MANAGEMENT OF TRAUMATIC DORSO-LUMBAR FRACTURES

Thesis study

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سَنُرِيهِمْ ءَايَٰتِنَا فِى ٱلْءَافَاقِ وَفِىٓ أَنفُسِهِمْ حَتَّىٰ يَتَبَيَّنَ لَهُمْ أَنَّهُ ٱلْحَقُّ ۗ أَوَلَمْ يَكْفِ بِرَبِّكَ أَنَّهُۥ عَلَىٰ كُلِّ شَىْءٍ شَهِيدٌ ﴿٥٣﴾

صدق الله العظيم

سورة فصلت الجزء الخامس و العشرون

Introduction

The dorsolumbar region of the spine (D11 to L2) is an unstable zone between a relatively fixed segment (Dorsal spine) and a mobile segment (lumbar spine) at a junction of dorsal kyphosis and lumbar lordosis, that what makes it a vulnerable zone for injury.

Acute traumatic injury to the dorsolumbar region is the second most frequent site after the cervical spine in adults. The injury, although not associated with high mortality rates causes sever morbity. It is estimated that about 75%of patients with dorsolumbar injuries sustain some degree of neurological deficit.

This raises the importance of studying the basic science of this region as the anatomy & biomechanics in order to understand why it is vulnerable & how different trauma forces cause different Fracture types.

Treatment of the dorsolumbar fractures constitutes one of the most controversial subjects. There are strong proponents of conservative therapy and those who believe in the surgical management, and even the surgical management is controversial as well. The management of dorsolumbar (thoracolumbar) fractures remains challenging; ideally it should effectively correct the deformity, prevent further more deficits and induce recovery to allow early mobilization and return to work.

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Review

Anatomy

The typical vertebra (fig. 1) consists of two major components: a roughly cylindrical ventral mass of mostly trabecularized cancellous bone, called the *body,* and a denser, more cortical posterior structure, called the *dorsal vertebral arch*. The vertebral bodies vary considerably in size and sectional contour but exhibit no salient processes or unique external features other than the facets for rib articulation in the thoracic region. In contrast, the vertebral arch has a more complex structure. It is attached to the dorsolateral aspects of the body by two stout pillars, called the *pedicles*. These are united dorsally by a pair of arched flat laminae that are surmounted in the midline by a dorsal projection, called the *spinous process*. The pedicles, laminae, and dorsum of the body form the vertebral foramen, a complete osseous ring that encloses the spinal cord. The transverse processes and the superior and inferior articular processes are found near the junction of the pedicles and the laminae. The transverse processes extend laterally from the sides of the vertebral arches. ***(Rothman-simeone the spine 2011)***

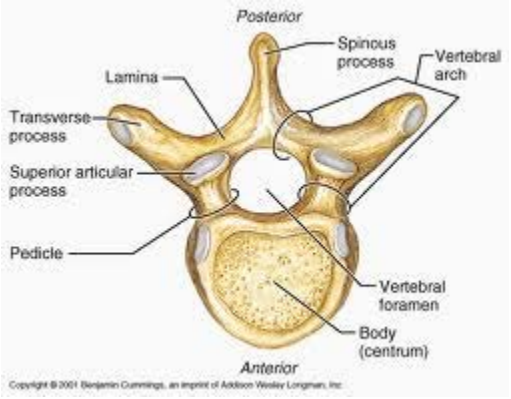

Figure 1: typical vertebra

Figure 2: facet joints

The articular processes (zygapophyses) form the paired diarthrodial articulations (facet joints) between the vertebral arches (fig.2). The superoinferior dimensions of the pedicles are roughly half that of their corresponding body, so that in their lateral aspect the pedicles and their articulating processes form the superior and inferior vertebral notches. Because the base of the pedicle arises superiorly from the dorsum of the body, particularly in the lumbar spine, the inferior vertebral notch appears more deeply incised. In the articulated spine, the opposing superior and inferior notches form the intervertebral foramina that transmit the neural and vascular structures between the corresponding levels of the spinal cord and their developmentally related body segments. ***(Rothman-simeone the spine 2011)***

Regional Characteristics

Although the 24 vertebrae of the presacral spine are divided into three distinct groups (fig. 3), in which the individual members may be recognized by one or two uniquely regional features, there is a gradual craniocaudal progression of morphologic changes. The vertebrae found above and below the point of regional demarcation are

transitional and bear some of the characteristics of both areas. ***(Rothman-simeone the spine 2011)***

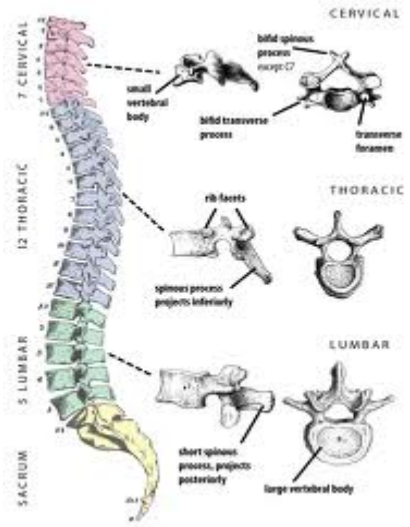

Figure 3: regional characteristics

Thoracic Vertebrae

All 12 thoracic vertebrae support ribs and have facets for the diarthrodial articulations of these structures. The first and last four have specific peculiarities in the manner of costal articulations, but the second to the eighth are similar (fig. 4). The body of a mid-thoracic vertebra is heart-shaped. Its length and width are roughly halfway between that of the cervical and lumbar bodies. Often a flattening of the left side of the body indicates its contact with the descending aorta. In the mid-thorax, the heads of the ribs form a joint that spans the intervertebral disc, so that the inferior lip of the body of one vertebra and the corresponding site of the superior lip of the infrajacent element share in the formation of a single articular facet for the costal capitulum. The typical thoracic vertebra bears two demifacets on each side of its body. The thoracic vertebral arch encloses a small, round vertebral foramen that would not admit the tip of an index finger, even when the specimen is from a large adult. This limited space for

the spinal cord predisposes to severe spinal cord injury with minimal dimensional compromise. Because the pedicles arise more superiorly on the dorsum of the body than they do in the cervical region, the inferior vertebral notch forms an even greater contribution to the intervertebral foramen. ***(Rothman-simeone the spine 2011)***

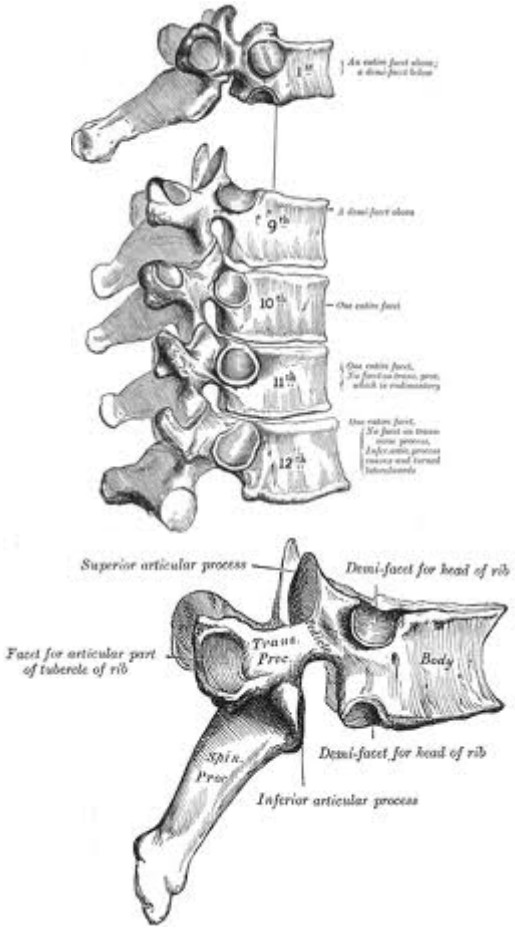

Figure 4: thoracic vertebra

The pedicle height increases from T1 to T12, but the transverse pedicle width (which is more critical for transpedicular screw containment) does not follow this same craniocaudal pattern.***(Cinotti and colleagues 1999)*** found that the pedicles in the T4 to T8 region had the

smallest transverse diameter documented similar findings in 50 cadaveric human spines, with the smallest diameters measured at T3 to T6.***(Scoles and colleagues 1988)***

On average, the transverse pedicle diameter at T3 is 3.4 mm in women and 3.9 mm in men. At T6, it averages 3 mm in women and 3.5 mm in men. At T1, however, the mean diameter is 6.4 mm in women and 7.3 mm in men. The superior articular facets form a stout shelf like projection from the junction of the laminae and the pedicles. Their ovoid surfaces are slightly convex, are almost vertical, and are coronal in their plane of articulation. They face dorsally and slightly superolaterally, and in bilateral combination they present the segment of an arc whose center of radius lies at the anterior edge of the vertebral body. They permit a slight rotation around the axis of this radius. The inferior articular facets are borne by the inferior edges of the laminae. The geometry of their articular surfaces is complementary to the superior processes. On the ventral side of the tip of the strong transverse processes, another concave facet receives the tuberculum of the rib whose capitulum articulates with the superior demifacet of the same vertebra. The spinous processes of the thoracic vertebrae are long and triangular in section. ***(Rothman-simeone the spine 2011)***

The spinous processes of the upper four thoracic vertebrae are more bladelike and are directed downward at an angle of about 40 degrees from the horizontal. The middle four thoracic spinous processes are longer but directed downward at an angle of 60 degrees, so that they completely overlap the adjacent lower segment. The lower four resemble the upper four in direction and shape. ***(Rothman-simeone the spine 2011)***

Lumbar Vertebrae

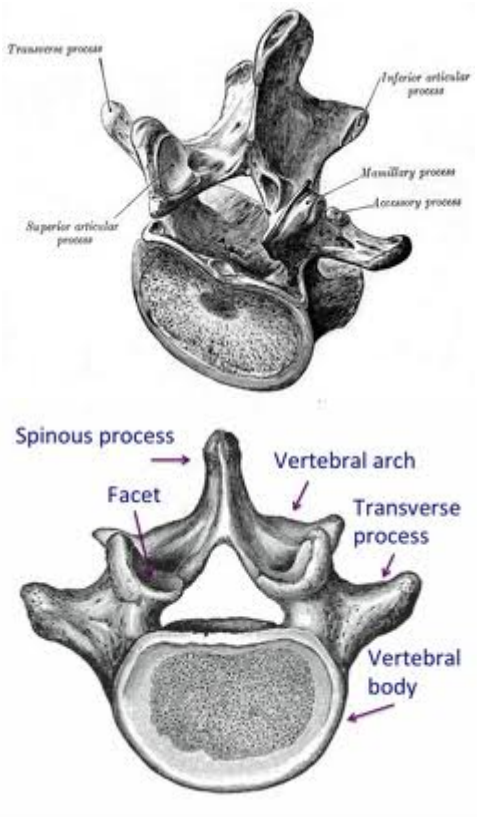

Figure 5: the lumbar vertebra

The lumbar vertebrae (fig 5) are the lowest five vertebrae of the presacral Column All their features are expressed in more massive proportions. They are easily distinguished from other regional elements by their lack of a transverse foramen or costal articular facets. The body is large, having a width greater than its anteroposterior diameter, and is slightly thicker anteriorly than posteriorly. All structures associated with the vertebral arch are blunt and stout. The thick pedicles are widely placed on the dorsolaterosuperior aspects of the body, and with their laminae they enclose a triangular vertebral foramen. Although the inferior vertebral notch is deeper than the superior, both make substantial contributions to the intervertebral foramen. ***(Rothman-simeone the spine 2011)***

The transverse processes are flat and winglike in the upper three lumbar segments, but in the fifth segment they are thick, rounded stumps. The fourth transverse process is usually the smallest. Aside from their relative size, the lumbar vertebrae can be recognized by their articular processes. The superior pair arise in the usual manner from the junction of the pedicles and laminae, but their articular facets are concave and directed dorsomedially, so that they almost face each other. ***(Rothman-simeone the spine 2011)***

The inferior processes are extensions of the laminae that direct the articulating surfaces ventrolaterally and lock themselves between the superior facets of the next inferior vertebra in an almost mortise and-tenon fashion. This arrangement restricts rotation and translation in the lumbar region. The lumbar segments also have pronounced mammillary processes, which are points of origin and insertion of the thick lower divisions of the deep paraspinal muscles. ***(Rothman-simeone the spine 2011)***

Arthrology of the Spine

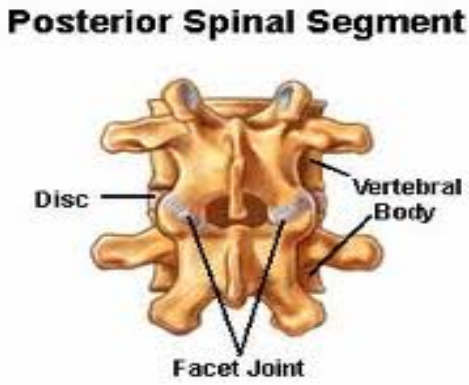

Figure 6: the facet joints

The articulations of the spine include the three major types of joints: synarthroses, diarthroses, and amphiarthroses. The *synarthroses* are found during development and the first decade of life. The best examples

are the neurocentral joints of the immature spine. The *diarthroses* are true synovial joints, formed mostly by the facet joints and costovertebral joints, All the spinal diarthroses are of the arthrodial or gliding type, with the exception of the trochoid or pivot joint of the atlantodens articulation. The *amphiarthroses* are nonsynovial, slightly movable connective tissue joints. They are of two types: the symphysis, as exemplified by the fibrocartilage of the intervertebral disc, and the syndesmosis, as represented by all the ligamentous connections between the adjacent bodies and the adjacent arches. ***(Rothman-simeone the spine 2011)***

Articulations of the Vertebral Arches

The synovial facet joints formed by the articular processes of the vertebral arches possess a true joint capsule and are capable of a limited gliding articulation. The capsules are thin and lax and are attached to the bases of the engaging superior and inferior articulating processes of opposing vertebrae. Because it is mostly the plane of articulation of these joints that determines the types of motion characteristic of the various regions of the spine, it would be expected that the fibers of the articular capsules would be longest and loosest in the cervical region and become increasingly taut in an inferior progression. The syndesmoses between the vertebral arches are formed by the paired sets of ligamenta flava, the intertransverse ligaments, the interspinous ligaments, and the unpaired supraspinous ligament. The ligamenta flava bridge the spaces between the laminae of adjacent vertebrae from the second cervical to the lumbosacral interval. ***(Rothman-simeone the spine 2011)***

The lateral extent of each half of a paired set begins around the bases of the articulating processes and can be traced medially where they nearly join in the midline. This longitudinal central deficiency serves to transmit small

vessels and facilitates the passage of a needle during lumbar punctures. The fibers of the ligamenta flava are almost vertical in their disposition, but are attached to the ventral surface of the cephalad lamina and to the superior lip of the infrajacent lamina. ***(Rothman-simeone the spine 2011)***

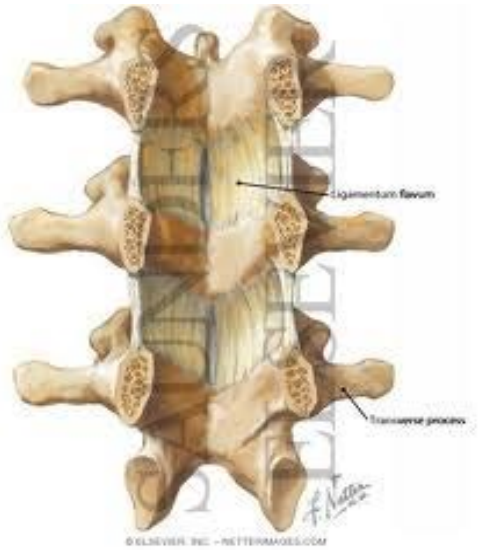

Figure 7:the ligamentum flavum

This shinglelike arrangement (fig. 7) conceals the true length of the ligaments because of the overlapping of the superior lamina. Their morphology is best appreciated from the ventral aspect as in the yellow elastic fibers that give the ligamenta flava their name maintain their elasticity even in embalmed specimens. It has been stated in some texts that the elasticity of the ligamenta flava serves to assist in the maintenance of the erect posture.A more probable reason for this property is simply to keep the ligament taut during extension, where any laxity would permit redundancy and infolding toward the ventrally related nervous structures, as occurs in degenerative lumbar spinal stenosis. There are two separable layers of the ligamentum flavum, one superficial and one deep that have distinct attachments to the inferior lamina the superficial