Percutaneous Transforaminal Endoscopic Spine Surgery: Introduction - Part 1

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Endoscopic spine surgery is evolving rapidly due to improvements in surgical technique, endoscope design, and instrumentation. In an experienced surgeon's hands, the endoscopic foraminal approach can be utilized for most lumbar disc herniations and for the diagnosis and treatment of degenerative conditions of the lumbar spine. The advantage of the foraminal endoscopic technique is the ability to reach, visualize, and treat intradiscal and foraminal pathologic lesions without destabilizing the posterior muscle column and facets. The learning curve is steep, but once mastered, the surgeon is able to reach any pathologic lesion in the foramen, including noncontained disc herniations, foraminal stenosis, foraminal osteophytosis, facet cysts, and annular tears.

Introduction

Wolfgang Rauschning's work illustrating the patho-anatomy of degenerative disc disease and degenerative conditions of the lumbar spine serves as a basis for treating pathologic findings with tissue-sparing, minimally invasive spine surgery. (1) Ideally, surgical interventional approaches should preserve normal anatomy and access the patho-anatomy without injuring normal tissue. The dorsal muscle column, if compromised as part of the surgical exposure, may be partly responsible for spinal instability and failed back surgery syndrome (FBSS).

Due to the morbidity of the posterior surgical approach, disc surgery has traditionally been reserved for disc herniations causing radiculopathy or progressive nerve deficits from mechanical compression on the spinal nerves. This relatively conservative posture was due to the inherent morbidity of traditional posterior surgery that must violate and alter the important function of the muscles and facets of the posterior spinal column. Surgical morbidity has, therefore, limited the use of surgery as an early treatment option in disc degeneration and herniation. Thus, surgery was usually not recommended for herniations without neurologic deficits. The dogma that, "disc surgery is really decompressive nerve surgery," dominates the rationale for decompressive

discectomy for herniated discs.

Many disc herniations, however, are not the result of an acute event, but an accumulation of several insults to the spine that lead to painful degeneration, annular tears, and eventual disc herniation. (2) Advances in endoscopic surgery therefore offer surgeons the opportunity to visualize and probe pathologic lesions that may cause pain as a prodromal symptom that progress to a full-blown herniation. Minimally invasive surgical options that do not have the inherent approach-related morbidity are possible with the endoscopic foraminal portal, therefore endoscopic diagnosis and surgical intervention can be considered for painful spinal conditions that were previously operated on only when there was evidence of nerve damage.

The foraminal approach provides excellent cannula access from T-10 to L-5 for foraminal structures illustrated in this cadaver dissection (Figure 1). The endoscope and instruments are introduced through a cannula between the traversing and exiting nerves in an area known as Kambin's Triangle (Figure 2). Yeung developed an endoscopic system that featured beveled and slotted cannulas with the open end directed toward the dorsal foramen, exposing the epidural space and the base of the disc herniation in the same endoscopic view (Figure 3). A multi-channel flow integrated operating endoscope offering high quality imaging became the flagship of the new system (Figure 4, 5).

Figure 1. Cadaver dissection of the foramen from L2-S1 demonstrates excellent access to the postero-lateral portion of the disc through Kambin's triangular zone. Blue hubbed needles represent ideal placement of endoscope into the disc. At L-5, S-1, less room is present in the foramen, and a lateral facetectomy may be necessary if a high and narrow Ilium is present. Note the more cephalad the disc, the larger the foraminal portal.

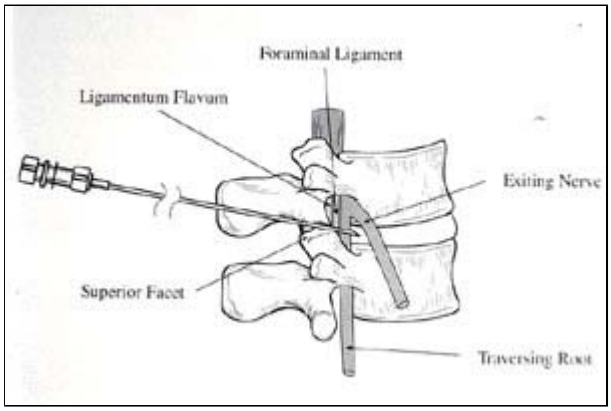

Figure 2. Kambin's Triangle is the site of surgical access for posterolateral endoscopic discectomy. It is defined as a right triangle over the dorsolateral disc. The hypotenuse is the exiting nerve, the base (width) is the superior border of the caudal vertebra, and the height is the traversing nerve root. Kambin initially emphasized avoiding the spinal canal and staying within the confines of the triangular zone.

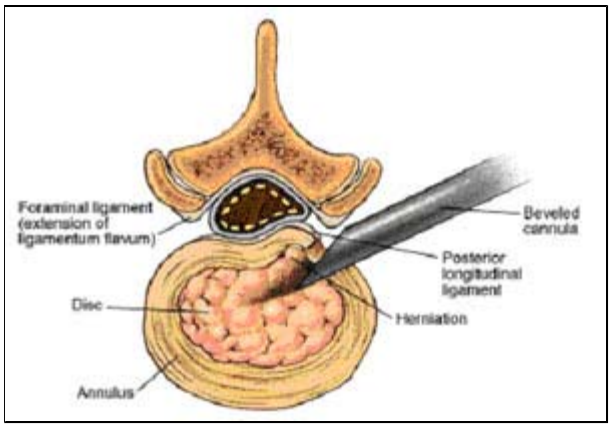

Figure 3a

From Regan JJ. Lieberman I. Atlas of Minimal Access Surgery, 2nd Edition. St. Louis: Quality Medical Publishing, 2003.

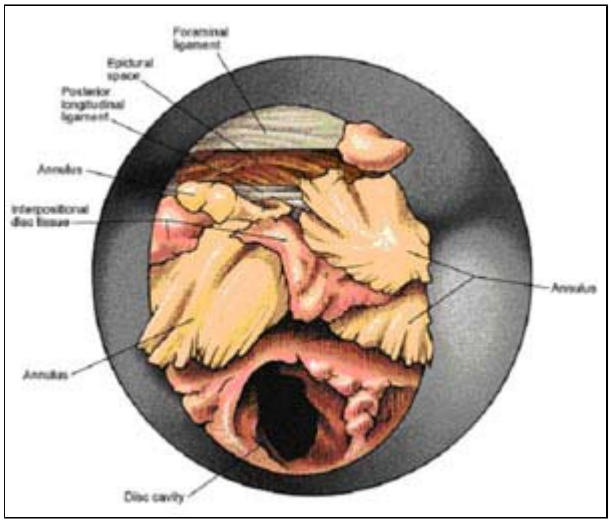

Figure 3b

From Regan JJ. Lieberman I. Atlas of Minimal Access Surgery, 2nd Edition. St. Louis: Quality Medical Publishing, 2003.

Figures 3a and 3b. Matthews and Yeung simultaneously advocated using Kambin's posterolateral approach to target the base of the disc herniation closer to the dura/traversing nerve root. Matthews first described the foraminal ligament as the "door" to the foramen. This approach advocated a more horizontal trajectory to the disc and visualization of the epidural space. By beveling the cannula, the YESS™ system provided visualization of the epidural space while targeting the base of the herniation. It was also no longer necessary to use a trephine to fenestrate the annulus.

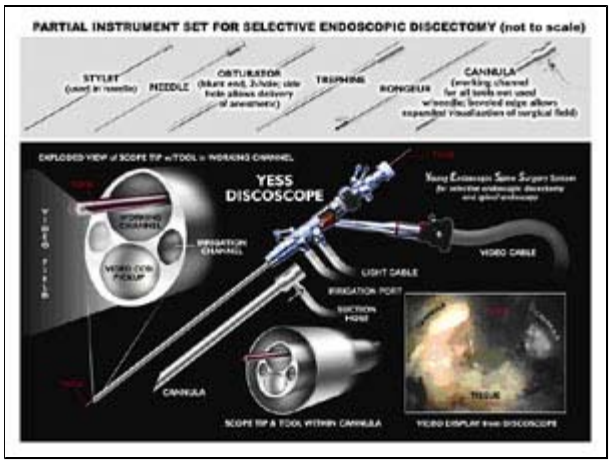

Figure 4. The YESS™ endoscope features multi-channel irrigation and a 2.8-mm working channel. Complementary access cannulas and instruments improved visualization of the epidural space and the foramen. (Illustration by David Azarello)

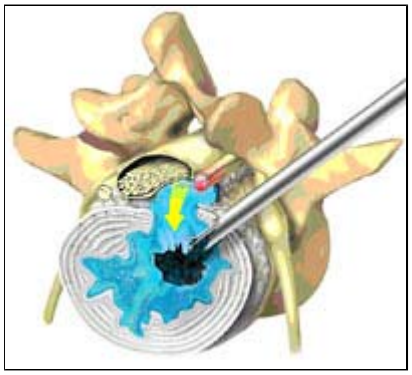

Figure 5. Uniportal technique for selective endoscopic discectomy. Small pituitary rongeurs are used for visualized posterior fragmentectomy. The beveled cannula can be positioned to view the epidural space, annular wall, nucleus pulposus, and intradiscal cavity in the same field of vision. The cannula can be rotated to provide surgical access, but at the same time used to protect the exiting nerve. (Illustration by David Azarello and Christopher Yeung)

The purpose of this article is to present advances in endoscopic technique and equipment that showcase the foraminal endoscopic approach to the spine as a minimally invasive, tissue-sparing alternative to traditional posterior transcanal surgery.

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