Chapter 3

CLINICAL ADVANCES IN THE USE OF PEDICLE SCREWS AND PEDICLE-SCREW-BASED CONSTRUCTS.

The use of pedicle screws has resulted in dramatic clinical improvements in the surgical care of spinal diseases; these improvements can be catalogued according to the disease process involved.

3.1 SCOLIOSIS

Detailed assessment of patients who have been surgically treated for scoliosis has demonstrated that the routine use of pedicle screws produces better results, in terms of collection in the coronal and sagittal planes and maintenance of the correction, than does the use of hook-based constructs. There is also better tilt-angle correction and rotational correction.

Vertebrectomy at the fifth lumbar level with reduction of the fourth lumbar vertebra onto the first sacral vertebra and with use of only single-level instrumentation and fusion has been widely accepted as a routine treatment for spondyloptosis.
3.2 SPINAL FRACTURE

The use of pedicle screws for the treatment of spinal fracture has allowed most surgeons to accomplish short-segment instrumentation (instrumentation extending from only one vertebra cephalad to the damaged vertebra and to one vertebra caudad to it). Although initial screw-breakage rates were high, they can be reduced to zero when the influence of comminution of the injured vertebral body is appreciated and the choice between anterior and posterior short-segment instrumentation is based predominantly on the load-sharing classification. The limits of in situ bending have been clearly defined.

Pedicle screws have dramatically facilitated the management of burst fractures of the fifth lumbar vertebrae well as the treatment of posttraumatic kyphosis in second and third world countries. In Lumbar Degenerative Disc Disease, the use of pedicle-screw based implants has resulted in union rates of approximately 95 percent after simple lumbar fusions for two and three-level lesions. This union rate was possible previously only with a single-level fusion.

3.3 SPINAL OSTEOTOMY

The fixation provided by pedicle screws has markedly altered the clinical course in patients with fixed multiplanar spinal deformities due to ankylosing spondylitis and in those with severe flatback deformity. Patients now can walk
with use of a removable brace after the osteotomy. They spend no time in bed, whereas periods of one to two months in bed were routine for patients who wore a plaster cast before the advent of the secure fixation provided by pedicle screws. Although it is difficult to prove, the postoperative neurological problems encountered secondary to major osteotomy are also thought to be greatly reduced by the secure short-segment fixation provided by pedicle screws. The loss of correction also must be somewhat reduced (Figure. 54, Figure. 55, Figure. 56 and Figure. 57).

Figure 54 - Figures 55 through 57: Spinal osteotomy has become a much more predictable surgical technique since the adoption of pedicle screws, which provide more secure fixation than any previous technique.

Figure 54 The site of the corrective osteotomy should be at the apex of the deformity, with removal of the laminar arch, the pedicles, and the part of the vertebral body and disc that represent the apex of the deformity.
Figure.55 - This patient had a post-fracture flatback deformity after Harrington strumentation, with fixed deformity in the lumbar spine. The osteotomy was performed through the third lumbar level.

Figure.56 - Close-up preoperative and postoperative lateral radiographs.
Figure 57: Preoperative and postoperative lateral photographs showing dramatic realignment.

3.4 SPINA BIFIDA

The unique benefits of pedicle screws in the correction, stabilization, and maintenance of correction of spina bifida and postlaminectomy deformities have been well documented. The reduction in the period of immobilization and the quality of the final outcome are difficult to demonstrate statistically because these deformities are unusual and the treatment is rarely standardized. However, the acceptance of pedicle screws for the treatment of these particularly difficult problems has been notable.

3.5 PARS INTERARTICULARIS DEFECTS

Repair of pars interarticularis defects has been facilitated considerably by the use of a pedicle screw at the cephalad end of the defect; a hook, wire, or cable then is used to provide internal fixation to the lamina. The infrequent
need for surgical repair of these defects makes statistical documentation of the effectiveness of screws difficult to prove. However, their use has made a number of new and different techniques available to surgeons and patients.

3.6 NEOPLASMS

Pedicle screws have facilitated the short-segment treatment, including total vertebrectomy, of primary and metastatic neoplasms. Short-segment instrumentation is more appropriate in some of these patients than it is in others. The use of short-segment treatment facilitated by pedicle screws has provided the opportunity to perform safe radical resection of primary spinal tumors for the first time. Sacral and lumbosacral resection of chordomas is now practical, and the outcomes are predictable.

3.7 LESIONS OF THE CERVICAL SPINE AND THE CERVICO THORACIC JUNCTION

The use of pedicle screws has been very helpful in the treatment of traumatic and developmental lesions at the cervicothoracic junction. Pedicle screws were used frequently from the second to the seventh cervical vertebra by Abumi and Kaneda and at the cervicothoracic junction by Albert et al. Pedicle-screw constructs have been compared favorably with lateral-mass plate constructs.
3.8 SPINOPELVIC TRAUMA

Severe, traumatic spinopelvic disruption and vertical fractures of the sacrum have been repaired successfully with surgical use of a combination of either iliac or iliosacral screws and caudad lumbar pedicle screws.

3.9 OVERVIEW

Although the routine use of pedicle screws has not been free of complications, it has dramatically improved the prevalence of union after spinal fusion. It also has facilitated shorter-segment instrumentation for fractures and spondylolisthesis and has made total vertebrectomy for neoplasms practical, with predictable outcomes. In addition, the chance of achieving proper realignment and relief of pain has been improved greatly, with fewer complications after the surgical procedure. The proper use of pedicle screws requires a detailed knowledge of the patient’s pedicle anatomy, the routine use of image intensification during application of the screws, the use of blunt identification of the isthmus of the pedicle with employment of the Funnel Technique, meticulous attention to wound care, the use of primarily autograft material to achieve fusion, and the availability of a full inventory of implants. Slow, supervised rehabilitation, with acknowledgment of the fundamental importance of load-sharing by the spinal column itself along with the implant, is also essential until healing of the fusion occurs.
References:


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