Revision Surgery of the Previously Operated Cervical Spines: Application of Pedicle Screw Fixation Systems
Kuniyoshi Abumi, MD, Yasuhiro Shono, MD, Kiyoshi Kaneda (Sapporo, Japan)

INTRODUCTION: Revision surgery of the previously operated cervical spine holds many difficult reconstruction problems. The purpose of this report is to investigate the clinical results of reconstructive surgery using pedicle screw fixation for previously operated cervical spine.

METHODS: Between 1991 and 1997, 45 patients with a previously operated cervical spine underwent revision surgery using pedicle screw fixation systems. There were 24 men and 21 women, and their average age was 58.1 years (range, 22-75 years). Cervical disorders for primary surgery were cervical spondylotic myelopathy in 20 patients, rheumatoid arthritis in 11, spinal injuries in five, spinal cord tumor in three and others in six. The main etiologies those required revision surgery were progression of degenerative change at the adjacent fusion level causing myelopathy in 13 patients, failure of anterior fusion in 11, postlaminectomy kyphosis or instability in ten, pseudarthrosis of posterior or circumferential fusion in five, insufficient posterior decompression in four, and recurrence or residual spinal cord tumor in two. Among the 11 patients with failure of anterior fusion, four patients had been managed by using anterior plate fixation. Before the revision surgery, 16 patients had marked cervical kyphosis with an average angle of 29 degrees (range 15-46 degrees). For revision surgery, 32 patients underwent posterior surgery alone using pedicle screw fixation, and the remaining 13 patients required supplemental anterior surgery. Twenty-five patients underwent simultaneous posterior decompression including laminectomy, laminoplasty and foraminotomy. Pedicle screw-plates system designed for the cervical spine (CPS) was used in 37 patients. Combination of CPS screw and Isola rod was used in four patients. VSP for thoracolumbar spine was utilized for one patient in the early phase of this series. Occipitocervical fixation using occipitocervical rods and CPS screws was performed in three patients. The number of the spinal segments in which fixation was performed ranged from one to 11 (average 3.5). Screws were inserted after probing and tapping under lateral X-ray image control. If pedicle probe could not pass the hard portion of the pedicles, holes by which to initiate probing were created by using Kirschner wire. After surgery, short soft neck color or Philadelphia color was used in all patients, and worm for varied time depending on extent of osteoporosis and range of fusion. However, no patients
All patients were permitted to walk or sit up in bed one day postsurgery unless contraindicated by their general condition.

RESULTS: All patients underwent more than 2 years follow-up review. Bony union was obtained in all patients. Kyphosis was corrected to 5.0 degrees in average (range: -8 to 32 degrees) at the latest follow-up. Loss of correction during bony union was within 3 degrees in all patients. There were no instrumentation failures. Of the 38 patients who had myelopathy preoperatively, 31 patients improved after surgery to some extent. There was no postoperative neurological deterioration. There were two cases of deep infection healed by continuous irrigation without metal removal. There were three patients with cerebrospinal fluid leakage related to posterior decompression. According to postoperative screw evaluation by CT and plain x-ray films, 18 of 244 screws (7.4%) inserted into the cervical pedicles showed perforation of the screw from the pedicle wall in various extents. However, there were no patients with neurovascular complications directly attributable to screw insertion into the cervical pedicles. Iatrogenic foraminal stenosis which caused C5 radiculopathy was observed in one, and the radiculopathy healed by foraminotomy and application of distraction force without removing the screws.

DISCUSSION/CONCLUSION: There are many etiologies those require revision surgery in the cervical spine including pseudarthrosis, postlaminectomy instability or kyphosis, insufficient decompression in previous surgery, development of degenerative change in the adjacent fused segment, etc. Revision surgery of the previously operated cervical spine holds many difficult reconstruction problems including a difficulty in exposing the operated field, redecompression, insufficient bed for bone grafting, kyphotic and/or translational deformity, etc. Repeated anterior approach in revision of failed anterior cervical fusion requires difficult dissection with risks of the vascular and visceral complications, and sometimes require extend of the fusion level to obtain the optimum bone graft bed. Furthermore, many patients who require one-stage posterior decompression and stabilization in revision surgery. Therefore, posterior reconstructive procedure is invariably required regardless of the initial surgery. Among the various posterior cervical instrumentation, facet wiring, lateral mass plate-screw and pedicle screw fixation does not require the lamina for fixation. However, the pedicle screw fixation has many biomechanical advantages. According to the results of this series, pedicle screw fixation provided high fusion rate and sufficient correction of kyphosis in the reconstructive surgery of previously operated cervical spine with complicated condition. We sometimes encountered the difficulties in pedicle screw in the patients who had undergone posterior surgery. As the results, rate of screw malposition by postoperative radiological evaluation was 7.4%; however, no
neurovascular complications directly attributable to screw insertion were observed. Probability of neurovascular injury by perforated screw from the pedicle may be low. Nevertheless, use of pedicle probe and X-ray image, and use of K-wire in some patients raised the reliability of the cervical pedicle screw insertion. In conclusion, pedicle screw fixation which does not require the lamina for stabilization is the useful procedure in revision surgery for the previously operated cervical spines. In addition, using this procedure, rigid fixation provides a high fusion rate as well as corrective capability of kyphosis.