

Minimally Invasive Spine Surgery Techniques

Gabriel Tender
Editor

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Chapter 1

Introduction to Minimally Invasive Spine Surgery



Gabriel Tender, Daniel Serban, and Anthony DiGiorgio

Spinal pathology is widespread in the United States and, as the population ages, the prevalence is only going to increase. Greater than 90% of adults older than 65 show radiographic evidence of spinal degeneration [1] and 25% of all adults report some sort of physical limitation due to spine problems [2]. This is one of the leading causes of emergency room visits, missed work days, disability and productivity loss in the country. The average annual health care costs of an individual with low back pain are nearly three times those of one without [3]. Overall, spinal pathology costs American society over \$200 billion per year [4].

This cost will continue to grow. Expenditures for patients with spine pathology have increased faster than overall healthcare expenditures [2] (which are already expanding at an alarming rate). Millions of patients are seeking relief with conservative measures each year [5] and over a third of these patients are taking some sort of opioid pain medication [3]. However, in select patients, surgical intervention has been shown to be cost-effective, decreasing analgesic use and days missed from work [5, 6].

Advances in spine surgery continue as surgeons strive for better outcomes, leading to the advent of minimally invasive surgery (MIS). Operations that had been performed via large incisions with dissection of tendon & ligamentous attachments can now be performed using tubes, expandable retractors and microscopes (Fig. 1.1).

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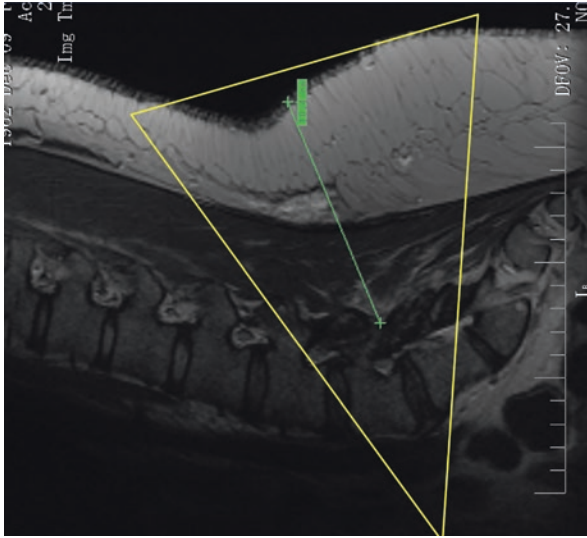


Fig. 1.1 Preoperative evaluation by lumbar MRI, suggesting the extent of the skin incision and muscle dissection necessary to access the disc in an obese patient. The same patient would be able to undergo a minimally invasive fusion through a less than 1 in. incision

These various portals minimize the disruption to the surrounding tissues, leading to less blood loss, decreased postoperative pain and faster recovery.

Advancing MIS techniques been expanded to all areas of the spine, and are not limited to degenerative disease. MIS has been utilized for neoplastic, infectious, deformity and traumatic etiologies as well. Mastery of these technologies is another tool for the surgeon's armamentarium, not meant to completely replace open surgery. In fact, algorithms have been developed to guide surgeons to the appropriate use of minimally invasive versus open surgery [7, 8].

As healthcare business models move to a more value-based paradigm, improved cost-effectiveness is needed to justify the increased upfront costs of new technologies. Additionally, MIS techniques come with a steep learning curve. The improved economic benefits of MIS are not immediately realized and there is a paucity of economic research showing a benefit of MIS [9–11]. However, as surgeons increase their experience, operative times and length of stay decrease [12]. Length of stay is one of the primary drivers in hospitalization costs after spine surgery [13], and decreasing this is sure to please patients, providers and payers alike.

While the perceived benefits of MIS are becoming more illuminated in the literature, market demands continue to push the envelope of this emerging technology. The competitive nature of modern medical practice continues to drive the delivery of surgical spine care. The ability to offer MIS techniques is becoming a requirement for today's spine surgeon.

Nonetheless, the minimally invasive spinal techniques started to blossom at the turn of the millennium and many had anticipated that they will become the standard of care within 5–10 years. We are now almost 20 years later and still the minimally

invasive techniques are used and taught in academic centers in only 10–20% of all cases. So why have the surgeons not embraced and the patients not demanded the minimally invasive spine techniques?

The answers are complex and an in-depth analysis is beyond the scope of this book. However, one of the major factors playing a role in the lack of widespread usage of MIS techniques is the difficult learning curve. The minimally invasive techniques are practiced and taught by “open” surgeons who have converted to the new techniques. The problem is, even the most talented surgeons will experience a longer operative time when they first start practicing the MIS techniques. This may be frustrating and discouraging, not to mention financially detrimental for the private practice spine surgeon. Fortunately, once the surgeon becomes experienced in the MIS techniques, the operative time typically decreases below that of open cases, and we have yet to encounter a surgeon who reverted to the open techniques once the minimally invasive ones were mastered.

Probably the best time to learn the MIS techniques is in residency (like everything else in surgery, or medicine for that matter). The residents are unbiased and they will learn new things as they are introduced to them, without having to break “old habits” or worry about increased operative time and implicitly decreased revenue. We strongly believe that the residents should be exposed to both the open spinal procedures (initially) and the minimally invasive techniques, once they have a good understanding of the anatomy. It is imperative for them to learn not only the surgical skills, but also the limitations of these techniques.

This book was written for the residents and all the spine surgeons who want to better understand the minimally invasive spine surgery techniques. It was intended to offer a unique technical manual with detailed algorithms for these techniques. Each chapter provides a thorough description of the standard surgical technique, followed by pearls learned through almost 20 years of MIS experience. Finally, and probably most importantly, we selected the most representative operative videos for each chapter, in an attempt to provide a “real life” experience to the training surgeon. We hope that our readers, from the novice resident to the experienced surgeon, will find something new and interesting in this book.

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Chapter 2

Microdiscectomy



Niki Calina, Daniel Serban, Adriana Constantinescu, Anthony DiGiorgio, and Gabriel Tender

Introduction

Lumbar microdiscectomy performed through a tubular retractor is typically the first minimally invasive operation of spine surgeons. This technique involves an algorithm of operative steps that allows safe removal of the herniated disc with minimal complications.

Indications

The indications for lumbar minimally invasive laminotomy are the same as for the open laminotomy—unilateral lumbar stenosis with compression of a spinal nerve and resultant radiculopathy, due to one or more of the following:

- herniated nucleus pulposus
- facet or yellow ligament hypertrophy
- synovial cysts or other space occupying lesions.

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Most surgeons recommend a short course of conservative treatment prior to surgical intervention, with the caveat that delaying the nerve decompression for more than 6 months from the onset of symptoms may result in chronic pain and/or persistent sensory/motor deficits, despite removal of the herniated disc.

Contraindications

There are no absolute contraindications for this technique.

A relative contraindication is a recurrent disc herniation that was initially treated by an open discectomy. In these cases, the same skin incision should be used. If the initial herniation was treated in a minimally invasive fashion, it should also be re-explored through the same incision, with a tubular retractor.

Another relative contraindication is morbid obesity, when the distance between the skin surface and the lamina is over 100 mm (the longest typical tubular retractor). However, since the fat is depressible, we have used this technique in many morbidly obese patients without having to convert to an open procedure.

Surgical Technique

The following operative steps are described:

- positioning
- skin incision
- retractor placement
- laminotomy
- yellow ligament removal
- discectomy
- closure

Positioning

The patient is placed in prone position on a Wilson frame, with the arms tucked to the sides and with adequate padding for all pressure points. If the Wilson frame is not available, we adjust the table to place the patient in slight hip flexion, in order to open up the interlaminar space and decrease the amount of lamina needing to be removed to access the disc.

Skin Incision

The level of interest is identified on the lateral image by placing a spinal needle in alignment with the intervertebral disc to be removed (Fig. 2.1). The skin incision is centered on the spinal needle entry point and is typically 1.5–2 cm in length, parallel