



EUROPEAN MUSCULOSKELETAL REVIEW

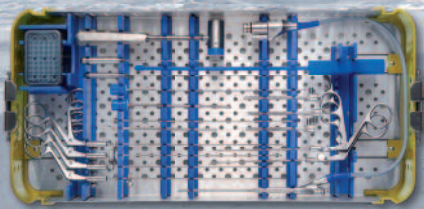
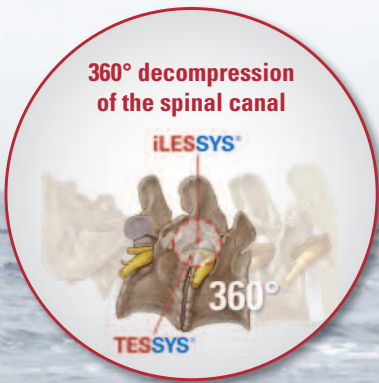
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**Endoscopic Spine Surgery –
Now and Looking Towards
the Future**

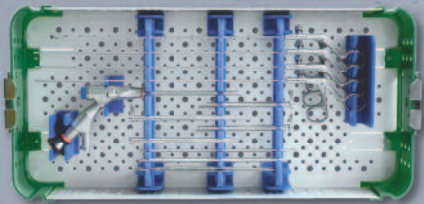
**A Summary of an
Educational Symposium
Held at the Swedish
Covenant Hospital
in Chicago, Illinois, 3
November 2011**

Janet Manson

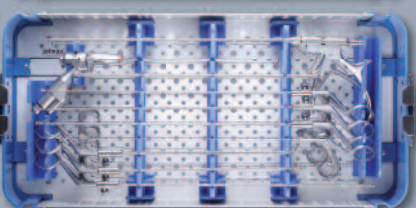
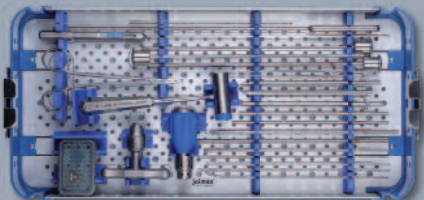
Medical Writer, Touch Briefings, London, UK



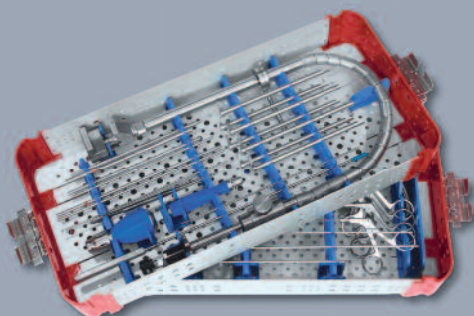
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Endoscopic Spine Surgery – Now and Looking Towards the Future

A Summary of an Educational Symposium Held at the Swedish Covenant Hospital in Chicago, Illinois, 3 November 2011

Janet Manson

Medical Writer, Touch Briefings, London, UK

Abstract

A key technological advancement in endoscopic lumbar surgery is the joimax-TESSYS® technique which allows direct access to the herniated nucleus pulposus (HNP) and direct visualisation of the nerve roots. Data presented demonstrated that when using this technique a patient outcome success rate up to 97 % was seen in sequestered or extruded herniations. The importance of the multifidus muscle as a spinal stabiliser was discussed and it was noted that, despite this, 99.8 % of US surgeons will use microdiscectomy when treating a patient with a disc herniation, which damages the multifidus. Due to shorter recovery times, there is intense patient demand for endoscopic lumbar surgery. The impact on a surgical practice of adopting joimax-TESSYS was reviewed, with a subsequent increase of 13 % in surgical volume and an increase of 15 % in new patient consults post-adoption. Finally, surgical demonstrations were presented, highlighting that TESSYS can successfully treat a range of conditions, including sequestered disc herniations and multisegmental degeneration. Preliminary European data suggest that there is similar efficacy of TESSYS to microdiscectomy; however, TESSYS was advantageous in that it was associated with less scarring and a shorter hospital stay and required less physiotherapy. Although there are limited US studies of patient outcomes following TESSYS, prospective studies are currently in progress to evaluate the success of this cutting-edge technique using the Society for Minimally Invasive Spine Surgery (SMISS) prospective registry.

Keywords

Transforaminal endoscopic surgery, minimally invasive

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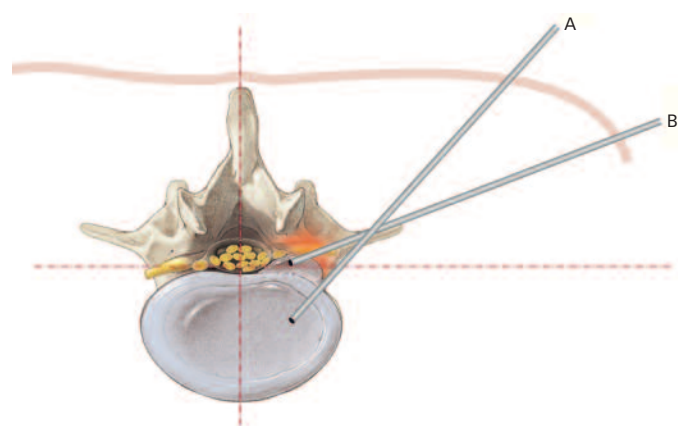
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Spinal surgery can be categorised into open or percutaneous approaches, with the latter having the advantage of being more minimally invasive. Minimally invasive spine surgery (MISS) is a broad term covering several different surgical approaches, but all are designed to access the spine while avoiding the corresponding muscle damage that occurs during open surgery.

In the last few decades, endoscopic techniques of MISS have been developed allowing direct access to, and visualisation of, the spine and the herniated nucleus pulposus (HNP).

In transforaminal endoscopic surgery (TES), access to the disc space is gained through the intervertebral foramen, and there are two main techniques for achieving this (see *Figure 1*). The first is the older intradiscal technique (A), which requires a high level of expertise and has the significant disadvantage that the nerve root is not visible during the procedure. The second is the more recent intracanal-transforaminal technique (B), which uses a more lateral trajectory to manoeuvre into the canal posterior to the disc.¹

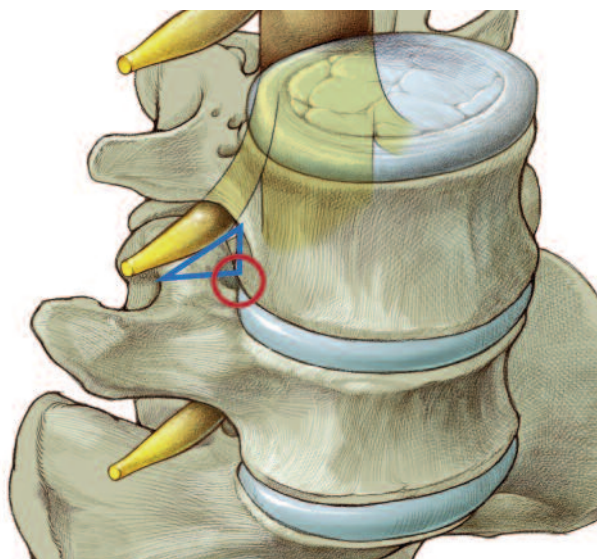
Figure 1: Different Transforaminal Approaches to the Lumbar Disc Herniation



(A) Intradiscal technique: the pathology is accessed indirectly.

(B) Intracanal-transforaminal technique: the pathology is directly accessed through a more lateral trajectory.

Figure 2: The Specific TESSYS® Approach



The blue triangle is the so-called Kambin Triangle and the red circle points to the specific TESSYS-targeted approach allowing direct access to the spinal canal.

The transforaminal endoscopic surgical system (TESSYS®, joimax GmbH) uses the intracanal-transforaminal technique and approach (see Figure 2), in conjunction with a set of guiding rods, guiding and working tubes and reamers developed by joimax.^{2,3}

The Endoscopic Spine Surgery educational symposium was chaired by Daniel T Laich and consisted of four presentations by leaders in minimally invasive endoscopic spine surgery.

In the first, Daniel T Laich introduced the advantages of TES, and outlined the findings of a study analysing patient outcomes after endoscopic spinal surgery.

Choll W Kim then summarised the muscle damage that can be caused by open surgery and microdiscectomy, and listed the obstacles to adoption of minimally invasive surgery.

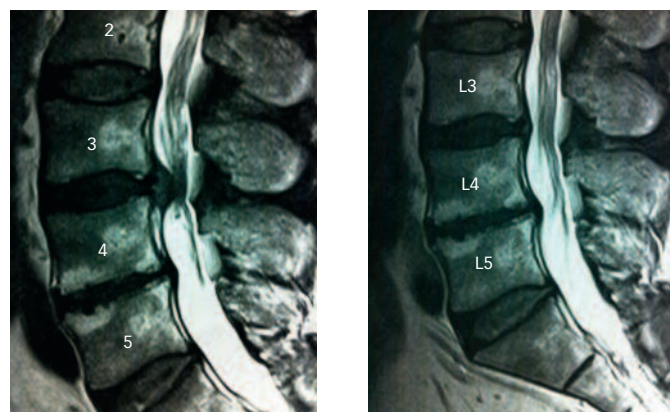
Following this, Rob Blok reviewed the impact that TESSYS has had on his practice, and finally Ralf Wagner demonstrated the surgical steps involved in TESSYS surgery and discussed his personal experiences using his altered fast-track technique. ■

What Are the Advantages of Transforaminal Endoscopic Surgery?

Daniel T Laich

Neurological Surgeon, Chicago Back Institute, Chicago, Illinois, US

Figure 3: Pre- and Post-surgical Magnetic Resonance Imaging Scans from a Patient with Cauda Equina Syndrome Showing that the Herniation Has Been Successfully Removed



There are significant advantages to TES: it is the least invasive surgery, causing virtually no trauma to the muscles, ligaments and bones and, because of this, it has no destabilising effect on the spine; there is minimal bleeding and less anaesthesia is needed than for open surgical techniques; it is easier on the patient both intra-operatively and post-operatively; and, lastly, patients have both a quicker recovery and resumption of their normal activities.

Does Transforaminal Endoscopic Surgery Work?

The clinical outcomes of 122 TES patients were presented. Although disease in one level was most common, 237 levels were addressed altogether. Eighteen of the patients had had prior microdiscectomy.

Visual analogue scale (VAS) pain scores and Oswestry Disability Index (ODI) scores were significantly improved in all patients after surgery. When starting with TESSYS, it is important that the surgical choice is based on the correct patient indications. Interestingly, a study by Dewing et al. noted a 16 % failure rate at 24 months post-microdiscectomy, but observed that the success of the operation was influenced by the herniation type and level.⁴

Patient data were hence analysed after examining the patient pathoanatomy and patients with back pain equal to, or greater than, leg pain were excluded. In patients with sequestered or extruded herniations endoscopic spinal surgery with TESSYS resulted in a 97 % success rate (75/77) of patient outcomes.

Lastly, a demonstration was presented of the successful results of joimax-TESSYS surgery on a patient who fell in the shower resulting in a cauda equina syndrome. Post-operative magnetic resonance imaging (MRI) scans confirmed successful decompression of the canal using this surgical technique (see Figure 3). ■

Why Endoscopic Spine Surgery?

Choll W Kim

Associate Clinical Professor of Orthopaedic Surgery, University of California, Director of the Minimally Invasive Spine Center, Alvarado Hospital, San Diego, California, US and founder of the Society for Minimally Invasive Spine Surgery (SMISS)

The goals of endoscopic MISS are identical to those of open surgery: to decompress when there is spinal stenosis; to fuse or stabilise the spine when needed; and, lastly, to realign the spine if there is a deformity. Endoscopic MISS and open surgery can be distinguished by the following key factors: the retraction methodology (the type of retractors, the length of time of retraction and the trajectory of the retraction); the preservation of tendon attachment, especially of the multifidus muscle; the extent of bone resection performed; and, finally, the approach trajectory of the surgery. It is important to note that the size of the incision is merely cosmetic.

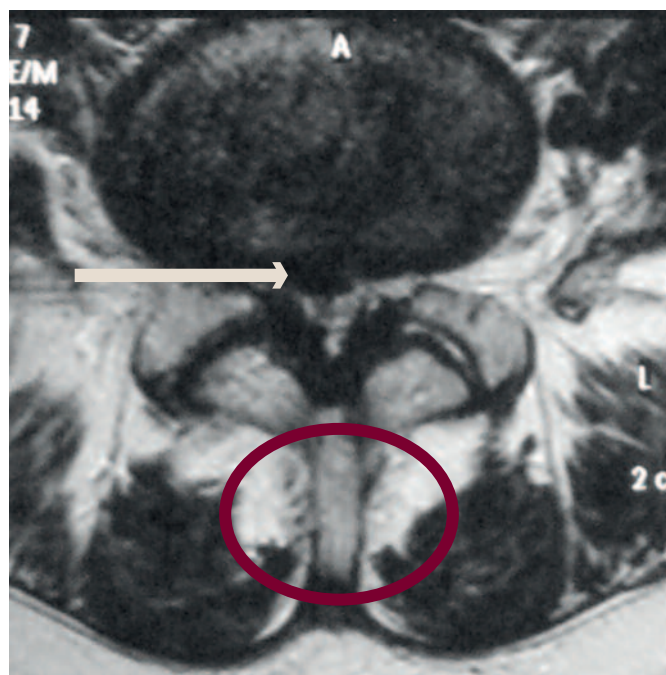
The key factor in transforaminal endoscopic spine surgery is saving the multifidus muscle (see *Figure 4*). This muscle is adjacent to the midline of the spine and provides biomechanical stability to the back. The longer you retract the multifidus, the more damage is inflicted.⁵ Interestingly, retraction during surgery does not just affect the back muscles. In a comparison of open surgery versus MISS, a two- to threefold higher level of the biochemical markers creatine kinase and aldolase has been observed in the peripheral blood, and this is also true of inflammatory cytokines.⁶ In addition, retraction had been demonstrated to cause muscle necrosis and fibrosis, muscle fibre size atrophy, loss of adenosine triphosphatase activity and systemic inflammation.^{7–10}

So what is the function of the multifidus, and what are the consequences of injury? Looking at measurements of muscle architecture, such as mass, fascicle length, insertion angle, muscle length, sarcomere length and elastic modulus, it is possible to make some predictions about the function of the multifidus. When analysing data comparing muscle strength with range of motion, we observe that the multifidus is very strong but imparts little joint motion.¹¹ The multifidus becomes stronger in flexion, and in this state is designed to generate the greatest amount of power. Interestingly, this muscle is unique in terms of its strength and range of motion compared with other back muscles.¹¹ In summary, the multifidus is designed for short, powerful movements. It is optimised to exert maximum force with flexion, and is a key stabiliser of the lumbar spine.

What Are the Obstacles to Adoption of Endoscopic Spine Surgery?

The top two reasons for the lack of adoption of transforaminal endoscopic spine surgery are technical challenges, namely the difficulties of performing the surgery and learning a new technique. The first methodology for endoscopic lumbar surgery used by surgeons was the 'inside-out' technique (also known as the intradiscal technique) (see *Figure 1A*). This surgery requires a high level of expertise and has the disadvantage that the nerve root cannot be seen during the operation. More recently an 'outside-in' (or intracanal) technique has been developed, and this uses a more lateral trajectory to manoeuvre into the canal posterior to the disc

Figure 4: The Multifidus Muscle Is an Important Stabiliser of the Spine



The standard midline approach detaches the multifidus tendon leading to degeneration of this muscle (circled in red).

(see *Figure 1B*). Using this technique the nerve can be visualised and the disc herniation accessed. A systematic literature review of transforaminal surgery outcomes from studies comparing the inside-out technique with the outside-in technique demonstrated a difference of 5.3 % versus 2.1 % in complication rates, respectively, and a difference of 7.5 % versus 4.6 % in patients needing re-operation, when evaluating the two techniques.¹²

There is patient demand for endoscopic lumbar surgery due to the shorter recovery times compared with previous, more invasive surgical techniques. Endoscopic MISS competes with microdiscectomy as the standard patient treatment but the most significant obstacle to adoption by more spinal surgeons is that it is technically difficult. The majority of US surgeons are familiar with the intradiscal (or inside-out) technique, but this technique does not allow direct access to the herniated disc or visualisation of the nerves. A key technological advance in MISS is the intracanal technique developed by joimax called TESSYS. This technique allows direct access (see *Figure 2*) to the HNP and visualisation of the nerve roots. European studies following patient outcomes post-surgery have proved promising and, although there are limited US studies, prospective studies are currently in progress using the Society for Minimally Invasive Spine Surgery (SMISS) prospective registry. ■

Personal Experiences of Adopting joimax-TESSYS®

Rob Blok

Head Surgeon, Spine Center of Southern Indiana, Jeffersonville, Indiana, US

MISS has the advantages of less scarring, increased stability, reduced risk of infections and a faster return to work for the patient. Rob Blok presented his personal experiences changing from open surgery to MISS, starting with his surgical fellowship where he was not exposed to MISS, then entering private practice where he migrated to tubular retractor systems and, finally, after being unhappy with the damage to the lumbar musculature, changing his surgical technique and learning to use the joimax-TESSYS system.

Due to the quick recovery time, there is a high demand for endoscopic lumbar surgery. Patients are educating themselves on new technology, using the Internet and discussing surgical results

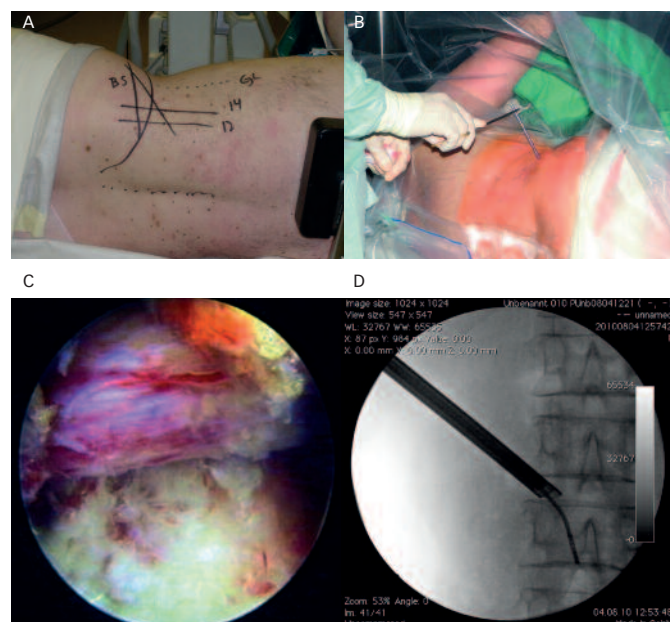
through word of mouth. After the joimax-TESSYS procedure was introduced to the practice, a patient travelled all the way from California to Kentucky for surgery after deciding that endoscopic lumbar surgery was appropriate for him. Educating local primary care physicians on spinal surgery options also increased patient volume. After adopting joimax-TESSYS, Rob Blok's surgical volume increased by 13 % and new patient consults increased by 15 %. Out of 200 endoscopic operations completed using this new method there was only one revision for a reherniation, and no infections were noted. TESSYS has now become the standard of care in his office, and he has had requests from surgeons at two local spine practices to be trained. ■

Surgical Demonstrations of joimax-TESSYS®

Ralf Wagner

Orthopaedic and Spine Specialist, LIGAMENTA Spine Centre Frankfurt, Germany

Figure 5: Creating Access to the Spinal Canal



(A) and (B) show the marking, planning and approach to the spinal canal with the patient in a lateral position. (C) shows an intra-operative endoscopic picture with an inflamed nerve root. (D) shows an X-ray with semi-flexible forceps capable of reaching even the disc level below.

Ralf Wagner demonstrated the surgical steps involved in gaining access to the HNP using TES, after first planning access and secondly marking the entry point. With special instruments, the surgeon

progressively and gently dilates the access through the soft tissue and muscles. The use of sophisticated reamers then allows careful widening of the intervertebral foramen and direct access to the herniated material within the spinal canal (see *Figures 5A and 5B*). After showing the steps to surgical access, two surgical demonstrations were given. Firstly, an intra-operative view of surgery on a 65-year-old male patient with sciatica and L4 plegia was shown. This was followed by an intra-operative view (see *Figure 5C*) of surgery on a 44-year-old female patient, who had prior microscopic surgery three years previously and a recurrent disc herniation at L4/5. In addition to these demonstrations, two important surgical tools for endoscopic lumbar surgery were outlined: flexible forceps (see *Figure 5D*), which are useful for cranially or caudally displaced disc herniations, and straight forceps, which are useful for medial disc herniations. The final demonstration of the successful use of TESSYS was a case study of multisegmental degeneration involving a 72-year-old patient with more than six months of right leg pain, who did not want to have open surgery. The patient had stenosis in L3/4, a calcified disc (L4/5) and listhesis of L5 on S1. Using TESSYS surgery, decompression was able to be completed on all three levels from one access port in less than one hour and 30 minutes.

Does TESSYS® Work?

Preliminary results were presented, from a randomised controlled study in progress, by the group of Alastair Gibson in Edinburgh, comparing the clinical outcomes and costs of TESSYS with microdiscectomy. A total of 81 patients were currently enrolled, with 43 patients undergoing TESSYS and 38 treated with microdiscectomy.

The patients were followed up at three months, one year and two years post-surgery, and the following outputs were measured and compared: ODI; 36-item short form health survey (SF-36) physical and mental scores; VAS for back pain, bad leg and good leg; and

overall costs. Initial results show very similar results in terms of efficacy between the two treatments; however, the endoscopic technique required a shorter length of hospital stay, was associated with less scarring and required fewer physiotherapy sessions. ■

Conclusion

In the current economic climate, patients are interested in returning to work as quickly as possible, and the shorter recovery time associated with endoscopic surgery has driven demand for this procedure. Although surgeons wishing to train in endoscopic surgery face a steep learning curve, the perceived advantages to the patient mean that adoption of this technique can impact favourably on patient numbers and referrals. Microdiscectomy is still considered the gold standard for the treatment of disc herniation. However, the

number of endoscopic surgeries for this condition is growing. Patients undergoing TESSYS can often leave the hospital on the day of their surgery, and therefore changing to this technique could lead to lower hospital operating costs and greater patient throughput. There is currently a paucity of literature following patient outcomes after endoscopic spinal surgery, although several studies are now in progress. Better information on patient outcomes may prove an important factor in increasing the adoption of this technique by spinal surgeons. ■

1. Ipreburg M, Transforaminal endoscopic surgery – Technique and provisional results in primary disc herniation, *European Musculoskeletal Review*, 2007;2:73–6.
2. Ipreburg M, Godschalk A, Transforaminal endoscopic surgery in lumbar disc herniation in an economic crisis – The TESSYS method, *US Musculoskeletal Review*, 2008;3:47–9.
3. Lewandowski K, Pre-operative planning for endoscopic lumbar foraminal decompression – A prospective study, *European Musculoskeletal Review*, 2008;3:46–51.
4. Dewing CB, Provencher MT, Riffenburgh RH, et al., The outcomes of lumbar microdiscectomy in a young, active population: correlation by herniation type and level, *Spine (Phila Pa 1976)*, 2008;33:33–8.
5. Gejo R, Matsui H, Kawaguchi Y, et al., Serial changes in trunk muscle performance after posterior lumbar surgery, *Spine (Phila Pa 1976)*, 1999;24:1023–8.
6. Kim KT, Lee SH, Suk KS, Bae SC, The quantitative analysis of tissue injury markers after mini-open lumbar fusion, *Spine (Phila Pa 1976)*, 2006;31:712–6.
7. Gejo R, Kawaguchi Y, Kondoh T, et al., Magnetic resonance imaging and histologic evidence of postoperative back muscle injury in rats, *Spine (Phila Pa 1976)*, 2000;25:941–6.
8. Kawaguchi Y, Matsui H, Gejo R, Tsuji H, Preventive measures of back muscle injury after posterior lumbar spine surgery in rats, *Spine (Phila Pa 1976)*, 1998;23:2282–7; discussion 2288.
9. Kawaguchi Y, Matsui H, Tsuji H, Back muscle injury after posterior lumbar spine surgery. Part 2: Histologic and histochemical analyses in humans, *Spine (Phila Pa 1976)*, 1994;19:2598–2602.
10. Kawaguchi Y, Matsui H, Tsuji H, Back muscle injury after posterior lumbar spine surgery. A histologic and enzymatic analysis, *Spine (Phila Pa 1976)*, 1996;21:941–4.
11. Ward SR, Kim CW, Eng CM, et al., Architectural analysis and intraoperative measurements demonstrate the unique design of the multifidus muscle for lumbar spine stability, *J Bone Joint Surg Am*, 2009;91:176–85.
12. Nellensteijn J, Ostelo R, Bartels R, et al., Transforaminal endoscopic surgery for symptomatic lumbar disc herniations: a systematic review of the literature, *Eur Spine J*, 2010;19:181–204.



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