



Expanding indications of full endoscopic spine surgery

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It is with great interest we read the surgical report written by Drs. Telfeian and Wagner entitled “*Transforaminal endoscopic thoracic discectomy: surgical technique*” (1). In this publication, the authors describe the step-by-step procedure of performing a thoracic discectomy full-endoscopically. Advantages of performing a full-endoscopic thoracic discectomy include (I) a smaller incision; (II) performing surgery under awake circumstances, which enables patient feedback as neuromonitoring; (III) offering surgery on an outpatient basis shortening the length of hospital stay; and (IV) reducing the bony invasiveness of the spine with consequently reducing the need for instrumented fusion (2). A potential disadvantage of offering full-endoscopic discectomy for thoracic disc herniations include the learning curve, as the authors also recommend prior endoscopic experience with the lumbar spine, sufficient practice in a cadaver laboratory and having a proctor. Another disadvantage may be the costs involved with offering endoscopic surgery. These costs can be divided into direct costs (e.g., equipment costs) but also indirect costs (e.g., productivity loss due to the learning curve).

Both authors of this technical report are front-runners in the evolving field of full-endoscopic spine surgery and both are actively involved in training the next generation of spine

surgeons. It is therefore our pleasure to further discuss the full-endoscopic transforaminal approach to treat thoracic disc herniations.

The quest for the least invasive technique

Throughout the last decades a clear shift can be observed among all types of surgeons from performing conventional open surgeries to offering less invasive technique (3,4). The first lumbar discectomy was described in the early 1900s by Krause and Oppenheim, who performed a surgery for what they then thought to be a chordoma (5). Later, in 1934 it was Mixter And Barr who published their experience with performing surgery for herniated lumbar discs (6). Until then, surgery was highly invasive and went alongside a high incidence of complications such as dural tears and instability of the spine. As during the coming decades, new surgical instruments were developed and existing instruments were improved, the invasiveness of lumbar discectomy could be reduced. With the development of microsurgery, it were Yasargil and Caspar that both started applying the surgical microscope to perform an interlaminar discectomy to treat sciatica (7,8). This interlaminar transflaval procedure is nowadays still regarded as the gold standard to surgically

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treat a lumbar herniated disc (9).

During that same time period, there also grew an increasing interest in the posterolateral approach of the disc, primarily mainly for diagnostic purposes. It was then Hijikata, who first described the percutaneous nucleotomy during which he used special tubes and rongeurs to perform a discectomy (10). Then in the 1980s this procedure was further developed and applied by Parviz Kambin. Kambin later also described the triangular safe entry zone of the spine between the exiting nerve root, the transversing nerve root and the superior endplate of the lower vertebral level. This safe entry zone is nowadays also known as Kambin's triangle (11). In later years, it was the adaption and implementation of these full-endoscopic transforaminal techniques by pioneers such as Anthony Yeung, Thomas Hoogland, Michael Mayer and Sebastian Ruetten, which made these techniques gain more mainstream attention among spine surgeons (12-14).

Open or endoscopic?

The question that remains for most clinicians is: should the endoscopic technique be preferred over the conventional technique? For many indications the evidence in favor of endoscopic procedures over conventional procedures, is thin. And most of the studies that are conducted, conclude non-inferiority which may make it more difficult to explain for surgeons why they offer endoscopic procedures as there are no apparent advantages in effectiveness.

Out of all the different indications of full-endoscopic spine surgery, lumbar disc herniation has been most intensively investigated recently. Prior, it was the consensus that there was only moderate quality of evidence on non-inferiority of full-endoscopic transforaminal discectomy compared to open discectomy and there was a lack of cost-effectiveness analyses in the literature (9). Furthermore, it was expected that the benefit of full-endoscopic procedures would only be small for lumbar disc herniation (15). However, as a robust randomized controlled trial showed, full-endoscopic transforaminal discectomy appeared not only to be non-inferior in effectiveness but also dominant in cost-effectiveness compared to open discectomy (16,17). This mainly because of the large amounts of societal costs that were saved in patients undergoing full-endoscopic surgery. Based on this study and other recent studies, there now appears to be high-quality evidence showing comparable leg pain reduction and high-quality evidence of modestly better functionality after full-endoscopic

discectomy at the long-term (16,18-20).

When we specifically look at thoracic disc herniations, a recently published study looked into the safety and efficacy of full-endoscopic discectomy (21). In a meta-analysis of 13 studies, comprising 285 patients, it was shown that both local anesthesia and the transforaminal approach were mostly used as the surgical strategy. Pooling all data from these studies led to an incidence of 1.3% for dural tears, 4.7% for dysesthesia, 2.9% for recurrent disc herniation, 2.1% for myelopathy, 1.1% for epidural hematoma, and 1.7% for reoperations after endoscopic surgery. The review concludes that full-endoscopic discectomy has a low incidence of adverse events in patients with thoracic disc herniations. However, the quality of evidence was low and therefore more comparative studies are needed.

Future prospects

These future studies should primarily focus on safety and effectiveness of full-endoscopic procedures in comparison with open procedures. Based on these studies, spine surgeons can therefore be encouraged to also offer these procedures as they most likely will demonstrate non-inferiority in safety and effectiveness, but also come with other benefits as a smaller incision, less need for fusion, shorter length of hospital stay and potentially less complications compared to open procedures. Conducting such studies might be challenging, however, as thoracic disc herniations are rare. Aside from conducting the well-known randomized controlled trials, comparative effectiveness studies may also provide the needed evidence to offer full-endoscopic thoracic discectomy as a routine procedure. International collaborations to combine patient data may also offer solutions for these challenges.

In addition to these comparative clinical effectiveness studies, health economic evaluations are also needed. The authors briefly touch this subject as they discuss that the high costs of equipment such as endoscopic towers, may not be justifiable to the hospital when the surgery pays the same. Health economic evaluations might help guide policy makers and hospital management in these decisions. For instance, as a recent study has shown, that from the Dutch health care perspective full-endoscopic surgery for lumbar disc herniations is dominant in cost-effectiveness (17). This dominance was also shown in a higher cost scenario for endoscopic surgery and for the learning curve cases of three different surgeons. With this in mind, it can be imaginable that the shorter length of hospital stay, the less

invasive nature of endoscopic surgery, the reduction of need for instrumented fusion and the fact that equipment may already be present for lumbar indications, may also lead to cost-effectiveness of full-endoscopic thoracic discectomy over open approaches.

Conclusions

These are exciting times for the minimally invasive spine surgeon, and especially for the full-endoscopic spine surgeon. The amount and quality of evidence is increasing, showing the merits of full-endoscopic spine surgery over conventional open techniques in degenerative spine surgery, the number of surgeons offering endoscopic spine surgery is increasing, and the indications for full-endoscopic spine surgery are expanding. As advocates for minimally invasive spine surgery ourselves, we embrace these developments in the field of minimally invasive spine surgery. But at the same time, we must remain critical about implementing full-endoscopic procedures for all these expanding indications. We may not see the same benefits for these additional indications as we see for lumbar or thoracic disc herniations. We may not experience a similar or shorter learning curve when performing full-endoscopic for spinal oncology. And finally full-endoscopic spine surgery may also not be cost-effective compared to open techniques when used treating multiple pathologies in the same patient. We will, however, never know if we as spine surgeons don't keep pushing the envelope and be innovative with the state-of-the-art tools we have. Therefore, we also advocate for conducting more robust research alongside performing full-endoscopic spine surgery for these expanding indications in order to ensure we offer patients the least invasive, safest and most cost-effective treatment.

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