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CHAPTER 75

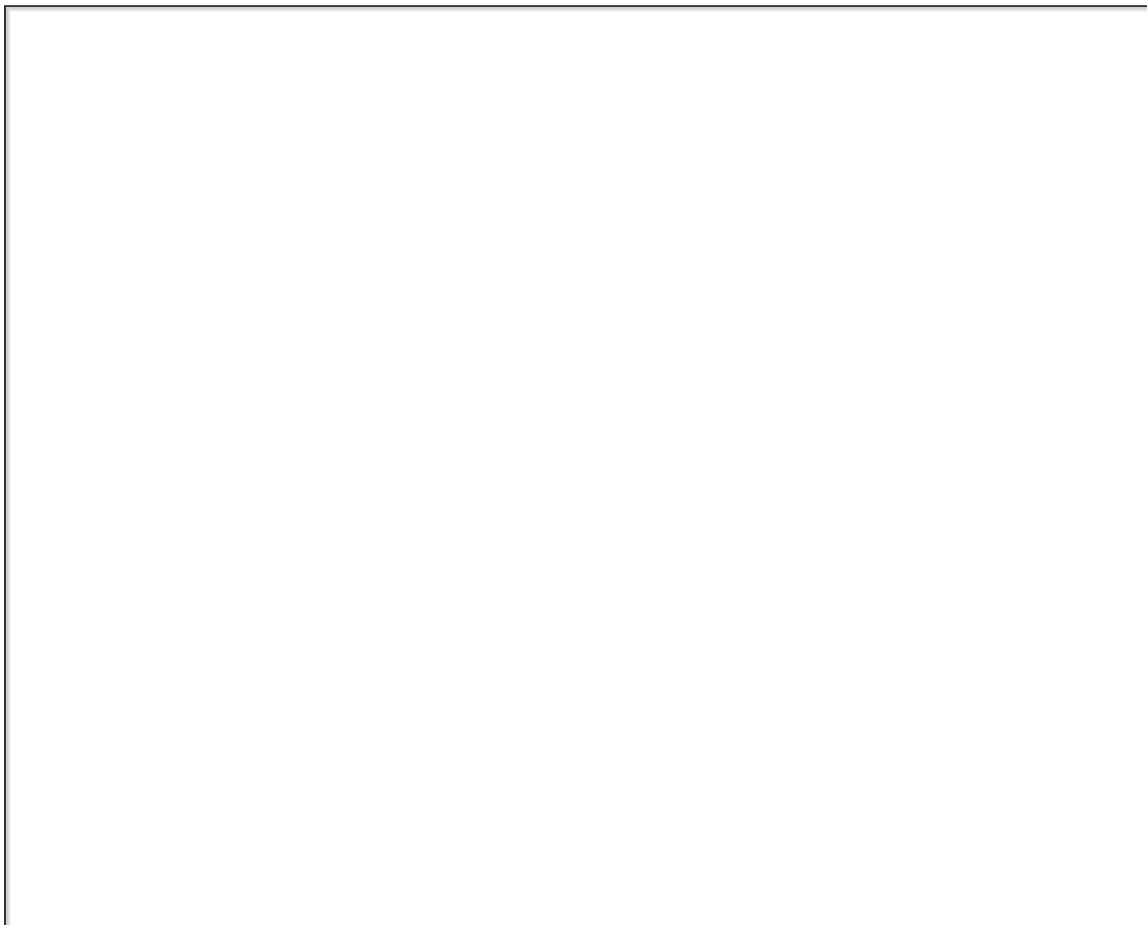
FACET JOINTS

Part of "CHAPTER 75 - General Considerations of Pain in the Low Back, Hips, and Lower Extremities"

The facet joints of the lumbar spine are paired articular structures. Each anatomic motion segment is associated with one pair (Fig. 75-11). These joints are diarthrodial planar joints where the joint surfaces are covered with articular cartilage and the joint is enclosed by a capsule. The facet joints form an articulation between the inferior articular process of the vertebrae above and the superior articular process of the vertebrae below. This sometimes leads to confusion because when the facet joints are viewed in isolation, the inferior, more caudal portion is actually the superior

P.1481

articular facet because it is named from the vertebrae below, and the superior portion of the joint is formed from the inferior articular process of the vertebrae above.



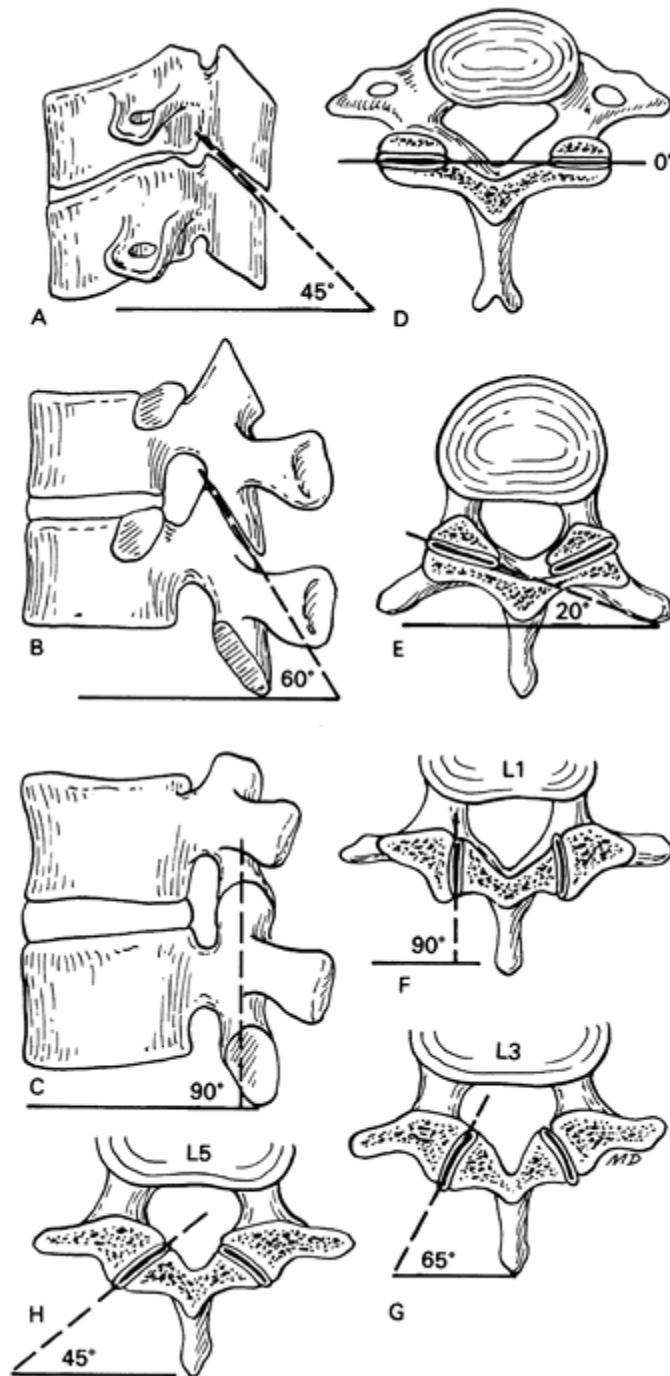


Figure 75-11. Planes of the articular facet surfaces of the vertebral arch joints. Lateral views show the angulation that determines the direction of movement permitted by the vertebral facet in the cervical (A), thoracic (B), and lumbar (C) regions. Depiction of the superior surfaces to show the facet planes horizontally. In the cervical region (D) they allow anterior flexion and extension, in the thoracic region (E) their angle permits an appreciable amount of rotation between consecutive vertebrae, and in the upper lumbar vertebrae (F) the facet planes are vertical. As they proceed caudad (G,H), however, there tends to be a gradual transition in the angle of the superior articular process, which gradually faces more posteriorly and less medially, while the inferior articular process gradually faces more anteriorly and less laterally. The lumbosacral joint, the part farthest from the sagittal plane, allows

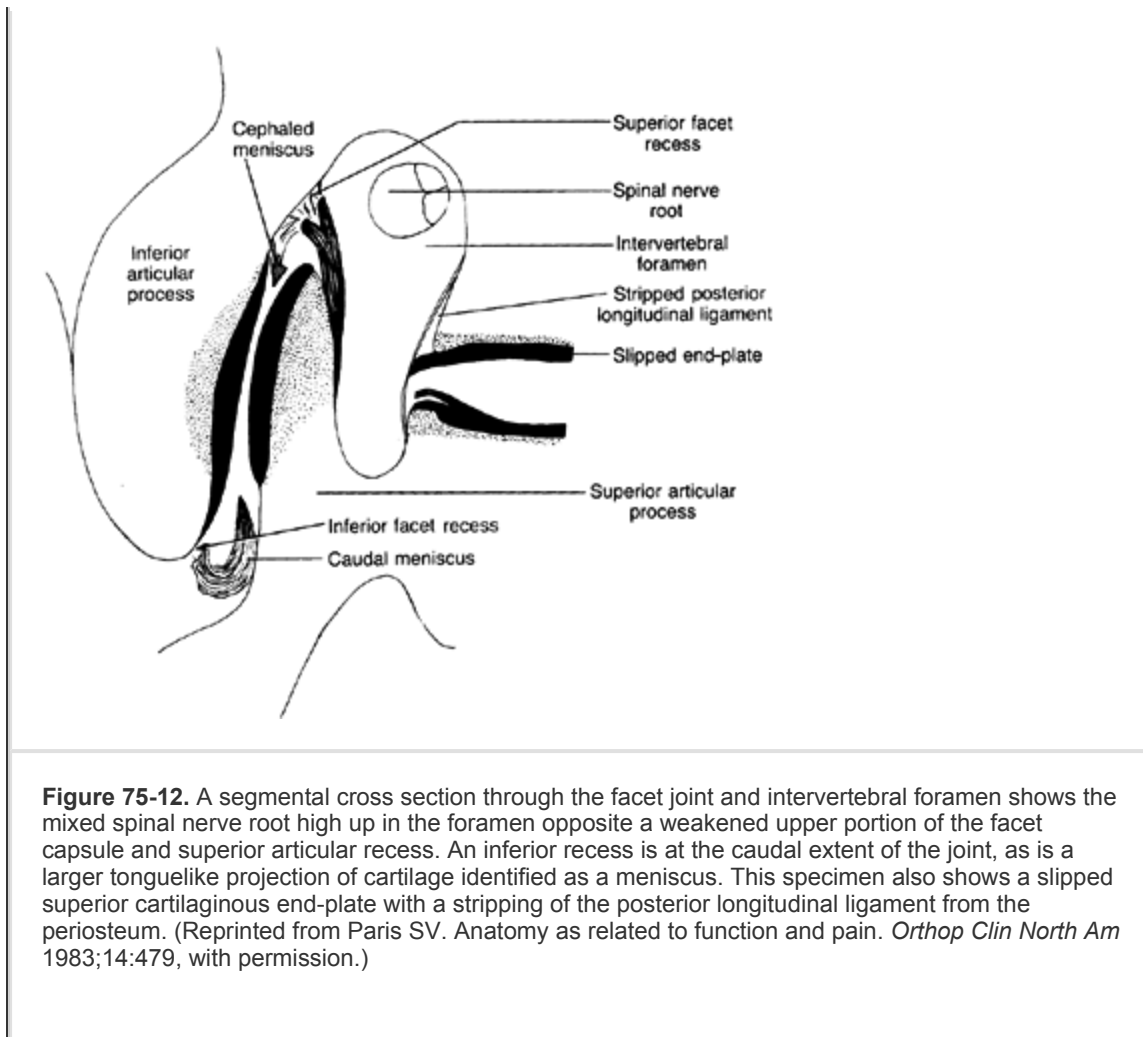
some rotation of the lower part of the lumbar spine. (Modified from Hollinshead WH. *Anatomy for surgeons*, 3rd ed. Vol 3, The back and limbs. Philadelphia: Harper & Row, 1982; and Lindh M. Biomechanics of the lumbar spine. In: Frankel VH, Nordin M, eds. *Basic biomechanics of the skeletal system*. Philadelphia: Lea & Febiger, 1980.)

The facet joints are complex structures whose shape and orientation are not only difficult to define at any specific intersegmental level but they also change as one moves in a cephalad to a caudad direction. In the upper lumbar segments they are vertical with a predominantly sagittal plane orientation, while in the lower lumbar segments they are somewhat less vertical and are approximately halfway between a sagittal and a coronal plane orientation.

Throughout all of the segmental levels the shape of the superior articular process is concave while the inferior articular process is correspondingly convex. In the upper lumbar spine the superior articular process faces medially while the inferior articular process faces essentially laterally. In the lower lumbar spine as the orientation of the joint gradually becomes closer to the coronal plane, the superior articular facet faces both posteriorly and medially while the inferior articular facet faces anteriorly and laterally.

The joint capsule encloses the facet joints and is relatively tighter anteriorly and more lax posteriorly. The multifidus muscle attaches in part to the posterior capsule and may exert a *tensioning* effect on the capsule (13,14). The superior capsule has been shown to be stretched and may be injured with axial loads, especially with the spine in extension (15). Attached to the interior surface of the joint capsule at the level of the superior and inferior joint recesses are fibrofatty or fibrous structures. They have been described as meniscuslike, and some authors believe that they may be a source of nociception if trapped between the joint surfaces. Other authors believe that they are too friable to exert tension on the joint capsule and therefore cannot be a source of nociception (16).

The facet joints and capsule are richly innervated through branches from the posterior primary ramus as it exits from the intervertebral foramina. The posterior primary ramus at a given segmental level sends fibers to the facet joint at that level but also to the facet joints above and below the level of the nerve exit (17) (Fig. 75-12). The innervation of the facet joints and capsule appears to be through mechanoreceptors as well as nociceptors, and there appear to be substance P-containing nerve fibers present (18,19).



Biomechanics and Function of the Facet Joint

The lumbar spine is a structure that includes five motion segments between L-1 and S-1. In the adult the lumbar spine typically adopts a lordotic posture and sits on the sacrum, which is angulated posteriorly. The posterior angulation of the sacrum results in the upper surface of S-1 being oriented 60 degrees to the vertical plane.

The function of the facet joints is to limit and guide the motion of the lumbar spine. The generally sagittal plane orientation of the facet joints markedly limits axial rotation in the lumbar spine. However, the relatively more coronal orientation at the L-5 to S-1 junction may allow somewhat greater rotation to occur. Flexion of the lumbar spine can be influenced dynamically through the lumbar spine musculature and through the passive restraint of connective tissue. It is interesting to note

P.1482

that in spite of the significant stature of the interspinous and supraspinal ligaments, the facet joints provide the greatest limitation to full flexion. In anatomic studies where the facet joints have been excised, there is a marked increase in the mechanical stresses that the disk experiences (20). During full flexion, contact between the more anterior portions of

the superior and inferior articular processes of the facet joints and tension in their joint capsules are the major restraint to motion. In full extension there is stretch applied to the superior aspect of the facet joint capsule, and there may be *bottoming out* of the inferior articular process on the laminae below (8).

The facet joints do not carry significant axial loads with the spine in a neutral position because of their vertical orientation. In extension, however, they have been shown to carry 16% to 20% of the total axial load. The actual anatomic structure of the facet joint that carries the axial load in extension is debated, and in fact it may be dependent on whether the spine and the disk exhibit degenerative changes (21). In the absence of disk degeneration the joint capsule carries significant loads, while in the presence of disk degeneration a greater portion of the load may be borne by the articular surface (22).

As noted previously, the lumbosacral junction is subject to significant shear stresses because of the lumbar lordosis and the posterior angulation of the sacrum. The L-5 to S-1 facet joint bears significant shear stress loads. These shear stresses may in part play a role in the increased incidence of spondylolysis and secondary spondylolisthesis.