

# ASRA NEWS

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

## FEBRUARY 2019

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

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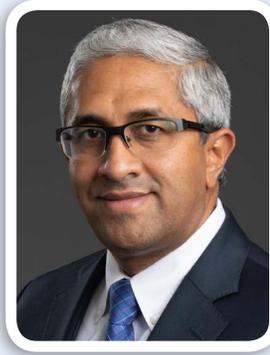
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# President's Message

## Looking Back and Looking Forward

As I write my last newsletter message as ASRA president, it is my turn to say “thank you” to each and every one of our members, all our volunteers in committees, and our board members who enable ASRA to be energetic. It has been a pleasure and joy to work with the wonderful ASRA staff. I am humbled, privileged, and honored to have served in this role and promote the mission of ASRA: advancing the science and practice of regional anesthesia and pain medicine to improve patient outcomes through research, education, and advocacy.



Asokumar Buvanendran, MD  
ASRA President

At the close of the 44th Annual Regional Anesthesiology and Acute Pain Medicine Meeting in April (#ASRAspring19), I will provide an update on the Society's state of affairs. I hope to see you there in person or it will be available as an online archive following the meeting.

We all should be very proud of ASRA's accomplishments during the past several years. We closed out 2018 with more than 5,330 members—a record for the history of our organization. Much of our success has been directly because of those members and their dedication to the organization, especially through their roles on committees and special interest groups. One of the goals has been to provide more opportunities for diverse new faces to participate, and we're happy to report that more than half the committee appointments went to new members this past cycle.

One example of our volunteer participation is the success and reach of the historic 2018 World Congress on Regional Anesthesia and Pain Medicine in April in New York City. This amazing event broke all attendance records with 2,750 attendees, the highest-ever number of abstracts, and truly accomplished our goals of inclusivity and international participation. For this event alone, ASRA assumed a leadership role and provided scholarships to reduce registration fees for participants from developing countries. It was a pleasure to work with Dr. Vincent Chan on this meeting, who again volunteered his time to serve as World Congress chair.

In the past 2 years, we also developed and expanded our education and CME offerings. We received recognition for our education with the prestigious Profile of Excellence Award from the American Association of Medical Society Executives for our innovative course, Introduction to Perioperative Point-of-Care Ultrasound (POCUS). The immense popularity of this course has prompted ASRA to increase this offering

**Figure 1:** *The World Congress on Regional Anesthesia and Pain Medicine is held every 4 years and brings together the five regional anesthesia and pain medicine societies. From left: Maria Minerva Calimag, MD, PhD, president, Asian and Oceanic Society of Regional Anesthesia and Pain Medicine; Maria Isabel Vasquez, MD, president, Latinoamerican Society of Regional Anaesthesia; Ezzat Aziz, MD, FRSA, president, African Society of Regional Anaesthesia; Jose De Andres, MD, PhD, FIPP, EDRA, president, European Society of Regional Anesthesia and Pain Therapy; Asokumar Buvanendran, MD, president, ASRA; and Vincent Chan, MD, FRCPC, FRCA, Planning Committee chair, 2018 World Congress on Regional Anesthesia and Pain Medicine.*



**“We provided resources, research funding, and education to more than 6,000 individuals in 2018 alone.”**

**Figure 2:** *ASRA's Practice Management Resource Center provides information on everything from coding and payments to adding value to your practice, with more resources being added regularly.*



Are you looking for resources to build a successful practice?

Do you need help making sense of regulations and administrative functions?

Do you want to spend more time helping your patients and less time filling out paperwork?

**ASRA's Practice Management Resource Center is here to help!**

[www.asra.com/resourcecenter](http://www.asra.com/resourcecenter)

**Figure 3:** *Regional Anesthesia and Pain Medicine* is now published monthly.



from twice in 2018 to three times in 2019. We also have invested in and implemented new educational formats and online activities.

ASRA continues to support our faculty by developing mentorship and training opportunities through our Faculty Development Committee. Those initiatives will further enhance our faculty in educational sessions and enable our researchers to grow as they communicate their findings and implications on practice.

ASRA is building the resources to support practice management as well. The Practice Management Committee has developed several resources housed on our Practice Management Resource Center, and in 2019, we offer online seminars in collaboration with Lake Forest Graduate School of Management of Negotiation, Human Resources, and Practice Finances. ASRA has responded to various issues from the Centers for Medicare and Medicaid Services, Centers for Disease Control and Prevention (CDC), Food and Drug Administration, and the Joint Commission, among others. We've had a year of collaboration with the American Society of Anesthesiologists on regional anesthesia and chronic pain portfolios.

The field of regional anesthesiology is recognizing ASRA more than ever. Another example of our increased reach and influence is that, in 2018, our *Regional Anesthesia and Pain Medicine* journal had the fifth highest impact factor among all anesthesiology journals. In 2019, all members will receive a monthly issue of this very prestigious journal as part of your benefits (Figure 3). The journal published new anticoagulation guidelines for both regional anesthesia and chronic pain, including updates of our popular ASRA Coags 2.0 app (Figure 4). We have continued our relationship with the European Society of Regional Anesthesia and Pain Therapy and are working with other international societies to broaden the reach of the journal. The Academy of Regional Anesthesia of India has subscribed its members to the journal, and several other Asian countries are considering this opportunity.

To support ongoing research in our field, ASRA has expanded its research program to include the Early-Stage Investigator Award

**Figure 4:** *ASRA Coags 2.0* combines the anticoagulation guidelines for acute pain and chronic pain into one app. It is available from iTunes and GooglePlay.



(up to \$30,000) and Graduate Student Award (up to \$10,000), both available annually. These join ASRA's Carl Koller Memorial Research Grant and Chronic Pain Medicine Grant, which are awarded biennially with grants up to \$200,000 each cycle.

We have also made great strides in the advocacy arena by participating in the American Medical Association annual meeting of the house of delegates as one of the newest members of the Specialty and Service Society as well as the Pain and Palliative Medicine Specialty Section Council. As part of this work, ASRA has supported a resolution on timely referral to pain management specialists to include interventional pain and a proposal advocating against misapplication of CDC's opioid guidelines by pharmacies.

In all, we provided resources, research funding, and education to more than 6,000 individuals in 2018 alone. I am sure that my successor, Dr. Eugene Viscusi, will have a very full agenda to continue to move the organization further. I am proud to have played the role I have, and I look forward to seeing the new heights ASRA will accomplish.

Thank you to everyone who has supported me in this key role and to all of the dedicated members of the Society. As I say my final thank you and goodbye, I look forward to a bright future for ASRA, and I hope each one of you will strive to be part of this great, vibrant society.

## Mentorship Matters

Again, I am amazed by the commitment and expertise of the ASRA members who have contributed material to this edition of the *ASRA News*. In particular, the attention given to issues of mentorship and the perspectives of both faculty and resident learners has really prompted me to consider the mentoring experiences I have encountered throughout my training and subsequent career.

I have been fortunate to have been mentored by a variety of individuals, and I can certainly attest to the benefits of mentorship from those with different perspectives in various aspects of my clinical and academic career. Many of my mentors' careers have focused on regional anesthesia and pain management. However, I have also experienced mentorship from nonphysicians; basic science researchers; cardiac, critical care, and generalist anesthesiologists; and physicians specializing in airway management. My mentors have demonstrated how to achieve success with clinical medicine, academics, and work-life balance as I moved through different phases of life. For me, mentors and my need for mentorship in any particular discipline have changed over time, and those changes have predictably been related to events in the workplace or on the home front. My mentors have graciously sacrificed their time, shared their experience, and been largely responsible for any of the successes that I have been fortunate enough to achieve.

As a faculty anesthesiologist, I have worked to pass on all of the tremendous mentoring and assistance that has been given to me. A common theme on normal workdays and while attending conferences is a desire to "take care of the littles." This definition of "littles" and what I can do to help has expanded over time. At one point, it meant trying to steer medical students toward a good lecture, help them with an abstract, or maybe just buy them lunch and discuss career options. This has now evolved into working with my fellows and junior faculty and hoping that they are now the ones mentoring the medical students. What I have attempted to create is an institutional legacy whereby subsequent generations

of faculty can accomplish far greater things than myself by not being forced to be the first one to navigate everything for the first time. Hopefully, these junior faculty and fellows can benefit from some of the experiences (both successes and colossal failures) that I have had over time. My mentor-mentee relationships have been incredibly rewarding, and I cherish the network of former medical students, residents, and fellows whose careers I now get to follow.

All of us in ASRA need to continuously seek out opportunities to become the best mentees and mentors that we can be. From the top to the bottom, we always have something to be learned, something that can be taught, and some person out there who we can help or who can help us. I encourage you to work to foster the

**“From the top to the bottom, we always have something to be learned, something that can be taught, and some person out there who we can help or who can help us.”**



Kristopher Schroeder, MD  
ASRA News Editor

mentorship process within your institution. Attempt to reenergize experienced faculty who may have disengaged for any number of reasons. Recognize and thank mentors who have helped you along the way. Help these leaders see that their mentorship has real and lasting value, and inspire them to take on new mentees. Encourage

your current or former mentees to develop relationships with new mentors or take on mentees of their own. Seek out mentors, and don't be bashful about reaching out to faculty outside of your institution. Finally, examine your own mentoring relationships, seek input from your mentees regarding what they need from the relationship, and think about what you can do to motivate and assist your mentees. Most of all: Have fun. These should be mutually beneficial relationships that can inspire creativity and link generations.

Happy mentoring!

# Learn from the Experts, Get Hands-On Practice, and Connect with Colleagues at ASRA's 2019 Spring Annual Meeting

**W**e are so excited for all of you to join us in Las Vegas, Nevada, at the Caesar's Palace Hotel this April 2019 for ASRA's 44th Annual Regional Anesthesiology and Acute Pain Medicine Meeting. Our team has worked tirelessly over the past 2 years to assemble, refine, and expand our program to ensure we are presenting the latest science and clinical skills that our members need for success in their practice. We've recruited world experts in our field to serve as faculty, designed workshops and interactive sessions that will engage attendees and maximize the learning experience, and built in social activities so everyone has fun at the same time.

When our planning committee was researching some of the most important topics affecting our practice today, the opioid epidemic quickly rose to the top of the list. Overuse and opioid-related deaths are complex and multifaceted problems, so we have invited U.S. Surgeon General Dr. Jerome Adams to present his valuable perspective and framing of this tremendous problem. But defining the problem only gets us halfway, so Drs. Christine Greco, Asokumar Buvanendran, and Chad Brummett will help us understand the role that acute pain physicians can play in bending the curve in the opioid epidemic, both with individual patients and within the larger medical care system.

Regional anesthesia and orthopedic surgery have been advancing in parallel for decades. The advantages that regional anesthesia provides orthopedic surgery patients in pain control, earlier mobility, and earlier discharge have been described for many years. Our planning committee felt that this was the perfect time to review the current state of this relationship. Where does regional anesthesia fit into same-day total joint arthroplasty? What are the current advancements in the field that will allow shoulder arthroplasties to be done in ambulatory surgery facilities? How do we improve outcomes in patients dealing with acute hip fractures? This conversation will include regional anesthesia experts from ASRA as well as experts from orthopedic surgery (American Association of Hip and Knee Surgeons as well as American Shoulder and Elbow Surgeons) to help us develop a full, 360-degree picture of how to care for these patients. ASRA feels that the best way to move forward in this fast-paced surgical arena is through excellent collaboration and communication with our surgical colleagues.

Quadratus lumborum, erector spinae, rhomboid intercostal and subserratus, infiltration between popliteal artery and capsule of knee, serratus anterior. Blocks for cardiac and thoracic surgery

without an epidural, blocks for patients where a transverse abdominis plane block isn't adequate, blocks that help patients mobilize earlier. Every day in our literature, new blocks are being described for a variety of purposes, each with their pros and cons. We have brought some of the original authors of these blocks to present the hands-on techniques, the science justifying the block, and new use cases for which we haven't had good regional anesthesia options in the past. But not everything new is great. We've challenged our faculty to question the latest and greatest. Are these blocks flights of fancy, or do they serve an actual purpose?

Big data and information overload surround us as modern clinicians. With help from the ASRA Education Special Interest Group, we've designed a session for those of us who don't



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ASRA 2019 Spring Annual Meeting  
Associate Professor  
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**“Understand the role that acute pain physicians can play in bending the curve in the opioid epidemic, both with individual patients and within the larger medical care system.”**

the power of these tools with real-time interactivity on Twitter and the ASRA meeting app during the actual session.

As regional anesthesiologists increase their expertise with ultrasound, the demand for new use cases for ultrasound skills is expanding. Point-of-care ultrasound (POCUS) will become an integral part of a modern-day anesthesiologist's practice in a very short time. It's likely that an ultrasound probe will hang around your neck instead of a stethoscope in a few years. We've created a program that everyone of any skill level can start getting a taste of POCUS at the Spring Meeting. Attend a lecture and see where the science lies. Sit down with Dr. Anahi Perlas or Dr. Jan Boublik to learn how to get started with POCUS for gastric or respiratory assessment during Thursday's problem-based learning discussion. Get started at the introductory workshop for basic POCUS or descend deeper into our more extensive hands-on workshop for

know how to handle all the articles, journals, commentary, and new information presented to us every day. Dr. Brian Sites will lead a session on how the modern learner can deal with the information firehose by leveraging social media, e-learning, and crowdsourcing the best content. We'll demonstrate



everything POCUS—short of an echo. POCUS is part of our future, and we want to make sure the ASRA community has every reason to dive right in.

This is just a sample of the meeting. We discuss the transition from acute to chronic pain, nonopioid therapies for pain control, cannabinoids in modern acute pain management, simulation sessions for critical events, pediatric regional anesthesia, updates on obstetric regional anesthesia, controversies in regional anesthesia, perspectives from international physicians, and much more. We have a new format for the Ask the Experts interactive sessions that will truly emphasize the interactive portion of these talks. We have

more opportunities for poster presenters to engage with our faculty and the attendees of the meeting. We'll have a brand-new type of workshop where you have access to a model and an expert faculty with no agenda—you can explore the topic you want to explore and do deep inquiry into a block that you may have struggled with. To top it off, you can join us for fantastic social events throughout the meeting, in the exhibit hall, at prearranged small group dinners, and the blow-out bash at the Omnia on the final night. Go to [asra.com](http://asra.com) to see the entire lineup of faculty and sessions.

Join us for the best ASRA meeting we've ever had. See you in Las Vegas!

# Mentorship in Regional Anesthesia and Pain Medicine: A Perspective From Trainees and Their Trainers

**M**entorship is widely regarded as a necessity in medical training. The literature suggests that trainees with a mentor gain assistance on career choice, professional development, and productivity, but current literature does not provide guidance on qualities of effective mentorship.<sup>1</sup> A survey of Canadian anesthesiology residency programs revealed that 94% of residents feel that mentorship is important during training and 54% of residency training programs have formal mentorship programs. However, of the 74% of residents who identified having at least one mentor, 42% did not interact regularly with that mentor.<sup>2</sup>

In formal mentorship programs, a new resident is assigned a faculty mentor; in less formal processes, residents seek out faculty with similar research or clinical interests. Although a formally assigned mentor can be helpful, especially when initiating training at a new hospital, many people feel that the most meaningful mentorship comes from working with a senior physician who has shared interests or background. This helps promote effective communication and increases the likelihood of spending significant and meaningful time together. The best mentors are energized and excited about their own work and accomplished in their own careers.

In addition, residents may seek out different mentors for different aspects of training: research, career development, clinical practice, and personal wellness. Although some mentor-mentee relationships work best if strictly defined, others may evolve loosely and change over time based on the needs of the mentee or mentor.

## PERSPECTIVES FROM MENTORS

We interviewed three attending anesthesiologists about their experiences as mentors and mentees to learn from their perspectives.

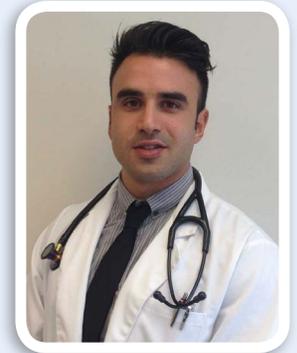
Dr. Tim Lamer, American Academy of Pain Medicine president-elect and Mayo Clinic Department of Pain Medicine consultant, stated, "When I was beginning my pain medicine career, it was a relatively new specialty. It was absolutely essential, and I was very fortunate to have excellent colleagues and mentors to really help get me started both academically and clinically. The value of those



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Thomas Zouki, MD  
CA3 Resident  
Advocate Masonic Medical Center  
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**“The most successful protégés are not content with one sponsor. Throughout their careers, they scan the horizon for leaders who either embody their values or value their strengths.”**

individuals to me emphasized the critical importance of role models and mentors and inspired me to give back by striving to be a good teacher, mentor, and role model as well. And, as it turns out, I have benefited more than my trainees and mentees over the years. Teaching, advising, and mentoring students and trainees has been one of the most rewarding components of my career. It is extremely gratifying to watch young physicians learn, grow, gain confidence, and ultimately become successful physicians and individuals. And it is both an honor and very humbling, year after year, to have the privilege of working with and learning from the bright, talented

students and trainees that come through our program. I know I have learned more from them than I have been able to give back to them.”

When asked about the benefits of mentorship, Dr. Rebecca Johnson, consultant in the Department of

Anesthesiology at Mayo Clinic, said, “Based on the literature, physicians with strong mentors are more productive, publish more articles, have more confidence in their abilities among their peers, and report greater perceived success and career satisfaction than those physicians without mentors. Strong mentoring relationships have been of benefit to me not only leading me to subspecialty selection in regional anesthesia but also providing me with various scholarly opportunities. I would cite lack of mentorship as a reason that, for some, career progression may be hindered. Good mentorship is difficult to find, and mentees can and likely need more than one mentor. Specific mentorship in different focus areas (eg, research, education, clinical practice) from multiple sources provides a mentee with more than one point of view and does not indicate failure on the part of the primary mentor.”

Finally, Dr. Susan Moeschler, consultant and fellowship director in the Mayo Clinic Department of Pain Medicine, described mentorship as “important for guidance, feedback, and a perspective from experience to foresee opportunities and challenges ahead. As a mentor, it is crucial to help guide mentees to the right track that will work for them to pursue their areas of interest and not just your areas of interest. There should be a mutual agreement on meeting frequency or expectations for joint publications. The relationship can be a loose process, as well, depending on the needs of both parties and if for only a one-time, brief exchange.”

#### HOW TO MAINTAIN A MENTOR-MENTEE RELATIONSHIP

Obtaining a mentor is just the beginning. The relationship must be consistently nurtured and periodically refreshed—tasks that largely fall to the junior player. Successful protégés understand that sustaining sponsorship looks a lot like earning it, and they find ways to support a mentor’s passion or help build his or her legacy outside of the organization. The most successful protégés are not content with one sponsor. Throughout their careers, they scan the horizon for leaders who either embody their values or value their strengths.<sup>3</sup> There should also be mutual respect and clear expectations from both parties.

#### PERSPECTIVES FROM MENTEES

Personally, each one of us has had tremendous experiences in our lives with mentorship.

Dr. E. Morgan Pollard shared: “I have been lucky to develop some wonderful mentor-mentee relationships during my residency. The key for me has been to find attending physicians who have shared interests, both professionally and personally. Working with a wide variety of consultants has given me the opportunity to find mentors I click with. In my experience, sharing commonalities makes forming a mentor-mentee relationship more of a natural occurrence than setting up formal mentorship programs and assigning mentors and mentees. I have found it especially helpful to identify mentors who teach to my learning style. I have gravitated toward mentors in pain and regional who go over regional anatomy on three-dimensional models, textbooks, radiologic imaging, and even mobile apps prior to performing the block together. I also find the most helpful feedback to be given with the help of a similar visual aid. Conversely, when the feedback is entirely verbal, I often have a more difficult time understanding how to improve. In both regional anesthesia and pain medicine, hand-eye coordination is an important skill to acquire. I’ve found that both the teaching and my previous feedback strategies have best helped me improve my hand-eye coordination, but all residents learn differently: It is important to be taught by a wide variety of attending physicians to help identify personal learning strategies as well as the mentors themselves.”

Dr. Thomas Zouki says, “For me, mentorship has been at the foundation of my success and progression in the medical field.

Medical school was a very intimidating environment. Everyone around me appeared so brilliant and polished, and I found myself plagued with self-doubt. Fortunately, I found a mentor in Dr. Iliou, who was my anatomy and pharmacology teacher. Dr. Iliou constantly encouraged me and reassured me. His positive reinforcement, along with excellent teaching and guidance, gave me a lot of confidence and motivation to maintain the hard work. Dr. Iliou was a retired anesthesiologist and pain physician. The countless anecdotes and incidents related to the field he discussed with me helped develop my interests for anesthesiology and pain medicine. Dr. Iliou was visibly passionate about the field of medicine: He taught the daily subject with enthusiasm and was very interested in students who were also passionate about the subjects, especially students who were engaged in class and inquisitive. He showed mentorship by closely following up with me, encouraging me by acknowledging my efforts, and challenging me to advance further. Good qualities of my other mentors have been those showing compassion, honesty, and willingness to give constructive feedback. As a mentee, I must also be willing to be open to constructive criticism for personal development.

“I believe that for mentorship to be successful, the mentor and the mentee must connect on a personal level. The mentor must see qualities as well as flaws in the mentee appropriate to his or her training level. A mentor needs to be personally connected, as well as emotionally engaged in the mentee’s success. I believe that failed mentorship comes from a forced mentor-mentee association in two individuals who do not share a common goal, which can ultimately lead to a lack of interest in mentorship from both parties.”

Poonam Pai, BH, MBBS, MS, added: “My chair has had a huge influence on me professionally as well as personally since the beginning of my residency. She helped me improve on my weaknesses while endorsing my strengths. She has been pivotal in matching my skill set with the opportunities available and promoting them. I am very grateful and humbled. Being an expert in the field of regional anesthesia, she made learning the basic anatomy and mastering the hand-eye coordination look so easy that I was instantly attracted to the subspecialty. I remember reading a picture on the cover page of a reputable journal as an intern which quoted, ‘Is the needle mightier than the blade?’ I understood the real meaning behind those powerful words only after my regional anesthesia rotation, and I subsequently considered regional anesthesia as a subspecialty of my interest. My mentor would go over how to arrive at the ideal anatomic ultrasound image by sequential stepwise scanning methods either in the operating room or during resident workshops held during didactic teaching sessions. She reinforced the important points, for example, needle visualization before advancement, by constantly saying, “Show me the needle,” and her words are engraved in my mind even now when I’m performing the block in her absence. If approached with

queries about techniques, she never hesitated to teach by scanning herself or showing me the video with the original description, not to mention instantly emailing me the journal article for further reading. Our discussions usually ended with updates from the literature which reiterated the importance of research and evidence-based medicine. I am now very excited about my career in regional anesthesia and the endless opportunities that come with it.”

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# Peaceful Faculty, Happy Fellows: The Journey Alongside Your Post-Post-Postgraduate Learner

Communicating with my fellows is akin to interacting with my children. The passion to see them succeed in our field and the expectation for their clinical and academic progress are no less vigorous. In addition, the methods I use to engage our fellows are eerily similar to how I engage my kids.

What follows is what I've learned on this journey through chartered, but mainly undisclosed, territory.

**1. Preemptive discussions, like all things in life, are better than reactionary responses.** Preemptive discussions represent mental preparation for things to come, an exchange of each party's objectives and a written or spoken timeline of events. I usually disclose to the fellows that, as postgraduate learners, they get out of the fellowship what they put in to it. They need to be the ones seeking the opportunities. (Alternatively, they also need to know when their plates are full.) A little bit of coaching before game day can smooth out the path ahead. Therefore, expectations from both sides are clearly laid out.

**2. Faculty have a multitude of ways to distribute information to the learner, and diffusion or osmosis are definitely not among them. Think of it more as active transport.** One of my truly engaging and exuberant faculty members, bless his heart, would at frequent intervals during the fellowship, corner a fellow for multiple hours in an effort to inundate him or her with information. Later, when I queried the fellow on some details of that topic, the fellow would not be able to recall. Meanwhile, the faculty could have sworn that he had touched on every single point.

As with the five languages of love, people have multiple learning styles. Some fellows need the topics to be in the form of a question and to be sent on the hunt (with lots of hints dropped along the way) for a response. Some fellows are visual learners, audio learners, or both. Some fellows are hands-on learners, cognitive learners, or both. Some fellows take your word for it, and some argue (hopefully tactfully) at each step of the way and need proof.

The best strategy is to present the information multiple times using different modalities, substantiating the topic repetitively and differently each time, until they successfully receive it. Learning trajectories are different for all. Embrace and build on their strengths. Be patient with their weaknesses.

**3. They can't read your mind.** You need to be concrete! And if they do not understand what you are saying, you need to be well versed in describing the topic in a different way. Leaving things vague and open-ended will only result in miscommunication and the potential for clinical or technical errors down the road.

**4. Selective hearing is a universal trait.** It does not matter whether I put things in writing, discuss them orally during our monthly discussions, or send more than one e-mail about topics. Please refer back to point #2: repetition using multiple different modalities to express the same concept or thought. If group e-mails do not work, I make sure that I e-mail directly to the individual. Persistence is key.



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**“As with the five languages of love, people have multiple learning styles. The best strategy is to present the information multiple times using different modalities, substantiating the topic repetitively and differently each time, until they successfully receive it.”**

**5. They need to have skin in the game.** “Everyone gets a sip of the honey from the honey pot.” Their success stories and mistakes must be meaningful, not just to patients or faculty, but to the fellows as well.

For example, in clinical practice, they should be asked to routinely check up on patients for whom they have cared. Getting feedback from patients and learning the results of their management are critical for their own professional growth. Therefore, rounding on patients is extremely important.

Another example from administration is to invite them to division meetings to contribute to decision-making conversations. In the least, they will better understand the concerns and issues that arise with each change in protocol.

**6. See one, do one, teach one.** They need to realize that they've transitioned from trainee to trainer. They are no longer just there to receive information, but they also have the dual role of distributing that information. This is actually a hard transition to make because

most fellows feel that because they are taking the extra year to learn more about their subspecialty, they want to be the ones performing procedures and receiving instruction directly from the faculty, not teaching a resident. I think it is extremely important for fellows to teach topics and procedures to residents. This encourages them to delve deeper into the subject, find ways to express the information clearly, and recognize their own knowledge deficits.

I used to have faculty solely present at our monthly meetings, feeling that the fellows had so little experience to draw on to give meaningful talks. Sadly, unless we had a very motivated group of fellows, their attendance was dismal. Currently, for our monthly educational rounds, I preserve some time for fellows to present current literature. This gives them opportunity to take on roles as educators and distribute knowledge to their faculty and fellow colleagues.

**7. You don't need to be a micromanager, but you should probably scrub in. Be a role model, not just a coach.** It helps that as a faculty, you work beside them instead of delegating and simply providing guidance. Letting them observe your technical skills or hear your thought processes can be enlightening for them (hopefully in a good way).

For example, it could be something clinical, like improving in-plane needle visualization, acquiring optimal ultrasound images, or demonstrating the best way to advance a needle for a neuraxial block. They may have a somewhat reasonably precise way to guide the needle or hold a probe, but a step-by-step breakdown of the needle or probe manipulation with demonstration can give them more alternative maneuvers. Let's face it: Sometimes, particular motions cannot be explained by words but are easier to demonstrate by action.

Or it could be something academic, such as writing a manuscript. Having them participate in the literature review, outline the goals and objectives, or write part of the passage with you could be much more beneficial to fellows' education than merely delegating the work to them while giving some words of guidance. Preparing a manuscript with a fellow certainly may require significantly more time than would be required to simply do it yourself. However, going through this exercise with the fellow will likely result in a much more positive and beneficial experience for that individual.

Finally, it may be something professional, such as being available on call or in person to handle challenging scenarios as they arise.

Seeing experienced faculty run through their decision tree and act on those decisions provides fellows with not just insight into how to proceed but also a peace of mind that the course of action taken was drawn from a greater breadth of experience.

**8. Positive feedback is a more powerful motivator than negative feedback.** Positive feedback ensures your fellow's mental well-being. It breaks the barriers to communication by allowing fellows to be freer with their ideas and musings, minimizing those unspoken thoughts or erroneous assumptions. It gives them more incentive to come back each day with joy and a desire to learn. It helps fellows focus on the important issues: ensuring their patients' comfort and furthering their education instead of diverting their mental energy to the emotional stress that comes with negative feedback.

However, receiving only positive feedback can lose its efficacy. Negative feedback should be delivered when the situation arises, but its delivery can be done tactfully and offer examples for improvement. Failed blocks or analgesic modalities should be discussed, and a debriefing period allows for self-reflection and personal growth.

**9. When faculty-fellow interactions become destructive instead of constructive, focus on goals instead of relationships.** Perhaps the most challenging topic is the occasional negative interaction between particular fellows and faculty that usually snowballs as the year progresses. I am still searching for an answer for this. Sometimes, different styles of interaction just do not fit well with each other, and asking faculty or fellows to modify their character traits to be receptive to the other party is like putting a Band-Aid on a gaping wound. Because I am not known to be a very confrontational person by nature, my response is to re-emphasize fellows' goals for their year to redouble their efforts toward patient care and their education, reminding them that one negative relationship should not dictate the entire year. However, I am amenable to suggestions on this topic. (E-mail me at [lle@anest.ufl.edu](mailto:lle@anest.ufl.edu))

## FINAL WORDS

**Every fellow class has a certain character, a particular footprint they leave behind,** and just as each fellow class is shaped by our teachings, so are we, as faculty, molded by their personalities and quirks. This unique feel from each fellow class is what keeps my job as fellowship director so fresh each year.

# PRO Regional Anesthesia Outside the Operating Room: Regional Anesthesia and Pain Medicine Specialists Should Help Train Non-Anesthesia Specialists to Perform Peripheral Nerve Blocks

Improved patient outcome benefits related to the provision of regional anesthesia in the perioperative setting have been well documented, including superior analgesia and reduced systemic analgesic use, hospital length of stay, and cardiopulmonary complications.<sup>1,2</sup> As a result, regional anesthesia techniques are becoming more common, and novel blocks and approaches are being regularly described. Mounting literature suggests the benefits of such techniques can improve patient care in a variety of scenarios outside of the operating room, most notably in acute care settings such as emergency medicine and critical care.<sup>3,4</sup> To improve patient access to the techniques while optimizing efficacy and safety, regional anesthesia specialists should help train non-anesthesia physicians to perform peripheral nerve blocks.

Trauma patients in the emergency department, especially those with hip fractures, represent the most studied population receiving peripheral nerve blocks outside of the operating room. Many are older than 65 years with multiple comorbidities and likely recognize the greatest benefit from early institution of a peripheral nerve block. They are frequently undertreated for pain because of concerns about hemodynamic instability, respiratory depression, and delirium, yet poorly managed pain can lead to similar consequences.<sup>5,6</sup>

The fascia iliaca compartment block, femoral nerve block, and three-in-one femoral nerve block have all been studied for hip fracture pain in the emergency department.<sup>7-9</sup> Results from a systematic review by Ritcey and colleagues<sup>10</sup> showed that patients with hip fractures who were treated in the emergency department with a peripheral nerve block reported equal or superior benefit in pain relief when compared to those receiving standard systemic analgesics. In addition, patients receiving a block required significantly fewer systemic opioids without experiencing an increase in complications related to the peripheral nerve block.<sup>10</sup> Another systematic review by Abou-Setta et al showed that hip fracture patients receiving nerve blockade pre- or intraoperatively had a significantly reduced risk of developing delirium.<sup>11</sup>

Peripheral nerve blocks for trauma beyond the operative setting are already included in national and local management guidelines in North America and Europe.<sup>12-14</sup> The American Academy of Orthopedic Surgeons strongly supports the use of regional anesthesia to improve preoperative pain control in hip fracture management.<sup>12</sup> National Institute for Health and Care Excellence (NICE) guidelines in the United Kingdom and provincial guidelines in



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**“This provides an extraordinary opportunity for regional anesthesia specialists to share their knowledge and expertise with other specialists to improve access and provide ongoing quality patient care.”**

Canada for hip fracture management both include peripheral nerve blockade in multimodal analgesia strategies.<sup>13-14</sup>

With approximately 500,000 hip fractures occurring annually in the United States alone that may benefit from the early provision of a nerve block, practitioners involved with patients' initial management should be trained in safe and effective

administration of those blocks. Unfortunately, many emergency medicine departments lack experience and credentialing pathways for regional anesthesia.<sup>15</sup> Anesthesiologists trained in regional anesthesia may not be available at all hours to provide such procedures upon patient presentation. This provides

an extraordinary opportunity for regional anesthesia specialists to share their knowledge and expertise with other specialists to improve access and provide ongoing quality patient care.

The key to success is to have clear training and credential pathways, perhaps for selective nerve blocks, before non-

anesthesiologists start performing regional anesthesia on patients. Proper training takes time and effort from both teachers and learners because it involves not only performing the nerve block itself but rather the whole package of dose selection, complications and their management, and patient selection. Who better than anesthesiologists who specialize in regional anesthesia to teach something about which they are passionate and proficient? The programs should also be evaluated to ensure effectiveness of the training, as well as quality and safety of care delivered.

Because of the obvious benefit to patient care and the already increasing use of peripheral nerve blocks outside of the operating room, anesthesiologists must help train other specialists rather than non-anesthesiologists finding their own way to acquire the skills. Only through advocacy for patient quality and collaboration can anesthesiologists continue to be recognized as experts beyond the operating room.

*“Knowledge alone is not power. The sharing of our knowledge is when knowledge becomes powerful.”*

– Rich Simmonds

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# CON Regional Anesthesia Outside the Operating Room: Regional Anesthesia and Pain Medicine Specialists Should Not Help Train Non-Anesthesia Specialists to Perform Peripheral Nerve Blocks

The provision of regional anesthesia by non-anesthesiologists has been the subject of growing discussion.<sup>1</sup> Emergency medicine (EM) and intensive care unit physicians are well positioned to learn ultrasound-guided procedural skills because of their regular use of ultrasound for focused assessment of trauma, vascular access, and cardiac evaluation. However, we are still determining the best way to teach and assess competence in regional anesthesia.<sup>2</sup> Therefore, it would not be reasonable to expect another specialty to be experts in these areas and be prepared to evaluate and ensure competency. Accordingly, for the benefit of our patients, we have a duty to share our knowledge of technical skills, but we must also expound the need for education regarding local anesthetic pharmacology, complications, and postoperative monitoring.

We now recognize that performing a minimum number of blocks does not make one competent. The Halsteadian apprenticeship model of “see one, do one, teach one” is no longer reasonable. As Dr. Joseph Neal has pointed out,<sup>3</sup> technical attainment does not imply comprehension regarding possible complications and their prevention or clinical acumen regarding which patients should not have a block. Technical performance is only one measure of competence. A survey of 171 US academic EM programs examining how ultrasound-guided nerve blocks were taught revealed that of the 121 participating institutions, 84% perform UGRA, but only 7% have a credentialing pathway.<sup>4</sup> No programs have a quality assurance initiative, but 16% periodically assess physicians for competency in UGRA. It is unknown whether a valid and reliable regional anesthesia assessment tool is used by these institutions to gauge competency.

Regional anesthesia involves more than guiding a needle to a target. Nontechnical skills such as communication, situational awareness, teamwork, planning, resource management, and decision-making have a considerable role in performance and, therefore, patient safety.<sup>5</sup> The level of mastery of a skill is measured on a spectrum ranging from competent to expert, which is the mastery with extensive knowledge of the whole skill domain, including nontechnical skills. Becoming an expert does not happen overnight; it comes with years of training, practice, and study of the literature for current evidence. The drive to become an expert is to provide the best quality care to our patients.

Collaboration between anesthesiologists and EM physicians has been shown to be successful in teaching femoral nerve blocks for patients presenting with hip fractures.<sup>6</sup> In that study,



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**“We are still determining the best way to teach and assess competence in regional anesthesia. Therefore, it would not be reasonable to expect another specialty to be experts in these areas.”**

every aspect of performance of the nerve block was designed in conjunction with an anesthesiologist with expertise in regional anesthesia. In other centers, non-anesthesiologists may not be cognizant of the importance of sterility, monitoring, sedation, local anesthetic dose and factors that affect it, procedure documentation, symptoms of toxicity, or the treatment of local anesthetic systemic toxicity (LAST). For example, the importance

of post-block monitoring was reaffirmed following an emergency department fatality following a fascia iliaca block.<sup>7</sup> Review of the case revealed insufficient documentation of the procedure as well as poor or lacking post-procedure observations. Specifically, the researchers concluded that opioids administered

prior to the fascia iliaca block contributed to post-procedure apnea and, secondarily, cardiac arrest. The monitoring standards we observe and practice while performing regional anesthesia may not be as recognized or appreciated by non-anesthesiologists with limited training in regional anesthesia. Anesthesiologists are also better prepared and skilled to manage immediate complications following regional anesthesia such as LAST or oversedation. Anesthesiologists are pioneers in patient safety and must continue to advocate for the safe practice of regional anesthesia by non-anesthesiologists.

Anesthesiology residents are required to perform a minimal number of blocks during training, but many anesthesiologists do not continue to practice regional anesthesia after residency because of inadequate experience.<sup>8</sup> Barrington et al<sup>9</sup> found that

10 hands-on training sessions, with accompanying didactic preparation and deliberate feedback from experts, were required to achieve proficiency in simply obtaining sonograms and identifying anatomical structures. Perhaps that training enables the anesthesiologist to be more aware of the other components essential to performing a nerve block. Yet, non-anesthesiologists with no formal training are taking up ultrasound. We would caution any health care provider, including anesthesiologists, before performing an unsupervised nerve block after only a single teaching session.

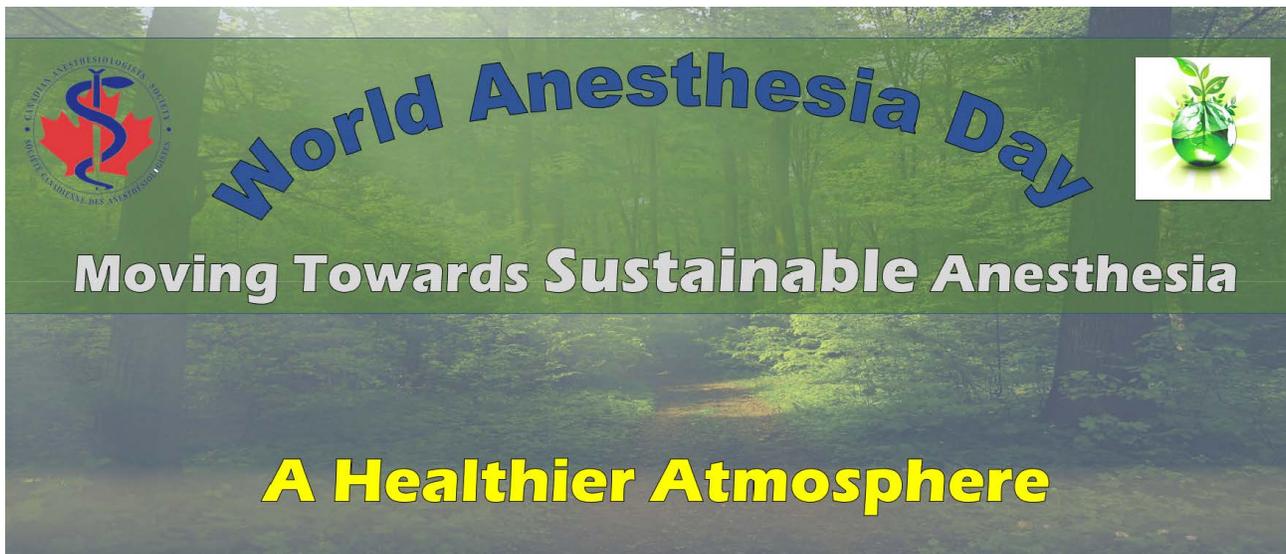
Finally, little data are available regarding the incidence of complications by non-anesthesiologists. Even experts encounter complications, and thus it is important for each department to institute quality assurance programs to maintain or improve practice. It is routine practice for regional anesthesiologists to follow up their patients and document complications or side effects. Who takes responsibility for the patient with postoperative neuropathy who received a preoperative block in the emergency department, followed by an intraoperative block by the anesthesiologist, who then had traction and over-rotation of their leg to repair a hip fracture? Anesthesiologists working in institutions where blocks are performed by non-anesthesiologists should actively look for documentation of a block to avoid repeating a block leading to LAST and consider if repeating a block is worth the risk of neuropathy, even after 24 hours.

Collaboration offers vast opportunity for learning, and we should not be resistant to overlapping skillsets; that said, expert training and patient safety should always take precedence over the yearning for medical professionals to venture outside their current scope of

practice. Practitioners of regional anesthesia should (1) develop or follow protocols to prevent complication (eg, ASRA's preblock checklist), (2) institute quality assurance programs to review complications and ensure practice improvement, and (3) develop training programs in conjunction with expert providers of regional anesthesia.

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**W**orld Anesthesia Day is recognized annually on October 16 and marks a significant day for acknowledging and celebrating the discoveries and advancements made in the international practice of anesthesia. This is a day to commemorate the birth of our specialty and to honor not only those who have come before but also those who represent the present and future of our specialty.

As anesthesiologists, we have made significant advancements in clinical care that have resulted in tremendous benefits for our patients. However, our practice also represents a significant contributor to the production of greenhouse gas via the administration of volatile anesthetic agents. As shown in Table 1, different volatile agents have different global warming potential, with sevoflurane being the least harmful to the environment and desflurane being the most potent greenhouse gas.<sup>1-3</sup> Nitrous oxide, in addition to acting as a greenhouse gas, also possesses ozone-depleting potential.<sup>4,5</sup>

The volatile agent repertoire has seen no advancements since the 1990s when sevoflurane was introduced. This may be secondary to a lack of health care-related carbon footprint regulation and therefore a lack of interest to explore other newer, inert gases with no global warming potential (eg, xenon).<sup>6</sup> Furthermore, our soil and water are being polluted by solid and liquid waste production in the operating room that results from abundant single-use product packaging and drug disposal.



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**Table 1:** GWP<sub>20</sub> and equivalent of distance for driving a car for selected anesthetic volatile agents or gas.

Agent	GWP <sub>20</sub> <sup>a</sup>	Km per OR-Day <sup>b</sup>
Sevoflurane	795	145
Isoflurane	1,800	181
Desflurane	5,550	2,554
Nitrous oxide	264	350

<sup>a</sup> GWP<sub>20</sub> = global warming potential over 20 years.

<sup>b</sup> OR-Day = 7-hour workday in the operating room using 0.5 liters/minute of fresh-gas flow.

The World Health Organization described climate change as one of the biggest threats to human health in the 21st century.<sup>7</sup> As physicians whose primary goal is to save humanity and do no harm, we must pay more attention and act to reduce the amount of carbon dioxide (CO<sub>2</sub>) we produce.

This year, we celebrated World Anesthesia Day in style in Edmonton, Canada. In partnership with the Edmonton-based Canadian Anesthesia Society Environmental Sustainability Section, we invited anesthesiologists in Edmonton to sponsor reforestation efforts in Fort McMurray, Alberta. This act served to partially offset the carbon footprint related to the provision of anesthesia and to rebuild the environment of Fort McMurray where a huge forest fire devastated the community in 2016. The forest fire was the result of unseasonable and extreme heat and wind, which many speculate was caused by climate change. A registered company (A Living Tribute) managed the reforestation effort by using the gathered funds from our event to plant native tree species in dedicated coves (groups of trees). Satellite imaging will allow for sponsors to track the progression of the coves over time. Each tree has a 22 kg (48 lb) carbon offset per year, and our event sponsored the planting of 256 trees.

In 2017, our Edmonton anesthesiology practice purchased 1,211,250 mL of sevoflurane, 593,280 mL of desflurane, and 54,600 mL of isoflurane. This is the equivalent of 6,430,365 kg of CO<sub>2</sub> resulting from volatile anesthetic agent administration—before considering the impact from nitrous oxide. Although many more trees are required to totally offset our carbon footprint, do not despair: There is hope! Through education, Edmonton is moving away from the use of desflurane and increasing the use of regional anesthesia in our practice, which has already decreased our CO<sub>2</sub> emissions by two tons from 2016.

On World Anesthesia Day, we also launched an awareness campaign where we set up an exhibit at the University of Alberta Hospital to inform the public about our initiative (see Figure 1). We educated the public on the impact of anesthesia on the environment and ways to decrease our carbon footprint, such as **reducing** our use of desflurane and employing more regional anesthesia techniques where appropriate, **recycling** our plastic waste, segregating solid waste and separating sharps-only waste from glass ampule waste, and **reusing** our equipment as much as possible rather than using disposable equipment. People from all walks of life visited the

**Figure 1:** Exhibit for the Sustainable Anesthesia Awareness Campaign From left to right: Dr. Cheryl Mack (anesthesiologist at the Stollery Children’s Hospital), Dr. Vivian Ip, Dr. Timur Ozsel (both are anesthesiologists at the University of Alberta Hospital), and Justine Klaverkibria (epidemiologist with special interests in climate change).



exhibit, including a 10-year-old girl who told us she would request environmentally sustainable anesthesia when she needed surgery.

Our innovative initiative with planting trees for Fort McMurray and awareness campaign will not offset our practice; however, as a specialty, we can make a public statement: “Primum non nocere”—first do no harm. We are health care providers, and we care for humanity.

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**“In 2017, our Edmonton anesthesiology practice purchased 1,211,250 mL of sevoflurane, 593,280 mL of desflurane, and 54,600 mL of isoflurane. This is the equivalent of 6,430,365 kg of CO<sub>2</sub> resulting from volatile anesthetic agent administration—before considering the impact from nitrous oxide.”**

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# How I Do It: Infiltration Between Popliteal Artery and Capsule of Knee (iPACK)

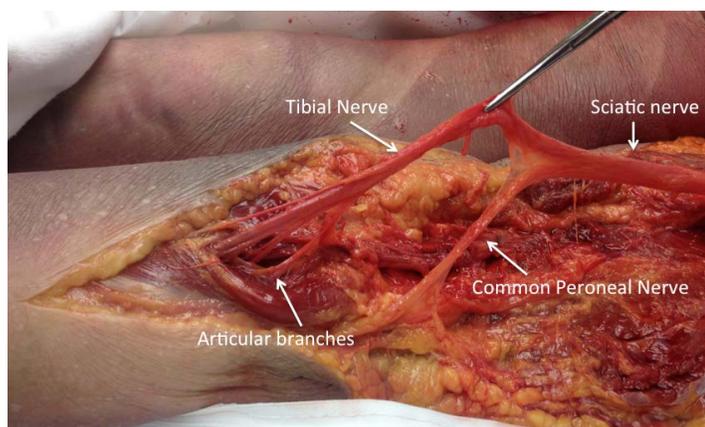
Controlling posterior knee pain after total knee arthroplasty is an important component of the comprehensive strategy for postoperative analgesia. The pain is mediated by articular branches that originate primarily from the tibial component of the sciatic nerve with contributions from the obturator nerve<sup>1,2</sup> (see Figure 1). Posterior knee pain can be controlled by sciatic nerve block, but that may lead to undesirable foot drop and delay diagnosis and treatment of surgically induced common peroneal nerve injury. A selective tibial nerve block in the popliteal fossa is an alternative to sciatic nerve block and can provide analgesia without causing a foot drop, but it decreases sensory perception in the sole of the foot and causes weakness of plantar flexion.<sup>3</sup>



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The articular branches, after arising from the main trunks of the tibial and obturator nerves, travel through a tissue space between the popliteal artery and the femur to innervate the posterior capsule of the knee (see Figure 2). These articular branches can be blocked by infiltrating the plane between the popliteal artery and the capsule of the knee (iPACK) with local anesthetic solution under ultrasound guidance. The goal of iPACK is to selectively block only the innervation of the posterior knee joint while sparing the main trunks of tibial and common peroneal nerves, thereby maintaining the sensorimotor function of the leg and foot. We introduced the

**Figure 1:** Dissection of popliteal fossa showing articular branches to posterior knee arising from tibial nerve. (Image courtesy of the Department of Anatomy at Penn State College of Medicine, State College, Pennsylvania.)



iPACK technique at ASRA's Annual Regional Anesthesiology and Acute Pain Medicine Meeting in 2012.<sup>4</sup>

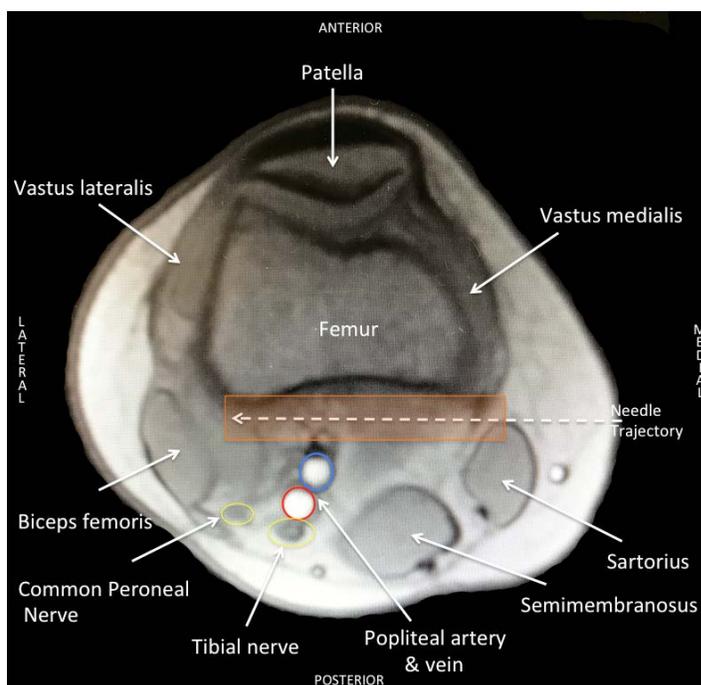
## TECHNIQUE: THE EARLY YEARS

When we conceived iPACK, our injections were performed with patients in a prone position. We have since transitioned to performing the iPACK in a supine position, but reviewing the original injection technique will enable better understanding of the sonoanatomy and procedure.

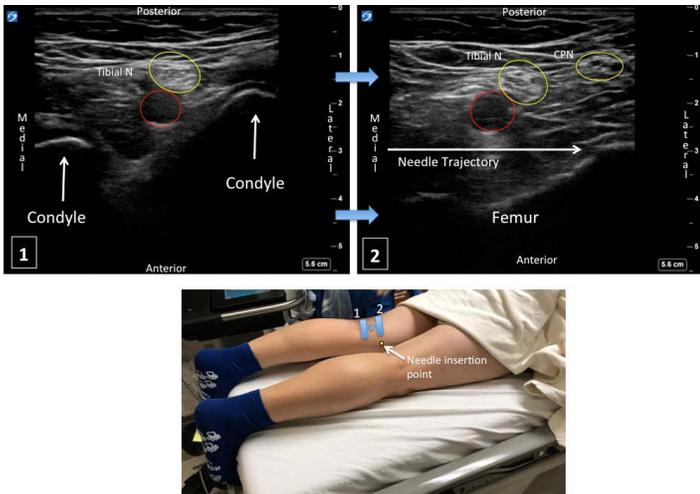
**Sonoanatomy.** With the patient in a prone position, a high-frequency linear probe or low-frequency curvilinear transducer can be used, depending on body habitus. Another advantage of the curvilinear probe is the wide-scanning view. The probe is placed transversely at or just above the popliteal crease to visualize the femoral condyles and the popliteal artery in cross section (see Figure 3). At this level, the femoral condyles appear as discontinuous, curved, hyperechoic lines. The popliteal artery is a pulsating anechoic structure in the center of the scan. The popliteal vein may be compressed from pressure of the transducer and not be visible on the image.

From this point, the probe is moved cephalad, keeping the popliteal artery in view, until the discontinuous, interrupted hyperechoic line of the condyles changes to a continuous, hyperechoic silhouette of the femoral shaft just cranial to the condyles. The location of

**Figure 2:** Cross-sectional anatomy of thigh proximal to femoral condyles. Orange box = target tissue plane for iPACK injection. (Image courtesy of the author.)



**Figure 3:** Scanning sequence of popliteal fossa for iPACK with corresponding sonograms. Red circle = popliteal artery. (Image courtesy of the author.)



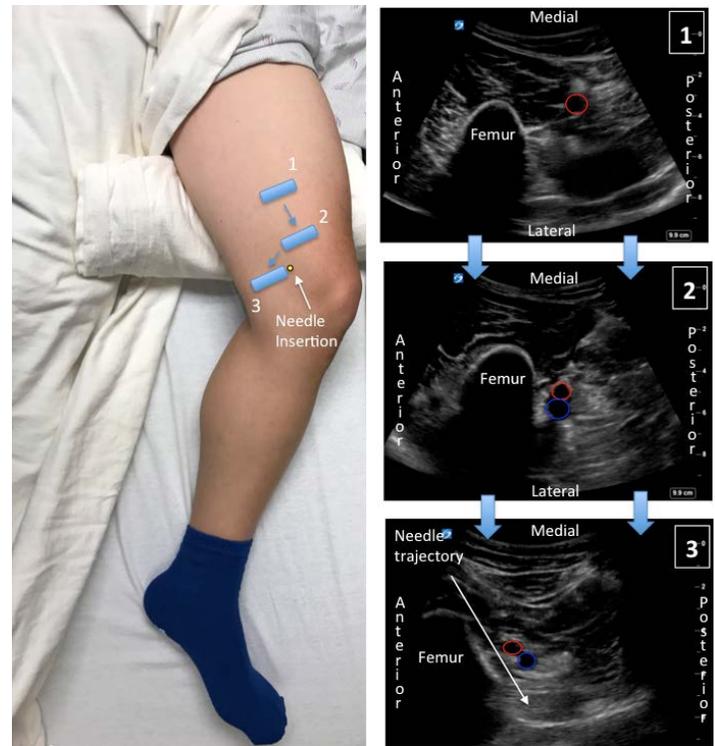
the tibial nerve (superficial to popliteal artery) and the common peroneal nerve (lateral edge of sonogram) can be seen by changing the tilt of the transducer. The plane between the popliteal artery and the femur is the space through which the articular branches are traversing and is the target tissue space for infiltration.

**Needle Insertion Technique.** The needle is inserted via an in-plane, medial-to-lateral approach. The insertion point is parallel to the femur, in the middle of the tissue plane. The needle is advanced until the tip is positioned 2 cm beyond the lateral border of the popliteal artery. Subsequently, the local solution is injected in 3-mL aliquots as the needle is withdrawn, which ensures even spread of local solution (ropivacaine 0.2% or bupivacaine 0.25% with epinephrine). Typically, 20 mL (range = 15–25 mL) of local solution is infiltrated in the tissue plane.

With the scanning procedure previously described, the image required for iPACK can be developed with the patient in supine (knee flexed or extended) or lateral decubitus positions. We recommend that the needle be inserted in a medial-to-lateral direction and the needle tip not be pushed 2 cm beyond the lateral edge of the popliteal artery to prevent anesthetizing the common peroneal nerve and causing a foot drop. If a lateral decubitus position is used, the side to be injected should be dependent, so that needle can be inserted from the medial thigh.

***“The goal of iPACK is to selectively block only the innervation of the posterior knee joint while sparing the main trunks of tibial and common peroneal nerves, thereby maintaining the sensorimotor function of the leg and foot.”***

**Figure 4:** Scanning sequence for iPACK using the posteromedial acoustic window with corresponding sonograms. Red circle = popliteal artery; blue circle = popliteal vein.



#### CURRENT TECHNIQUE

Over time, our technique has evolved to performing the iPACK injection with the patient supine and scanning from a posteromedial acoustic window. Because iPACK is usually combined with adductor

canal block or femoral nerve block, our current technique prevents multiple prepping or draping and position changes for different blocks.

Place the patient in a supine position with the lower extremity flexed at the knee and abducted at the hip (frog leg position). Support the knee with a

roll of blanket under the thigh (see Figure 4). To begin scanning, place the transducer on the lower third of the medial thigh to visualize the femur and the femoral vessels in cross section. Slide the transducer caudally, observing the femoral artery as it dives into the popliteal fossa through the adductor hiatus to become the popliteal artery. At this point, move the transducer posteriorly and

inferiorly to visualize the space between the popliteal artery and the shaft of the femur just superior to the femoral condyles. Insert the needle in plane from the anterior end of the transducer in a medial to lateral trajectory, keeping it parallel to the acoustic shadow of the femur. With the needle tip resting 2 cm beyond the lateral border of the artery, inject 20 ml of local anesthetic solution, after negative aspiration of blood, to infiltrate the tissue space in divided doses as the needle is withdrawn. The local anesthetic injectate is a mixture of 15 ml of bupivacaine 0.25% combined with 5 ml of liposomal bupivacaine 1.3%.

In our practice, iPACK has largely replaced selective tibial nerve block as part of the multimodal regimen for controlling posterior knee pain after total knee arthroplasty and cruciate ligament

surgeries. Future studies should be undertaken to further refine the technique.

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# Genicular Nerve Denervation for Osteoarthritis of the Knee

Osteoarthritis (OA) of the knee is very common, with approximately 33%–85% of people older than 55 years exhibiting radiographic evidence of the disease. All-cause knee pain is present in 20%–30% of those aged 65 years and older.<sup>1</sup> Knee pain affects 250 million people worldwide, and that number is expected to increase as the population ages and knee pain from OA becomes more common. Risk factors for OA-induced knee pain include high body mass index (BMI), previous joint injury, occupational hazards that place excessive mechanical stress on the knee joint, and structural misalignment. Chronic knee pain leads to disability, psychological distress, and impaired quality of life.

Signs and symptoms of OA of the knee include pain that increases with activity and improves with rest, swelling, feeling of warmth, stiffness especially in the morning or after a period of inactivity, crepitus, and decreased range of motion.

Treatment includes conservative options such as physical therapy, anti-inflammatory drugs, and injections with steroids or hyaluronic



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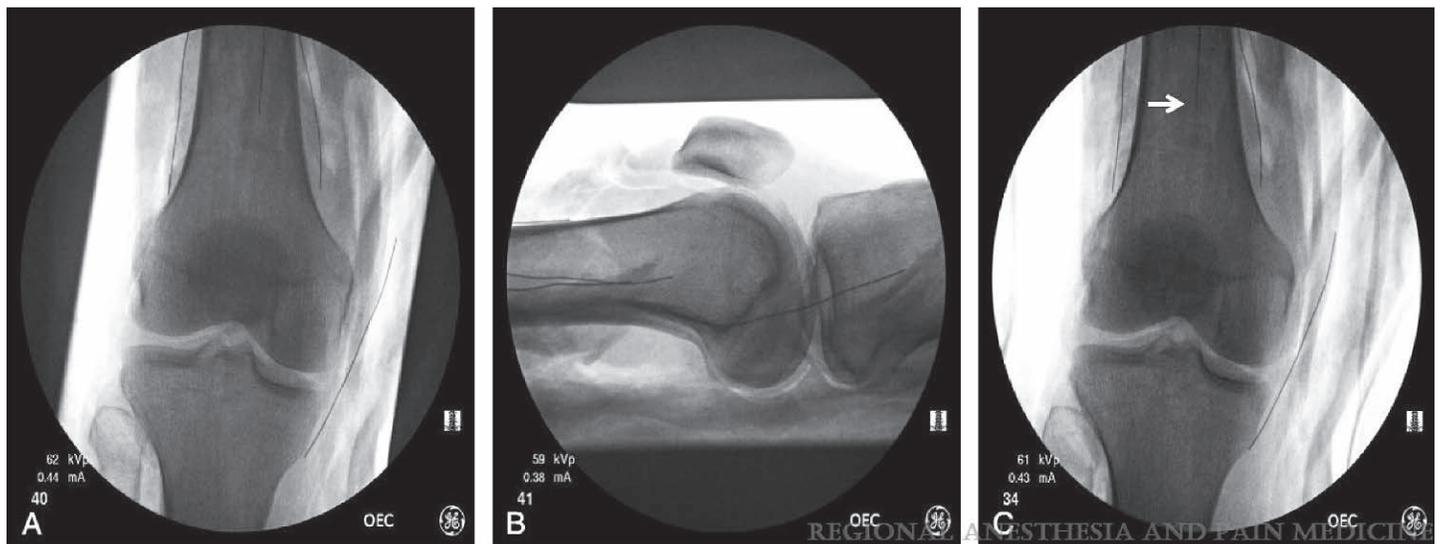
acid. A recent study found greater cartilage loss and no significant difference in knee pain with 40 mg of intra-articular triamcinolone compared with placebo (saline) at 2 years.<sup>2</sup> Other studies on the efficacy of hyaluronic acid injections have demonstrated confounding results.

For severe pain or for those who have failed to respond to conservative treatment, total knee arthroplasty (TKA) is an option. The procedure has perioperative and postoperative risks, including development of chronic pain (approximately 20%) and limited implant longevity. In addition, not all patients are eligible for a TKA secondary to young age, high BMI, or medical comorbidities.<sup>3</sup>

Nonsteroidal anti-inflammatory agents may help manage the pain; however, they are associated with significant risks, including gastric bleeding and increased cardiovascular events. Duloxetine, which is approved by the US Food and Drug Administration for the treatment of musculoskeletal pain, can also be used. Use of opioids can lead to numerous side effects, including dependence, tolerance, hyperalgesia, endocrine imbalance, and addiction.

Because of the lack of optimal treatment options, alternative methods are needed to manage patients with knee pain that results from OA. A relatively novel option is radiofrequency (RF) ablation of the genicular nerves. Genicular nerves arise from branches of the tibial and common peroneal nerves. The tibial nerve gives rise to the superior and inferior medial genicular nerves. The common

**Figure 1:** Anteroposterior visual of the knee. Radiographs in the anteroposterior (A) and lateral (B) views detail the stainless-steel wires that were placed along four of the nerve branches supplying the anterior capsule of the knee. C is an anteroposterior view, where the white arrows note the branch from the vastus intermedius that approximates a course along the midline of the anterior femur. Printed with permission from Franco C, Buvanendran A, Petersohn J, et al. Innervation of the anterior capsule of the human knee: implications for radiofrequency ablation. *Reg Anesth Pain Med* 2015;40:363–368.



**Figure 2:** *Targets for traditional radiofrequency ablation. Final needle position in anteroposterior and lateral views of the superior medial and lateral genicular nerves and the inferior medial genicular nerve. Printed with permission from Halyard Health, Inc.*



peroneal nerve gives rise to the superior lateral genicular nerve and inferior lateral genicular nerve; however, the latter is not targeted during RF because of its close proximity to the common peroneal nerve and the risk for foot drop. A branch of the vastus intermedius may be a fourth nerve target, particularly for subpatellar pain (see Figure 1).

Thermal or internally cooled RF ablation can be used to denervate the genicular nerves. The target for the superior medial, superior lateral, and the inferior medial inferior medial genicular nerves is the junction between the femoral or tibial shaft and the epicondyle. The target for the branch from the vastus intermedius is approximately 2 cm above the patella in the midline. If using traditional RF ablation, multiple lesions at each target should be performed (see Figure 2). The condyles should be properly aligned to accurately gauge the depth of needle insertion (see Figure 3), and the needles should be inserted approximately two-thirds of the distance across the femoral shaft for the superior medial and superior lateral genicular nerves and approximately halfway across the tibial shaft for the inferior medial genicular nerve. RF lesioning should be performed after appropriate sensory and motor testing.

Randomized controlled trials have demonstrated the efficacy of using RF ablation for denervation of the genicular nerve. Choi et al<sup>4</sup> performed a double-blinded and randomized controlled trial that compared the efficacy of genicular RF ablation to a sham procedure. They found a statistically significant decrease in visual analog scores in the RF group compared with the sham group. In addition, patients reported significant functional improvement and satisfaction with the treatment at 3-month follow-up.<sup>4</sup>

Davis et al<sup>5</sup> compared the effectiveness and safety of cooled RF ablation with corticosteroid injections in patients with knee OA. All patients underwent a diagnostic block of the superior medial, superior lateral, and inferior medial genicular nerves. If patients

**Figure 3:** *Incorrect epicondyle alignment. Lateral view showing improper alignment of the epicondyles. Printed with permission from Halyard Health, Inc.*



*“Because of the lack of optimal treatment options, alternative methods are needed to manage patients with knee pain that results from OA. A relatively novel option is radiofrequency (RF) ablation of the genicular nerves.”*

reported a 50% reduction in their numeric rating score (NRS), they were randomized to receive a single, intra-articular injection of a corticosteroid or cooled RF ablation. Significant reductions in NRS scores, Oxford knee scores, and global perceived effect up to 6 months were found in the cooled RF ablation group, and there were no reported side effects from the procedure.<sup>5</sup> Another study is underway comparing the effectiveness of cooled RF ablation to a single intra-articular injection of hyaluronic acid.

RF denervation of the genicular nerves is generally considered safe; however, potential complications include bleeding, infection, pain at the procedure site, and skin burn. When performing the procedure, verify that the electrode tip is deep enough in the soft tissue to prevent skin burn.

Although more research is required, RF ablation for alleviation of OA-related knee pain deserves consideration as a mechanism to reduce opioid administration, decrease pain, and improve quality of life.

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# The Slipping Rib Syndrome: An Often-Overlooked Diagnosis

Slipping rib syndrome, also known as floating rib syndrome or Cyriax syndrome, is a condition that clinicians often overlook or underdiagnose and patients misrecognize. Although it was first published by Davies-Colley in 1921,<sup>1</sup> Cyriax described the syndrome in 1919 as a forward displacement of the inferior rib tips, causing pain in the chest or upper abdomen. Even though the lifetime prevalence of this condition is estimated to be 20%–40%,<sup>2</sup> only a few individuals develop persistent or chronic pain from it and seek treatment, which may explain why the condition is so often underdiagnosed.

An illustrative case treated in our pain clinic was a 37-year-old, otherwise healthy, female patient who complained of 7 years of progressive, left-sided, anterolateral chest wall pain at the level of the 10th rib. The pain was insidious in onset without any provocative factors (ie, trauma). She had been referred by her primary care physician to a general surgeon 3 years prior to her visit to the pain clinic, who ruled out more serious causes of her pain. She underwent an “injection in her rib cage” at that time, which relieved her pain for several months. However, the pain returned, and she was then referred to our pain clinic for better long-term management.

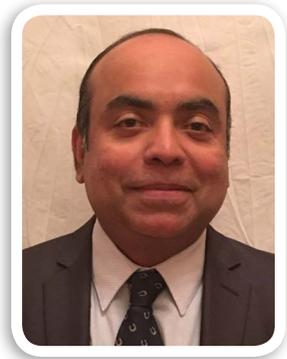
During her encounter in our pain clinic, her only complaint was sharp, progressive, anterolateral, lower chest pain, aggravated by movement and deep breathing, and not alleviated by conservative measures (eg, ice pack, acetaminophen, nonsteroidal anti-inflammatory drugs). All other systems were

***“Only a few individuals develop persistent or chronic pain from it and seek treatment, which may explain why the condition is so often underdiagnosed.”***

**Figure 1:** Adult ribcage. A fibrous band attaches the false rib (8th through 10th) to each other. The floating ribs (11th and 12th) are visible in panel B.



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unremarkable. On physical examination, her vital signs were within normal limits, and the examination was benign except for a left hooking maneuver that reproduced the pain. Our recommendations included a trigger point injection at the tender location, lidocaine patch, and acetaminophen, which helped to alleviate her symptoms and permitted her to resume activities of daily living.

Slipping rib syndrome typically consists of unilateral lower chest wall or upper abdominal pain, caused by a hypermobile rib (typically the 8th, 9th, or 10th rib) that generates pain when sliding anteriorly and posteriorly on the superior rib. The latter results in irritation of the intercostal nerves and produces sharp, stabbing pain followed by dull aching. The pain is typically intermittent, can be acute or chronic, and can range from mild, tolerable pain to excruciating pain. Some patients may have a trigger point area of tenderness. Unlike the true ribs (first through seventh) that attach directly by cartilaginous joints and ligaments, the false ribs (8th through 10th) are attached to each other by a cartilaginous cap in children and a fibrous band in adults (see Figure 1). Because the ribs are not held together by muscle, they are more susceptible to increased mobility and trauma and are mostly involved in slipping rib syndrome. If the loose rib impinges the intercostal nerve, it can cause excruciating pain around the chest into the back. The condition is sometimes accompanied by a clicking sensation, and patients are often able to demonstrate the popping sensation to the physician. Nausea or vomiting may accompany the pain, confusing the diagnosis.

The differential diagnosis of slipping rib syndrome is listed in Figure 2.

**Figure 2:** *Differential diagnosis for unilateral rib pain.*

- Slipping rib syndrome
- Rib fracture
- Pleuritic chest pain
- Gastritis or peptic ulcer
- Esophagitis
- Costochondritis
- Hepato-splenic disease
- Cholecystitis
- Tietze syndrome
- Cardiac origin

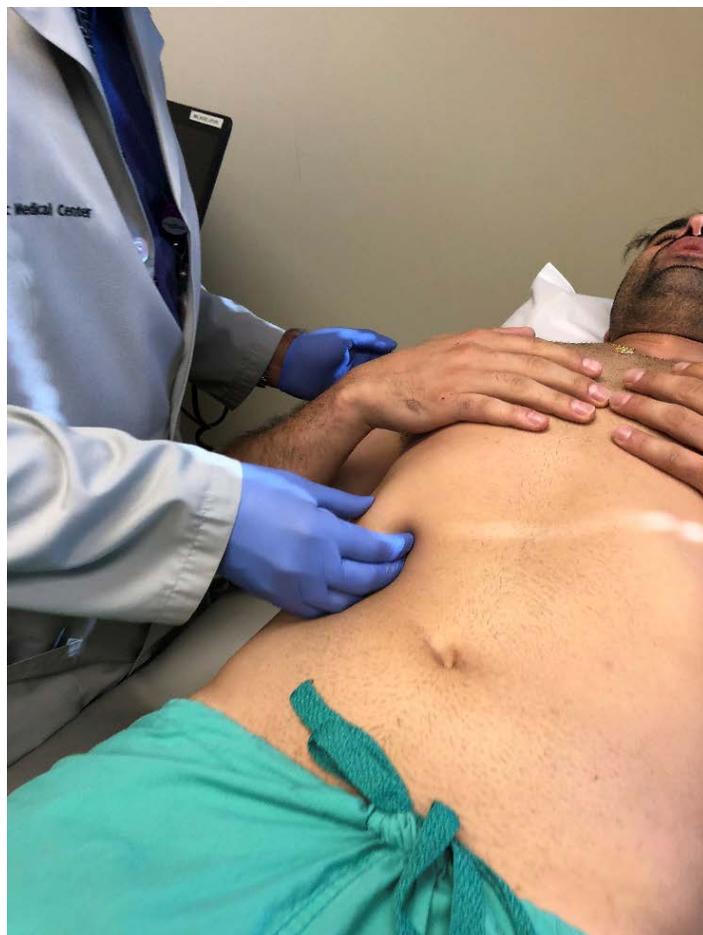
No definite etiology is associated with slipping rib syndrome. Overuse or rib trauma are thought to be some of the common risk factors but are not required, as in the case of the female patient presented earlier. McBeath and Keene<sup>3</sup> demonstrated that the human ribs would be able to slip on one another and cause the painful syndrome only if the cartilaginous tips or fibrous attachments are disrupted.

Because the condition is often overlooked, many unnecessary diagnostic examinations are performed to work up the diagnosis (eg, plain radiography, computed tomography, magnetic resonance imaging). The gold standard for diagnosing the condition is a simple hooking maneuver (see Figure 3), which was first described by Heinz and Zavala<sup>4</sup> in 1977 and consists of having examiners slide their fingertips under the costal margin on the implicated side, then lifting anteriorly and superiorly. If the pain is reproduced, sometimes accompanied by a clicking sensation, the syndrome is diagnosed. Furthermore, to identify the location of the disease, local anesthetic can be injected at the suspected site; alleviation of the confirms the disease location.

Treatment depends on the severity of the associated pain or lifestyle limitations. Mild, tolerable pain can be managed by simple reassurance, temporary activity limitations, and use of icepacks or low-level pain medications (eg, nonsteroidal anti-inflammatory drugs, acetaminophen). For moderate levels of pain, intercostal nerve blocks with local anesthetic with or without systemic steroids have been shown to be very effective, including for the case described in this article. For more severe pain or failure to respond to other management, resection of the anterior rib and costal cartilage have been performed successfully. Almost every publication in which surgery was performed concluded that patients have complete resolution of pain following excision of the slipping ribs.<sup>5</sup>

To summarize, slipping rib syndrome is a condition with a simple presentation and diagnostic test and treatment options. However,

**Figure 3:** *Hooking maneuver. The examiner slides his or her fingertips under the costal margin of the implicated side, then lifts anteriorly and superiorly.*



vigilance is required to narrow the differential diagnosis and effectively manage the condition.

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# Is a Shift Occurring in Neuromodulation? An Evaluation of the Use of Intraoperative Neuromonitoring in the Placement of Spinal Cord Stimulators

Spinal cord stimulation (SCS) is a well-established therapy used for more than 50 years in treatment for chronic, intractable pain conditions, including failed back surgery syndrome and complex regional pain syndromes.<sup>1</sup> With traditional tonic stimulation and most newer waveforms, successful SCS treatment requires the superposition of SCS-induced paresthesias in regions of perceived pain, which confirms recruitment of the fibers serving the relevant spinal segment(s).<sup>2</sup>



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The accepted standard for confirmation of paresthesia overlap is via verbal feedback from a conscious patient, which also mitigates the risk of inadvertent injury to the neural axis. In the past several years, however, a new option called neuromonitoring has emerged that allows for both proper mapping of lead placement and safety monitoring of the neural axis in anesthetized patients.

Although neuromonitoring is relatively new in the application of SCS, surgeons have long accepted its use in various procedures, such as spinal surgery, to safely monitor the spinal cord in anesthetized patients. Additional benefits of neuromonitoring include a more predictable procedure, elimination of undesired patient movement, and less stress to the patient and the physician.

Anesthetic management can be difficult in interventional pain procedures,<sup>3</sup> including awake lead implantation for SCS, because it is often challenging to balance appropriate pain control and the level of consciousness or responsiveness. In addition, patients can often become disinhibited or agitated with the use of anesthetics, making the procedure difficult to perform and placing the patient at increased risk of an untoward event. Also, delays can occur in mapping paresthesias because patients may be slow to arouse secondary to sedative medications, thus making the time required for surgery much less predictable. Lastly, although awake placement for spinal cord stimulators is commonly performed, no published data specifically investigate awake placement for either safety or confirmation of lead positioning. However, despite these factors, awake placement has been a preferred method for SCS implantation.

In some situations, placing patients under general anesthesia may be advantageous, such as a completely uncooperative patient who jeopardizes the safety and efficacy of the procedure, or perhaps during surgical lead placement because a laminotomy is required. When patients cannot give consistent conscious feedback because of general anesthesia, it is imperative to have a method to monitor cord protection. Neuromonitoring has been widely accepted in spinal surgery for this purpose.<sup>4</sup> Asleep lead placements, however, do not allow for verbal feedback and could therefore contribute to suboptimal lead placement. Even with the advent of paddle electrodes, which are typically placed on the accepted anatomic midline by fluoroscopic imaging without paresthesia mapping, leads will produce inadequate coverage in one out of every six patients.<sup>5</sup> Spinal mapping work has demonstrated the spinal cord's physiologic midline does not match the anatomic midline in approximately 40% of patients.<sup>6</sup> Therefore, protocols were needed and are now established to use intraoperative neuromonitoring to confirm proper positioning and placement of the leads.<sup>7</sup>

The recent Neurostimulation Appropriateness Consensus Committee guidelines confirm the protocols of correct lead placement in either an awake patient or through the use of neuromonitoring in an asleep patient.<sup>8</sup> Observation of compound motor action

potentials (CMAPs)<sup>9</sup> or somatosensory-evoked potentials<sup>10</sup> in the painful dermatome(s) in response to intraoperative SCS can be used as a proxy for verbal confirmation of paresthesia coverage. CMAPs use myotomal coverage as a marker for dermatomal coverage (see Figure 1). In addition, neuromonitoring is used as

a safety measure to monitor the spinal cord and neurologic function during an asleep procedure.

Initially, several retrospective studies demonstrated that the asleep procedure with neuromonitoring is at least as safe and efficacious as the awake procedure and may have fewer adverse events.<sup>11,12</sup> Interestingly, the studies demonstrated that the asleep method had reduced intraoperative time when compared with the awake surgical technique and had approximately half the incidence of device failure (defined as the need for reoperation secondary to a device-related issue).<sup>11</sup> These studies led to the advent of published protocols<sup>7</sup> and a prospective, multicenter (high-volume and experienced academic and private centers) study directly comparing asleep placement with the use of intraoperative neuromonitoring versus awake placement.<sup>13</sup> Confounding factors were limited by including only paddle electrodes and performing

***“Asleep placement with neuromonitoring . . . provided superior paresthesia coverage of the painful areas and lower excess paresthesias. . . . Furthermore, a lower adverse event profile was noted in the asleep group.”***

**Figure 1:** Placement of an electrode generating electromyography responses using myotomal coverage as a marker of dermatomal coverage. (a) Midline placement. (b) Right-sided dominant placement. (c) Left-sided dominant placement.



an open-label study in which physicians implanted the SCS to the best of their ability in their preferred technique. The results demonstrated that asleep placement with neuromonitoring allows for significantly lower procedure and operating room times and more efficient and accurate positioning of the electrodes. It also showed that the asleep procedure provided superior paresthesia coverage of the painful areas and lower excess paresthesias (paresthesia in areas where patients did not have pain). Furthermore, a lower adverse event profile was noted in the asleep group. This has been the best data to date looking at SCS placement in any group, whether awake or asleep. This summary of the published data and protocols has been recognized throughout the field and was presented at the International Neuromodulation Society World Congress in 2017, North American Neuromodulation Society Annual Meeting in 2018, and World Congress on Regional Anesthesia and Pain Medicine in 2018.

Several different practice models for implementation exist, including using a large neuromonitoring company who charges a small nominal fee per hour or day for services but also maintains the ability to code for the procedure, having a sharing model with a neuromonitoring company for reimbursement, or employing your own staff and taking ownership of the billing and coding. Each scenario is a financially feasible platform in both hospital-based and acute surgical center practices. Lack of understanding and familiarity outside the surgeons' space has led to inappropriate myths in regard to neuromonitoring's utility, implementation, and finances, but dispelling those myths may have led to increased use.

Since the increased adoption of neuromonitoring during placement of SCS in asleep patients, several other applications and innovations have been studied. Perhaps the most impactful is that it is beginning to be used in the placement of dorsal root ganglion (DRG) stimulators). A prospective series has shown that use of neuromonitoring during DRG stimulation placement is equal to awake placement in both number of adverse events and lead placement confirmation.<sup>14</sup> Additional studies have used direct intraoperative recording to determine the mechanisms of action of each neuromodulation company's different stimulation waveforms.<sup>15</sup> Finally, it can be used in combination with the newer closed-loop technology, in which objective measures of pain relief and paresthesia coverage can be determined.<sup>16</sup>

In summary, use of intraoperative neuromonitoring has potentially shown superior benefit, but it is important to realize that it will not eliminate the awake procedure. Rather, it is a viable option for those who choose to implement it. Additional benefits include a streamlined and predictable procedure that decreases procedural and intraoperative time with more accurate placement of leads and fewer adverse events. Those benefits are balanced with a center's ability to implement its use and the method in which they chose to apply it.

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# Radiation Safety for the Chronic Pain Physician

On November 8, 1895, physicist Wilhelm Conrad Roentgen discovered x-rays while working in his laboratory at Wurzburg University in Germany. A year later, Thomas Edison created the first fluoroscope. Radiation technology has subsequently undergone significant advancements and has become an increasingly important tool for the interventional pain management physician.

The number of interventional pain procedures performed annually has increased over the past 20 years, much of which can be attributed to advancements in imaging technology. The major advantages of fluoroscopy are visualization of the procedure area, confirmation of direct medication placement, and detection of unintentional intravascular injection, all of which increase clinical efficacy, decrease possible side effects, and enhance patient safety.<sup>1</sup> As more physicians use fluoroscopy, interest in radiation safety has grown. Unfortunately, that increased interest has not translated into additional or, in some circumstances, adequate in-depth training. The International Commission on Radiological Protection has called for improvements in training to ensure the health of both physicians and their patients.<sup>2</sup>

## TERMINOLOGY

Part of the difficulty in understanding radiation safety is its confusing terminology. Units used to define the biologic effects of radiation and enable calculations of effective absorbed dose are referred to as *dose equivalents*. Multiple units are often used to describe similar concepts, depending on whether the author is using imperial or international system of units (SI) units. The radiation energy absorbed is described as radiation absorbed dose (rad, imperial unit) or gray (Gy, SI unit). To predict biologic effects of radiation during occupational exposure, rad is converted to radiation equivalent man (rem, imperial unit) or sievert (Sv, SI unit). One rem is equal to 0.01 Sv. Most articles describing radiation dose use millisievert (mSv) as the preferred unit.

## RADIATION SPECIFICS

But what exactly is radiation, and how does it produce harmful effects? In a simple sense, radiation is a wave or particle of energy emitted from a source. X-rays are photons of energy that are part of the electromagnetic spectrum, along with gamma, ultraviolet, infrared, radar, microwave, and radio waves. Those waves and their associated physical properties are identified by their different wavelengths. As x-ray photons pass through the human body, the energy they impart can create ionized atoms and free radicals, which can produce harmful effects. Photons that interact with but



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do not ionize atoms are deflected in various directions, which is referred to as *scatter radiation*. Scattered photons place physicians and other staff in the room at risk for exposure to the same harmful effects as the primary x-ray beam photons. X-rays that do not interact with any atoms are transmitted to the image receptor and create the desired radiograph.

Most of the radiation dose pain physicians may be exposed to is in the form of scatter radiation, not the primary x-ray beam.<sup>2</sup> When the x-ray source is located below a patient without any rotation, the maximum scatter is primarily in the form of backscatter projecting below the table, and most unintended exposure reaches the physician's lower extremities and feet. However, when the x-ray tube is rotated toward the physician and the x-ray beam projects away from him or her, most of the scatter radiation will project back to the physician, occurring at the level of more radiosensitive structures such as the eyes, thyroid, and breast tissue.

## FLUOROSCOPY UNIT CHARACTERISTICS

The two main determinants of image quality are peak kilovoltage (kVp, tube voltage) and milliamperes (mA, tube current). Typical tube currents are 1–5 mA and tube voltages are 75–125 kVp. The automatic brightness control on the fluoroscopy unit adjusts the kVp and mA to enhance image quality (brightness and contrast) while balancing patient safety. If the fluoroscopy unit is used in manual mode, ideally the kVp should be increased prior to increasing the mA to limit the increase in radiation exposure. For an equivalent increase in exposure, the mA must be doubled, whereas the kVp would have to be increased by only 15%.

## RADIATION EXPOSURE RECOMMENDATIONS

The average annual background radiation exposure from natural sources for individuals living in the United States is estimated to be 3 mSv. A comparison of radiation doses from frequent sources and the amount of time that it would take to receive the same amount of radiation from nature are found in Table 1.

The National Council on Radiation Protection and Measurements' (NCRP's) annual effective dose equivalent (EDE) limits for different organs or areas of the body are listed in Table 2. Initially, NCRP described maximal permissible dose (MPD) for occupational exposure. Although MPDs are often listed in textbooks, the terminology has been replaced by the EDE limiting system to indicate that "no dose is considered permissible."

Physician radiation exposure is cumulative over a lifetime. According to NCRP, adhering to the limits ensures that lifetime risk from radiation exposure remains acceptable, not negligible. Individuals ideally should not receive more than 10% of the EDE limits annually. An occupational worker's lifetime effective dose should be limited to his or her age in years times one rem.

## RADIATION EXPOSURE DURING PROCEDURES

Patient doses during fluoroscopically guided interventional pain procedures have been reported to range between 0.08 and 0.15 mSv per minute of fluoroscopy when pulsed fluoroscopy of 3–15 frames per second (fps) is used. Average patient radiation doses for some common interventional pain procedures are listed in Table 3. With proper planning and protection, these doses should be substantially lower to the physician.

Physician exposure can be monitored quarterly with thermoluminescent dosimeter badges, which are worn on the outside of the lead apron and submitted to the specific manufacturing company for processing to ensure the physician is staying below recommended radiation dose limits. If exposure limits are exceeded, it may trigger warnings and procedural modification recommendations.

## RISKS

Biologic effects of radiation exposure are divided into two categories: nonstochastic (ie, deterministic) and stochastic. Deterministic effects are seen after a certain threshold is passed. Above that threshold, injury occurs (eg, cataracts, erythema), and higher radiation doses will increase severity. The acute radiation doses required to cause nonstochastic effects should not be exceeded during routine interventional pain procedures as long as appropriate safety measures are followed.

Typically, interventional pain physicians are exposed to cumulative low-dose radiation. Significant previous radiation exposure lowers the dose threshold for a stochastic effect, which is defined by an

**Table 1:** *Radiation doses.*<sup>3</sup>

Source	Radiation dose (mSv)	Background equivalent radiation time
Background (yearly)	3	—
Round-trip coast-to-coast flight	0.03	4 days
Extremity x-ray	0.001	3 hours
Chest x-ray	0.08	10 days
Spine x-ray	1.5	6 months
Spine computed tomography	6	750 days
Abdomen or pelvis computed tomography	10	1250 days

**Table 2:** *Annual effective dose equivalent limits per organ system.*<sup>4</sup>

Area/organ	Annual effective dose equivalent limits (mSv)
Thyroid	500
Extremities	500
Gonads	500
Lens of the eye	150
Whole body	50
Pregnant women	5

**Table 3:** *Patient radiation doses for specific pain procedures.*<sup>5,6</sup>

Procedure	Radiation exposure (secs)	Radiation dose (mSv)
Interlaminar epidural	5.9	0.008–0.015
Joint injection	7.5	0.01–0.019
Kyphoplasty, single level	228	0.304–0.57
Kyphoplasty, multiple levels (per level)	168	0.224–0.42
Lumbar medial branch block	5.7	0.008–0.014
Lumbar transforaminal epidural	10.9	0.015–0.027
Spinal cord stimulation trial	134	0.179–0.335

increasing likelihood of effect with higher total radiation doses. Unlike deterministic effects, it is assumed that there is no threshold below which the effect does not occur, a concept represented in the popular linear no-threshold model. In addition, the severity of stochastic effects is not determined by dosage. Cancers, both hematologic and tumors, are examples of stochastic effects.

Interventional pain physicians are at risk for both types of radiation exposure injury because of the chronic, low-dose radiation exposure over a lifetime. Most information on the biologic effects of radiation has come from epidemiologic studies of human populations that have been exposed to acute high-dose radiation such as the atomic bomb survivors in Hiroshima and Nagasaki and individuals near the Chernobyl power plant. The long-term adverse effects and biologic consequences of cumulative exposure to low-dose radiation remain unclear. Furthermore, the risk of developing cancer in people subjected to low-dose radiation is debated and uncertain.

#### TIPS FOR REDUCING RADIATION EXPOSURE

Lifetime radiogenic risk depends on annual operative workload, radiation protection measures, and years of occupational exposure. With appropriate safety measures and knowledge, physicians can drastically reduce their radiation exposure.

**Distance From X-Ray Source to Physician.** Radiation exposure is inversely proportional to the square of the distance from the x-ray source, which is known as the inverse square law. Therefore, if physicians double their distance from the source, the radiation exposure reduces by a factor of four. At 1 m, the scatter radiation exposure level is approximately 0.1% of the patient skin entrance dose by the primary beam. Physicians should stand as far away from the radiation source as reasonably and safely as possible.

**Distance From Image Intensifier to Patient.** Skin entrance dose is lowest when the distance between the image intensifier and patient is small and the distance between the x-ray tube and patient is large. Those same principles will limit scatter radiation to the performing physician and operating room personnel. The shortest distance from the x-ray tube to patient should be 30 cm, and longer distances, if possible, should be sought.

**Collimation.** A collimator is a device built into the C-arm that will narrow the x-ray beam surface area to the area of interest, which decreases the patient dose and scatter radiation to operating room staff and improves image quality. The intensity of scatter radiation is a function of exposed field size. Therefore, doubling the field of view doubles scatter radiation dose rates. Thus, physicians should seek maximum collimation.

**Pulsation.** Fluoroscopy is categorized into two types: pulsed and continuous. Frame rate is the number of fps during the use

of fluoroscopy. Continuous fluoroscopy obtains 30 fps, which approaches the maximum temporal resolution of the human eye, so image acquisition appears as one fluid, continuous motion (like a movie). In pulsed fluoroscopy, physicians manually select a lower fps setting that the human eye detects as separate image captures. The video appears “choppy”; however, the radiation dose is significantly reduced because fewer images are needed. Thus, seeking the lowest reasonable fps rate and avoiding continuous fluoroscopy when possible will help limit exposure.

**Magnification.** As the area of interest is projected toward a larger area of the image receptor (magnified), more x-rays are needed to maintain good spatial resolution, which increases a beam’s intensity. This can be detrimental to the patient’s skin at the entrance site and increases scatter radiation to operating room personnel. Physicians should minimize magnification.

**Protection.** Lead shielding protects through its density and its positive charge. Lead aprons come in 0.25-mm lead equivalent thicknesses with thicker amounts providing better protection. At 0.25-mm and 0.5-mm thick, lead aprons will decrease radiation exposure more than 90% and 99%, respectively. The apron should hang to at least the knees, because most of the scatter radiation exposure is to the lower extremities. Physicians should also wear a thyroid collar (0.5-mm lead equivalent) and lead glasses. Follow proper care instructions: folding the apron or collar can create cracks in the shielding, thus allowing an area of decreased radiation protection. The clinic should have a protocol to test lead shielding devices periodically for defects.

Additional lead shields can be attached to the operating room table, hanging down and blocking scatter radiation to the physician and other staff. A mobile, clear lead shield can also be interposed between the physician’s upper body and the image intensifier, thus decreasing scatter radiation from the patient to the physician above the table.

**Beam Orientation.** Because of backscatter, the radiation dose is always highest on the side of the patient or table facing the x-ray tube. Furthermore, x-ray beam orientation can have drastic effects on tube output, with anteroposterior views requiring the least amount of tube output and thus dose. Oblique and lateral views increase the total dose, and backscatter radiation to the physician is increased if the x-ray tube is moved closer to the physician in these projections. Therefore, when using oblique and lateral orientations, stand on the side of the image intensifier, where scatter radiation levels can be two to three times lower compared with the side of the x-ray tube.

#### CONCLUSION

With the increasing use of fluoroscopy in interventional pain management, physicians must be knowledgeable about radiation

safety. Multiple health problems are linked to radiation exposure, so knowing how to reduce radiation is important for patient and operating room personnel safety. NCRP has created the ALARA Principle (As Low As Reasonably Achievable), which recognizes that no magnitude of radiation exposure is known to be completely safe. With each patient and every x-ray image obtained, remember the three cardinal principles of ALARA: increase distance, decrease time, and use shielding.

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# Transition Clinics in Pain Medicine

Opioid use in the United States is widespread for both acute and chronic pain conditions. Given the potential negative effects of opioid analgesics, the Centers for Disease Control and Prevention (CDC) issued guidelines for best practices in opioid prescribing.<sup>1</sup> Transition clinics in pain medicine are designed to help patients prevent the transition from acute opioid use to chronicity. Meeting that challenge requires a multidisciplinary approach, including pharmacologic and interventional pain management, physical therapy, and rehabilitation medicine, as well as pain psychology and behavioral support.

## CHRONIC OPIOID USE

Although opioids were initially developed for the treatment of acute pain states, their use in the setting of chronic pain is extensive. According to CDC, 259 million prescriptions for opioid analgesics were written in 2012.<sup>2</sup> Nearly 20% of ambulatory patients seen in 2012 with the chief complaint of pain were prescribed opioid analgesics.<sup>3</sup>

The list enumerating all possible adverse effects of opioids is extensive, but perhaps most concerning is the potential for misuse, addiction, and death. Annual costs associated with misuse and abuse of prescription opioids are estimated at \$53.4 billion for nonmedical uses, \$55.7 billion for abuse and dependence, and \$20.4 billion for overdose.<sup>1</sup> Their pervasive use and potential for severe consequences has led to the United States' declaring the opioid use epidemic a public health emergency.<sup>4</sup>

## RISK FACTORS FOR TRANSITION TO CHRONICITY

In March 2017, CDC published a *Morbidity and Mortality Weekly Report* describing the development of chronic opioid use among nearly 1.3 million opioid-naïve noncancer patients who received a first prescription for opioid analgesics.<sup>5</sup> The report identified several risk factors for transition to chronicity of opioid use, including number of supplied days of opioid analgesics, provision of refills, use of long-acting opioids, and cumulative opioid dose. Each additional day of supplied opioid analgesics beyond 3 days was associated with a marginal increase in risk for transition to chronicity as measured by continued use at 1 and 3 years after the initial episode. Opioid use at 1 year from the first episode was 6.0% for those with at least 1 day of prescribed opioid therapy, 13.5% for those with at least 8 days, and 29.9% for those with at least 31 days. The provision of a second prescription or refill doubled the risk of transition to chronicity: approximately one patient in seven still used opioids 1 year following the initial episode. The authors also emphasized that the greatest incremental increases in

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transition to chronicity were associated with the initial prescription exceeding 10 or 30 days, provision of a third prescription, or cumulative dose exceeding 700 morphine milligram equivalents.

The CDC data are illuminating, but one important caveat is that the analysis does not account for the etiology of pain. In the transition to chronic opioid use following surgery, the concept of chronic postsurgical pain (CPSP) takes center stage. Defined as pain for at least 2 months following surgery that is attributed to surgery itself and not related to preexisting or other medical conditions, CPSP is thought to be based on a variety of demographic as well as biopsychosocial factors.<sup>6</sup> Patients at increased risk for development of CPSP often have high intensity of perioperative pain, perioperative opioid consumption, or the presence of certain psychological states, including depression, anxiety, and posttraumatic stress disorder.<sup>7</sup>

## TRANSITIONAL CLINICS IN PAIN MEDICINE

Transitional clinics in pain medicine are designed to prevent the transition of acute opioid use to chronicity and exist in various states of comprehensiveness. One of the more thorough programs that have been chronicled in the literature, the Transitional Pain Service (TPS) at Toronto General Hospital, provides a continuum of services, including identification of high-risk individuals through preoperative

consultation, provision of guidance for perioperative pain management, meticulous education for patients and family members, and postoperative clinic follow-up that coordinates pharmacologic management, psychotherapy, and rehabilitation medicine in a multidisciplinary effort guiding patients toward a full recovery.<sup>7</sup>

#### APPLICATIONS TO PRACTICE

The perioperative home framework augments anesthesiologists' role in patient recovery following surgery, which affords an opportunity to target modifiable risk factors for transition to chronicity of opioid use. Enhanced recovery after surgery protocols designed to minimize perioperative opioid use may be successful in the inpatient setting, but it may not extend to the outpatient setting in the absence of a cultural change related to opioid prescribing at discharge.<sup>8</sup>

Working with surgical colleagues, pharmacists, patients, and their families to discuss the optimal duration of opioid prescriptions as well as choices for opioid formulation can help mitigate those risks. Leveraging nonopioid analgesics and nonpharmacologic modalities is another part of a comprehensive approach to multimodal analgesia and requires the involvement of multiple specialties, including physical therapy, rehabilitation medicine, and pain psychology.

#### RECOMMENDATIONS

1. Patients going for surgery should be evaluated for the presence of risk factors for CPSP.
2. Patients at risk for developing CPSP should be evaluated by the TPS for perioperative pain control. Their perioperative care should focus on using a multidisciplinary approach for treating pain in the perioperative period using nonopioid analgesics, physical therapy, education, psychological support, and regional anesthesia.
3. Patients should be followed in the postoperative period for evaluation of the continuous need of pain control, use of nonopioid approaches, weaning down opioids if used after surgery, and functional restoration.
4. Some patients may develop CPSP, and those may need to be referred at an early stage to a chronic pain clinic to provide multidisciplinary pain management without the need for high-dose opioids for a prolonged duration postoperatively.

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