TRANSPEDICULAR FIXATION IN THE TREATMENT OF THORACOLUMBAR FRACTURES COMPARISON OF THE TWO INSTRUMENTATION SYSTEMS

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During the period between September 1987 and July 1992, thirty-two patient with thoracolumbar spine fractures treated with pedicle screw-plate fixation and with pedicle screwrod fixation were evaluated retrospectively.

The average age on admission was thirty-two years. There were twenty-two male and ten female patients in this group. These patients were evaluated separately, according to the instrumentation system used. The first group consisted of thirteen paient treated with pedicle screw-palet system and the second group consisted of nineteen patients treated with pedicle screw-rod system were compared clinically and radiologically.

There were no significant differences in the post-operative rehabilitation programs and functional outcomes, but more spinal segments were fused in the first group. It was concluded that pedicle screw-plate system might offer a good and cheap alternative to pedicle screw-rod systems.

There have been several reports of use of fixation systems in the treatment of unstable thoracolumbar spine fractures (7, 9, 13). Among these were Harrington distraction and compression rods (2), grasping rod and locking hook systems (3), Harrington rods with supplemental were fixation (5) and relatively recently developed pedicle screw-plate (9, 10, 11, 12, 13, 14) and pedicle screw-rod (4, 6) systems.

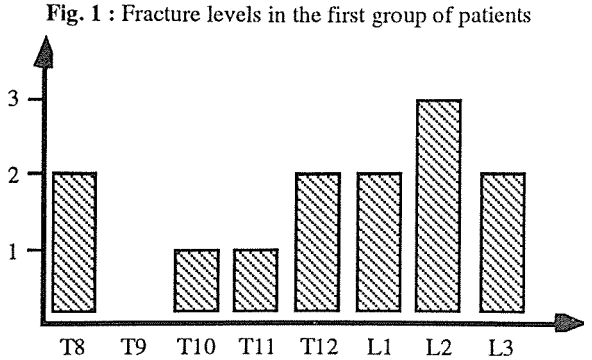
Despite the increasing popularity of pedicle screw-rod systems for pedicle fixation in patients having thoraco-lumbar unstable fractures, pedicle screw-plate systems still offer a good alternative. The current report is based on a retrospective comparison of thirteen patients treated with pedicle screw-plate system with nineteen patients treated with pedicle screw-rod systems for unstable thoracolumbar spinal fractures.

MATERIALS and METHODS

During the period between September 1988 and July 1992, forty-nine patients had been admitted to our hospital because of unstable thoracolumbar spine fractures and associated injuries. Among these, thirty-two patients had been treated with pedicle fixation. These patients were divided into two groups according to the instrumentation sytem used. The first group consisted of the patients treated with pedicle screw-plate combination and the second group consisted of patients treated with pedicle screw-rod combinations. The pedicle screw-plate system used had been St. George Spinal Plating System. Ten AO, two IQL, six Alıcı, and one Isola spinal instrumentations had been used as pedicle screw-rod systems. The mean age on admission in the first group was twenty-nine years (range, eight to thirty-eight years) and in the second group was thirty-two years (range, eleven to fifty-nine years). Nine patients were men and four patients were women in the first group and thirteen patients were men and six patients were women in the second group. Three patients in the first group, ad three patients in the second group were lost to follow up. Thus, ten of the thirteen patients (77%) in the first group and sixteen of the nineteen patients (84 %) were followed for an average of twenty-seven months and eleven months respectively after the operation.

There were two T_8, one T_{10}, one T_{11}, two T_{12}, two L_1, three L_2, and two L_3 fractures in the first group (Fig. 1). In the second group, there were one T_{11}, three T_{12}, seven L_1, four L_2, one L_3, and three L_4 fractures (Fig. 2).

Fig. 1 : Fracture levels in the first group of patients



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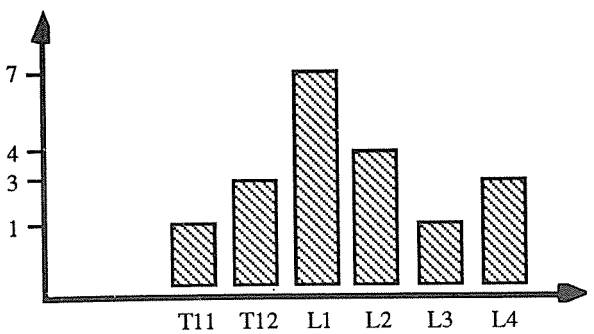
There were seven unstable burst fractures, one flexion distraction injury and five translational injuries in the first group; and two flexion distraction injuries ten unstable burst fractures, and seven translational injuries in the second group.

A prophylactic course of antibiotics was used (cefazolin sodium, one gram intravenously preporatively and one gram intravenously every eight hours until the last dose twenty-four hours after the operation) in all patients.

The level of arthrodeses for the screw-plate fixation through the pedicles were from the seventh thoracal level to tenth thoracal level in two patients, from the eighth thoracal level to twelfth thoracal level in one patient, from the ninth thoracal level to first lumbar level in one patient, from the tenth thoracal level to second lumbar level in two patients, from the eleventh thoracal level to third lumbar level in two patients, from the twelfth thoracal level to fourth lumbar level in three patients, from the first lumbar level to fifth lumbar level in two patients. Thus approximately 4.85 spinal levels had to be arthrodesed in the first group. The level of arthrodeses for the screw-rod fixation through the pedicles were from the tenth thoracal vertebra to first lumbar vertebra in one patient, from the eleventh vertebra to the second lumbar vertebra in two patients, from the twelfth vertebra to the second lumbar vertebra in nine patients, from the first lumbar vertebra to the third lumbar vertebra in three patients, from the second lumbar vertebra to the fifth lumbar vertebra in one patient, and from the third lumbar vertebra to the fifth lumbar vertebra in two patients. Thus approximately 3.21 spinal levels had to be arthrodesed in the in the second group.

Fig. 2 : Fracture levels in the second group of patients.



All arthrodeses were done at the Department of Orthopaedic Surgery and Traumatology, Medical Faculty, University of Hacettepe by chief residents in eleven cases and by senior surgeons in two cases the first group; and by chief residents in seventeen cases and by senior surgeons in two cases in the second group.

No irrigation solutions were used during the operations.

No power drills or high speed burrs were used to drill the pedicles or the vertebral bodies. The junction of the transverse process and the superior facet was used as the location of the point of insertion of the screw in order to prevent penetration of the medial wall and damage to the nerve roots. A K-wire was used to locate the pedicular canal and to create a channel through the pedicle into the vertebral body for subsequent placement of a screw. In both group of patients, the direction of a tap directed into the pedicle were checked with an image intensifier mounted on a c-arm and then the screw was placed in the pedicle. No laminectomy was needed to be done to place the screw under direct vision.

After the AO screws or Shanz screws were in place, the reminder of the systems used were applied; St. George plates in the first group and AO spinal internal fixator or Alıcı spinal instrument or IQL spinal intstrument in the second group. Strips of autogenous bone from the outer table of the iliac crest were used as grafts and no allografts were used in the current series. The wound was closed in the usual fashion.

Most patients were allowed to sit or out of bed in the third postoperative day, if the neural function was sufficient to be of practical use. If paralyzed, the patients were allowed to sit for progressively increasing periods with the assistance of physiotherapists. A brace was used in all the patients in both groups. Despite of this, we observed two screw failures in the screw-plate combination, one screw failure in the AO spinal internal fixator, and one screw failure in the IQL spinal instrumentation. We did not observed any implant failure in Alıcı spinal instrumentation until now.

Ten patients in the first group and fourteen patients in the second group were seen at intervals of six months after operation. The status of fusion and the position of the implants were evaluated by means of radiographs in anteroposterior, lateral and oblique projections. In addition to these routine radiograms. CT scanning were performed through the fractured level and through the pedicular screws were performed in six of the patients in the first group and in five of the patients in the second group. If a solid bridge of bone

connecting the transverse processes of the vertebral bodies were showed in the radiograms, a solid fusion was concluded to be. In two patients in the first group and in two patients in the second group the extent of maturation of the fusion were not clear.

The measurement technique developed by Dickson and Harrington (14) was used to quantitate 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° in the first group and 24° in the second group; 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 one was 21 % in the first group and 26 % in the second group. Immediately postoperatively corresponding mean measuremenets were 0° and 0 % in the first group (15), and were 4° and 7 % in the second group. At the follow-up examinations the corresponding values were 6° and 4 % in the first group, and 11° and 10 % in the second group.

The classification of neural function developed by Frankel and associates (16) was used to grade recovery of neural function.

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.

In the first group neural functions of the three patients with complete neural function loss (Grade; A) and two patients with intact neural function (Grade; E) remained unchanged following the surgical intervention and at the time of the follow-up examination. Of the four patients with spinal cord or cauda equina lesions (Grades B, C, D), three improved from D to E, and one from B to C. Of the remaining four patients with complete neural function loss, three improved from A to B, and one made a dramatic improvement from A to D, who had L_2 unstable burst fracture and cauda equina lesion following a traffic accident, regained a useful motor power below the level of the lesion and became continant after the operative.

In the second group neural functions of the two patients with complete neural function loss (Grade; A) and seven patients with intact neural function (Grade; E) remained unchanged following the surgical intervention and at the time of the follow-up examination. One patient with grade B lesion improved to grade D, three patients with grade B lesions improved to grade E, two patients with grade A lesions improved to grade D, one patient with grade B lesion improved to grade C, and one patient with grade C lesion improved to grade D.

In the first group of patients, 4.85 spinal segments had to be used while in the second group only 3.21 spinal segments had to be used ($P = 0.05$). The ratio of radiologically demonstrated solid fusion following the operation in the first group was 20 % and in the second group 21 %. There was not any significant difference in the neurologic outcomes of the two patient groups. Back pain was not seen as a significant complaint following the operation in both groups.

Sagittal CT scannings of patient, who were thought to be able to withstand the difficult position of this mode of CT scanning, were performed to avoid the artifacts of metal implants in both groups. The artifacts of the pedicle screws were negligible and it was possible to track the course of the screws in the pedicle canal and in the body of the vertebrae. Spinal plates and rods caused a same degree of artifacts in axial scannings. If transverse traction devices in used above and below the fractured level, the artifacts caused by these devices significantly decreases. In the first group, one screw was observed lying in the same section with the thoracic aorta with no clinical evidence. In a patient in the first group, one of the screws was seen in the inter vertebral disk space and another one was seen to perforate the medial pedicular wall, but no clinical sign was encountered. In the screw-plate group one screw breakage was observed and this implant was removed. The patient was free of any symptoms related to his back following the second operation.

In the second group, we observed two implant failures. A patient with an unstable burst fracture of the third lumbar vertebra had been treated with IQL spinal instrumentation. Four months after the operation, the patient was seen because of a sudden feeling of a "crack" at her back and a pedicle screw breakage was found. In another patient who was operated for an L1 unstable burst fracture, an a symptomatic Shanz screw fracture was observed but the patient rejected a second operation for implant removal.

There were only one patient with complication possibly related to incorrect placement of one of the screws into the pedicle in the first group. Immediately following the operation, the patient described decreased cutaneeous sensation at the distribution of left

L2 root and on X-rays the corresponding pedicle screw was observed directed inferiorly and medially, possibly compressing the L2 root, which resolved spontaneously.

No case of early infection, pulmonary embolism or death was observed.

DISCUSSION :

The integrity of the vertebral body and the posterior structures, and the alignment of the spine were regarded as the three major factors on which the stability of the spine depends and if any of these factors are lost, the spine is unstable (2). Pedicle screw fixation systems of the fractured spine are enjoying increasing world-wide popularity. All these systems depend on the ability of a screw to obtain and maintain purchase in the pedicle canal and in the vertebral body until solid fusion takes place.

Preoperative and postoperative clinical and radiological analysis in this small group of patients, shows that pedicular fixation with both screw-plate and screw-rod combinations are quite effectively accomplishes reduction and stabilization of the thoracolumbar spine. Pedicle screw-rod systems have an advantage over pedicle screw-plate systems necessitating significantly less spinal segmental fusion. However spinal plating with pedicular screw fixation still offers a very good and cheap alternative to screw-rod systems.

REFERENCES :

1. Alpaslan, A.M., Leblebicioğlu, G., Eryılmaz, M: Internal Fixation of Unstable Thoracolumbar Fractures with St. George Spinal Plates. J. Turkish Spinal Surg. : Vol; 1, No 3, 15-18, 1990.
2. Denis, F. : THe THree Column Spine and Its Significance in the Classification of Acute Thoracolumbar Spinal Injuries. Spine, 8: 817, 1983.
3. Dickson, J.H., Harrington, P.R., and Erwin, W.D.: Results of Reduction and Stabilization of the Severely Fractured Thoracic and Lumbar Spine. J. Bone and Joint Surg., 60-A: 709, 1978.
4. Fıajgenbaum, M.C., Tylkowski, C.M.: TReatment of Unstable Fractures of Thoracic and Lumbar Spine with Cotrel-Dubousset Instrumentation. In 4th Proceeding of the International Congress on Cotrel-Dubousset Instrumentation. Sauramps Medical, Montpellier, 6-7, 1989.
5. Frankel, H.L., Hancock, D.O., Hyslop, G., Melzak, J., Michaelis, L.S., Ungar, J. H., Vemon, J.D.S., and Walsh, J.J.: THe Value of Postural Reduction in the Initial Management of Closed Injuries of the Spine with Paraplegia and Tetraplegia, Part I. Paraplegia, 7: 179-192, 1969.
6. Jacobs, R.R., Nordwal, A., Nachemson, A.: Reduction, Stability, and Strength Provided by Internal Fixation System for the Thoracolumbar Spinal Injuries. Clin. Orthop. 171: 300-308, 1982.
7. Louis, Rene: Fusion of the Lumbar and Sacral SPine by Internal Fixation with Screw Plates. Clin. Orthop. 203: 18-33, 1986.
8. Prothero, S.R., Parkes, J.C., and Stinchfield, F.E.: Complications After Low Back Fusion in 1000 Patients. A Comparison of Two Series One Decade Apart. J. Bone and Joiunt Surg., 48-A: 57-65, Jan. 1966.
9. Roy-Camille, R., Saillant, G., and Mazel, C.: Internal Fixation of Lumbar Spine with Pedicle Screw Plating. Clin Orthop. 203: 7, 17, 1986.
10. Roy-Camille, R., Barcat, E., Demeulenaere, C., and Saillant, G.: Chirurole par Abord Posterior du Rachis Dorsal et Lombaire. Techniques Chirurgicales, 44: 176-178, 1982.
11. Roy-Camille, R., Saillant, G., Mazel, C.: Plating of Thoracic, Thoracolumbar, and Lumbar Injuries with Pedicle Screw Plates. Ortop. Clin. North Am.: 17, 147-159, 1986.
12. Roy-Camille, R., Saillant, G., Mazel, C., Gagna, G., Caubel, P., Ciniglio, M.: The Surgical Treatment of Post Traumatic Vertebral Deformities. Ital. Journ. lOrth. Traumatol. XII, 4: 419-426, 1986.
13. Roy-Camille, R., Saillant, G., Berteaux, P., and Marrieanne, S.: Early Treatment of Spinal Injuries. In MacKibbin. B. (Ed.) : Recent Advances in Orthopaedics., Number 3. Dublis Churchill Livingstone, 57-87, 1979.
14. Steffee, A.D., Biscup, R.S., Sitrowski, D.J.: Segmental Spine Plates with Pedicle Screw Fixation. A New International Fixation Device for disorders of the Lumbar and Thoracolumbar Spine. Clin. Orthop., 203: 45-53, 1986.
15. Wolter, D., Eggers, C., Hoser, H., und Krumbiegel, A.: Wirbelsaulen und Beckenfracturen im Rahmen der Mehrfachverletzung. Chirurg.: 59, 648-655, 1987.