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Original Article

NEUROLOGICAL OUTCOME FOLLOWING LATE DECOMPRESSION OF SPINAL CORD INJURY AT THORACOLUMBAR JUNCTION

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Abstract:

Background: : Spinal cord injury is a catastrophic event that occurs as a result of spinal column disruption. Decompressive surgery of the column is performed following spinal cord injury not only to improve but also to prevent neurological impairments. There is no conclusive evidence that only early surgery improves neurological recovery or recovery is compromised by a delay of several days.

Objectives: The objective of this study was to evaluate the neurological outcome of late decompressive surgery following SCI at thoracolumbar junction.

Materials & Method: This single center case series analysis was conducted from 17th December 2018 to 16th December 2019 in the department of Neurosurgery, Chittagong Medical College and Hospital. Thirty one patients who were operated for SCI at thoracolumbar junction were prospectively enrolled in this study. Age, sex, associated comorbidities, mechanism of trauma, level of fractures, preoperative and follow-up American Spinal Injury Association (ASIA) grading score, time elapsed from injury to surgical treatment, preoperative magnetic resonance imaging, and surgical procedure were evaluated for each patient. After surgery patients' were followed up and recorded ASIA score on 7th POD, 14th POD and after 6 weeks than 3rd month and 6th month after surgery. The patient populations were divided into three groups related to the timing of surgery: surgery within 4-10 days (n=11), 11-20 days (n=13) and 21-30 days (n=7) from the trauma.

Results: Out of 31 patients majority (80.6%) were male and mean age was 34.9 (±11.6) years. Ten (32.3%) patients had fractures at the thoracic twelve level and 21 (67.7%) patients at lumbar one level. Before surgery 3 (9.7%), 9 (29%), 14 (42.5%) and 5 (16.1%) patients were in grade A, B, C and D respectively. After surgery, at 6 months follow up 2 (6.5%), 4 (12.9%), 7(22.6%), 9 (29%) and 9 (29%) patients were in grade A, B, C, D and E respectively. 77.5% patients showed at least one ASIA grade improvement at latest follow-up. No intra-operative complications were observed. Post-operatively, 3 (9.7%) had sacral bed sores and 2 (6.5%) had respiratory infection.

Conclusion: More than two third of the patients with SCI at thoracolumbar junction had at least 1 grade improvement in 6 months following late surgical decompression.

Keywords: Neurological Outcome, Thoracolumber Injury, Decompression, Spinal Injury, ASIA Grade

Introduction:

The Thoracolumbar junction is the most susceptible region of the spine in trauma, as it is located between a relatively stiff dorsal spine and a more mobile lordotic lumbar spine that extends from T11 to L2. Spinal cord injury is a catastrophic event that occurs as a result of spinal column disruption; associated with variable neurological outcomes including motor, sensory, and autonomic deficits.

Spinal cord injury is caused by several different incidents such as- road traffic accidents (RTA), fall from height, violent trauma, sports-related, diving into shallow water, and industrial accidents. Among these road traffic accidents and falls from height are the leading events. More than 50% of thoracic and lumbar injuries occur between T11 and L1. [1] Overall one-third of these fractures are associated with neurological deficits.

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Thoracolumbar fractures are more frequent in men and the peak incidence is observed between 20 to 40 years. [2] Spinal cord injury reflects both the force and direction of the traumatic event. During injury, structural damage to the spine occurs due to several forces acting together. The most relevant forces are axial compression, flexion/distraction, hyperextension, rotation, and shear. The axial load may result in burst fracture and wedge fracture caused by the combination of central and eccentric compressive force anterior to the axis. Flexion/distraction injuries cause rupture of the posterior ligaments and facet joint capsules. Hyperextension may result in posterior compression fractures of facets, laminae, or spinous processes and rotational injuries combine compressive forces and flexion/distraction mechanisms.[3]

When sustaining a spinal cord injury, there are two types of pathophysiological events occur, which are referred to as primary and secondary injury. Primary injury is the initial mechanical insult to the spinal cord. This type of damage to the spinal cord is immediate and is irreversible. Secondary injury, on the other hand, is caused by a cascade of events that involve disturbances in homeostasis, electrolyte imbalance, vascular change, edema, hypoxia, ischemia and many other processes.[4] So secondary injury can be preventable if we intervene to minimize or prevent this cascade of events from further damaging the spinal cord. The goal in spinal decompression surgery is to relieve pressure from an injured spinal cord in hopes of preventing further damage by secondary mechanisms of injury. So treatment of SCI includes stabilization of the vertebral column, maintaining anatomical alignment and producing a proper environment for the neural elements to optimize neurological recovery. This procedure can be done either by anterior, posterior or both approaches. However, the posterior approach is less extensive.

Clinical research in the past decade suggested that early stabilization of spinal fractures may improve neurological outcomes, and reduce complications and hospital stay.[5] Literature reports a range of recovery of neurological deficit of about 50-85% of early operated patients and this improvement suggests that an early decompression of the spinal cord (< 72 hours since trauma) and posterior stabilization maximize this opportunity. The existing surgical procedure and study support that decompressive surgery after SCI attenuates secondary injury mechanisms and improves neurological outcomes. [6]

The role and timing of surgical decompression after an acute spinal cord injury remains one of the most controversial topics pertaining to spinal surgery.[7] There is no conclusive evidence in the literature that only early surgical decompression and stabilization improve neurological recovery or that improvement is compromised by a delay of several days.[8]

Chances of neurological recovery and improvement are different in different patients and depend on various factors, including primary neurological state, trauma mechanism, vertebral fracture type, location, and age. Among all these factors, the extent of neurological deficits (based on ASIA-impairment scale classification) considered the most important predictive factor for functional outcome and prognosis. [9] Considering the above points, this study was planned to evaluate the neurological outcome after 6 months in patients operated for SCI at thoracolumbar junction beyond 72 hours in the Neurosurgery department, Chittagong Medical College and Hospital.

Methods:

This Single institutional study ethics approval was granted by the local institutional ethics board. Written informed consent was obtained from all patients or guardians. This was a prospective interventional study conducted in the Department of Neurosurgery, Chattogram Medical College and Hospital, Chattogram, Bangladesh from December 2018 to December 2019. Consecutive sampling technique was applied where all patients with a diagnosis of traumatic spinal cord injury (SCI) at thoracolumbar junction confirmed by radiological investigation either by X-ray or MRI, admitted in the Neurosurgery department, CMCH during the study period were included in the study based on certain inclusion criteria: 1. Traumatic spinal cord injury at the thoracolumbar junction; 2. Age between 18 to 60 years; 3. Radiological finding of neural compression; 4. Clinical features of cauda equina syndrome after trauma. The exclusion criteria were: Patient below 18 years and above 60 years; 2. Patient with concomitant traumatic brain injury; 3. Pathological fractures; 4. Injury at thoracolumbar junction with other levels; 5.Duration of injury more than 30 days; 5. Patients or attendants who denied formal consent.

This study included 31 diagnosed case of traumatic spinal cord injury over the age of 18 who were admitted and transferred to the Department of Neurosurgery at Chittagong Medical College Hospital.

On admission, data regarding basic demographic profile (age and sex), scrutiny of cerebrovascular risk profile, a detailed physical examination, routine laboratory testing, and spine imaging were collected by direct supervision or from the history sheets for all patients. Preoperative neurological status by ASIA-impairment scale was recorded. Patients were categorized according to the duration of surgery following injury (surgery within 4-10 days, 11-20 days and 21-30 days from the trauma). Decompressive surgery was done after proper counseling and taking informed written consent. All patients were granted their permission for this study before surgery. The patient was placed in a prone position and images were obtained to determine the direction of the pedicle and level of injuries. Posterior midline incision was made and paraspinal muscles were dissected laterally. Complete decompression was done by opening of the compromised spinal canal which was followed by total laminectomy and flavectomy. In addition, fusion was also carried out with an autologus bone graft. Exclusively all patients underwent posterior stabilization of the spine using trans-pedicular screw –rod system. Stabilization was extended only to the first unaffected vertebra above and below the lesion. Post-operatively, neurological status was recorded. Neurological outcome was assessed by ASIA impairment scale. Regular follow up was given after surgery and outcome was recorded on 7th Postoperative and 14th Postoperative day, and after 6 weeks and then 3rd month and 6th month following surgery. Final follow-ups were done 30 days post-attack and GOS scores were noted. The patient's party was counseled to bring the patient at follow-up after 30 days at the hospital outdoors when patients were examined physically including a neurological examination. For those patients who could not come at due time, information was collected over the telephone through structured interviews with the patient or the responsible attendant. In circumstances where a responsible attendant would not be available, data were collected by direct visits or by providing allowances to attend outdoors for weak economic conditions. If the death occurred within 30 days, the time of death was collected and noted.

After completion of data collection, data were checked and edited manually and verified before tabulation. Data were coded, entered and recorded in the form of Excel worksheet. Statistical analyses were conducted with SPSS (Statistical Package for Social Science) version 23.

Continuous data were expressed as mean ± standard deviation (SD). Categorical variables were presented as percentages (%) or proportions. Study population was divided into three groups according to the timing of surgery. Among these groups, continuous and categorical variables were analyzed. Student's t-test was used to analyze normally distributed continuous variables.. Categorical variables were compared by means of Chi-square test. Statistical significance was assessed at the 0.05 level.

Results:

In this interventional study total 31cases with spinal cord injury were enrolled to observe the neurological outcome following surgical decompression. Patients were categorized into three groups according to the interval of surgical decompression from injury: Earliest Group (4-10 days), intermediate group (11-20 days) and late Group (21-30 days). Overall and Group specific findings are described in the following Tables.

Table I: Age distribution of the patients (n=31)

Variables	Overall (n=31)	Interval of decompression from injury			p value
		4-10 days (n=11)	11-20 days (n=13)	21-30 days (n=7)	
Age (years)					
Mean ±SD	34.9±11.6	33.0±10.9	35.5±11.3	36.7±14.4	0.791†
Range	18-60	18-47	22-60	18-55	

†p value was derived from ANOVA test

Table I shows that, overall mean age of the 31 included patients was 34.9 (±11.6) years with a range of 18-60 years. The three groups were similar in terms of mean age distribution.

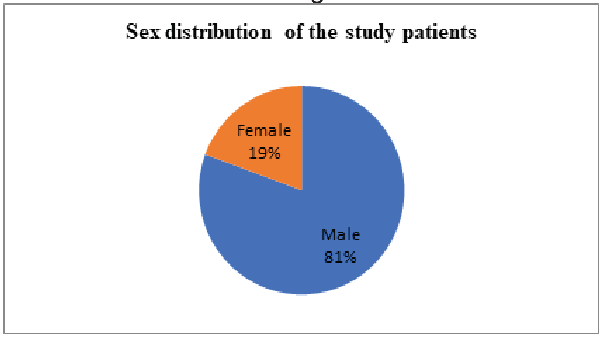

Figure 1: Overall sex distribution of the study patients (n=31)

Figure shows overall male predominance (81%) in the study.

Table II: Sex distribution of the patients stratified by groups based on surgical timing (n=31)

Gender	Interval of decompression from injury			p value
	4-10 days (n=11)	11-20 days (n=13)	21-30 days (n=7)	
Male	8 (72.7%)	10 (76.9%)	7 (100%)	0.327*
Female	3 (27.3%)	3 (23.1%)	0 (0%)	

Data are expressed as frequency (percentage). *p value was derived from Chi-square test.

The three groups based on surgical timing were similar in terms of gender distribution.

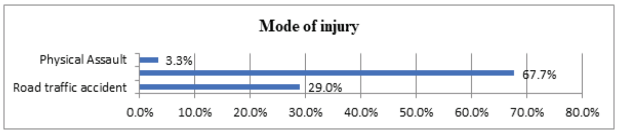

Figure 2: Distribution of the patients by their mode of injury

Figure shows that, in majority of the cases fall from height was the mode of injury (67.7%) for spinal trauma Table shows predominant mode of injury is fall from height but the three groups based on surgical timing were similar in terms of the distribution of the mode of injury distribution.

Table III: Distribution of the patients by their mode of injury by groups based on surgical timing (n=31)

Mode of injury	Interval of decompression from injury			p value
	4-10 days (n=11)	11-20 days (n=13)	21-30 days (n=7)	
RTA	4 (36.4%)	2 (15.4%)	3 (42.9%)	
FFH	6 (54.5%)	11 (84.6%)	4 (57.1%)	0.372*
PA	1 (9.1%)	0 (0%)	0 (0%)	

Data are expressed as frequency (percentage). *p value was derived from Chi-square test. RTA: Road traffic accident; FFH: Fall from height; PA: Physical Assault.

Only 3 (9.7%) of the patients had co morbid DM and same number of patients had complete paraplegia at presentation. In majority (67.7%) of the patients fracture site was lumber one. About half of the patients had intact sensory level at injury site and about one fourth of the patients had no autonomic involvement. However, the three groups were similar with respect to their previously mentioned baseline clinical characteristics (Table IV).

Table IV: Baseline clinical characteristics of the patients (n=31)

Variables	Overall (n=31)	Interval of decompression from injury			P value
		4-10 days (n=11)	11-20 days (n=13)	21-30 days (n=7)	
Comorbidity					
No	28 (90.3%)	10 (90.9%)	13 (100%)	5 (71.4%)	0.119*
DM	3 (9.7%)	1 (9.1%)	0 (0%)	2 (28.6%)	
Paraplegia					
Complete	3 (9.7%)	3 (27.3%)	0 (0%)	0 (0%)	0.054*
Incomplete	28 (90.3%)	8 (72.7%)	13 (100%)	7 (100%)	
Sensory level at injury site					
Intact	16 (51.6%)	5 (45.5%)	7 (53.8%)	4 (57.1%)	
Impaired	12 (38.7%)	3 (27.3%)	6 (46.2%)	3 (42.9%)	0.186*
Absent	3 (9.7%)	3 (27.3%)	0 (0%)	0 (0%)	
Autonomic involvement					
No	8 (25.8%)	2 (18.2%)	4 (30.8%)	2 (28.6%)	0.768*
Yes	23 (74.2%)	9 (81.8%)	9 (69.2%)	5 (71.4%)	
Fracture level					
D_12	10 (32.3%)	2 (18.2%)	4 (30.8%)	4 (57.1%)	0.256*
L_1	21 (67.7%)	9 (80.0%)	9 (69.2%)	3 (42.9%)	

At baseline only 3 (9.7%) patients were in ASIA grade A and all of them were undergone surgery within 4-10 days. Majority of the patients were in ASIA grade C (42.5%) followed by grade B (29%) (Table V). Though the neurological status on admission was different in three groups it was failed to reach statistical significance (p=0.0654).

Table V: Baseline ASIA grade of the patients (n=31)

ASIA grade	Overall (n=31)	Interval of decompression from injury			P value
		4-10 days (n=11)	11-20 days (n=13)	21-30 days (n=7)	
A	3 (9.7%)	3 (27.3%)	0 (0%)	0 (0%)	
B	9 (29.0%)	2 (18.2%)	5 (38.5%)	2 (28.6%)	0.065*
C	14 (42.5%)	6 (54.5%)	5 (38.5%)	3 (42.9%)	
D	5 (16.1%)	0 (0%)	3 (23.1%)	2 (28.6%)	

Data are expressed as frequency (percentage); *p value was derived from Chi-square test.

3 patients underwent surgery within 4-10 days had base line ASIA grade-A. Among them 2(66.7%) had no change in their follow up ASIA grade, remaining one patient got only one grade improvement. But all the patients with base line ASIA grade B and C got at least one grade improvement. The details of the ASIA grade on admission and after 6 months of surgery are shown in table VI.

Table VI: Change in ASIA grade from pre-op to 6 months follow-up in 31 patients by their time of intervention

Group	Baseline ASIA gr	no	AISA grade after 6 months A	B	C	D	E
4-10 days	A	3	2 (66.7%)	1 (33.3%)	0 (0%)	0 (0%)	0 (0%)
	B	2	0 (0%)	0 (0%)	1 (50.0%)	1(50.0%)	0 (0%)
	C	6	0 (0%)	0 (0%)	0 (0%)	3(50.0%)	3 50.0%)
11-20 days	B	5	0 (0%)	1 (20.0%)	3 (60.0%)	1(20.0%)	0 (0%)
	C	5	0 (0%)	1 (25.0%)	0 (0%)	3(75.0%)	1(25.0%)
	D	3	0 (0%)	0 (0%)	0 (0%)	0 (0%)	3 (100%)
21-30 days	B	2	0 (0%)	1 (50.0%)	1 (50.0%)	0 (0%)	0 (0%)
	C	3	0 (0%)	0 (0%)	2 (66.7%)	1(33.3%)	0 (0%)
	D	2	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (100%)
Overall	A	3	2 (66.7%)	1 (33.3%)	0 (0%)	0 (0%)	0 (0%)
	B	9	0 (0%)	2 (22.2%)	5 (55.5%)	2(22.2%)	0 (0%)
	C	14	0 (0%)	1 (7.1%)	2 (14.3%)	7(50.0%)	4(28.6%)
	D	5	0 (0%)	0 (0%)	0 (0%)	0 (0%)	5 (100%)

Data are expressed as frequency (percentage).

Table VII shows that total, 14 out of 15 patients (93.33%) got sensory improvement. This improvement was most prominent with in 14th postoperative day. There is no significant difference in sensory improvement regarding timing of surgery from spinal cord injury.

Table VII: Change in sensory function from pre-op status to 6 months follow-up in 31 patients by their time of intervention

Group	Baseline	no	After 6 months Intact	Improved	Not improved
4-10 days	Intact	5	5 (100%)	0 (0%)	0 (0%)
	Impaired	3	1 (33.3%)	2 (66.7%)	0 (0%)
	Absent	3	0 (0%)	2 (66.7%)	1 (33.3%)
11-20 days	Intact	7	7 (100%)	0 (0%)	0 (0%)
	Impaired	6	1 (16.7%)	5 (83.30%)	0 (0%)
	Absent	0	0 (0%)	0 (0%)	0 (0%)
21-30 days	Intact	4	4 (100%)	0 (0%)	0 (0%)
	Impaired	3	0 (0%)	3 (100%)	0 (0%)
	Absent	0	0 (0%)	0 (0%)	0 (0%)
Overall	Intact	16	16 (100%)	0 (0%)	0 (0%)
	Impaired	12	2 (16.7%)	10 (83.3%)	0 (0%)
	Absent	3	0 (0%)	2 (66.7%)	1 (33.3%)

Data are expressed as frequency (percentage).

Overall, out of 23 patients who had autonomic involvement at presentation 15 (65.2%) patients had no improvement in their autonomic function within 6 months following decompression surgery. The improvement was most prominent in patients who had surgery within 4-10 days followed by patients had surgery within 11-20 days from injury.

Table VIII: Change in autonomic function from pre-op to 6 months follow-up in 31 patients by their time of intervention

Group	Baseline	no	After 6 months Intact	Improved	SIC	Indwelling catheter
4-10 days	Intact	2	2 (100%)	0 (0%)	0 (0%)	0 (0%)
	Present	9	0 (0%)	2 (22.2%)	2 (22.2%)	5 (55.6%)
11-20 days	Intact	4	4 (100%)	0 (0%)	0 (0%)	0 (0%)
	Present	9	0 (0%)	1 (11.1%)	2 (22.2%)	6 (66.7%)
21-30 days	Intact	2	2 (100%)	0 (0%)	0 (0%)	0 (0%)
	Present	5	0 (0%)	0 (0%)	1 (20.0%)	4 (80.0%)
Overall	Intact	8	8 (100%)	0 (0%)	0 (0%)	0 (0%)
	Present	23	0 (0%)	3 (13.6%)	5 (21.7%)	15 (65.2%)

Data are expressed as frequency (percentage).

Table shows only 6 (19.4%) of patients had 2 grade improvement within 6 months following surgery 4 of them had decompression within 4-10 days and rest 2 had decompression within 11-20 days from injury. None of the patients who had surgery beyond 20 days from injury achieved such 2 grade improvement within 6 months following surgery.

Table IX: Change in ASIA grade scale from baseline to 6 months after operation

Group	no	Changes in ASIA grade in 6 months				p value*
		1 Grade deterioration	No Change	1 Grade Improvement	2 Grade Improvement	
4-10 days	11	0 (0%)	2 (18.2%)	5 (45.5%)	4 (36.4%)	0.311
11-20 days	13	1 (7.7%)	1 (7.7%)	9 (89.2%)	2 (15.4%)	0.305
21-30 days	7	0 (0%)	3 (42.9%)	4 (57.1%)	0 (0%)	0.201
Total	31	1 (3.2%)	6(19.3%)	18(58.1%)	6 (19.4%)	

Data are expressed as frequency (percentage); *p value was derived from Chi-square test. . -1 expressed as one level deterioration from pre-operative status, 0 expressed as Pre-operative status or no change, 1or 2 expressed as one or two level improvement ie, from B-C,D-E or C-E,B-D.

Data of the present study shows that 6 months follow up after surgery the neurological improvement was not related to the fracture level. However, age was significantly correlated with neurological outcome (p=0.021) (Table X)

Table X: Statistical analysis of relationship of ASIA score improvement at 6 months follow-up with age of the patient, and fracture level.

Characteristics	no	Not improved (n=7)	Improved (n=24)	P value
Age Mean (±SD) years	31	45.57 (±9.16)	32.33 (±11.12)	0.021†
Fracture level				
T12	10	4 (40.0%)	6 (60.0%)	0.109*
L1	21	3 (14.3%)	18 (85.7%)	

Data are expressed as frequency (percentage) if not otherwise mentioned;*p value was derived from Chi-square test;†p value was derived from independent sample t test

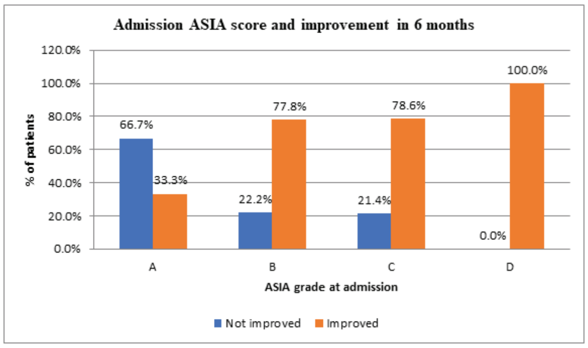

Figure 3: Relationship between ASIA score improvement at 6 months follow-up and admission ASIA score.

Figure 3 show that all patients with baseline ASIA grade D had improvement at 6 months and in same period only 33.3% of the patients improve with baseline ASIA grade A. However, this difference failed to reach statistical significance (p=0.187).

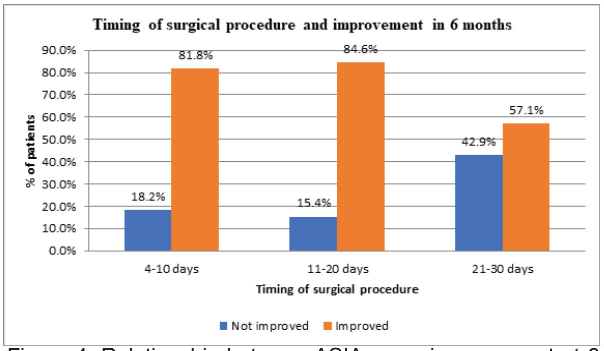

Figure 4: Relationship between ASIA score improvement at 6 months follow-up and timing of surgical procedure.

Figure 4 show that 81.8% of the patients having surgical intervention within 4-10 days had improvement after 6 months compared to only 57.1% patients who had surgery 21-30days following index event. However, this difference failed to reach statistical significance (p=0.341).

No intra-operative complications were observed. Post-operatively, three (9.7%) had sacral bed sores and two (6.5%) had respiratory infection. All the three cases of sacral bed sores healed well after doing regular dressing, use of pneumatic bed and regular posture change. Respiratory and wound infections settled with appropriate antibiotics.

Table XI: Post-operative complications of the patients (n=31)

Complications	Overall (n=31)	Interval of decompression from injury			P value
		4-10 days (n=11)	11-20 days (n=13)	21-30 days (n=7)	
No complication	26 (83.9%)	9 (81.8%)	11 (84.6%)	6 (85.7%)	
Bed sore	3 (9.7%)	0 (0%)	2 (15.4%)	1 (14.3%)	0.323*
Respiratory tract infection	2 (6.5%)	2 (18.2%)	0 (0%)	0 (0%)	

Data are expressed as frequency (percentage); *p value was derived from Chi-square test.

Discussion:

This study presents neurological outcome of late decompressive surgery in patients with traumatic SCI at thoracolumbar junction. Thirty one patients were included in the study. These patients were followed up from 1st POD till the end of 6thmonths to see the outcome in terms of sensory, motor and autonomic recovery. Outcome was assessed by ASIA impairment scale.

In the present study, out of 31 patients only 19.4% (6/31) patients achieved 2 grade improvement within 6 months following surgery. On the other hand, a considerable portion of the patients (19.4%) had no changes in their baseline neurological status. Though statistically not significant there was a trend that the time of decompression was closely related to the outcome.

The best improvement (2 grade improvement in ASIA grade scale) was obtained in patients operated within 4-10 days from the spinal trauma (36.4% of patients in this group) while it happened in 15.4% of the patients operated between 11-20 days and in 0% of the patients operated between 21-30 days. Probably as our sample size was too small to obtain a statistically significant difference between these three subgroups, however, these data suggest that performing the surgical procedure as soon as possible from the trauma influences a postoperative neurological improvement but at the same time we realize that we need a larger case series to better validate our statistical data.

In our study we had 80.6% males and 19.4% female patients. The mean age was 35 years. It is similar to a study conducted to evaluate the functional outcome of surgically managed thoracolumbar spine fracture where they found 95% males and 5% female patients. The average age was 28.3 years and more common in the second and third decade.[10] Another author in their study found that average age was 31 years, with a male predominance. [11,12,13] In the present series we noted fall from a height in 67.7% patients as the most common mode of injury and was mainly the result of work injury. RTA was the second commonest cause 29% of patients. Similarly, other authors noted fall from a height in 81% patients as the most common mode of injury followed by RTA (19%).[12,13]

In the present study, 67.7% of patients admitted with fractures at L1 level and 32.3% with fractures at T12 level. In a series of an author, they had 86.1% of patients with fractures between T11--L2 levels. 9.52% with fractures between T1- T10, 4. 5% with fractures between L3-L5 levels.[10] Other authors in their study noted that the commonest vertebra to be fractured was L1 comparable to our study. [12,13]

In the present study, there were 9.7% patients with ASIA Grade-A, 29% with Grade B, and 42.5% with Grade-C and 16.1% with Grade-D at admission and at last follow up showed at least 1 ASIA Grade improvement. Study conducted to evaluate the outcome by an author noted that patients who had neurological deficits showed at least 1 grade improvement at last follow up. [11] Different authors noted that neurological improvement was seen in 50% of cases with 40% improving with 1 grade and 20% with 2 grades and none had a decrease in neurological level where as patients with incomplete paraplegia, neurological status improved at least by 1 grade and 64.4% of those with incomplete lesions showed an improvement of at least 1 grade.[12,13,14]

The ASIA grade at admission appeared in our study as a still further element that can influence the postoperative outcome confirming what other authors have proven in past years.[15] In our series in fact patients in grade D improved in 100% of the cases while patients in grade C improved in 78%, grade B improved in 77.7%, but it is really interesting to see that six months after the trauma even 1 patients out of 3 with ASIA grade A improved, probably due to the spinal shock that alters the actual initial clinical assessment.

In the present study, age was significantly associated with neurological improvement after at six months of surgery. Patients who demonstrated improvement were significantly lower age than the patients showing no improvement. One author also observed such association between age and neurological improvement and reported that, younger patients with deficits have a better prognosis than older ones in the same neurological conditions whose outcome may be influenced by co morbidities.[15]

We found 77.4% of the included patients in the study got some degree of neurological improvement. But, significantly greater proportion of patients who improved at least one ASIA grade were operated within 4-20 days of SCI. The percentage of patients showing neurological recovery (1 grade in power on ASIA scale) did not appear to differ whether patients were operated within 4-10 days or within 11-20 days (81.8% versus 84.6) but dropped significantly to 57.1% after 20 days. To understand timing of surgery in thoracolumbar spine injury, an author reported that, neurological recovery can still be expected in about one-third of patients (34.4%) who present 72 hours after injury.[16]

A randomized controlled trial on 27 patients with thoracolumbar SCI between T8 and L2, found that in patients where surgery was delayed for 3 to 15 days, only 4 out of 15 patients showed neurological improvement.[17] Interestingly patients with ASIA grade A, who received delayed surgery only one out of seven patients improved by 1 grade.

Similarly, we have reported that 33.1% patients with ASIA Gr-A showed neurological improvement. These findings indicate that patients with complete SCI may have the most to gain from early decompression, which is contrary to the bulk of published literature which favors delaying surgical decompression in complete SCI patients. These findings are contradicted by results of a randomized, controlled trial conducted by another author on 35 patients involving T5-L1 SCI.[18] They reported 1 out of 9 patients in the late-surgery group showed improvement of 1 grade on the ASIA scale. However, because of the small numbers involved, these were likely under powered study similar to present study.

Regarding the return of bowel and bladder function it is seen in the present study thatno improvement occurred in all the cases in complete paraplegia. In 11 out of 28 cases of incomplete paraplegia, bowel and bladder function got almost normal in 6 months follow up, whereas rest 5 patients were practiced self intermittent catheterization and indwelling catheter was present in 15 patients. It is almost similar finding to an author where they stated in 9 out of 20 patients in incomplete paraplegia bowel and bladder function got normal in 6 months follow up.[18-19] In our series, 85.7% of lumbar level patients with motor complete injuries improved compared with the 60% of thoracic level patients with motor complete damage. However, these data failed to reach statistical significance. These findings were consistence with that of one study reported that, higher proportion of patients SCI at lumbar level with motor injuries improved compared to thoracic level (60% versus 44%).[20]

In the present series, 3 patients developed bed sore over the sacral region and posterior iliac crest in the postoperative period. This was due to not using pneumatic bed and improper postural care. All of the patients were complete paraplegics. In 6 months follow-up 2 of these patients bed sore healed with proper postural care and after using pneumatic bed and with local dressing. Post-operative neurological deterioration was observed in one case (3.2%). At admission this case was in ASIA grade C and after 6 months it changed to grade B. Decompression was done after 13 days from injury and in postoperative period bed sore was developed. Other complications reported by the previous studies [17-20] like infection of the surgical wound with in situ implants, pull-out of screws, dural tear, and persistent fistula with leakage of urine, morbidity of the bone graft donor site were not observed in the present series.

For SCI patients, with column instability or neurological deficits, the surgical decompression of spinal cord and the restoration of vertebral alignment are the gold standard treatment, and recent study indicates that early surgery (within 12 hours) is associated with neurological improvement with statistical significance. [19-20] Evidence regarding remaining SCI populations and clinical outcomes are still controversial and inconsistent.[20] Nevertheless this type of ultra-early surgery is not feasible in our perspective. Such patients are undergone decompression surgery usually after 72 hours (late surgery) in our hospital. According to the present evidence, it is mandatory to operate the patient within 72 hours after trauma but we think that to perform surgery as soon as possible can still further positively influence the neurological outcome. In the present study, it has been evaluated the neurological outcome of such 31 patients having injury at thoracolumbar junction for 6 months after operation. Overall more than half of the patients were found to have at least 1 grade and about one fifth of the patients had 2 grade neurological improvement in 6 months following surgery.

Conclusion: In this study, more than two third of the patients with SCI at thoracolumbar junction had at least 1 grade improvement in 6 months following late surgical decompression. Further, multi-centered studies and larger case series are needed to confirm short and long-term mortality and functional outcomes as well as better validate our statistical data.

Limitation of the study: Our study is limited as per design as sample size was small and patients were selected from a single center and it is only generalizable to those who present to a hospital for care. There was absence of control group. While the efficacy of surgical intervention could not be determined in the absence of a control (non surgical) group, it would be unethical to have such a control. Neuroimaging facility should be round the clock for providing earliest intervention where possible which we could not offer. Follow up after discharge was short, a longer follow up might bring a better result. Neither the type of fracture nor its relation with the neurological status had been assessed in the study. Sexual status of the patient after surgery not included as the basic parameters of the study was based on ASIA impairment scale.

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