INTRODUCTION

Low back pain is a universal problem. Four out of every five people experience an episode of disabling low back pain during adulthood. Lumbar disc prolapse is one of the most common causes of low back pain. Most episodes settle with conservative treatment but 10 % of patients require an operation ***(Welch and Gerszten, 2002)*.**

Microsurgical technique provides excellent lightening and magnification of the operative field. Magnification and micro-instruments used result in minimal retraction of the nerve root. Extradural fat is preserved, minimizing the chances of subsequent adhesions, and accurate bipolar coagulation is used resulting in a minimal loss of blood ***(Peul, 2007)***.

Compared with the standard open discectomy, the microdiscectomy enables the use of smaller incisions of the skin and fascia and facilitates a less traumatic surgical procedure. Unlike conventional approaches, the surgeon sees the inside of the disc space, and video cameras may observe and record the operation ***(Foley and Smith, 1997).***

Most patients are encouraged to walk as tolerated; many go back to work within 5 to 10 days especially those with desk type of work. All patients are required to participate in lumbar physical therapy. Most athletes return to their normal athletic activities within 8 weeks after surgery ***(Gibson and Waddell, 2007).***

With microdiscectomy, the optics and light source are above the surgical field, requiring modified instruments to keep surgical tools and hands from obscuring the field of view. In conventional discectomy, the operating surgeon's head can impinge into the light beam and that the assisting surgeon is often unable to achieve a satisfactory view of the operating field ***(Katayama et al., 2006).***

As with any form of spine surgery, there are several risks and complications that are associated with a microdiscectomy, including Dural tear (cerebrospinal fluid leak) -- this occurs in 1% to 2% of these surgeries, does not change the results of surgery, but post-operatively the patient may be asked to lay recumbent for one to two days to allow the leak to seal. Nerve root damage which may be due to traction during surgery, bowel or bladder incontinence, Bleeding and Infection ***(Nakagawa et al., 2003).***

AIM OF THE WORK

This study aims to evaluate advances of microscopic lumbar discectomy in different types of lumbar disc herniation (s) regarding improvement of symptoms, post operative hospitalization and complications.

Chapter (1)

Anatomy of Lumbar Spine

Osseous anatomy

The basic anatomy of the lumbar spine is well understood. There are typically five lumbar vertebrae, each composed of a vertebral body anteriorly and a neural arch posteriorly (fig.1). The neural arch in turn is made up of a posterior spinous process, two lateral transverse processes, and the laminae between them. Between the transverse processes and the vertebral body are the pedicles. The spinal and transverse processes act as attachment points for the deep back muscles. The neural arch surrounds the vertebral canal and protects the spinal cord.

The articular processes bear complementary relationships rostrally and caudally. The rostral facet is concave and faces dorsomedially to meet the caudal facet from above. The caudal facet an extension of the laminae, faces ventrolaterally and complements the superior articulating facet of the vertebral body below ***(Williams et al., 1995).***

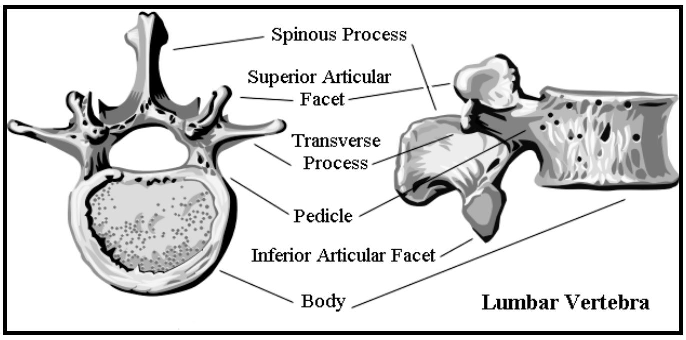

Fig. (1): Showing anatomy of lubmar vertebrae ***(Williams et al., 1995)***.

The Intervertebral Disc

The intervertebral discs serve as an articulation between adjacent vertebral bodies. The disc has two basic functions. The first is to act as a physiological shock absorber, and the second is to serve as a site of limited motion between adjacent vertebrae. The lumbar disc consists of three parts (fig.2): the cartilaginous plate, a structure covering the bone of adjacent vertebrae and acting as a barrier between the nucleus pulposus and the adjacent vertebral bodies; the nucleus pulposus; the semi-gelatinous center of the disc, which serves as a physiological shock absorber; and finally, the annulus fibrosus, a circular fibrous structure that restrains the lateral forces produced by the compressed nucleus. The annulus is closely attached to the adjacent vertebral bodies; it is stronger anteriorly than posteriorly, and it is not as well attached to the posterior as to the anterior ligament. This arrangement may partly explain the propensity of discs to herniate posteriorly rather than anteriorly ***(Weinstein, 2007).***

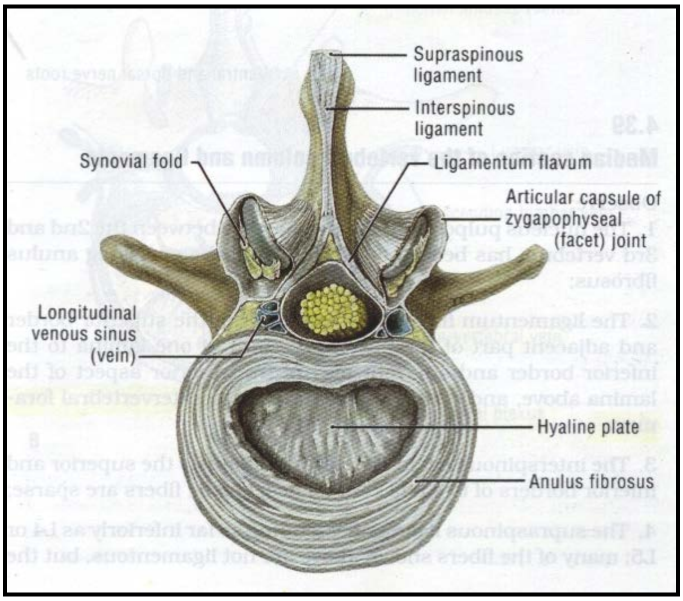

Fig. (2): Transverse section of an intervertebral disc & ligaments ***(Williams et al., 1995)***.

Vertebral Canal

The vertebral canal is the cavity comprised, in the isolated vertebrae, between the vertebral body and the posterior arch (fig.3). The walls of the canal are formed: anteriorly, by the posterior aspect of the vertebral body; laterally, by the pedicles; and posteriorly, by the articular processes and the parts interarticulares, the laminae, and the base of the spinous process. The vertebral canal can be roundish, ovoid, and triangular shaped ***(Postaccheini and Rauschning, 1999).***

[A] **[B]** **[C]**

Fig. (3): Showing vertebral canal morphology of $L_{3,4,5}$ respectively ***(Postaccheini and Rauschning, 1999).***

Intervertebral foramen

The intervertebral foramen (fig.4) or neuroforamen is an osteofibrous canal, rather than a true foramen. It is formed by two adjacent vertebrae and the intervertebral disc in between. The neuroforamen may be oval, auricular or tear drop shaped. The nerve-root canal includes two portions: a proximal -subarticular or intervertebral- portion; and a distal portion, corresponding to the lateral recess. The proximal portion is delimited, anteriorly, by the intervertebral disc and, posterolaterally, by the anterior border of the superior articular process, covered by the ligamentum flavum. The distal portion begins at the level of the superior vertebral end-plate and terminates at the entrance of the intervertebral foramen. In this portion the nerve-root canal is delimited posteriorly by the base of the superior articular process and the pars interarticulans, and laterally by the pedicle ***(Postacchini, 2005).***

The main structure contained in the neuroforamen is the spinal nerve root (or radicular nerve), which occupies up to 50% of the area of the foramen. The spinal nerve root runs in the upper portion of the foramen, which also contains the anterior spinal branch of the lumbar artery, the radicular artery and veins, and the sinuvertebral nerve ***(Williams et al., 1995).***

Ligaments of the Lumbar Region

The Anterior and Posterior Longitudinal Ligaments:

The anterior longitudinal ligament is attached closely to the anterior surface of the vertebral bodies but less tightly to the intervertebral discs. The anterior longitudinal ligament usually ends at S2 level, where it blends with the periosteum. Occasionally it proceeds further, until the S5 vertebra or the coccyx. The posterior longitudinal ligament (fig.5) is attached in a cruciate fashion to the lumbar discs and the adjacent margins of the vertebral bodies. It is less closely attached to the midportion of the vertebral bodies and tends to thin out laterally in its attachment to the intervertebral disc. At intervertebral level, therefore, the ligament displays a characteristic rhomboidal shape. The central portion is firmly attached to the vertebral end-plates, whereas it does not adhere to the posterior aspect of the vertebral bodies. It is bowstrung across the concavity of the vertebral body, thus leaving a thin space occupied by vessels entering the vertebral body or exiting from it ***(Postacchini, 2005).***

The Ligamentum Flavum:

Ligamentum flavum, (fig.6) connect laminae of adjacent vertebrae in the vertebral canal. Their attachments extend from capsule of posterior joint to where laminae fuse to form spines; here their posterior margins meet and are partially united, intervally being left for veins connecting internal to posterior external vertebral venous plexus. Their predominant tissue is yellow elastic tissue, whose almost perpendicular fibers descend from the lower anterior surface of one lamina to the posterior surface and upper margin of the one below it ***(Williams et al., 1995).***

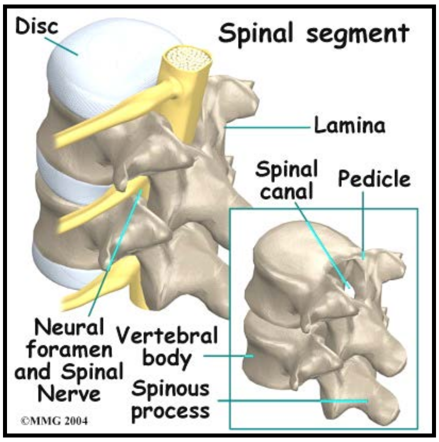

Fig. (4): Showing neural foramin and spinal nerve
(Postaccheini and Rauschning, 1999).

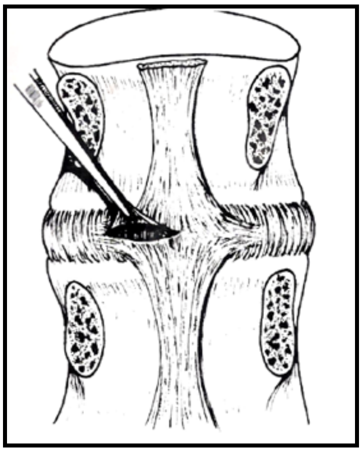

Fig. (5): Posterior longitudinal ligament ***(Williams et al., 1995).***

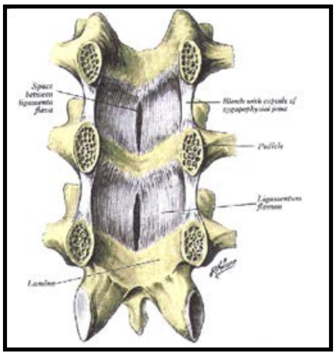

Fig. (6): Ligamentum flavum (anterior aspect in the lumbar region) ***(Williams et al., 1995)*.**

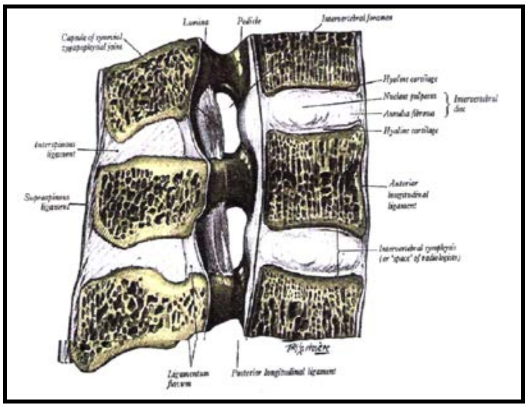

Fig. (7): Showing interspinous and supraspinous ligaments ***(Williams et al., 1995)*.**

The Supraspinous and Interspinous Ligaments: *(fig. 7)*

The supraspinous ligament is a thick fibrous band, which usually reaches the spinous process of L4 or more rarely that of L3 or L5. Distally to its end, it continues with the tendineous raphe of the longissimus dorsi muscle ***(Postacchini, 2005).***

The interspinous ligament is formed by fibrous bundles running in a posterocranial direction. It includes three portions.

The ventral portion, consisting of two halves, right and left, represents a posterior expansion of the ligamentum flavum. The middle portion, which is the largest component of the ligament, inserts caudally, on the ventral half of the proximal border of the caudal spinous processs and cranially on the dorsal half of the distal border of the cranial spinous process. The bundles of the dorsal portion insert on the dorsal half of the proximal margin of the caudal spinous process and, running posterocranially, mingle with the bundles of the supraspinous ligament. The middle portion contains a median cleft, usually occupied by fat. The cleft is wider in the last two interspinous ligaments and, with increasing age, may become a cavity a few millimeters wide ***(Postacchini, 2005).***

Muscles at the Lumbar Region

Running along the whole length of the vertebral column from skull to sacrum is a posterior mass of mainly longitudinal extensor muscles, supplied segmentally by posterior rami of spinal nerves. They form a bulge on either side of the midline of the back, best seen in the lumbar region covered posteriorly by the thoracolumbar fascia. The deepest muscles are the interspinalis and intertransversalis. The remainder form intermediate and superficial masses collectively called transversospinalis and erector spinae, each of which is composed of three groups. Transversospinalis includes the rotatores, multifidus and semispinalis, while erector spinae comprises intercostalis, longissimus and spinalis ***(Postacchini, 2005).***

Chapter (2)

BIOMECHANICS

Biomechanical properties

Vertebrae, discs and ligaments form a column of vertebral motion segments, called functional spinal units. Each functional spinal unit includes a disc, the two adjacent vertebrae and the connecting ligaments; it represents the smallest segment of the spine showing biomechanical properties similar to those of the whole spine. Due to the presence of discs and ligaments, the whole spine acts as a flexible column, straight in the coronal plane and curved in the sagittal plane. The curved alignment of the spine in the sagittal plane increase spinal flexibility and the ability to withstand mechanical forces, whilst maintaining the stability of the spine ***(White, 1990).***

Intradiscal pressure

Intradiscal pressure plays a major role in disc biomechanics. It has been assessed in vivo upon different body postures and using definite element models. It has been shown that in vivo intradiscal pressure reaches peak levels with sitting, decreases with standing and is lowest while lying down. Moreover, in the different body postures, intradiscal pressure increase with the anterior flexion of the trunk. With these in vivo measurements it is also possible to assess the loads carried by the disc during various postures and exercises, as well as to evaluate the effects of muscle tone on the intradiscal pressure. It has been found that, under general anesthesia, intradiscal pressure decrease by about 1/3 compared with normal values due to muscle relaxation. The severity of disc degeneration affects intradiscal pressure. As disc degeneration advances, there is a decrease both in the intradiscal pressure under unloading conditions and in the maximum pressure borne by the disc ***(White, 1990).***

Disc under compression, flexion and axial torque

Upon daily activities the intervertebral discs are submitted to various mechanical stresses, which, in most cases, occur simultaneously ***(Panjabi et al., 1988).***

Compression

Under axial compression the nucleus pulposus expands horizontally (fig.8), thus inducing increased tensile stresses in the annular fibers. The magnitude of tensile stresses is maximum in the inner annulus and decrease progressively towards the external annulus. Vertebral end plates undergo compression stresses, mainly in the area adjacent to the nucleus pulposus.

Axial compression causes circumferential disc bulging in the horizontal plane, which is largest in the posterior annulus. The degree of disc bulging is inversely related to the tensile status of the annular fibers and the intradiscal pressure. When the latter is within normal values, compression load increase tensile stresses in the annular fibers; this allows the annulus to withstand the nuclear expansion and disc bulging is mild. However, when the intradiscal pressure decreases, annular fibers are subjected to low tensile stresses and this reduces their ability to resist the nuclear expansion and to limit disc bulging under load. When an axial compression load exceeding the physiologic limits is applied to the functional spinal unit, vertebral end plates are the first structures to fail. They fracture or deform under the compression forces generated by the nucleus. On the other hand, mechanical stresses caused by axial compression are not sufficient to provoke failure of the annulus fibrosus ***(Klein et al., 1983)***.

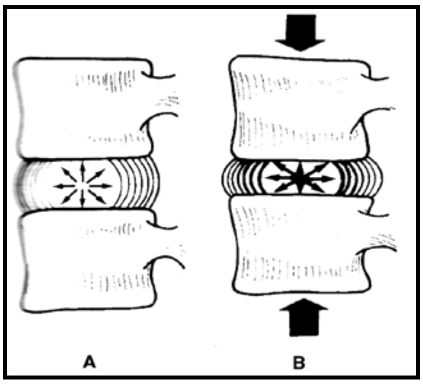

Fig. (8): Mechanical stress in the annual fibers under axial compression loading. (A) unloaded disc (B) loaded ***(Klein et al., 1983).***

Flexion, extension and lateral bending (fig.9)

Under flexion loading, the annulus is submitted to compressive stresses in the region where the compressive force is applied and to tensile stresses in the opposite zone. Thus, anterior flexion loading causes compressive stresses in the anterior part of the disc and tensile stresses in the posterior part, whereas the opposite occurs under extension loading. On lateral bending, compressive stresses take place on the concave side of the spinal curve and tensile stresses on the convex side.

Upon flexion extension loading, the nucleus pulposus moves away from the zone of the disc submitted to compression forces, i.e., it moves posteriorly during flexion and anteriorly during extension. Possibly, this shifting of the nucleus provides a better distribution of the load across the disc during vertebral motion.

Upon flexion loading, the disc bulges anteriorly during anterior flexion, posteriorly during extension and on the convex side of the spinal curve during lateral bending; thus, disc bulging occurs in the zone of the disc submitted to compressive stresses ***(Brinckman and Grootenboer, 1991).***