MINIMALLY-INVASIVE FIXATION OF SPINAL CORD INJURY PATIENT USING MIDLINE INCISION- AN ANALYSIS OF 11 CASES
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ABSTRACT

BACKGROUND
Instrumenting the fractured spinal column has seen many changes in last 5 decades. Starting from Luque’s rod (Dr. Eduardo Luque), Hartshill’s rectangle, the Harrington rod (Dr. Paul Harrington), Variable Spinal Plating (VSP), pedicle screw and rod fixation being the latest. The emphasis is on minimally invasive and least possible trauma to paraspinal muscles. Percutaneous pedicle screw fixation is at present a gold standard of minimally-invasive procedure.

MATERIALS AND METHODS
11 patients were operated between August 2013 till March 2016 with this method and the outcome was evaluated.

RESULTS
The neurological recovery is not the goal of spinal column fixation in SCI patients in most of the cases. The only goal is stabilisation of spinal column, pain relief, rehabilitation, prevention of bed sore, RTI by achieving vertical chest, UTI by preventing stasis of urine in bladder, etc.

CONCLUSION
The presenting operative procedure for achieving this goal of stabilisation is very well achieved in 10 out of 11 cases with minimal soft tissue trauma. The improvement in alignment and restoration of anatomy of spinal column, restoration of spinal canal diameter as judged radiologically is achieved in 9 of out of 11 cases.

KEYWORDS
Spinal Column, Fixation, Minimally Invasive, Midline Incision.


BACKGROUND
Percutaneous pedicle screw placement was originally described by Magerl in 1977 as a means to secure an external spinal fixation system for the treatment of spinal instability secondary to acute trauma or tuberculosis.¹² Since that time, the indications for percutaneous pedicle screw placement have greatly expanded due to advances in spinal instrumentation and surgical techniques.

Today, percutaneous pedicle screws are routinely placed to supplement interbody fusion techniques for degenerative disc disease, spondylolisthesis or scoliosis and to stabilise thoracolumbar fractures.³⁴⁵⁶⁷ The placement of pedicle screws percutaneously minimises muscle dissection, decreases blood loss and reduces infection rates, which has translated into diminishing hospital stays and better patient outcomes.⁵⁹¹⁰¹¹¹²¹³ There is no doubt spinal column stabilisation at an early stage is a mainstay of present day management of the spinal cord injury patients. Definitely, the purpose is not a neurological recovery, but this may be facilitated by the procedure in the similar manner as early stabilisation helps in management of compound fractures. The cause/mechanism/cascade of event of neurological deficiency in spinal cord injury is ill-understood complex phenomenon having no correlation with radiological appearance. With less compression and retropulsion of L1 or other junctional vertebra, there is worst possible neurological consequences, i.e. complete paraplegia. It has also been seen that there has been no recovery in such cases. On the other hand, severe compression fracture (to the extent of being designated as unstable) of the vertebra and retropulsion is seen with minimal neurological disturbance. Till date, there is no clinical, radiological or any other method to prognosticate such injury.

Literatures do not give similar opinion about this unfortunate event of one’s life. Thus, the responsibility of orthopaedic surgeon is to give the best possible opportunity by appropriate and timely rehabilitation. It has always been a matter of controversy in such patients whether to interfere and fix these fractures when-
1. There is minimal or less or no neurological deficiency (even in radiologically unstable fracture).
2. Whether one should fix and/or decompress a spine after 3 weeks or more after injury¹⁴¹⁵¹⁶¹⁷ or at the
earliest. Many people still favour a waiting period before choosing for stabilisation.

The contention of the author is:

1. To stabilise the spinal column at the earliest possible if the injury is unstable whether there is neurological deficiency or not.
2. The procedure must be the least traumatic.
3. There is automatic decompression of the spinal canal after restoration of the normal/near normal anatomy of the spinal canal/column barring.
   a. Loose bony fragments inside the spinal canal.
   b. When sharp bony projections penetrate the dural tube.
4. In the author’s experience, it has been felt (no conclusive data) that even with minimally invasive, the cord maybe in very bad state somewhat liquefied especially in upper segment with worst prognosis. The rupture of dural tube had no correlation with status or neurological recovery.
5. It has been repeatedly noticed that the spinal canal, which was obstructed and do not allow a probe pre-stabilisation readily allows a thick probe to be passed along the spinal canal after stabilisation.

MATERIALS AND METHODS

11 consecutive patients were operated and in all cases pedicle screw and rod fixation was done. Decompression was not routine and was not considered for the purpose of present paper.

Records were made about number of segments involved, number of segments stabilised, achievement of radiological alignment of the spinal column and restoration of the spinal canal. Records were also made about the type of vertebral fracture.

Preoperative plain radiograph and MRI was routine investigation. Postoperatively, only plain radiograph was done.

Operative Procedure

The untraumatised vertebra above and below the fractured vertebra as noticed in plain radiograph and supported by MRI were marked under image intensifier. The MRI gave the real status about the vertebra to be picked up for passing the pedicle screw. The operation was done in lateral position as is practiced at this spine hospital with left side up. The patient was stabilised so that the torso of the patient is perpendicular to the operating table. The image intensifier should readily be passed under the table to take true AP and true lateral images of the spinal column. The level for pedicle screw fixation was marked on the back of the patient as accurately as possible targeting the profile of the chosen pedicle.

A 3-cm incision was made in the midline at both places. The muscles were detached on the corresponding area on both sides from the spinous process up to the lateral border of facets.

The position of K-wire was marked in AP view and its direction was seen in both AP and lateral views. Then, the K-wire was introduced to about 2-cm. The position was confirmed in both views. Now, starter was used and the pedicle was invaded with the help of a pedicle finder. A pedicle probe was used to confirm the confinement of the pedicle. Proper size pedicle screw was introduced with constant image guidance with proper superoinferior, mediolateral directions. A proper size rod was chosen. The lower screw head was seen and the rod was passed upward in the line of the upper screw through the muscles. The rod was manipulated easily into the screw head and inner screw were applied.

The required extension of the spine was achieved by pressure and counter pressure of the spine or by pressing on the rod keeping the inner screw loose, so that rod could slide. Then, the inner screws were tightened. Proper distraction can be achieved by using distracter.
Case 1-

Figure 3. Intraoperative Picture Showing Screw Placement in Both Pedicles of Single Vertebra, Placement Technique of Connecting Rods, Suture Length and Intraoperative Radiograph

(The authors do not prefer use of mechanical distractor for the possibility of insulting the cord, which has no normal bony or muscular protection by injudicious distraction, which even for a moment could damage the cord irreversibly). Similarly, the rod was fixed in another side. Wound was closed in layers.

Postoperative Management
Patient was allowed movement of the lower limbs and side turn from very beginning. Additional anterior spinal support was provided on 10th day. Stitches were removed on 12th day and patient was made to sit. After acclimatisation of the patient, he/she was mobilised on wheelchair. As the condition allowed, the patient was made to stand and walk with crutches.

Figure 4. Postop Radiograph Lateral and AP Views

Figure 5. Clinical Picture Postoperative 12th day and 3 Months

Case 2-

Figure 6. Preop Radiograph

Figure 7. Intraop Pictures of Incision Length and Screw Placement
RESULTS AND OBSERVATION

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name</th>
<th>Age</th>
<th>Sex</th>
<th>Number of Vertebra # in MRI</th>
<th>Spinal Canal Compromise</th>
<th>Vertebral Height Compression</th>
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<tr>
<td>1</td>
<td>Meena Devi</td>
<td>28</td>
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Table 1

<table>
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<tr>
<th>Case No.</th>
<th>Number of Segment Fixed*</th>
<th>Levels of Fixation</th>
<th>Restoration of Spinal Canal (on X-Ray)</th>
<th>Restoration of Spinal Column Alignment</th>
<th>Need of Decompression (yes/no)</th>
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<td>80%</td>
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<tr>
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<td>2</td>
<td>D11, L2</td>
<td>100%</td>
<td>Yes</td>
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</table>

Table 2

*in most of the cases, only one healthy vertebra above and below was fixed.

DISCUSSION

1. Percutaneous pedicle screw fixation is an established procedure; it needs-
   a. Specific instrumentation.
   b. Longer learning curve.
   c. A paramedian opening for each screw of about 2 cm.18,19,20
2. In this procedure, small midline incision was used, paraspinal muscles were erased subperiosteally and retracted at the level of pedicle screw fixation only for screw introduction. The muscles fell in place after application of screw and normal contour of the back was restored. Possibly, no muscle strength was lost as it was in accordance with the nerve supply of the paraspinal muscles.

3. Single midline incision served the purpose of both sides.

4. It needed no extra or specialised instrumentation other than normal instrumentation for pedicle screw fixation.

5. A midline incision was cosmetically better.

6. No extra learning curve.

7. It is versatile, if one needs to do decompression. The same midline incision can be extended (which is not possible in percutaneous fixation).

8. It is also of great advantage in case of caries spine where stabilisation is to precede definitive procedure of anterior decompression, bone graft, etc.

Limitations
When large number of pedicle screws to be used.

CONCLUSION
The minimal trauma, good cosmesis, versatility to extend the midline incision for decompression and no extra learning curve gives this procedure and edge over the conventional percutaneous pedicle screw fixation for spinal cord injury patients.

REFERENCES