Endoscopic Discectomy of Lumbar Disc Prolapse

Thesis
Submitted for partial fulfilment of the requirement of M.D. Degree in Neurosurgery.

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- 2007 -

Acknowledgment

First of all, my deep thanks are to ***God***, without his helps and cares, this work could not be accomplished.

I would like to express my sincere thanks and appreciation to my honored ***Professor Dr. Alaa El-din Abd El-Hay ,*** *Professor of Neurosurgery, Faculty of medicine, Ain –Shams university*. No words can describe his stimulating supervision, continuous encouragement and support. It has been an honor and privilege to work under his generous supervision.

Also, I would like to express my deepest thanks and appreciation to my ***Professor Dr. Mohamed Ashraf Ghobashy ,*** *Professor of Neurosurgery, Ain-Shams Faculty of medicine,* for his great help, support and continuous advice which helped me to overcome many difficulties to complete this work.

My deep gratitude goes to my ***Professor Dr. Wael Abd El-Monem Ezzat ,*** *Assistant Prof. of Neurosurgery Ain-shams Faculty of medicine*, for his great help, continuous support, and meticulous supervision throughout this work. No words can describe his helpful and stimulating supervision.

Yaser Atef El-Serafey.

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List of Abbreviations

AF **:** *Annulus Fibrosus.*
AMD **:** *Artroscopic Mico-Discectomy.*
NP **:** *Nucleolus Pulposus.*
METR'x **:** *Micro-Endoscopic Tubular Retractor system.*
MED **:** *Mico-Endoscopic Discectomy.*
MRI **:** *Magnetic Resonance Image.*
MISS **:** *Minimal Invasive Spinal Surgery.*
CT **:** *Computed Tomography.*
CSF **:** *Cerebro-Spinal Fluid.*
RM **:** *Range of Motion.*
HNP **:** *Herniated Nucleolus Pulposus.*
FSU **:** *Functional Spinal Unit.*
GAG **:** *Glycosaminoglycan.*
GAGS **:** *Glycosaminoglycan Sulphate.*
Gd.CM **:** *Gadolinium Contrast Medium.*
NSAIDs **:** *Non-Steroidal Anti-inflammatory Drugs.*
PLA2 **:** *Phospholipase A2.*
Ig-G **:** *Immunoglobuline G.*
SEPs **:** *Somato-sensory Evoked Potentials.*
MEPs **:** *Motor Evoked Potential.*
EMG **:** *Electromyography.*
SN **:** *Spinal Nerve.*
SLRT **:** *Straight Leg Raising Test.*
FNST **:** *Femoral Nerve Straight Test.*
KFT **:** *Knee Flexion Test.*
LDP **:** *Lumbar Disc Prolapse.*
LBP **:** *Low Back Pain.*
L3-4 disc **:** *Lumbar 3/4 disc.*
L4-5 disc **:** *Lumbar 4/5 disc.*
L5-S1 disc **:** *Lumbar 4 / Sacral 1 disc.*
LD **:** *Laparoscopic Discectomy.*
PLD **:** *Percutaneous Lumbar Discectomy.*
TENS **:** *Trans-cutaneous Electrical Nerve Stimulation.*
IDET **:** *Intra-Discal Electro-thermal Therapy.*
IDP **:** *Intra-Discal Pressure.*
TNF-alpha **:** *Tumour Necrotic Factor-alpha.*
ESR **:** *Erytherocyte Sedimentation Rate.*
LOS **:** *Length Of Hospital Stay.*
OA **:** *Osteoarthritis.*
OM **:** *Osteomylitis.*
RA **:** *Rheumatoid arthritis.*

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Introduction through the history

Humans have been plagued by back and leg pain since the beginning of the recorded history. Primitive cultures attributed it to the work of demons ***; Goodrich, 2004.***

The term sciatica gained recognition since *1764*, when the ***Italian Cotunio*** described its manifestation. Its signs and symptoms were further defined by ***Putti*** and ***Valleix*** in *1917* ***; Dyck, 1984.***

In *1934* ***Mixter and Barr*** attributed sciatica to lumbar disc herniation and suggested surgical treatment.

Symptomatic lumbar disc disease is responsible for a tremendous cost to society. It is believed to be a major contributor to the estimated *60 %* to *80 %* lifetime incidence of low-back pain in the general population. Patients with radiculopathy represent another large segment of the population who consume care costs related to lumbar disc disease ***; Baldwin, 2002.***

The standard procedure for disc removal was a total laminectomy followed by a transdural approach to the disc. In *1939* ***Semmes*** presented a new procedure to remove the ruptured intervertebral disc that included subtotal laminectomy and retraction of the dural sac to expose and remove the ruptured disc with the patient under local anesthesia. This procedure, now is the classic approach for the removal of an intervertebral disc, it has been improved with the use of microscope and video imaging ***; Wood, 1998.***

In the past *60* years, the traditional surgical treatment of herniated lumbar discs has consisted of an open laminectomy with visualization and extraction of herniated fragments ***; Kambin, 1997.***

It is important to emphasize that less muscle dissection that occurs, the less potential dead space there is for haematoma when a limited wound incision is made, there is a reduced requirement for healing by secondary intention and in the end less scar formation. A further disadvantage of a long incision is the denervation of the paravertebral muscles on ***EMG,*** which occurs in *96 %* of patients which persist for many years following surgery and re-innervation is only partial ***; Delamarter and McCulloch, 1997.***

The evolution from blind manual posterolateral discectomy to endoscopic or microscopic extraction of disc fragments in the late 1980's became feasible because of the technological advances and the availability of small caliber, high-resolution glass fiber-optics that enabled the spine surgeon to visually differentiate anatomically normal from abnormal spine structures ***; Hermantin et al., 1999.***

One of the major benefits of minimally invasive discectomy is early mobilization . A patient who can get out of bed the same day as the surgical procedure and be at home as an out-patient on the same day of the procedure a tremendous advantages over a patient who has a more painful wound and requires longer bed rest and hospitalization ***; Bookwlter et al., 1994.***

In *1997* ***Foley*** and ***Smith*** introduced the microendoscopic discectomy procedure; utilizing an endoscope through a tubular retractor system and long tapered instrumentation designed specifically for use in a small working space, allowed the spinal surgeons to reliably decompress a symptomatic lumbar nerve root via an endoscopic minimally invasive approach. This procedure offers many advantages , by reducing tissue trauma, allowing direct visualization of the nerve root and disc pathology, allowing bony decompression, enables the surgeon to address not only contained lumbar disc herniation, but also sequestrated disc fragments and lateral recess stenosis ***;Perez-Cruet, 2002.***

Endoscopic lumbar discectomy with *ligmentum flavum preservation technique* is done by retraction the ligament medially after releasing it from superior, inferior and lateral edges. Then restore it anatomically (as a natural barrier) after disc removal and root decompression. This technique is feasible under the endoscope and helpful in reducing the epidural fibrosis and post-operative scar formation ***; Zhou et al., 2005.***

The use of endoscope in lumbar disc herniation reduce the incidence of the post-discectomy syndrome by more than twice ***; Matveev et al., 2005.***

Aim of the Work

Endoscopic lumbar discectomy will be done at ***Ain-Shamas university*** hospitals for ***40*** patients with lumbar disc herniation, presenting with single level, unilateral disc prolapse in a virgin back. Non of the patients have multiple disc levels, tight canal stenosis, congenital anomalies of the working level, previous surgery of the spinal level, signs of spinal instability, and psychological disorder.

For all the patients, presenting with specific signs of root dysfunction in form of motor or sensory deficits, failure of conservative treatment in form of medical and physical therapy, clinical evaluation as well as radiological investigations will be done to confirm diagnosis of the side and the level of the disc herniation.

For all the patients, ***Endoscopic lumbar discectomy*** will be done with follow-up survey in form of clinical outcome, hospital stay, morbidity, and the results will be compared with that of the other results of ***Endoscopic lumbar discectomy*** in literatures, and with the results of ***Micro-discectomy*** in literatures, to evaluate the new modalities of ***Endoscopic lumbar discectomy***.

Development and Anatomy

During the *4th* week of development, cells of the ***sclerotomes*** shift their position to surround both the spinal cord and notochord . This positional change is effected by differential growth of the surrounding structures and not by active migration of sclerotome cells. This mesenchymal column retains traces of its segmental origin as the sclerotomic blocks are separated by less dense areas containing intersegmental arteries ***; Sadler, 1996.***

During further development, the caudal portion of each sclerotome segment proliferates extensively and condenses . This proliferation is so extensive that it proceeds into the subjacent intersegmental tissue and binds the caudal half of one sclerotome to the cephalic half of the subjacent sclerotome. Hence, by incorporation of the intersegmental tissue into the precartilaginous vertebral body. So, the body of the vertebra becomes intersegmental in origin.

Mesenchymal cells located between cephalic and caudal parts of the original sclerotome segment do not proliferate but fill the space between two precartilaginous vertebral bodies. In this way, they contribute to formation of the intervertebral disc . Although the notochord regresses entirely in the region of the vertebral bodies, it persists and enlarges in the region of the intervertebral disc. Here it contributes to the nucleus pulposus, which is later surrounded by circular fibers of the annulus fibrosus. Combined, these two structures form the intervertebral disc .

Rearrangement of ***sclerotomes*** into definitive vertebrae causes the ***myotomes*** to overbridge the intervertebral discs, and this alteration gives them the capacity to move the spine . For the same reason, intersegmental arteries, at first located between the sclerotomes, now pass midway over the vertebral bodies. Spinal nerves, however, come to lie near the intervertebral discs and leave the vertebral column through the intervertebral foramina ***; Sadler, 1996.***

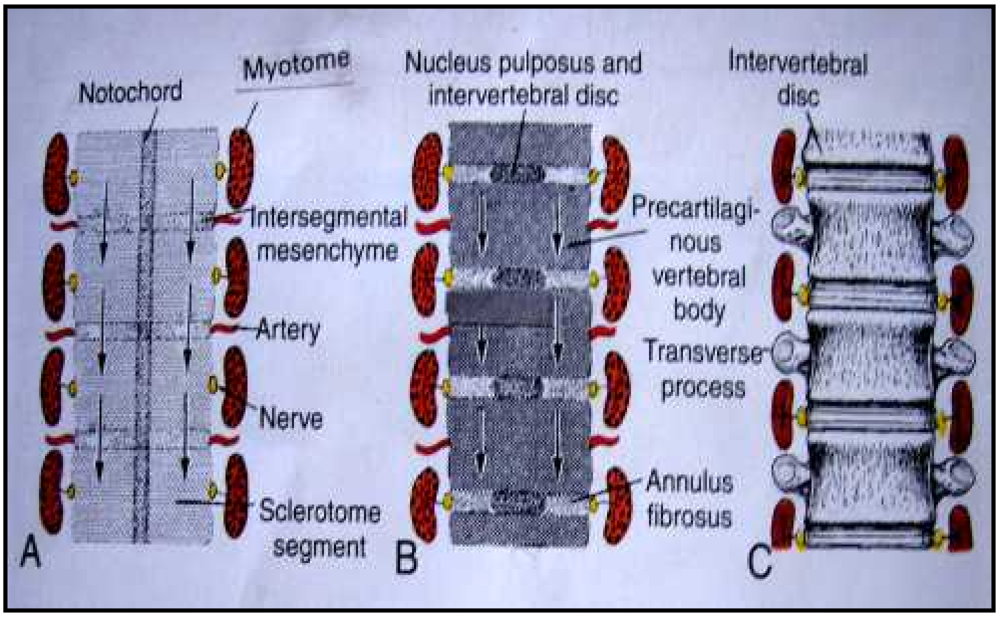

Fig. (1) : *Development of the lumbar spine,* **A : *Sclerotome*** *and* ***Myotome*** *formation at the 4th week of development ,* **B :** *Disc formation,* **C :** *Vertebral body formation* ***; Sadler, 1996.***

<u>LUMBAR VERTEBRA, (Fig. 2)</u> **:**

Normally, there are five lumbar vertebrae and five associated discs. Because the lumbar vertebrae are subjected to the greatest loads in the spinal column, they are relatively massive structures. In a small percentage of patients, abnormal segmentation results in either sacralization of the fifth lumbar vertebra or in lumbarization of the first sacral segment ***; Wienstien, 1992.***

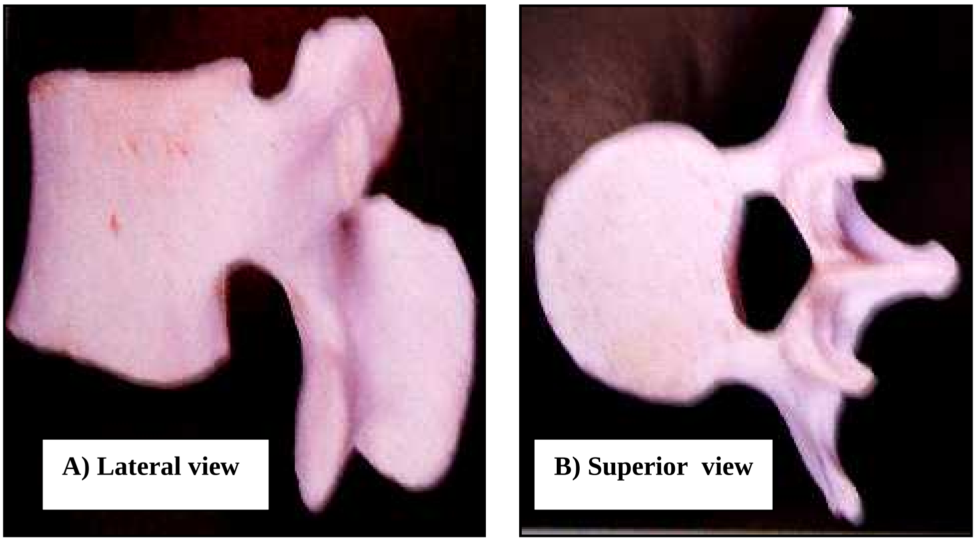

Fig. (2) : *Pictures of typical lumbar vertebra,* **A: Lateral view,** *and* **B: Superior view** (*seen from upward*), show , *Vertebral body, Pedicles,* *Laminae, Spinous process, Lateral processes, Facets, Superior notch, Inferior notch, and Vertebral canal* ***; Agur , 1996.***

Each lumbar vertebra consists of a vertebral body and a neural arch. The neural arch consists of two pedicles, the transverse processes, the superior and inferior articular facets, the laminae, and the spinous process. Each vertebra is attached to its neighbors by the intervertebral disc, a variety of spinal ligaments, and the articular facet joints. In the upper lumbar spine, the facet joints are oriented in a vertical direction, the inferior facet faces laterally, and the superior facet, faces somewhat medially. The effect of this anatomical arrangement is the limitation of axial rotation that permits flexion/extension. However, at the two lowest vertebrae, the facets are directed somewhat more horizontally, and this change permits greater axial rotation in the lower lumbar spine. Such increased mobility may explain the more common occurrence of disc hemiation at *L4* and *L5* ***; Wienstien, 1992.***

THE VERTEBRAL CANAL, (Fig. 3) **:**

The spinal canal is formed by the neural arch dorsally and the vertebral bodies and discs ventrally. In most individuals, the spinal cord ends at the lower end of *L1*; the cauda equina, composed of motor and sensory nerve roots, occupies the dural sac below that level. Nerve roots leave the canal at each level of the lumbar spine (although, anomalies are possible). Normally, as each root leaves the dural sac, it crosses the disc space and enters the lateral recess. This space is formed by the posterior aspect of