

## POSTERIOR STABILISATION OF BURST FRACTURES OF DORSOLUMBAR SPINE

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### ABSTRACT

#### BACKGROUND

Injury to spinal cord and spinal column are serious injuries causing death and disability in the young adult population. Spinal injuries have the lowest functional outcomes and lowest rates of return to work after injury of all major organ system. Although the incidence is relatively small, the impact is enormous as measured in terms of catastrophic physical disability, psychological consequences, and the tremendous cost and the demands on the health care system. With advances in medical technology and the increased experience with large number of spinal injuries, the impetus for the development of programmatic approaches in the management of these devastated victims was provided. The management of spinal injuries is continuously evolving. Many different approaches exist in the treatment of these patients; the comprehensive of spinal cord injuries, multidisciplinary speciality approaches which include orthopaedic surgeon, neurosurgeon, urologist, improvement and better quality of life.

#### METHODS

**Pre-Operative Evaluation:** Mode of injury, fracture level, Magerl's type, preoperative neurologic status, pain experience, sagittal index, post-operative neurologic recovery, vertebral body compression ratio, Cobb's angle, complications and rehabilitation were studied and compared with the other studies. Pre-operative MRI was done mandatorily in each case.

**Surgical Procedure:** Under general anaesthesia through posterior midline approach to the spine, we exposed posterior elements of vertebrae one above and one below the fractured vertebra under image intensifier control, we inserted pedicle screws into the pedicles of normal vertebra above and below the fractured vertebra.<sup>[1]</sup> By compression and distraction manoeuvres, also by gentle manipulative manoeuvres we reduced the retropulsed, translated vertebrae, to achieve near anatomical restoration. We used Cotrel-Dubousset pedicle screw instrumentation for posterior spinal fusion one level above and below the fractured vertebra with the bone graft harvested from posterior iliac crest. (Fig. 1)

**Post-operative Protocols:** Postoperatively, intravenous broad-spectrum antibiotics were given for three days with proper back care. Patients were ambulated with the help of Taylor's brace. Sutures were removed on the 10<sup>th</sup> postoperative day and the patients were discharged and followed in the OPD once in two months for one year. At each visit, patients were evaluated with SCIM score, ASIA score and grade and X-rays. Evaluation of pain relief was done according to Visual Analogue Scale (VAS). (Fig. 2). Functional assessment was done with the spinal cord independence measure developed by A Catz et al specifically for patients with spinal cord lesions. SCIM includes the following areas of function: Self-care (0-20) respiration and sphincter management (0-40), mobility (0-40) each area is scored according to its proportional weight in these patients' general activity. The final score ranges from 0-100.

Functional outcome was assessed at 3 weekly intervals up to 31 weeks and the mean SCIM scores were plotted in a graph for all the patients comparing with preoperative average during the course of the study. (Fig-3)

#### RESULTS

Out of 25 patients, 15 cases were paraplegic and 10 cases were paraparetic. Most common mode of injury was fall from height constituting 63% either from a building, or from a pole or a tree. The rest were road traffic accidents. Gender incidence was found to be male preponderant with 20 males (80%) and 5 females (20%). Most common age group involved was between 18 to 28 years (16 pts.). Most common vertebral level of injury was L1 followed by T12. Sixteen patients presented to the hospital within 24 hrs. Six patients presented between 24 and 72 hrs. The rest presented a week later to the hospital. The neurological status according to ASIA impairment scale was noted. Thirteen were grade A, 3 were grade B, 6 were grade C and three were grade D at the time of admission. Postoperatively, 4 patients remained in grade A, 5 patients had grade C, 6 patients had grade D and 10 had grade E. All the patients had neurogenic bladder at the time of admission, nine remained neurogenic post-operatively and 16 patients attained normal bladder status. Pain showed an average of 4.73 pre-operative value and an average post-operative value of 1.13 on VAS scale. Radiologically, the mean pre-operative Cobb's angle was 14.26 degrees and post-operative mean was 3.63 degrees. The mean improvement in Cobb's angle was 10.63 degrees. The mean vertebral body compression (height) ratio was 60.83 and mean post-operative ratio was 81.66. Improvement was a mean 20.83 in VBHR post operatively justifying the procedure. The mean preoperative sagittal index was 20.43 degrees and mean postoperative sagittal index was 14.6 degrees. Functional outcome was assessed by Spinal Cord Independence Measure score. The mean pre and post-operative scores were 32.26 and 81.53 respectively. Mean improvement in SCIM score was 49.27. This was done at three weekly intervals up to 31 weeks from admission. Bed sores occurred in 5 patients, 8 patients developed UTI, two patients developed upper respiratory infection and two suffered fever in the post-operative period.

## CONCLUSION

Incidence of thoracolumbar spine fractures has a single peak in young adult age group irrespective of the sex of the patient. Incidence is higher in males with almost equal distribution in rural and urban areas. Unlike western hemisphere, the major cause of thoracolumbar spine fracture is fall from height (not the road traffic accidents). Incidence of thoracolumbar spine has got significant relation to the patient's occupation, especially people working as tree climbers, construction workers. Most common level of fracture of thoracolumbar spine is thoracolumbar junction (T12-L1). Surgical stabilisation of unstable thoracolumbar spine fractures with short segment posterior spinal instrumentation with pedicle screws, indirect decompression, reduction and posterior fixation has a role to play in the management of unstable thoracolumbar spine fractures. In neurological recovery, injury to cauda equina i.e. lumbar spine injuries showed a better prognosis as compared to thoracic spine injuries (cord injury). Fixation helps in early mobilisation and rehabilitation and fusion helps in preventing early implant failure. Fixation not only helps in reducing the incidence of complications associated with recumbence but also provides good pain relief. Restoration of normal anatomy of spine i.e. restoration of vertebral body height prevents the progression of kyphosis thereby providing mechanical stability to the spine.

## KEYWORDS

Spinal Injuries C26.117.500, Pedicle Screws E07.695.370.437.500, Bone Transplantation E04.555.130.

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**INTRODUCTION:** An expanding population, increasing number of falls and motor vehicles on limited infrastructure of most places in developing countries, various modes of treatment and their effectiveness made this injury a target of concern from both medical and socio-economic standpoints. High velocity trauma producing severe bone injuries have become very common. The increase in the number of vertebral fractures makes a formidable challenge to the trauma surgeon. Frequently, multiple fractures are produced in the extremities, adding new dimensions to the problems of their management. Of the multiple posterior fixation instruments like Herschel frames, Luke rods, Steffe plating, sublaminar wiring, Cotrel-Dubousset system, we chose Cotrel-Dubousset system for posterior fixation and posterior interlaminar fusion for the treatment of our patients. The results of surgical treatment for unstable thoracolumbar fracture spine have been compared and contrasted with the other studies.

Age, gender, residence, mode of injury, fracture level, Magerl's type, preoperative neurologic status, pain experience, sagittal index, post-operative neurologic recovery, vertebral body compression ratio, Cobb's angle, complications and rehabilitation were studied and compared with the other studies. Pre-operative MRI was done mandatorily in each case. Post-operatively patients were followed up with radiological investigation.

**AIM AND OBJECTIVES:** Injury to spinal cord and spinal column are serious injuries causing death and disability in the young adult population. These injuries have the lowest

functional outcome and lowest rates of return to work after injury of all major organ system.

1. Assessment of thoracolumbar spine fractures.
2. To observe the results of short segment posterior spinal instrumentation.
3. To observe the neurological recovery after short segment posterior instrumentation.
4. To observe the radiological restoration of anatomy after short segment posterior instrumentation.

**MATERIAL AND METHODS:** The study was a prospective study conducted over a period of two years from July 2012 to July 2014. Twenty five patients who presented at Government General Hospital, Kakinada during the above said period with traumatic burst fracture of thoracolumbar spine.

### Inclusion Criteria:

1. Age group, 18 to 60 included.
2. Patients with traumatic burst fractures involving thoracolumbar spine.
3. Patients with or without neurological deficits were included.
4. Patients who presented to our hospital within three weeks of trauma were included.

### Exclusion Criteria:

1. Patients with pathological and fragility fractures.
2. Patients with history of previous back surgery.
3. Obese patients with obesity (BMI>30).
4. Pregnancy.

**RESULTS & OBSERVATIONS:** Out of 25 patients, 15 cases were paraplegic and 10 cases were paraparetic. Most common mode of injury was fall from height constituting 63% either from a building, or from a pole or a tree. The rest were road traffic accidents. Gender incidence was found to be male preponderant with 20 males (80%) and 5 females (20%). Most common age group involved was between 18

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to 28 years (16 pts.). Most common vertebral level of injury was L1 followed by T12. Sixteen patients presented to the hospital within 24 hrs. Six patients presented between 24 and 72 hrs. The rest presented a week later to the hospital. The neurological status according to ASIA impairment scale was noted. Thirteen were grade A, 3 were grade B, 6 were grade C and three were grade D at the time of admission. Post-operatively 4 patients remained in grade A, 5 patients had grade C, 6 patients had grade D and 10 had grade E. All the patients had neurogenic bladder at the time of admission, nine remained neurogenic post-operatively and 16 patients attained normal bladder status. Pain showed an average of 4.73 pre-operative value and an average post-operative value of 1.13 on VAS scale. Radiologically, the mean pre-operative Cobb's angle was 14.26 degrees and post-operative mean was 3.63 degrees. The mean improvement in Cobb's angle was 10.63 degrees. The mean vertebral body compression (height) ratio was 60.83 and mean post-operative ratio was 81.66. Improvement was a mean 20.83 in VBHR postoperatively justifying the procedure. The mean preoperative sagittal index was 20.43 degrees and mean postoperative sagittal index was 14.6 degrees. Functional outcome was assessed by Spinal Cord Independence Measure score. The mean pre and post-operative scores were 32.26 and 81.53 respectively. Mean improvement in SCIM score was 49.27. This was done at three weekly intervals up to 31 weeks from admission (Fig. 3). Bedsores occurred in 5 patients, 8 patients developed UTI, two patients developed upper respiratory infection and two suffered fever in the post-operative period. The pre and post-operative radiographic compared and depicted (Fig. 4).

**DISCUSSION:** The results of surgical treatment for unstable thoracolumbar fracture spine have been compared and contrasted with the other studies. Age, gender, residence, mode of injury, fracture level, Magerl's type, preoperative neurologic status, pain experience, sagittal index, post-operative neurologic recovery, vertebral body compression ratio, Cobb's angle, complications and rehabilitation were studied and compared with the other studies. The male-female ratio was 4:1 in USA. Louis et al 1998 had 2:1 male-female ratio. Robert et al 1993 had 2:1 male-female ratio. Romani et al 2002 had 6.5:1 male-female ratio. In our study male-female ratio was 4:1. Louis et al 1998 had a mean age of 35 years.<sup>[1]</sup> In his study, Robert et al 1993 had a mean age of 25 years in his study and Ramani et al had mean age of 32.6 years.<sup>[2]</sup> In our study, the mean age of incidence of thoracolumbar fracture was 29.9 years, 90% of patients were in the age group between 18-35 years. From the above observations, the incidence of thoracolumbar fracture spine was the highest in young adults in both males and females (Table – 1). The incidence in males was higher because males are more active outdoors. Incidence was higher among adult males, who probably have recently started their career. Chow et al (1996) observed that average duration of hospital stay was 8-12 days. They concluded that non-operative management of thoracolumbar burst fractures with hyperextension

casting or bracing was proven to be a safe and effective method of treatment in selected patients.<sup>[3]</sup> In a study at LTMG Hospital, Mumbai, Ramani and Laud found that 40% of the patients are young people below the age of 30 years and 80% of them are males.<sup>[2]</sup> Augustus white III & Manohar Panjabi attributed the susceptibility of the thoracolumbar transition to anatomical & biomechanical reasons. 1. The transition from a relatively rigid thoracic kyphosis to a more mobile lumbar lordosis occurs at T11-12. 2. The lowest thoracic ribs (T11 and T12) provide less stability at the thoracolumbar junction region compared to the rostral thoracic region, because they do not connect to the sternum and are free floating. 3. The facet joints of the thoracic region are oriented in the coronal (frontal) plane, limiting fixation and extension while providing substantial resistance to anteroposterior translation. In the lumbosacral region, the facet joints are oriented in a more sagittal alignment, which increases the degree of potential flexion and extension at the expense of limiting lateral bending and rotation.<sup>[4]</sup>

Most frequent causes of vertebral column injury were motor vehicle accidents (45%) followed by falls (20%), sports (15%) and acts of violence (15%) in the western literature. In our study, 53.33% sustained injury due to fall from height, RTA came second with 46.66%. Among falls, we had 46% falls from tree, 38% falls from roof, 16% falls from electric poles.

From our study, we have observed that in most of the injuries due to fall from tree or building or pole or fall into well, the people were from rural areas; however, injury due to fall from a roof and injury due to direct hit over the back occurred in patients from urban areas. The most common mode of injury in our study was fall from height; RTA came second. Akbarnia Behrooz et al 1994 had 69.23% of T12-L1 level of fractures, which was the commonest level in this study.<sup>[5]</sup> Ramani et al 2002 had 83.33% of T12-L1 level fractures, which was the commonest level.<sup>[5]</sup> Robert et al 1993 had 52.63% of T12-L1 fractures in their study, which was the commonest level. In our study, we had 50% of T12-L1 fractures and we have also noticed that in majority of patients who sustained injury due to fall from height, lumbar spine was fractured (60%). By this study, we have observed that the incidence of thoracolumbar spine fractures was common at thoracolumbar junction (T12-L1), which is a junction between less mobile thoracic spine and more mobile lumbar spine. (Table -2).

We have classified fractures according to Magerl's classification. As all are burst fractures in our study, we have got 26% A-3.1, 37% A-3.2, and 37% A-3.3 fractures.

Ramani et al 2002 had 75% of cases admitted after 72 hours of injury in their hospital.<sup>[5]</sup> In our study, we had 34% of patients who came after 24 hours but within 72 hours of injury. Only 12% of patients presented within 24 hours after injury. This indicated the lack of medical facilities in rural areas, poverty, ignorance, and illiteracy, lack of referral and lack of quick transportation facilities. All patients who presented to us earlier were from urban areas. Louis et al 1998 had 80% of patients with neurological recovery at least

on Frankel grade at the time of final follow-up.<sup>[1]</sup> In our study, 47% of patients with preoperative neurologic deficits had complete neurologic recovery and 44% of patients remained paraparetic and 10% of patients remained completely paraplegic. Most of recovered patients had lumbar spine fractures. In comparison with the other studies, we had good neurologic recovery postoperatively. Pain status in our study, preoperatively it is 4.73 and postoperatively it is improved significantly to 0.8. Behrooz et al 1994 had an average preoperative vertebral body compression ratio of 75%, 89% of vertebral body height in the immediate postoperative period and 84% of vertebral body height in the latest follow-up<sup>[5]</sup>. Olerud et al 1988 had an average preoperative vertebral body height of 56%.<sup>[6]</sup> Immediate postoperative period, the average height was 88% and the latest follow-up average vertebral body compression ratio was 83%. In our study, the average preoperative vertebral body compression ratio was 60.83% and 81.66% in the latest follow-up. (Table-3). Louis et al 1998 had an average preoperative angle of kyphosis of 15°, 5° in the immediate postoperative period and 10° in the latest evaluation.<sup>[4]</sup> Behrooz et al 1994 had an average preoperative angle of kyphosis of 15°, 0° in the immediate postoperative period and 9° in the latest evaluation.<sup>[5]</sup> Okayama et al 1996 had got an average final follow-up angle of kyphosis of 12°. <sup>[7]</sup> Robert et al 1993 had got an average preoperative angle of kyphosis of 7.42° and 5.45° kyphosis in the latest evaluation.<sup>[8]</sup> Kyphosis increased due to implant failure. In our study, the average preoperative angle of kyphosis was and 4.23°. There is negligible progression of kyphosis postoperatively. (Table -4). Sagittal index preoperative mean is 20.43 and postoperative mean is 14.8 in our study.

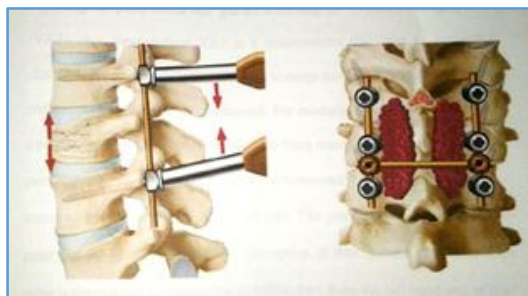
Functional outcome in terms of Spinal Cord Independence Measure in our study is preoperative mean is 32.26 and postoperative mean is 81.53. Behrooz et al 1994 had 7.7% of respiratory complications, 7.5% of UTI and 7.7% pseudoarthrosis. Mortality was nil in his study. Ramani et al 2002 had 33% of wound infection rate, 23.3% of dural lacerations, CSF leakage and mortality of 3.33%. Incidence of bedsores and UTI were accepted as a common association in Ramani et al 2002 study. The high incidence of dural lacerations is due to combined anterior and posterior decompression, particularly when there was an associated laminar fracture. Daneal J Fletcher et al 1994 had 24% of UTI, 7.7% of bedsores and 34.6% of cardiorespiratory complications. Robert et al 1993 had an incidence of 15.78% of pseudoarthrosis. Other complications were not mentioned. The high incidence of pseudoarthrosis is due to implant failure rate, which is secondary to pre-stressing of the screws, through forced compression, distraction, or in situ bending. In our study, we had 27% of UTI, 20% of bedsores and our mortality rate was 0%. We have got one case of wound infection. Pseudoarthrosis, dural lacerations or CSF leak nil.

**COMPLICATIONS:** In comparison with other studies, we have observed that the incidence of UTI and bedsores were more in our study. Wound infection of one case. Pseudoarthrosis, dural lacerations and CSF leak were nil in our study.

Incidence of bedsores was slightly higher in our study probably because of illiteracy, ignorance of patients and their families. Except in one person who died, we had no cardiorespiratory complication because of good anaesthetic support and intensive care facility.

Behrooz et al 1994 used long Herrington's rods and short arthrodesis. The implant failure rate was 15.38%, due to pulling out of hooks. We had one case of wound infection, No pseudoarthrosis, dural lacerations or CSF leak probably because of good surgical technique and very well maintained aseptic theatre and staff. As laminectomy was not performed, there is increased posterior stability and strong tension band which probably has prevented the implant failure and pseudoarthrosis in our study. Robert et al 1993 used Cotrel-Dubousset short segment pedicle screws instrumentation; the implant failure rate was 52.63%. Ebelke et al 1991 has a 6% of prevalence of broken screws with overall incidence of 33% hardware failure. (Table - 5). In our study, the implant failure rate was nil. We have used the "C"-arm control for reduction of burst fractures. Forced manipulations were not adopted. Sagittal profile of thoracic kyphosis and lumbar lordosis were maintained by pre bending the rod, prior to the application and it was rotated to the appropriate alignment. Use of adjunct Taylor's brace probably helped in avoiding the implant failure till the posterior arthrodesis had taken over. In situ rod bending rarely performed in our study group.

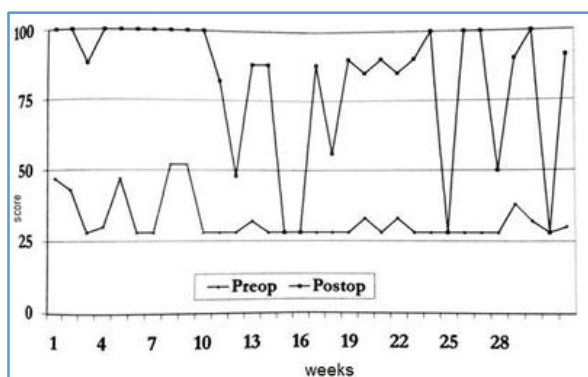
**CONCLUSION:** Incidence of thoracolumbar spine fractures has a single peak in young adult age group irrespective of the sex of the patient. Incidence is higher in males, with almost equal distribution in rural and urban areas. Unlike western hemisphere, the major cause of thoracolumbar spine fracture is fall from height (not the road traffic accidents). Incidence of thoracolumbar spine has got significant relation to the patient's occupation, especially people working as tree climbers, construction workers. Most common level of fracture thoracolumbar spine is thoracolumbar junction (T12-L1). Surgical stabilisation of unstable thoracolumbar spine fractures with short segment posterior spinal instrumentation with pedicle screws, indirect decompression, reduction and posterior fixation has a role to play in the management of unstable thoracolumbar spine fractures. In neurological recovery, injury to cauda equina i.e. lumbar spine injuries showed a better prognosis as compared to thoracic spine injuries (cord injury). Fixation helps in early mobilisation and rehabilitation and fusion helps in preventing early implant failure. Fixation not only helps in reducing the incidence of complications associated with recumbence but also, provides good pain relief. Restoration of normal anatomy of spine i.e. restoration of vertebral body height prevents the progression of kyphosis there by providing mechanical stability to the spine.



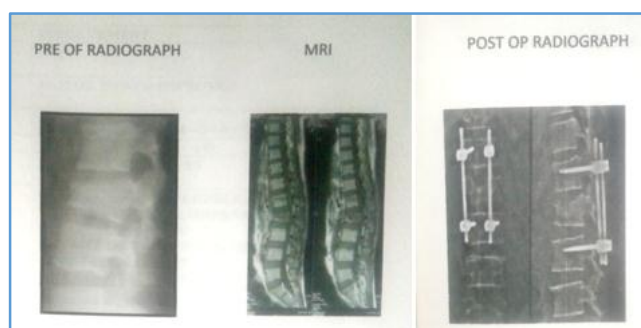
**Figure 1: Schematic Pic. of Surgery**



**Figure 2: VAS Scale**



**Figure 3: SCIM Score**



**Figure 4: Pre and Post-operative Results**

Gender Distribution	M:F Ratio	Mean Age (Years)
Louis et al 1998	2: 1	35
Robert et al 1993	3.75: 1	25
Ramani et al 2002	6.5: 1	32.6
Our Study	4: 1	29.9

**Table 1: Gender Distribution**

	Level T12-L1
Behrooz et al 1994	69.23%
Ramani et al 2002	83.33%
Robert et al 1993	52.63%
Our Study	63.33%

**Table 2: Level of injury**

	Preoperative	Immediate Postoperative	Latest
Behrooz et al 1998	75%	89%	84%
Olerud et al 1988	56%	88%	83%
Our study	60.83%	83.43%	81.66%

**Table 3: Average Vertebral Body Compression Ratio of Fractured Vertebra**

	Preoperative	Immediate postoperative	Latest
Louis et al 1998	15°	5°	10°
Behrooz et al 1994	15°	0°	9°
Okayama et al 1996	-	-	12°
Robert et al 1993	7.42°	-	5.45°
Our study	14.26°	-	3.63°

**Table 4: Cobb's Angle**

Implant Failure Rate	Implant	Failure Rate
Behrooz et al 1994	Harrington	15.38%
Robert et al 1993	CD short segment pedicle screws	52.63%
Ebelke 1991	Pedicle screws VSP plate	33%
Our Study	Pedicle screws, short segment	Nil

**Table 5: Implant Failure Rate**

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