CURRENT ASPECTS OF SPINE PROBLEMS

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Common problems in the thoracic and lumbar spine may be divided into 3 groups: degenerative lumbar spine disorders, thoracolumbar spine injuries, and spinal deformities. These problems affect patients in several ways; for example, the quality of life and function of patients are disturbed from pain or neurologic deficits. Moreover, the deformity may be obvious and cosmetically unacceptable. Disorders of the spine can be treated conservatively or operatively, depending on the severity of the diseases or injuries. Surgical procedures used in spine surgery are 1) decompression of neural elements, 2) realignment of the spine, and 3) stabilization of the spine by fusion or instrumentation. Each surgical procedure has its own indications and goals. In order to achieve a successful outcome, the appropriate procedures must be carefully selected and employed for each patient.

DEGENERATIVE LUMBAR SPINE DISORDERS

The most common degenerative disorders affecting the lumbar spine are herniated nucleus pulposus or ruptured disc, degenerative lumbar spinal stenosis, and spondylolisthesis. The quality of life and function of the patients may be compromised in 2 way. One is pain that may come from nerve root irritation or instability of the spine. The other is neurologic dysfunction such as muscle weakness, sensory disturbance, and more seriously, bowel and bladder dysfunction, due to mechanical compression of neural tissues. Main surgical procedures suitable for these conditions are a) decompression i.e., discectomy for ruptured disc and laminectomy $\pm$ facetectomy for spinal stenosis, b) fusion or arthrodesis, and c) instrumentation.

A. Decompression

Surgical decompression is mandatory when there is/are

1) cauda equina compression,
2) progressive neurologic deficits,
3) intractable pain, or

4) persistent pain interfering with quality of life and does not respond to conservative treatment for at least 2-3 months.

In addition, the neural compression has to be confirmed by either myelogram, CT scan, or MRI.

B. Fusion

Fusion is indicated when spinal instability is anticipated or has already existed. In addition to spinal decompression, spinal fusion should be preformed in the following conditions:

1) Degenerative spondylolisthesis
2) Spinal stenosis with pre-existing scoliosis or kyphosis with
    a. flexibility, 50% or more on side bending,
    b. progression of curvature,
    c. predominant leg pain on the concave side,
    d. loss of lumbar lordosis, or
    e. lateral spondylolisthesis, correctable on side bending
3) Recurrent spinal stenosis at a previously decompressed level
4) Excessive removal of facet joint, more than 50% on each side
5) Radical disc excision at the same level as laminectomy

C. Instrumentation

Instrumentation enhances successful fusion and provides for immediate stability as well as ability to correct the pre-existing deformity. Beside spinal decompression and fusion, an appropriate type of internal fixation is helpful in the following conditions:

1) Multilevel fusion (fusion of 2 or more motion segments)
2) Recurrent spinal stenosis with iatrogenic spondylolisthesis
3) Translational displacement more than 4 mm in flexion and extension
4) Angulational displacement more than 10 ° in flexion and extension
5) Pre-existing scoliosis or kyphosis that needs correction

THORACOLUMBAR SPINE INJURIES

Problems in the thoracolumbar spine injuries are related to spinal instability, deformity, and neurologic compression. According to the Three-column Concept of Francis Denis, the spine is unstable if 2 or more columns are disrupted. Spinal instability may lead to progressive deformity and progressive or late neurologic deficits. If the deformity is significant and the spine is unbalanced, back pain is inevitable. The spinal cord and nerve roots may be damaged permanently and completely from disruption or laceration. Recovery of neural function, however, can be expected if the spinal cord and nerve roots are not completely injured and adequate decompression is achieved. Therefore, goals of treatment of thoracolumbar spine injuries are to : a) restore patient mobility, b) achieve stable spinal column with good alignment, c) enhance neurologic recovery, d) prevent neurologic worsening, e) prevent late pain and spinal deformity. When the injured spine is stable (one-column failure and the neurologic function is normal conservative treatment is appropriate, In contrast, surgical treatment should be executed if the injured spine is unstable (2 or 3 column failure)

DECOMPRESSION

Decompression of the spinal cord or the spinal nerve roots can be achieved by direct removal of bony fragment or disc material. Spinal decompression can also be preformed indirectly by anatomical reduction of the injured spine. Decompression should be considered when there is

1) incomplete spinal cord injury or
2) singnificant nerve roots injury.

REALIGNMENT

The deformed, injured spinal column can be realigned by either the closed or open method. When only one column is injured, the deformity can be reduced by closed method using postural reduction and maintained in hyperextension position.

Open reduction, however, is helpful in:
1) fracture-dislocation,
2) fracture with kyphotic deformity of 30 ° or greater, and
3) multiple adjacent compression fractures.

FUSION

Fusion of the injured spine is usually preformed in unstable spine injuries especially when there is failure of ligamentous structure. Spinal fusion is also employed in conjunction with intenal fixation.

INSTRUMENTATION OR INTERNAL FIXATION

Proper instrumentation of the injured spine allows for a) immediate stability, b) spinal realignment, c) early ambulation, d) early rehabilitation, and e) reduction in hospital stay. Thus, instrumentation is needed when the spine is unstable (failure of 2 or 3 columns). Internal fixation is also beneficial when open reduction or decompression is performed.

SPINAL DEFORMITIES

The goals of treatment of spinal deformities are to prevent progression of deformity, to correct the deformity, and to achieve a balanced spine.

Surgical treatment is indicated when:

1) the deformity is severe, for instance, a scoliotic curve greater than 40 °- 50 ° in a growing child or curves over 50 °- 60 ° in a mature adolescent,
2) there is progression of deformity while under nonoperative therapy, and
3) the deformity is obvious and cosmetically unacceptable.

Correction or realignment of the deformity can be achieved by soft tissue release and excision of facet joints as well as by forces applied through the implants. Fusion is performed to prevent progression of the deformity and to obtain a solid, stable spine. Instrumentation not only helps in correction of the deformity but also maintains the spine in the corrected alignment and enhances successful fusion.

SPINAL INSTRUMENTATION

Instrumentation allows for 1) realignment of the deformed spinal column from any causes and maintenance of the correction achieved, 2) stabilization of the unstable spinal coulmn such as tracture or fracture-dislocation and degenerative spondylolisthesis, and 3) indirect decompression of the neural structures by means of realignment.

Several advantages become abvious when the spine is instrumented; for example, high successful fusion rate, immediate stability, and ability to correct the deformity.

Goals of instrumentation in spine surgery are:

1) to correct the deformity
2) to stabilize the spine thereby
    a) protecting the neural elements
    b) reducing rehabilitation time
    3) reducing hospital stay
3) to improve the rate of successful fusion
4) to reduce the number of segments requiring fusion

IMPLANT-RELATED COMPLICATIONS

Though instrumentation has several advantages, implant-related complications are not uncommon. The most important complication is implant breakage. Other complications are failure at the bone-implant interface, hardware prominence, and allergy.

Implant breakage, such as breakage of wire, pedicle screw, rod or spinal plate, is anticipated when there are biological defects or biomechanical defects. Biological defects, due to poor vascularity, inappropriate bone graft, and suboptimal fusion bed, lead to non-union and implant breakage eventually. Biomechanical defects from implant design and materials reduce the strength and stiffiness of the implants. Furthermore, improper surgical techniques produce excessive load on the implants, thereby increasing the chance of implant failure.

Failure at the bone-implant interface, such as hook dislodgement, predicle screw pullout, and hook or wire cuts through bone, occurs in nonsegmental fixation, in osteoporotic bone, and when excessive stress is placed on the spine-implant interface.

Hardware prominence, causing soft tissue irritation, may be a serious problem for a thin patient especially when the implants are bulky.

Allergy to metal, though uncommon, can induce soft tissue inflammation leading to late infection, non union, and implant failure.

SUMMARY

In order to achieve a successful outcome, appropriate surgical procedures must be selected and performed properly. When decompression is mandatory, the neural structures must be decompressed adequately. If the instability is created iatrogenically or

has existed already, stabilization by means of fusion and/or instrumentation must be considered. Fusion bed must be well prepared. Fusion mass should be placed under compressive load, and autogenous bone graft is preferential. Proper type of instrumentation must be undertake. Segmental fixation should be employed whenever possible. The spine-implant construct must be strong, stable, and load sharing construct.