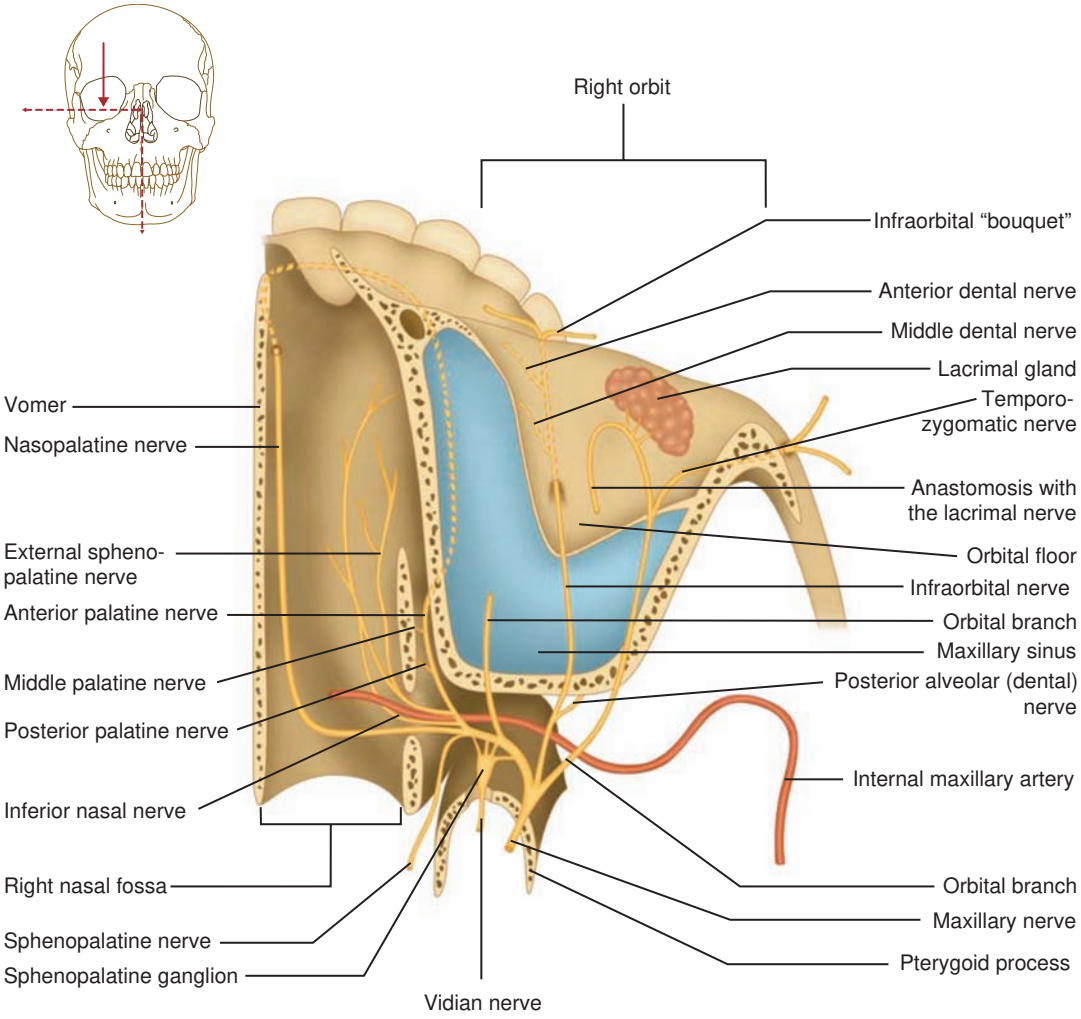
Because of the highly vascular nature of the nasal mucosa, epistaxis is the major complication of this technique. This vascularity can lead to significant systemic absorption of local anesthetic with resultant local anesthetic toxicity, especially when cocaine is used. Patients occasionally may experience significant orthostatic hypotension after sphenopalatine ganglion block. This can be a problem because postblock monitoring may be lax due to the benign-appearing nature of the technique. For this reason, patients who undergo sphenopalatine ganglion block should be monitored closely for orthostatic hypotension and initially allowed to ambulate only with assistance.

Abstract

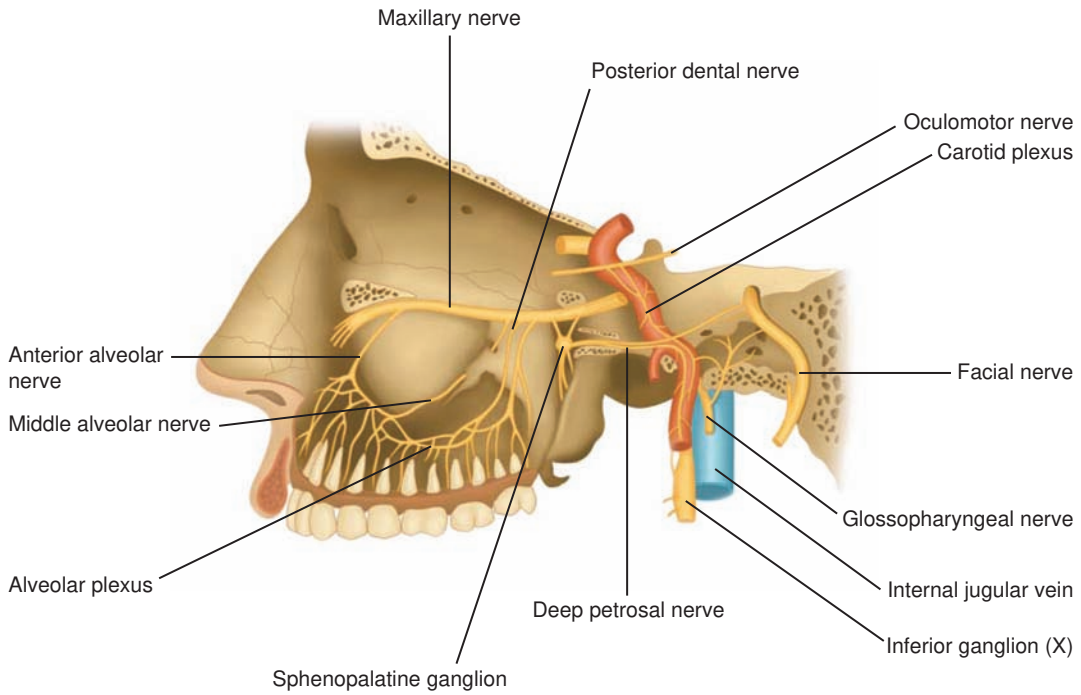
The sphenopalatine ganglion (pterygopalatine, nasal, or Meckel ganglion) is located in the pterygopalatine fossa, posterior to the middle nasal turbinate. Sphenopalatine ganglion block may be used in the treatment of acute migraine headache, acute cluster headache, and a variety of facial neuralgias including Sluder, Vail, and Gardner syndromes. This technique is also useful in the treatment of status migrainosus and chronic cluster headache. The sphenopalatine ganglion can be blocked by topical application of local anesthetic or by injection.

Keywords

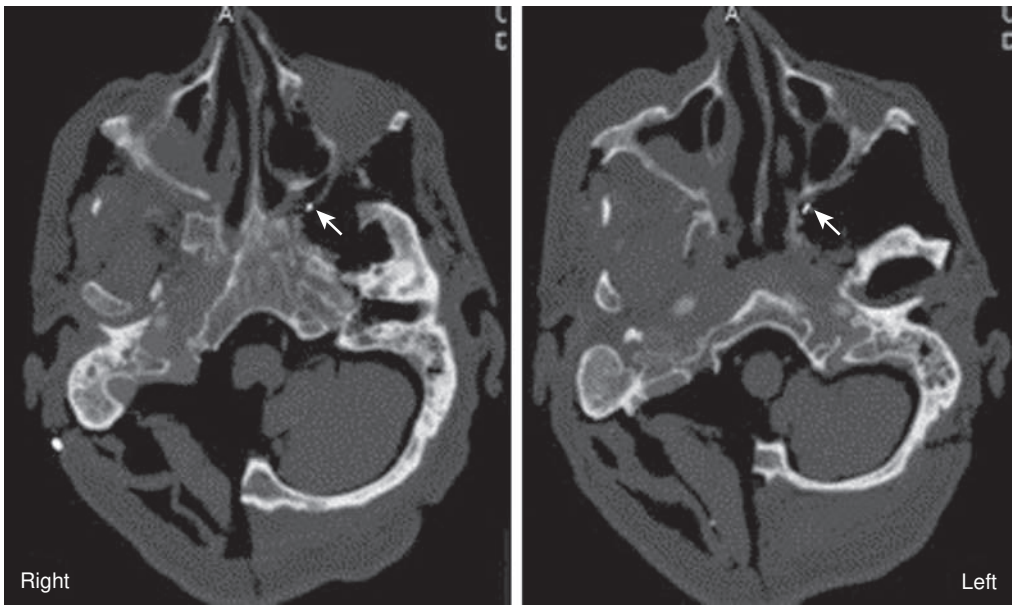
cluster headache
Gardner syndrome
Meckel ganglion
migraine headache
pterygopalatine ganglion
sphenopalatine ganglion
nerve block
Vail syndrome



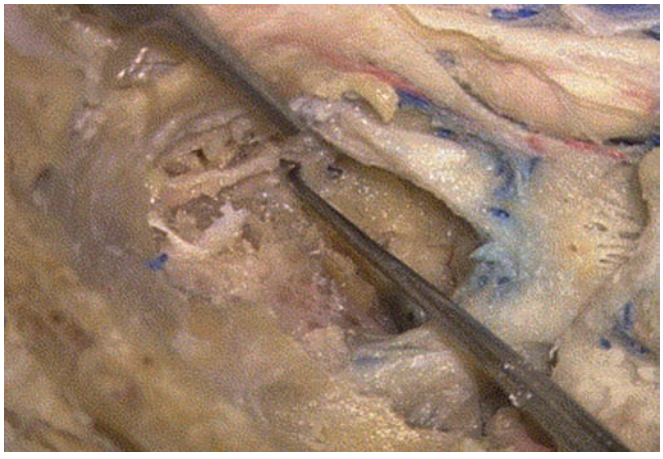
• **Fig. 3.1** The sphenopalatine ganglion (pterygopalatine, nasal, or Meckel ganglion) is in the pterygopalatine fossa, posterior to the middle nasal turbinate. (From Barral J-P, Croibier A, eds. Maxillary nerve. *Manual Therapy for the Cranial Nerves*. Edinburgh: Churchill Livingstone; 2009:129–138.)



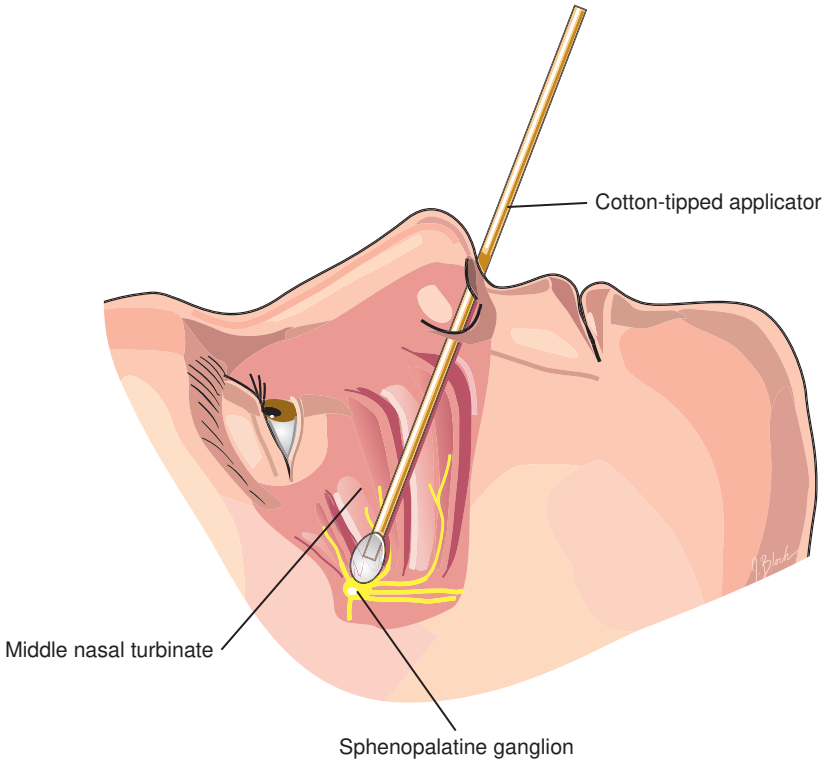
• **Fig. 3.2** Anatomy of the sphenopalatine (pterygopalatine) ganglion. Note that the sphenopalatine structure sends major branches to the gasserian ganglion, trigeminal nerves, carotid plexus, facial nerve, and superior cervical ganglion. (From Barral J-P, Croibier A, eds. Maxillary nerve. *Manual Therapy for the Cranial Nerves*. Edinburgh: Churchill Livingstone; 2009:129–138.)



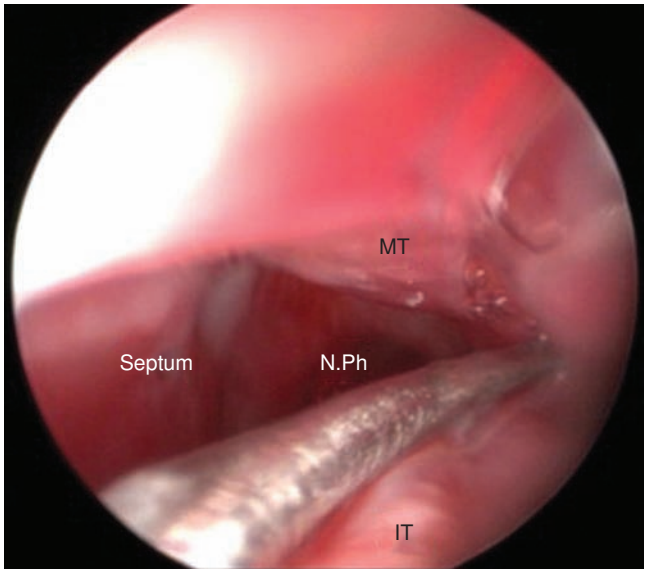
• **Fig. 3.3** Axial computed tomographic cuts through the region of the sphenopalatine ganglion. The *right* side of each image was not dissected. The *left* side of each image was dissected and a radiopaque marker placed in the pterygopalatine fossa to indicate the position of the sphenopalatine ganglion *(arrows).* (From De Salles AAF, Gorgulho A, Golish SR, et al. Technical and anatomical aspects of novalis stereotactic radiosurgery sphenopalatine ganglionectomy. *Int J Radiat Oncol Biol Phys.* 2006;66[4][suppl]:S53–S57.)



• **Fig. 3.4** View of the pterygopalatine fossa through Meckel cave. Notice the upper retraction instrument lifting the second division of the trigeminal nerve to expose the sphenopalatine ganglion *(tip of lower instrument).* (From De Salles AAF, Gorgulho A, Golish SR, et al. Technical and anatomical aspects of novalis stereotactic radiosurgery sphenopalatine ganglionectomy. *Int J Radiat Oncol Biol Phys.* 2006;66[4]:S53–S57.)



• **Fig. 3.5** Two 3½-inch cotton-tipped applicators are soaked in the local anesthetic chosen, and one applicator is advanced along the superior border of the middle turbinate of each nostril until the tip comes into contact with the mucosa overlying the sphenopalatine ganglion.



• **Fig. 3.6** Under control of an endoscope (4 mm, 0 degrees), a long 20-gauge needle is passed between the middle turbinate *(MT)* and inferior turbinate *(IT)* and inserted into the mucosa just behind and over the middle turbinate tail, seeking the sphenopalatine foramen. *N.Ph*, Nasopharynx. (From Ali AR, Sakr SA, Rahman ASMA. Bilateral sphenopalatine ganglion block as adjuvant to general anaesthesia during endoscopic trans-nasal resection of pituitary adenoma. *Egypt J Anaesth.* 2010;26[4]:273–280.)

CLINICAL PEARLS

Clinical experience has shown that sphenopalatine ganglion block with local anesthetic is useful in aborting the acute attack of migraine or cluster headache. The simplicity of the transnasal approach lends itself to use at the bedside, in the emergency room, or in the pain clinic. Although cocaine is probably a superior topical anesthetic for use with this technique, the various political issues surrounding the use of controlled substances make another local anesthetic such as viscous lidocaine a more logical choice.

For the acute headache sufferer, this technique can be combined with the inhalation of 100% oxygen via mask through the mouth while the cotton-tipped applicators are in place. Experience has shown that this technique aborts about 80% of cluster headaches. Sphenopalatine ganglion block should be carried out on a daily basis with the endpoint of complete pain relief. This usually occurs within five block procedures.

Suggested Readings

Kent S, Mehaffey G. Transnasal sphenopalatine ganglion block for the treatment of postdural puncture headache in obstetric patients. *J Clin Anesth*. 2016;34:194–196.

Slullitel A, Santos IS, Machado FC, Sousa AM. Transnasal sphenopalatine nerve block for patients with headaches. *J Clin Anesth*. 2018;47:80–81.

Triantafyllidi H, Arvaniti C, Schoinas A, et al. Bilateral sphenopalatine ganglion block reduces blood pressure in never treated patients with essential hypertension. A randomized controlled single-blinded study. *Int J Cardiol*. 2018;250:233–239.

Waldman SD. Sphenopalatine ganglion block. In: *Pain Review*. 2nd ed. Philadelphia: W.B. Saunders; 2017:370–372.

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4

Sphenopalatine Ganglion Block: Greater Palatine Foramen Approach

CPT-2019 CODE	
Local Anesthetic	64505
Neurolytic	64999
Fluoroscopic guidance	77002
Ultrasound Guidance	76942

RELATIVE VALUE UNITS	
Local Anesthetic	8
Neurolytic	20
Fluoroscopic guidance	8
Ultrasound Guidance	8

Indications

Sphenopalatine ganglion block may be used in the treatment of acute migraine headache, acute cluster headache, and a variety of facial neuralgias including Sluder, Vail, and Gardner syndromes. This technique is also useful in the treatment of status migrainosus and chronic cluster headache. There is anecdotal evidence that sphenopalatine ganglion block may also be useful in the palliation of pain secondary to acute herpes zoster of the trigeminal nerve as well as postdural puncture headache and untreated essential hypertension. The greater palatine foramen approach to sphenopalatine ganglion block is useful in patients who have an alteration of the nasal anatomy secondary to trauma or malignancy that would preclude use of the transnasal approach.

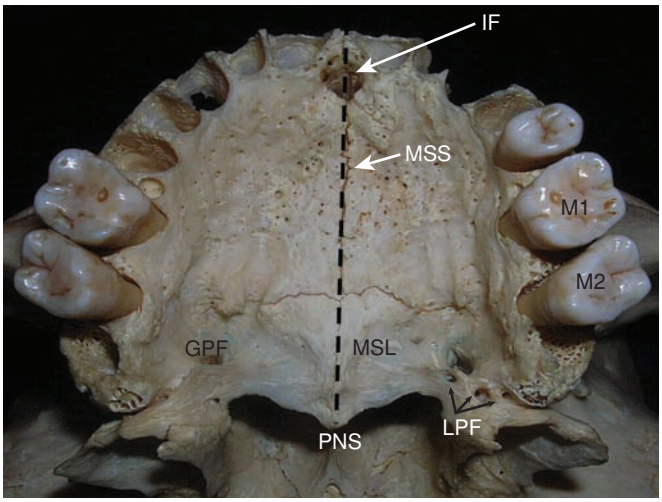
Neurodestructive procedures of the sphenopalatine ganglion using neurolytic agents, radiofrequency lesioning, or freezing may be indicated for the palliation of cancer pain and rarely for headache and facial pain syndromes that fail to respond to conservative management. Recent experience with electrical stimulation of the sphenopalatine ganglion has shown promising early results.

Clinically Relevant Anatomy

The sphenopalatine ganglion (pterygopalatine, nasal, or Meckel ganglion) is in the pterygopalatine fossa, posterior to the middle nasal turbinate. It is covered by a 1- to 1.5-mm layer of connective tissue and mucous membrane. This 5-mm triangular structure sends major branches to the gasserian ganglion, trigeminal nerves, carotid plexus, facial nerve, and superior cervical ganglion. The sphenopalatine ganglion can be blocked by topical application of local anesthetic via the transnasal approach or by injection via the lateral approach or injection through the greater palatine foramen. The greater palatine foramen is crescent shaped and allows for passage of the greater palatine nerve and the descending palatine vessels (Figs. 4.1 and 4.2).

Technique

Sphenopalatine ganglion block via the greater palatine foramen approach is accomplished by the injection of local anesthetic onto



• **Fig. 4.1** Ventral view of the hard palate. *GPF,* Greater palatine foramen; *IF,* incisive foramen; *LPF,* lesser palatine foramina; *M1, M2,* first and second molars; *MSL,* middle sagittal line; *MSS,* middle sagittal suture; *PNS,* posterior nasal spine. (From Piagkou M, Xanthos T, Anagnostopoulou S, et al. Anatomical variation and morphology in the position of the palatine foramina in adult human skulls from Greece. *J Craniomaxillofac Surg.* 2012;40[7]:e206–e210.)

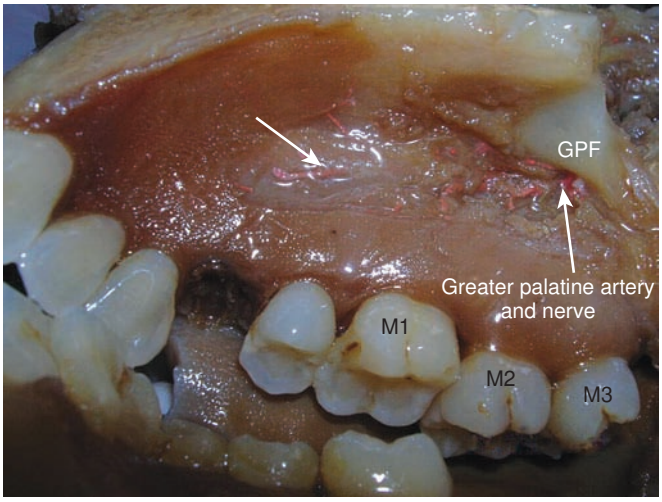
Abstract

The sphenopalatine ganglion (pterygopalatine, nasal, or Meckel ganglion) is located in the pterygopalatine fossa, posterior to the middle nasal turbinate. Sphenopalatine ganglion block may be used in the treatment of acute migraine headache, acute cluster headache, and a variety of facial neuralgias including Sluder, Vail, and Gardner syndromes. This technique is also useful in the treatment of status migrainosus and chronic cluster headache. The sphenopalatine ganglion can be blocked by topical application of local anesthetic or by injection. The greater palatine foramen approach to sphenopalatine ganglion block is useful in patients who have an alteration of the nasal anatomy secondary to trauma or malignancy that would preclude use of the transnasal approach.

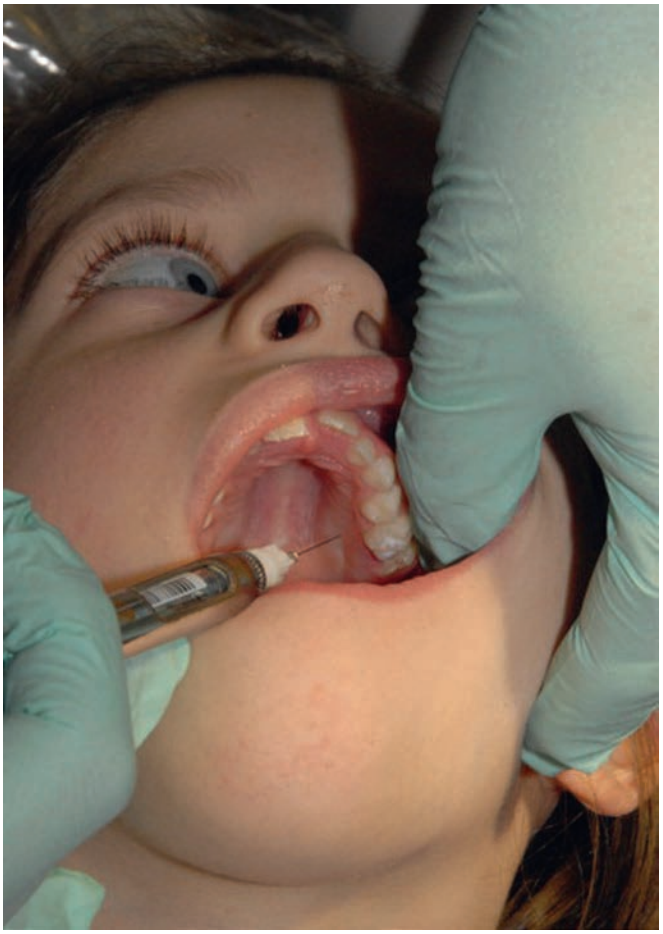
Keywords

cluster headache
Gardner syndrome
greater palatine foramen
Meckel ganglion
migraine headache
neurolytic sphenopalatine ganglion block
pterygopalatine ganglion
sphenopalatine ganglion nerve block
Vail syndrome

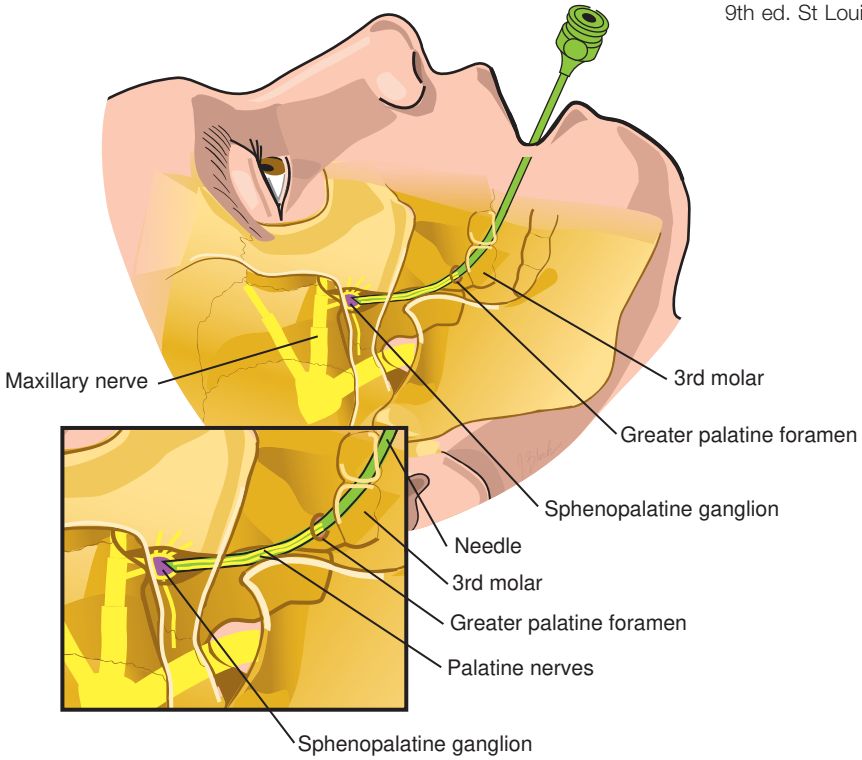
the ganglion. The patient is placed in the supine position with the cervical spine extended over a foam wedge. The greater palatine foramen is identified just medial to the gum line of the third molar on the posterior portion of the hard palate. A 25-gauge, 2-inch needle is advanced about 2.5 cm through the foramen in a superior and slightly posterior trajectory (Fig. 4.3). Use of an angled dental needle may facilitate needle placement into the greater palatine foramen, especially in patients who are unable to fully open their mouths (Figs. 4.4 and 4.5). The maxillary nerve is just superior



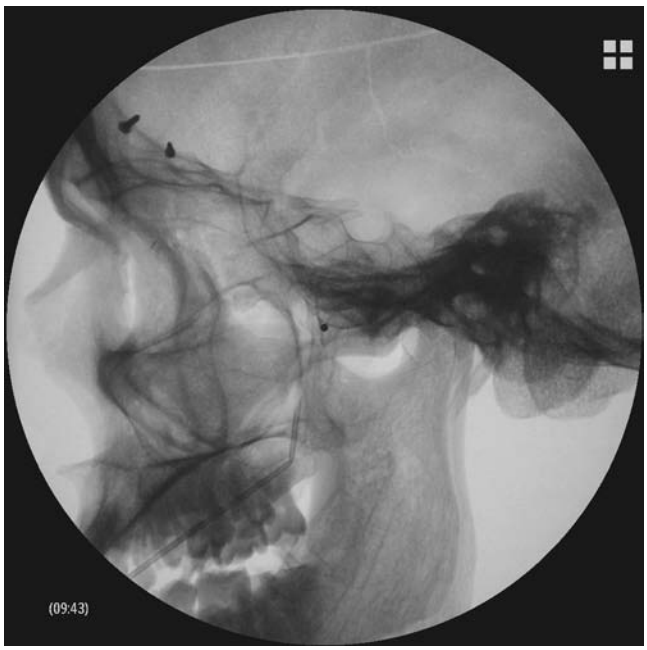
• **Fig. 4.2** Greater palatine foramen *(GPF)* and its content (greater palatine artery, vein, and nerve). *M1, M2, M3,* first, second, and third molars. (From Piagkou M, Xanthos T, Anagnostopoulou S, et al. Anatomical variation and morphology in the position of the palatine foramina in adult human skulls from Greece. *J Craniomaxillofac Surg.* 2012;40[7]:e206–e210.)



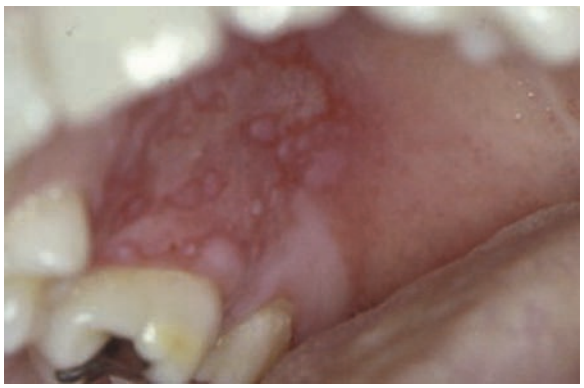
• **Fig. 4.3** Placement of a needle into the greater palatine foramen. (From McDonald RE, Avery DR, Dean JA, Jones JE. Local anesthesia and pain control for the child and adolescent. In: Dean JA, Avery DR, McDonald RE, eds. *McDonald and Avery's Dentistry for the Child and Adolescent*. 9th ed. St Louis: Mosby; 2011:241–252.)



• **Fig. 4.4** Proper needle placement for sphenopalatine ganglion block using the greater palatine foramen approach.



• **Fig. 4.5** Lateral fluoroscopic view of the tip of an angled dental needle placed through the greater palatine foramen.



• **Fig. 4.6** Recurrent intraoral herpes lesions are a contraindication to sphenopalatine ganglion block via the greater palatine foramen. (From Scully C, ed. Herpesvirus infections. *Oral and Maxillofacial Medicine: The Basis of Diagnosis and Treatment*. 3rd ed., New York: Churchill Livingstone; 2013:277–285.)

to the ganglion, and if the needle is advanced too deep, a paresthesia may be elicited. After careful, gentle aspiration, 2 mL of local anesthetic is slowly injected.

Side Effects and Complications

Because of the highly vascular nature of this anatomic region, significant systemic absorption of local anesthetic with resultant local anesthetic toxicity is a distinct possibility. This approach to sphenopalatine ganglion block should be avoided in patients who have intraoral infections, including herpes zoster (Fig. 4.6). Patients occasionally may experience significant orthostatic hypotension after sphenopalatine ganglion block. Therefore, patients who undergo sphenopalatine ganglion block should be monitored closely for orthostatic hypotension and initially allowed to ambulate only with assistance.

CLINICAL PEARLS

Clinical experience has shown that sphenopalatine ganglion block with local anesthetic is useful in aborting the acute attack of migraine or cluster headache. The simplicity of the transnasal approach lends itself to use at the bedside, in the emergency room, or in the pain clinic. Although cocaine is probably a superior topical anesthetic for use with this technique, the various political issues surrounding the use of controlled substances make another local anesthetic such as viscous lidocaine a more logical choice.

If previous trauma or tumor precludes the use of the transnasal approach to sphenopalatine ganglion block, injection via the greater palatine foramen represents a good alternative. Because of the proximity of the sphenopalatine ganglion to the maxillary nerve, care must be taken to avoid inadvertent neurolysis of the maxillary nerve when performing neurodestructive procedures on the sphenopalatine ganglion. Because the sphenopalatine ganglion can be localized more accurately by stimulation, radiofrequency lesioning via the lateral approach probably represents the safest option if destruction of the sphenopalatine ganglion is desired.

For the acute headache sufferer, this technique can be combined with the inhalation of 100% oxygen via mask after the injection of local anesthetic. Experience has shown that this technique aborts about 80% of cluster headaches. Sphenopalatine ganglion block should be carried out on a daily basis with the endpoint of complete pain relief. This usually occurs within five block procedures.

Suggested Readings

Ho KWD, Przkora R, Kumar S. Sphenopalatine ganglion: block, radiofrequency ablation and neurostimulation — a systematic review. *J Headache Pain*. 2017;18(1):118.

Kent S, Mehaffey G. Transnasal sphenopalatine ganglion block for the treatment of postdural puncture headache in obstetric patients. *J Clin Anesth*. 2016;34:194–196.

Slullitel A, Santos IS, Machado FC, Sousa AM. Transnasal sphenopalatine nerve block for patients with headaches. *J Clin Anesth*. 2018;47:80–81.

Tepper SJ, Caparso A. Neuromodulation for headaches—sphenopalatine ganglion stimulation. In: Krames ES, Peckham PH, Rezai AR, eds. *Neuromodulation*. 2nd ed. London: Academic Press; 2018:783–790.

Triantafyllidi H, Arvaniti C, Schoinas A, et al. Bilateral sphenopalatine ganglion block reduces blood pressure in never treated patients with essential hypertension. A randomized controlled single-blinded study. *Int J Cardiol*. 2018;250:233–239.

Waldman SD. Sphenopalatine ganglion block. In: *Pain Review*. 2nd ed. Philadelphia: W.B. Saunders; 2017:370–372.

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5

Sphenopalatine Ganglion Block: Lateral Approach

CPT-2019 CODE	
Local Anesthetic	64505
Neurolytic	64999
Fluoroscopic Guidance	77002
Ultrasound Guidance	76942

RELATIVE VALUE UNITS	
Local Anesthetic	8
Neurolytic	20
Fluoroscopic guidance	8
Ultrasound Guidance	8

Indications

Sphenopalatine ganglion block may be used in the treatment of acute migraine headache, acute cluster headache, and a variety of facial neuralgias including Sluder, Vail, and Gardner syndromes. The technique is also useful in the treatment of status migrainosus and chronic cluster headache. There is anecdotal evidence that sphenopalatine ganglion block may also be useful in the palliation of pain secondary to acute herpes zoster of the trigeminal nerve as well as postdural puncture headache and untreated essential hypertension.

The lateral approach to sphenopalatine ganglion block is useful in patients who have an alteration of the nasal anatomy secondary to trauma or malignancy that would preclude use of the transnasal approach. It is also the preferred route for neurodestructive procedures of the sphenopalatine ganglion. Neurodestruction of the sphenopalatine ganglion may be performed with neurolytic agents, radiofrequency lesioning, or freezing and is indicated for the palliation of cancer pain and rarely for headache and facial pain syndromes that fail to respond to conservative management. Recent experience with electrical stimulation of the sphenopalatine ganglion has shown promising early results.

Clinically Relevant Anatomy

The sphenopalatine ganglion (pterygopalatine, nasal, or Meckel ganglion) is located in the pterygopalatine fossa, posterior to the middle nasal turbinate. It is covered by a 1- to 1.5-mm layer of connective tissue and mucous membrane. This 5-mm triangular structure sends major branches to the gasserian ganglion, trigeminal nerves, carotid plexus, facial nerve, and superior cervical ganglion (Fig. 5.1). The sphenopalatine ganglion can be blocked by topical application of local anesthetic via the transnasal approach, by injection via the pterygopalatine fossa or through the greater palatine foramen, or by lateral placement of a needle via the coronoid notch.

Technique

Landmark and Fluoroscopically Guided Technique

Sphenopalatine ganglion block via the lateral approach is accomplished by the injection of local anesthetic onto the ganglion via a needle placed through the coronoid notch. The patient is placed in the supine position with the cervical spine in the neutral position. The coronoid notch is identified by asking the patient to open and close the mouth several times and palpating the area just anterior and slightly inferior to the acoustic auditory meatus (Fig. 5.2). After the notch is identified, the patient is asked to hold the mouth open in the neutral position.

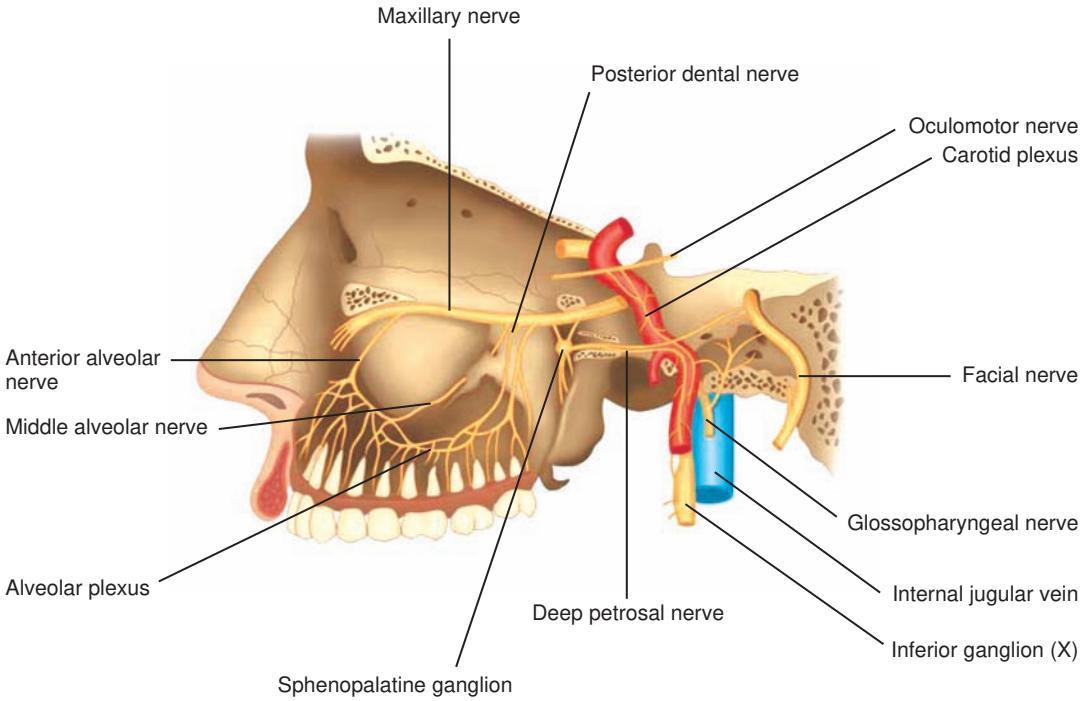
A total of 2 mL of local anesthetic is drawn up in a 3-mL sterile syringe. Some pain management specialists empirically add a small amount of non-particulate steroid preparation such as dexamethasone to the local anesthetic. After the skin overlying the coronoid notch is prepared with antiseptic solution, a 22-gauge, 3½-inch styletted needle is inserted just below the zygomatic arch directly in the middle of the coronoid notch. The needle is advanced about 1.5 to 2 inches in a plane perpendicular to the skull until the lateral pterygoid plate is encountered. At this point, the needle is withdrawn slightly and redirected slightly superior and anterior, with the goal of placing the needle just above the lower aspect of the lateral

Abstract

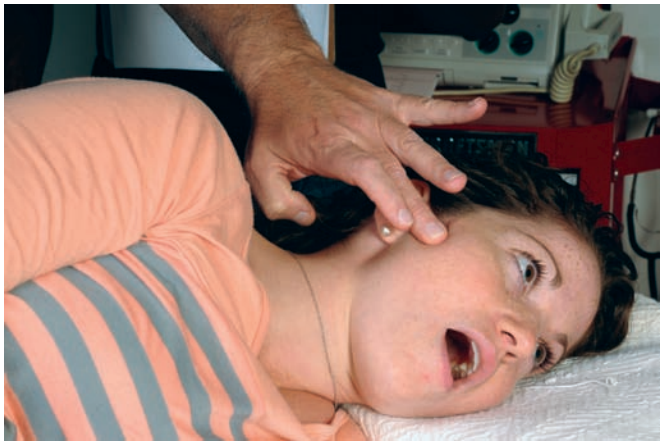
The sphenopalatine ganglion (pterygopalatine, nasal, or Meckel ganglion) is in the pterygopalatine fossa, posterior to the middle nasal turbinate. Sphenopalatine ganglion block may be used in the treatment of acute migraine headache, acute cluster headache, and a variety of facial neuralgias including Sluder, Vail, and Gardner syndromes. This technique is also useful in the treatment of status migrainosus and chronic cluster headache. The sphenopalatine ganglion can be blocked by topical application of local anesthetic or by injection. The greater palatine foramen approach to sphenopalatine ganglion block is useful in patients who have an alteration of the nasal anatomy secondary to trauma or malignancy that would preclude use of the transnasal approach.

Keywords

cluster headache
coronoid notch
Gardner syndrome
maxillary nerve
Meckel ganglion
migraine headache
neurolytic
sphenopalatine ganglion block
pterygopalatine fossa
pterygopalatine ganglion
sphenopalatine ganglion
sphenopalatine ganglion nerve block
Vail syndrome



• **Fig. 5.1** Anatomy of the sphenopalatine (pterygopalatine) ganglion. Note that the sphenopalatine (pterygopalatine) structure sends major branches to the gasserian ganglion, trigeminal nerves, carotid plexus, facial nerve, and superior cervical ganglion. (From Barral J-P, Croibier A, eds. Maxillary nerve. *Manual Therapy for the Cranial Nerves*. Edinburgh: Churchill Livingstone; 2009:129–138.)



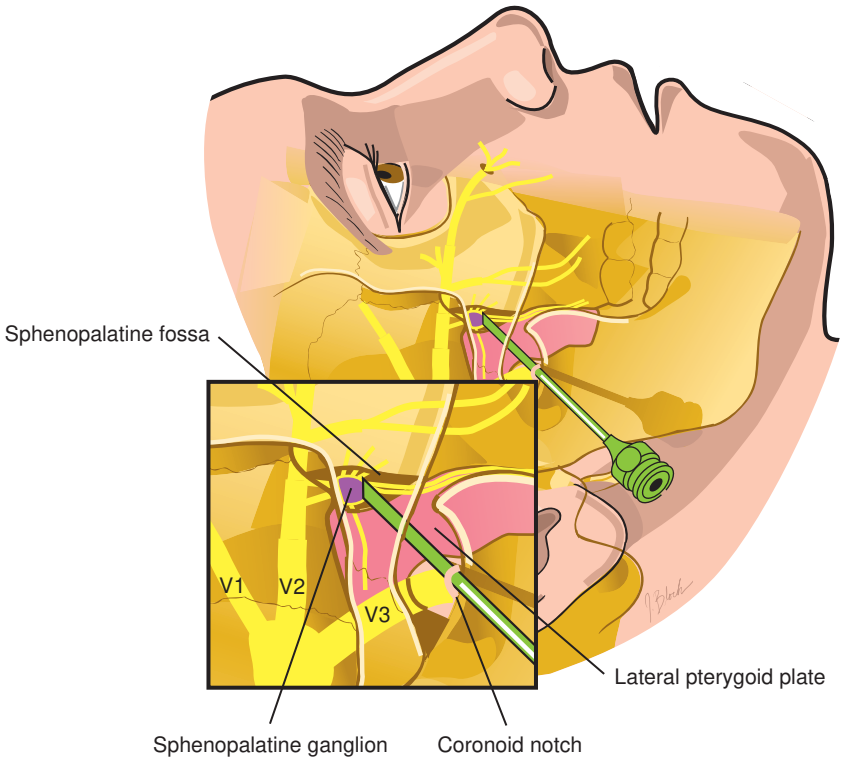
• **Fig. 5.2** The coronoid notch is identified by asking the patient to open and close the mouth several times and palpating the area just anterior and slightly inferior to the acoustic auditory meatus.

pterygoid plate so that it can enter the pterygopalatine fossa below the maxillary nerve and in close proximity to the sphenopalatine ganglion (Fig. 5.3). If this procedure is performed under fluoroscopy, the needle tip is visualized just under the lateral nasal mucosa, and its position can be confirmed by injecting 0.5 mL of contrast medium (Fig. 5.4). Additional confirmation of needle position can be obtained by needle stimulation at 50 Hz. If the needle is in the correct position, the patient experiences a buzzing sensation just behind the nose with no stimulation into the distribution of other areas innervated by the maxillary nerve.

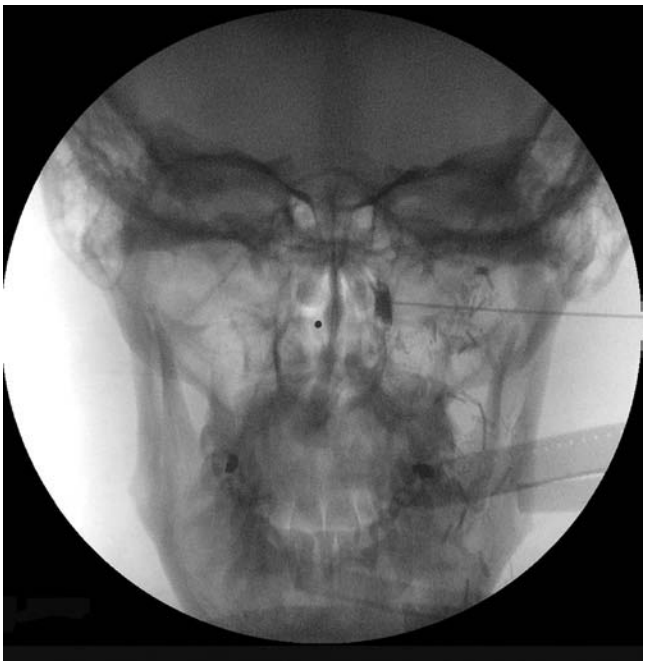
After correct needle placement is confirmed, careful aspiration is carried out, and 2 mL of solution is injected in incremental doses. During the injection procedure, the patient must be observed carefully for signs of local anesthetic toxicity. Because of the proximity of the maxillary nerve, the patient also may experience partial blockade of the maxillary nerve.

Ultrasound-Guided Technique

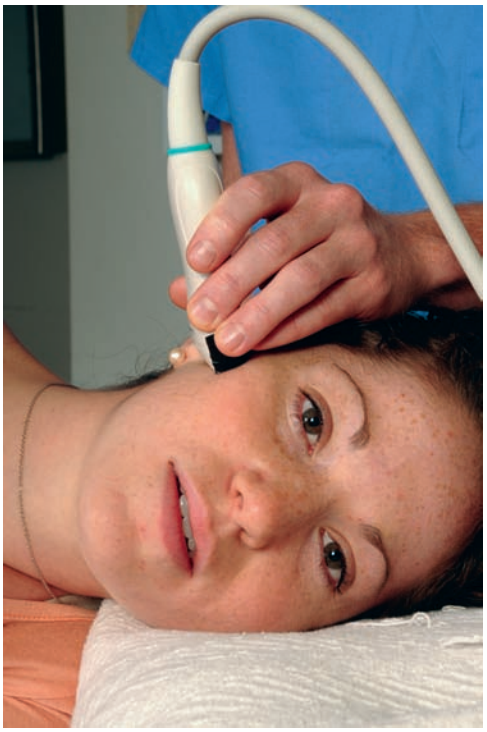
The coronoid notch is identified as described in the previous section (see Fig. 5.2) and the skin overlying the notch is then prepared with antiseptic solution. A linear transducer is then placed in the transverse plane directly over the mandibular notch. The masseter muscle is easily identified by following its origin on the zygomatic arch (Fig. 5.5). Just below and deep to the masseter muscle is the pterygopalatine fossa. The ultrasound transducer is moved slightly craniad and caudad until the maxillary nerve is clearly identified within the pterygopalatine fossa. After the maxillary nerve is identified, a 22-gauge, 10-cm straight styletted radiofrequency needle with a 2-mm active tip is inserted at a point just below the zygomatic arch in the middle of the coronoid notch using an out-of-plane approach. The needle is advanced under real-time ultrasound guidance until the tip rests just below the previously identified maxillary nerve. If a paresthesia in the distribution of the maxillary nerve is elicited, the needle should be withdrawn and redirected in a slightly superior and anterior trajectory allowing the needle tip to pass just above the inferior aspect of the lateral pterygoid plate to permit entry into the pterygopalatine fossa just



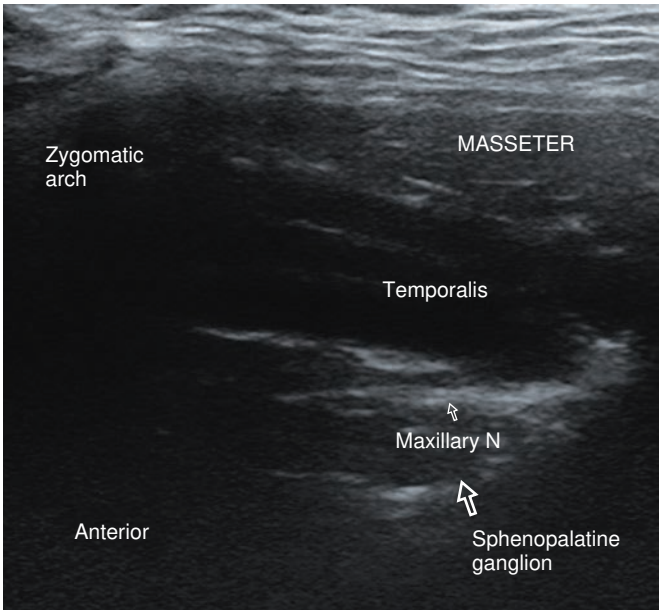
• **Fig. 5.3** Proper needle placement for sphenopalatine ganglion block using the lateral approach.



• **Fig. 5.4** Anteroposterior fluoroscopic image showing the tip of the needle with spread of the contrast agent along the lateral wall of the nasal cavity in proximity to the sphenopalatine ganglion. (From Narouze S. Complications of head and neck procedures. *Tech Reg Anesth Pain Manag.* 2007;11[3]:171–177.)



• **Fig. 5.5** Proper transducer position for sphenopalatine ganglion block via the lateral pterygoid approach.



• **Fig. 5.6** Transverse ultrasound image of the sphenopalatine ganglion. *N,* Nerve.

CLINICAL PEARLS

Clinical experience has shown that sphenopalatine ganglion block with local anesthetic is useful in aborting the acute attack of migraine or cluster headache. The simplicity of the transnasal approach lends itself to use at the bedside, in the emergency room, or in the pain clinic. Although cocaine is probably a superior topical anesthetic for use with this technique, the various political issues surrounding the use of controlled substances make another local anesthetic such as viscous lidocaine a more logical choice.

If previous trauma or tumor precludes the use of the transnasal approach to sphenopalatine ganglion block, injection of local anesthetic via the greater palatine foramen or the lateral approach represents a good alternative. Because of the proximity of the sphenopalatine ganglion to the maxillary nerve, care must be taken to avoid inadvertent neurolysis of the maxillary nerve when performing neurodestructive procedures on the sphenopalatine ganglion. Because of the ability to more accurately localize the sphenopalatine ganglion by stimulation, radiofrequency lesioning via the lateral approach represents probably the safest option if destruction of the sphenopalatine ganglion is desired.

For the acute headache sufferer, this technique can be combined with the inhalation of 100% oxygen via mask after the injection of local anesthetic. Experience has shown that this technique aborts about 80% of cluster headaches. Sphenopalatine ganglion block should be carried out on a daily basis with the endpoint of complete pain relief. This usually occurs within five to eight block procedures.

below the maxillary nerve and in proximity to the sphenopalatine ganglion (Fig. 5.6). When the operator is satisfied with the position of the needle tip, stimulation of the needle at 50 Hz should be carried out. If the patient experiences a stimulation pattern involving the gingiva, incisors, canine, and premolar teeth on the ipsilateral side, then the needle tip is too close to the maxillary nerve and must be repositioned caudally and medially. If the patient reports a buzzing sensation within his or her nose, without any stimulation of the ipsilateral gingiva and/or teeth, the needle tip is in satisfactory position and, after careful aspiration, the solution may be carefully injected.

Side Effects and Complications

Because of the highly vascular nature of the pterygopalatine fossa, significant facial hematoma may occur after sphenopalatine ganglion block via the lateral approach. This vascularity means that the pain management specialist should use small, incremental doses of local anesthetic to avoid local anesthetic toxicity.

Patients occasionally may experience significant orthostatic hypotension after sphenopalatine ganglion block. Therefore, patients who undergo sphenopalatine ganglion block should be monitored closely for orthostatic hypotension and initially allowed to ambulate only with assistance.

Suggested Readings

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6

Sphenopalatine Ganglion Block: Radiofrequency Lesioning

CPT-2019 CODE	
Neurolytic	64999
Fluoroscopic Guidance	77002
Ultrasound Guidance	76942

RELATIVE VALUE UNIT	
Neurolytic	20
Fluoroscopic Guidance	8
Ultrasound Guidance	8

Indications

Radiofrequency lesioning of the sphenopalatine ganglion block may be used in the treatment of chronic cluster headache, cancer pain, and a variety of facial neuralgias including Sluder, Vail, and Gardner syndromes that have failed to respond to more conservative treatments. There is anecdotal evidence that sphenopalatine ganglion block may also be useful in the palliation of pain secondary to acute herpes zoster of the trigeminal nerve as well as postdural puncture headache and untreated essential hypertension. The greater palatine foramen approach to sphenopalatine ganglion block is useful in patients who have an alteration of the nasal anatomy secondary to trauma or malignancy that would preclude use of the transnasal approach.

The lateral approach to sphenopalatine ganglion block is used to place the radiofrequency needle, although the transnasal and greater palatine foramen approach can be used in patients who have an alteration of the nasal anatomy secondary to trauma or malignancy that would preclude use of the lateral approach. Neurodestructive procedures of the sphenopalatine ganglion using the lateral approach may be performed with neurolytic agents, freezing, or radiofrequency lesioning. Radiofrequency lesioning has the added advantage of allowing the use of a stimulating needle, which facilitates correct needle placement.

Clinically Relevant Anatomy

The sphenopalatine ganglion (pterygopalatine, nasal, or Meckel ganglion) is located in the pterygopalatine fossa, posterior to the middle nasal turbinate (Fig. 6.1). It is covered by a 1- to 1.5-mm layer of connective tissue and mucous membrane. This 5-mm triangular structure sends major branches to the gasserian ganglion, trigeminal nerves, carotid plexus, facial nerve, and superior cervical ganglion. The sphenopalatine ganglion can be blocked by topical application of local anesthetic via the transnasal approach, by injection via the pterygopalatine fossa or through the greater palatine foramen, or by lateral placement of a needle via the coronoid notch.

Technique

Radiofrequency lesioning of the sphenopalatine ganglion block is accomplished by placing a radiofrequency needle in proximity to the sphenopalatine ganglion using the lateral approach via an introducer needle. The patient is placed in the supine position with the cervical spine in the neutral position. A 3½-inch cotton-tipped applicator is soaked in contrast medium and placed between the middle and inferior turbinates to serve as a radiopaque marker (Figs. 6.2 and 6.3).

A total of 2 mL of local anesthetic is drawn up in a 3-mL sterile syringe. After the skin lateral to the angle of the mouth is prepared with antiseptic solution, a 22-gauge, 10-cm insulated blunt curved needle with a 5- to 10-mm active tip is inserted through an introducer needle placed through the previously anesthetized area. The needle is advanced toward the tip of the cotton-tipped applicator, which rests on the mucosa just over the sphenopalatine ganglion at the level of the middle turbinate. The trajectory of the needle should be toward the posterior clinoid. The needle is slowly advanced under fluoroscopic guidance into the pterygopalatine fossa below the maxillary nerve and in close proximity to the sphenopalatine ganglion (Fig. 6.4). The pterygopalatine fossa will appear like an inverted vase on fluoroscopy. The needle tip ultimately is visualized just under the lateral nasal mucosa, and its position can be confirmed by injecting 0.5 mL of contrast medium.

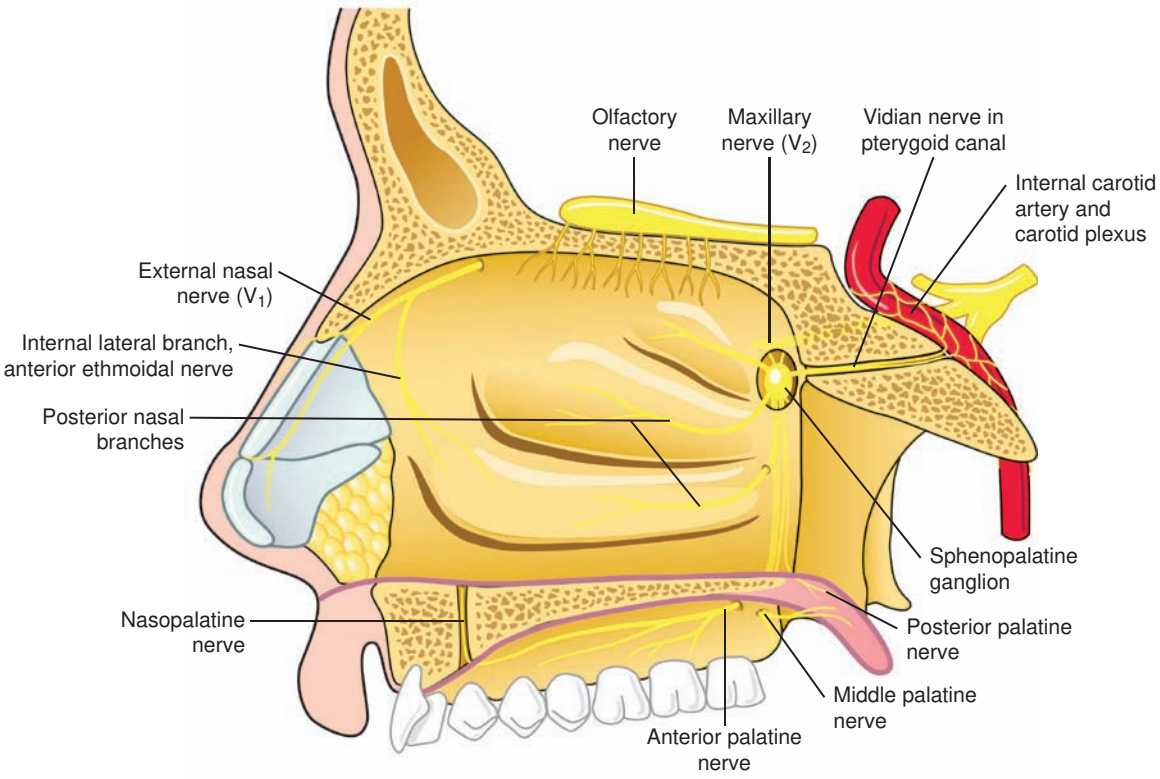
Sensory stimulation is then applied to the needle at 0.5 V at a frequency of 50 Hz. If the needle is in the correct position, the patient experiences a buzzing sensation just behind the nose with no stimulation into the distribution of other areas innervated by the maxillary nerve, which is often perceived by the patient as a buzzing sensation in the upper teeth (see "Side Effects and Complications" for pitfalls in needle placement). After correct needle placement is confirmed, pulsed radiofrequency lesioning is performed for 90 seconds at 44°C. Often a second lesion and sometimes a third lesion is necessary to provide long-lasting relief.

Abstract

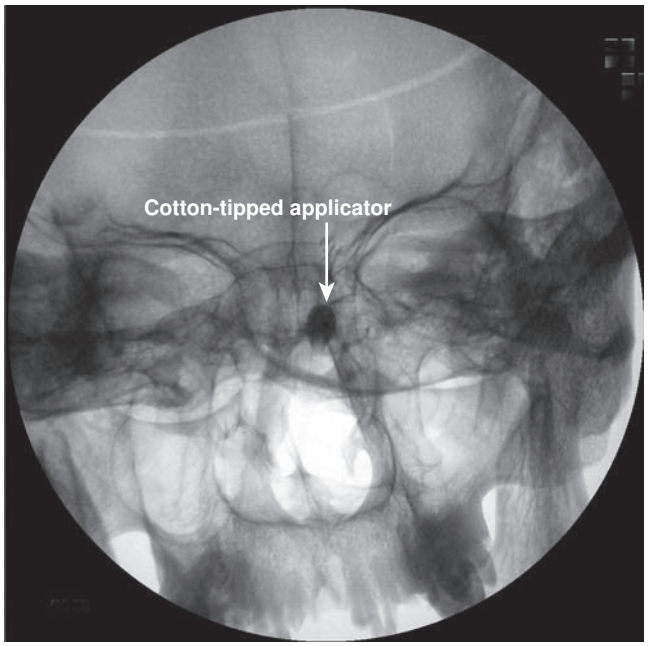
The sphenopalatine ganglion (pterygopalatine, nasal, or Meckel ganglion) is located in the pterygopalatine fossa, posterior to the middle nasal turbinate. Sphenopalatine ganglion block may be used in the treatment of acute migraine headache, acute cluster headache, and a variety of facial neuralgias including Sluder, Vail, and Gardner syndromes. This technique is also useful in the treatment of status migrainosus and chronic cluster headache. The sphenopalatine ganglion can be blocked by topical application of local anesthetic or by injection. The greater palatine foramen approach to sphenopalatine ganglion block is useful in patients who have an alteration of the nasal anatomy secondary to trauma or malignancy that would preclude use of the transnasal approach.

Keywords

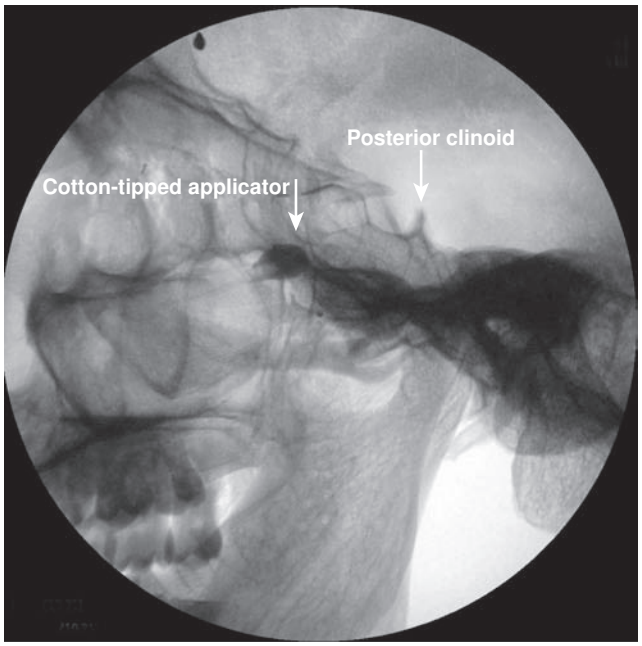
cluster headache
coronoid notch
Gardner syndrome
maxillary nerve
Meckel ganglion
migraine headache
neurolytic
sphenopalatine ganglion block
pterygopalatine fossa
pterygopalatine ganglion
radiofrequency destruction of the sphenopalatine ganglion
sphenopalatine ganglion
sphenopalatine ganglion nerve block
Vail syndrome



• **Fig. 6.1** Anatomy of the sphenopalatine ganglion within the pterygopalatine fossa. (From Narouze S. Complications of head and neck procedures. *Tech Reg Anesth Pain Manag.* 2007;11[3]:171–177.)



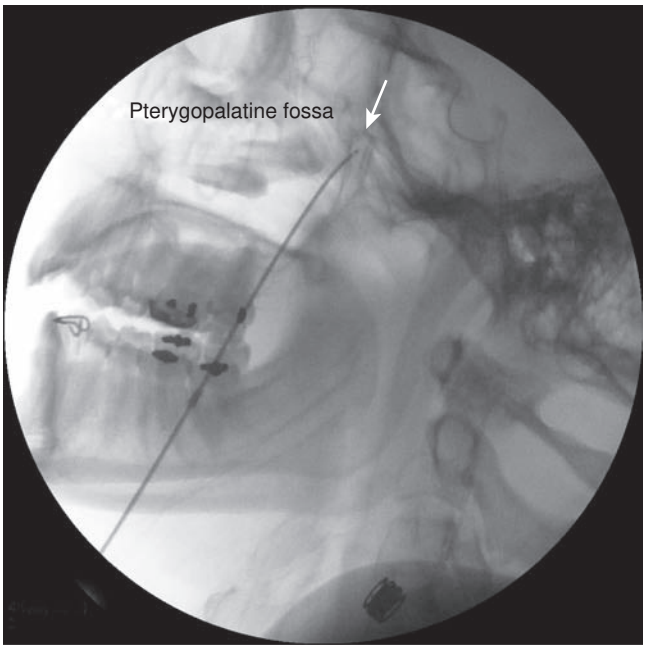
• **Fig. 6.2** Anteroposterior fluoroscopic image demonstrating the placement of a 3½-inch cotton-tipped applicator that has been soaked in contrast medium and placed between the middle and inferior turbinates to serve as a radiopaque marker.



• **Fig. 6.3** Lateral fluoroscopic image demonstrating the placement of a 3½-inch cotton-tipped applicator that has been soaked in contrast medium and placed between the middle and inferior turbinates to serve as a radiopaque marker.

TABLE 6.1 Identification of Specific Stimulation Patterns

Needle Position	Stimulation Pattern	Corrective Maneuver
Needle in proper position	Stimulation at base of nose	None
Needle in proximity to maxillary nerve	Stimulation in upper teeth	Redirect needle more caudad
Needle in proximity to greater and lesser palatine nerves	Stimulation in hard palate	Redirect needle more posteriorly



• **Fig. 6.4** Lateral fluoroscopic image demonstrating placement of the stimulating needle *(arrow)* in the pterygopalatine fossa in proximity to the sphenopalatine ganglion.

Side Effects and Complications

Because of the highly vascular nature of the pterygopalatine fossa, significant facial hematoma may occur after radiofrequency lesioning of the sphenopalatine ganglion. Owing to the proximity of other nerves, misplacement of the radiofrequency needle can result in damage to the affected nerve with permanent neurologic deficit. Stimulation before lesioning can help detect needle misplacement by identification of specific stimulation patterns (Table 6.1). The stimulation associated with proper placement of the needle is felt at the root of the nose. If the needle is malpositioned in proximity to the maxillary division of the nerve, the stimulation is experienced in the upper teeth. Should this occur, the needle should be positioned more caudad. If the needle is malpositioned near the greater and lesser palatine nerves, the stimulation is experienced in the hard palate. Should this occur, the needle should be redirected more medially and posteriorly.

Patients occasionally may experience significant orthostatic hypotension or bradycardia during stimulation of the sphenopalatine ganglion. This phenomenon is thought to be analogous to the oculocardiac reflex and can be prevented with atropine. Patients who undergo stimulation of the sphenopalatine ganglion should be monitored closely for orthostatic hypotension and bradycardia and initially allowed to ambulate only with assistance.

CLINICAL PEARLS

Clinical experience has shown that sphenopalatine ganglion block with local anesthetic is useful in aborting the acute attack of migraine or cluster headache. The simplicity of the transnasal approach lends itself to use at the bedside, in the emergency room, or in the pain clinic. Although cocaine is probably a superior topical anesthetic for use with this technique, the various political issues surrounding the use of controlled substances make another local anesthetic such as viscous lidocaine a more logical choice.

If previous trauma or tumor precludes the use of the transnasal approach to sphenopalatine ganglion block, injection of local anesthetic via the greater palatine foramen or the lateral approach represents a good alternative. Because of the proximity of the sphenopalatine ganglion to the maxillary nerve, care must be taken to avoid inadvertent neurolysis of the maxillary nerve when performing neurodestructive procedures on the sphenopalatine ganglion. Because of the ability to more accurately localize the sphenopalatine ganglion by stimulation, radiofrequency lesioning via the lateral approach represents probably the safest option if destruction of the sphenopalatine ganglion is desired.

Suggested Readings

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7

Greater and Lesser Occipital Nerve Block

CPT-2019 CODE	
Unilateral	64405
Bilateral	64405-50
Neurolytic	64640
Fluoroscopic Guidance	77002
Ultrasound Guidance	76942

RELATIVE VALUE UNITS	
Unilateral	8
Bilateral	12
Neurolytic	20
Fluoroscopic Guidance	8
Ultrasound Guidance	8

Indications

Occipital nerve block is useful in the diagnosis and treatment of occipital neuralgia. This technique is also useful in providing surgical anesthesia in the distribution of the greater and lesser occipital nerves for lesion removal and laceration repair. This simple technique may also be used to supplement general anesthesia for neurosurgical procedures involving the occipital region. Recent anecdotal reports suggest that occipital nerve block may be useful in the palliation of the acute pain of migraine headache with the ability to allow the clinician to reduce the amount of opioids required to treat the pain.

Clinically Relevant Anatomy

The greater occipital nerve arises from fibers of the dorsal primary ramus of the second cervical nerve and to a lesser extent from fibers of the third cervical nerve. The greater occipital nerve pierces the fascia just below the superior nuchal ridge along with the occipital artery. It supplies the medial portion of the posterior scalp as far anterior as the vertex (Fig. 7.1).

The lesser occipital nerve arises from the ventral primary rami of the second and third cervical nerves. The lesser occipital nerve passes superiorly along the posterior border of the sternocleidomastoid muscle, dividing into cutaneous branches that innervate the lateral portion of the posterior scalp and the cranial surface of the pinna of the ear (see Fig. 7.1).

Technique

Landmark and Fluoroscopically Guided Technique

The patient is placed in a sitting position with the cervical spine flexed and the forehead on a padded bedside table (Fig. 7.2). A total of 8 mL of local anesthetic is drawn up in a 12-mL sterile syringe. When occipital neuralgia or other painful conditions involving the greater and lesser occipital nerves are being treated, a total of 80 mg of depot-steroid is added to the local anesthetic with the first block, and 40 mg of depot-steroid is added with subsequent blocks.

The occipital artery is then palpated at the level of the superior nuchal ridge. After preparation of the skin with antiseptic solution, a 22-gauge, 1½-inch needle is inserted just medial to the artery and is advanced perpendicularly until the needle approaches the periosteum of the underlying occipital bone (Fig. 7.3). A paresthesia may be elicited, and the patient should be warned of such. The needle is then redirected superiorly, and after gentle aspiration, 5 mL of solution is injected in a fanlike distribution, with care taken to avoid the foramen magnum, which is located medially (Fig. 7.4; see also Fig. 7.3).

The lesser occipital nerve and a number of superficial branches of the greater occipital nerve are then blocked by directing the needle laterally and slightly inferiorly. After gentle aspiration, an additional 3 to 4 mL of solution is injected (Fig. 7.5; see also Fig. 7.3).

Ultrasound-Guided Technique

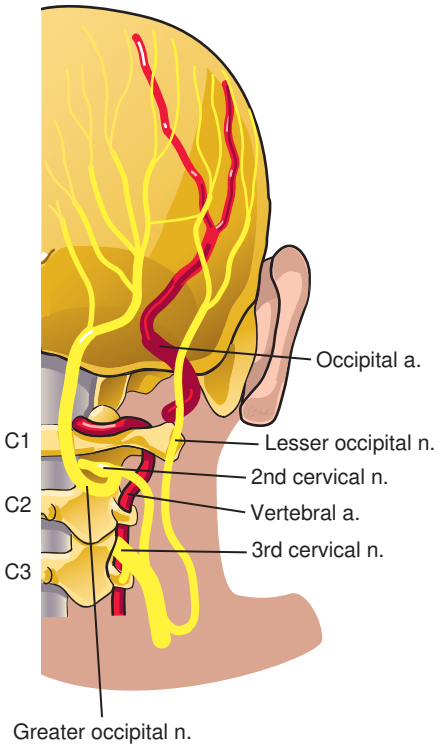
For ultrasound-guided blockade of the greater and lesser occipital nerves, the patient is placed in a sitting position with the cervical spine flexed and the forehead on a padded bedside table. A total of 8 mL of local anesthetic is drawn up in a 12-mL sterile syringe. When occipital neuralgia or other painful conditions involving the greater and lesser occipital nerves are being treated, a total of 80 mg of depot-steroid is added to the local anesthetic with the first block, and 40 mg of depot-steroid is added with subsequent blocks. The nuchal ridge is identified by palpation and then the occipital artery is located by palpation. A high-frequency linear ultrasound transducer is then placed in the transverse position at the nuchal ridge at the point at which the pulsation of the occipital artery was identified (Fig. 7.6). Color Doppler imaging may be

Abstract

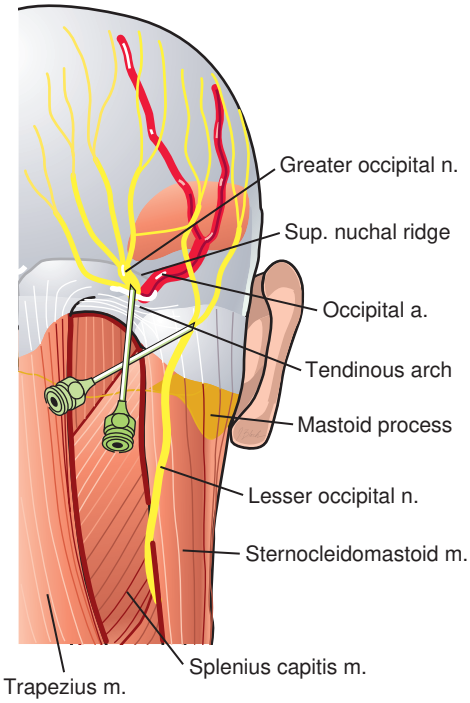
The greater occipital nerve arises from fibers of the dorsal primary ramus of the second cervical nerve and to a lesser extent from fibers of the third cervical nerve. It supplies the medial portion of the posterior scalp as far anterior as the vertex. The lesser occipital nerve arises from the ventral primary rami of the second and third cervical nerves. The lesser occipital nerve passes superiorly along the posterior border of the sternocleidomastoid muscle, dividing into cutaneous branches that innervate the lateral portion of the posterior scalp and the cranial surface of the pinna of the ear. Occipital nerve block is useful in the diagnosis and treatment of occipital neuralgia. This technique is also useful in providing surgical anesthesia in the distribution of the greater and lesser occipital nerves for lesion removal and laceration repair.

Keywords

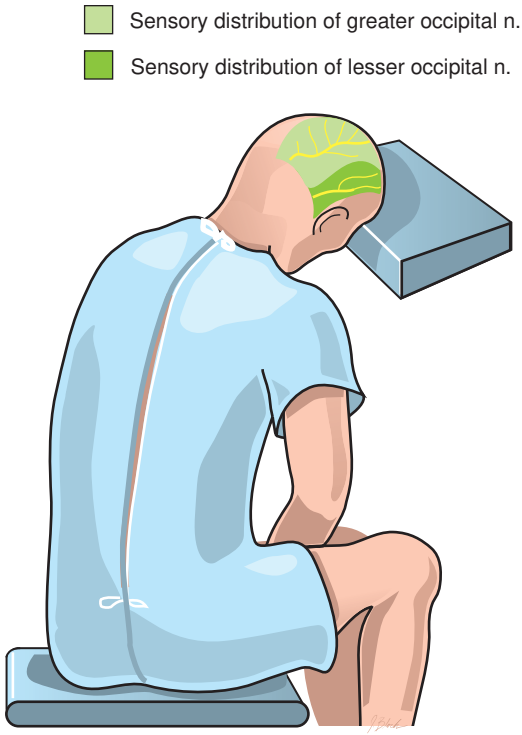
greater occipital nerve
headache
lesser occipital nerve
occipital nerve block
occipital neuralgia
ultrasound-guided occipital nerve block



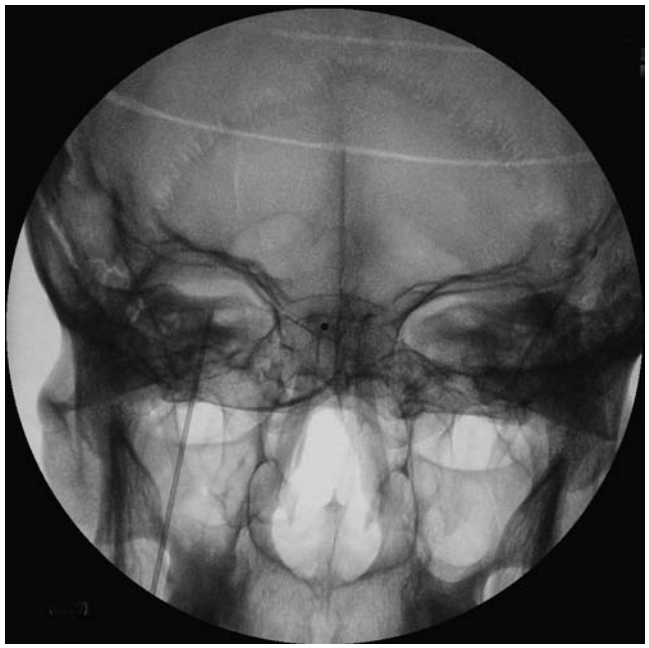
• **Fig. 7.1** Anatomy of the occipital nerve. *a.,* Artery; *n.,* nerve.



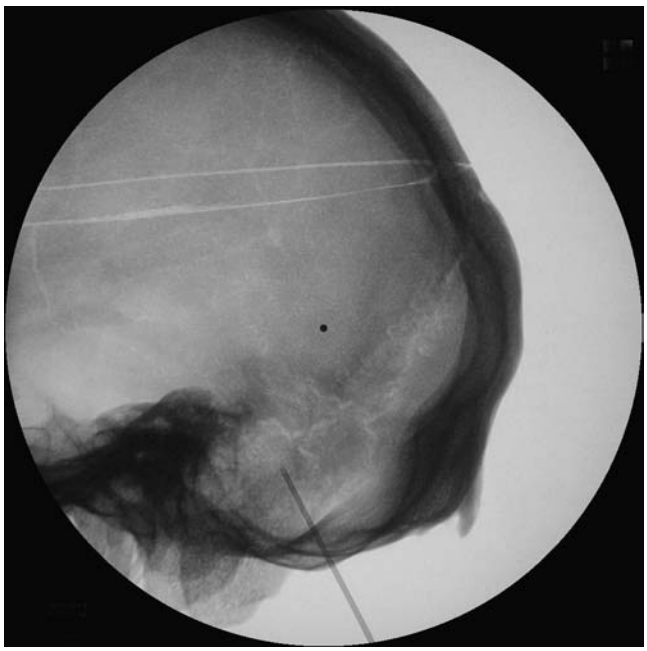
• **Fig. 7.3** Needle position and trajectory for greater and lesser occipital nerve block. *a.,* Artery; *m.,* muscle *n.,* nerve; *Sup.,* superior.



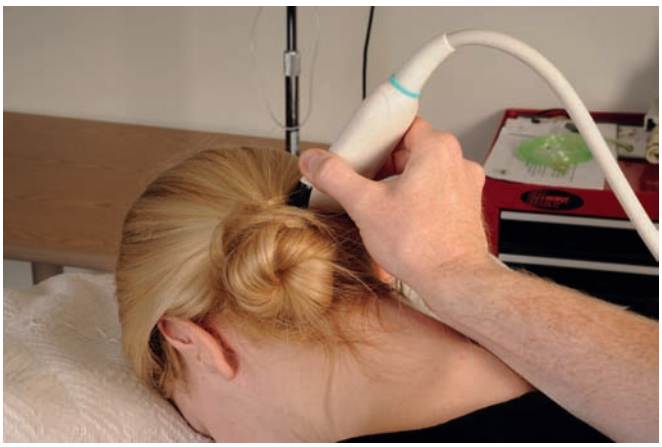
• **Fig. 7.2** For the greater and lesser occipital nerve block procedure, the patient is placed in a sitting position with the cervical spine flexed and the forehead on a padded bedside table. *n.,* Nerve.



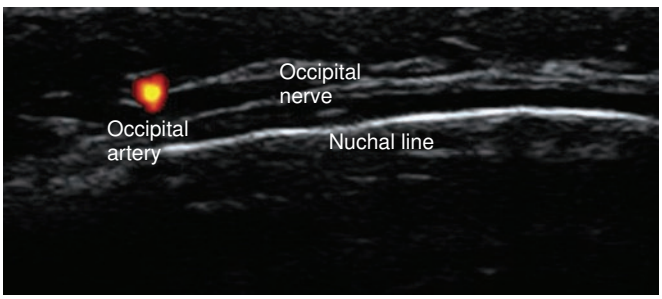
• **Fig. 7.4** Needle tip in proximity to the greater occipital nerve.



• **Fig. 7.5** Needle tip in proximity to the lesser occipital nerve.



• **Fig. 7.6** Proper transverse position of the high-frequency linear ultrasound transducer over the point of palpation of the occipital artery.



• **Fig. 7.7** Transverse ultrasound scan demonstrating the ovoid greater occipital nerve and the occipital artery.

used if there is difficulty in locating the occipital artery (Fig. 7.7). The occipital nerve will be in close proximity to the artery and will appear on the sonogram as a hypoechoic ovoid structure that does not compress when pressure is applied with the overlying ultrasound transducer (see Fig. 7.7). After the nerve is clearly identified, a 3½-inch spinal needle is inserted at the medial border of the ultrasound transducer using an in-plane approach and is advanced toward the occipital nerve until the needle tip impinges on the periosteum of the occipital bone. The patient may experience a paresthesia in the distribution of the greater occipital nerve and should be warned of such before the needle is advanced. When the needle tip is in proximity to the greater occipital nerve, after careful aspiration, 4 mL of the solution is injected in a fanlike manner. The needle is removed and pressure is placed on the injection site to avoid hematoma formation. The greater occipital nerve can also be blocked at the point where it passes between the obliquus capitis inferior and semispinalis capitis muscles.

The lesser occipital nerve and a number of superficial branches of the greater occipital nerve are then blocked by directing the needle laterally and slightly inferiorly. After gentle aspiration, an additional 3 to 4 mL of solution is injected (see Figs. 7.3 and 7.5).

Side Effects and Complications

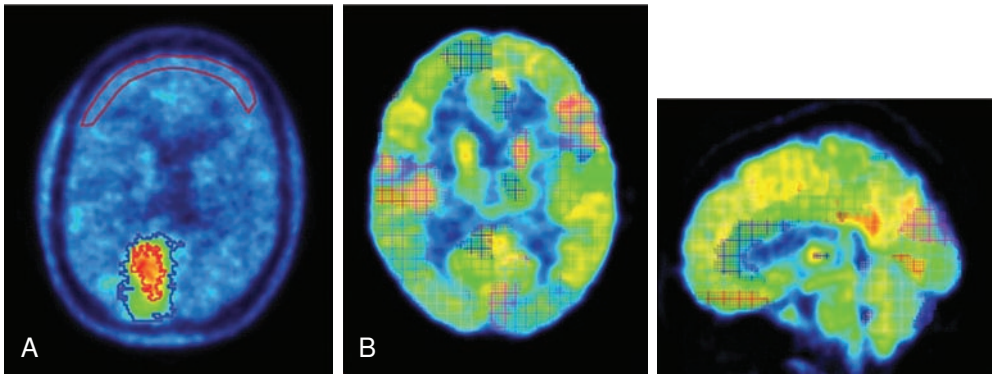
The scalp is highly vascular, and this, coupled with the fact that both nerves are in close proximity to arteries, means that the pain specialist should carefully calculate the total milligram dose of local anesthetic that may be given safely, especially if bilateral nerve blocks are being performed. This vascularity and the proximity to the arterial supply give rise to an increased incidence of postblock ecchymosis and hematoma formation. These complications can be decreased if manual pressure is applied to the area of the block immediately after injection. Despite the vascularity of this anatomic region, this technique can be performed safely in patients receiving anticoagulants by using a 25- or 27-gauge needle, albeit with increased risk of hematoma, if the clinical situation indicates a favorable risk-to-benefit ratio. Application of cold packs for 20-minute periods after the block also decreases the amount of postprocedure pain and bleeding the patient may experience.

As mentioned earlier, care must be taken to avoid inadvertent needle placement into the foramen magnum because the subarachnoid administration of local anesthetic in this region results in an immediate total spinal anesthesia.

CLINICAL PEARLS

The most common reason that greater and lesser occipital nerve block fails to relieve headache pain is that the headache syndrome being treated has been misdiagnosed as occipital neuralgia. In the author's experience, occipital neuralgia is an infrequent cause of headaches and rarely occurs in the absence of trauma to the greater and lesser occipital nerves. More often, the patient with headaches involving the occipital region is, in fact, suffering from tension-type headaches. Tension-type headaches do not respond to occipital nerve blocks but are amenable to treatment with antidepressant compounds such as amitriptyline in conjunction with cervical steroid epidural nerve blocks. Therefore, the pain management specialist should reconsider the diagnosis of occipital neuralgia in patients whose symptoms are consistent with occipital neuralgia but who fail to show a response to greater and lesser occipital nerve blocks.

Any patient with headaches severe enough to require neural blockade as part of the treatment plan should undergo magnetic resonance imaging of the head to rule out unsuspected intracranial disease, which may mimic the clinical symptoms of occipital neuralgia (Fig. 7.8). Furthermore, cervical spine radiography should be considered to rule out congenital abnormalities such as Arnold-Chiari malformations that may be the hidden cause of the patient's occipital headaches.



• **Fig. 7.8** (A and B) Positron emission tomography/magnetic resonance images of an occipital tumor in a patient with occipital headaches. (From Kops ER, Herzog H. Errors in MR-based attenuation correction for brain imaging with PET/MR scanners. *Nucl Instrum Methods Phys Res A.* 2013;702:104–107.)

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