# ASRA NEWS

A PUBLICATION OF THE AMERICAN SOCIETY OF REGIONAL ANESTHESIA AND PAIN MEDICINE

FEBRUARY 2020

## In This Issue



ASRA PAIN MEDICINE EDUCATION RESEARCH

Advancing the science and practice of regional anesthesiology and pain medicine to improve patient outcomes through research, education, and advocacy

# Table of Contents



*Cover photo by Raj Gupta, MD.*



American Society of Regional Anesthesia and Pain Medicine

3 Penn Center West, Suite 224 • Pittsburgh PA 15276
phone toll free 855-795-ASRA • fax 412-471-7503 • www.asra.com


*ASRA News* is published quarterly in February, May, August, and November. ISSN: 2474-2864

# President's Message: Collaboration With ESRA Translates Into More Benefits and Opportunities for ASRA Members

It is always remarkable that, regardless of where we practice, at our core we are so similar. The world is getting much smaller. In 2019, I had the pleasure of attending the 38th European Society of Regional Anaesthesia and Pain Therapy (ESRA) Congress in Bilbao, Spain. The meeting offered exceptional educational and scientific content, and as always, our European colleagues were wonderful and gracious hosts. However, the best part of the Congress for me was the face-to-face time with our global colleagues.

When I started my career some three decades ago, attending a European meeting seemed "foreign" - with different drugs, different techniques, and very different expectations. I walked away from the ESRA meeting impressed that we are quite similar in our techniques, drugs, outcomes, and expectations, but we are still diverse enough to learn quite a bit from one another. Clearly, by collaborating on a global scale, we are stronger.

The collaboration between ASRA and ESRA is strong. ASRA's journal, *Regional Anesthesia and Pain Medicine*, is also the official journal of ESRA. Both societies offer meeting registration discounts for the others' members to promote broader networking and collaboration. ASRA recently added an ESRA membership category, enabling ESRA members to join ASRA and receive benefits such as our special interest groups and their related communities. ESRA also offers a reduced membership category for ASRA members and shares the ESRA Academy, a multimedia site that provides a wealth of resources, including webcasts, videos, tools, and review articles.

> *"We recognize the power of our societies working together and also our global responsibility to lead the direction for education and practice in regional anesthesia and pain medicine."*

Our collaboration with ESRA has manifested in several meaningful publications as well. For example, "Impact of Perioperative Pain Management on Cancer Recurrence: An ASRA/ESRA Special Article" and the soon-to-be published "ESRA/ASRA Pediatric Regional Anesthesia Joint Committee Practice Advisory III: Infection, Coagulation and Local Anesthetic Systemic Toxicity" were written by volunteers from and vetted by both societies. The "European Society of Regional Anaesthesia and Pain Therapy and the American Society of Regional Anesthesia and Pain Medicine Joint Committee Practice Advisory on Controversial Topics in Pediatric Regional Anesthesia" was last published in 2015.

Eugene R. Viscusi, MD
ASRA President

Our Newsletter Committee is working with ESRA representatives on developing content, including a series of articles on how procedures are done on either side of the Atlantic. Often what is considered standard practice in Europe isn't the same as what is done in the United States, so the articles will enable us to learn new ideas and techniques and find the best approaches for all. A peek at ASRA's Twitter feed demonstrates this European/North American collaboration as well. The discussions are often lively, always insightful, and demonstrate clear lasting connections between our members.

As part of this collaborative initiative, I've reached out to Alain Delbos, the current ESRA president, to define some tangible joint projects for the coming years. We recognize the power of our societies working together and also our global responsibility to lead the direction for education and practice in regional anesthesia and pain medicine.

I'd love to hear what other ideas you have to further develop this collaboration. What topics would benefit from having both a European and North American "voice" for guidelines, practice advisories, or education? Please send your ideas to asraeditor@asra.com, and ASRA leaders will consider the suggestions for future projects. Together, we can create great opportunities for our collective memberships and, ultimately, our patients.

# From the Editor's Desk: ASRA's Universe Is Expanding

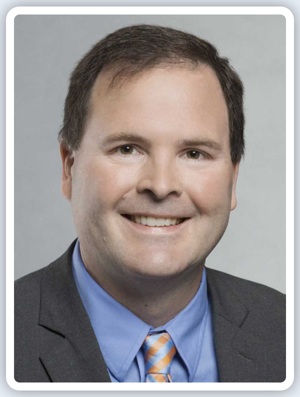
"Dogs and cats living together . . . mass hysteria!" - An immortal phrase uttered by Peter Venkman in the 1984 movie *Ghostbusters*. Although we are past the season of battling ghosts, he expressed well the difficulties many have with understanding the complexities of practicing a form of medicine that may be just outside of their clinical bubble.

Many ASRA members exist in one distinct group and have little reason to interact with those outside of their professional silo. The divisions might fall along practice lines, with those predominately practicing acute and regional anesthesia demonstrating little interest in chronic or interventional pain medicine. The reverse can certainly be true, where those practicing chronic or interventional pain medicine exhibit little interest in what occurs in the immediate perioperative period and how pain is managed in that arena. Physicians have similar silo tendencies in the clinical arena, where they might demonstrate little interest in trying to intellectually collaborate with NP/PA or surgical colleagues. Prior to assuming the role of *ASRA News* editor, I spent little time peering across the aisle at what my physician colleagues in chronic or interventional pain management were interested in or what other medical professional colleagues' approach to pain management looked like.

But now the formerly chasmic divides between acute and chronic pain management are breaking down. Procedures, approaches, or treatment algorithms formerly strictly confined to one persuasion or the other are finding a home in their colleagues' practices. For example, chronic pain physicians are now using abdominal fascial plane blocks, formerly isolated to the treatment of acute surgical pain associated with abdominal incisions, to diagnose and treat abdominal nerve entrapment syndromes. Patients with chronic pain and complex regional pain syndrome may now benefit from either an acute pain procedure (peripheral nerve catheter placement) or acute pain medication (ketamine).

*"...Now the formerly chasmic divides between acute and chronic pain management are breaking down."*

With increasing knowledge of sonoanatomy and comfort with ultrasound-assisted procedures, regional anesthesia and acute pain management practitioners are more comfortable performing procedures formerly thought to be outside of their scope of practice. Those providers might be more available in the inpatient setting and therefore more able to provide acute services. For example, in some locations regional anesthesia providers might be more available and able to provide stellate ganglion blocks for patients with recurrent or recalcitrant ventricular tachycardia.

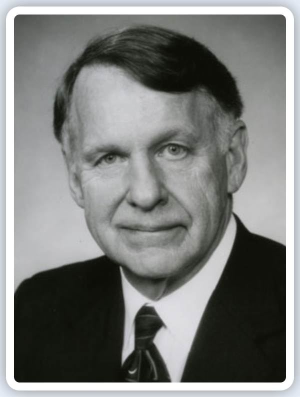


Kristopher M. Schroeder, MD
Associate Professor
University of Wisconsin School of Medicine & Public Health
Madison, WI
*ASRA News* Editor

Collectively, we are becoming aware of just how interconnected the practices of acute and chronic pain management truly are. We are recognizing that aggressive perioperative pain management might affect the development and degree of chronic pain following surgical procedures. The idea that those practice changes may extend the impact of anesthesiologists far beyond the surgical procedure is a very intriguing proposition. At the same time, patients presenting for surgical procedures with a history of significant opioid agonists or mixed agonist-antagonist administration can benefit greatly from the perioperative management skills and advice provided by providers generally focused on chronic pain management.

While specialized training certainly has value (I am not yearning to run out and insert an intrathecal pump), the lines between ASRA members are beginning to blur. With that in mind, I encourage all ASRA members to expand their horizons and attempt to understand the literature and perspective of their pain management colleagues. What might this mean? From a selfish perspective, I would love for every member to read (or listen) to every article in each edition of *ASRA News* or peer across the aisle at what those with a different pain management focus are publishing in *Regional Anesthesia and Pain Medicine*. At your own institution, seek out opportunities to collaborate with other pain management specialists. Finally, consider attending the less-aligning annual meeting (I attended the 18th Annual Pain Medicine meeting in fall 2019 and found the unique perspective—and New Orleans beignets—incredibly rewarding). ASRA has an expanded universe to offer, and accessing it requires minimal effort to obtain massive benefits.

# In Memoriam: Phillip O. Bridenbaugh, MD 1932-2019



Phillip O. Bridenbaugh, MD

Phillip O. Bridenbaugh was a leader. Growing up on a farm in Homer, Nebraska, with eight siblings, no one could have predicted his rise to the very top of the American Society of Regional Anesthesia and American Society of Anesthesiologists' leadership. Yet, he did.

His youth was spent, at least part of the time, with his older "brother Don," who also led our specialty and many aspects of regional anesthesia during his career in Seattle. Considering both personal friends and professional mentors, and from the farm country of Northeast Nebraska myself, I developed a bond with them that comes from common roots. I rarely heard either Don or Phil refer to each other without adding the adjective "brother" to the other's name. It was always brother Phil or brother Don.

Phil graduated from the University of Nebraska Medical School in Omaha and had to wait to see anesthesiologists in action until he moved to Seattle. He did a rotating internship at King County Hospital (now Harborview), and then his residency at the Mason Clinic. Following this, his interests in academic medicine drew him to an NIH fellowship at Stanford, and then a year of research in London, England, with Dr. Churchill-Davidson, of neuromuscular blocker fame.

When considering his next steps, he returned to Seattle and the Mason Clinic with brother Don and Dan Moore in 1965. The department was growing during his early years in Seattle, and engagement in organized medicine was valued highly. Phil learned that lesson well and went on to become involved in, and president of, the American Society of Regional Anesthesia, the American Society of Anesthesiologists, the Ohio Society of Anesthesiologists, the Society of Academic Anesthesia Chairs, and the Association of University Anesthesiologists. Additionally, he was editor-in-chief of *Regional Anesthesia and Pain Medicine*, and an editor for both *Anesthesia and Analgesia* and *Anesthesiology*.

One of his notable contributions to regional anesthesia came from his partnership with Michael Cousins of Australia, in co-editing the first comprehensive modern textbook, *Neural Blockade in Clinical Anesthesia and Pain Medicine*. Although Mike Cousins had also been a fellow at Stanford, their collaboration stemmed from a week Mike spent at the Mason Clinic as a visiting professor prior to his return to lead the department in Adelaide, South Australia. It was during that week in Seattle that Mike asked Phil to partner on the book project which went through four editions under their leadership.

David Brown, MD
Principal
Clear Consults
Hayward, WI

Phil did not spend all his time writing, editing, and leading our specialty groups. Rather, after leaving a leadership role at the Mason Clinic, in 1977 he took the position as chair of Anesthesiology at the University of Cincinnati, which he headed for more than 25 years. Having visited him and his department as a visiting professor in the 1990s, I saw first-hand how effectively he showed the way to others, both nationally, and at home. He knew what was going on in Cincinnati and nationally; a real tribute to his abilities, dedication, and wisdom. He and his wife, Diann, were married 38 years, and she, also an anesthesiologist, often "ran the operating rooms" in the university practice.

If you examine Phil's publication record, you can see the fingerprints of his fellowship training in basic science of neurophysiology and neuropharmacology. His University of Cincinnati team's rhesus monkey model of spinal cord pharmacology and physiology produced great clarity in that difficult-to-study area. He often shared with me that he longed for getting the balance right between clinical work, education, and research in an academic department.

As Phil moved on from leading almost all the important organizations in our specialty, he didn't quit. He is also to be remembered for his dedication to international humanitarian work. In 2011, he was honored by the American Society of Anesthesiologists as the first recipient of the Nicholas M. Greene, MD Award for Outstanding Humanitarian Contribution. This award and his international work often centered in Africa, and though a long way from Homer, Nebraska, Phil's world knew no boundaries. He cared.

*Phillip O. Bridenbaugh, MD, passed away on December 21, 2019, in Cincinnati, Ohio. He served as ASRA president from 1990 to 1991.*

# 2020: Embracing Tradition and Visions of the Future

## The 45th Annual Regional Anesthesiology and Acute Pain Medicine Meeting, April 23-25, San Francisco

I am thrilled to be the chair of the 45th Annual Regional Anesthesiology and Acute Pain Medicine Meeting taking place April 23-25, 2020, in San Francisco, CA. The process of planning this meeting actually began a few years ago, and our team has done our homework by listening to the feedback from past meetings and developing a collection of lectures, interactive sessions, and workshops geared to your needs. There are many hard-working volunteers behind the scenes (Figure 1) who are putting together a thought-provoking and inspiring event that I know regional anesthesiologists and acute pain medicine practitioners will enjoy.

Following the immensely successful 18th Annual Pain Medicine Meeting, we want to continue to promote diversity and inclusion. Regional anesthesiology and acute pain medicine continue to grow and evolve exponentially in not only science, research, and guidelines, but also in our membership. This year, you will see a number of new faces sharing their expertise throughout the refresher courses, parallel sessions, problem-based learning discussions, and workshops.

*"We play an integral role in driving enhanced recovery and managing the complicated issues in perioperative pain management."*

One of the main themes of the meeting is the role of acute pain physicians in perioperative medicine. We play an integral role in driving enhanced recovery and managing the complicated issues in perioperative pain management. As I've said before, the PACU is not the finish line and there is so much more we can do to provide value for our patients beyond the operating room. We are bringing together leaders in our field to discuss our impact on outcomes. Does ERAS work for every patient? What about the complicated patients who are outliers? We will also talk about the pain trajectory – from acute pain to transitional pain to chronic pain – can we predict which patients are most at risk and intervene earlier so as no patient is left behind? Expert faculty will address these topics throughout the meeting, including Dr. Kristin Schreiber, Dr. David Clarke, Dr. Tong Joo Gan, Dr. Sean Mackey, Dr. Meg Rosenblatt, Dr. Rebecca Johnson, Dr. Ellen Soffin, Dr. Andrea Nicol, Dr. Stephen Macres, and Dr. Tessa Walters.

Jaime L. Baratta, MD
Chair
Scientific/Education Planning Committee 2020

Regional anesthesia is continually evolving and developing, and ASRA is dedicated to not only embracing our tradition with comprehensive experience in upper and lower extremity blocks, but continuing to introduce new techniques that can greatly help our patients, including erector spinae blocks, retrolaminar blocks, costoclavicular blocks, iPACK blocks, pectoralis blocks, quadratus lumborum blocks, and more. What is the future of regional anesthesia and acute pain medicine? Our expert faculty from around the world, including Dr. Manoj Karmakar, Dr. Amit Pawa, Dr. Sarah Madison, and so many more, are here to tell you. Open scanning sessions and master classes in both adult and pediatric regional anesthesia will give participants at all levels time to further hone their skills and learn from our experts. Has the ultrasound become the new stethoscope? Point-of-care ultrasound (PoCUS) experts Dr. Karen Boretsky and Dr. Stephen Haskins will debate this topic as well as help participants get hands-on experience in PoCUS. We've invited orthopedic surgeons to give their perspective on enhanced recovery and pain management in ambulatory joint surgery, joint revision surgery, and spine surgery including Dr. Sohail Mizra, an expert in enhanced recovery for spine surgery.

We will again offer the Practice Management Portfolio (PMP) to help anesthesiologists ensure viability and accountability of their regional and acute pain services in this challenging healthcare environment. Dr. Alexandru Visan, Dr. F. Kayser Enneking, Dr. Sanjay Sinha, and Dr. Colin McCartney will help us to understand the cost of our services and the path to take charge to ensure consistency and reliability in our practice.

One of our main focuses this year is physician wellness. We have a special session on recognizing and combating burnout and enhancing physician wellness as it continues to plague medicine as a whole. Dr. Michael Weinstein, a

**Figure 1:** *Planning committee.*

| Scientific/Education Planning Committee |
|---|
| Jaime Baratta, MD, 2020 Chair |
| Vincent W.S. Chan, MD, FRCPC, FRCA, Ex-Officio, CME Committee Chair |
| Nabil Elkassabany, MD, MSCE, 2021 Scientific/Education Planning Committee Chair |
| Meera Gonzalez, MD, Member-at-Large |
| Carrie Guheen, MD, Resident Section Advisor |
| Rajnish Gupta, MD, Immediate Past Chair |
| David Hardman, MD, Member-at-Large |
| Kellie Jaremko, MD, Resident Section Chair 2019-2020 |
| Rebecca Johnson, MD, Chair, 2022 Scientific/Education Planning Committee Chair |
| Jinlei Li, MD, Member-at-Large |
| Stephen Macres, MD, Member-at-Large (Local Faculty) |
| Jennifer Noerenberg, MD, Practice Management Committee |
| Carlos Pino, MD, Ex-Officio CME Committee Co-Chair |
| Steven Porter, MD, Member-at-Large |
| Brian Sites, MD, Ex-Officio, Editor-in-Chief, Board Liaison |
| Eugene Viscusi, MD, Ex-Officio, ASRA President |
| Jon Zhou, MD, Member-at-Large |

renowned trauma surgeon, will offer his inspiring journey and ultimate triumph through this all too common topic, while Dr. Jody Leng will give insight on physician wellness programs. In addition to panel discussions, we will have a number of wellness activities including a fun-run through the beautiful city as well as a "Bark Break" visit from some local rescue dogs just looking for some hugs. Our wellness program will surely provide opportunities to both get your heart rate going as well as unwind.

ASRA meetings always include a lot of fun, too. On Thursday, we have our Wine & Bubbly Networking Reception in the Exhibit Hall, which provides an opportunity to connect with colleagues and learn about the latest products and services in the industry. We will again offer our ASRA Let's Eat program, where you can sign up to eat dinner and network with some new friends.

**Figure 2:** *Session highlights.*

| Acute Pain Medicine Session Highlights |
|---|
| Renaming the Acute Pain Service as the **Inpatient Pain Service** |
| Focus on the **Pain Trajectory and Transitional Pain Service** |
| Acute Pain Management in **multiple joint revisions**, the patient on **opioid dependence treatment,** the patient with **chronic pain syndrome** |
| Regional Anesthesia and Outcomes: What can we learn from **Big Data**? |
| **Regional Anesthesia Technical Highlights** |
| **PoCUS** with our experts Stephen Haskins, Anahi Perlas, and Jan Boublik |
| **Open-Scanning** sessions with our amazing faculty for participants looking to hone their skills |
| **Master Classes** with our expert faculty for those already proficient in regional anesthesia |
| **New Blocks on the Block** workshop with the latest concepts |

On Saturday, don't miss the Excellence in ASRA Awards Luncheon where Dr. Guy Weinberg will be presenting the Gaston Labat Lectureship. Finally, on Saturday evening, we will again offer our popular Annual Meeting Celebration, a time to enjoy old friends and new and relax high atop the hotel with a view of the beautiful City by the Bay.

Throughout its history, ASRA has always been very inclusive of those who are newer to the field and still in training. In addition to dedicated workshops offered at substantially lower prices, our Resident/Fellow Meet and Greet on Friday evening is a great way for trainees to connect with one another and meet Regional Anesthesia and Acute Pain Medicine Fellowship Directors.

As we embrace the future of regional anesthesia and acute pain medicine in this innovative program with expert faculty and amazing networking opportunities, the 2020 Spring ASRA meeting cannot be missed! And as the Journey song goes.... "When the lights go down in the city, and the sun shines on the bay," you want to be there! We cannot wait to see you in San Francisco.

# Regional Anesthesia Billing: Surgical Anesthesia Versus Postoperative Analgesia

Jason P. Zatkoff, DO
Ann Arbor Anesthesia Associates
St. Joseph Mercy Oakland
Pontiac, MI

Brian F. S. Allen, MD
Assistant Professor
Vanderbilt University Medical Center
Nashville, TN

A sound knowledge of regional anesthesia billing and coding is essential for physicians performing nerve blocks to prevent unintentional consequences, especially overbilling. Yet, billing and coding are often misunderstood and underemphasized. This may reflect the complexity of the material; acute pain consultation and follow-up are governed by different rules than procedural billing, which is itself comprised of several different components. Adding to the complexity, the Centers for Medicare and Medicaid Services (CMS) sets billing rules that other payers often use but can have variations based on state regulations or individual payers.[1] This article will focus narrowly on regional anesthesia procedural billing with the goal of assisting the practicing regional anesthesiologists in the perioperative setting. Specifically, this article will explore the nuances of billing nerve blocks that are intended for surgical anesthesia versus those for postoperative analgesia.

## CPT CODES

As a general overview, physician services are coded using the Current Procedural Terminology (CPT) code system with or without modifiers (Table 1 and 2). CPT codes are assigned relative value units (RVUs), which account for three components: physician work, practice expense, and malpractice expense. Each component of the total RVU is adjusted by a geographic practice cost index, and the total is multiplied by a conversion factor (CF), yielding the monetary value of services provided. CFs vary based on patient insurer (the payer) as well as the region: the 2019 Medicare CF is $36.0391, Medicaid is lower, and private insurance is often substantially higher.[2] Of note, some payers have alternative methods of reimbursement, such as negotiating a percentage of billed charges in lieu of payment based on RVUs.

## ASA CODES

Although CPT codes are typically associated with a defined amount of RVUs, codes for provision of anesthesia services are handled differently. The CPT code for the surgical procedure performed is cross-walked to an associated anesthesia (ASA) code, which has two components: base units, determined by the complexity of the surgical procedure the patient is undergoing, and time units, determined by the time between anesthesia start and stop times (Table 3). When a nerve block is intended as a surgical anesthetic, the time taken to perform the block is captured as time units under the applicable ASA code at a rate of one time unit per 15 minutes—and it may be subdivided. In contrast, a procedure performed for postoperative (or nonoperative) analgesia is billed under a CPT code separate from the anesthetic's base and time units (Table 1). A block for postoperative pain thus generates a fixed number of RVUs with no time component.[3]

Having two methods for coding the same procedure based on the intent and subsequent use of that procedure is a central challenge in properly coding and billing acute pain procedures, especially when the two methods may produce modest differences in fees. As an example, an infraclavicular block performed as a surgical anesthetic and performed in five minutes would be worth 0.33 time units (depending on a payer's rounding rules), whereas the same block performed as postoperative analgesia would be worth 1.48 RVUs. Depending on the payer and the agreed reimbursement for time units and RVUs, a block for postoperative analgesia might generate higher revenue. If coded incorrectly, physicians risk incurring penalties for fraud and abuse.[4]

> *"Having two methods for coding the same procedure based on the intent and subsequent use of that procedure is a central challenge in properly coding and billing acute pain procedures."*

**Table 1:** *CPT codes, work RVUs, and type of procedural services.*

| Procedural Service | CPT Code (Single Injection / Continuous Catheter) | Work RVUs (SS/Cath if Relevant) |
|---|---|---|
| Transversus abdominis plane (TAP) block (abdominal plane block, rectus sheath block) bilateral | 64488/89 | 1.60/1.80 |
| Transversus abdominis plane (TAP) block (abdominal plane block, rectus sheath block) unilateral | 64486/87 | 1.27/1.48 |
| Injection, anesthetic agent; brachial plexus | 64415/16 | 1.48/1.81 |
| Injection, anesthetic agent; femoral nerve | 64447/48 | 1.50/1.63 |
| Epidural without image guidance; cervical/thoracic | 62324 | 1.89 |
| Injection, anesthetic agent; other peripheral nerve or branch | 64450 | 0.75 |
| Ultrasound guidance for needle placement | 76942 | 0.67 |

CPT, Current Procedural Terminology; RVU, relative value unit

**Table 2:** *Modifier codes and their descriptions.*

| Modifier Code | Modifier | Description |
|---|---|---|
| 22 | Increased Procedural Services | Designates increased procedural services because of special circumstances (eg, morbid obesity, trauma, or malformation that interferes with the procedure). May increase reimbursement by 20%–25% but must be documented thoroughly. |
| 50 | Bilateral Procedure | Added when performing bilateral procedures (eg, right and left femoral nerve blockade). Some CPT codes include a bilateral description and should not get this modifier (eg, bilateral TAP blocks). Reimbursement is 150% of single procedure. |
| 51 | Multiple Procedures | Added to a second or subsequent procedure performed on the same day (eg, femoral plus sciatic block). Reimbursement is 50% for second procedure. |
| 59 | Distinct Procedural Service | Shows that procedure separate and separately billable from another service on the same day (e.g. an anesthetic). |
| LT/RT | Left/Right, respectively | Gives procedure laterality. |

CPT, Current Procedural Terminology

**Table 3:** *ASA codes, base units, and type of anesthesia services.*

| Anesthesia Service | ASA Code | Base Units |
|---|---|---|
| Anesthesia for total shoulder replacement | 01638 | 10 |
| Anesthesia for total knee replacement | 01402 | 7 |
| Anesthesia for thoracotomy procedure with one lung ventilation | 00541 | 15 |
| Anesthesia for intestinal endoscopic procedures | 00811 | 4 |

ASA, anesthesia service

**Table 4:** *Examples of cases for billing regional anesthesia procedures.*

| Case Description | Anesthesia Type | Bill Block As |
|---|---|---|
| Total shoulder arthroplasty. Interscalene catheter placed in pre-op. LMA placed in OR. | General | Post-op analgesia (CPT code). |
| Transmetatarsal foot amputation. Ankle block in OR. Propofol drip and NC O2 in OR. | Regional | Surgical anesthesia (ASA code). |
| Distal radius open reduction internal fixation. Infraclavicular block in OR. LMA placed in OR after block. | General | Post-op analgesia. |
| AV fistula placement. Axillary block in pre-op holding. Patient taken straight to OR after block. Propofol drip and NC O2 in OR. | Regional | Surgical anesthesia: block time is included in anesthesia time. |
| Abscess incision and drainage of calf. Femoral and sciatic blocks in pre-op holding. Patient to OR 45 minutes after block. Minimal sedation in OR. | Regional | Surgical anesthesia: start anesthesia time when patient is taken to OR. |
| Total knee arthroplasty. Adductor canal block in pre-op. Spinal in the OR. | Spinal | Spinal as surgical anesthesia, adductor canal as post-op anesthesia. |

ASA, anesthesia service; CPT, Current Procedural Terminology; LMA, laryngeal mask airway; NC, nasal cannula; OR, operating room

## PURPOSE OF THE BLOCK

When documenting a perioperative regional anesthesia procedure, physicians must clearly distinguish its purpose (Figure 1). If the planned surgical anesthetic relies on a regional anesthesia procedure, then the block should be considered as the primary anesthetic. Billing it as a post-operative analgesic would be improper.

Another example of improper practice would be an infraclavicular block performed for a carpectomy where the patient is maintained intraoperatively on a propofol infusion with nasal cannula O2 and the anesthetic is charted as monitored anesthesia care with block for postoperative pain. Instead, it should be a regional anesthetic and the block billed as part of the ASA code for the procedure (base + time units). However, in the same circumstances, if the block were performed and a laryngeal mask airway placed, the anesthetic would be charted as general and the block could be billed as a separate CPT code for postoperative pain. See Table 4 for other examples of cases and their proper billing codes.

## GAPS IN CARE

Gaps between surgical anesthetic block placement and surgery can affect reimbursement (Figure 2). Although CMS guidelines may permit a gap in anesthesia care once the anesthetic has begun, billing systems typically struggle to allow for breaks in anesthesia service. Practically, this means that blocks performed for surgical anesthesia can be included in the anesthesia time of a case as long as a gap did not occur in the anesthesia provider's continuous care. For example, a block for surgical anesthesia performed in the operating room would be billed under an ASA code as base + time units (Figure 2A), and a block performed in a holding room can be included in ASA code billing if the anesthesiologist remains physically present with the patient until they go to the operating room at the end of the block (Figure 2B). In contrast, the same block would not be billed if the anesthesia provider performs the block, steps away from the bedside to let the block "soak," and returns to take the patient to the operating room briefly thereafter (Figure 2C).

## POSTOPERATIVE ANALGESIC BLOCKS DURING A SURGICAL ANESTHETIC

Postoperative analgesic blocks billed as CPT codes can be performed before the documented anesthesia start time (Figure 2D), after the anesthesia end time, or during an ongoing anesthetic. Per CMS, if a postoperative analgesic block is performed between anesthesia start and end, anesthesia time is still billed as usual (base + time units from anesthesia start to end) and the block CPT code is billed separately from the anesthetic (Figure 2E and 2F).

CPT Codes and Modifiers for Postoperative Analgesia Modifiers (Table 2) are appended to CPT codes for postoperative analgesic blocks to telegraph important information to insurers and payers. The -59 modifier shows that a block procedure should be billed separately

**Figure 1:** *Block purpose and associated billing code.*

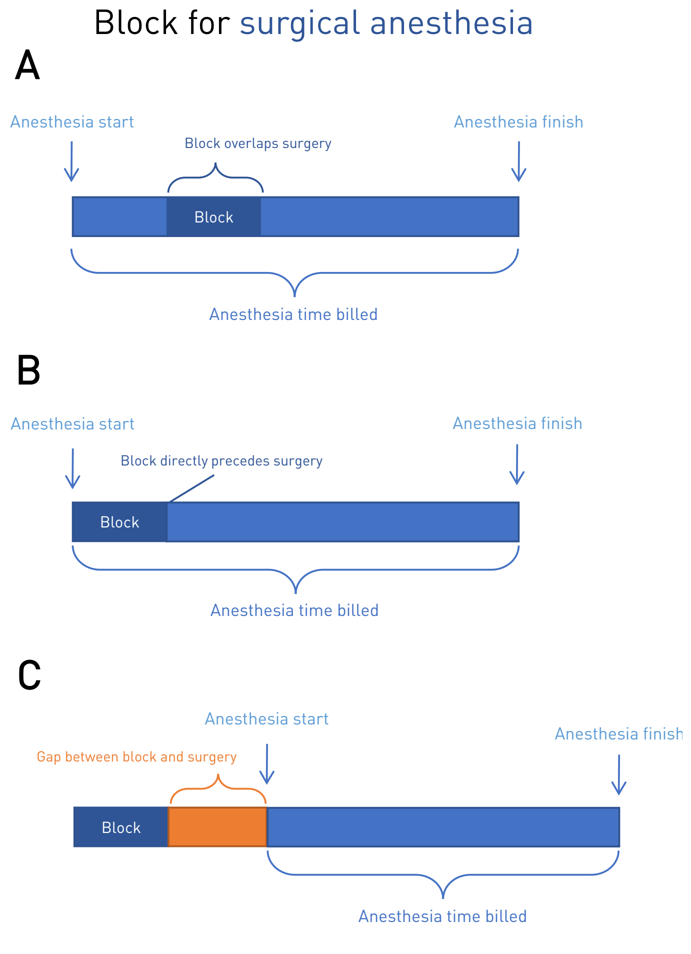
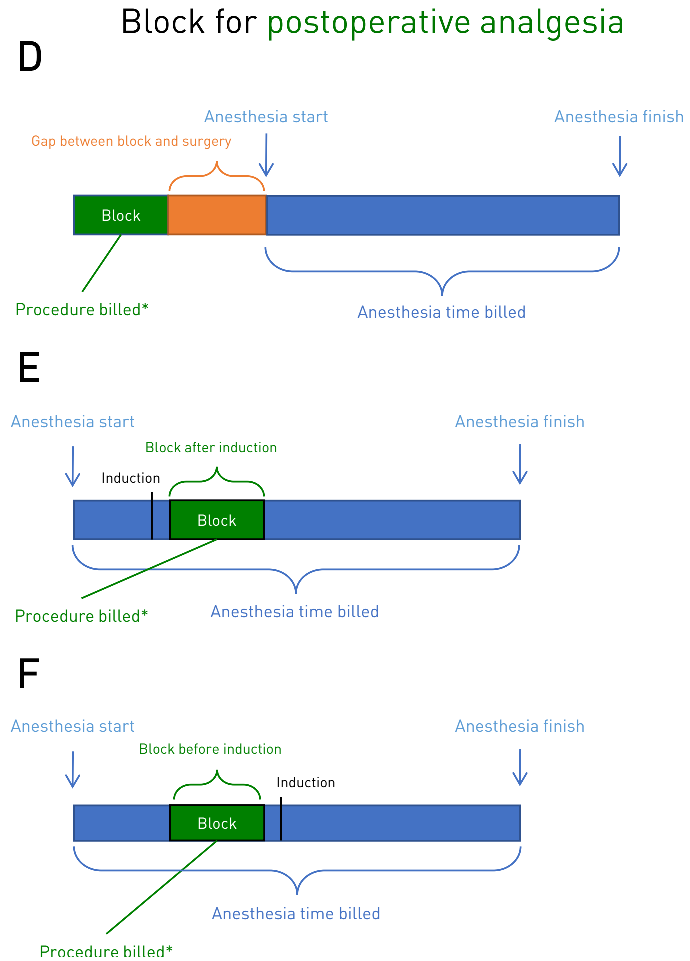



**Figure 2:** *Timing considerations for billing.*




ASA, anesthesia service; CPT, Current Procedural Terminology

from the surgical anesthetic. Without a modifier, separate billing of block and anesthetic may be rejected. Table 1 provides examples of CPT codes and 2019 RVUs for several anesthetics and several blocks. This is not an exhaustive list, and CMS may adjust the values each year with input of an American Medical Association committee.

Many types of blocks lack their own specific CPT code. Interscalene and supraclavicular blocks are both coded as brachial plexus injections (64415), whereas adductor canal blocks are cross-walked to the femoral nerve injection code (64447). For blocks not included within or substantially similar to blocks where a CPT code exists, the “other peripheral nerve injection” code can be used (64450). Ultrasound guidance has its own CPT code, which can be billed once in addition to the block performed (if two blocks are performed, the ultrasound code may be billed only once), provided appropriate documentation is present. This includes documentation of ultrasound use, image copy (proof of use) retained in the chart or picture archiving and communication system, and a statement about image interpretation such as “ultrasound interpreted and normal except as noted.”

## REQUIRED DOCUMENTATION ELEMENTS

Additional required billing documentation elements include date of service, diagnosis, indication for procedure, block type, and proceduralist signature. Language used for diagnosis should map easily to diagnosis codes (ICD-10), not the surgical diagnosis—communication with your group’s coders is valuable to make sure your documentation is clear and thorough enough to meet local compliance standards. Typically, a postoperative analgesic block will have a diagnosis code G89.18 (acute postprocedural pain) with a secondary diagnosis code for the region of the pain.

Documentation of a surgeon's (or other clinician's) request for a block is also needed when billing for a postoperative analgesic block but not a surgical anesthetic block. Ideally, the request would be done formally by the surgeon as a note or order. A less desirable option is to record the surgeon's request in the documentation of the block itself. When supervising trainees, attestation of presence during ultrasound-guided and key portions of the procedure is necessary to bill.

## CONCLUSIONS

Physicians who perform nerve blocks should be aware of billing nuances and recognize the pitfalls of documentation and coding for regional anesthesia. This review has attempted to summarize the material in such a way that physicians and practices can navigate those tricky issues. The authors also hope that awareness of current billing standards and the sometimes-perverse incentives they create inspires physicians to advocate for changes in the health care system to help align patient care and reimbursement incentives.

This information is presented to the best of our knowledge, reflecting the rules in effect as this article was prepared.

Prior to any implementation of practice or billing changes, please seek consultation with your local billing, coding, and compliance staff.

REFERENCES


1. Reinhardt U. The little-known decision-makers for Medicare physician fees. *The New York Times*. https://economix.blogs.nytimes.com/2010/12/10/the-little-known-decision-makers-for-medicare-physicans-fees. Published December 10, 2010. Accessed September 13, 2019.
2. Medicare program: CY 2020 revisions to payment policies under the Physician Fee Schedule and other changes to Part B payment policies. https://www.regulations.gov/document?D=CMS-2019-0111-0092. Published August 14, 2019. Accessed September 28, 2019.
3. Kim T-WE, Mariano ER. Updated guide to billing for regional anesthesia (United States). *Int Anesthesiol Clin*. 2011;49(3):84–93. https://doi.org/10.1097/AIA.0b013e31820e4a5c
4. Centers for Medicare and Medicaid Services. Medicare fraud and abuse: prevent, detect, report. 2019. https://www.cms.gov/Outreach-and-Education/Medicare-Learning-Network-MLN/MLNProducts/Downloads/Fraud-Abuse-MLN4649244.pdf

# Ultrasound-Guided Selective Cervical C3 and C4 Nerve Root Block: A Novel Anesthetic Approach to Perioperative Analgesia for Clavicular Fractures

Joey Hung, DO
Anesthesiology Postgraduate
Year Three Resident

Moustafa Ahmed, MD
Assistant Professor of
Anesthesia and Critical Care
Director of Chronic Pain Division

Anesthesiology Department
UT Health
University of Texas Health Science Center at Houston
McGovern Medical School
Houston, Texas

The clavicle serves as a bony connection between the arm and trunk, connecting distally with the acromion and proximally with the sternum. Clavicular fractures make up approximately 2.6% of all fractures, occur more frequently in men, and involve the shoulder girdle in 44% of cases.[1,2] They have been classified into three groups based on the Allman classification. Group I fractures occur in the middle third of the clavicle, group II the distal third, and group III the proximal third.[3] Previous research has demonstrated that 69% of clavicular fractures are group I, 28% group II, and 2.8% group III.[3]

Often, clavicular fractures are treated conservatively with oral analgesics (ie, acetaminophen, nonsteroidal anti-inflammatory drugs, and opioids). Use of a sling to provide limb immobilization may also improve pain control. However, complications may still arise, including nonunion, malunion, post-traumatic arthritis, refracture, or chronic pain syndrome. Unstable clavicular fractures may result in brachial plexus injuries, ulnar neuropathy, or inadequate shoulder stabilization and therefore may mandate surgical intervention and repair.[4] Indications for primary open fixation include fracture comminution and tenting of the skin, significant clavicular displacement, or fractures that fail to respond to closed reduction or conservative management.

*"Regional anesthesia techniques that target the C3 and C4 nerve roots can potentially maximize analgesia while minimizing upper-extremity motor blockade and may be preferable in patients undergoing clavicular surgery."*

Secondary to surgical manipulation and skin incision, clavicular surgeries may result in significant postoperative discomfort. Inadequate pain control in the recovery unit can delay discharge and increase hospital costs. In addition to efforts to maximize multimodal analgesics, regional anesthesia techniques, including low-volume interscalene and superficial or deep cervical plexus blocks, have been used to alleviate postoperative clavicle pain.[5,6]

Regional anesthesia techniques that target the C3 and C4 nerve roots can potentially maximize analgesia while minimizing upper-extremity motor blockade and may be preferable in patients undergoing clavicular surgery. The approach may also minimize motor blockade and improve a patient's ability to participate in physical therapy.

## SELECTIVE C3 AND C4 NERVE ROOT BLOCKADE

**Anatomy.** The third to the eighth cervical nerve roots exit the corresponding spinal foramen anterior to the transverse process between the anterior and posterior tubercle. In contrast to the other cervical transverse processes, C7 has a rudimentary or near-absent anterior tubercle with a prominent posterior tubercle.

**Sonoanatomy.** In a transverse axial view of the cervical transverse process, the spinal nerve root appears as a hypoechoic discoid shape between the anterior and posterior tubercles of the transverse process and has a "bull horn" or "double humped camel" appearance (Figures 1 and 2). However, at C7, the transverse process may be described as a "thumb sign" (Figure 3) because of the absent anterior tubercle and prominent posterior tubercle. The unique appearance of the transverse processes at these levels aids in the identification of nerve roots in the cervical region.

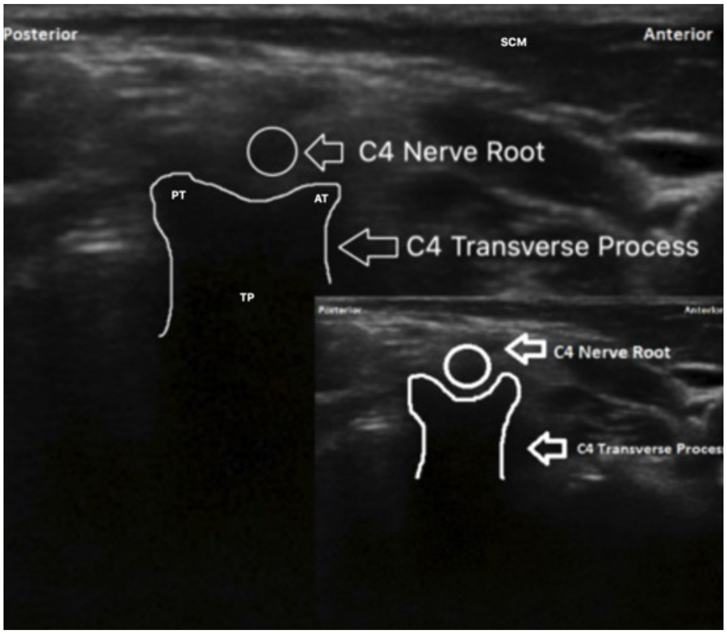
**Scanning technique.** Position the patient supine with their head slightly elevated and turned to the contralateral side. A high-frequency linear transducer generally facilitates visualization of superficial structures. Using aseptic technique, place the transducer transversely to the lateral aspect of the neck and cephalad to the clavicle to obtain a transverse axial view. Move the transducer cephalad until the spinal nerve root and its corresponding transverse process comes into view. Count the level of the nerve roots using the landmarks described previously, and identify the vertebral artery with or without the aid of color doppler to prevent the risk of puncture. Once the C4 nerve root is identified on ultrasound, insert a 20-gauge short-beveled needle in-plane in a posterior to anterior direction. Inject 1 mL of 0.5% bupivacaine very slowly and observe cephalad spread of the local anesthetic (Figure 4). Move the probe more cephalad to identify the C3 transverse process and its corresponding nerve root, and inject another 1 mL of 0.5% bupivacaine into the area. Prior to local anesthetic injection, carefully aspirate or use dextrose 5% or normal saline to confirm the correct needle tip position and prevent any accidental intravascular injection because of the radicular arteries' and epiradicular veins' proximity to the target injection site.

## DISCUSSION

Surgical repair of clavicular fractures may be associated with significant perioperative discomfort. Anatomically, injections of local anesthetic at the C3 and C4 nerve root levels with upward spread to levels C2 and C3 are effective in providing analgesia for the skin overlying the clavicle.[7,8] Providing local anesthetic and sensory blockade to the supraclavicular nerve, one of the four branches from the superficial cervical plexus, offers significant cutaneous analgesia superficial to the clavicle.[8]

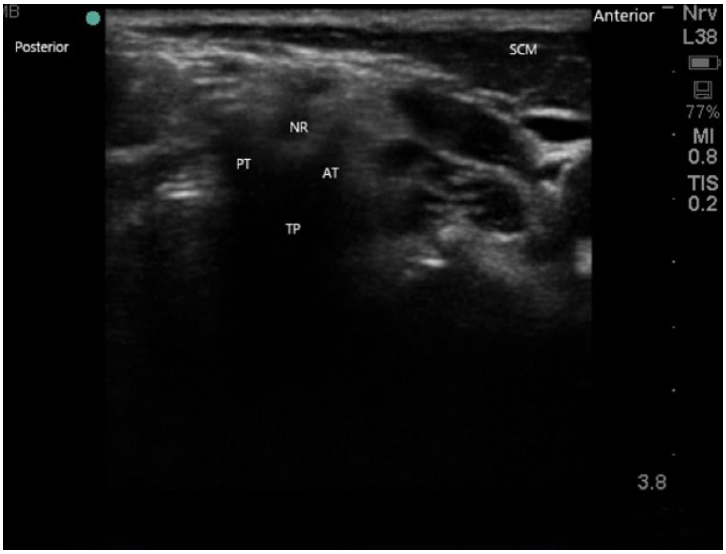
Myotomes are the pattern of innervation of skeletal muscles by motor axons. Understanding the sensory innervation of myotomes may explain an additional component of the pain patients feel following clavicular fracture repair.[9] The clavicle serves as an insertion point for many important muscles, including the sternocleidomastoid, pectoralis major, subclavius, deltoid, and trapezius.[9] Effective regional treatment of pain resulting from muscular manipulation during clavicular fracture repair requires sensory blockade of muscles interconnecting at the clavicle. The myotome nerve supply of those insertion muscles varies from

**Figure 1:** *Ultrasound image of C4 transverse process showing double hump of the anterior and posterior tubercles and corresponding nerve root superficial to it.*



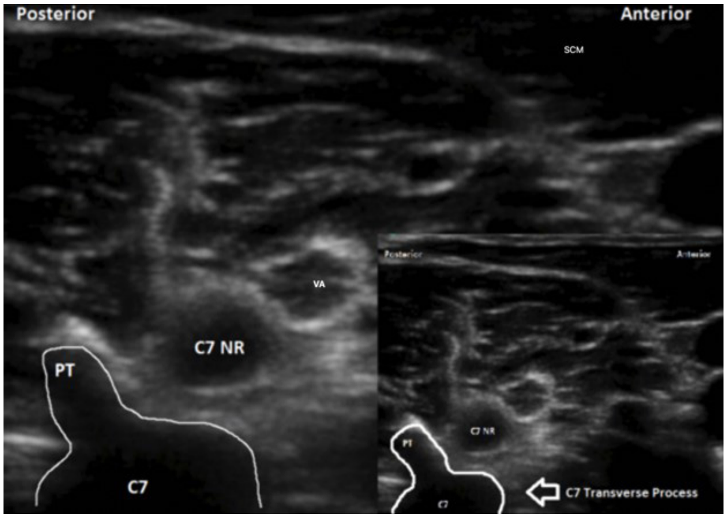

AP, anterior tubercle of C4; PT, posterior tubercle of C4; TP, transverse process of C4

**Figure 2:** *Ultrasound image of C5 transverse process showing double hump of the anterior and posterior tubercles and corresponding nerve root superficial to it.*



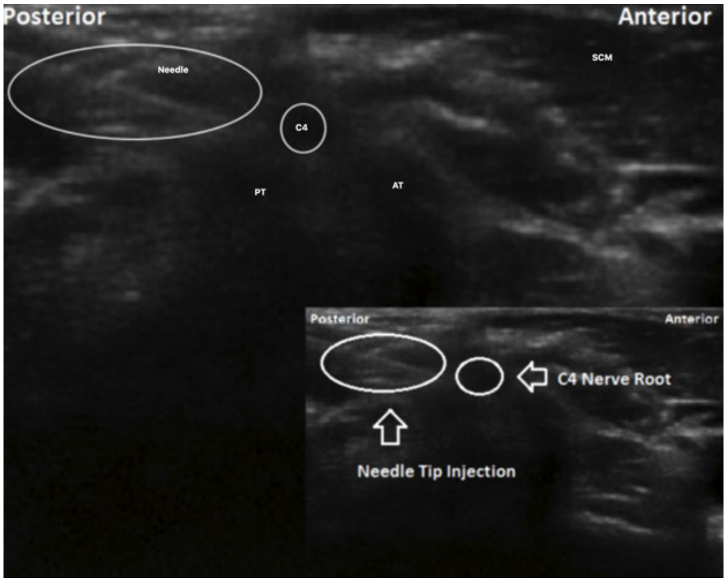

AP, anterior tubercle of C5; NR, C5 nerve root; PT, posterior tubercle of C5; TP, transverse process of C5

**Figure 3:** *Ultrasound image of C7 transverse process showing its rudimentary anterior tubercle and prominent posterior tubercle (thumb sign), C7 nerve root, the hypoechoic circular structure superficial to it, and the vertebral artery lateral to it.*




C7, C7 nerve root; PT, posterior tubercle of C7; TP, transverse process of C7; VA, vertebral artery

**Figure 4:** *Ultrasound image of C4 transverse process and corresponding nerve root showing needle tip and local anesthetic injection at C4 nerve root.*




AP, anterior tubercle of C4; C4, C4 nerve root; PT, posterior tubercle of C4

C2–C6. Targeting the cervical nerve roots at C3 and C4 with cephalad spread of local anesthetic can effectively treat clavicular pain from muscle manipulation.

Sclerotome refers to a single spinal segmental innervation of bone and periosteum.[10] Currently published sclerotome maps are based on a small number of studies and therefore only demonstrate areas of vague referred pain not specific to any skeletal territories supplied by single spinal nerves. The clavicle's sclerotomes have not been reliably identified in the literature; however, our experience with selective C3 and C4 nerve root blockade suggests that those levels are likely involved in clavicular innervation.

Finally, the technique requires only 2 mL of local anesthetic, certainly less than that for standard interscalene or superficial cervical plexus nerve blocks. By minimizing local anesthetic administration, significant motor and sensory blockade can be avoided. Nevertheless, the phrenic nerve, derived from C3–C5, can be blocked by the scant volume of local anesthetic and may illicit respiratory compromise in selected patients. Physicians should also take care to avoid intravascular injections because of the significant localized vascularity and observe for the development of epidural anesthesia because of the proximity of the injection point to the nerve roots.

In conclusion, the selective injection of minimal volumes of local anesthetic adjacent to the C3 and C4 nerve roots should be considered for the provision of perioperative analgesia in the setting of clavicular fracture repair. However, care should be taken to minimize potential risks (eg, vascular puncture, intravascular injection, epidural spread, phrenic nerve blockade). Further studies are required to evaluate the C3 and C4 nerve root block's analgesic impact and risk profile when used for clavicular fractures.

REFERENCES


1. Postacchini F, Gumina S, De Santis P, Albo F. Epidemiology of clavicle fractures. *J Shoulder Elbow Surg*. 2002;11(5):452. https://doi.org/10.1067/mse.2002.126613
2. Robinson C. Fractures of the clavicle in the adult. Epidemiology and classification. *J Bone Joint Surg Br*. 1998;80(3):476. https://doi.org/10.1302/0301-620x.80b3.8079
3. Allman F Jr. Fractures and ligamentous injuries of the clavicle and its articulation. *J Bone Joint Surg Am*. 1967;49(4):744.

4. Melenevsky Y, Yablon C, Ramappa A, Hochman G. Clavicle and acromioclavicular joint injuries: a review of imaging, treatment, and complications. *Skeletal Radiol*. 2011;40:831–842. https://doi.org/10.1007/s00256-010-0968-3

5. Gray A. Cervical plexus block. In *Atlas of Ultrasound-Guided Regional Anesthesia*. 3rd ed. Philadelphia, PA: Elsevier/Saunders. 2018. 372–381.

6. Shanthanna H. Ultrasound guided selective cervical nerve root block and superficial cervical plexus block for surgeries on the clavicle. *Indian J Anesthesia*. 2014;58(3):327–329. https://dx.doi.org/10.4103%2F0019-5049.135050

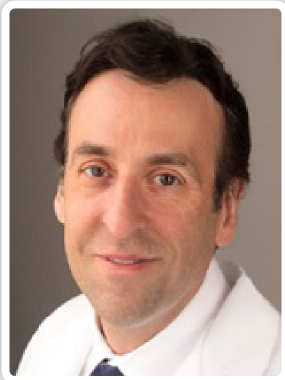
7. Schuenke M, Schulte E, Schumacher U. *Atlas of Anatomy: General Anatomy and Musculoskeletal System*. 2nd ed. New York, NY: Thieme Medical Publishers, Inc. 2014.

8. Day M, Justiz R, Nader A. Head and neck blocks. In *Essentials of Pain Medicine*. 4th ed. St. Louis: Elsevier/Saunders. 2018. 763–778.

9. Brendler SJ. The human cervical myotomes: functional anatomy studied at operation. *J Neurosurg*. 1968;28(2):105–511. https://doi.org/10.3171/jns.1968.28.2.0105

10. Ivanusic JJ. The evidence for the spinal segmental innervations of bone. *Clin Anat*. 2007;20:956–960. https://doi.org/10.1002/ca.20555

# Contralateral Oblique View for Epidural Access: A Coalescence of Precision and Ease



Jatinder S. Gill, MD
Assistant Professor

Thomas Simopoulos, MD, MA
Division Chief of Pain Medicine
Co-Director, The Spine Center
Assistant Professor

Department of Anesthesiology, Critical Care, and Pain Medicine
Beth Israel Deaconess Medical Center
Boston, MA

Fluoroscopic epidural access, whether for an epidural steroid injection or for spinal cord stimulator lead insertion, is one of the most common procedures in the field of pain medicine. Safety is of particular importance when performing procedures involving the cervical spine, and therefore accuracy with needle placement is critical. An American Society of Anesthesiologists closed claims analysis for cervical procedures performed from 2005–2008 found 20 reported cases of direct spinal cord injury during interlaminar cervical epidural access.[1]

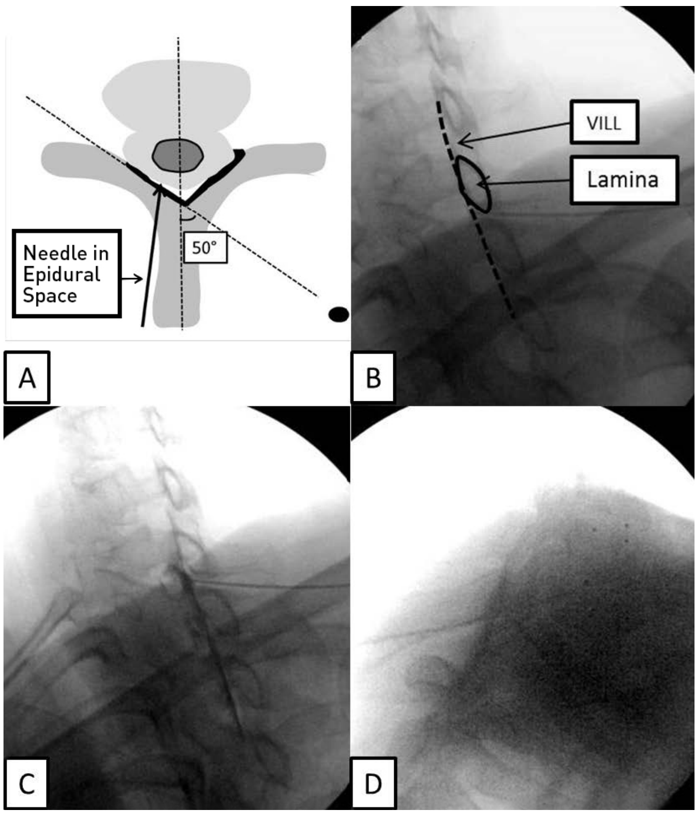
The likely primary driver is ineffective use of fluoroscopy; however, even more likely is the limitation of fluoroscopy itself. Because the distance from the epidural space to the spinal cord is diminutive, the depth of the needle as it approaches the cervical epidural space must be continually monitored and a radiologic landmark must serve as a depth marker for the epidural space. The commonly used depth view for fluoroscopic epidural access, the lateral view of the spine, affords neither. The needle tip is often poorly visualized or may not be visualized at all, and the spinolaminar junction is an inadequate radiologic landmark for the depth of the epidural space because of great variability.[2]

The contralateral oblique (CLO) view, on the other hand, affords both. The needle tip is always well visualized and the relationship of the posterior boundary of the epidural space to the ventral inter-laminar line (VILL) is very tight (Figure 1).[2] Thus, the needle can be placed directly within 1–2 mm of the target and the epidural space can be immediately accessed. The needle trajectory can be clearly projected (Figure 1).[2] These advantages make the CLO view a clear favorite both for ease of access and for precision, likely enhancing overall safety of fluoroscopic epidural access. Its advantages extend to the lumbar spine as well, with demonstrated superiority in visualization and precision.[3]

## STEP-BY-STEP CERVICAL AND CERVICOTHORACIC EPIDURAL ACCESS

1. Position the patient prone with their neck slightly flexed and forehead on a pillow.
2. Identify the correct cervical vertebral level (not higher than C6–C7).
3. Open the interlaminar space (may require cephalad tilt of the fluoroscope).
4. Identify the laterality of pain symptoms.
5. Mark the insertion point on the correct side. Remain within the lateral margin of the spinous process to prevent inserting the needle too lateral. A needle insertion point below the laminar edge provides an additional safety margin and improved needle trajectory.
6. Infiltrate with local anesthetic, making sure that the skin does not translate.
7. Advance the needle until it engages in firm tissue. This may be a few centimeters, depending on the patient.
8. Rotate the C-arm to 50 degrees CLO. The image intensifier obliquity is opposite to the side where the needle is inserted. For midline needle approaches, either direction may be used.
9. Confirm correct needle trajectory, identify the ventral laminar margin and conceptualized ventral interlaminar line, and estimate the distance to the VILL (Figure 1).
10. Advance the needle to just before the VILL in anteroposterior (AP) and CLO views.
11. Expect to lose resistance at or within 2 mm of the VILL (Figure 1). Do not advance more than 2.5 mm beyond the VILL. Loss of resistance can be subtle or nonexistent, especially with thin gauge needles.
    - If no loss of resistance is encountered beyond the VILL, check the needle for occlusion, ensure that the tip has not crossed the midline, ensure angulation is appropriate (lesser the angulation, deeper the needle) and check the lateral view as a secondary backup. Inject a small amount of contrast (0.1–0.2 mL) to evaluate for an epidural

**Figure 1:** *Epidural space in the contralateral oblique view.* **1A:** *As soon as the needle crosses the lamina and ligamentum, epidural access is attained. It is important that the angle of obliquity and the laminar angle are matched, mean laminar angle at C7–T1 has been shown to be 53 degrees, and 50 degrees may be used with loss of resistance expected on or just beyond the ventral interlaminar line (VILL).* **1B:** *The VILL is a hypothetical line joining the ventral laminar margin in the contralateral oblique view.* **1C:** *The loss occurs just on the VILL or slightly beyond (1–3 mm) but in the posterior half of the foramen.* **1D:** *In the lateral view, the needle and the landmarks are poorly visualized.*



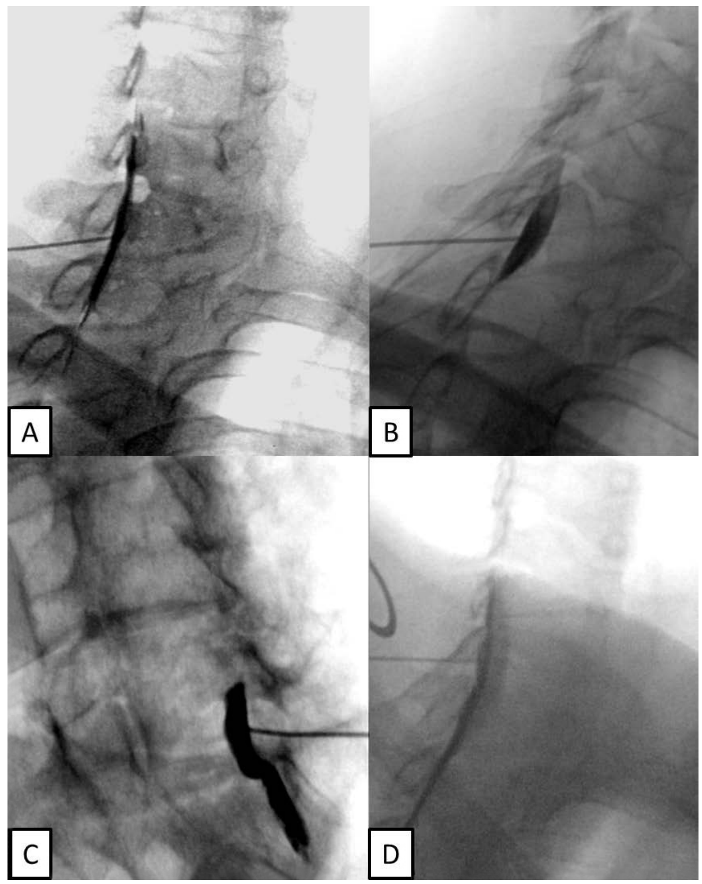

spread pattern. Do not rely purely on loss of resistance and keep a high index of suspicion that the needle may already be in the epidural space.

- Save AP and CLO images prior to and following contrast injection.

## CONTRAST PATTERNS

A multitude of epidural contrast spread patterns may be seen in the contralateral view (eg, thick, thin, nerve root spread, multi-intense, vacuolations) depending on location of spread (eg, ipsilateral, contralateral, bilateral), and

**Figure 2:** *Contralateral oblique view contrast spread patterns.* **2A:** *Contralateral vacuolation is observed in this typical spread.* **2B:** *A thick pattern may represent midline pooling or epidural space distension with restricted spread. Intradural spread may also appear like this.* **2C:** *In the lumbar spine ligamentum flavum (outlined), hypertrophy has a typical appearance. The needle is advanced beyond the ventral interlaminar line before resistance is lost.* **2D:** *Lower-intensity contralateral spread appears as only a thin film in the X-ray path.*




*"The CLO view is a clear favorite both for ease of access and for precision, likely enhancing overall safety of fluoroscopic epidural access."*

epidural distention may also occur (Figure 2).[4] Physicians should familiarize themselves with those patterns yet recognize that despite the pattern, the dorsal margin of the contrast approaches the ventral margin of the lamina in the CLO view and subarachnoid or other spread must be considered when it is not observed.

## DIFFERENCES BETWEEN CERVICAL AND LUMBAR ACCESS

The CLO view is equally efficacious in the lumbar epidural space because of its precision and superior needle visibility and trajectory; however, there are a few important differences.[3]

A 45-degree angle of insertion is optimal for accessing the lumbar epidural space.[3] The needle tip may advance several millimeters beyond the VILL in patients with ligamentum flavum hypertrophy (Figure 1). This is important to keep in mind during percutaneous, minimally invasive lumbar decompression procedures.

In patients with ligamentum flavum hypertrophy, laterally placed needles may be deeper to the VILL because the ligamentum is hypertrophied paramedially. This phenomenon is not observed with attempted cervical epidural access because the ligament is not generally hypertrophied to such a degree. In contrast, needles inserted in the midline in the cervical region may be slightly deeper to the VILL, which may be secondary to the needle having crossed the midline and flattening the laminar angle.

## PRACTICE PEARLS

1. Ensure the rotation of fluoroscope is contralateral and at the correct angle.
2. Ensure the needle tip has not crossed the midline toward the obliquity of the C-arm.
3. Stop just before the VILL and carefully assess for loss of resistance.
4. If the C-arm does not oblique to 50 degrees to assess the right side, flip over the C-arm image intensifier or position the patient on the opposite side of table. Otherwise, use an angle of lesser obliquity such that the fluoroscope does not line up with the angle of the lamina, but recognize that this will reduce the CLO approach's accuracy. This method requires special precaution because the epidural needle will appear further anterior with lesser obliquity.[1]
5. If no loss of resistance is encountered immediately beyond the VILL, check needle for occlusion, make sure the needle tip is contralateral, inject a small amount of contrast (0.1 mL) to assess for posterior or epidural spread patterns, and check the lateral view for secondary confirmation.
6. On occasion, a needle inserted in the midline may advance 1–3 mm beyond the VILL in the cervical spine because of crossing the midline or laminar angle flattening. In contrast, a paramedial needle may appear deeper in the lumbar spine because of ligamentum flavum hypertrophy.

## LIMITATIONS

Despite significant clinical advantages, physicians require substantial time to become familiar with the view before they can regularly adopt it. However, initially starting with the lateral view and using the CLO view as a secondary and confirmatory view will help them become more confident. Additionally, the view does not allow physicians to clearly discern between contralateral and ventral catheter placement, as might be required for spinal cord stimulator lead placement. To unequivocally distinguish between dorsal or ventral placement of a catheter, lateral view is needed. The view is also of limited use when the C-arm cannot provide the appropriate obliquity requisite.

## WIDESPREAD ADOPTION

The CLO view is precise and easy to use. By providing improved needle visibility and clear radiologic landmarks for depth assessment, it may also enhance the safety of cervical epidural access. In addition to our studies, the CLO view has been favorably evaluated in larger numbers,[5] but current reports do not indicate how well the approach has been adopted into clinical practice. National clinical practice surveys may aid in estimating technique integration.

One of the barriers to adoption of the CLO view may be a lack of familiarity with the radiographic anatomy. To address that concern, using the CLO view in combination with the lateral view helps physicians to rapidly improve their comfort and familiarity. In our experience, the learning curve is very steep, but once physicians are familiar with the CLO view, it becomes indispensable for interlaminar access and is the standard view at our academic medical center practice. Educational seminars, fellowship forums, workshops, and teaching rounds may further aid in the adoption and utility of the CLO view.

REFERENCES

1. Rathmell JP, Michna E, Fitzgibbon DR, et al. Injury and liability associated with cervical procedures for chronic pain.

*Anesthesiology*. 2011;114(4):918–926. https://doi.org/10.1097/ALN.0b013e31820fc7f2

2. Gill JS, Aner M, Nagda JV, Keel JC, Simopoulos TT. Contralateral oblique view is superior to lateral view for interlaminar cervical and cervicothoracic epidural access. *Pain Med*. 2015;16(1):68–80. https://doi.org/10.1111/pme.12557

3. Gill JS, Nagda JV, Aner MM, Keel JC, Simopoulos TT. Contralateral oblique view is superior to the lateral view for lumbar epidural access. *Pain Med*. 2016;17(5):839–850. https://doi.org/10.1093/pm/pnv031

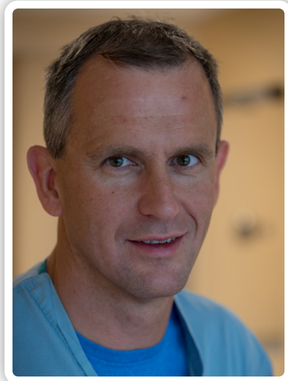
4. Gill J, Nagda J, Aner M, Simopoulos T. Cervical epidural contrast spread patterns in fluoroscopic antero-posterior, lateral, and contralateral oblique view: a three-dimensional analysis. *Pain Med*. 2017;18(6):1027–1039. https://doi.org/10.1093/pm/pnw235

5. Derby R, Melnik I, Choi J, Lee SH, Lee JE. Reliability and safety of contra-lateral oblique view for interlaminar epidural needle placement. *Pain Physician*. 2017;20(1):E65–E73.

# Emerging Technologies in Acute Pain Medicine

Mastoora Nasiri, MD
Clinical Instructor
Division of Regional Anesthesia and Acute Pain Medicine
Department of Anesthesiology, Perioperative, and Pain Medicine
Stanford University School of Medicine
Stanford, California

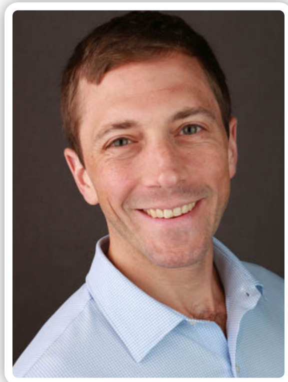
Linda Le-Wendling, MD
Clinical Associate Professor
Department of Anesthesiology
Fellowship Director
Division of Acute and Perioperative Pain Medicine



Barys Ihnatsenka, MD
Associate Professor
Department of Anesthesiology
Division of Acute Pain Medicine and Ambulatory Medicine

University of Florida College of Medicine
Gainesville, Florida

Patrick Tighe, MD, MS
Associate Professor
Donn M. Dennis MD Professor in Anesthetic Innovation
University of Florida Term Professor
Depts. of Anesthesiology, Orthopaedics, & Information Systems/ Operations Management
Co-Director, Perioperative Cognitive Anesthesia Network (PeCAN)
University of Florida
Gainesville, Florida



Anthony Machi, MD
Assistant Professor
Department of Anesthesiology and Pain Management
Fellowship Director
Regional Anesthesia and Acute Pain Medicine
University of Texas Southwestern Medical Center
Dallas, Texas

The challenge of effective acute pain management looms large in American society in light of the opioid crisis. Scientists and innovators are advancing new pharmacologic agents (eg, neosaxitoxin) and procedural modalities (eg, percutaneous nerve stimulation) to provide effective non-opioid options. However, nonpharmacologic and nonprocedural technologies continue to evolve as well, and they are poised to usher in new frontiers of acute pain medicine. We believe three such technologies will impact acute pain medicine in the years to come: virtual reality, mixed-reality simulation, and artificial intelligence.

## VIRTUAL REALITY

Virtual reality (VR) is an interactive, realistic, three-dimensional (3D), computer-generated experience that uses visual, auditory, perceptual, and even possibly olfactory senses for participants to completely immerse themselves in a different world.[1] While wearing a small headset, a user can completely engross in a different reality and engage their focus on something other than actual circumstances. Initially used for simulation, entertainment, and desensitization to phobias, now its applications include mitigating painful and anxiety-provoking experiences during the perioperative period and rehabilitation and minimizing the psychosocial component of pain.

Pain perception in the brain cortex affects attention, emotion, memory, and the senses. Research has suggested that VR influences the interplay of pain pathways and consequently how the cortex ultimately perceives painful stimuli.[2] By interrupting attention toward painful stimuli, VR helps participants perceive the stimulus as less painful. Similar to cognitive behavior therapy, VR can change subjects' emotional association with painful stimuli, improving the thought process and coping skills for the situation.[3] When consciousness is transferred away from painful stimuli, VR analgesia is produced.[2,4]

Investigation with functional magnetic resonance imaging shows decreased brain activity in areas corresponding to experimental thermal pain stimulation, and like what is seen with opioids, reduced activity in the insula and thalamus.[5] In the clinical setting, VR has been most effective in providing analgesia for frequent but short painful procedures, such as burn dressing changes.[1,6] In addition, evidence shows effectiveness for periodontal procedure analgesia, phantom limb pain, fibromyalgia, and complex regional pain syndrome, as well as minimizing periprocedural sedation.[2,7–9]

With our current understanding of the technologic advancements in medicine and multimodal approaches to pain management, VR can potentially have an expanding role in health care. VR is now inexpensive and can be linked to smartphones, making it easily accessible. Future applications include its use as an adjunct to biofeedback in the multimodal treatment of pain. VR may also be incorporated in perioperative rehabilitation and physical therapy and used to decrease the need for periprocedural sedation. Drawbacks are minimal but include motion sickness and time for coaching. Given the lack of significant barriers, VR can be considered in a multimodal analgesic regimen when devising plans to minimize opioid use and improve patients' experiences.

## MIXED-REALITY SIMULATION

The mixed-reality simulator for thoracic epidural and paravertebral blocks is an educational tool that incorporates both a physical high-fidelity model of the thoracic spine with VR imaging of the anatomy deep to the skin (Figure 1). In this simulator, learners can perform complex blocks using common endpoints (loss of resistance, hydrolocation while still being able to correlate the ultrasound images and needle trajectories with the underlying anatomy. For example, when an ultrasound image is acquired in axial view, the mixed reality simulator will show the insonating beam as a semitransparent red plane on a 3D representation of the underlying anatomy. This assists learners in understanding what structures they visualize on ultrasound and how different manipulations of the ultrasound probe alter the structures visualized. In addition, as a physical needle is advanced on the thoracic spine physical block, a virtual image of the needle appears on the 3D anatomic image so that the exact location of the needle tip and shaft can be identified during needle advancement. Both the endpoints and complications (eg, inadvertent dural puncture, pneumothorax) are realistically calculated into the model.

*"Nonpharmacologic and nonprocedural technologies... are poised to usher in new frontiers of acute pain medicine."*

Currently, the simulators are being used for independent learning of midthoracic paravertebral and epidural block techniques, fully equipped with:

- Prompts on a practical approach to landmark-based, ultrasound-assisted, and ultrasound-guided thoracic epidural and paravertebral blocks
- In-depth anatomy lessons through comprehensive slide presentations on thoracic paravertebral and epidural anatomy, with 3D representation from different perspectives
- Guidance on ultrasound image acquisition and interpretation
- Tailored feedback

The procedures are broken into multiple steps to focus learners in minimizing common pitfalls and errors that accompany routine tasks (eg, determining correct vertebral level for placement, optimal image acquisition, precise in-plane needle advancement). Future directions would be to incorporate more challenging and realistic spinal anatomy as well as extending the simulator to include fascial plane blocks.

## ARTIFICIAL INTELLIGENCE

From the perspective of health care applications and research, artificial intelligence (AI) generally refers to analytical AI whereby algorithms are taught a cognitive representation of the world around us. More formally, when researchers discuss analytical AI, they often refer to machine-learning algorithms that identify patterns and inferences among data. From the patterns, the algorithms develop generalizations to organize unlabeled data (eg, unsupervised learning) or to understand how features associate with labels in training data to predict unlabeled observations based on the features of those observations (eg, supervised learning).

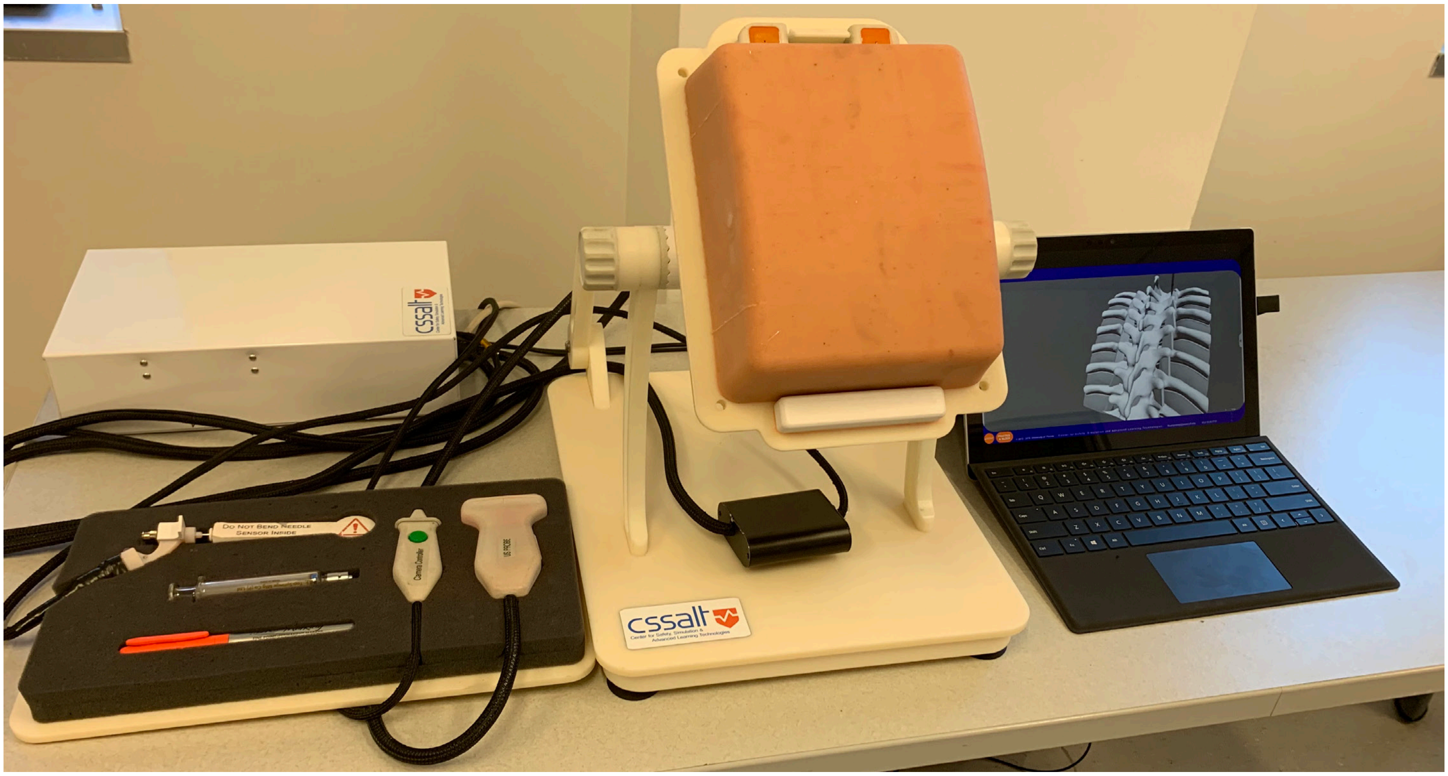
For structured, organized data, many machine-learning approaches are comparable to traditional statistical techniques.[10] For instance, introductory lessons on machine-learning classification algorithms compare them to logistic regression. Indeed, for well-organized and structured data that fulfills the requisite assumptions for statistical techniques, standard statistical methods offer important advantages over machine-learning algorithms. For example, with an outcomes research question that uses electronic health records data, a researcher identifies an outcome of interest (eg, 30-day mortality), considers features that may be associated with the outcome (eg, age, sex, American Society of Anesthesiologists status, block type), and uses a statistical function to measure the weight of each feature or parameter in association with the outcome. These advantages emphasize inference and interpretability and quantifiably measure magnitude and confidence in how the features relate to the outcome of interest.

Unfortunately, not all data are organized and structured in a manner suitable for traditional statistical approaches. Moreover, many interesting problems violate the requisite assumptions for traditional statistical testing or trade mechanistic understanding for prediction accuracy. For example, using a two-dimensional image to predict the risk of an outcome involves significant information that can be difficult to access. Information exists in the intensity of each pixel, but also on the relationship between nearby pixels, between distant pixels, and in the broader shapes comprised by individual pixels. Given the differences in data structures and the organization of latent information they contain, classifying the needle location on an ultrasound image as either "safe" or "dangerous" may be quite challenging for logistic regression but perhaps relatively straightforward for machine-learning techniques such as a deep convolutional neural network. Machine learning offers important advantages when using messy data or addressing nontraditional problems.

Machine learning has many potential indications in acute pain medicine. Physicians can use machine-learning classifiers to improve the prediction of pain-related outcomes following surgery through larger and more complex electronic health record datasets. Another exciting advance driven by deep learning is the potential for real-time annotation of ultrasound images to denote regions of interest, such as the location of a nerve or warning of a compressed vein. Interest is also growing in using machine-learning approaches for facial recognition as a pseudo-objective marker of pain intensity, an opportunity that is perhaps especially needed for at-risk populations such as neonates, patients with advanced dementia, and other patients with limited communication.

The utilities of statistics, outcomes research, and machine learning are all limited by our ability to apply the knowledge in a way that offers holistic patient benefits.

**Figure 1:** *Mixed-reality simulator.*



Despite the increasing attention to machine learning and AI, we must remember that our patients are more than their data.

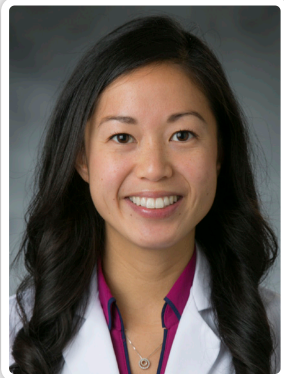
## CONCLUSION

Virtual reality, mixed-reality simulation, and artificial intelligence are three technologic advancements that will change how we approach patient management and augment the treatment of acute pain in the future. More research and development are required for each modality before they realize broad application; however, the potential for gentler, safer, and more effective acute pain management is on the horizon.

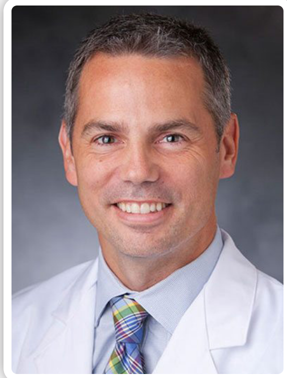

REFERENCES

1. Hoffman HG, Chambers GT, Meyer WJ 3rd, et al. Virtual reality as an adjunctive non-pharmacologic analgesic for acute burn pain during medical procedures. *Ann Behav Med*. 2011;41(2):183–191. https://doi.org/10.1007/s12160-010-9248-7
2. Li A, Montano Z, Chen VJ, Gold JI. Virtual reality and pain management: current trends and future directions. *Pain Manag*. 2011;1(2):147–157. https://doi.org/10.2217/pmt.10.15
3. Gold JI, Belmont KA, Thomas DA. The neurobiology of virtual reality pain attenuation. *Cyberpsychol Behav*. 2007;10(4):536–544. https://doi.org/10.1089/cpb.2007.9993
4. Sharar SR, Carrougher GJ, Nakamura D. Factors influencing the efficacy of virtual reality distraction analgesia during postburn physical therapy: preliminary results from 3 ongoing studies. *Arch Phys Med Rehabil*. 2007;88(12 Suppl 2):S43–S49. https://doi.org/10.1016/j.apmr.2007.09.004
5. Hoffman HG, Richards TL, Van Oostrom T. The analgesic effects of opioids and immersive virtual reality distraction: evidence from subjective and functional brain imaging assessments. *Anesth Analg*. 2007;105(6):1776–1783. https://doi.org/10.1213/01.ane.0000270205.45146.db
6. Das DA, Grimmer KA, Sparnon AI, et al. The efficacy of playing a virtual reality game in modulating pain for children with acute burn injuries: a randomized controlled trial [ISRCTN87413556]. *BMC Pediatr*. 2005;5(1):1. https://doi.org/10.1186/1471-2431-5-1
7. Furman E, Jasinevicius TR, Bissada NF, et al. Virtual reality distraction for pain control during periodontal scaling and root planing procedures. *J Am Dent Assoc*. 2009;140(12):1508–1516. https://doi.org/10.14219/jada.archive.2009.0102
8. Keefe FJ, Huling DA, Coggins MJ, et al. Virtual reality for persistent pain: a new direction for behavioral pain management. *J Pain*. 2012;153(11):2163–2166. https://doi.org/10.1016/j.pain.2012.05.030
9. Pandya PG, Kim TE, Howard SK, et al. Virtual reality distraction decreases routine intravenous sedation and procedure-related pain during preoperative adductor canal catheter insertion: a retrospective study. *Korean J Anesthesiol*. 2017;70(4):439–445. https://doi.org/10.4097/kjae.2017.70.4.439
10. Bzdok D, Altman N, Krzywinski M. Points of significance: statistics versus machine learning. *Nat Methods*. 2018;15:233–234. https://doi.org/10.1038/nmeth.4642

# How I Do It: Objective Structured Clinical Examination for Training in Regional Anesthesia



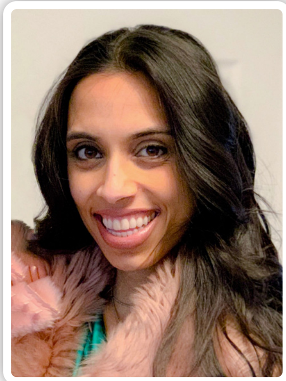
Amanda Kumar, MD



Jeff Gadsden, MD

Duke University Medical Center (DUMC)
Durham, North Carolina

Joon-Hyung Kim, MD



Irim Salik, MD

Jeff L. Xu, MD

Westchester Medical Center/New York Medical College (WMC/NYMC)
Valhalla, New York

Objective structured clinical examination (OSCE) is a common adjunct to modern medical education used to measure trainees' competency in history taking or data gathering, physical examination, communication, clinical acumen, and professionalism. OSCE can be used as both formative and summative assessments while providing feedback to the trainee.

Despite the growing popularity of OSCE in medical training, its role in regional anesthesia training is less clear. Research has suggested that use of OSCE in medical training is reliable but only modestly valid to provide a comprehensive assessment of a trainee's competence.[1] Instead, it may be considered as complementary to existing assessment modalities. We recently surveyed educators from four different United States anesthesia programs to understand how OSCE is used in regional anesthesia training.

### How long have you been performing OSCE exams for regional anesthesia training, and why did you introduce it?

**DUMC:** We incorporated OSCE in our curriculum in 2017 as mock exams for learning purposes for our regional anesthesia and acute pain medicine fellows. Our goal was to broaden their learning experience and overall competency in regional anesthesia with a particular emphasis on uncommon or challenging clinical scenarios that they may otherwise not have a chance to experience in their daily practice throughout training.

**WMC/NYMC:** We started a regional anesthesia OSCE project in 2017 to supplement a structured curriculum in resident education during the regional anesthesia rotation. We felt the regional anesthesia OSCE could improve the objective assessment component of resident competency and expertise in the service to our patients and increase residents' confidence in their readiness for OSCEs of the American Board of Anesthesiology applied examination.

**OHSU:** We have administered OSCEs for regional anesthesia since 2017. The OSCEs were added to assess for competency in a more structured way and to build out our point-of-care ultrasound curriculum.

**UTH:** We integrated OSCEs into the curriculum for the month-long regional anesthesia rotation in 2018. We wanted to give residents early exposure to the OSCE process, as well as incentivize engagement in the medical decision making processes of regional anesthesia.

### What challenges did you encounter setting up the OSCE?

**DUMC:** We are extremely fortunate to have a high-fidelity simulation center and the support of our department to allow nonclinical time for education. One of the more challenging aspects of creating the OSCEs was the development of assessment tools, validating the tools, and determining how, or if, the performance on the OSCEs should be incorporated into fellows' global milestone evaluations.

**WMC/NYMC:** The OSCE simulation center is located off campus at our affiliated medical school, and it can be challenging to gather faculty and residents at an offsite location. Appropriate training is required for the faculty administering the OSCE. Although all residents have protected didactic time each week, it can be difficult for our anesthesia department to spare multiple faculty members with nonclinical time to facilitate the OSCE simulation. Our residents receive a percentage score on each encounter with a standardized patient based on our scoring rubric; however, translating the results into their milestone evaluations can be challenging.

**OHSU:** Barriers to the OSCE include training the faculty and fellows on administering the OSCE, as well as instilling a cultural understanding that it is important to complete the curriculum as outlined. We have had to reinforce the need to adhere to the curriculum on multiple occasions with the faculty. Also, using a faculty member as the simulated patient could bias the evaluation because the faculty may potentially play the role of the patient differently based on their previous interactions with the resident.

**UTH:** Our main challenge has been related to faculty motivation. The resident undergoes two OSCE assessments: one at the midpoint of the regional anesthesia rotation and the other on their final day of the rotation at the end of their month. At the beginning of the OSCE implementation, the faculty would be the attending for the regional anesthesia of the day. Because of the challenges in achieving full participation from all attendings, either the division chief or the regional anesthesia resident education director now administers the OSCE.

Leila Zuo, MD

Dawn Dillman, MD

Oregon Health and Science University (OHSU)
Portland, Oregon

Nadia Hernandez, MD

Johanna Blair de Haan, MD

University of Texas Health Science Center at Houston (UTH)
Houston, Texas

### When do you perform the OSCE exams?

**DUMC:** We administer the regional anesthesia OSCE in January for our fellows, which is five months into their one-year clinical fellowship. We believe this is an ideal time to consolidate skills and knowledge learned throughout the first half of their fellowship. Furthermore, it also refreshes their crisis resource management skills in anticipation of their American Board of Anesthesiology applied oral board examinations and OSCEs.

**WMC/NYMC:** Residents' level of training ranges from clinical anesthesia year one (CA-1) to CA-3. In the last week of the four-week regional anesthesia rotation, the resident completes two OSCE stations. Residents also participate in annual simulation training sessions at the New York Medical College clinical skills simulation center, which include regional anesthesia–related scenarios.

**OHSU:** Two OSCEs are incorporated into the four-week basic rotation that occurs during late CA-1 or CA-2 in our main operating rooms. Two additional OSCEs occur during the four-week advanced rotation in CA-3 at our ambulatory facility.

**UTH:** Our residents rotate on the regional anesthesia service for a full month. The OSCE is administered halfway through the month and repeated at the end of the month, with different question stems. Residents on our regional anesthesia rotation range from CA-1 in the second half of their year to CA-3 near graduation. We aim to achieve the same depth of knowledge with our first-year residents as we do with our graduating residents.

**What scenario(s) do you include in the OSCE? What domains do you assess?**

**DUMC:** Our OSCE has six scenarios, including high-fidelity simulations such as an intrathecal pump malfunction, pneumothorax after paravertebral block, and postpartum hemorrhage after a transverse abdominis plane block for Cesarean section. The simulations assess the learner's monitoring and data interpretation as well as management of hemodynamic instability, local anesthetic systemic toxicity (LAST), opioid overdose, and advanced cardiac life support. We include skills stations such as block performance and neuraxial anatomy identification. Other stations require learners to demonstrate knowledge of local anesthetic toxic doses and LAST treatment algorithms, communication skills, and ability to discuss a treatment plan for a patient with a peripheral nerve injury after a nerve block. We continually evaluate our OSCE curriculum and receive input from faculty in the regional division as well as our fellows to update the curriculum with relevant stations each year.

**WMC/NYMC:** The rotating resident completes one OSCE with two cases (case 1: adductor canal block and case 2a: supraclavicular nerve block or 2b: infraclavicular nerve block). Prior to the nerve block procedures, the resident is asked to (1) describe how to position the transducer to approach the target, (2) identify relevant anatomical structures using an ultrasound probe, and (3) demonstrate simulated needle placement on how to insert the needle and where to deposit the local anesthetics. We have created additional case scenarios using various peripheral nerve blocks and interfascial plane blocks. During NYMC's annual simulation training sessions, residents participate in a series of stations that focus on obtaining informed consent, formulating and discussing treatment options, and managing periprocedural complications related to regional anesthesia. Residents are assessed on their proficiency in interpersonal and communication skills, professionalism, and technical skills related to patient care, which are difficult to evaluate in written or oral exams.

*"Fellows noted that the OSCE allowed them to perform tasks they otherwise would not have a chance to practice and that the knowledge they gained during the session would change their future practice of anesthesia."*

**OHSU:** Residents undertake four OSCE stations on four separate occasions. The first basic rotation OSCE is peripheral nerve block basic preparation and setup, which is usually administered on the afternoon of the resident's first day on the rotation. The OSCE involves the physical setup of the patient and equipment for an interscalene peripheral nerve catheter. This OSCE may be performed with a mannequin, with a standardized patient, or as an observed structured assessment of technical skills with a patient. The second week basic rotation OSCE is evaluation and consent for a regional anesthesia procedure, which involves an interview and obtaining consent from a standardized patient for a regional anesthetic. The topic is also included in the American Board of Anesthesiology OSCE content outline. The first advanced rotation OSCE measures response to LAST complications and is ideally done in the first week of the rotation with a CPR mannequin. This OSCE is particularly useful to ensure that the resident is aware of where rescue equipment is located in a facility where they practice less often. The final advanced rotation OSCE is nerve injury complications and is scheduled for the last week of the rotation. It is usually done with a faculty member playing the role of the patient.

**UTH:** We have a bank of six OSCE scenarios: (1) patient with lateral ankle pain following an open reduction internal fixation of the ankle, (2) patient with knee pain following anterior cruciate ligament surgery whose surgeon wants them to participate in physical therapy, (3) patient with traumatic amputation of his right leg presenting for right above-knee amputation, with surgeons requesting a nerve block for postoperative analgesia, (4) patient undergoing left inguinal hernia repair where the surgeon requests an opioid-sparing regimen with a peripheral nerve block, (5) surgical regional anesthesia for a patient presenting to the operating room for creation of a left upper-extremity arteriovenous fistula for dialysis access, and (6) requested postoperative analgesia with brachial plexus blockade following a rotator cuff repair. We select three scenarios for the midpoint OSCE and three for the final OSCE.

### What tactic(s) do you use?

**DUMC:** We use SimMan for our high-fidelity scenarios. A faculty member serves as the patient for our communication and skills stations.

**WMC/NYMC:** We use OSCE-like simulation for teaching purposes in performing ultrasound-guided nerve blocks. OSCE sessions with standardized patients take place on an annual basis at the simulation center.

**OHSU:** We use Anesthesia Toolbox, a multi-institution collaboration containing a peer-reviewed curriculum, including educational online modules, podcasts, recommended readings, and OSCEs. It has curricula for regional resident basic and advanced rotations that include all modalities. Each OSCE in the Anesthesia Toolbox is accompanied by a script and a checklist used for evaluation purposes. Mannequins or standardized patients may be used, depending on the OSCE scenario.

**UTH:** In the course of providing routine postoperative regional anesthesia, OSCE scenarios are presented to learners. If no patients are available, residents are asked to identify sonographic anatomy on a volunteer faculty member or medical student who consents to scanning. Needling is not included in the OSCE exam; our OSCE focuses more on correct medical decision making. Residents are asked to determine an appropriate regional anesthesia technique for a given scenario, to correctly identify anatomy, and to understand the different types of local anesthetic used.

### Who administers the OSCE?

**DUMC:** Our regional anesthesia faculty have a strong commitment to education, and several are involved as instructors for our OSCE sessions. They help facilitate sessions, serve as confederates during high-fidelity simulations, and lead debriefing sessions. Additionally, we have support from staff in our simulation center.

**WMC/NYMC:** OSCE is administered by either the regional anesthesia fellow or regional anesthesia attending. Anonymous survey responses from current residents-in-training indicate that residents slightly favor OSCE conducted by the regional anesthesia attending.

**OHSU:** The OSCE is administered by the regional anesthesia attending on service. Our workflow is typically lighter in the afternoon, and it is usually possible to work in a 15-minute OSCE. Multiple OSCEs spread over time (as opposed to blocked into one group) are easier to administer and limit the number of learning objectives addressed in a single day.

**UTH:** Our OSCE exams are administered by either the service division chief or director of resident education for the rotation. Initially this was because of a lack of faculty participation; however, we have also found that it is useful for consistency and evaluation for improvement in the resident from midpoint to final OSCE assessment.

### How are trainees evaluated?

**DUMC:** Fellows are evaluated using an analytic grading rubric that includes 10–25 items per station. They also receive a score for any knowledge worksheets that are incorporated into the station and a global holistic score from 1–4 (unsatisfactory to very good) on their overall performance. These evaluations are sent to each individual learner. One of the OSCE's most important aspects is that we facilitate debriefing sessions after each station to allow for immediate feedback, reflection, and education.

**WMC/NYMC:** During regional anesthesia OSCEs, each of the OSCE scenarios (case 1 and case 2a or 2b) have 10 questions. Each correctly managed question nets the examinee one point. A passing grade is 14 out of a total of 20 points. During the annual simulation sessions, residents are given direct feedback from simulated patient actors on interpersonal and communication skills and professionalism within a simulated environment as well as a web link that allows them to review their own performance.

**OHSU:** Each OSCE has a 20- to 25-point grading rubric. We currently use OSCEs as formative feedback only, with immediate debriefing between the faculty and resident.

**UTH:** Residents are evaluated on the following factors: (1) identification of the correct block for the question stem, (2) correct identification of ultrasound anatomy for the desired block, and (3) appropriate local anesthetic concentration and volume selected. The factors are graded yes or no for three question stems, and they receive one point for each "yes" and zero points for each "no." The resident must achieve six of nine points to pass the OSCE. The grade on the midpoint OSCE is not recorded but is used as a motivating tool for the resident. The final OSCE score (pass or fail) is recorded on the resident's rotation evaluation.

**What general outcomes or observations have you seen with using OSCE? What are the measures of resident satisfaction or improvement?**

**DUMC:** We have completed two years of our OSCE curriculum and have collected anonymous survey feedback. OSCE is used for teaching (debriefing sessions after each station) and evaluation (fellows receive their scored evaluations, which are also shared with the program director). Every fellow has rated the OSCE simulation as excellent, the highest possible rating. In particular, they noted that the OSCE allowed them to perform tasks they otherwise would not have a chance to practice and that the knowledge they gained during the session would change their future practice of anesthesia. Seventy-five percent of our fellows expressed that they prefer or strongly prefer the OSCE simulation format over traditional learning methods such as a lecture series.

**WMC/NYMC:** Residents who have completed the proctored sessions in regional anesthesia rate the OSCE sessions highly because they provide them with an organized way to plan the procedure and identify the salient steps examiners might want to test. Based on our experience, the addition of hands-on OSCE sessions to formal resident didactic curriculum results in significant improvements in resident satisfaction because it constitutes constructive feedback based on Accreditation Council for Graduate Medical Education core competency domains, such as patient care (technical skills in regional anesthesia), interpersonal and communications skills, and medical knowledge.

**OHSU:** Simulation and the OSCEs have the highest satisfaction scores of any part of our program on our annual program evaluation. Residents appreciate the opportunity to apply their knowledge and ensure that they are providing optimal care. The OSCE format frequently uncovers deficits that allow for immediate feedback and improvement of care.

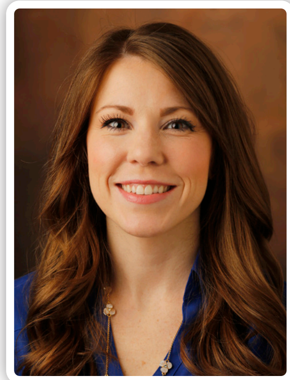
**UTH:** Administration of the OSCE, especially the midpoint OSCE, has motivated our residents to be more academically engaged with the regional anesthesia service. The ability for support staff to direct residents in a structured format during the exam reduces anxiety.

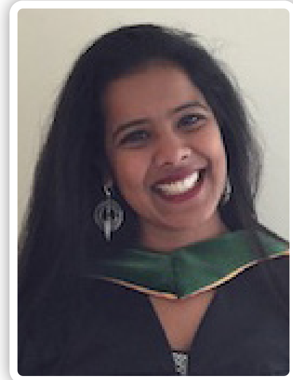
*This article was written by members of the ASRA Education in Regional Anesthesia Special Interest Group. Learn more about this group at members.asra.com/education-in-regional-anesthesia-sig/*


REFERENCES

1. Hastie MJ, Spellman JL, Pagnano PP, Hastie J, Egan BJ. Designing and implementing the objective structured clinical examination in anesthesiology. *Anesthesiology*. 2014:120(1);196–203. https://doi.org/10.1097/ALN.0000000000000068

# Chronic Pain: Why Do We Treat the Whole Person Last, When Good Evidence Says We Should Do It First?






Jenna L. Walters, MD
Assistant Professor of Anesthesiology and Pain Medicine
Chronic Pain Resident Rotation Director
Associate Chronic Pain Fellowship Director
Vanderbilt University Medical Center
Nashville, Tennessee

Priyanka Ghosh, MD
Interventional Pain Fellow
Weill Cornell Tri-Institutional Pain Fellowship
Weill Cornell Medicine
New York, New York


The National Institute of Health (NIH) estimated that in 2016, approximately 20% of U.S. adults suffered from chronic pain.[1] Chronic pain is the number one cause of long-term disability in the United States and costs our country an estimated $635 billion each year in direct and indirect costs.[2,3] As state and national legislation is enacted to combat the opioid epidemic, patients continue to experience chronic pain and are undergoing rapid forced opioid tapers with limited alternative options for pain control. National overdose deaths continue to rise with a twofold increase in the last decade.[4] Numerous studies outline the risks of long-term opioids for chronic, nonmalignant pain, but what is the alternative?[5–7]

As patients search for a new way forward, the interest in complementary and alternative medicine has surged in the United States. According to NIH, in 2012 approximately 54% of Americans suffered from a musculoskeletal pain disorder, and 40% of them used complementary and alternative medicine.[8] In light of the opioid epidemic and the call for more options to treat chronic pain, several commercial insurance companies have adopted policies covering alternative modalities such as acupuncture. As interest increases, what do we tell our patients about these therapies?

## ACUPUNCTURE

A recent review of complementary medicine in the United States found acupuncture to be effective for both pain and function in patients with chronic low back and knee pain.[9] A systematic review by Dimitrova et al also highlighted the benefits of acupuncture in the treatment of painful peripheral neuropathy.[10] Interestingly, the study also showed improvements in both sensory and motor nerve conduction. Xu et al performed a systematic review concluding that acupuncture had a significantly higher effective rate compared to medication for chronic migraines.[11] Finally, the American College of Physicians currently recommends acupuncture for acute, subacute, and chronic low back pain.[12]

*"The goal is to treat the whole patient, not just their disease, while empowering patients to live their best life despite chronic pain."*

## MIND-BODY TECHNIQUES

Mindfulness-based stress reduction has similar results for low back pain with improved pain scores and functionality at 26 and 52 weeks when compared to usual care.[13] It has also been shown to improve mood and catastrophizing, which frequently coexist in patients that experience chronic pain.[14] Multiple randomized controlled trials have highlighted the benefits of mindfulness and meditative awareness for patients who suffer from fibromyalgia, a disease with few treatment options but frequently associated with debilitating symptoms and loss of functionality.[15,16] Several studies evaluating cognitive-behavioral therapy for fibromyalgia have supported the theory that it affects neuroplasticity and alter brain connectivity.[17,18]

Physical practices such as yoga and tai chi combine the benefits of a meditative practice with movement. Several systematic reviews have provided evidence that yoga can improve both pain and function for patients with chronic low back pain.[19,20] A randomized controlled trial performed in veterans demonstrated similar results with improvement in both disability and pain.[21] Tai chi has been studied extensively for chronic pain related to osteoarthritis and has moderate to strong evidence to support the improvement of pain and function.[22,23] For patients with fibromyalgia, yoga and tai chi may not only improve pain but also quality of life and pain acceptance.[24,25] Patients with chronic pain frequently suffer from fear avoidance behavior, and mind-body modalities can help break the vicious cycle of pain, anxiety, and fear in relation to movement.

## INTEGRATIVE PROGRAMS

Several institutions have used this evidence to support the development of pain rehabilitation or functional restoration programs. The Mayo Clinic in Rochester, MN, created the first such program in 1974. These centers combine alternative modalities with physical therapy, psychological intervention, and education to reduce pain, improve function, decrease opioid burden, and ultimately help patients live better. A systematic review found that multidisciplinary rehabilitation can reduce pain and disability while simultaneously increasing the likelihood of return to work.[26] Unfortunately, patients are typically referred to such programs when they have failed all other modalities. Why are we reserving this type of collaborative therapy as the last option? Instead, it should be the model for how we treat all patients with chronic pain.

The Department of Veterans Affairs has recently made an investment in this treatment paradigm by developing the Whole Health Initiative that uses evidence-based, integrative pain care. The program includes a team of family practitioners, interventionalists, physical and occupational therapists, health coaches, and psychologists that use multimodal medication management, procedural interventions, physical activity, behavioral modification, acupuncture, mindfulness, meditation, biofeedback, yoga, tai chi, and other alternative therapies to treat chronic, nonmalignant pain without high-dose opioids. The goal is to treat the whole patient, not just their disease, while empowering patients to live their best life despite chronic pain. As we battle not only the opioid epidemic, but the financial and emotional impact of chronic pain, this collaborative and integrative model provides the framework for the future of chronic pain treatment—a way forward for our patients.

REFERENCES


1. Dahlhamer J, Lucas J, Zelaya C, et al. Prevalence of chronic pain and high-impact chronic pain among adults - United States, 2016. *MMWR Morb Mortal Wkly Rep*. 2018;67(36):1001–1006. https://doi.org/10.15585/mmwr.mm6736a2
2. Pain. National Institute on Drug Abuse website. https://www.drugabuse.gov/related-topics/pain. Updated May 12, 2017. Accessed December 27, 2019.
3. Gaskin DJ, Richard P. The economic costs of pain in the United States. In: Institute of Medicine Committee on Advancing Pain Research, Care, and Education. *Relieving Pain in America: A Blueprint for Transforming Prevention, Care, Education, and Research*. Washington, DC: National Academic Press; 2011. https://www.ncbi.nlm.nih.gov/books/NBK92521
4. Overdose death rates. National Institute on Drug Abuse website. https://www.drugabuse.gov/related-topics/trends-statistics/overdose-death-rates. Updated January 2019. Accessed December 27, 2019.
5. Veiga DR, Monteiro-Soares M, Mendonca L, et al. Effectiveness of opioids for chronic noncancer pain: a two-year multicenter, prospective cohort study with propensity score matching. *J Pain*. 2019;20(6):706–715. https://doi.org/10.1016/j.jpain.2018.12.007
6. Krebs EE, Gravely A, Noorbaloochi S. Effect of opioid vs nonopioid medications on pain-related function in patients with chronic back pain or hip or knee osteoarthritis pain: The SPACE randomized clinical trial. *JAMA*. 2018;319(9):872–882. https://doi.org/10.1001/jama.2018.0899
7. Da Costa BR, Nuesch E, Kasteler R, et al. Oral or transdermal opioids for osteoarthritis of the knee or hip. *Cochrane Syst Rev*. 2014;9:CD003115. https://doi.org/10.1002/14651858.CD003115.pub4
8. Clarke TC, Nahin RL, Barnes PM, Stussman BJ. Use of complementary health approaches for musculoskeletal pain disorders among adults: United States 2012. *Natl Health Stat Report*. 2016;98:1–12.
9. Nahin RL, Boineau R, Khalsa PS, Stussman BJ, Weber WJ. Evidence-based evaluation of complementary health approaches for pain management in the United States. *Mayo Clin Proc*. 2016;91(9):1292–1306. https://doi.org/10.1016/j.mayocp.2016.06.007
10. Dimitrova A, Murchison C, Oken B. Acupuncture for the treatment of peripheral neuropathy: a systematic review and meta-analysis. *J Altern Complement Med*. 2017;23(3):164–179. https://doi.org/10.1089/acm.2016.0155
11. Xu J, Zhang FQ, Pei J, Ji J. Acupuncture for migraine without aura: a systematic review and meta-analysis. *J Integr Med*. 2018;16(5):312–321. https://doi.org/10.1016/j.joim.2018.06.002
12. Qaseem A, Wilt TJ, McLean RM, Forciea MA. Noninvasive treatments for acute, subacute, and chronic low back pain: a clinical practice guideline from the American College of Physicians. *Ann Intern Med*. 2017;166(7):514–530. https://doi.org/10.7326/M16-2367
13. Cherkin DC, Anderson ML, Sherman KJ, et al. Effect of mindfulness-based stress reduction vs cognitive behavioral therapy or usual care on back pain and functional limitations in adults with chronic low back pain: a randomized clinical trial. *JAMA*. 2016;315(12):1240–1249. https://doi.org/10.1001/jama.2016.2323
14. Williams AC, Eccleston C, Morley S. Psychological therapies for the management of chronic pain (excluding headache) in adults. *Cochrane Database Syst Rev*. 2012;11:CD007407. https://doi.org/10.1002/14651858.CD007407.pub3

15. Cash E, Salmon P, Weissbecker I, et al. Mindfulness meditation alleviate fibromyalgia symptoms in women: results of a randomized clinical trial. *Ann Behav Med.* 2015;49(3):319–330. https://doi.org/10.1007/s12160-014-9665-0

16. Van Gordon W, Shonin E, Dunn TJ, et al. Meditation awareness training for the treatment of fibromyalgia syndrome: a randomized controlled trial. *Br J Health Psychol*. 2017;22(1):186–206. https://doi.org/10.1111/bjhp.12224

17. Lazaridou A, Kim J, Cahalan CM, et al. Effects of cognitive behavioral therapy (cbt) on brain connectivity supporting catastrophizing in fibromyalgia. *Clin J Pain*. 2017;33(3):215–221. https://doi.org/10.1097/AJP.0000000000000422

18. Shpaner M, Kelly C, Lieberman G, et al. Unlearning chronic pain: a randomized controlled trial to investigate changes in intrinsic brain connectivity following cognitive behavioral therapy. *Neuroimage Clin*. 2014;5:365–376. https://doi.org/10.1016/j.nicl.2014.07.008

19. Cramer H, Lauche R, Haller H, Dobos G. A systematic review and meta-analysis of yoga for low back pain. *Clin J Pain*. 2013;29(5):450–460. https://doi.org/10.1097/AJP.0b013e31825e1492

20. Wieland LS, Skoetz N, Pilkington K, et al. Yoga treatment for chronic non-specific low back pain. *Cochrane Database Syst Rev*. 2017;1:CD010671. https://doi.org/10.1002/14651858.CD010671.pub2

21. Groessl EJ, Liu L, Chang DG, et al. Yoga for military veterans with chronic low back pain: a randomized clinical trial. *Am J Prev Med*. 2017. https://doi.org/10.1016/j.amepre.2017.05.019

22. Hall A, Copsey B, Richmond H, et al. Effectiveness of tai chi for chronic musculoskeletal pain conditions: updated systematic review and meta-analysis. *Phys Ther*. 2017;97(2):227–238. https://doi.org/10.2522/ptj.20160246

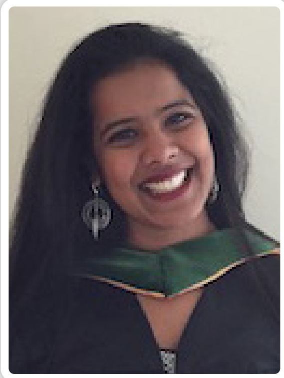
23. Peng P. Tai chi and chronic pain. *Reg Anesth Pain Med*. 2012;37(4):372–382. https://doi.org/10.1097/AAP.0b013e31824f6629

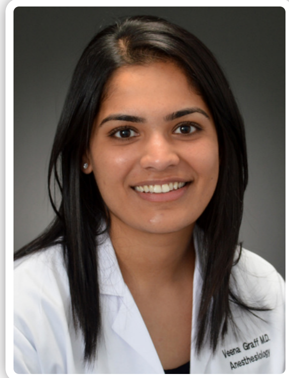
24. Carson JW, Carson KM, Jones KD, et al. A pilot randomized controlled trial of the yoga of awareness program in the management of fibromyalgia. *Pain*. 2010;151(2):530–539. https://doi.org/10.1016/j.pain.2010.08.020

25. Hall AM, Maher CG, Lam P, Ferreira M, Latimer J. Tai chi exercise for treatment of pain and disability in people with persistent low back pain: a randomized controlled trial. *Arthritis Care Res*. 2011;63(11):1576–1583. https://doi.org/10.1002/acr.20594

26. Marin, TJ. Multidisciplinary treatment at the early stages of low back pain. *Cochrane Database Syst Rev*. 2017;6:CD002193. https://doi.org/10.1002/14651858.CD002193.pub2

# Kambin's Triangle Approach to Transforaminal Epidural Injections





Priyanka Ghosh, MD
Interventional Pain Fellow
Weill Cornell Tri-Institutional
Pain Fellowship
Weill Cornell Medicine
New York, New York

Lynn Kohan, MD, MS
Associate Professor
Anesthesiology and
Pain Medicine
Director, Pain Fellowship
University of Virginia
Health System
Charlottesville, Virginia

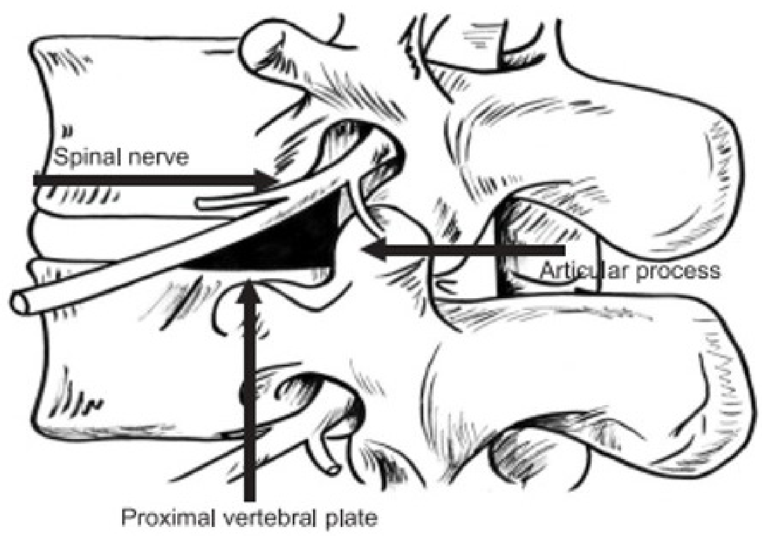
Veena Graff, MD, MS
Assistant Professor
Anesthesiology and
Critical Care
University of Pennsylvania
Perelman School of Medicine
Philadelphia, Pennsylvania

Lumbar spinal stenosis affects more than 200,000 adults in the United States yearly, resulting in substantial pain and disability.[1] Generally, patients experience radiating pain in the lower limbs secondary to narrowed intervertebral foramen. Pain is partially caused by physical compression from degenerative changes and thickening of the ligamentum flavum, zygapophysial joint, and surrounding soft tissues; however, no unifying theory explains the exact etiology of the pain in lumbar spinal stenosis.[1] Theories include inflammatory changes around nerve roots, venous congestion, and hematogenous disability.

One of the mainstays of interventional treatment is an epidural steroid injection (ESI). Steroids interrupt the synthesis of prostaglandins, block conduction of nociceptive fibers, and decrease edema around the nerve root, thereby potentially decreasing pain.[2] ESIs use two common approaches: midline interlaminar and transforaminal. The transforaminal approach has shown excellent clinical efficacy, with improved pain scores, improved ability to complete activities of daily living, and decreased pain-related anxiety and depression.[2–3] The transforaminal method is often preferred because the injection can be directed toward the more relevant side and nerve root to maximize localized drug concentration.[4] Comparative studies have shown that transforaminal ESIs are either equal or superior to midline interlaminar ESIs in efficacy and that they are effective in reducing pain, restoring function, and avoiding surgery in a substantial proportion of patients with lumbar radicular pain.[5] This article compares and contrasts the merits and flaws of the two approaches in technique for transforaminal ESI: the safe triangle method and Kambin's triangle method.

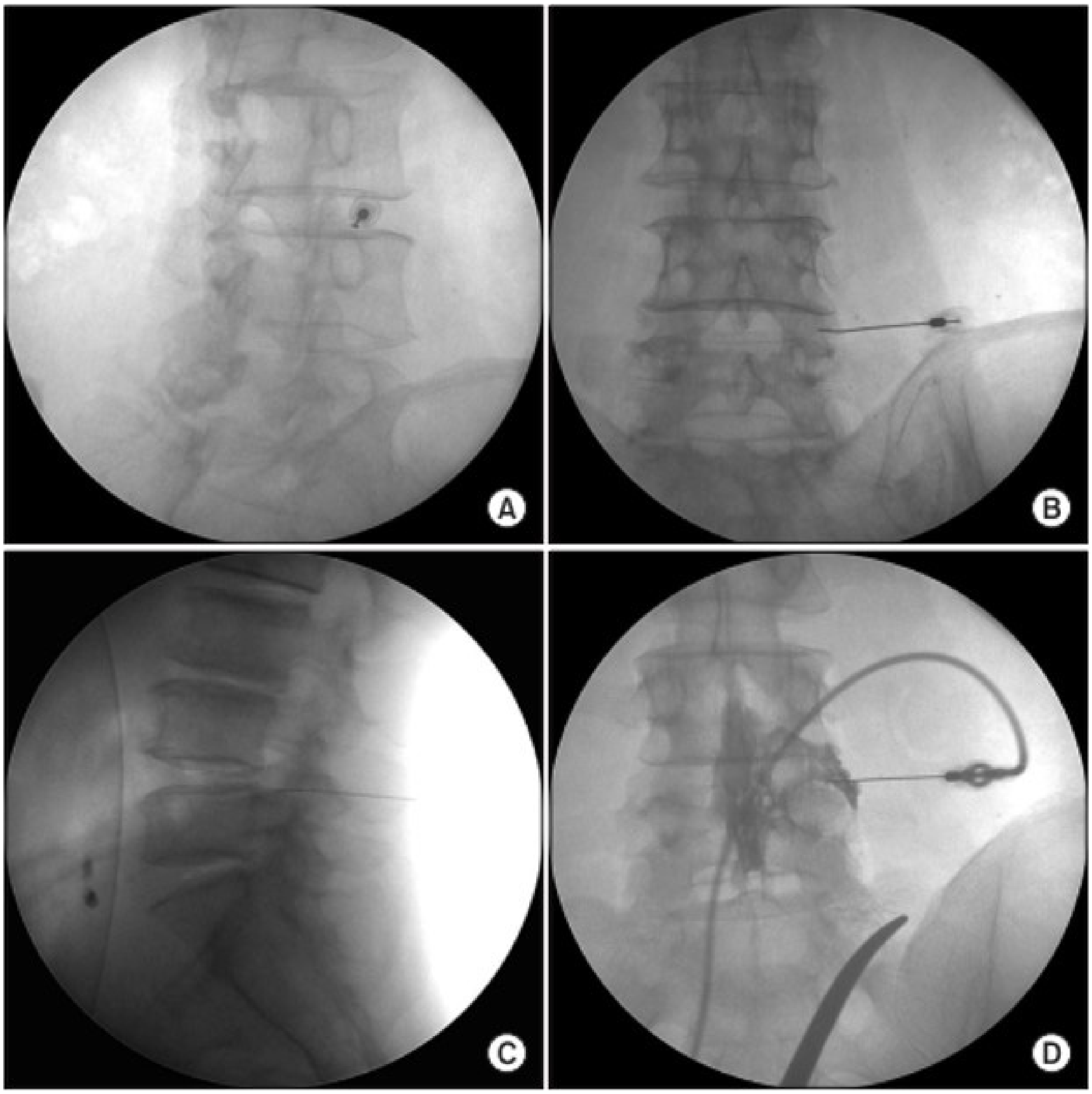
The transforaminal approach, although proven to have better clinical efficacy, has the potential for significant complications, including air emboli, cerebral thrombosis, epidural hematoma, nerve root injury, vascular transection, and vasospasm. However, the most devastating complications are cord ischemia or vascular injury from needle trauma or intravascular injection of particulate

**Figure 1:** *Schematic image of Kambin's triangle. The base is the caudad vertebral body, the height is the traversing nerve root, and the hypotenuse is the exiting nerve.*




Adapted with permission from Park JW, Nam HS, Cho SK, Jung HJ, Lee BJ, Park Y. Kambin's triangle approach of lumbar transforaminal epidural injection with spinal stenosis. *Ann Rehabil Med.* 2011;35(6):833–843. https://doi.org/10.5535/arm.2011.35.6.833

**Figure 2:** *Kambin's triangle approach of L5 nerve root under fluoroscopy.* **2A:** *Oblique view, where the needle is advanced past the superior articular process (SAP).* **2B:** *Anteroposterior view, which demonstrates the tip in the interpedicular line.* **2C:** *Lateral view used to advance past the SAP to minimize risk of penetration until the needle is at the posterior, inferior aspect of the interverterbral foramen.* **2D:** *Contrast is injected to confirm epidural spread.*




Adapted with permission from Park JW, Nam HS, Cho SK, Jung HJ, Lee BJ, Park Y. Kambin's triangle approach of lumbar transforaminal epidural injection with spinal stenosis. *Ann Rehabil Med.* 2011;35(6):833–843. https://doi.org/10.5535/arm.2011.35.6.833

*"Given the high risk of complications, selecting the safest technique for performing a transforaminal ESI is important."*

matter.[3] The spinal cord's blood supply is complex, with large arteries such as the artery of Adamkiewicz originating between T8–L1 and smaller segmental arteries, which increases the potential risk of vascular damage or ischemia during procedures. Given the high risk of complications, selecting the safest technique for performing a transforaminal ESI is important.

## SAFE TRIANGLE TECHNIQUE

The most commonly used technique is the safe triangle or supraneural/subpedicular approach, performed under fluoroscopy. First, the classic Scottie dog view is obtained; then the needle is directed through the skin toward the inferior lateral boundary of the pedicle. The needle is advanced in the lateral view until the needle enters the superior/posterior aspect of the foramen. This approach is generally safe and avoids many dangerous areas such as the radiculomedullary artery. However, it has been associated with reports of devastating neurologic and ischemic complications.[4]

## KAMBIN'S TRIANGLE APPROACH

Another technique, based on a critical reanalysis of the anatomy of the neuroforamen, is an approach termed Kambin's triangle, which is thought to be safer than the "safe triangle" technique.[4] The landmark is described as a right triangle over the dorsolateral disc. The exiting nerve root forms the hypotenuse of the triangle, the superior border of the caudad vertebral body forms the base or width of the triangle, and the dura/transversing nerve root forms the height (Figure 1).[6]

To reach Kambin's Triangle, the fluoroscopic image is created in the oblique view, which aligns the superior articulate process (SAP) in the center of the intervertebral disc, then the needle is advanced in a lateral, inferior direction to the SAP. When the needle contacts the SAP, the direction of the needle is changed to the lateral aspect of the bony landmark. Needle advancement and final placement are confirmed with a lateral view and contrast imaging (Figure 2).

This technique has been offered as an alternative to the traditional safe triangle approach based on a theoretically superior anatomical argument. Park et al compared Kambin's triangle to the subpedicular approach in terms of frequency of complications during the procedure and the effect of the transforaminal ESI at two and four weeks. The researchers found no statistical difference in pain relief efficacy between the two methods at two and four weeks, but they did find that the Kambin's triangle method resulted in less nerve root pricking, but not long-term damage.[4] However, cases of intradiscal injections have been reported with Kambin's triangle.[7] In another study, researchers found that the Kambin's triangle method was useful in situations where placing the needle at the anterior epidural space was difficult.[6]

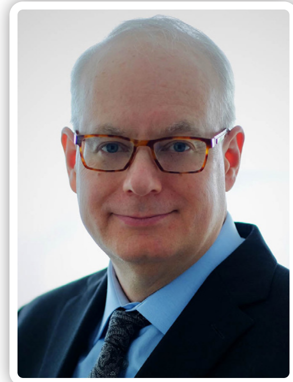
Kambin's triangle offers an alternative method to the classic safe triangle approach for transforaminal ESI. Although both methods have pros and cons, Kambin's triangle is less frequently used. However, it may have potential for being efficacious in situations where the safe triangle method is more technically difficult or more dangerous for patients. Larger-scale studies are required to effectively compare the two techniques head to head.

REFERENCES


1. Lurie J, Tomkins-Lane C. Management of lumbar spinal stenosis. *BMJ*. 2016;352:h6234. https://doi.org/10.1136/bmj.h6234.
2. Vad VB, Bhat AL, Lutz GE, Cammisa F. Transforaminal epidural steroid injections in lumbosacral radiculopathy: a prospective randomized study. *Spine (Phila Pa 1976)*. 2002;27(1):11–16. https://doi.org/10.1097/00007632-200201010-00005
3. Smith CC, Booker T, Schaufele MK, Weiss P. Interlaminar versus transforaminal epidural steroid injections for the treatment of symptomatic lumbar spinal stenosis. *Pain Med*. 2010;11(10):1511–1515. https://doi.org/10.1111/j.1526-4637.2010.00932.x
4. Botwin KP, Gruber RD, Bouchlas CG, et al. Fluoroscopically guided lumbar transformational epidural steroid injections in degenerative lumbar stenosis: an outcome study. *Am J Phys Med Rehabil*. 2002;81(12):898–905. https://doi.org/10.1097/00002060-200212000-00003
5. MacVicar J, King W, Landers MH, Bogduk N. The effectiveness of lumbar transforaminal injection of steroids: a comprehensive review with systematic analysis of the published data. *Pain Med*. 2013;14(1):14–28. https://doi.org/10.1111/j.1526-4637.2012.01508.x
6. Park JW, Nam HS, Cho SK, Jung HJ, Lee BJ, Park Y. Kambin's triangle approach of lumbar transforaminal epidural injection with spinal stenosis. *Ann Rehabil Med*. 2011;35(6):833–843. https://doi.org/10.5535/arm.2011.35.6.833
7. Zhu J, Falco FJ, Formoso F, Onyewu O, Irwin FL. Alternative approach for lumbar transforaminal epidural steroid injections. *Pain Physician*. 2011;14(4):331–341.

# How I Do It: Ultrasound-Guided Sacral Lateral Branch Blocks

Sacroiliac joint- (SIJ-) related pain has traditionally been diagnosed and treated with intra-articular injections;[1] however, the increased interest in radiofrequency ablation techniques targeting the posterior joint innervation (sacral lateral branches) has underlined the need for diagnostic blocks specifically targeting those nerves. Although fluoroscopy guidance has been validated for this purpose, it is seldom used because of the 17 injections (and nine skin entry sites) required.[2] A simplified, ultrasound-guided technique, however, requires only three injections.[3]




Marta Vargas-Salazar, MD
Fellow

Jan Venter, MD, CCFP
Fellow

Roderick J. Finlayson, MD, FRCPC
Professor

Department of Anesthesiology
Alan Edwards Pain Management Unit
McGill University Health Center
Montreal, Quebec, Canada


## ANATOMY

Although the anterior aspect of the joint is innervated by the ventral rami of L4 and L5, a posterior sacral neural network (PSN) innervates the dorsal aspect of the joint and posterior ligaments (posterior sacral complex).[4] The results of a cadaveric study demonstrated that the PSN received contributions from the S1 and S2 lateral branches in 100% of specimens, from S3 in 88% of cases, and rarely from the L5 and S4 levels in 8% and 4%, respectively.[5] When a contribution from the L5 dorsal ramus was present, it merged with the PSN and did not innervate the joint directly.

Most of the nerves contributing to the PSN cross the lateral sacral crest (LSC) between the second and third transverse sacral tubercles; however, a superior lateral branch can also innervate the SIJ at the S1 level in up to 40% of subjects. Although the LSC is difficult to identify using fluoroscopic imaging, it is a reliable sonographic landmark and constitutes the injection target when performing an ultrasound-guided sacral lateral branch block (SLBB).

*“Ultrasound guidance was associated with shorter performance times, fewer needle passes, and a lower incidence of vascular breach.”*

## SONOANATOMY

**Transverse (short axis) scan and technique.** This view is used for needle placement and injection. Place a C5-2 MHz curved transducer on the lower sacrum and perform a systematic scan, first identifying the sacral hiatus in the midline, then moving over to the target side keeping the median sacral crest in view. Then move the probe cephalad to visualize the posterior sacral foramina (S4, S3, S2, and S1) and LSC (Figure 1 and 2).

**Sagittal (long axis) scan.** This view is used to confirm level and needle position before injection. The posterior foramina appear as gaps in the bony contour of the sacrum (Figure 2F).

## BLOCK TECHNIQUE

Key landmarks are identified by scanning the sacrum in the transverse plane, cephalad from the sacral hiatus (Figure 1 and 2). Perform three injections of local anesthetic on the sacral lateral crest by advancing the needle in-plane from a medial to lateral direction: 1.5 mL between S2 and S3, 0.5 mL between S2 and S3, and 0.5 mL lateral to S1. After each needle placement, perform a sagittal scan to confirm needle position in the cephalo-caudal dimension (Figure 2F).

## CLINICAL PEARLS

- In the upper sacral spine, the S1 posterior foramen can be identified by localizing the L5-S1 facet joint, then scanning caudad until the foramen is visualized. At the level of the S2 posterior foramen (S2), the caudad aspects of the SIJ and posterior superior iliac spine (PSIS) immediately cephalad to it can serve as confirmatory landmarks.

- Because of sacral angulation, the injection target at the S1 level can be more challenging to access than at other levels.
- The median sacral crest may hinder needle placement, particularly in thinner patients, necessitating a more lateral needle entry site.
- Vascular breach is common during injection procedures targeting the sacral area and can be prevented by identifying vulnerable vessels in the projected needle path using duplex color Doppler.

**Figure 1:** *Posterior view of the sacrum on a skeletal model. Left side of the model depicts the injection points for an ultrasound-guided sacral lateral branch block on the lateral sacral crest between the S2 and S3 transverse sacral tubercles (1); on the lateral crest immediately above the S2 transverse sacral tubercle (2); and on the lateral crest at the level of the S1 transverse sacral tubercle (3). Right side of the model depicts the individual scan lines corresponding to the sonograms in Figures 2A–2F.*

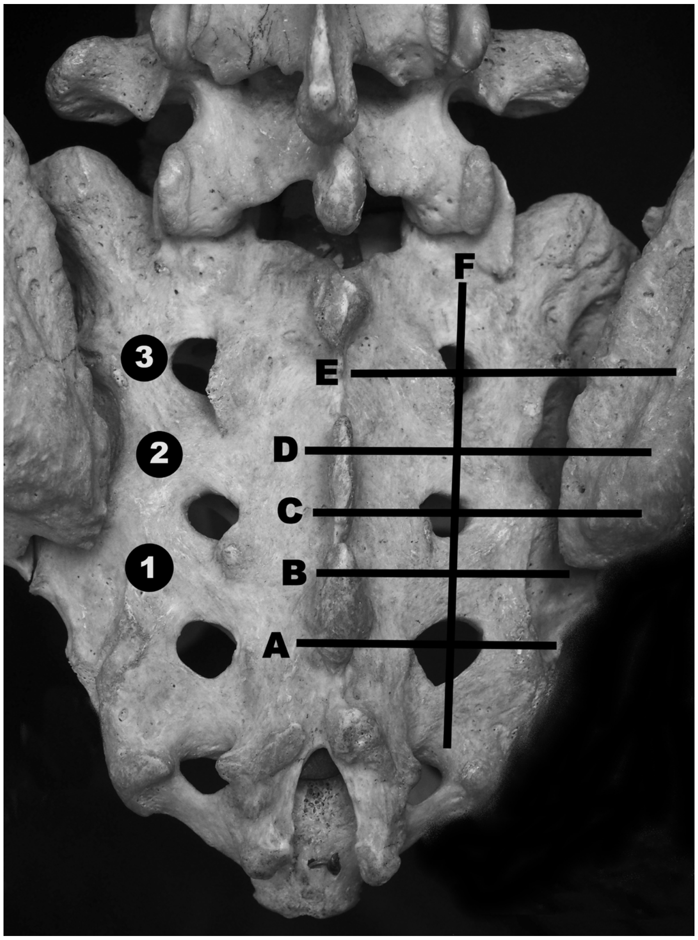
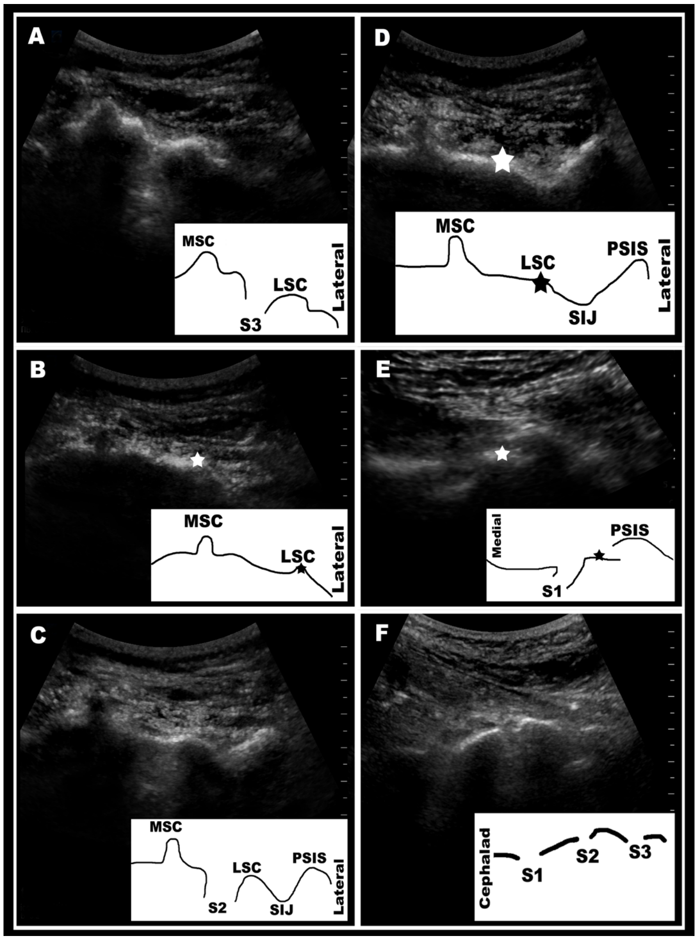



**Figure 2:** *Sonographic images of the posterior sacrum depicting the various views required for the performance of an ultrasound-guided sacral lateral branch block. This view is used to confirm needle positions prior to injection (bi-planar technique). Injection points are marked by a star (★), and scan lines are illustrated in Figure 1.* **2A:** *transverse sonographic view of the lower sacrum demonstrating the median sacral crest, posterior foramen of S3, and lateral sacral crest (LSC);* **2B:** *transverse scan of the lower sacrum depicting the injection point on the LSC, midpoint between the posterior foramina of S3 and S2;* **2C:** *transverse scan at the level of the S2 posterior foramen illustrating the caudad aspects of the sacroiliac joint and posterior superior iliac spine;* **2D:** *transverse scan of the posterior sacrum demonstrating the injection point on the lateral sacral crest cephalad to the S2 posterior foramen;* **2E:** *transverse scan of the sacrum illustrating the injection point lateral to the S1 posterior foramen;* **2F:** *sagittal sonographic view of the sacrum with visualization of the posterior foramina of S1, S2, and S3.*



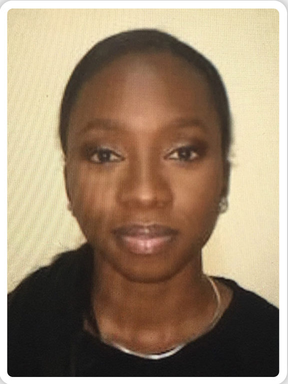
## SUPPORTING EVIDENCE

To date, one randomized controlled trial involving 40 patients with chronic low back pain compared fluoroscopy- and ultrasound-guided SLBB techniques.[3] In the fluoroscopy group, SLBB were performed according to a previously described 17-injection technique, which involves 9 skin entry sites and the targeting of the L5 posterior root and S1–S3 sacral lateral branches. The ultrasound-guided technique consisted of the three injections described previously, and analgesic testing was done by probing the dorsal sacroiliac ligament, sacroiliac joint, and interosseous ligament with a 22-gauge block needle. Ultrasound guidance was associated with shorter performance times, fewer needle passes, and a lower incidence of vascular breach. However, the block effect (the proportional decrease in numerical rating scale between pre-block and post-block analgesic testing) was similar in both groups. Furthermore, no statistical differences were found in the proportions of patients achieving complete analgesia at each test site.

REFERENCES


1. Cohen SP, Chen Y, Neufeld NJ. Sacroiliac joint pain: a comprehensive review of epidemiology, diagnosis and treatment. *Expert Rev Neurother*. 2013;13:99–116. https://doi.org/10.1586/ern.12.148
2. Dreyfuss P, Henning T, Malladi N, Goldstein B, Bogduk N. The ability of multi-site, multi-depth sacral lateral branch blocks to anesthetize the sacroiliac joint complex. *Pain Med*. 2009;10:679–688. https://doi.org/10.1111/j.1526-4637.2009.00631.x
3. Finlayson RJ, Etheridge JP, Elgueta MF, Thonnagith A, Nelems B, Tran DQH. A randomized comparison between ultrasound- and fluoroscopy-guided sacral lateral branch blocks. *Reg Anesth Pain Med*. 2017;42:400–406. https://doi.org/10.1097/AAP.0000000000000569
4. King W, Ahmed SU, Baisden J, et al. Diagnosis and treatment of posterior sacroiliac complex pain: A systematic review with comprehensive analysis of the published data. *Pain Med*. 2015;16:257–265. https://doi.org/10.1111/pme.12630
5. Roberts SL, Burnham RS, Ravichandiran K, Agur AM, Loh E. Cadaveric study of sacroiliac joint innervation: implications for diagnostic blocks and radiofrequency ablation. *Reg Anesth Pain Med*. 2014;39:456–464. https://doi.org/10.1097/AAP.0000000000000156

# Temporomandibular Joint Disorders and the Role of Pain Physicians




Chinyere Archie, MBBS
Resident
Department of Anesthesiology

Patrick Courtright, MD, MBS
Resident
Department of Anesthesiology

Rany Abdallah, MD, PhD
Anesthesiologist
Acute and Chronic Pain Division

Temple University Health System
Philadelphia, Pennsylvania


The temporomandibular joint (TMJ) is important to activities we perform on a daily basis. It facilitates complex movements necessary for chewing, swallowing, and speaking; as such, pain and decreased mobility related to TMJ disorders can significantly impair a patient's quality of life. Affected patients usually seek initial medical care from dentists, family practitioners, internists, or otolaryngologists. Prompt recognition may be challenging, and even with a diagnosis, pain related to TMJ pathology may be difficult to manage appropriately. Many patients are eventually referred to chronic pain physicians, and our expertise here is crucial.

TMJ disorders (TMD) encompass a wide range of joint-related dysfunction. Collectively, they are fairly common and affect up to 25% of the population.[1] TMD affects females to a disproportionately greater degree, with studies reporting female to male ratios ranging from 2:1 to 8:1.[1] Only a small percentage of affected patients seek treatment.

## DIAGNOSIS

Understanding the joint's anatomy is imperative for a correct diagnosis that eliminates differential diagnoses. The TMJ is a diarthroidal hinge joint formed by the temporal bone and the mandible.[2] The mandibular fossa and articular tubercle of the temporal bone are the superior articular surfaces that meet the posterior, cephalad projection of the mandible, called its condyle, at this synovial joint. An articular disc lies between the two fibrocartilaginous surfaces and divides the joint into two cavities (Figure 1)[3].

Pain is a common presentation of TMD and can occur anywhere along the distribution of the trigeminal nerve.[2] It may be well localized around the TMJ but is often perceived along the inferior line of the jaw, within surrounding muscles involved in motion of the jaw (including the masseter and temporalis), in the ear, in the neck, and as far posterior as the suboccipital region. Other symptoms include restriction of jaw movement or locking, bothersome sounds such as clicking or crepitus, difficulty chewing or swallowing, and facial swelling.[1] On physical examination, evaluate the muscles and soft tissues surrounding the TMJ, occlusal position, mandibular range of movement, and posture of the jaw, head, and neck.

**Figure 1:** *Schematic of temporomandibular joint.*

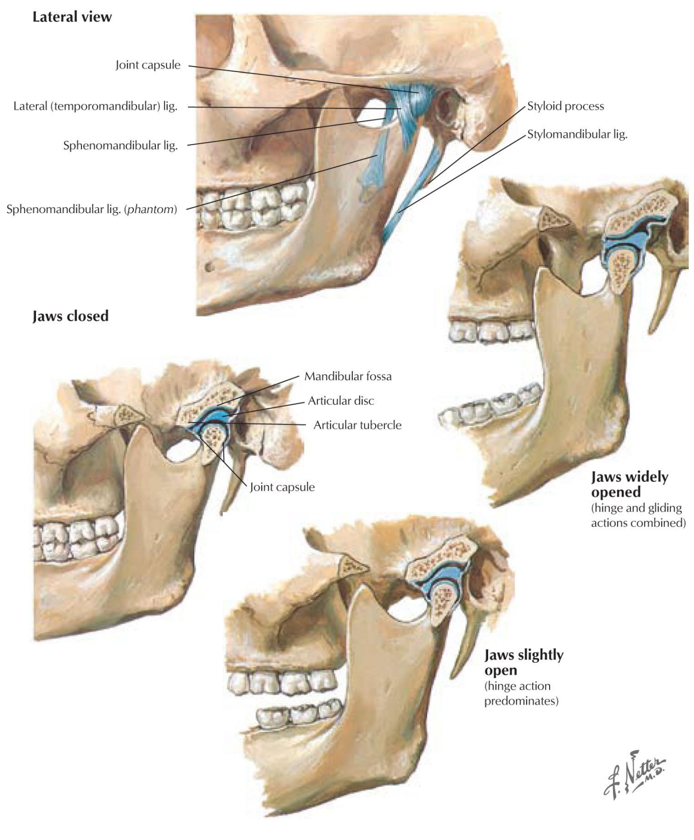
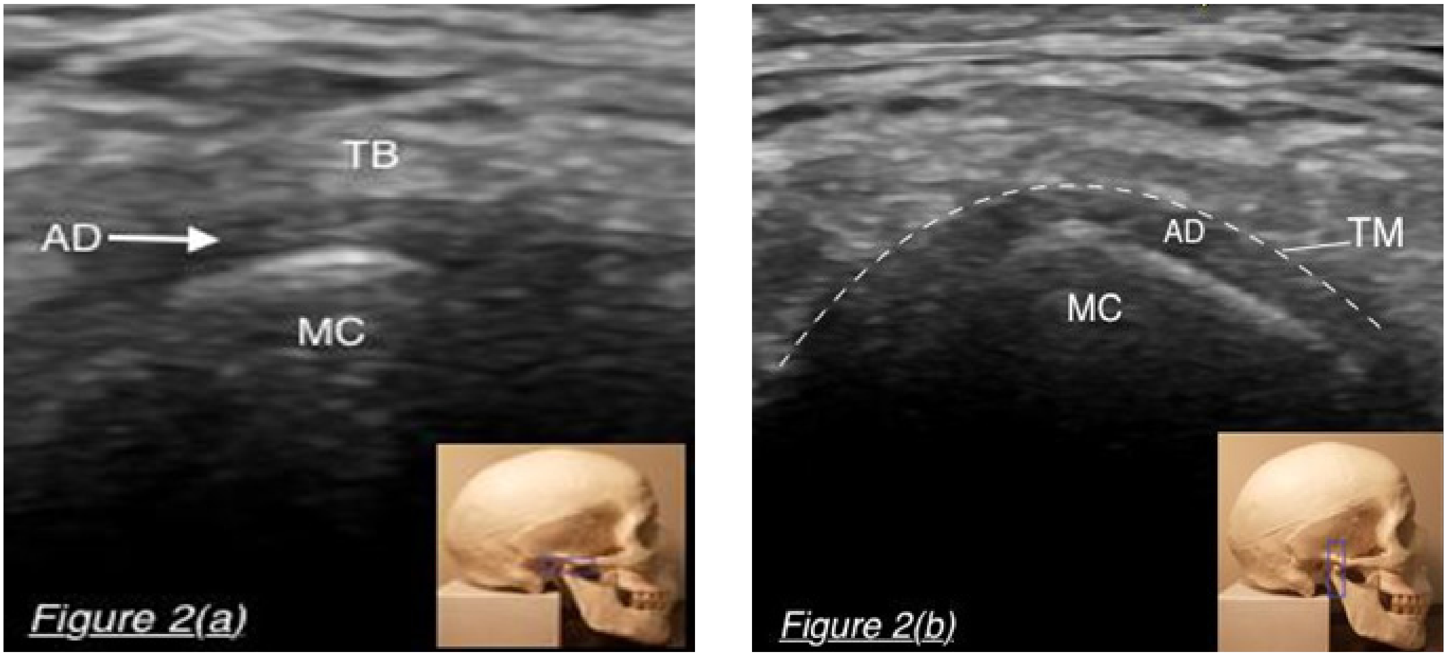


**Figure 2:** *Ultrasound image of temporomandibular joint.* **2A:** *Transverse section;* **2B:** *Longitudinal section; Inlays: guide for linear ultrasound probe placement for examination.*




AD, articular disc; MC, mandibular condyle; TB, temporal bone; TM, mandibular fossa of temporal bone

Computer tomography and magnetic resonance imaging can definitively diagnose many conditions affecting the TMJ. Examples include joint effusions, capsular disruptions, degenerative changes, and occlusal abnormalities.[4] Imaging studies can also detect the presence of other diagnoses that may mimic TMD, such as aural and dental inflammatory conditions, temporal arteritis, mandibular diseases, and muscular injury.

## PAIN MANAGEMENT

The clinical picture is not always straightforward. Given the intricate anatomy and range of function of the TMJ, and the fact that pathology of so many nearby structures may have a contributing etiology, determining the best approach to pain management is challenging. Pain specialists are being referred increasing numbers of patients with TMJ-related issues.

> *"Pain related to TMJ pathology may be difficult to manage appropriately. Many patients are eventually referred to chronic pain physicians, and our expertise here is crucial."*

The Research Diagnostic Criteria for Temporomandibular Disorders protocol presents a reliable diagnostic algorithm to which physicians should refer.[5,6] The classification subdivides etiologies into myogenic, arthrogenic, disc displacement, and cervical spine groups of disease. It incorporates pain screening tools, symptom questionnaires (useful for detailed history taking), diagnostic criteria checkpoints, and a behavioral checklist, which can help identify social stressors. It is a very useful tool for diagnosis and planning of treatment.

Noninvasive pain management modalities should be the first approach. Options include physical therapy, pharmacologica agents, and splints.[1] Modification of emotional stressors that may aggravate symptoms through nocturnal grinding is important and requires active patient participation. Patients may be referred  to mental health providers to assist with care. Physical therapy and transcutaneous electrical nerve stimulation may help improve the TMJ's range of motion.[1] Nonsteroidal anti-inflammatory drugs reduce inflammation and associated pain. Muscle relaxants can be beneficial for treating any spasmodic contribution to pain. Tricyclic antidepressants are useful for treating bruxism and sleeplessness related to symptoms. Occlusal splints stabilize the TMJ by repositioning the mandibular condyles into centric relation and facilitate relaxation of muscles in spasm.[7]

Surgical intervention may be necessary if conservative measures are inadequate. Arthrocentesis and drainage of debris and inflammatory collections are both diagnostic and therapeutic. Sodium hyaluronate and corticosteroid intra-articular injections may benefit patients with osteoarthritis in the joint (Figure 2). Injections of botulinum toxin A into surrounding musculature may help in relieving the pain of chewing. Additionally, arthroscopic surgery, arthrotomy, modified condylectomy, discectomy, or total joint replacement may be indicated.

Pain physicians should be familiar with all the diagnosis and management of TMD-related pain. Patients with TMD often seek medical care before presenting to a pain physician and may be frustrated with the challenges of diagnosis and symptom control. It is important that we elicit the pertinent history and physical examination findings to eliminate other differential diagnoses. We should be able to offer patients with TMD excellent care with a good understanding of the etiology and appropriate treatment for this group of diseases. It is our responsibility to coordinate a comprehensive treatment plan that often necessitates a multidisciplinary approach to manage this painful condition.

REFERENCES


1. Murphy M, MacBarb R, Wong M, Athanasiou, K. Temporomandibular disorders: a review of etiology, clinical management, and tissue engineering strategies. *Int J Oral Maxillofac Implants*. 2013;28(6):e393–e414. https://doi.org/10.11607/jomi.te20

2. Miloro M, Ghali GE, Larsen P, Waite P. *Peterson's Principles of Oral and Maxillofacial Surgery*. Hamilton, Ontario, Canada. C. Decker, Inc. 2004.

3. Rotter BE. Temporomandibular joint disorders. In: Flint PW, Haughey BH, Lund VJ, et al., eds. *Cummings Otolaryngology: Head and Neck Surgery*. 6th ed. Philadelphia, PA: Saunders Elsevier. 2015: 1345–1352.

4. Suenaga S, Nagayama K, Nagasawa T, Indo H, Majima H. The usefulness of diagnostic imaging for the assessment of pain symptoms in temporomandibular disorders. *Jpn Dent Sci Rev*. 2016;52(4):93–106. https://doi.org/10.1016/j.jdsr.2016.04.004

5. Schiffman E, Ohrbach R, Truelove E, et al. Diagnostic criteria for temporomandibular disorders (DC/TMD) for clinical and research applications: recommendations of the International RDC/TMD Consortium Network and Orofacial Pain Special Interest Group. *J Oral Facial Pain Headache*. 2014;28(1):6–27. https://doi.org/10.11607/jop.1151

6. Peck C, Goulet J, Lobbezoo F, et al. Expanding the taxonomy of the diagnostic criteria for temporomandibular disorders. *J Oral Rehabil*. 2014;41(1):2–23. https://doi.org/10.1111/joor.12132

7. Carlier JF. Usefulness of occlusal splints. *J Dentofacial Anom Orthod*. 2012;15:204. https://doi.org/10.1051/odfen/2012104

# Reusable Versus Disposable: Current State of Affairs

Alian Aquino, MD
Assistant Professor
Department of Anesthesiology
University of Wisconsin–Madison
Madison, Wisconsin

Living in a clean situation is essential to the health of all beings, and yet humans are the only species that chooses to destroy its environment. One major contributor is plastic, and therefore any proposed solution for environmental preservation must involve sustainable production, use, and disposal of plastics. Dramatic reductions in single-use disposable products, increased use of reusable products, improved retention and management of plastics for recycling and repurposing, and increased use of bio-based plastics are needed across all sectors of the economy. The health care sector is an enormous consumer of plastics and must begin to use sustainably produced products or demand them where they do not yet exist.

Plastics have unarguably revolutionized medical care. Unfortunately, the environmental destruction and public health effects of plastic waste are growing at an unprecedented rate. In an effort to minimize transmission of communicable diseases and increase workflow and cost efficiency, many hospital administrators have supported widespread adoption of single-use disposable plastic products. This wasteful strategy has little data to support its implementation, benefits a minority of patients, is tragically short sighted, and adds to the growing ecologic and humanitarian crisis of climate change. We must find a way to minimize transmission of disease, maximize fiscal and labor efficiency, and minimize environmental destruction. Finding a balance will be difficult, but they do not need to be mutually exclusive.

*"Every product contributes to resource depletion, and we must manage our resources wisely to benefit current and future generations."*

## BENEFITS OF REUSABLE PRODUCTS

A product's environmental impact is a calculation of the energy consumption associated with raw material acquisition, product production and transport, autoclave and other sterilization procedures, premature device loss, landfill use, and eutrophication. The results are then compared for various devices and many times reported in carbon dioxide equivalents to yield the carbon footprint for a particular product or process.

We can examine particular products that have single-use disposable and reusable varieties. Some examples include laryngeal mask airways (LMAs), laryngoscope blades, and surgical textiles. Reusable LMAs have fewer negative environmental effects in nearly all categories (ie, carcinogenesis, global warming potential, acidification, air pollutants, eutrophication, ecotoxicity, smog, water intake, ozone depletion), typically contributing less than 50% of the effects of disposable LMAs.[1] Reusable rigid laryngoscope handles and blades have a significantly lower environmental impact compared to single-use disposable alternatives.[2] Furthermore, disposable metal handles and blades are worse than their plastic counterparts, secondary to significantly higher greenhouse gas emissions associated with their production.[2] Reusable surgical textiles offer substantial sustainability benefits over the same disposable product in energy usage (200%–300% less), water usage (250%–330% less), carbon footprint (200%–300% less), volatile organic production from degradation, solid waste production (750% less), and improved instrument recovery.[3]

Typically, the environmental benefits of reusable products are a consequence of their intrinsic reusability and reduced energy expenditure associated with transportation. For regional anesthesia, neuraxial blockade, or perineural catheter insertion, reusable gowns and drapes can be used to create a sterile field while increasing the likelihood of reducing the environmental footprint of regional anesthesia. Every product contributes to resource depletion, and we must manage our resources wisely to benefit current and future generations.

## IS DISEASE TRANSMISSION A RISK?

Intuitively, preferential use of single-use disposable products should decrease the risk of transmission of communicable diseases and life-threatening pathogens. Indeed, they are a good solution for indwelling devices and to prevent transmission of highly virulent communicable diseases. For example, prion diseases are cited as a major infection concern thereby favoring single-use disposable products for those patients. Although use of single-use products in the setting of infectious disease processes may seem reasonable, a paucity of data supports those conclusions. Critics of reusable devices highlight the documentation of proteinaceous material remaining on reusable LMAs. In addition, iatrogenic transmission of Creutzfeldt-Jakob disease has been reported in more than 250 patients worldwide, with six cases attributed to contaminated neurosurgical equipment, but all were prior to current sterilization procedures and standards. Of note, no reported cases of iatrogenic infection of any type are linked to a reusable LMA.[1]

Reusable metal laryngoscope blades are associated with significantly higher success rates with rapid-sequence intubation compared to single-use plastic alternatives.[4] It logically follows that reusable metal blades may be associated with a decreased risk of pulmonary aspiration and iatrogenic infection by minimizing intubation attempts and the amount of time that a patient is anesthetized with an unprotected airway. With regard to surgical textiles, the Centers for Disease Control and Prevention and others concluded that no data suggest important differences in reusable versus disposable gowns and drapes in preventing surgical site infections. General lack of any bacterial contamination from permeation of a gown barrier reflects the similarity of reusable and disposable textiles in protecting health care workers and patients.[3] Clearly, disposable barrier devices may have a role for patients with highly infective or particularly virulent infectious agents. However, data do not support selecting disposables for all patients to prevent any possible risk of infection.[1]

## COST SAVINGS

No discussion of proposed sustainability initiatives is complete without addressing their financial implications. Certain products should be reused because of financial cost and technologic composition. Unfortunately, a minority of health care items are available as reusable products, and the number of disposable product options is growing rapidly. Cost analysis has been performed for single-use disposable and reusable varieties of LMAs, laryngoscopes, and surgical textiles. Eckelman and colleagues demonstrated, assuming full use, that a $200 reusable LMA costs $5 per use, plus $3 per cleaning for a unit cost of $8, excluding utility and hospital overhead costs, whereas the cost of disposable LMAs is 20% higher at $9.60 per unit.[1] A study at a single institution demonstrated that transitioning to use of disposable laryngoscope handles increased overall costs by $495,000–$604,000 per year relative to reusable handles, depending on the cleaning scenario. The same study found that single-use disposable blades increased costs by $180,000–$265,000 per year relative to reusable blades, depending on the cleaning scenario.[2]

Cost differences between reusables and disposable textiles may be overshadowed by personnel garment preferences. These preferences could explain the higher reusable use percentages in Europe (50%) versus the U.S. (10%), rather than any fundamental cost differences. Neither disposable nor reusable systems have eliminated the other product type. This suggests similar costs because significant cost differences would have driven the market to essentially zero for the expensive option.[3]

Collectively, we are at a pivotal point in history where we have an opportunity to make an incredibly positive impact on environmental health. To accomplish this, we can no longer consider environmental destruction an externality but rather an ever-present factor to consider when making purchasing decisions. Looking forward, we can strive for new biomedical ethics, by which we remain faithful to preserving patient care without compromising ecologic health. Adopting those ethics requires a profound reorganization of our professional priorities and our standards of daily practice.[5] The environmental and humanitarian crisis of climate change demands such a reorganization. With collaboration, awareness, and hard work, we can preserve patient care and improve ecologic health.

REFERENCES


1. Eckelman M, Mosher M, Gonzalez A, Sherman J. Comparative life cycle assessment of disposable and reusable laryngeal mask airways. *Anesth Analg*. 2012;114(5):1067–1072. https://doi.org/10.1213/ANE.0b013e31824f6959

2. Sherman JD, Raibley LA 4th, Eckelman MJ. Life cycle assessment and costing methods for device procurement: comparing reusable and single-use disposable laryngoscopes. *Anesth Analg*. 2018;127(2):434–443. https://doi.org/10.1213/ANE.0000000000002683

3. Overcash M. A comparison of reusable and disposable perioperative textiles: sustainability state-of-the-art 2012. *Anesth Analg*. 2012;114(5):1055–1066. https://doi.org/10.1213/ANE.0b013e31824d9cc3

4. Amour J, Le Manach YL, Borel M, et al. Comparison of single-use and reusable metal laryngoscope blades for orotracheal intubation during rapid sequence induction of anesthesia: a multicenter cluster randomized study. *Anesthesiology*. 2010;112(2):325–332. https://doi.org/10.1097/ALN.0b013e3181c92111

5. Ahuja NK. Health and high water. *N Engl J Med*. 2019;381:2196–2197. https://doi.org/10.1056/NEJMp1909480