Cervical Disc Prothesis
in degenerative Disc Disease

Essay

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Of Master Degree in Orthopaedics

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INTRODUCTION

Cervical disc disease which is accompanied by neural element compression and refractory to conservative management is traditionally treated by discectomy, decompression and fusion [١].

The possibility of accelerated adjacent segment disease after fusion has been growing. The drawbacks to fusion including the alteration of spinal biomechanics, graft and hard ware complication. Neural decompression not fusion remains the primary goal and indication of anterior cervical surgery. Cervical arthroplasty provide the apportunity to preserve motion after neural decompression [٢].

Recent artificial disc technology has rapidly advanced and provided great potential for treatment strategies for several spine disorders especially in the cervical spine [٣].

The prosthesis which are under investigation are constructed predominantly of metal-on-polyethylene or metal-on-metal bearing surfaces and osteoconductive coating to facilitate fixation. The unique anatomy and biomechanics of the cervical spine must be considered extrapolating from the experience of appendicular arthroplasty and lumbar disc replacement [٤].

Cervical arthroplasty has been performed world wide for more than three years. Arthroplasty attempts to address some of the short coming current anterior arthrodesis technique [٥].

Disc replacement appears to diminish the adverse mechanical effect of fusion with satisfactory short term results, but long term follow up is needed to determine if the preservation of motion translates into a lower prevalence of adjacent segment disease [٦].

However, the early success of disc arthroplasty in lumbar spine encouraged the merge of similar group of cervical disc arthroplasty which similarly preserve motion in the hypermobile segment of the spine while maintaining stability. Such an evolution deserves review of literature to point out the merits of such devices and highlight its results and possible complication.

ANATOMY

OF LOWER CERVICAL SPINE

The typical cervical vertebra consists of body and a neural arch. The arch is composed of two pedicles that form its sides and the lamina that form the roof. A spinous process projects dorsally from the junction of the lamina while the transverse processes project laterally from the pediculolaminar junction (Figure ١, ٢) [٧].

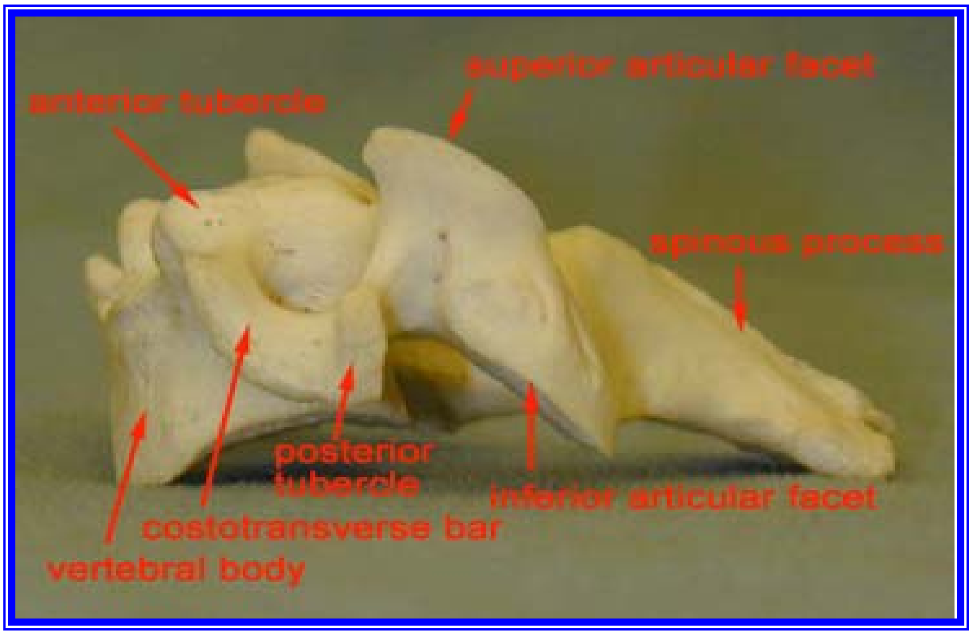

Figure ١: Anatomy of cervical vertebrae (C٤ lateral view) [٨].

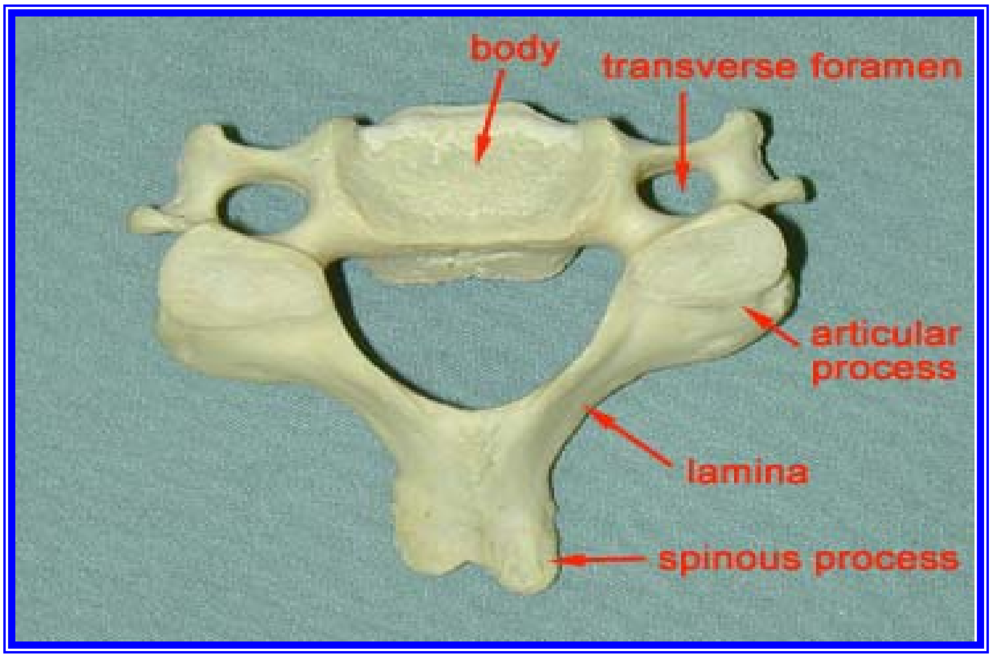

Figure ٢: Anatomy of cervical vertebrae (C٤ superior view) (٨).

Synovial articulation between two vertebrae takes place by the main articular processes. The intervertebral foraminae are formed of deep notch on the lower border of a pedicle with anather smaller notch on the upper border of adjacent one. The anterior height of the bodies is less than posterior height so the cervical lordosis is caused by the discs, rather than the bodies, as the shape of the disc is high anteriorly and narrows posteriorly. With the exception of atlas and axis intervertebral discs separate the vertebral bodies.

In atypical cervical vertebrae, the ovoid body measures about half as much from side to side as it does in its anteroposterior dimension [٧].

The size of each subsequent vertebra is increasing progressively cephalocauded. The upper surface is concave from side to side and this concavity is deepened by means of uncinate process projection upward from the posterolateral aspect of the rim of the body

The upper surface is also convex in the anteroposterior direction. The lower surface of the vertebral bodies is convex from side to side and concave in the anteroposterior direction. A prominent inferior over hanging lip is noted on the anteroinferior surface of the vertebral body. The inferior and posterolateral aspects of the vertebrae above are beveled and lie in apposition to the uncinate process of the body below making joint of Luschka [٩].

The superior and inferior surfaces are saddle-shaped because of the laterally placed uncovertebral joints. These joints form toward the end of the first decade and are in a position that frequently prevents a disc rupture from directly pressing on the nerve root. The nerve roots pass anteriorly to the facet joints and posteriorly to neurocenteral joints. Osteophytes from the neurocenteral joints may compress the nerve root or the spinal cord [٩].

The seventh cervical vertebra is considered atypical because of its particularly long and unbifurcated spinous process, which is known as vertebrae prominence. Also it has a small transverse foramen since it does not transmit the vertebral artery [٧].

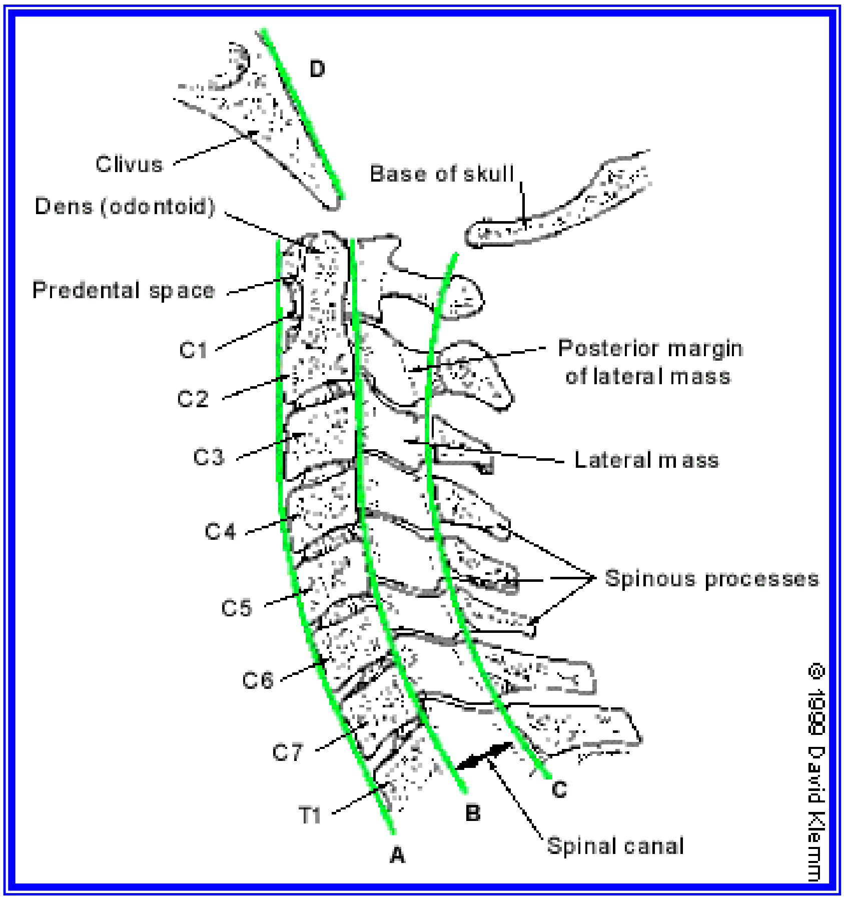

Figure ٣: Lateral view of the cervical spine [١٠].

The pedicles are short and the articular processes are also short and relatively bulky. Unlike the lumbar spine, the pedicles of the cervical spine project posterolaterally, thus electing the size and shape of the transverse process arises near the junction of pedicle and lamina, whereas the anterior root of the transverse process arises from the side of the body. Between them, there is the transverse foramen, limited distally by a bar of bone, the costo-transverse lamella, which unites the two elements of the process. Each element ends in a tubercle, and between the anterior and posterior tubercles is a sulcus for the spinal nerve [١١].

The cervical facet joints govern the movement that is permitted in the lower neck. The articular surfaces of the superior facets face upwards and posteriorly, those of the inferior downwards and anteriorly. These joints project upward at a ٤٥° angle with the horizontal plane (Figure ٣) [١٢].

Ligaments and Joints:

Ligaments of the cervical spine are essential for the maintenance of alignment and stability. The ligaments include the anterior longitudinal ligaments, posterior longitudinal ligaments, the interspinous ligaments, the supraspinous ligaments, the capsular ligament, ligamentum flavum, and the intertransverse ligaments. The anterior longitudinal ligament is attached to the ventral surfaces of the vertebral bodies and the intervening disc. It spans the entire length of the spine from the skull to the base of sacrum. The main biomechanical feature of the anterior longitudinal ligament is resistance of hyperextension. The superficial fibers extend four or five vertebral bodies and the deep fibers span two vertebral bodies. (Figure ٤) [١٣].

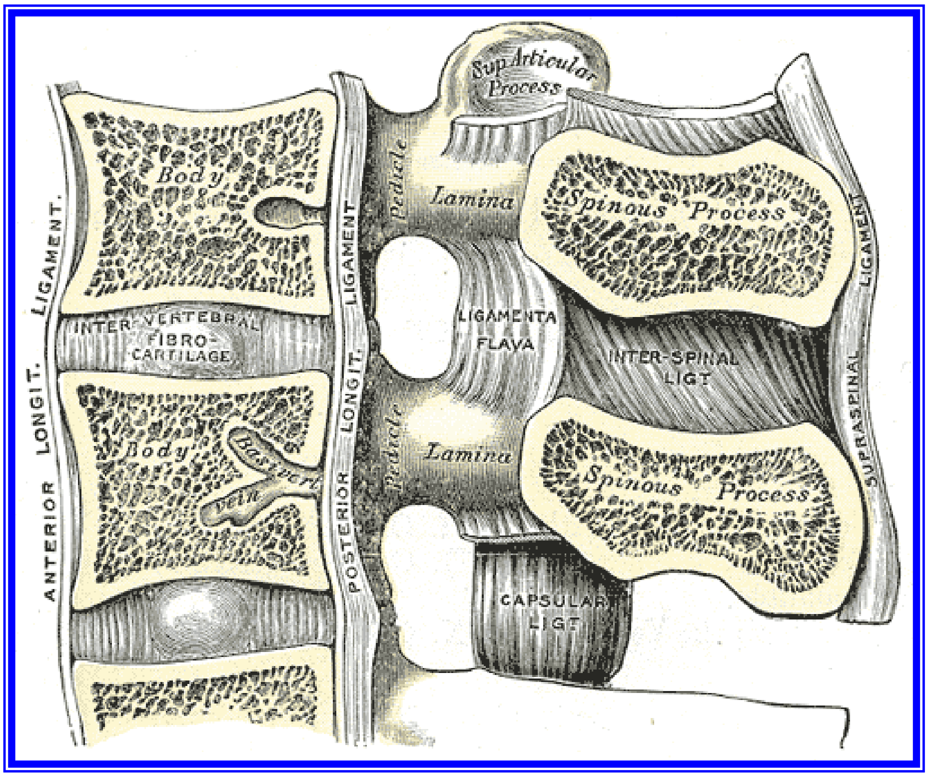

Figure ٤: Cross section in spinal column [٧].

The posterior longitudinal ligament is attached to the discs on the dorsal surface of the vertebral bodies rostrally fan out to become continuous with the tectorial membrane. The main biomechanical effect of the posterior longitudinal ligament is resistance to hyperflexion [١٣].

The posterior longitudinal ligament has been reported as being double layered. The anterior layer, which sends fibers to the annulus fibrosus, has been termed "the deep layer", and the posterior layer, which lies directly on the dura mater, has been termed "the superficial layer". In the far lateral portion of the spinal canal, the superficial layer of the posterior longitudinal ligament become part of the periradicular sheath and is attached firmly to the pedicle, like anchors. Such pedicle like anchor may help to prevent the nerves from being avulsed from the spinal cord as attraction injury [١٤].

The ligamentum flavum connect the laminae of the adjacent vertebrae. They are best seen from the interior of the vertebral canal; when looked at from the outer surface they appear short, being overlapped by the laminae. In the cervical region the laminae are thin, but broad and long. Their marked elasticity serves to preserve the upright posture, and to assist the vertebral column in resuming it after flexion [١٥].