PLATE-SCREW COMBINATION IN THE FIXATION OF UNSTABLE VERTEBRAL FRACTURES: (MID TERM RESULTS)

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Thirteen patients (10 male and 3 female) with thoracal, lumbar or thoracolumbal fractures that were treated with St. George plate and pedicle screw combination were studied at mid term follow-up. The average age at time of surgery was 29 years, and average follow-up was 63 months. While 7 of the patients had complete neurological function loss (Frankel A), 2 patients had full neurologic function (Frankel E). The other 4 patients had incomplete neurologic lesions (Frankel B(1), Frankel D.(3)). The losses of vertebral height, degree of kyphotic deformity and translation were measured on the preoperative, postoperative and the last follow-up plain radiographs. The mean preoperative angle of deformity was 22°, the displacement percentage was 21% and the height loss was 40%. The immediate postoperative angle of deformity was 0°, the ranslation was 0% and the height loss was 0%. At the last follow-up the mean angle of deformity was 4° and the mean height loss following the operation was 8%. The spinal canal and placement of the implants were evaluated with computed tomography. at the last follow-up, neurologic status of the 3 patients with complete neurologic function loss (Frankel A) and two patients with intact cord function (Frankel E) remained unchanged. Three of the remaining 4 patients with complete neurologic function loss improved from A to B, and one improved dramatically from A to D. Of the three patients with incomplete cord or cauda equina lesions, one improved from B to C and the rest three improved to E. There were no pseudoarthroses or implant failure. With its strength the plate screw combination established the normal contours of the fractured spine. Plate-screw combination is a cheap and effective method in the stabilisation of the spinal column after fractures.

Key words: *Vertebral fractures, Plate-screw.*

INTRODUCTION

Optimal treatment of the fractures of the thoracic and lumbar spine still remains controversial. Several methods of surgical stabilisation although with uncertain assistance on neurologic recovery provide better anatomic reduction, results, in more stability, and decrease the rate of long term disability (1, 3, 5, 12, 13, 14, 15). The internal fixation system selected must provide distraction for anterior injuries, compression for posterior injuries, resist bending and torsional forces in unstable injuries and restore normal anatomical spinal configuration. Prompt and complete reduction of the deformity with restoration of the spinal canal integrity and rigid fixation can be expected to assist neurologic recovery.

The spine surgeon, dealing with thoracic, thoracolubar and lumbar spine fractures is faced with several methods of internal fixation and there is still debate in the optimal fixation system to be used for vertebral fractures. Prior to 1960's, surgical stabilisation of the spine was technically limited. The development of Harrington distraction and compression rods has opened a new horizon in the spinal surgery by satisfactorily reducing the angular deformity and restoring vertebral body height (7). More securely grasping rod and locking-hook system provides more stability. Harrington rod with supplemental wire fixation significantly increases stability and strength (5). Several pedicle-screw systems, in which the flexion-bending moment is transferred to either a plate or rod by the pedice screws, offer the advantage of internal fixation to a shorter segment of the spine than with hook systems and provide better stabilisation (13,14). Gurr and McAfee reported that five level instrumentation with the Cotrell-Dubousset System and three level instrumentation with Steffee plates and screws restored greater stability to the destabilized spine when compared to Harrington and Luque rods (11). steffee reported a better clinical and fusion success rate of his implant than the other fixation system (30). The plate screw system of Roy-Camille involves two vertebrae above and two vertebrae below (22). However, the screws are fixed in position along the plate and the angle between the screws and the rod is relatively constrained Wolter determined that good seating of the screw heads is accomplished by providing the plates with slotted screw holes having wave-like indentations (31).

In the article, we review our institution's experience with St. George plate-screw system of in thirteen

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patients with thoracic, thoracolumbar and lumbar fractures.

MATERIALS AND METHODS

During the period between May 1988 and February 1990, thirteen patients with thoracal, thoracolumbar and lumbar fractures treated with St. George plates were included in this study. There were ten male and three female patients. Their mean age was twenty-nine years (ranging between 8 to 38 years). The mean follow-up was 63 months (ranging between 53 and 72 months).

Ten patients were injured in an automobile accident and two were in a fall. Five patients had injuries associated with the spinal lesion. These injuries were one hemopneumothorax, two pelvic fractures, one diaphragm rupture requiring surgical exploration and repair, one diaphyseal humerus fracture with radial nerve lesion that resolved completely by the postoperative sixth month, one diaphyseal tibia fracture and an ipsilateral talus fracture, and few other assorted injuries.

In one patient a laminotomy and in three patients laminectomies were performed by the neurosurgeons in conjunction with spinal plating.

Eight of the patients were admitted directly to our hospital following injuries and five following their first medical aid at another health centre. Mean time from injury to spinal instrumentation was eleven days (range, zero to thirty-two days). All the operations were performed by injured the orthopaedic surgeons at our institution. Second lumbar vertebra was injured most frequently.

We classified cases treated with St. George spinal plates according to Denis (6) There were seven unstable burst fractures, one flexion-distraction injury and five translational injuries.

Neurological status of the patients was determined according to Frankel classification system (10). There were seven grade A patients, two grade E patients, one grade B patient and the remaining three patients were grade D.

Patients were instrumented posteriorly as described by Wolter. Closed reductions were performed in this group of patients and Harrington rods were not needed to be used to ensure reduction contrary to Wolter's description (31).

Patients were cared for postoperatively on a regular hospital bed and were allowed to log-rolled every two hours. Wearing a plastic body cast, the patients could begin walking, and if paralysed could begin sitting for progressively increasing periods under the supervision of the physiotherapists.

Measurement technique developed by Dickson and Harrington(7) was used to quantite the deformity of the spine. The mean preoperative angle of deformity, which is determined by drawing a line along the posterior surfaces of the vertebral bodies above and below the fracture and measuring the angle of the intersected lines was 22° and the mean displacement percentage, which is the ratio of the distance that the displaced vertebra has moved forward relative to the posterior surface of the fractured vertebra, to the width of the normal vertebra immediately below the fractured one was measured as 21%. The mean height loss of the vertebral body was measured as 40%.

Sagittal CT scans of the patients who were thought to be able to withstand the bizarre position of this mode of CT scanning were performed to avoid the artefacts of the metal implants. The artefacts of the pedicle screws were negligible and it was possible to track the course of the pedicle screws in the pedicle and in the body of the vertebrae.

RESULTS

Each patient was assigned a preoperative and postoperative grade based on the neurological examination at the time of the initial hospital admission and again at the time of follow-up. Neurologic status of the 3 patients with complete neurologic function loss (Grade A) and two patients with intact neurologic function (Grade E) remained unchanged following the surgical intervention. Of the four patients with incomplete cord or cauda equina lesions (Grades Band D), three improved from D to E, and one from B to C. Three of the remaining four patients with complete neurologic function loss improved from A to B and one made a dramatic improvement from A to D, who had L2 burst fracture and complete cauda equina lesion following a motor vehicle accident, regained useful motor power below the level of the lesion and became continent after the operation.

The mean interval from the day of injury to the day of admission was two and a half day (ranging zero to nine days). The mean hospital stay was fifty-two days (ranging twenty to three hundred seventy-two days).

The postoperative mean value for kyphotic deformity, translation and the height loss was 0°, 0% and 0%, respectively. After an average of 63 months follow up, the mean angle of kyphotic deformity was 4°, and the mean height loss was 8%. There was no change in the mean displacement percentage. In the final follow up CT scans of 5 patients could be obtained. It was determined that the normal architecture of the spinal canal was achieved and there were no residual bone fragment in the spinal canal.

During the study, implants of 7 patients have been removed and no further changes on the radiological measurements were observed following implant removal until this report was written.

The average numbers of fused segments were 4.85. At the latest control, none of the patients complained of uncompromising back pain and restricted spinal motion.

COMPLICATIONS

There was one patient with a complication possibly related to inaccurate placement of one of the screw into the pedicle. Following the operation, a patient described decreased cutaneous sensation at the distribution of left L_2 root and on X-rays, the corresponding pedicle screw was observed directed inferiorly and medially, possibly compressing the L_2 root. One of the screws was observed in the thoracic aorta with no clinical evidence and one in the vertebral disc space with no discernible sign. In one patient removal of the implant was necessary at the 14. month because of late infection. We did not observe any complications related to the implant failure. No sign of mechanical loosening and loss of the reduction demonstrated during the follow up period. After removal of the implants, it was observed that some plates were bent and rotated in situ, especially at the thoracolumbar junction. No cases of pulmonary embolism, meningitis or death were observed.

DISCUSSION

Currently, pedicle screw fixation of the spine is one of the most popular method due to its advantages. THere are several fixation systems available attached through pedicles, using plates and screws [21,22,23,24,25,28,29,30,31], wires and screws[6], rods and screws[11,2,3,26], and spinal external fixation devices using intrapedicular threaded pins[17,18]. All these systems provide a strong anchor to the spine, resulting in shorter constructs that avoids the need to sacrifice uninjured motion segments. It is possible to apply stronger corrective forces and there is no need for external braces.

In an experimental investigation, Schläpfer et al. demonstrated that the plate fixations provide the highest rigidity, in comparison with ESSF device with or without screw fixation of the facet joints, Jacob distraction rods and Harrington distraction rods[27]. Gurr and McAfee reported that three level instrumentation with Steffee plates and screws restored greater stability to the destabilized spine when compared to Harrington and Luque rods[11]. Preoperative and postoperative clinical and radiological analysis in our small group of patients clearly shows that, spinal plating with pedicle screw fixation is quite effectively accomplishes reduction and stabilisation of the fractured thoracic and lumbar spine and prevents occurrence of late deformities.

In two spine fracture models, Ferguson et al. demonstrated that Roy-Camille plates were the stiffest in angular and shear measurements in all tested planes of motions in comparison with other systems[8]. Animal experiments show that a higher implant stiffness is associated with a higher fusion rate[4]. Steffee observed in his study that the clinical and fusion success rates of VS plates were significantly better than the other fixation systems[30]. In our study, we have achieved fusion in all our patients and there were no pseudoarthroses.

Clinical considerations in choosing the right implant should include not only a spinal construct's rigidity but also the length of its fatigue life[19]. In a biomechanical study, Ashman found that stresses at the root of pedicle screws exceeded the endurance limit of stainless steel in systems with rigid screw plate attachment (i.e., Steffee plate)[30]. We did not observe any screw breakage in our study and we concluded that St. George spinal plate is a semiconstrained system that does not cause frequent screw breakage.

The disadvantages of this system are the necessity to sacrifice uninjured motion segments secondary to a longer construction and possibly the higher amount of bleeding. However, recently McLain reported early failure of short segment pedicle instrumentation for thoracolumbar fractures and he stated that longer constructs could take the advantage of contact forces between the lamina and fixation rod, whereas no such contact could be obtained with the use of short segment constructs without excessive contouring the rod [20]. To prevent early failure and late sagittal collapse, additional hooks above and below the pedicle screw is advised and this procedure results in lengthening the shorter construct[9].

The major advantage of plate-screw combination fixation is its cost. As a comparison, the average costs of TSRH instrumentation, Isola instrumentation and Alıcı (MSS) are $4200, $400, $3000, respectively. However plate-screw combination system costs $600, being as effective but with a less cost. Hence this instrumentation system is a good and cost-effective alternative in the treatment of spinal fractures.

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