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Original Research Article

Comparative Study of Instrumentation for Dorsolumbar Junction Spine Fractures

Suresh N Parmar[1], Parth P Modi[2], Vinay Rohra[3], Rajendra Kabaria[4]

[1]Associate Professor, Department of Orthopedics, Government Medical College, Bhavnagar, Gujarat, India
[2]Assistant Professor, Department of Neurosurgery, Government Medical College Baroda, Gujarat, India
[3]Senior Resident, Department of Neurosurgery, Government Medical College Baroda, Gujarat, India
[4]Assistant Professor, Department of Neurosurgery, Government Medical College, Bhavnagar, Gujarat, India

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Corresponding Author: Dr. Rajendra Kabaria
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Abstract:

Objectives: Comparison of Results of Various Types of Instrumentations in Fractures of the Dorsolumbar Junction and Determination of the Optimum Type of Instrumentation, Type of Decompression and Type of Reconstruction for Different Types of Fractures of the Dorsolumbar Junction.

Material and Methods: This was a study of 60 patients with dorsolumabar junction fractures who were treated with open reduction and internal fixation at our institute. These patients were subjected to detailed neurological examination according to the proforma. The study was conducted between 32 patients (fixed with Harrington rod Group A) and 28 (pedicle screw rod Group B) with dorsolumbar spine fractures.

Results: In our study, 60% fractures occur T11 to L2. Fall from tree were the common mode of injury in rural population, while in urban area, it was due to road accident followed by fall. Fractures of spine are more common in males as compared to females. Fixation with pedicle screw rod associated fast recovery and did not need any type of brace during postop rehabilitation, complication like implant failure, infection, etc. were less in pedicle screw group.

Conclusion: Although, pedicle screw fixation is technically demanding procedure, requires image intensifier facilities and implant is more costly than Harrington instrumentation, but in benefit of patient, it is better than Harrington instrumentation, but in benefit of patient, it is far better than Harrington instrumentation.

Keywords: Dorsolumabar Junction, Fixation, Instrumentation, Dorsolumbar Spine.

Introduction

The Dorsolumbar spine area at T10-L2 is the most common region of the spine affected by trauma due to the specific biomechanics of this segment. This area is commonly referred to as the Dorsolumbar junction. It is highly susceptible to injury because it is a transition area from the rigid and less mobile thoracic spine due to the attached ribs bilaterally to a more flexible caudal lumbar spine. Care of vertebral injuries contributes to major expenditure of health care resources. [1]

Injury to this area can result in a permanent neurological deficit from compression and injury to the conus medullaris or the descending nerve roots and warrants immediate attention and assessment. The most common mechanisms for Dorsolumbar traumatic injuries include motor vehicle accidents, falls from height, recreational injuries, and work-related injuries. Most of them are high-velocity and high-energy injuries, which usually involve additional injuries. Consensus guidelines have been proposed for the systematic management and implementation of treatment algorithms, especially in multisystemic injuries. The American College of Surgeons provides the advanced trauma life support (ATLS) protocol for trauma providers, and evidence has demonstrated a reduction in morbidity and mortality with this implementation. [2,3]

Dorsolumbar injuries in trauma are concentrated at the Dorsolumbar junction,60% occurring between T11 and L2. Lumbar and thoracic injuries together represent 37-41% of traumatic spinal cord injuries. Neurologic deficit occurs in 26% of TL junction fractures. Since the earliest attempts, the treatment of fractures and fracture dislocations of the thoracic and lumbar spine has been controversial. Initially all fractures of the DL junction were treated conservatively. Since the past 30 years more and more surgeons are shifting towards open reduction

and internal fixation of these fractures. Biomechanical analyses of the stiffness of fused spinal junctions have commonly been performed by experimental studies evaluating individual surgical technique. However, these experimental studies have significant drawbacks: Large numbers of subjects or cadavers are required, and the results of the experiment are dependent on the material and experimental environment. [4,5]

In the early years laminectomy was the main stay of surgical treatment. Recently reports by Levine and Edwards, Bohlman, McAfee, Bohlman & Yuan, Luque, Cassis and Ramirez-weill, Cotrel – Dubosset and Guillamat have emphasized the advantages of open reduction and internal fixation with instrumentation.

Objectives of the study are: Comparison of Results of Various Types of Instrumentations in Fractures of The Dorsolumbar Junction and Determination of The Optimum Type of Instrumentation, Type of Decompression and Type of Reconstruction for Different Types of Fractures of The Dorsolumbar Junction.

Material and Methods

This was a study of 60 patients with dorsolumabar junction fractures who were treated with open reduction and internal fixation at our institute. These patients were subjected to detailed neurological examination according to the proforma given below, at (a) admission (b) immediate post op period (c) 6 weeks (d) 6 months and (e) after one year. Each patient was assessed by means of Cotlers criteria after a mean follow up period of one year and the following results were obtained.

- Preliminary data consisting of age, sex and occupation.
- Patient study regarding mechanism of injury, neurological symptomatology.
- Radiological evaluation of the injury that included standard anteroposterior and lateral radiograph. Radiological evaluation should include spinal alignment, presence of any rotation or translation, assessment of kyphosis, loss of vertebral height, widened interpedicular distance or interspinous distance.
- Detailed neurological examination in the form of sensory, motor, reflexes, bladder and bowel involvement and graded according to modified Frankel (ASIA impairment scale) classification.

It is observed that if methyl prednisolone given within 3-8 hours of injury and administered over 24-48 hours, better neurological recovery occurs. [6]

Surgical Indications [7]: Incomplete neurological deficit.

1. Progressive neurological deficit.
2. Spinal cord compression.
3. Fracture dislocation.
4. Kyphosis >30 degrees.
5. Concomitant injuries requires early mobilisation.

Principles of Posterior Short Fixator with Pedicular Screws

1. Stable internal fixation designed to fulfil the local biomechanical demand.
2. Preservation of blood supply by means of surgery and soft tissue preservation.
3. Anatomic alignment particularly in regard to sagittal plane.

Techniques of Safe Pedicle Screw Application: Roy-Camille et al suggested that a pedicle screw should be introduced by drilling the path and then applying the screw. Most American surgeons realised the danger of this approach. They adopted a blunt technique to identify the pedicle and routinely used biplane image intensification during the placement of pedicle screws. The use of taps of gradually increasing diameter to assess the quality of cortical purchase through the isthmus of the pedicle and the use of image intensification to assess the length of the screw necessary to obtain purchase in the vertebral body, but not through the anterior vertebral cortex have become standard procedures for safe screw application resulting in strong fixation. This technique called the funnel technique is now used widely.

- The dorsal projection of the pedicle localised under image intensifier.
- Point of entry in thoracic spine just below the upper facet joint, 3 mm lateral to the center of joint near the base of transverse process. Lumbar spine practically at all levels of the long axis of the pedicle pierces the lamina at the interaction of the true line, a vertical line tangential to the lateral border of the superior articular process and horizontal line bisecting the transverse process. The point of intersection lies in the angle between the superior articular and the base of transverse process. The entry point made with the help of 90 degrees curve bone awl.
- Once the isthmus of the pedicle is directly palpated, a small 2 mm pedicle probe is passed through the isthmus into the vertebral body.
- A large (5 mm) probe then is used to enlarge the path through the isthmus of the pedicle.
- Small K-wire (55 mm in length) are placed into the probed pedicles as radiographic markers (the anteroposterior and lateral C-arm images confirm the pedicle path. The lateral C-arm images also confirm the length of the screw to be used; the depth of each Wire is measured after it is removed).

- Threads then are cut into the pedicle in all directions the bottom of the pedicle (in the vertebral body) and the superior, inferior, medial and lateral inner walls of the pedicle.
- The screw then is inserted into the pedicle with the screwdriver. The purchase (insertional torque) must progressively increase until final seating.
- The anteroposterior and lateral C-arm images confirm proper positioning after all of the screws, rods and connectors are inserted.

Results

In our study, 60 patients of Dorsolumbar injuries treated by spinal instrumentation, out of which 2 by Harrington's instrumentation (Group A) and 28 by pedicle screw and rod (Group B). The results are found to be comparable to literature. Average follow up in Group A is 12 months and in Group B, 18 months. Incidence of injury is found to be more common in young adults and adults (Table 1), especially in males in both groups. This is supported by literature that Dorsolumbar injury occur between 20 to 40 years age group men as they are more common involved in outdoor activities. In most part of India, fall from tree, electric pole or into unprotected well is the commonest mode of injury. Our study also reflects this general trend as majority of the cases were due to fall from height. In developed countries, road traffic accidents.

Table 1: Age and Male-Female Distribution

Age Group (Years)	Male		female	
	Group A	Group B	Group A	Group B
10-19	4	2	1	1
20-29	10	8	2	6
30-39	9	7	1	-
40-49	4	3	-	-
50 and more than 50	1	1	-	-
total	28	21	4	7

Table 2: Mechanism of Injury

Mechanism	Group A	Group B
Fall from height	19	20
Fall of heavy object on back	8	5
RTA	5	3
Total	32	28

Table 3: Types of Injury

Type of Injury	Group A	Group B
Flexion	10	10
Extension	1	0
Flexion rotation	4	5
Combination	5	3
Vertical compression	12	10
Total	32	28

Discussion

There are several surgical techniques currently employed to treat Dorsolumbar burst fractures, including anterior fixation, posterior fixation, and combined anterior posterior fixation. Biomechanical analysis of the various types of surgical techniques is therefore critical to enable selection of the appropriate surgical method for successful spinal fusion. However, the effects of various spinal fusion techniques on spinal stiffness have not been clearly defined, and the strengths and weaknesses of each fusion technique are still controversial. [8-10]

In our study, most common type of injury is flexion type followed by vertical compression type of injury. These injuries are associated with anterior and middle column failure as described by Dennis, because fall occurs in flexion and axial loading. During axial loading, thoracic spine deforms in kyphosis in the lumbar spine in lordosis resulting Dorsolumbar junction experiences pure compression. The vulnerability of D12-L1 region is due to the fact that thoracic spine is much stiffer than lumbar spine in sagittal and lateral flexion extension. This reflects the restraining effect of ribcage and relatively thinner discs of thoracic spine. This is the reason that Dorsolumbar region trauma is mostly concentrated at Dorsolumbar junction, i.e. more than 60% injury occurs at T11 to L2 vertebra. This trend of injury pattern also confirms at our hospital records. Literatures show

Dorsolumbar injuries, 47% associated with other injuriesand up to 20% of this injury are missed. [11] In our study, this association is much less. In our hospital, most of the patients came from remote areas and could not reach hospital within time. In our study, fracture calcaneum most commonly associated with Dorsolumbar junction trauma due to fall from height. Wood et al. [12] reported that anterior fi xation resulted in clinical outcomes similar to those achieved with posterior fixation and significantly reduced the complication rate following anterior treatment of burst fractures. Schreiber et al. [13] reported that although the stiffness of flexion, extension, and lateral bending increased as significantly as a result of anterior fixation additional posterior fixation was still recommended because horizontal movement of vertebrae increased. In addition, Payer [14] reported that posterior fixation is a safe, reliable surgical method for spinal alignment, stability, and decompression in cases of neurological deficit. However, additional anterior fixation is recommended because instrument failure and recurrence of kyphosis have been reported when surgery is performed without vertebral body reconstruction. [13]

In our study, time for pedicle screw and rod fixation is 2 hours and 15 minutes and 360 mL blood loss, while Harrington's instrumentation requires 2 hours 30 minutes time and 470 mL blood loss. The patients treated with the Harrington distraction instrumentation were made to sit with support (Taylor's brace) after 6 weeks, postoperatively. This is because of the fact that although Harrington rods provide vertical compression load bearing, but they do not resist bending, shearing and torsional forces. As a result, if the patient is ambulated earlier, the hooks tend to get displaced leading to implant failure. The incidence of hook cut through is as high as 10%. Although, Dickson and Harrington (1978) have ambulated their patients 2 weeks after the surgery, but the former have used molded plaster jacket or polypropylene brace, and the latter, polypropylene brace in all the cases, which are not used in our study. [15]

KRAG (1986) showed pedicular instrumentation achieved three-dimensional adjustment in eliminating encroachment on the spinal canal. AEBI M (1988) confirms that correction achieved by pedicular screw-rod instrumentation is bettered than Harrington and complication rate is low. ZINDRIK (1987) proved that pedicular screw performs better than hooks or sublaminar wires. They resist not only in flexion and extension, but torsion as well. Also, the pedicle in the dorsolumbar region is large enough to allow easy placement of the screw. He also maintains that rods and plates can be countered to accommodate normal physiological contours. SIMMONS et al (1978) showed transpedicular fixation can selectively distract or compress the segment and prevent further collapse.

In our study, one case of neurologically deteriorated, which is treated by Harrington's instrumentation, otherwise all patients either treated by Harrington or pedicle screw instrumentation having incomplete neurology, neurological recovered at least one Frankel's grade. Although, recovery rate is faster in prospective group. This is because of good quality of reduction and fixation.

Incidence of implant failure in retrospective group is 12%, which is near to McAfee, PC Bohlman study (7 to 10%). In pedicle screw system, most commonly associated complication is screw malposition 0-42% and most of them are asymptomatic. [8] In our prospective study, two cases of implant cut-out occur. The advantage of pedicle screw surgical management is immediate mobilisation and earlier rehabilitation and better restoration of sagittal alignment. [16,17]

Conclusion

Although, pedicle screw fixation is technically demanding procedure, requires image intensifier facilities and implant is more costly than Harrington instrumentation, but in benefit of patient, it is better than Harrington instrumentation, but in benefit of patient, it is far better than Harrington instrumentation. Surgical stabilisation has advantage of return of functional stability of vertebral column, which resulta. Early mobilisation of patient out of bed thereby reducing disuse atrophy to a minimum, Relief of pain experience, while turning on bed and Diminished incidence of ischial pressure sore.

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