COMPARATIVE STUDY BETWEEN ANTERIOR AND POSTERIOR APPROACHES FOR LOWER CERVICAL DEGENERATIVE DISC DISEASE

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Abbreviations

ACD	Anterior cervical discectomy
ACDF	Anterior cervical discectomy and fusion
COX-2	Cyclooxygenase 2
CS	Chondroitin sulfate
CSF	Cerebrospinal fluid
CSM	Cervical spondylotic myelopathy
CSR	Cervical spondylotic radiculopathy
CT	Computed tomography
DDD	Degenerative disc disease
EMG	Electromyography
HA	Hydroxyapatite
IMHSI	Intramedullary high signal intensity
JOA	Japanese orthopaedic association
KS	Keratin sulfate
MEPs	Cortical motor-evoked potentials
MRI	Magnetic resonance image
NCV	Nerve conduction velocity
NSAIDs	Nonsteroidal anti-inflammatory drugs
OPLL	Ossified posterior longitudinal ligament
PEEK	Polyetheretherketone cage
PSI	Patients satisfaction index
SSEPs	Somatosensory-evoked potentials
VAS	Visual analogue scale

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Review Of Literature

Introduction

Cervical joint disorders affected people in the remote past just as today. Indeed, 4500 years ago, the Egyptians knew that certain neck lesions produced paraplegia **(breasted, 1930)**.

In 1932, Mixter became the first surgeon to remove a preoperatively diagnosed ruptured intervertebral disc **(Ehni,1975)**.Mixter and Barr called these lesions "ruptured" discs, while others favored such adjectives as "prolapsed," "herniated," or "protruded," **(Spurling & Bradford, 1939)**.

Whether to choose an anterior or a posterior approach has been one of the most vigorously debated topics in neurosurgery since the anterior approach was pioneered by Cloward **(Cloward, 1958)** and Robinson and Smith **(Robinson & Smith,1955)** in the 1950 s. The surgeon must decide between an anterior and a posterior approach and among several options with either approach (Fig.1). A number of factors must be considered in selecting the appropriate operative procedure, including the location of maximal neural compression, the presence of deformity or instability, the potential morbidity, and the experience of the surgeon **(Terry & Michael, 1997)**.

The optimal surgical treatment of multilevel cervical spinal cord compression caused by ossified posterior longitudinal ligament (OPLL) or cervical spondylosis remains controversial. Anterior decompression at multiple disc spaces, multilevel corpectomy, laminectomy with or without fusion have all been performed to treat multilevel disease. Laminoplasty was developed in Japan in the 1970s as an alternative to laminectomy. **(John & Paul, 2003)**

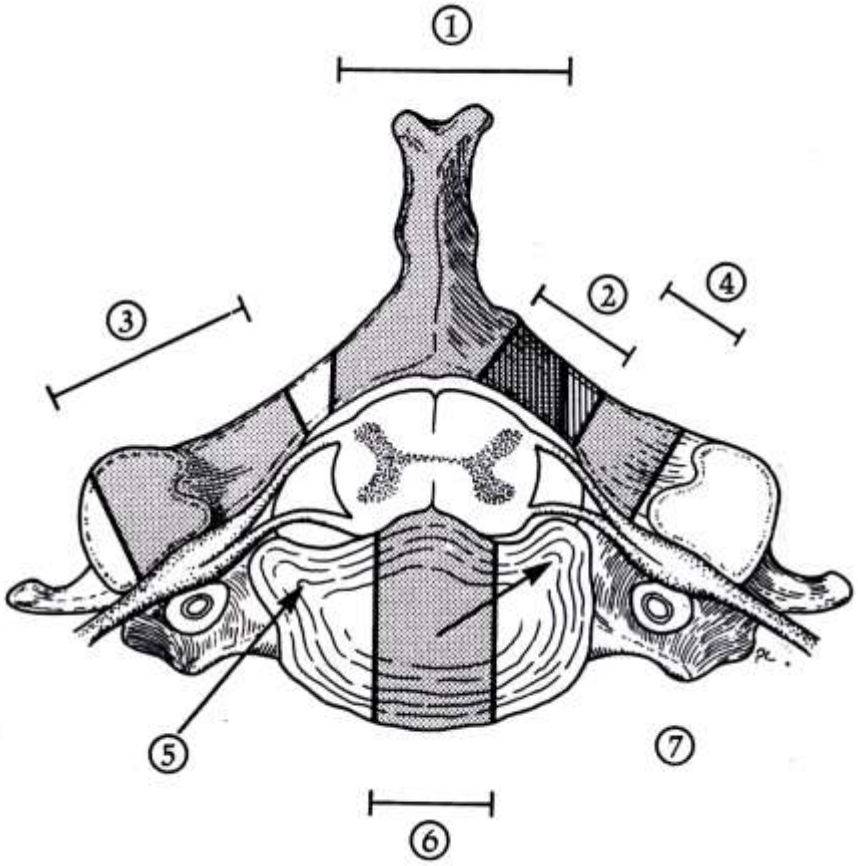


Fig. 1
Transverse section of the cervical spine illustrating the various surgical approaches.

1. Laminectomy;
2. Hemilaminectomy or microsurgical laminotomy;
3. Extended foraminal decompression (this will destabilize the facet joint);
4. Microsurgical proximal foraminotomy (the usual position of foraminal osteophytes is medially in this area);
5. Anterolateral foraminal approach **(Verbiest, 1968);**
6. Anterior approach (Cloward);
7. Lateral extension of anterior approaches to perform an anterior foraminotomy.

(Torrens, 1991)

The surgical treatment of patients with radiculopathy due to degenerative cervical disc disease includes a variety of posterior and anterior approaches **(Adamson, 2001 – Hacker, 2000)**. The classic procedure for cervical radiculopathy has been anterior cervical discectomy and fusion (ACDF) or posterior foraminotomy. For a half century ACDF has persisted as a classic therapy. It provides good access to the spinal canal but not the neural foramen. Posterior foraminotomy has been associated with excellent outcomes. In addition it does not require sacrifice of a functioning motion unit. It has been, however, less favored than anterior procedures.

Anterior cervical foraminotomy was described by Jho in 1996 . He believed that the procedure offers an advantage over cervical fusion because it allows preservation of the motion segment while resecting the arthritic uncovertebral joint, osteophytes, and extruded disc fragments that can induce cervical radiculopathy. **(Jho, 1996)**

In addition to conventional surgical procedures, alternative operative intervention for degenerative spinal disorders has branched into two distinct trends: minimally invasive percutaneous surgery; and aggressive radical surgery, implantation of hardware, and bone fusion. Although minimally invasive spinal surgery tends to produce incomplete treatment, radical surgery can be associated with deleterious anatomical and functional effects. Ideally, surgery would not only be a minimally invasive, biologically compliant, effective procedure involving minimal risks but also a cost-effective overall treatment. The original anatomy and function of the human body need to be respected in surgical repair. In light of these ideal criteria, this concept would be termed functional spinal surgery.

(Hae-Dong, 2003)

Anatomy

A typical cervical vertebra (C3 – C6): (Fig.2)

The "typical vertebra" is composed of a posterior neural arch of a horseshoe shape that is attached to the posterior aspect of the vertebral body, thus forming the spinal canal. This arch gives rise to the zygapophyseal joints on either side, which are anchored to the vertebral body via the pedicles. Two laminae form the posterior aspect of the spinal canal unite in the midline to form the spinous process. Two transverse processes are formed, one on each side of the body, at the anterior aspect of the arch near the articular pillars. The "vertebra prominens" or C7 vertebra has certain peculiar characteristics being larger with thick spinous process; which is not bifid.

- THE BODY: The broad kidney-shaped body is the same size as, or smaller than, the vertebral foramen. On each side it is projecting up into a posterolateral lip or uncus. The uncus on the upper surface of cervical vertebrae 3 to 7 (and also on T_1 vertebra) may appear to form a joint with the adjacent disc because a small cavity may develop in this region (the so-called neurocentral, uncovertebral or Luschka's joint). These are not synovial joints though often stated to be so, but are due to degenerative changes in the disc **(McMINN, 1990)**. The lower margin laterally is beveled reciprocal with this. In the midline the lower margin is projected downwards a little. The anterior surface of the body is concave from above down, and the anterior longitudinal ligament is firmly attached to this surface. Longus colli overlies the ligament.

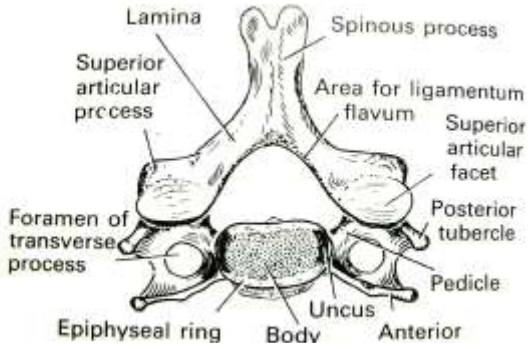
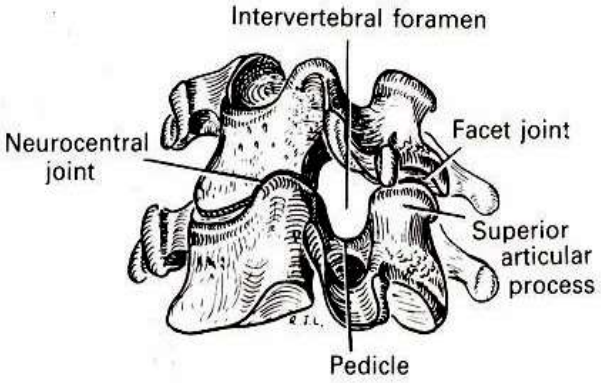


Fig. 2 C6 vertebra: **A**. From above.



B. to show the boundaries of the intervertebral foramen. **(McMINN,1990)**

The superior and inferior margins are referred to as endplates. These endplates are slightly concave in all directions. They are the reproductive zones that provide growth in height. They are thin in the adult and thick in the child in accordance with their respective degree of function. These endplates detach more easily from the vertebral body than from the disc; in fact, they are considered part of the disc **(Junghanns, etal., 1972)**. They are composed of two parts:

* A central part layered with cartilage and riddled with small apertures that play an essential role in the nutrition of the disc.

* A peripheral part, white in color, that forms an annular pad into which the annulus fibrosus of the disc is inserted.

- THE LAMINAE: They enclose a relatively large vertebral foramen, somewhat triangular in cross section. Their borders are grooved for ligamenta flava (the back of the upper border and the front of the lower border).

- THE FACET JOINT AND CAPSULE: While the disc allows for vertebral mobility, the zygapophyseal joints (or facet joints) provide a restraint for vertebral motion. Their orientation varies with the different vertebral levels. In the cervical spine, the superior articular processes face posteriorly and slightly laterally. The angle of inclination of the facet joints in the horizontal plane are 45^{O}. (Fig.3) The articular surfaces of the facets are covered with cartilage. The facet joints are enveloped by a baggy capsule, which imparts to the joint a degree of elasticity **(Junghanns, et al.,1972)**.

  The facet joint capsule is the most richly innervated part of the spine with respect to nociception as well as proprioception. This degree of innervation allows the proximal and distal supporting structures to adjust to the numerous combinations of tension and pressure imposed by various different postures or physical exertion.

Both the horizontal plane (45o) of the facet joint and weak capsule allow more mobility than lumbar and thoracic vertebrae (Flexion and extension motion).

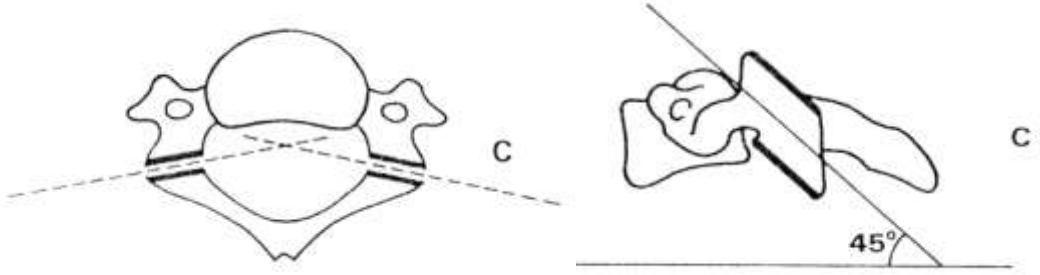


Fig. 3 Orientation of the facet joints

(Junghanns, et al., 1972)

- TRANSVERS PROCESS: attached to the pedicle and body is the lateral projection of the transverse process, perforated by its foramen. The proximal part of the posterior bar of bone that projects from the pedicle behind the foramen is the true transverse element, and it ends in the posterior tubercle (Fig.2). The bar of bone that projects from the body in front of the foramen ends in the upturned anterior tubercle. The anterior tubercles enlarge progressively from C3 to C6. The anterior and posterior tubercles are joined by a down-curved plate of bone, the intertubercular lamella. The vertebral artery lies in the foramen of the transverse process, and the posterior root ganglion of the nerve of the same number lies behind it on the lamella.

The vertebral artery enters its vertebral course nearly always at C6. So, it is not surprising, therefore, that the foramen of C7, which transmits only the vein, is small or even sometimes absent.