Percutaneous Fixation of Unstable Fractures of the Dorso-Lumbar Spine Using WSH Plate and Cannulated Screws System

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Abstract

Standard techniques for lumbar pedicle screw fixation involve open exposures and extensive muscle dissection that is associated with extensive blood loss, long hospital stays, and high cost. Mini-invasive techniques are widely accepted as being the less aggressive procedure in any kind of surgery. Further attempts of development of percutaneous techniques in spinal surgery were reported, but little among them with a real success.

The aim of the present study is to evaluate the early results of treatment of unstable fractures of the dorso-lumbar spine using the WSH (world spine holding) percutaneous spine fixation system.

From April 2009 to April 2010 fifteen patients aged 17-55 years with unstable fractures of the dorso-lumbar spine without neurological impairment were treated in Beni-Suef University and Insurance Hospitals with the WSH percutaneous spine fixation system. The range of follow up the patients was 6-18 months. The mean operative time was around one hour and blood loss was negligible. The mean hospital stay was two days.

According to the modified Macnab criteria, excellent results are 80%, good results are 13.5% and fair results are 6.5%. Complications included only one patient with subcutaneous hematoma.

The results of the percutaneous fixation of the dorso-lumbar fracture were promising allowing biomechanically sound internal spine fixation with minimal tissue trauma and achieving the same result as more traditional, invasive approaches.

Key Words: Percutaneous surgery – Dorso-lumbar spine – Pedicle – Screw fixation.

Introduction

The use of pedicle screws for spinal stabilization has become increasingly popular worldwide. Pedicle screw systems engage all three columns of the spine and can resist motion in all planes. Several studies suggest that pedicle screw fixation is a safe and effective treatment for many spinal disorders [1,2]. Standard techniques for pedicle screw placement, however, require extensive tissue dissection to expose entry points and to provide for lateral-to-medial orientation for optimal screw trajectory. Open pedicle fixation and spinal fusion have been associated with extensive blood loss, long hospital stays, and high cost [3].

Mini-invasive techniques are widely accepted as being the less aggressive procedure in any kind of surgery, whenever they are applicable in the treatment of chosen cases [4]. The technique of percutaneous placement of pedicle screws in the lumbar spine was introduced by Magerl in 1977 [5] and was initially described for the management of spinal fractures and spondylo-discitis [5,6]. This closed technique of pedicle screw insertion in the lumbar spine has gained increasing popularity for fixation in patients with suspected segmental lumbar instability and has been described in several publications [7-13].

The aim of the present study is to evaluate the early results of treatment of unstable fractures of the dorso-lumbar spine using the WSH percutaneous spine fixation system.

Patients and Methods

Fifteen patients with unstable fractures of the dorso-lumbar spine without neurological impairment were treated in the Beni-Suef University and Beni-Suef Insurance hospitals with the WSH percutaneous spine fixation system from April 2009 to April 2010. Falling from a height was the main cause of injury followed by motor car accident. The average age was 35 years, 9 were men and 6 were women, 46.5% of these fractures (7 cases) were at the 1st lumbar vertebrae, 13% (2 cases) at
the 12th thoracic vertebrae and the remaining fractures (6 cases) at different levels of the dorso-lumbar spine. There was one case with double level fracture (1st and 2nd lumbar vertebrae). Radiological measurements of anterior compression angle were recorded before and after the operation. The mean follow-up ranged from 6 to 18 months (mean 13 months). All cases were immobilized post-operatively in dorso-lumbar support for 6 weeks.

**Surgical technique:**

The WSH system is based on specially designed plates and cannulated screws (Fig. 1). The surgical technique is extremely simple, using only few instruments, well known of any spinal surgeon, and standard pedicle screw driving. All the patients were operated in the prone position under general anesthesia. C-arm fluoroscopy device is used for guidance of percutaneous screw placement. It is important to check that adequate AP and lateral fluoroscopy images of the lumbar spine can be obtained before preparing and draping the patient.

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**Initial skin landmarks are made before the intervention, indicating the projected incisions which should be placed about 1 cm outside the facet joint external border and about 2 cm length. Incisions are made through the fascia down to bone contact.**

A perforator is used in a standard manner to give access to pedicles, through the muscles, under radioscopic guidance, using the Magrel technique [6], (Fig. 2-A) and thereafter a Kirschner wire (Fig. 2-B) is inserted through the way created by the perforator. Two sequential dilators are then used to dilate the fascia and to separate bluntly the underlying para-spinous muscles down to the spine, and then a working tube is put in place. This stage allows the introductions of the plate dilator. The progression of the plate dilator is enabling by small movements of rotation, slowly reclining muscular masses away from bone, preparing a room for the plate placement.

The plate (either with 3 or 4 holes) is then set through the Kirschner wire, down to its final position (Fig. 2-C&D). The perforator is then moved to the adjacent pedicle and a new hole is made in the same way, permitting the positioning of a new wire through the other hole of the plate. The same procedure is repeated on the opposite side (Fig. 2-E&F). Now, all 4 wires are in place, and then perforated screws can now be driven into the pedicles, always under fluoroscopy guidance. Final fastening of proximal then distal screws, on both sides, is done simultaneously to avoid much stresses over the pedicle screws against plate ends during the indirect reduction of the fracture by the plates on both sides. Second day post-operatively, patients were immobilized in brace and then followed-up clinically and radio logically for at least 3 months.
Results

The results are very encouraging. The mean operative time was around one hour and half ranging from 60 to 100 minutes, with the longer operative times occurring with the early cases.

Blood loss was negligible. Complications included only one patient with subcutaneous hematoma.

The mean hospital stay was two days. Seventy nine percent of the patients were discharged on the second postoperative day while the remaining patients were discharged on the third postoperative day.

Radiologically, all cases healed without deformity with correction of the anterior compression angle postoperatively (Figs. 3,4). There was one case slight backing out of one screw that did not affect the final outcome of reduction and healing. In that case we removed the hard ware earlier (8 months after the fixation) as we plane to remove the plate and screws percutenously one year at least postoperatively.

Outcome was classified according to the modified Macnab (14) criteria (Table 1). Results were considered excellent in 12 patients (80%), good in 2 patients (13.5%), and fair in one patient (6.5%). all were judged to have solid union Fig. (5).

Fig. (2): D- The plate is set through the k-wire to its final position and the procedure is repeated at the opposite side.  
E- Final position of the screws and plates.  
F- The 4 stab wounds of the percutenous technique.

Fig. (3A): Preoperative X-ray of 19 years old male patient with burst fracture of L3 after falling from height without neurological deficit.

Fig. (3B): Postoperative X-ray showing the fixed segment with percutenous WSH system with a good alignment.
Fig. (4A): Preoperative X-ray of a 25 female patient with unstable burst fracture of L1 without neurological deficit.

Fig. (4B): Postoperative X-ray showing the fixed segment with percutaneous WSH system with a good alignment.

Fig. (5A): Preoperative X-ray of 52 female patient with fracture L1&L2 due to falling from height without neurological manifestations.

Fig. (5B): Postoperative X-ray with fixed segment by percutaneous plate and screws with good reduction.

Table (1): Modified Macnab criteria for characterizing outcome after spinal surgery.

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<th>Result</th>
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<tr>
<td>Excellent</td>
<td>No pain; no restriction of mobility; return to normal work &amp; level of capacity.</td>
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<tr>
<td>Good</td>
<td>Occasional non-radicular pain; relief of presenting symptoms; return to modified work.</td>
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<tr>
<td>Fair</td>
<td>Some improved functional capacity; still handicapped &amp; unemployed.</td>
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<tr>
<td>Poor</td>
<td>Continued objective symptoms of root involvement; additional operative intervention needed at the index level irrespective of length of post-operative follow-up.</td>
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Discussion

Traditional open surgical methods for the insertion of posterior instrumentation have several disadvantages including the risk of significant blood loss, the potential for serious infections, and the need for extensive para-spinous muscular dissection. Extensive dissection may lead to muscular denervation and necrosis resulting in prolonged postoperative pain and disability. For these reasons, the development of minimally invasive techniques to achieve spinal fixation would appear desirable [15-17].

The successful placement of pedicle screws requires surgical skills and experience, especially for the percutaneous insertion technique [18].

Percutaneous fixation of the lumbar spine was first described by Magerl [6], who used an external fixator. Mathews and Long [19] first described and performed a wholly percutaneous lumbar pedicle fixation technique in which they used plates as the longitudinal connectors. Lowery and Kulkarni [20] subsequently described a similar technique in which rods were placed. Although the later authors reported a high success rate, Mathews and Long [19]
noted a significant rate of nonunion. In all cases, the longitudinal connectors were placed either externally [6] or superficially, just beneath the skin [19,20]. This has several potential disadvantages. First, the superficial hardware can be irritating and requires routine removal [20]. Second, longer screws are required, producing a less effective biomechanical stabilization than that achieved using standard pedicle fixation systems and leading to higher potential for implant failure.

Our implant is really in close contact to the bone, allowing fixation comparable to open positioning of screws. As other systems available, there is no need for median approach, avoiding large dissection of muscular masses. However yet it doesn’t need neither complex instrumentanation nor long learning of its use, which is not the case of its relatives. Plates can be placed in reverse position, allowing their use either in lordotic or kyphotic curves, which is not the case with systems necessitating specific guidance through specially developed devices.

The WSH system eliminates the need for a large midline incision and significant para-spinous muscle dissection. Both the pedicle screws and the plates are placed through stab incisions. The paraspinous muscles are bluntly splint rather than divided, leading to potentially shorter periods of hospitalization and recovery. Blood loss and tissue trauma are minimized. Ideal lateral-to-medial screw placement is much more easily, especially in obese patients, as significant para-spinous tissue retraction is avoided. We can remove the hardware in the same manner percutaneously after one year at least after the fixation so long no more complications from the implant.

In our study we had excellent results in 12 patients out of 15 (80%), good in 2 patients (13.5%) and fair in one patient (6.5%), these results were better than those obtained by Foley et al. on their study using the same percutaneous transpedicular technique, applying a rod system, they had excellent results in 6 patients out of 12 patients (50%), good results in 5 (41.5%) and poor results in one patient (8.5%).

Conclusion:
We conclude that preliminary results of percutaneous fixation of the dorso-lumbar fracture were promising allowing the surgeon to perform biomechanically sound internal spinal fixation with minimal tissue trauma to minimize approach related morbidity while achieving the same result as more traditional, invasive approaches.

