INTRODUCTION

Spondylolisthesis is a common cause for lower-back pain, radiculopathy, and neurogenic claudication among the adult population ***(Vibert et al., 2006).***

In 1976 a classification system was developed.

Subtypes included congenital, isthmic, degenerative, pathologic, iatrogenic and traumatic etiologies. Isthmic and degenerative causes are by far the most common in the adult population ***(Wiltse et al., 1976)***.

Neurogenic claudication is characterized by pain radiating down to the lower extremities in a radicular distribution when a patient is standing or walking and generally relieved by sitting down or leaning forward. Limitations in walking ability help to reveal how severe the symptoms from neurogenic claudication are ***(Drury et al., 2009)***.

Laminectomy was the mainstay for many years until fusion procedures became more popular ***(Vibert et al., 2006)***.

The gold standard of the spondylolisthesis surgical treatment is fusion. The different techniques for fusion discussed in literature have advantages and disadvantages, with mixed and variable results and with the possibility of having several complications ***(Zagra et al., 2009)***.

Herkowitz and Kurz in a 3-year prospective analysis of 50 patients found that additional posterolateral intertransverse fusion offered better clinical results than simple laminectomy ***(Herkowitz et al., 1991)***.

In 1993, a prospective randomized study by Zdeblick demonstrated instrumented fusion procedures of the lumbar spine produced better fusion rates than uninstrumented fusion procedures did ***(Zdeblick, 1993)***.

From theoretical considerations, posterior lumbar interbody fusion (PLIF) has been considered better than posterolateral fusion. Theoretical advantages in favor of (PLIF) include anterior column support, indirect foraminal decompression, restoration of lordosis, and reduction of the slip ***(Ekman et al., 2007)***.

The transforaminal lumbar interbody fusion (TLIF) has been shown to be effective in short-term studies with less morbidity and expense to the patient than a combined anterior-posterior spinal fusion or a posterior lumbar interbody fusion ***(Salehi et al., 2004)***.

Furthermore, interbody fusion combined with posterolateral fusion has shown increased mechanical strength compared with posterolateral fusion alone ***(La Rosa et al., 2003).***

AIM OF THE WORK

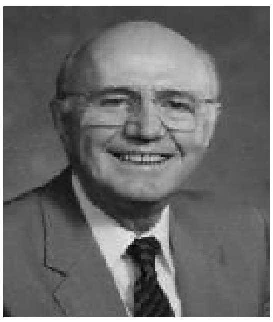
To illustrate the early functional outcome postopearatively in consideration with the preoperative clinical and radiological prognostic factors of adult patients having grade (I or II) spondylolisthesis treated with instrumented posterlateral fusion with or without interbody fusion.

HISTORY OF SPONDYLOLISTHESIS

The term spondylolisthesis is originally derived from two Greek words, “spondylos” forspine and “(o)listhesis” for forward gliding. Therefore, it means the “(forward) slipping of the spine”. In 1854, Herman Friedrich Kilian (1800–1863) coined the term “spondylolisthesis” which means the “downward gliding of the spine” ***(Kilian, 1854).***

Spondylolisthesis must have been observed in ancient times but was probably first mentioned in 1782 by the Belgian surgeon and obstetrician G. Herbiniaux (1740 – end of the 18th century). He claimed that it interfered with child bearing and resulted in the death of both mother and child ***(Herbiniaux, 1782).***

In 1882, Franz Ludwig Neugebauer (1856–1914), an obstetrician in Warsaw, published a monograph on spondylolisthesis in which he described exactly the clinical features of spondylolisthesis also in relation to obstetrical problems of a narrowing birth canal in patients with severe spondylolisthesis ***(Neugebauer, 1882)***. In 1976, Wiltse, Newmann and Macnabwere the first to classify spondylolisthesis into five categories: dysplastic, isthmic, degenerative, traumatic and pathological types ***(Wiltse et al., 1976).***



Dr. Leon Wiltse

ANATOMY OF THE LUMBAR SPINE

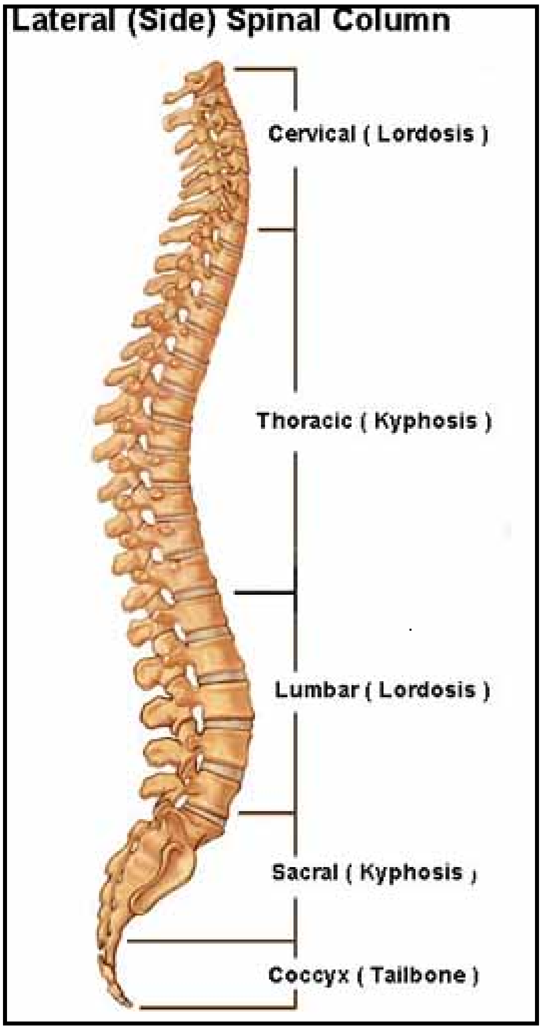


Fig. (1): Curves of the spine ***(Reference: spineuniverse.com/anatomy)***

Important Structures:

The important parts of the lumbar spine include:

- Bones and joints.
- Nerves.
- Connective tissues.
- Muscles.
- Spinal segments.
- This section highlights some important structures of them.

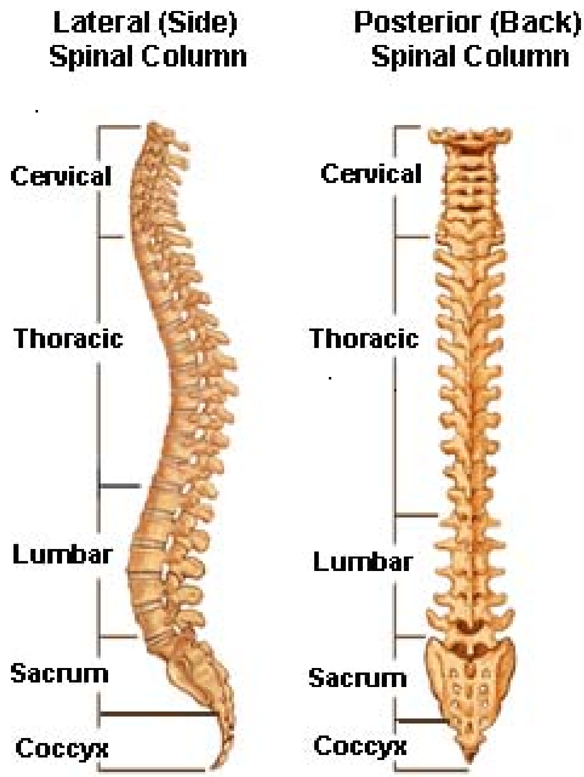


Fig. (2): General outline of the spine ***(Reference from spineuniverse.com/anatomy).***

There are five lumbar vertebrae and the sacrum making up the lumbar spine. We can consider each vertebra as having three functional components: the vertebral bodies, designed to bear weight; the neural arches, designed to protect the neural elements; and the bony processes (spinous and transverse), designed as outriggers to increase the efficiency of muscle action ***(Wong & Transfeldt, 2007A).***

The **lumbar vertebrae** are the largest segments of the movable part of the vertebral column, and can be distinguished by the absence of a foramen in the transverse process, and by the absence of facets on the sides of the body. The **body** is large, wider from side to side than from before backward, and a little thicker in front than behind. It is flattened or slightly concave above and below, concave behind, and deeply constricted in front and at the sides. The **pedicles** are very strong, directed backward from the upper part of the body; consequently, the inferior vertebral notches are of considerable depth. The **laminae** are broad, short, and strong; the **vertebral foramen** is triangular, larger than in the thoracic, but smaller than in the cervical region. The **spinous process** is thick, broad, and somewhat quadrilateral; it projects backward and ends in a rough, uneven border, thickest below where it is occasionally notched. The **superior** and **inferior articular processes** are well-defined, projecting respectively upward and downward from the junctions of pedicles and laminae. The facets on the superior processes are concave, and look backward and medialward; those on the inferior are convex, and are directed forward and lateralward. The former are wider apart than the latter, since in the articulated column the inferior articular processes are embraced by the superior processes of the subjacent vertebra. The **transverse processes** are long, slender, and horizontal in the upper three lumbar vertebrae; they incline a little upward in the lower two. In the upper three vertebrae they arise from the junctions of the pedicles and laminae, but in the lower two they are set farther forward and spring from the pedicles and posterior parts of the bodies. They are situated in front of the articular processes instead of behind them as in the thoracic vertebrae, and are homologous with the ribs. Of the three tubercles noticed in connection with the transverse processes of the lower thoracic vertebrae, the superior one is connected in the lumbar region with the back part of the superior articular process, and is named the **mammillary process;** the inferior is situated at the back part of the base of the transverse process, and is called the **accessory process (*Gray et al., 2008)***.

The **Fifth Lumbar Vertebra** is characterized by its body being much deeper in front than behind, which accords with the prominence of the sacrovertebral articulation; by the smaller size of its spinous process; by the wide interval between the inferior articular processes; and by the thickness of its transverse processes, which spring from the body as well as from the pedicles **(*Gray et al., 2008*).**

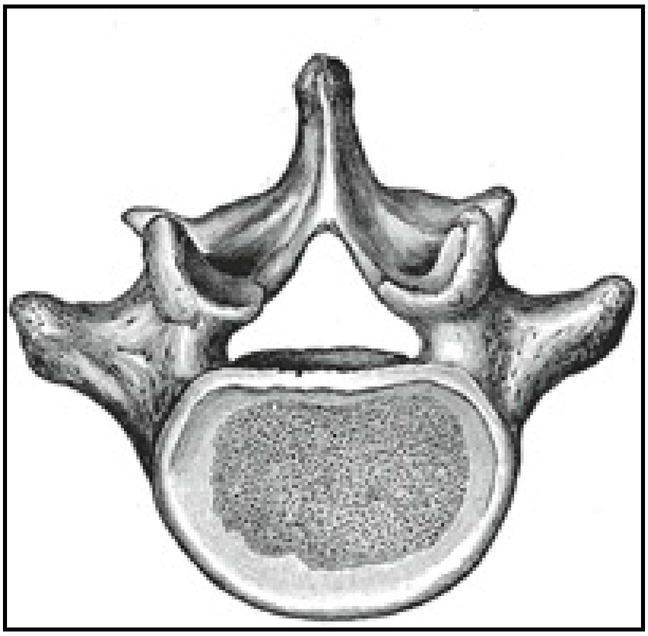


Fig. (3): Fifth lumbar vertebra, from above ***(Gray et al., 2008).***

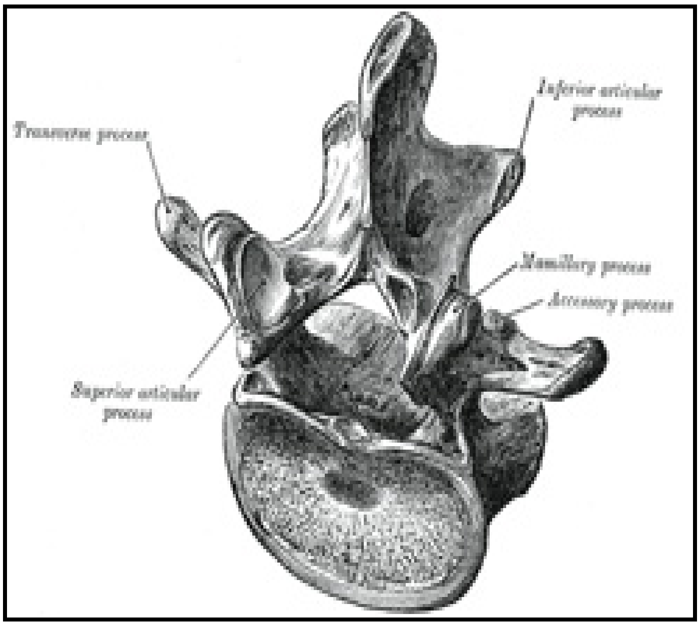


Fig. (4): Typical lumbar vertebra showing both mammillary and accessory processes **(*Gray et al., 2008*).**

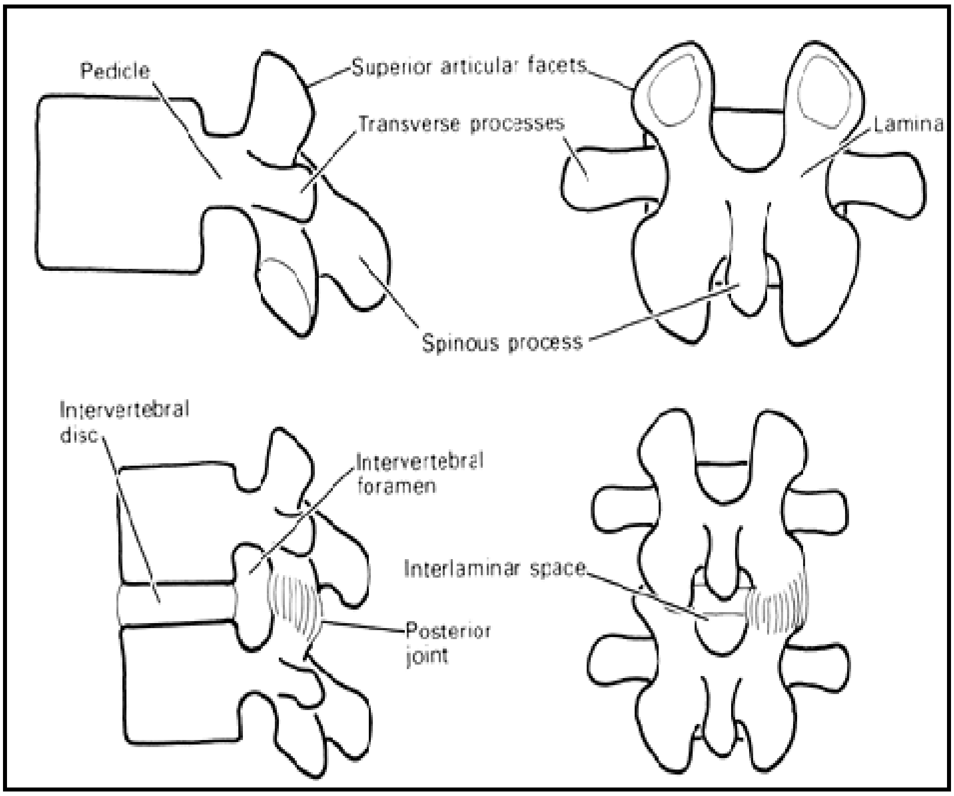


Fig. (5): The components of a lumbar vertebra: the body, the pedicle, the superior and inferior facets, the transverse and spinous processes, and the intervertebral foramen and its relationship to the intervertebral disc and the posterior joint ***(Wong & Transfeldt, 2007 A).***

The facet joints

The zygapophyseal joints are synovial joints that permit simple gliding movements. Although the lax capsule of the joints is supported to some extent from anteriorly by the ligamentum flavum, and posteriorly by supraspinous ligament, the major structure restraining movement in these joints are the outermost fibres of the annulus fibrosus. When these annulus fibres exhibit degenerative changes, excessive joint play is permitted. This is why degenerative changes within the discs render the related posterior joints vulnerable to strain.**(*Wong& Transfeldt, 2007 A*)**.

The nerve supply of the facet joint is derived from the branches of the dorsal ramus of each spinal nerve that branches in and just beyond the neural foramen into ventral and dorsal rami. These branches of the dorsal rami also supply the periosteum of the posterior bony elements and the overlying muscle and skin ***(Williams et al., 2005).***

The neural foramen

On the left and right side of each vertebra is a small tunnel called **neural foramen** (Foramina is the plural term) (**Fig.6**). The two spinal nerves that leave the spine at each vertebra go through the foramina, one on the left and one on the right. Each nerve branches in and just beyond the foramen into ventral and dorsal rami. The dorsal rami supply the facet joints as mentioned above. Besides, there is the recurrent meningeal (sinovertebral nerve) which maybe best considered as recurrent branches of the ventral rami. They receive sympathetic input via grey rami communicantes or directly from thoracic sympathetic ganglia. Then the sinovertebral nerve re-enter the foramen to supply the structures forming the walls of the vertebral canal as well as the dura and epidural soft tissue ***(Williams***

et al., 2005). The intervertebral disc (described later) sits directly in front of the opening. A bulged or herniated disc can narrow the opening and put pressure on the nerve. A facet joint sits in back of the foramen. Bone spurs that form on the facet joint can project into the tunnel, narrowing the hole and pinching the nerve.

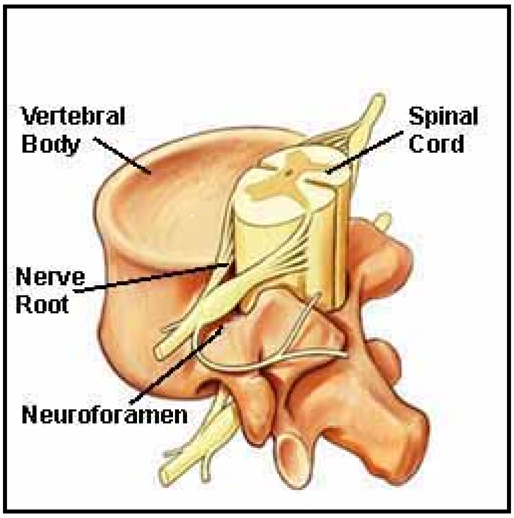


Fig. (6): The neural foramen (spineuniverse.com/anatomy)

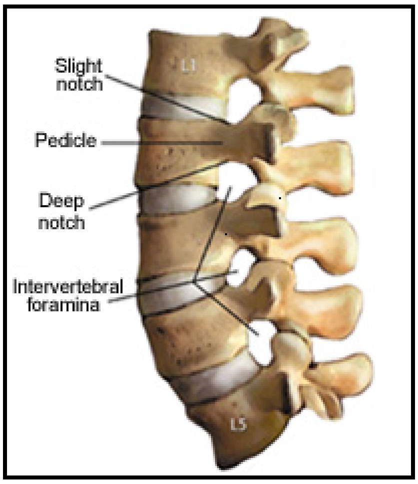


Fig. (7): The lumbar spine **(from back.com/anatomy)**

Nerves

The spinal cord extends down to the L2 vertebra. Below this level, the spinal canal encloses a bundle of nerves that goes to the lower limbs and pelvic organs. The Latin term for this bundle of nerves is cauda equina, meaning horse's tail and is enclosed within the thecal sac where it is accompanied by the filum terminale that connects the lower conical part of the spinal cord (the conus medullaris) to the back of the coccyx.

Between vertebrae, two large nerves branch off the spinal cord, one on the left and one on the right. Each spinal nerve branches in and just beyond the intervertebral foramen into ventral and dorsal rami. There is also an important input from the sympathetic system via grey rami communicantes or directly from thoracic sympathetic ganglia. The branches of the spinal nerve concerned are the dorsal ramus and the recurrent meningeal or sinovertebral nerves ***(Williams et al., 2005).***

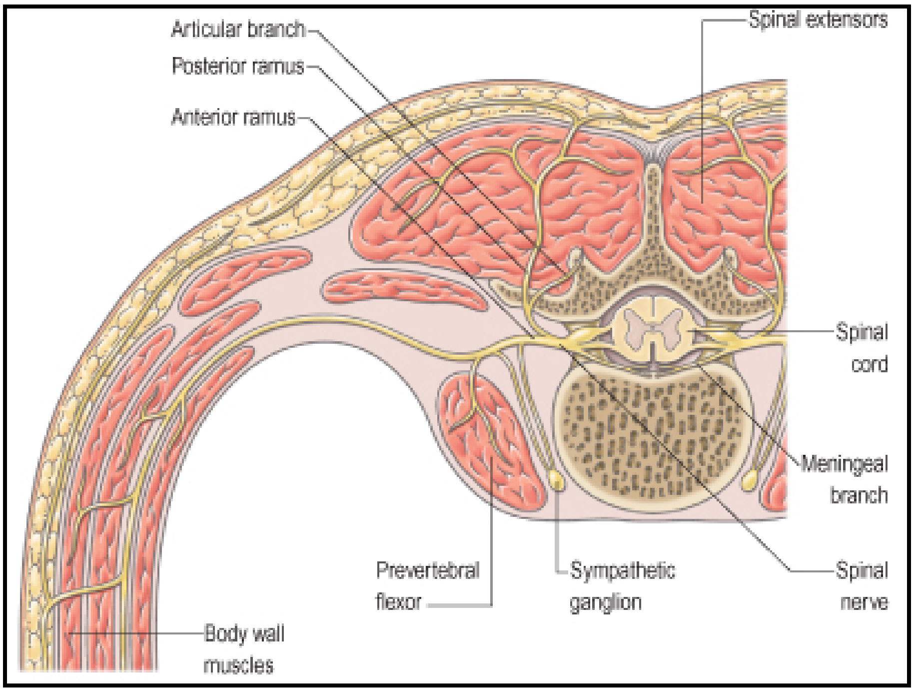


Fig. (8): Formation and branching of a typical spinal nerve ***(Williams et al., 2005).***

The ligaments

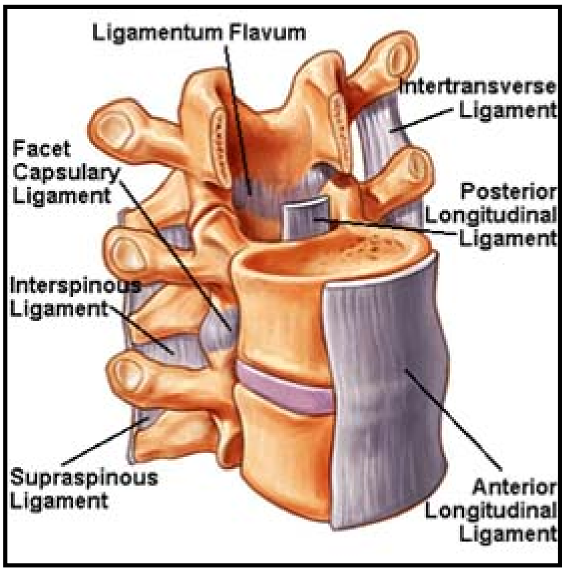


Fig. (9): The ligaments of the lumbar region **(*spineuniverse.com/anatomy*).**