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Surgical Outcome of Short Segment Instrumentation including Fracture Vertebrae of Thoracolumbar Burst Fracture

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Background: Fractures of the thoracolumbar region are the most common injuries of the spine; among them burst fractures are the most frequent. Several studies were done to see the surgical outcome in thoracolumbar burst fracture hence surgery was recommended for better outcome. So, the current study was aimed to evaluate the clinical, functional and radiological outcome of short-segment pedicle screw fixation including the fractured vertebral body. **Objectives:** The aim of the study was to evaluate the surgical outcome of short segment pedicle screw fixation including fracture vertebrae of unstable thoracolumbar burst fracture with incomplete spinal cord injury. **Methods:** In this prospective observational study, a total of 62 cases were studied from May 2019 to May 2021 through non randomized purposive sampling. All the patients were between 15 to 60 years of age and operated within 21 days of fracture by posterior decompression & stabilization by short-segment pedicle screw fixation including the fractured vertebral body. Postoperative functional outcome was assessed clinically by ASIA,

ODI, VAS, Denis Work Scale, Macnab criteria and radiologically by Cob's kyphotic angle, kyphotic deformation, Beck index & Bridwell criteria. Postoperative follow up was conducted at 6th, 12th & 24th weeks. Statistical analyses of the results were be obtained by using window-based Microsoft Excel and Statistical Packages for Social Sciences (SPSS-24). **Results:** The mean age was 31.42±11.2 years with male dominancy (74.19%). Most of the cases were manual workers (51.61%). FFH was the most common cause of injury (80.65%) and L1 was the most common level of injury (54.84%). The mean duration between injury and operation time was 14.45±3.72 days. Regarding improvement of ASIA grade, 1 grade in 46 (74.19%) cases, 2 grade in 2 (3.23%) case, no improvement in 14 (22.58%) cases were seen. Complications were hemorrhage 2(3.23%), dural tear 2(3.23%), CSF leak 2(3.23%), urinary retention 4(6.45%), skin infection 2(3.23%) and bed sore 2(3.23%). **Conclusion:** Thoracolumbar burst fracture with incomplete spinal cord injury can be treated with short-segment pedicle screw fixation including the fractured vertebral body effectively. This method offered a better kyphosis correction, no instrument failures, appraisable clinical and functional recovery, reduce pain and improve working status with early rehabilitation.

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INTRODUCTION

Thoracolumbar spine fractures are one of the most common types of traumatic injury, with approximately 90% of spinal fractures occurring at the thoracolumbar segment. [1] Especially, the majority of thoracolumbar injuries occur at the T11 to L2 level, which is the biomechanically weak for stress. Typically, two-thirds of these fractures occur in men, and there is a peak of occurrence between 20 and 40 years of age. [2] Injuries at the thoracolumbar spine are usually the result of a high-energy trauma and tend to be associated with injuries to other skeletal segments. The presence of a neurological deficit ranges from 20% to 36% of the fractures at the thoracolumbar junction; however, even in patients who do not experience any complications chronic pain and limitation of daily activities with difficulty to return to work are often encountered. [3]

Spinal "burst fracture", firstly described by Holdsworth & Chir was redefined by Denis. [4, 5] According to Denis classification, burst fracture refers to failure of at least the anterior and middle columns of the spine under substantial axial loads. They account for a quarter to half of all fractures in the thoracolumbar region where the majority of spinal fractures occur. Thoracolumbar burst fractures, frequently associated with kyphotic deformity and neurological deficit, are very common in younger patients and could have a great impact on their daily physical activities. [6] The vast majority of burst fractures are associated with some degree of canal compromise, typically as a result of retropulsion of an osseous fragment or fragments from the posterior superior end plate. The primary goal of treatment of the thoracolumbar fracture is keeping patients alive, protecting from the further neural damage, obtaining the stability by reconstructing anatomical alignment of spinal columns and returning patients to workplace through early mobilization and rehabilitation. These fundamental principles have not been changed for decades. [7]

Pedicle screw devices allow immediate stable fixation as the screws traverse all the three columns. Biomechanical and clinical studies have shown that spinal instability results when there is a failure of at least two of Denis three columns. Long-segment pedicle screw fixation (LSPF) usually involves inserting eight screws: two level above & below the fracture. Short-segment posterior fixation (SSPF) involves inserting four screws: one level above & below the fracture. [8]

Segmental fixation with additional screws at the level of the fracture an increase construct stiffness and shields the fractured vertebral body from anterior loads. Furthermore, this additional point of fixation allows for a 3-point reduction maneuver analogous to that used for reduction of long bone fractures. [9] In this study, we tried to evaluate the efficacy of inclusion of the fractured vertebra in short segment fixation in terms of clinical and the radiological outcomes in unstable thoracolumbar junction burst fractures.

METHODOLOGY

This prospective observational study as carried out in the Department of Orthopaedic Surgery, National Institute of Traumatology & Orthopaedic Rehabilitation (NITOR), Dhaka, during May 2019 to May 2021. A total of 62 patients were participated in the study. Patients with thoracolumbar burst fracture with incomplete spinal cord injury were the study population. After taking consent and matching eligibility criteria, data were collected from patients on variables of interest using the predesigned structured questionnaire by interview, observation. Statistical analyses of the results were be obtained by using window-based Microsoft Excel and Statistical Packages for Social Sciences (SPSS-24).

RESULTS

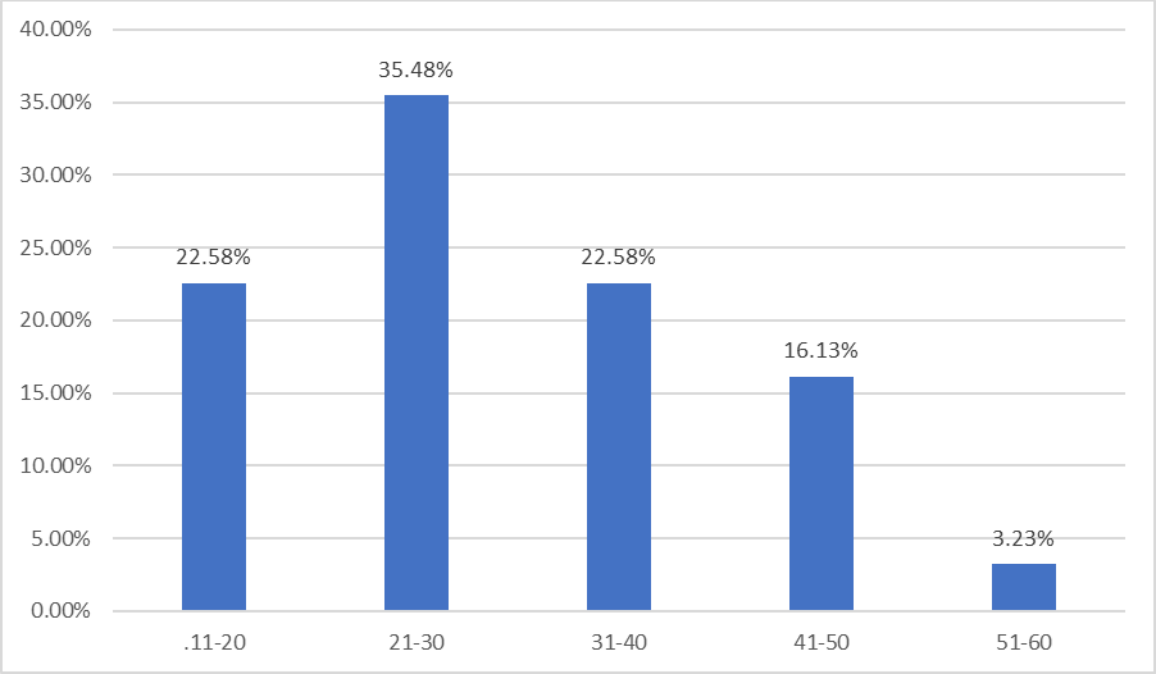

Figure I: Distribution of cases according to age (N=62)

Figure I showed distribution of patients by age. In this study, the highest number of patients 22 (35.48 %) were observed in the 3rd decade and the lowest number of patients 2 (3.23%) was observed in the 6th decade. The mean age was (31.42±11.2) years with range from 17 to 60 years.

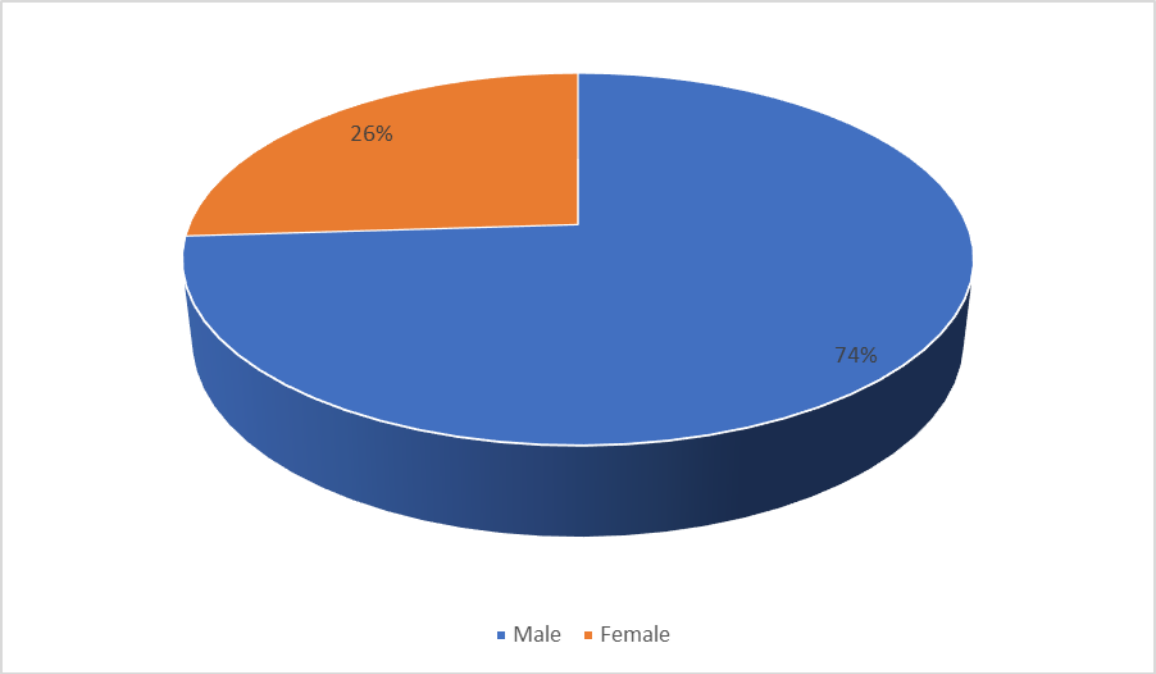

Figure II: Gender distribution of the study patients (N=62)

The above pie chart shows the gender distribution of the study patients. Male was 46 (74.19%) and female 16 (25.81%).

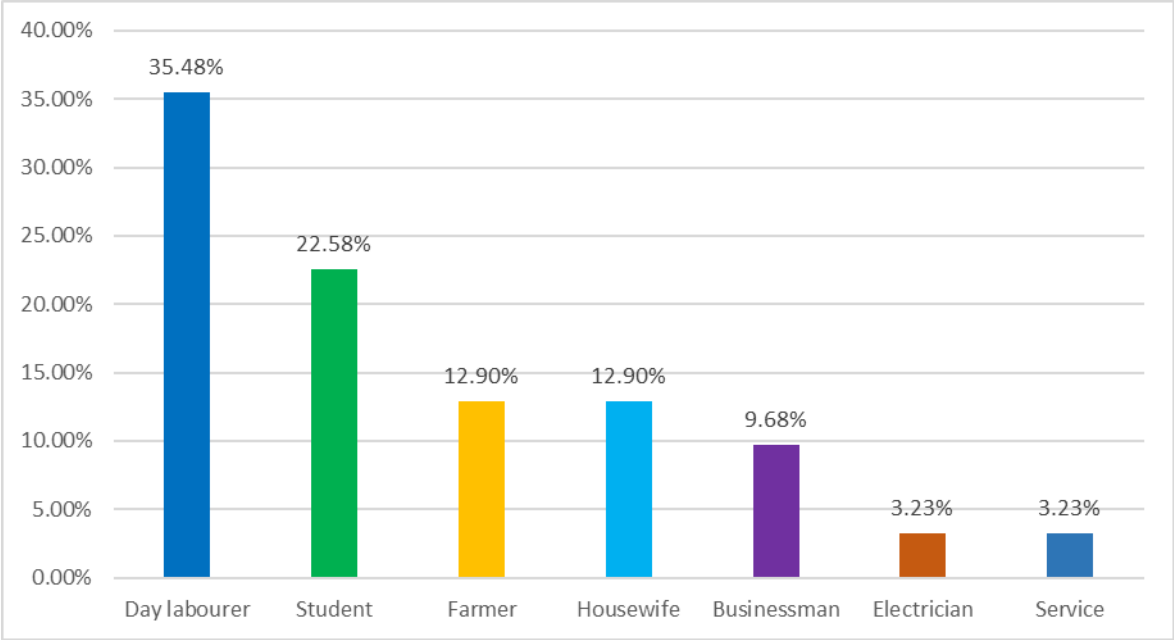

Figure III: Distribution of patients according to occupation (N=62)

Occupation of the subjects demonstrates that most of the cases were day labourer which was 22 (35.48%). Other occupants were student 14 (22.58%), farmer and housewife 8 (12.9%) each, businessman 6 (9.68%), electrician and service holder 2 (3.23%) each. So, most of the cases were manual workers (51.61%).

Table I: Distribution of cases according to Mechanism of injury (N=62)

Mechanism of Injury	Frequency	Percentage (%)
Fall from Height	50	80.65%
Motor Vehicle Accident	8	12.90%
Falling of Heavy object over head	4	6.45%
Total	62	100.00%

In this study, the most common cause of injury was fall from height which accounted for 50 (80.65%) cases. Other causes include motor vehicle accident 8 (12.9%) and falling of heavy object over head in 4 (6.45%) cases.

Table II: Distribution of Patients according to level of injury (N=62)

Level of Injury	Frequency	Percentage (%)
D12	2	3.23%
L1	34	54.84%
L2	26	41.94%
Total	62	100.00%

In this series, most common level of injury was in L1 level, 34 (54.84%) followed by L2 level 26 (41.94%) and D12 level 2 (3.23%) in descending order.

Table III: Distribution of cases according to duration between injury and operation (N=62)

Duration (In days)	Frequency	Percentage (%)
6-10	12	19.35%
11-15	24	38.71%
16-20	26	41.94%
Total	62	100.00%

The mean duration between injury and operation time was 14.45±3.72 days, ranging from 8 days to 20 days. Maximum patients were operated within 16 to 20 days (41.94%)

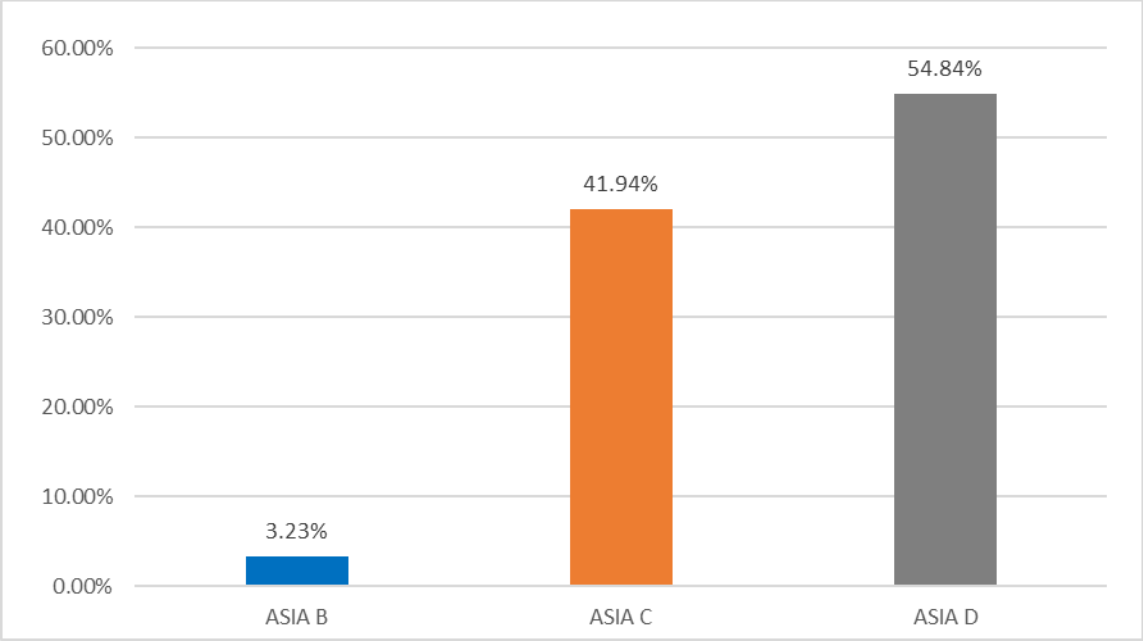

Figure IV: Neurological status on admission (N=62)

The figure shows the distribution of patient's neurological status on admission on the basis of ASIA grade. Highest number of patients 34 (54.84%) were in ASIA grade D. 26 (41.94%) were in ASIA grade C and lowest no of patients 2 (3.23%) were in ASIA grade B.

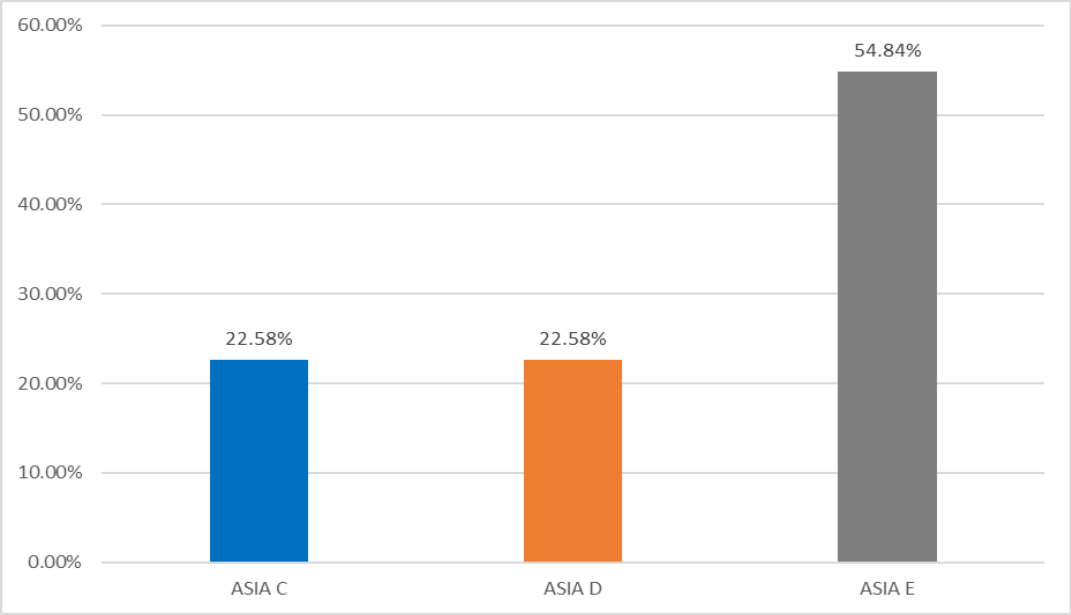

Figure V: Neurological status on last follow up (N=62)

Figure shows the distribution of patient's neurological status on the basis of ASIA grade on last follow up. Highest number of patients 34 (54.84%) were in ASIA grade E. Fourteen (22.58%) cases were in ASIA grade D and C each.

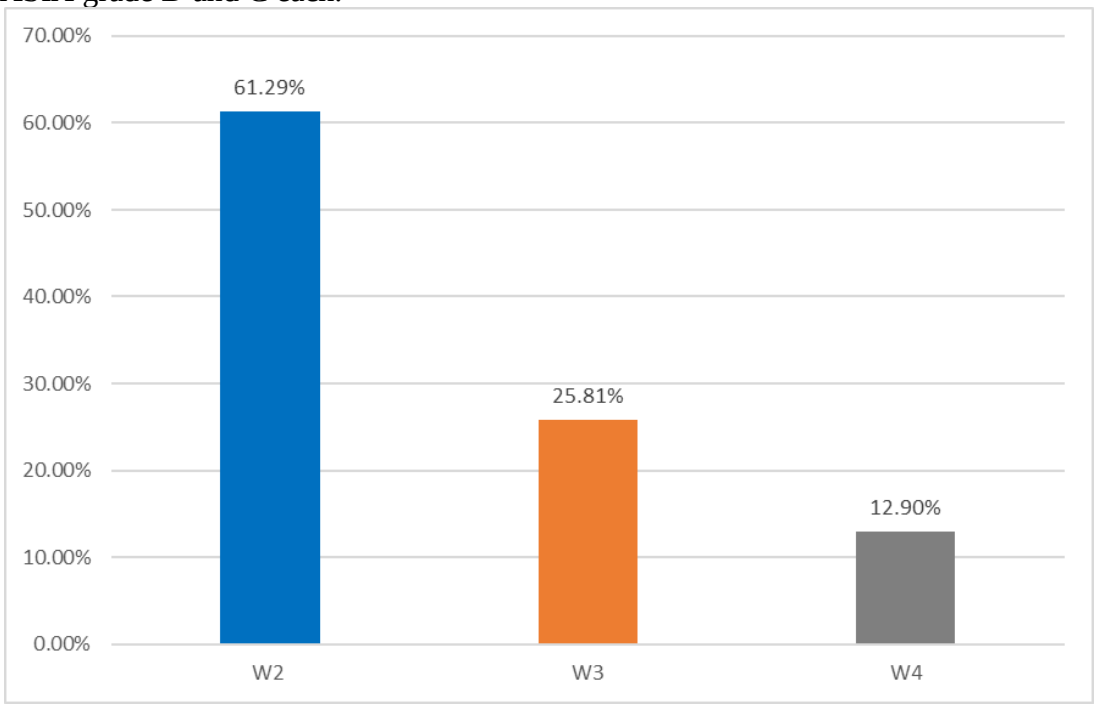

Figure VI: Denis Work Scale of the cases (N=62)

Among 62 cases, 38 (61.29%) cases were in Denis W2 group at last follow up. Sixteen (25.81%) in W3 and the remaining 8 (12.9%) in W4 group at last follow up.

Table IV: Distribution of cases according to post-operative shift of ASIA grade (N=62)

Pre-operative ASIA Grade	ASIA grade at last Follow up			Total
	ASIA C	ASIA D	ASIA E	
ASIA B (2)	2	0	0	2
ASIA C (26)	12	12	2	26
ASIA D (34)	0	2	32	34
Total 62	14	14	34	62

Table VI Shows the distribution of shift of patient's neurological status on admission to last follow up on the basis of ASIA grade. Highest number of patients 34 (54.84%) were in ASIA grade D on admission. Out of them, 2 (3.23%) remained in same grade. Thirty two (51.61%) cases improved 1 grade and moved to ASIA grade E on last follow up. Twenty six (41.94%) cases were in ASIA grade C on admission. Among them, 12 (19.35%) remained in same grade. Twelve (19.35%) improved 1 grade and 2 (3.23%) improved 2 grades on last follow up. The remaining 2 (3.23%) were in ASIA grade B on admission and improved 1 grade on last follow up.

Table V: Post-operative functional outcome by Macnab criteria (N=62)

Post-operative Macnab criteria	Number	Percentage
Excellent	28	45.16
Good	20	32.25
Fair	8	12.90
Poor	6	9.68

Table V: Shows 28(45.16%) was found excellent in the final follow up and 20 (32.25%) found good. On the other hand, 8 (12.90%) cases were found fair and 6 (9.68%) were found poor

Table VI: Operative complications of the cases (N=62)

Complication	Frequency	Percentage (%)
Per-operative complication		
Haemorrhage	2	3.23%
Dural tear	2	3.23%
Early post-operative complication		
CSF leak	2	3.23%
Urinary Retention	4	6.45%
Late post-operative complication		
Superficial skin infection	2	3.23%
Bedsore	2	3.23%
Total	14	22.58%

Among 62 cases, in 14 (22.58%) cases there were complications during operative procedure. Haemorrhage and dural tear was present in 2 (3.23%) case each. These are the per-operative complication. Early post-operative complication includes CSF leak was seen in only 2 (3.23%) case and urinary retention in 4 (6.45%) cases. Late post-operative complications included superficial skin infection in 2 (3.23%) and bed sore in 2 (3.23%) case.

DISCUSSION

The present study was carried out between May 2019 and May 2021 at NITOR,

Dhaka. A total of 62 patients of throcolumbar burst fracture with incomplete spinal cord injury were selected. All the patients, after proper resuscitation and investigation, were treated by short segment pedicle screws & rods fixation including fractured vertebrae and followed up. After an average of 06 months follow up for each patient, the following findings were compiled. All the relevant findings obtained from data analysis were presented in tables and figures.

In this study, the highest number of patients 22 (35.48 %) were observed in the 3rd and the lowest number of patients 2 (3.23%) was observed in the 6th decade. The mean age was (31.42±11.2) years with range from 17 to 60 years. It is clear from many studies that young people suffer spinal injuries more often than any other age group. The mean age was 30.74±10.31 in the study of Raja. [10] Among the 62 cases, male was 46 (74.19%) and female 16 (25.81%) with a male: female ratio of 2.88:1. Katonis showed that their study patients 63% were male and 37% were female out of total 60. [11]

Occupation of the subjects demonstrates that most of the cases were day labourer which was 22 (35.48%). Other occupants were student 14 (22.58%), farmer and house wife 8 (12.9%) each, businessman 6 (9.68%), electrician and service holder 2 (3.23%) each. The total manual workers were 32 (51.61%). This agrees with the notion that manual workers are more susceptible to spinal injuries. In the series of Ahsan, 32 (61.53%) patients were manual worker and rest 20 (38.46%) patients were sedentary workers. [12]

In this study, the most common cause of injury was fall from height which accounted for 50 (80.65%) cases. Other causes include motor vehicle accident 8 (12.9%) and falling of heavy object over head in 4 (6.45%) cases. Fall was the most common cause of thoracolumbar burst fracture in 92% & 59.25% cases which has also been observed in Lee respectively but other study showed road traffic accident is the common cause of injury (Payer, 2006). [13, 14] In this series, most common level of injury was in L1 level, 34 (54.84%) followed by L2 level 26 (41.94%) and D12 level 2 (3.23%) in descending order. Body of L1 vertebrae is the commonest site of thoracolumbar burst fracture. This is supported by other literatures like Ahsan (44.23% cases). [12] The mean duration between injury and operation time was 14.45±3.72 days, ranging from 8 days to 20 days. Maximum patients were operated within 16 to 20 days (41.94%).

Highest number of patients 34 (54.84%) were in ASIA grade D on admission. Out of them, 2 (3.23%) remained in same grade. Thirty two (51.61%) cases improved 1 grade and moved to ASIA grade E on last follow up. Twenty six (41.94%) cases were in ASIA grade C on admission. Among them, 12 (19.35%) remained in same grade. Twelve (19.35%) improved 1 grade and 2 (3.23%) improved 2 grades on last follow up. The remaining 2 (3.23%) were in ASIA grade B on admission and improved 1 grade on last follow up. In the series of Ahsan, 6 patients (11.5%) were ASIA scale C, 22 patients (42.3%) were ASIA scale D and 24 (46.2%) was E on admission whereas, 51 patients (98.1%) were in ASIA scale E and one patient (1.9%) was ASIA scale D on last follow up. [12] In the series of Muralidhar, 26 (86.7%) were improved, in that 17 (56.6%) cases showed one grade improvement, 8 (26.6%) showed two grade improvement and one (3.33%) improved three grades. [15] The current study showed no decrease on ASIA impairment scale suggesting the credibility of the procedure.

In this study, overall results were classified according to Modified Macnab criteria for characterizing outcomes after surgery as excellent, good, fair and poor. Among 62 cases, 28(45.16%) was found excellent in the final follow up and 20 (32.25%) found good. On the other hand, 8

(12.90%) cases were found fair and 6 (9.68%) were found poor. Kirshblum in his study showed excellent 53%, good 27% and fair 22%. No patient deteriorated in any of the studies. [16]

Among 62 cases, 38 (61.29%) cases were in Denis W2 group at last follow up. Sixteen (25.81%) in W3 and remaining 8 (12.9%) in W4 group at last follow up. In the series of Defino out of 18 cases, after 2 years follow up, 6 (33.33%) of the cases return to their normal work involving intense physical activity (W1), ten (55.5%) returned to their previous job involving light physical activity (W2), 1 (5.5%) was forced to change his job but continued to work on a full-time basis (W3) and 1 (5.5%) was unable to return work (W4). [17] As the follow up period in current study is short, the outcome on Denis's work scale is poor in contrast to Defino.

Among 62 cases, in 14 (22.58%) cases there were complications during operative procedure. Haemorrhage and dural tear was present in 2 (3.23%) case each. These are the per-operative complication. Both of these complications were managed per-operatively. Dural tear was repaired with 5/0 prolene. Early post-operative complication includes CSF leak was seen in only 2 (3.23%) case and urinary retention in 4 (6.45%) cases. These two cases were managed conservatively. Late post-operative complications included superficial skin infection in 2 (3.23%) and bed sore in 2 (3.23%) case. Superficial skin infection was managed by appropriate antibiotic according to C/S. Bed sore was managed by regular dressing and changing posture. Lee showed that 2 (7.4%) patients with superficial wound infections responded to antibiotics and antiseptic dressing and 1 (3.7%) patient with bed sore required plastic surgery of total 27 patients. [13] Alanay also showed bed sore was found in 3 (10%) patients and wound infection was found 2 (6.67%) patients in a series of 30 patients. Both of those study results were similar to mine. [18]

Limitations of the study

The present study was conducted in a very short period due to time constraints and funding limitations. The small sample size was also a limitation of the present study.

CONCLUSION

On the basis of results in the present study, it can be concluded that thoracolumbar burst fracture with incomplete spinal cord injury can be treated with short-segment pedicle screw fixation including the fractured vertebral body effectively. This method offered a better kyphosis correction, no instrument failures, appraisable clinical and functional recovery, reduce pain and improve working status with early rehabilitation.

RECOMMENDATION

This study can serve as a pilot to much larger research involving multiple centers that can provide a nationwide picture, validate regression models proposed in this study for future use and emphasize points to ensure better management and adherence.

ACKNOWLEDGEMENTS

The wide range of disciplines involved in surgical outcome of short segment pedicle screw fixation including fracture vertebrae of unstable thoracolumbar burst fracture with incomplete spinal cord injury research means that editors need much assistance from references in the evaluation of papers submitted for publication. I would also like to be grateful to my colleagues and family who supported me and offered deep insight into the study.

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