Minimally Invasive Spine Osteosynthesis in Acute Dorso-Lumbar Trauma

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ABSTRACT

INTRODUCTION: The spine is a complex three-dimensional structure which provides protection of the spinal cord, load transmission, and the capacity for motion. The dorso-lumbar junction between the rigid thoracic vertebral column and the relatively mobile lumbar column creates a fulcrum at this junction, thus it remains the most common site of vertebral column injuries. The minimal invasive technique eliminates the need of large incision leading to shorter hospital stay and early recovery.

METHOD: This prospective study was carried out at Department of Orthopedics of UCMS-TH between November 2015 to July 2017AD. Evaluations of the patients were done post-operatively according to modified Macnab criteria and by ASIA scoring.

RESULTS: In our study the mean age was 39 years comprising 52% male and 48% female out of total 31patients. Majority of fracture occurred in L1 region (45 %) where the common mechanism of injury (87%) was due to fall injury and most common fracture pattern was compression fracture (93%). The mean operative time was 155.77 minutes with average blood loss of 93.9 ml. 50% have excellent functional outcome according to Macnab's criteria whereas 83.9% patient have ASIA score 'E'. Pain, implant failure and nerve root irritation were found in 39 %, 7 % and 3 % respectively.

Conclusion: Minimal invasive spine osteosynthesis in acute dorso-lumbar trauma is one of the best treatments since it has small incision with minimum blood loss and good functional outcome. The procedure has minimal complication and helps in early mobilization of the patient with less damage to muscles and gives smaller scars.

KEYWORDS: Dorso-lumbar Spine, Pedical Screw, Minimal invasive surgery

INTRODUCTION

The spine is a complex three-dimensional structure which provides three important functions for the body: protection of the spinal cord, load transmission, and the capacity for motion. The incidence of spinal fractures is reported to vary between 16-64/1,00,000 depending on the study area and population concerned.[1]

The thoraco-lumbar spine remains the most common site of vertebral column injuries.[2] The thoraco-lumbar junction is a zone of structural and functional transition, which makes it vulnerable to injury, this transition zone between the rigid thoracic vertebral column and the relatively mobile lumbar column creates a fulcrum at the thoraco-lumbar junction, for this reason 75% of fractures occur between T12 and L2 and they are associated with neurological injury in up to 48% of cases.[3]

The primary goals of treatment of these patients include preserving life, protecting neurologic function, and restoring alignment and stability of the spine.[4]

Conventional techniques of open lumbar pedicle screw fixation involve a single midline or bilateral paramedian incisions, extending above and below the instrumented levels allowing lateral retraction of the soft tissue to visualize the pedicle screw entry points at the intersection of the transverse process and facet complexes. The percutaneous technique eliminates the need of large incision as both the pedicle screws and contoured rods are placed by stab incision, with blunt splitting of paraspinous muscles leading to shorter duration of hospital stay and recovery.[3]

MATERIALS AND METHODS

This prospective, observational study was carried out in the Department of Orthopedics, Universal College of Medical Sciences Teaching Hospital (UCMS-TH), Bhairahawa, Nepal from November 2015 to July 2017

For sample size a biostatistician was consulted and it was calculated by the survey system on www.surveysystem.com. A total of 31 thoracolumbar cases were operated over a period of 12 months in Universal College of Medical Sciences, Bhairahawa, Nepal. Taking this figure as population, with confidence level of 95% and the confidence interval of 5%, the sample size calculated was 29. However, we took a convenient sample of 31 patients.

All patients admitted to Department of Orthopedics of UCMS-TH between November 2015 and July 2017 who have completed six-months follow-up and who presented with thoraco-lumbar fracture and fulfilled the inclusion criteria were enrolled into this study. Ethical clearance was obtained from Institutional Review Board of UCMS-TH

Inclusion criteria

a) Dorso-lumbar fractures of traumatic etiology
b) Age: 15-65 years
c) Both males and females
d) Patient with complete spinal cord injury for the purpose of stabilization.
e) Unstable fractures:
   - Vertebral height less than 50%
   - Fracture with neurological deficit

Exclusion criteria

a) Pathological fractures of dorso-lumbar spine
b) Stable fracture managed conservatively
c) Medically unfit for surgery
d) Patient not willing for surgery
e) Polytrauma
f) Age: <15years and >65 years

Patients suspected with dorso-lumbar fracture presenting in casualty or outpatient department were attended by orthopedic junior resident or the orthopedic surgeon. A complete physical examination was performed from head to toe to rule out potential life threatening or other occult injury. The patient's spine was then immobilized and kept on spine board. Radiographs were done in the antero-posterior; lateral views and MRI was done in all cases. All thoracolumbar fractures were admitted, informed and written consent were taken. Surgery was carried out as early as possible to avoid subsequent compressive neuropathy and spinal cord injury.

After prophylactic antibiotics of cefuroxime 1.5gm I.V. stat. Patient was under general anesthesia in prone position with abdomen uncovered. Under aseptic condition, painting and draping was done. Identification of fractured vertebra and entry point was made with fluoroscopy guidance. An incision of approximately 2 cm was made in the skin, slightly lateral to the pedical entry point. Soft tissue was moved away from entry point and entry point was made with the help of K-wire and hand reamer under fluoroscopy. Sound was used to check the integrity of the pedicle following which pedicle tapping was performed. Subsequently screw was placed and appropriate lengths of rods were placed. distracted and locked. A control image was performed to check the position of screws, rods and restoration of the alignment. Skin was closed.

Clinical methods of blood loss assessment included counting the blood soaked mops and

gauze pieces and multiplying them by estimated volume of blood they carried, measuring blood lost to suction bottles and estimating that which was in around the operative field.[7]

Immediately after operation the patient was shifted to the post-operative ward for observation. IV analgesics were administered for pain management. Neurovascular examination was performed pre-operatively, immediate post operatively and on regular follow ups. IV antibiotics 3rd generation cephalosporin was given for 5 days. After 1st post-operative day patient was shifted to ward and physiotherapy such as isometric and toe mobility exercise were started as tolerable by patient. Patient party was counseled about methods of prevention of bed sores. On 2nd post-operative day dressing was done and continued on interval of 2 days till hospital stay.

Clinical evaluations of the patients were done post-operatively at one week, suture removal done on 14th post-operative day. Functional and neurological outcome was graded on 6-weeks, 12-weeks, 3 months and 6-months according to modified Macnab criteria and by ASIA scoring. Assistive devices (Knight-Taylor corset and walkers) and gait training on Rail road were performed on 6th week follow-up.

Patients were evaluated clinically on the basis of modified Macnab criteria and ASIA scoring.

Fig1: Patient kept on prone position

Fig2: 2cm incision

Fig3: Making entry point

Fig4: Taping for screw in pedicle

Fig5: Sound checking integrity of pedicle

Fig6: Placement of screw in pedicle


Fig7: Contoured rod passed using free hand technique



Fig8: Indirect Reduction by Distraction

Fig9: Application of the Nut

Fig10: Sutures at the End of Surgery

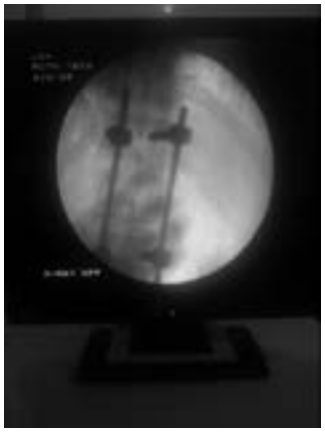
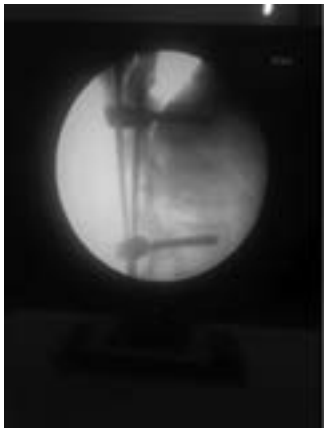

Fig11: Immediate post op image of pedicle screw fixation with rods.

Fig12: Shows the healing scar of surgery

Fig13: Instruments and Implants

RESULTS

Of the 31 patients in this study the mean age was 39 years, ranging from 20 to 63 years of age. Gender wise female constituted 48% (15) and male 52% (16) of total patients.Of 31 patient T12 fracture 23 % (7), T11 fracture7% (2) L1 fracture 45% (14), L2 fracture 19% (6), L3 fracture and L4 fracture was found by 3% (1) each. A large proportion of patients were of T12-L1Fracture. In mechanism of injury 87% (27) was due to fall injury, 13% (4) due to RTA was noted. The fracture pattern was compression fracture 93% (29), compression plus burst fracture 7% (2). 96.8 % (30) had posterior longitudinal ligament injured and 3.2% (1) had intact posterior longitudinal ligament. 65% (20) had TLICS score of 4, 13% (4) had TLICS score of 5, 19% (6) had TLICS score of 6, 3% (1) had TLICS score of 7. 94 % (29) had A1 fracture and 6% (3) had A3 fracture according to AO classification. Average blood loss was 93.9ml. minimum 70ml to maximum 120ml. The mean time duration of operation was 155.77 minutes, minimum 58 to maximum 180 minutes. 94% (29) of patients had callus formation and in 6% (2) of patients callus formation couldn't be observed.The excellent function achieved was about 50% (13), fair function about 19% (6) and good about 39% (12) using Macnab's criteria. 83.9% (26) of patients had ASIA scored 'E' at six months duration. Similarly, the patients having ASIA scoring 'C' and 'D' at six months were 3.2 % (1) and 12.9 % (7) respectively. 52 % (16) of patients had no complications, 39 % (12) of patients had pain, 3% (1) patients had pain & nerve root irritation, and 7% (2) patients had pain & implant failure. There was no evidence of wound infection.

DISCUSSION

A spinal fracture is a serious injury. The most common fractures of the spine occur in the thoracic and lumbar spine or at the connection of the two (dorso-lumbar junction), these fractures are typically caused by fall from height or high-velocity accidents, such as a car crash.[8]

Attention must also be paid to the fact that younger and active workers refuse conservative treatment in order to avoid bed rest and an inactive period; a traditional open surgery may be an overtreatment in all these cases, considering blood loss, possible complications, hospital stay, and delayed functional recovery.[6]

We studied 31 cases of dorso-lumbar fracture to evaluate the functional outcome of transpedicular screw and rod fixation in unstable thoracolumbar fractures by using TLICS scoring system and McNab's criteria.

The minimum age was 20 years and the maximum age was 63 years with mean of 39 years which was similar to the study conducted by Richard et.al.[9] In this study the predominant cause of dorso-lumbar fracture was fall from height (87%) and RTA (13%) similar to the study conducted by Dr. Waqar Alam et.al. in which the most common mechanism of injury noted was fall injury.[5] The majority of injury was at T12-L1 region (69%) most common fracture was L1 fracture (45%) followed by T12 fracture (24%) as reported by Ajay et.al.[8]

After surgical intervention the average hospital stay was 5.45 days, with a minimum of 4 days hospital stay and maximum 8 days. Average intra-operative blood loss was 93.9ml, minimum 70 ml to maximum 120 ml. The mean operative time was 155.77 minutes, with a minimum of 58 minutes to maximum of 180 minutes. The study results are coherent with an observational study conducted by Ajay et.al.[8]

No infection was reported in surgical site during hospital stay as well as the follow up visits in any patient and the majority of fractures were L1 which showed similarity to the study conducted by De Iure et.al.[6]

Modified Macnabs criteria was used to evaluate functional outcome for this study where we observed excellent function in about 42% (13), fair function in about 19% (6) and good in about 39% (12) similar to the study conducted by Alam et.al.[5] 83.9 % patients had ASIA socre of 'E' at six months follow-up. Similarly, ASIA score 'C' and 'D' at six months follow up were

3.2% (1) and 12.9% (7) respectively which was similar to study conducted by KS kim et.al.[10] 52% (16) patients had no complication, 39% (12) patients had pain, 3% (1) patients had pain & nerve root irritation, and 7% (2) patients had pain & screw failure. These findings were consistent with study conducted by M chiba et.al.[11]

CONCLUSION

From this study, we conclude that minimal invasive spine surgery is one of the best approaches for surgical management in acute dorso-lumbar trauma since it has small incision less than 2 cm with minimum blood loss and good functional outcome as shown in the study using modified McNab's criteria.

The procedure has minimal complication and helps in early mobilization of the patient with less damage to muscles and gives smaller scars. It is safe and efficacious in acute polytrauma requiring posterior instrumentation. However Complex biomechanics/physics of instrumentation and steep learning curve with increased radiation exposure limits its application in all cases.

LIMITATIONS & RECOMMENDATIONS

The major limitation of this prospective study is the small sample size. A further prospective study with a large number of patients is recommended to derive a definite conclusion, justify our results and for broader understanding of minimal invasive spine surgery in acute dorso-lumbar trauma including both functional and radiological outcome in account.

CONFLICT OF INTEREST

The author(s) declare(s) no conflict of interest in publication of this paper

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GLOSSARY

Fig-1: Pre op x-ray

Fig-2: Post-op x-ray

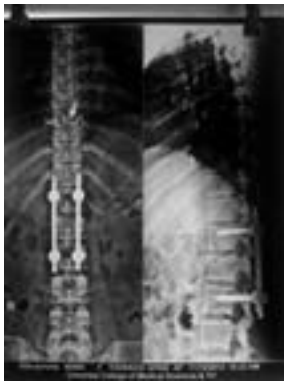

Fig: 1month follow-up x-ray

Fig: 2 months follow-up x-ray

Fig: 3 months follow-up x-ray

Fig: 6 months follow-up x-ray

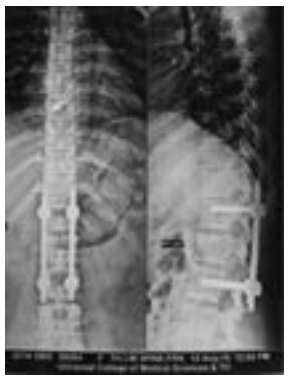

Fig: 10 months follow-up x-ray

Fig: after implant removal x-ray

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