



Endoscopic spine surgery—increasing usage and prominence in mainstream spine surgery and spine societies

Andrew S. Chung, Jon Kimball, Elliot Min, Jeffrey C. Wang

Department of Orthopedic Surgery, Keck School of Medicine, University of Southern California, Los Angeles, CA, USA

Correspondence to: Jeffrey C. Wang, MD. Department of Orthopedic Surgery, Keck School of Medicine, University of Southern California, 1520 San Pablo St., Suite 2000, Los Angeles, CA 90033, USA. Email: Jeffrey.wang@med.usc.edu.

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Introduction

While Dr. Parvis Kambin described the first endoscopic view of the herniated disc in 1988, technical and technological limitations prevented initial widespread adoption of spinal endoscopy (1). However, shortly thereafter, Dr. Kambin's description of the safe working zone, Kambin's triangle (2), helped to establish the viability of endoscopic and other minimally invasive spinal surgical (MISS) techniques. A relatively rapid expansion in the number of relevant surgical techniques followed over the next several decades.

Today, transforaminal, interlaminar, cervical, and thoracic approaches have all been described utilizing spinal endoscopy. Surgical indications have similarly expanded from the management of simple disc herniations to include spinal instrumentation and the management of tumors and infection (1,3).

In light of these significant advancements and the current patient-driven health care climate, interest in spinal endoscopy appears to be at an all-time high, especially outside of the United States. This heavy interest level has been reflected on both a national and international scale, with many of the prominent spinal societies placing increasing focus on spinal endoscopy. This trend in interest from more open to less invasive surgical approaches parallels the history of laparoscopy and joint arthroscopy, where patient demand for less morbid procedures and surgeon efforts to accelerate post-operative recovery have forced surgical evolution. Ultimately, it appears that spinal endoscopy is here to stay, and that more widespread adoption of spinal endoscopy is imminent.

Spinal endoscopy—just another MISS technique?

Similar to other MISS techniques, the main benefit of spinal endoscopy is decreased bony and soft tissue dissection and improved cosmesis when compared to open techniques. Consequently, spinal endoscopy appears to be associated with less blood loss and post-operative pain and earlier post-operative mobilization and return to work (4–8). By allowing for maximal preservation of native anatomy, additional benefits may include a decreased risk of segmental instability and consequent adjacent segment degeneration in the long-term.

Finally, when compared to equivalent traditional MISS techniques, proponents of spinal endoscopy argue that it may allow for improved visualization of pathology. This may further mitigate iatrogenic damage to native anatomy that would otherwise be necessary to improve visualization during other surgical approaches. Consequently, spinal endoscopy may be the least invasive of all surgical approaches to the spine.

Spinal endoscopy—a steep learning curve

Even for the experienced surgeon, the learning curve for spinal endoscopy is steep (9). Not surprisingly, however, the learning curve depends heavily on the specific procedure being performed (10,11). For instance, data suggests that more difficult techniques may require upwards of 70 cases in order for good/excellent results to be achieved (12).

It is therefore important to emphasize that careful introduction of spinal endoscopy into one's practice is warranted to prevent unnecessary injury to patients. Careful

patient selection, adherence to strict indications, and a slow and graduated incorporation of endoscopic techniques are all crucial during the early adoptive phase. Initial learning can safely be facilitated through cadaveric dissections and other laboratory training opportunities, expert mentorship, and importantly, by starting with only the simplest surgical cases.

Spinal endoscopy—the patient needs must always come first

Current data suggests that spinal endoscopy may be non-inferior to other MISS or open techniques in specific surgical settings (5,6,13). Specifically, several randomized-controlled trials and meta-analyses to date have demonstrated equivalent outcomes in patients undergoing spinal endoscopy for the treatment of lumbar stenosis (14), lumbar disc herniations (15-17), and cervical radiculopathy (18,19) when compared to the use of more conventional MISS techniques.

With growing enthusiasm for spinal endoscopy, many variations of surgical techniques have now been described for the treatment of these aforementioned pathologies. Furthermore, there has been a rapid expansion in recent years in the proposed surgical indications for spinal endoscopy. Given the infancy of these technical variations and more novel surgical applications, supporting literature is, in many cases, still limited to a few case series at best. While early data appears to support the efficacy of spinal endoscopy in these expanded settings, it is crucial to remember that our patients' needs must always come first. Consequently, until higher quality evidence emerges, it is absolutely essential to emphasize that careful and slow incorporation of only the most clinically validated techniques into one's surgical armamentarium is a must, particularly in the early stages of adoption.

Spinal endoscopy is not without complications

During the early experience, surgeons should anticipate higher rates of recurrences and treatment failures with use of spinal endoscopic techniques when compared to equivalent open or traditional MISS techniques. The risk of complications may additionally be comparatively higher. Complications including durotomies, neural injury, iatrogenic facet damage, and post-operative diskitis have all been described. Overall rates of complications reported in the literature vary from 0.14% to up to 21% (20,21).

Most experts attribute the variable complication profile seen in spinal endoscopy to the substantial learning curve associated with initial skill development. Fortunately, it appears that there is an inverse relationship between surgeon experience and the rate of related complications. Thus, in experienced hands, the risk of complications and rates of treatment failure appear comparable to that of similar MISS procedures (21,22). Nonetheless, this latter point again underscores the importance of slow and careful incorporation of spinal endoscopy techniques into one's practice.

In the context of this discussion, it is understandable, that the fear of harming one's patients represents a significant barrier to entry to spinal endoscopy particularly for the established and traditionally trained surgeon. As spinal endoscopy is not routinely taught in residency or fellowship in the United States, a baseline comfort level with related techniques is typically non-existent. This thereby brings to light a notable deficiency in current spinal surgical training.

The Slow adoption of spinal endoscopy in the United States

Despite several decades of developmental history in the United States and a recent surge in international interest in spinal endoscopy, adoption of spinal endoscopy has been slow. In contrast, spinal endoscopy has been more rapidly adopted outside of the United States, particularly in Asian countries. While it is ultimately a matter of opinion on why the adoption rate of endoscopic surgery in the United States has lagged far behind the rest of the world, we offer several reasons below that may account for this ongoing delay.

Firstly, in the United States, the vast majority of endoscopic surgery is being taught at weekend courses and not in academic spine training programs. The few formal training opportunities that do exist are limited to post-graduate mentorships. This is mainly due to the fact that the leaders in endoscopic surgery are mostly in private practice and are therefore not directly involved in graduate medical education. Therefore, surgeons, at best, are learning endoscopic techniques in their "spare" time at cadaver courses, which typically only last one or two days. It is understandably quite difficult to learn any spine surgery technique during a short cadaver course, let alone, a technically very demanding one. Consequently, when combined with the steep associated learning curve, surgeons are less likely to adopt spinal endoscopy into their practice. Ultimately, these latter points highlight a potential need

for more structured spinal endoscopy instruction. Perhaps the development of endoscopic spine surgery curricula at academic programs is the optimal way to ensure adequate training in this regard.

Another reason why the United States adoption of spinal endoscopy has been slow is perhaps related to the high financial costs associated with the incorporation of spinal endoscopy into a surgical practice. This latter barrier, in combination with the overall low reimbursements for discectomy surgeries, may result in a net financial loss for both the surgeon and the surgical facility, further de-incentivizing the adoption of spinal endoscopy. However, this could potentially be offset by the continued evolution of endoscopic-assisted spine fusion, as financial losses to the surgeon and the facility may consequently be mitigated to some degree. In light of this, perhaps by lowering the initial costs to entry, more surgeons will be further inclined to adopt this technology into their practices.

The more rapid adoption of spinal endoscopy abroad is also likely a consequence of less stringent political and economic restrictions placed on the incorporation of new technologies outside of the United States. Furthermore, there is a long history of the early adopters of endoscopic surgery being potentially viewed as on the fringe of appropriateness. Although a thorough review of the political history involved would be beyond the scope of this article (and inevitably no “hard” evidence would be available), it is important to understand that certain political forces have also limited the growth of endoscopic surgery in the United States.

Another factor that has limited the growth of endoscopic surgery in the United States is related to both the amount and quality of the evidence that exists in support of the technique. Furthermore, aside from the publications of a few key opinion leaders within the United States, most of the current scientific literature comes from abroad. Proponents of the techniques will state that there is an abundance of published evidence in support of endoscopic techniques. Other proponents have even made claims both at national and international meetings, that scientific evidence is not required, and personal experience should prove that these are worthwhile techniques—we do not agree with this latter statement. On the contrary, those who oppose endoscopic surgery, will point to the limited amount of supporting evidence that exists, and more specifically, the paucity of high-level evidence that exists in support of endoscopic surgery. Ultimately, it is clear that this is a subjective argument, which we are not attempting to resolve

in this article. Nonetheless, it is important for readers to be aware of some of the ongoing debates.

Perhaps the last reason why endoscopic surgery has been slow to be adopted in the United States, is the close relationships that exist between surgical techniques and the industry vendors who sell the related equipment. For instance, the vast majority of endoscopic courses in the world today are sponsored by the vendors who manufacture and sell the equipment. This may lead to the perception that endoscopic techniques are closely tied to the interests of the commercial companies. While this is certainly not uncommon with most novel spine surgery techniques, in this day and age where relationships are highly scrutinized and disclosures and potential conflicts have to be completely transparent, this reality could incite a degree of skepticism regarding the true utility of these techniques. In light of this, professional societies have begun to offer instructional courses that utilize multiple vendors and are directly overseen by the societies themselves. These types of courses may help to alleviate some of the aforementioned concerns, ultimately serving as additional useful avenues of endoscopic training.

Spinal endoscopy—NASS Coverage Guidelines (23)

The North American Spine Society has recently put forth updated coverage recommendations regarding endoscopic spinal surgery. The society has established, based on available literature, that endoscopic decompression and discectomies are non-inferior to open surgeries in the following settings: (I) primary or recurrent lumbar disc herniation with radiculopathy and (II) spinal stenosis—if non-operative treatment measures fail and symptoms are prolonged. It is important to note that the society is explicit in their guidelines in that these recommendations do not represent “standard of care”. Consequently, the ultimate burden of responsibility and surgical decision-making falls on the treating physician.

Conclusions

With increasing popularity of less invasive spine surgery and despite some notable barriers to entry, more widespread adoption of spinal endoscopy in the United States appears inevitable. While favorable outcomes may be achieved with use of spinal endoscopy for select surgical indications, higher quality evidence is warranted to fully support its clinical efficacy. Furthermore, in a rapidly advancing field,

surgeons must exercise careful optimism in the adoption of spinal endoscopic techniques and pace its implementation into their day-to-day practice commensurate with their skill level. These techniques should be slowly incorporated into a surgeon's practice only after undergoing proper education on surgical techniques and indications. Finally, in the early adoptive phase, stringent patient selection and rigid surgical indications are crucial to ensure optimal patient care.

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Footnote

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