STABILIZATION OF THORACOLUMBAR SPINAL INJURIES

AVM NB AMARESH^{VSM*}, Col J SIKDAR,^{AVSM VSM†},
Lt Col ANIL JOSHI[#], Lt Col LC PANDEY^{**}

ABSTRACT

Spinal Cord injury cases are being managed in Base Hospital Delhi Cantt since Oct. 97. 27 cases of thoracolumbar injuries were admitted in this hospital during the period Oct 97 to Aug 99. 20 patients underwent surgical treatment (9 thoracic and 11 lumbar) and 7 were treated conservatively. All these operations were done within 3 weeks following trauma, and methylprednisolone therapy was instituted in those who reached the hospital early. Contraindications to surgery included stable fracture, bed sores, any focus of sepsis and generalized bone disorders. Transpedicular fixation with Dyna-lok system was done in 10 cases, universal spinal system was applied in 6 cases and Harrington instrumentation was carried out in 4 cases. Decompression laminectomy was done in all cases. Patients with incomplete cord injury showed neurological improvement and early rehabilitation was possible after surgery.

MJAFI 2001; 57 : 03-07

KEY WORDS : Harrington instrumentation; Pedicle screw and plate; Spine trauma; Thoracolumbar fractures.

Introduction

Thoracolumbar region is the most commonly involved region in spinal injuries. Stabilization of spinal fractures by posterior route is the most common and widely acceptable method of surgical treatment. Harrington introduced posterior spinal instrumentation in 1959, since then it is most frequently used system for stabilization and fusion of unstable thoracolumbar fractures [1]. The primary goals of Harrington rod stabilization in spinal injuries are to improve alignment, provide stability, allow earlier rehabilitation, and prevent late kyphotic deformity [2]. Early stable fixation allows early mobilization of the patient and reduces the complications of prolonged bed rest. Most patients treated with dual Harrington rod stabilization require external bracing for the protection of hook laminar interface until solid arthrodesis is achieved. To overcome these shortcomings newer methods of fixation were introduced. In 1970, Edward Luque, developed a segmental spinal fixation system for the treatment of severe progressive scoliotic deformities to avoid need for external bracing [3]. Cotrel and Dubousset of France, in 1980 developed a universal posterior spinal fixation system that allowed multiple hook fixations on a singular rod as a mechanism for correction and fusion of spinal deformity [4]. Roy-Camille (1986) developed a system of spine plates and pedicle screws for internal stabilization of the lumbar and cervical spine [5]. Steffee (1986) utilized spinal plates with segmental pedicle screw fixation for unstable conditions of the spine

where fusion and internal stabilization was required [6]. Pedicle screw fixation is rapidly becoming a widely used method of spinal instrumentation. The use of transpedicular fixation avoids the requirement for anterior spinal surgery and provides stabilization of all three columns of vertebrae.

The present study analyses the initial experience of stabilization of thoracolumbar spine fractures using Harrington system, Universal spine system and Pediclescrew and plate fixation.

Material and Methods

27 patients with thoracolumbar spine fractures were admitted at Base Hospital Delhi Cantt from Oct 97 to Aug 99. All patients were clinically evaluated and findings of sensory and motor system examination were recorded. Frankel's functional classification was used to assess neurological status of patient [7]. X-ray of thoracolumbar region was taken in all cases followed by CT scan/MRI to ascertain the severity and extent of spinal cord lesion (Fig 1). Patients were categorized according to type and level of spinal injury. 20 patients had unstable thoracolumbar fractures (11 burst fractures and 9 fracture dislocation), of which 13 had incomplete cord injury and 7 had complete cord injury. Stabilization of thoracolumbar spine was carried out using Harrington instrumentation (4 cases), universal spinal system (6 cases) and pedicle screw and plate system (10 cases). Patients who had stable injury or burst fractures without neurological deficit were not considered for study. Harrington dual rod fixation was carried out for fracture of thoracic region in 4 cases. Universal spinal system and pedicle screw and plate fixation was done for thoracolumbar fractures in 16 cases. Indications for pedicle screw and plate were unstable fractures and fracture dislocations of lower thoracic and lumbar spine associated with incomplete or complete neurological deficit.

All cases were operated by posterior midline approach under general anaesthesia. The area to be instrumented was confirmed

*Senior Consultant, Surgery, Office of Director General Armed Forces Medical Services, Ministry of Defence, New Delhi -110011, †Senior Advisor (Surgery & Orthopaedics), **Classified Specialist (Surgery & Orthopaedics), Base Hospital, Delhi Cantt-110 010.

Fig. 1 : MRI of spine showing fracture DV12 with transaction of the cord

under image intensifier. Facet joint destruction and decortication was performed. Decompression laminectomy of affected vertebrae was done. Subsequent preparation and fixation depended on type of implant chosen and level of fracture. For Harrington instrumentation superior hook was placed in facet joint and inferior hook on lamina of vertebrae 2 level below the fractured vertebrae. Fusion was extended throughout the instrumented area. In universal spinal system, schanz pins were inserted into the pedicle of vertebrae 2 to 3 levels above and 2 levels below the fractured vertebrae under image intensifier. In pedicle screw fixation, pedicle screw was fixed on pedicle of vertebrae above and below the fracture segment under image intensifier. Plate was placed and locked by using the second nut. Same procedure was repeated on the other side. Distraction was carried out before tightening the second screw.

Post operatively, antibiotic prophylaxis continued till drain was removed. Mobilization started with thoracolumbosacral orthosis after 14 days. Patient was reviewed clinically and radiologically at one monthly interval for 6 months and then at 3 month intervals. All patients were placed in thoracolumbosacral orthosis before mobilization from bed which were worn for 3 months.

Results

20 cases of thoracolumbar fractures with incomplete or complete cord injury were operated. There were 09 thoracic and 11 lumbar spine cases. The commonest location of injury was DV12 & LV-1, which accounted for 40% of fractures and it was fol-

Fig. 2 : Postoperative radiograph showing spinal stabilization using pedicle screw and plate fixation.

lowed by DV10-DV-11 (15%). Location of injury is shown in Table-1. Maximum number of cases (75%) were in 3rd and 4th decade of life.

TABLE 1

Location of injury

Site of injury	Number of cases	Percent
DV-12	4	20%
LV-1	4	20%
DV-10,11,12	3	15%
Others	9	45%

Minimum age was 17 years and maximum age was 50 years. There were 15 male and 5 female patients. The commonest mode of injury was road traffic accident (60%). Various causative factors are shown in Table -2.

TABLE 2

Mode of injury

Type of accident	Percentage
Road traffic accident	60%
Fall from height	30%
Others	10%

Improvement in neurological status after surgery occurred in 13 cases (65%). 4 patients had full neurological recovery and they walked without support.

4 patients had two grade improvement and 5 cases had one grade improvement in Frankel's grading. 7 cases had no neurological improvement.

Intraoperative complications included 2 cases of dural tear which were repaired and one case of hemothorax due to slippage of drill while inserting transpedicular screw. Post operative wound sepsis occurred in 2 cases, *Staphylococcus* was grown in both cases. 4 patients had loosening of implants, out of these 3 patients had fixation with Harrington and 1 patient had fixation with Dynalok system. Intraoperative and postoperative complications are shown in Table-3.

TABLE 3
Intraoperative and postoperative complications

Complications	No. of cases	Percent
Dural tear	2	10
Hemothorax	1	5
Wound sepsis	2	10
Implant loosening	4	20

Discussion

In the present study road traffic accident has been the most important etiological factor in causing spinal fracture followed by fall from height. Rimoldi (1991) and Riebel (1993) have also reported motor vehicle accidents as the principal causative factor [8,2]. Dor-solumbar region DV12-LV 1 was fractured in 8 cases (40%) in our study. Rimoldi reported involvement of DV-12 in 32% cases and LV1 involvement in 27% of cases, in a series of 147 cases [8]. Riebel (1993) reported incidence of fracture or dislocation involving DV-12 and LV-1 in approximately 60% of all thoracic and lumbar spinal fractures and fracture dislocations [2].

In the past fracture spine cases were treated with non-operative methods like immobilization in external cast and brace without surgical intervention. Watson Jones, in 1943 felt that non-operative treatment of flexion compression injuries produced results that were satisfactory [9]. Reid (1988) and Whitesides (1977) stated that operative intervention in neurologically intact fractures is not always indicated and the majority of patients can be treated nonoperatively while Denis (1984) maintained that burst fractures with no neurological deficit must be reduced and internally fixed to prevent further complications including kyphosis and progressive neurological deficit [10,12]. Stambough (1977) advocated stabilization of unstable thoracolumbar spine injuries to prevent pulmonary and venous complications, relieve pain, realign spine and

decompress neural elements. He stated that stabilization allows early mobilization, rehabilitation and reduced hospital stay of the patient [1]. Bernard 1983, Blouth and Dickson also advise internal fixation of unstable fractures in thoracic and lumbar spine [13-15]. Jacob's (1980) produced a series of 100 patients with thoracolumbar spinal injuries, 34 of whom were treated with recumbency and 59 treated with Harrington instrumentation. He felt that instrumentation of spine provides superior results to the recumbent method of treatment [16]. Rimoldi studied the effect of surgical intervention of rehabilitation time in 147 patients with unstable thoracic and lumbar fractures [8]. Patients with incomplete neurological lesion demonstrated a significant increase in motor points if both decompression and stabilization were performed within 2 weeks of injury. Patients with complete lesions demonstrated a significant reduction in rehabilitation time, if stabilization was augmented with sublaminar wiring. Flesch et al have shown that time period of rehabilitation was shortened by 400% when the injured spine was stabilized by Harrington instrumentation compared with conservatively treated patients [17].

In our study stabilization was carried out in 20 patients, out of which neurological improvement was found in 13 patients (65%). Burkee in a study of 115 cases found significant improvement in 38% cases who were operated and 35 % neurological improvement in nonoperated group [18]. Jacobs found increased incidence of neurological improvement in operated patient (53%) compared to conservatively treated patients (44%) [16].

In present study posterior approach was used for stabilization in all cases. It has the primary advantage that it uses the well-known and familiar technique of post midline exposure [1]. Moreover in an acutely fractured spine with disruption of the posterior column, spine cannot be stabilized by anterior route alone and requires a 2- stage procedure entailing posterior instrumentation with distraction followed by anterior or posterolateral decompression.

In our study three types of fixation methods were used depending upon the site of fracture. Number of cases in each type of fixation is small to draw a definite conclusion regarding superiority of one method over other. Harrington distraction rod system was the first instrumentation system to provide consistent clinical success in the treatment of thoracolumbar burst fractures [15,17]. It allows some restoration of vertebral height at the injured level, reduction of kyphosis and spinal canal clearance. However this

system has some disadvantages like only semirigid fixation can be achieved and external support is essential. Immobilization of more number of mobile segments is required and incidence of hook dislodgement is quite high with this system. For fractures of lumbar spine Harrington rod and universal spinal system is not preferred. Pedicle screw device is preferred. Pedicle screw device is preferred in lower thoracic, lumbar fracture and lumbar spine alone. Pedicle screw and plating achieves three column fixation and fusion of only a short segment is required. Movements in lumbar spine and functional lordosis are preserved. It provides better stability than that achieved with classic Harrington rod or universal system [1]. Universal spinal system also uses hook rod/Schanz pins and rod fixation. It also requires fixation 2-3 levels above and below the fractured vertebrae. Sagittal plane restoration and distraction at end of rod is like Harrington system. Incidence of hook dislodgement is avoided with the use of Schanz screws. Transpedicular screw and plate fixation is the only posterior system allowing fixation of all three columns compared with only post column fixation in the other two devices. It provides rigid fixation and reduces requirement of thoracolumbosacral orthosis for prolonged period [1].

Small dural tear occurred in 2 cases while carrying out decompression and was repaired. Haemothorax occurred in 1 case while inserting pedicle screw and was managed with insertion of chest tube. 4 patients had loosening of implants at follow up of which 3 patients had fixation with Harrington rod and 1 patient had fixation with Dyna-lok system. Superficial wound infection was seen in 2 cases, which was treated with local dressing and antibiotic therapy. Sasso (1993) has also reported hook dislodgement in 4 cases, wound infections in 2 cases, 1 pseudoarthrosis in a study of 109 patients who were treated with Harrington Fixation [19]. In 23 AO pedicle screw and compression plate fixation, fracture of screws and plate was found in 1 case, wound infection in 1 case, arachnoiditis in 1 case and dural tear in 1 case. Overall complication rate was 37.5% [20]. Riebel has reported very high rate of rod related complications like breakage, hook cut-out, pseudoarthrosis, infection and neurological deterioration (15.5%) in addition to postoperative complications with use of Harrington rod [2]. Esses (1993), has reported an overall complication rate of 27.4% with pedicle screw fixation in a study of 617 cases [20]. Roy Camille reported complications associated with pedicle screw fixation. Neurological complications occurred in 5% of cases, breakage in 9%, loosening in 1% and misplacement of screws in 10% cases [5].

Present study includes small number of cases and follow up is short to draw any definite conclusion, however early results of spinal stabilization are encouraging in patients with incomplete cord injuries and support the view that early decompression and stabilisation can benefit neurological recovery. In patients with complete cord injury, spinal stabilization is beneficial for early mobilization and rehabilitation.

References

1. Stambough JL. Posterior instrumentation for thoracolumbar trauma. *Clinical Orthopaedics and Related research*. 1997;335:73-88.
2. Riebel GD, YOOJU, Fredrickson BE, Yuan HA. Review of Harrington rod treatment of spinal trauma. *Spine* 1993;18(4):479-91.
3. Luque ER. Segmental spinal instrumentation of the lumbar spine. *Clin Orthop* 1986;203:126-34.
4. McBride GG. Cotrel Dubousset rods in surgical stabilization of spinal fractures. *Spine* 1993;18:466-73.
5. Roy-Camille, Saillant G, Mazel CH. Plating of thoracic, thoracolumbar and lumbar injuries with pedicle screw plates. *Orthop Clin North Am* 1986;17:147-59.
6. Steffee AD, Biscup RS, Sitkowski DJ. Segmental spine plates with pedicle screw fixation. A new internal fixation device for disorders of the lumbar and thoracolumbar spine. *Clinical Orthopaedics and Related Research*. Feb 1986;203:45-53.
7. Frankel HL, Hancock DO, Hyslop G et al. The value of postural reduction in the internal management of closed injuries of the spine with paraplegia and tetraplegia. *Paraplegia* 1969;7:179-92.
8. Rinoldi RL, Zigler JE, Capen DA, Serena SH. The effect of surgical intervention on rehabilitation time in patients with thoracolumbar and lumbar spinal canal injuries. *Spine* 1992;17(12):1443-9.
9. Watson Jones R. *Fractures and Joint Injuries*, 3rded, Edinburgh, E & S. Livingstone, 1943.
10. Reid DC, Hu R, Davis LA, Saboc LA. The non operative treatment of burst fractures of the thoracolumbar junction. *The journal of trauma* Aug 1988;28(8):1188-94.
11. Whitesides TE. Traumatic Kyphosis of the thoracolumbar spine. *Clin Orthop* 1977;128:128:78-92.
12. Denis F, Armstrong GW, Searls K et al. Acute thoracolumbar burst fractures in the absence of neurological deficit: A comparison between operative and non operative treatment. *Clin Orthop* 1984;189:142-9.
13. Bernard TN, Whitecloud TS, Rodriguez RP, Haddad RJ. Segmental spinal instrumentation in the management of fractures of the thoracic and lumbar spine. *South Med J* 1983;76:1232-6.
14. Blauth M, Tschern H. Therapeutic concepts and results of operative treatment in acute trauma of the thoracic and lumbar spine: the Hanover experience. *J Orthop trauma* 1987;1(3):240-52.
15. Dickson JH, Harrington PR, Erwin WD. Results of reduction and stabilization of the severely fractured thoracic and lumbar spine. *J Bone Joint Surg*. 1978;60A:799-805.

16. Jacobs RR, Asher MA, Snider RK. Thoracolumbar spinal injuries-A comparative study of recumbent and operative treatment in 100 patients. *Spine* 1980;5:463-77.
17. Flesch JR, Leider LL, Erickson DL, Chou SN, Bradford DS. Harrington instrumentation and spine fusion for unstable fractures and fracture dislocation of the thoracic and lumbar spine. *J Bone Joint Surg* 1977;59A:300-8.
18. Burkee DC. Hypertension injuries of the spine. *J Bone Joint Surg* 1971;53B:3-12.
19. Sasso RC, Cotler HB. Posterior instrumentation and fusion for unstable fractures and fracture-dislocations of the thoracic and lumbar spine:A comparative study of three fixation devices in 70 patients. *Spine* 1993;18(4):450-60.
20. Essess SL, Sachs BL, Dreyzin V. Complications associated with the technique of pedicle screw fixation, A selected survey of ABS members. *Spine* 1993;18(15):2231-9.

ATTENTION ADVERTISERS

Rates of advertisements in Medical Journal Armed Forces India.

Full page	Rs. 5000/- per issue
Half page	Rs. 3000/- per issue
Inserts	Rs. 5000/- per insert (two pages) (printed inserts to be supplied by client)

Address for Correspondence

EDITOR-IN-CHIEF
MEDICAL JOURNAL ARMED FORCES INDIA
C/O ARMED FORCES MEDICAL COLLEGE, PUNE - 411 040