



Original Research Article

Use of cage in spinal reconstruction

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ABSTRACT

Earlier, in the beginning of 20th Century, orthopedic spinal disorders would be the candidates for conservative management. These patients often lost the best chances for neurological and functional recovery and suffered long term morbidity. Various methods of operative intervention are used. Out of all methods, anterior decompression and reconstruction with or without stabilization is the most attractive modality from orthopedic and rehabilitation point of view. The purpose of this study is to show the role of anterior decompression and reconstruction of the spine using cage graft with or without instrumentation. 22 patients are included in this study with mean follow up of 24 months. Outcome measures for the study were: Denis Pain Scale, Denis Work Scale, and Bridwell Grading System of fusion. Spinal injuries are more common in males while tuberculous and degenerative spinal disease are common in females. Most of the spinal injuries are concentrated over D-L region while tuberculosis in dorsal spine. Cervical & Lumbar spines are prone to degenerative changes. Outcomes with Denis pain scale suggested that maximum pain was seen in patients with traumatic and degenerative spine, with Denis Work Scale suggested that out of 22, 10 were totally disabled, 7 were cases of traumatic paraplegia whereas 3 were of tuberculous spine and of Bridwell grading system of fusion showed that out of 22 patients 9(40%) had definite fusion status which was primarily assessed by plain radiograph. Hence, in spinal injuries, earlier decompression with rigid reconstruction of spine especially anterior spine fusion achieve good results in terms of neurological recovery pain free rehabilitation and functional recovery.

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1. Introduction

Earlier, in the beginning of 20th Century, orthopedic spinal disorders would be the candidates for conservative management in the form of Body-Jackets and Bed rest. (Bohler 1925, Guttman 1950). These patients often lost the best chances for neurological and functional recovery and suffered long term morbidity.¹ In this developing era, with urbanization and industrialization, orthopedic spinal disorders are increased in incidence and prevalence. These include spinal traumas-the most common orthopedic spinal cause of morbidity and mortality; spinal tuberculosis,

degenerative spinal disorders and spinal neoplasms. These orthopedic spinal disorders are vigorously treated and management has greatly evolved. Jacob and Casey suggested the early operative intervention for spinal injuries with the goals of: early decompression and protection of neural elements, correction and maintenance of deformity and early pain free mobilization.² In 1986, Harms and Biedermann developed the first implant for the spine. The oval-shaped mesh cylinder was designed to act as a vertebral spacer.³ Various methods of operative intervention are used, first being posterior correction with instrumentation and arthrodesis with or without posterior decompression, second posterior instrumentation and posterolateral decompression and fusion, third anterior decompression, fusion or

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reconstruction with or without anterior instrumentation and fourth anterior decompression and reconstruction with posterior instrumentation-stabilization.⁴

Although posterior fixation, at an increasing distance from the axis of intervertebral rotation, affords greater leverage and resistance to motion about the instantaneous axis of rotation, inadequate anterior column support leads to a potentially unstable mechanism and an instrumentation load bearing configuration.⁵

Out of these methods, anterior decompression and reconstruction with or without stabilization is the most attractive modality from orthopedic and rehabilitation point of view due to direct visualization and decompression of the cord by removing the compressing etiology and also reconstruction of anterior column, through which 80-90% of loads are transferred, provide the best stability and good fusion rate resulting in low morbidity like late collapse of anterior column with progression of deformity, implant failure especial posterior instrumentation and late neurological involvement.⁶

Biomechanical principles of spinal reconstruction are based on the three-column concept of Denis. About 80-90% of axial compression force is transmitted by anterior and middle column; these columns require first priority for reconstruction or fusion. Until the reconstruction of anterior and middle columns, the spine requires protection against the axial compression at the level of failure, which can be provided by strut bone graft which also helps in fusion or vertebral replacement devices-cage grafts. (Distracting device) Posterior column is loaded with tensile (flexion distraction or kyphotic) stresses and failure of this column requires reconstruction by pedicle screws/plate system (Compressive Device) or Hartshills and sub laminar wiring.

When all three columns of unstable spine reconstructed described above, spine becomes stable and stiffer against axial compression, tensile forces and torsional force also if posterior instrumentation is cross linked.^{7,8}

Considering the bio-mechanical principles, ideal construct includes, Anterior decompression corpectomy, Anterior cage with bone grafting and Anterior instrumentation with cross-linking or posterior pedicle screw fixation with cross linking.

The purpose of this study is to show the role of anterior decompression and reconstruction of the spine using cage graft with or without instrumentation.

2. Materials and Methods

22 patients with different spinal injury are included in this study with mean follow up of 24 months (Range from 6 -30 months). The patients coming to hospital campus and falling into the inclusion criteria were taken in the study. Males and females above 18 years, with spinal injury and deformity were included in the study others having any comorbidities like cardiac complications, renal complications, with the

history of any prior spinal surgeries and pregnant females were excluded from the study.

The patients falling into the inclusion criteria were informed about the nature of the surgery and written informed consent from the patients for the participation was taken.

Outcome measures for the study were: Denis Pain Scale, Denis Work Scale, and Bridwell Grading System of fusion.

2.1. Surgical techniques

During anterior surgery, position of the patient for cervical spinal reconstruction is supine whereas for dorsolumbar reconstruction patients were given right lateral position with the kidney bridge.

For cervical spine patients South which and Robinsons exposure technique was used whereas for the dorsal spine (D2-D5) left periscapular or transpleural approach is used, for dorsal spine (D6-D11) left transpleural approach is used, for Dorsolumbar junction (D12- L1) left trans diaphragmatic opening the pleural and retroperitoneal space is used, for Lumbar spine (L2-L5) left retro peritoneal approach is used.

Fractured or diseased body causing cord compression is removed leaving the anterior and right lateral cortex intact. Large curettes, pointed nibblers and Kerrison Rongeurs are used to debride and decompress the cord.

The intervertebral disc above and below the level are removed and the end plates are partially curetted to bleed.

For reconstruction for the spine any sturt cortical graft usually tricortical iliac bone graft or cage packed with cancellous bone graft were used which were snugly fit into the slots and placed over the vascular bed. Cage were placed anteriorly at the maximum distance from IAR.

In this study anterior instrumentation is done using anterior mossmiami and Z-ALT system were used.

During the posterior surgery patients were placed in prone position over the Relton hall frame or on the bolsters with free abdomen and hips and knees in some flexion.

Medial longitudinal incision was used and paraspinial muscles were retracted to expose the posterior elements of the injured spinal level. For insertion of the pedicle screws Roy Camille method⁹ or more specifically Magerl method modified by Krag¹⁰ for lumbar spine and Cinotti et al.,¹¹ method for thoracic spine were used for search of the entry point. Entry were widened by an awl and proper sized pedicle screws were placed and confirmed under IITV. Mossmiami screws were fixed with mossmiami rods using, compression of distracting devices, reduction by ligamento taxes were achieved and then rods and screws were locked by inni. and outti. In case of steffe plates, appropriate size steffe plates are placed over screws. No cross linking is required in steffe system but mossmiami need cross linking using transverse connector and connecting bar.

3. Result and Discussion

In present series 14(64%) are male patients while 8(36%) are females. Spinal injuries are more common in males while tuberculous and degenerative spinal disease are common in females. Most of the spinal injuries are concentrated over D-L region while tuberculosis in dorsal spine. Cervical & Lumbar spines are prone to degenerative changes.

Out of 22, 12 patients had traumatic spine injuries. In context of neurological injury fracture dislocations and burst fractures are more dangerous. Even though no case of seat belt injury was noted.

8 Patients of 22 presented with tuberculosis spondylitis.

The Table 1 suggests that earlier the decompression, better are the chances of recovery. McAfee et al., have explained that grey matter of the cord is more sensitive to ischemia as compared to the white matter which resists ischemia upto 1week which indicates a possible advantage if decompression is performed within this period. Improvement in neurology after late decompression may be due to alleviation of neurological claudication secondary to chronic compression.

Table 2 : Clearly suggests the role of surgery in improving the neurology as well as establishing stable neurology due to improved mechanical stability. In traumatic spine, with complete neurological deficit, chances of recovery is very less but still surgery helps in providing stable neurology where as in traumatic spine with incomplete neurological deficit early decompression and spinal column reconstruction is well established. Anterior decompression, debridement and anterior column reconstruction gives best prognosis in early cases of Tuberculous spines before flaccid paraplegia along with definitive treatment by anti-Koch's regimen.

The outcomes with Denis pain scale suggested that maximum pain was seen in patients with traumatic and degenerative spine where as tuberculous spine has relatively less pain relief.

The outcomes with Denis Work Scale suggested that out of 22 patients, 10 patients were totally disabled, 7 patients of them were cases of traumatic paraplegia where as 3 patients were of tuberculous spine.

Outcomes of Bridwell grading system of fusion shows out of 22 patients 9 patients (40%) showed definite fusion status which was primarily assessed by plain radiograph but in many cases fusion was difficult to assess on the plain X-ray especially where radio opaque cage and cages with intracage cancellous bone graft were used.

Plain CT scans, bone scans or MRI especially with titanium implants could be better tools for fusion assessment.

Dieter Grob et al. did a study on Titanium mesh cage in spinal surgeries and illustrated the different applications of TMC and suggested that TMC is used in the classical

way to replace anterior column defects, but it also helped to circumvent difficult situations where no other standardised solutions were available. Also Alexander R. et al., studied the Use of Allograft Bone and Cages in Fractures of the Cervical, Thoracic, and Lumbar Spine suggested that the material properties of cage devices improve to better match the modulus of elasticity of host vertebral bone, their frequency of use undoubtedly will increase in patients with spinal trauma and other spinal disorders.

Bryan W. et al. did a study on The Use of Interbody Cage Devices for Spinal Deformity: A Bio mechanical Perspective and concluded that structural inter body support probably is the best method to minimize longitudinal rod and screw-bone interface strain. Moreover, anterior load bearing structural grafts and inter body devices have been shown to increase construct stiffness, decrease the incidence posterior implant failure, permit the use of smaller diameter longitudinal rods, and may enhance the rate of successful spinal arthrodesis.



Fig. 1:



Fig. 2:



Fig. 3:

Figures 1 and 2 : Showing patients preop X-Ray, immediate post op X-Ray and 18 months and 2 years follow up and picture showing the functional outcome post-surgery.

Table 1: Injury surgery interval and final neurological outcomes

Injury surgery interval	Neurological improvement	No changes in neurological status	Neurological worsening including paraoperative deaths
0-2 days	4	3	1
3-14 days	2	2	-
15-30 days	-	-	-
After 30 days	-	-	-

Table 2: Final neurological status comparing with pre-operative neurology

	Neurological improvement	No change in neurology	Neurological worsening including death
Traumatic	6	5	1
Tuberculosis	5	2	1
Degenerative	2	-	-
Total	13	7	2

**Fig. 4:**

4. Conclusion

In spinal injuries, earlier decompression with rigid reconstruction of spine especially anterior spine fusion achieve good results in terms of neurological recovery pain free rehabilitation and functional recovery. Following anterior reconstruction spine has to be stabilized by anterior and posterior instrumentation preferably with cross linking. Bone grafting anterior column reconstruction is helpful in preventing kyphosis. Anterior column reconstruction can be done using cage with bone graft if bone stalk allows to expedite the rehabilitation. In case of multiple level replacement of vertebrae by cage the natural curvature of spine cannot be reproduced. Therefore, such cage should be stabilized by anterior or posterior instrumentation to prevent dislodgment or tilting of cage. In case of degenerative spondylolisthesis kidney cage with bone graft implanted by PLIF surgery give best results in terms of fusion, pain relief, root decompression and disc height maintenance which further prevents upper disc degeneration. BMP sprayed cage augments fusion and decrease donor site morbidity.

5. Source of Funding

None.

6. Conflict of Interest

The authors declare that there is no conflict of interest.

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