Endoscopic Spine Surgery: A New Paradigm

Cirurgia Endoscópica de Coluna: Um Novo Paradigma

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Abstract

The author describes briefly the history of vertebral spine disc pathology and the evolution in its treatment, along with the parallel history of percutaneous procedures that culminated in the development of endoscopic spine surgery. Then the rational for the surgical technique is described, its current and future application, and a consideration on endoscopic spine surgery being an actual paradigm shift in spine surgery is made.

Keywords: Endoscopy; Spine/surgery

Resumo

O autor descreve sumariamente a história da patologia do disco intervertebral e a evolução no seu entendimento e tratamento convencional, assim como a história paralela dos procedimentos percutâneos que culminou no desenvolvimento da cirurgia endoscópica da coluna vertebral. Descreve o racional para a utilização da técnica cirúrgica, as indicações atuais e futuras e conclui com o argumento que a cirurgia endoscópica da coluna vertebral é de facto uma mudança de paradigma na cirurgia da coluna.

Palavras-chave: Coluna Vertebral/cirurgia; Endoscopia

Introduction

It was in 1909 when Krause and Oppenheim described the first lumbar discectomy[1] (Fig. 1). Erroneously they described the herniated disc as a chondroma of the lumbar spine. It took another 13 years until Adson came up with the first report about surgical removal of herniated nucleus pulposus.[2]

However, like often happens in the history of Medicine, the merits for the first disc surgeries went to two other colleagues, namely Mixter and Barr, who still are considered as having been the "first disc surgeons".[3] They actually published the first series of successful disc operations in 1934. Their technique was a complete laminectomy and some of the disc herniations were removed through a transdural approach. It was clear from the beginning that this was a very traumatic surgery with the potential of a variety of complications, including pseudomielomeningocele, instability as well as disabling back pain.

The search for less damaging approaches had started. The reduction of collateral damage was the driving force for the two pioneers of lumbar microsurgery; in the same year, 1977, Yasargil[4] and Caspar[5] described independently an interlaminar

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approach using the microscope. The pioneering work of JA McCulloch[6] made this technique popular in the 90s of the last century and it has since become the "gold standard" for the surgical treatment of this very common pathology, disk herniation.

In the parallel world of percutaneous procedures…

Percutaneous procedures for the treatment of lumbar disc pathology started in 1964 with Lyman Smith's chemonucleolysis[7,8] using Chymopapain, an enzyme derived from the papaya plant, that was able to hydrolyze proteoglycans.[8] The rise and fall of chemonucleolysis, although interesting and relevant in itself, sits outside of the scope of this paper.

In the 70s, Hijikata,[9] a Japanese surgeon, and Parviz Kambin[10,11](Fig. 1), an american neurosurgeon, used the posterolateral access to the disc space which, in the pre-computed tomography (CT) and pre-magnetic resonance imaging (MRI) era, was used to perform diagnostic discographies, the only clear way, along with myelography, to see de disk herniation and its effect in the spinal canal (Fig. 2). Back in those times the discographies were performed by the surgeons themselves, and not by interventional radiologists like today. So these pioneers, these visionaries thought something along the lines of if they can reach the disk to inject a contrast to then do an x-ray to see the pathology, maybe they could also use the posterolateral route to access safely the lumbar disk in a safe, Percutaneous fashion, and do a decompressive procedure. They used this posterolateral approach to the annulus under fluoroscopic control to perform what they called a "percutaneous nucleotomy" with the aid of special tubes and long forceps. It was an x-ray guided "blind" technique, without direct visualization, and did not gain widespread attention among the surgical community at the time but it was the birth of the idea of "percutaneous" discectomy.

Kambin,[12,13] who is considered the father of endoscopic spine surgery, kept at it. He described his famous "safety triangle" in a seminal paper in 1990,[13] that would get his name to became an eponym. Kambin's triangle is defined in the following manner: the base is the disk and upper endplate of lower vertebra, the height is the shoulder of the traversing nerve root and the hypothenuse is the exiting nerve root.

The technologic revolution of endoscopy emerging in the 1980s, initially transformed abdominal surgery (endoscopy + laparotomy = laparoscopy) and orthopedic knee surgery (endoscopy + arthrotomy = arthroscopy), making its way into diverse surgical specialties. This evolution allowed the application of endoscopic technology to spinal pathology treatment.[13-15]

The next conceptual leap occurred in Europe. In the early 2000's, Thomas Hoogland described and developed the Thomas Hoogland Endoscopic Spine System (THESSYS) procedure, a variation on the transforaminal approach, that involved doing an access foraminoplasty with special reamers.[16] This allowed for the so called "outside-in" technique, wich translates to working on the epidural space, on the spinal canal, and not inside the disk. The effectiveness of endoscopic surgery and the scope of applications grew with this conceptual evolution. Soon after, another major leap occurred, and also in Germany. Sebastien Ruetten, a spine surgeon with a passion for endoscopy, took the transforaminal foraminoscope and applied it to the classic interlaminar window because of the difficulty of using the technique in L5-S1.[17] The L5-S1 level poses unique challenges to the transforaminal approach, like high riding iliac crest, smaller foraminal height and a dorsal root ganglion that occupies approximately 50% of the foramen. The L5-S1 interlaminar window is the largest of the lumbar spine, and the combination of smaller foramen and larger interlaminar window makes L5-S1 better suited for an interlaminar than a transforaminal approach, except for foraminal pathology. Ruetten's breakthrough allowed the utilization of the endoscope as a truly minimally invasive alternative to the tubular approach and the microscope. The conceptual revolution demanded technological evolution, with better suited endoscopes for each approach, endoscopic high speeding burr and better tools to deal with bony decompression, and this led to widening the possible indications for endoscopic spine surgery.[18] This significantly enlarged the indication spectrum of this technology: from "simple" disk herniation surgery to spinal stenosis, to the cervical and thoracic spine, to endoscopically assisted fusions, the range of applications of the technology grew immensely in the last decade. This is no less than a paradigm shift in spine surgery, and technology and the technique have matured and endoscopic spine surgery is entering its slope of enlightenment.

Endoscopic Spine Surgery: A Micro--Invasive Innovation**

What is it?

Endoscopic spine surgery is a micro-invasive technique for spinal pathology, employs an 8 mm portal housing an endoscope, a 4K screen, saline solution, and surgical instruments. It offers better visualization than the microscope due to direct visualization, because endoscopic cameras allow us to move

** Conclusion: The Case for Endoscopic Spine Surgery

the "eye's" lens remotely to the site of the surgical pathology. It started as a micro-invasive option for the treatment of disk herniations in the lumbar spine, and then the scope of indications grew to more complex pathology like lumbar stenosis, cervical disk herniations and stenosis,[19] thoracic disk herniations,[20] fusion,[21] even infection[22] and tumor pathology.[23]

Figure 1. Parviz Kambin: percutaneous discectomy, 1986.

Figure 2. Endoscope and endoscopic tools

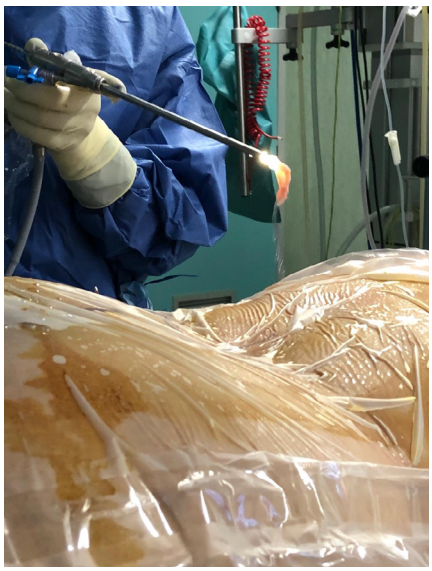

Figure 3. Lumbar Facet radiofrequency

What it is not

It is not a pain treatment procedure like the following techniques: epidural infiltration, foraminal block, facet joint infiltration, ozonotherapy, radiofrequency ablation, and nucleoplasty. These are pain treatment procedures and not surgery.

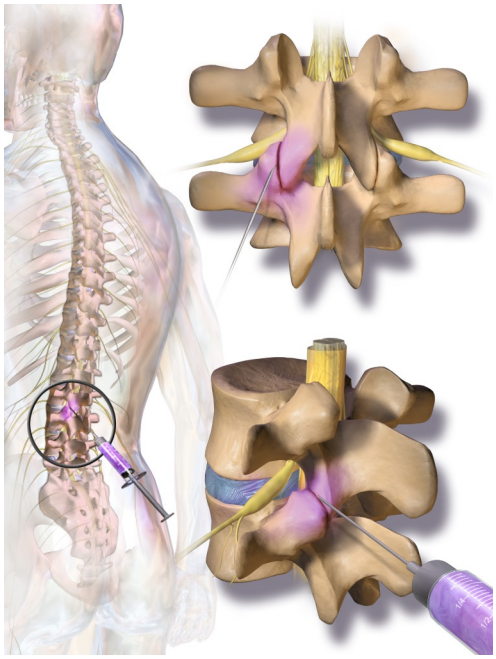

Figure 4. Endoscopic sequestrectomy of a massive disk herniation

Endoscopic spine surgery offers truly minimally invasive treatment, evidenced by favorable results from randomized controlled trials (RCTs).[24] Patient demand for less invasive procedures, improved cosmetic outcomes, faster recovery, reduced post-operative pain, suitability for awake spinal surgery and ambulatory outpatient surgery,[23,25] and a better option for athletes and older patients make a compelling case for this paradigm shift in spine surgery. In some selected cases, in foraminal pathology, it can be a better option than spinal fusion.

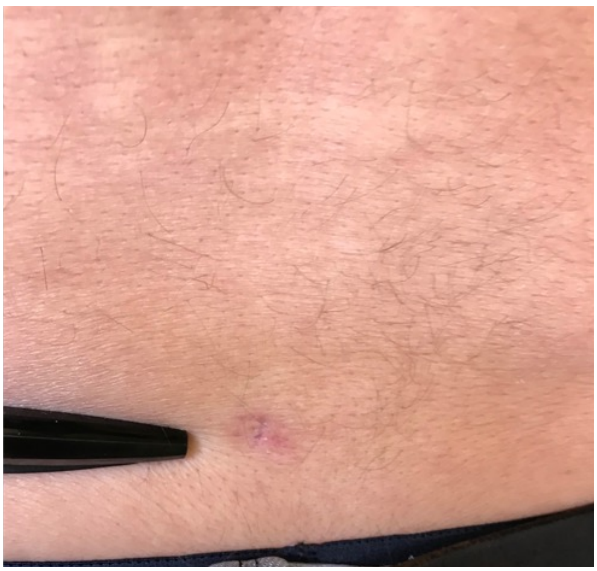

Figure 5. Post-operative scar of endoscopic discectomy

Figure 6. Post-operative scar of 2 level endoscopic lumbar stenosis decompression, 88y old patient

A new gold standard is emerging,[26] marking the "slope of enlightenment" phase in the technologic adoption cycle. Understanding endoscopic spine surgery's role within an invasiveness and complexity index enhances its utility in treating spinal pathology, leading to broader adoption.[27] Despite a steep and long learning curve, endoscopic techniques offer a less morbid and potent approach to spinal pathology, enhancing patient care standards.

In conclusion, endoscopic spine surgery represents a paradigm shift in spine surgery, epitomizing the trend towards minimally invasive procedures. The technique's advantages, patient demand, and potential to elevate patient care support its transformation into the new gold standard in decompression procedures in the spine.

Responsabilidades Éticas

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