

# The Walking Recovery One Year after Surgical Management of Thoracolumbar Burst Fracture in Paraplegic Patients

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## Abstract

The aim of this study was to highlight the walking recovery after surgical management of traumatic burst fractures at the thoracolumbar junction (T10 or T11 or T12 or L1) in paraplegic patients to decide what surgeons should tell their patients to help them develop realistic expectations and potentially improve their outcome. This is a series of adult patients presented with paraplegia from isolated thoracolumbar fracture and underwent surgical intervention from August 2009 to August 2015. Patients with preexisting disability from previous neurologic condition, patients with associated severe head injury or major medical comorbidities or life-threatening injuries were excluded. Neurological status was assessed on admission using the American Spinal Injury Association (ASIA) impairment scale (AIS). The walking ability was assessed 12 months after surgery using the modified Benzel scale. This study included 53 patients with a mean age of 39.4 years (ranging from 18 years to 58 years). Patients presented with AIS grade A are 6, 18 patients with AIS grade B, and 29 patients with AIS grade C. All the patients with L1 fracture and 70.96% of the patients with T12 fracture regained the ability to walk, but unfortunately all the patients with T10 and T11 fractures didn't regain the walking ability 12 months after surgery. The severity of spinal cord injury and hence the walking recovery were related to the spinal level of fracture. A prospectively controlled study with more patients is needed to reevaluate the walking recovery in paraplegic patients with T10 and T11 fractures.

Key words: thoracolumbar burst fracture, spinal cord injury, surgical outcome, american spinal injury association impairment scale, walking

## Introduction

Thoracolumbar burst fractures are a very common entity in neurosurgical practice. Clinical picture could be devastating due to severe neurological deficits.

Paraplegia is a term that refers to impairment or loss of motor and/or sensory function in the lower limbs secondary to damage of neural elements in the thoracic, lumbar, or sacral segments of the spinal cord.<sup>1)</sup>

The walking ability after surgical management of thoracolumbar burst fracture in paraplegic patients is underreported in the literature, and this creates a difficulty in answering the question of the percentage of regaining the ability to walk, and some neurosurgeons become pessimistic by

the severe weakness on presentation and transfer this feeling to patients.

Mondloch et al. stated that “what patients think will happen (their recovery expectations) can influence what actually happens (their health outcomes)” and added that “Physicians should foster more positive recovery expectations which ultimately improve patient health outcomes”.<sup>2)</sup>

The aim of this study was to highlight the walking recovery after surgical management of thoracolumbar burst fractures in paraplegic patients to decide what surgeons should tell their patients to help them develop realistic expectations and potentially improve their outcome.

## Materials and Methods

This study is a series of patients presented with paraplegia from thoracolumbar junction burst fracture and had surgical intervention in our University

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hospitals during a six-year period from August 2009 to August 2015.

### Inclusion criteria

Adult patients presented in American Spinal Injury Association (ASIA) Impairment Scale (AIS) grades A through C, from a magnetic resonance imaging (MRI)-confirmed spinal cord compression from an isolated traumatic spinal burst fracture at the thoracolumbar junction (T10 or T11 or T12 or L1) and were surgically managed.

### Exclusion criteria

Patients with pre-injury disability from previous neurologic condition, patients with associated severe head injury or peripheral nerve injury or major medical comorbidities or life-threatening injuries.

The clinical data were collected from medical charts and included; patients' demographics, mode of trauma, preoperative clinical state, preoperative radiological findings, time between trauma and surgery, operative details, postoperative management, and the progressive notes in the follow-up visits.

Patients were admitted in the intensive care unit (ICU) and initially managed according to the Advanced Trauma Life Support (ATLS) guidelines. Foley urinary catheter was inserted into all patients.

Methylprednisolone was intravenously administered to patients admitted within 8 hours of injury, in the form of 30-mg/kg bolus then 5.4 mg/kg/h for 24 hours in patients treated earlier than 3 hours after injury, and for 48 hours in patients treated 3–8 hours after injury.

All patients received a proton pump inhibitor upon admission. Prophylactic intravenous antibiotic (ceftriaxone) and intramuscular Tetanus toxoid 0.5 ml were administered to patients with open wounds.

The preoperative neurologic state was assessed using the AIS (Table 1).<sup>1)</sup>

Computed tomography (CT) scan brain and CT whole spine with sagittal and coronal reconstruction were done for all patients after vital stabilization. MRI on the thoracolumbar junction was done for all patients based on the neurological level of injury (NLI).

The patients were prepared for surgical decompression and stabilization as soon as possible. In the operating theater, patients had general anesthesia with muscle relaxant. Surgical decompression through laminectomy was done at the level of spinal cord compression.

Stabilization was done using pedicle screws 2 levels above and 2 levels below the fractured vertebrae.

Packed RBCs transfusion was administered to patients with postoperative hemoglobin < 9 gm/dl. CT scan thoracolumbar junction was done in the first postoperative day to check the position of the screws.

**Table 1 The American Spinal Injury Association Impairment Scale (AIS)**

|                                    |  |
|------------------------------------|--|
| <b>Grade A: complete</b>           | No sensory or motor function is preserved in the sacral segments S4–S5.  |
| <b>Grade B: sensory incomplete</b> | Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4–S5 (light touch, pin prick at S4–S5 or deep anal pressure), and no motor function is preserved more than three levels below the motor level on either side of the body. |
| <b>Grade C: motor incomplete</b>   | Motor function is preserved below the neurological level and more than half of key muscle functions below the neurological level of injury have a muscle grade < 3.  |
| <b>Grade D: motor incomplete</b>   | Motor function is preserved below the neurological level and at least half of key muscle functions below the neurological level of injury have a muscle grade of 3 or greater.   |
| <b>Grade E: normal</b>             | If sensation and motor are graded as normal in all segments.   |

For prophylaxis against deep venous thrombosis, patients used antiembolic compression stockings and received low-molecular-weight heparin.

Drains were removed in the second or third postoperative day when the draining fluid decreased to < 50 ml in 12 hours. Sutures were removed 10–14 days after surgery.

Patients were discharged to a special rehabilitation center for few months, then were discharged home and continued physiotherapy 3 times per week in a well-equipped physiotherapy center and were followed up in our outpatient clinic every 3 months.

The walking ability was assessed using the modified Benzel scale (Table 2), which scores ambulation from I to VII. Grade V is the first level where ambulation is observed and represents the ability to walk 7.5 m (25 ft) with or without assistance.

## Results

This study included a series of 53 adult patients who presented with paraplegia, AIS grades A through C, from an MRI-confirmed spinal cord compression from traumatic burst fracture at the thoracolumbar junction (T10 or T11 or T12 or L1) and were managed surgically. Their mean age was 39.4 years (ranging from 18 to 58 years). The study included 31 women (58.4%) and 22 men (41.5%).

The time between trauma and admission ranged between 2 hours and 10 hours. Five patients suffered

**Table 2** Modified Benzel scale

| Grade | Description  |
|-------|--|
| I     | No motor or sensory function is preserved in sacral segments S4-5.   |
| II    | Sensory but no motor function is preserved in sacral segments S4-5.  |
| III   | Motor function is preserved below the neurologic level, and the majority of key muscles below the neurologic level have a muscle grade < III; unable to walk.  |
| IV    | Unable to walk; some functional motor control below the level of the injury that is significantly useful (e.g., assist in transfers, etc.) but that is not sufficient for independent walking.                               |
| V     | Limited walking; motor function allows walking with assistance or unassisted, but significant problems secondary to lack of endurance or fear of falling limit patient mobility (must be able to ambulate at least 25 feet). |
| VI    | Unlimited walking; ambulatory without assistance and without significant limitations other than slightly dyscoordinated gait (must be able to ambulate at least 150 feet without a helper).                                  |
| VII   | Neurologically intact with the exception of minimal deficits that cause no functional difficulties (must have a neurologically normal gait and be able to walk without assistance of assistive devices)                      |

**Table 3** Preoperative patient characteristics

| Characteristics          | Number of patients (%) |
|--------------------------|------------------------|
| Mode of trauma           |                        |
| Traffic accidents        | 38 (71.69)             |
| Fall from a height       | 15 (28.3)              |
| Level of spinal fracture |                        |
| T10                      | 4 (7.54)               |
| T11                      | 7 (13.2)               |
| T12                      | 31 (58.49)             |
| L1                       | 11 (20.75)             |

from hypertension, two from diabetes mellitus, and one from myocardial ischemia. Traffic accidents were the most common mode of trauma (71.69%). Fracture levels were mainly T12 and L1 (Table 3).

Six patients presented with AIS grade A, eighteen patients with AIS grade B, and twenty-nine patients with AIS grade C. The preoperative AIS grades of the patients according to their spinal level of fracture are listed in Table 4.

The mean duration between trauma and surgical intervention was 9.3 hours (ranging from 6 hours to 18 hours).

**Table 4** The walking ability 12 months after surgery using the modified Benzel classification in relation to the level of spinal fracture

| Level of spinal fracture | No. of patients (n) | Preoperative AIS grade |       |       | Modified Benzel classification 12 months after surgery |    |     |    |   |    |     |
|--------------------------|---------------------|------------------------|-------|-------|--|----|-----|----|---|----|-----|
|                          |                     | AIS A                  | AIS B | AIS C | I  | II | III | IV | V | VI | VII |
| T10                      | 4                   | 2                      | 2     | –     | 2  | 1  | –   | 1  | – | –  | –   |
| T11                      | 7                   | 2                      | 4     | 1     | 1  | 1  | 3   | 2  | – | –  | –   |
| T12                      | 31                  | 2                      | 11    | 18    | –  | 1  | 7   | 1  | 9 | 13 | –   |
| L1                       | 11                  | –                      | 1     | 10    | –  | –  | –   | –  | 1 | 10 | –   |

Two patients developed post-operative deep wound infections and improved by debridement and intravenous antibiotics without removing the fixation system, and seven patients experienced superficial decubitus ulcers.

The mean hospital stay was 21.6 days (ranging from 14 to 29 days), while the mean stay in the rehabilitation center was 87.4 days (ranging from 61 to 112 days).

There was no deterioration in AIS grade in any patient. All the patients with T12 and L1 fractures improved in AIS grade.

The walking ability 1 year after surgery (using the modified Benzel classification) in relation to the level of spinal fracture is shown in Table 4. All the patients with L1 fractures and 70.9% of the patients with T12 fractures were able to walk independently with or without walking aids, but unfortunately, all the patients with T10 and T11 fractures didn't regain the walking ability even 12 months after surgery.

## Discussion

This is a one-center series of adult patients, who underwent spinal cord decompression and fixation of a thoracolumbar burst fracture, in a 6-year period from August 2009 to August 2015. Only the patients with neurologic deficit AIS grades A through C were included to highlight their walking ability 12 months after surgery.

In this study, only 4.76% of the patients with T12 and L1 fractures presented with paraplegia AIS grade A in comparison to 36.36% of those with T10 and T11 fractures. All the patients with L1 fracture and 70.96% of the patients with T12 fracture regained the ability to walk, and all the patients with T10 and T11 fractures didn't regain the ability to walk 12 months after surgery. These findings denote that the severity of spinal cord injury and hence the walking recovery rates were

related to the spinal level of fracture. A prospective controlled study with more patients is needed to confirm this relation and to reassess the prognosis especially in patients with T10 and T11 fractures.

The absence of AIS grade A in the patients with L1 burst fracture in this study may be related to the relatively wide spinal canal in the lumbar spine than the thoracic spine. Also injury to the conus medullaris, which is usually situated at the level of L1 is a type of incomplete spinal cord injury.

All the patients in this study were operated within 24 hours after trauma. In our University hospitals, there is a consensus that early surgical cord decompression (within 24 hours of injury) could influence the patient outcome in terms of AIS score improvement. So, the needed equipment and the experienced staff are 24/7 available for such cases. Late surgical cord decompression (> 24 h of injury) is indicated (in our center) in patients with significant concurrent traumatic brain injury, or associated life-threatening injuries that preclude early cord decompression.

Several studies found that early spinal cord decompression within 24 hours of injury had the potential to confer a neuro-protective effect and was associated with better neurologic recovery by reducing the secondary ischemic-hypoxic cord injury. Also, it was emphasized that early surgery has a lower percentage of postoperative complications and reduced hospitalization than late surgery.<sup>3-7)</sup>

On the other hand, La Rosa et al. assumed that neurological examination within 24 h of injury may be difficult to rely on its accuracy for prognosis owing to sedation and poor cooperation of the patient.<sup>6)</sup>

This study was mainly aiming to provide our new patients the real information about the anticipated walking recovery 1 year after surgical intervention. Schouten et al. concluded that "By providing consistent, accurate information surgeons will help patients develop realistic expectations and potentially optimize outcomes".<sup>8)</sup>

The limitations of this study are absence of a control group, small number of patients, and a single center study.

## Conclusion

All the patients with L1 fracture and 70.96% of the patients with T12 fracture in this study regained the ability to walk after prompt surgical decompression. The severity of spinal cord injury and hence the walking recovery rate were related to the spinal level of fracture. A prospectively controlled

study with more patients is needed to reevaluate the walking ability in paraplegic patients with T10 and T11 fractures.

## Conflicts of Interest Disclosure

The author certifies that he has no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership; employment; consultancies; stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

## Informed Consent

Informed consent was obtained from all individual participants included in the study.

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