



## The analysis of functional and radiographic outcomes of conservative treatment in patients with low lumbar burst fractures



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### ABSTRACT

**Introduction:** Burst fractures of the low lumbar spine constitute approximately one percent of all lumbar fractures. There is still no consensus on the optimal treatment of low lumbar burst fractures. We aimed to evaluate the functional and radiographic outcomes of conservative treatment in patients with low lumbar burst fracture.

**Methods:** 15 patients (11 males, 4 females; mean age  $32 \pm 8$ ) who had low lumbar spine burst fracture treated with a custom-moulded thoracolumbosacral orthosis (TLSO) with a thigh extension were enrolled. The mean follow-up period was  $22 \pm 6$  months. 14 patients were neurologically intact and one had isolated nerve root injury. There were 24% type A fractures and 76% type B fractures according to the Denis classification system. Functional outcomes were evaluated by using Oswestry Disability Index (ODI), Short-Form 36 (SF-36) and Visual Analogue Scale (VAS). Radiographic outcome was analyzed by measuring anterior vertebral height loss, kyphosis angle, amount of canal retropulsion. Functional and radiographic outcomes were reviewed initially and at 1, 3, 6, 12 months, and at the latest follow-up. Functional and radiographic improvements were analyzed statistically.

**Results:** The mean bracing period was  $11.9 \pm 1.7$  weeks. The mean initial ODI, SF-36, and VAS score of the patients was  $78.3 \pm 9.6$ ,  $23.7 \pm 8.9$ , and  $8.7 \pm 0.7$ , respectively. The mean ODI, SF-36, and VAS score of the patients at the final follow-up was  $26.4 \pm 6.5$ ,  $68.1 \pm 11.2$ , and  $2.8 \pm 1.7$ , respectively. The improvement in functional outcomes was measured to be significant ( $p < 0.05$  for ODI, SF-36 and VAS). The mean initial anterior vertebral height loss, kyphosis angle, amount of canal retropulsion was found to be  $27.2\% \pm 9.6\%$ ,  $-6.8^\circ \pm 3.2^\circ$ ,  $37.4\% \pm 10.2\%$ , respectively. The mean anterior vertebral height loss, kyphosis angle, and amount of canal retropulsion at the final follow-up was  $23.1\% \pm 6.7\%$ ,  $-4.2^\circ \pm 2.4^\circ$ ,  $19.6\% \pm 7.7\%$ , respectively. Among the radiographic outcomes, only the amount of canal retropulsion improved statistically ( $p = 0.042$ ).

**Conclusion:** Conservative treatment using a custom-moulded thoracolumbosacral orthosis with a thigh extension is a safe and effective method in patients with low lumbar spine burst fractures and can improve functional and radiographic outcomes.

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### Introduction

Burst fractures of the low lumbar spine constitute roughly 1% of all lumbar fractures, and frequently caused by high-energy trauma [1–3]. The lumbosacral spine possess a critical role in axial weight-bearing of the spine [2]. This segment of the spine has unique anatomic and biomechanical characteristics, including its location below the pelvic brim and the apex of the lumbar lordosis in conjunction with the stabilizing effect of the iliolumbar ligaments

that protect this region from traumatic injury [2,4–7]. The spinal canal is widest in this region with neurologic damage, ending up with injury to the cauda equina in contrast to the conus medullaris [6].

There is still no consensus on the optimal treatment of low lumbar burst fractures. While some spine surgeons advocate nonoperative treatment in the neurologically stable patient [2,5,8–10], others prefer operative treatment [6,7,11,12]. Patients, who are nonoperatively treated, necessitate pain control and may utilize a thoracolumbosacral orthosis (TLSO) [5]. Several investigators have observed that isolated nerve root deficits at this level act similarly to peripheral nerve injury with a good prognosis for spontaneous recovery with conservative treatment [3,13,14]. Progressive kyphosis should be avoided by obtaining regular plain

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radiographs in patients treated conservatively [1]. Early studies have reported that conservative treatment of low lumbar burst fractures can be related with good short-term pain outcomes [5,8–10].

The objective of this study was to evaluate retrospectively the functional and radiographic outcomes of conservative treatment using a custom-moulded thoracolumbosacral orthosis with a thigh extension in patients with low lumbar burst fractures.

## Patients and methods

15 consecutive patients (11 males, 4 females) with low lumbar (L3–L5) burst fractures were identified from 2006 through 2011 at a single medical centre (Table 1). The mean age of the patient cohort was  $32 \pm 8$  years. Minimum criteria for inclusion in the current study were; damage to the at least one vertebral endplate, and loss of both anterior and posterior vertebral height with retropulsion of bone into the canal, documented by computed tomographic scanning. Patients with pathological fractures such as osteoporotic fractures were excluded.

Of the 15 patients, 7 sustained injuries associated with motor vehicle accidents, 6 with falls, and two with direct blow. The time from injury to admission was between 2 h and 13 days. 7 patients presented with L3, 5 patients with L4, and three patients with L5 vertebra fractures. Associated injuries were present in 10 patients and included extremity fractures (5 patients), closed head injury (2 patients), pelvic fractures (2 patients), and abdominal trauma (1 patient).

The mean follow-up period was  $22 \pm 6$  months. 11 (73%) out of 15 patients had a minimum of 2 years' follow-up. All patients were treated conservatively. Conservative treatment consisted of an initial period of bed rest (2–5 days) and then ambulation as tolerated in a custom-moulded TLSO with a thigh extension. 14 patients were neurologically intact and one had isolated unilateral nerve root injury (L4 right side).

The initial and follow-up radiographs were reviewed. The initial radiographs were obtained with the patient supine due to the acuteness of the injury. Radiographs at the follow-up evaluation were achieved with the patient standing. There were 24% type A and 76% type B fractures according to the classification system developed by Denis et al. [15]. Kyphosis and scoliosis were measured with the Cobb technique [16]. Loss of anterior vertebral was computed as a percentage of the height of the fractured vertebral body compared with the average of the two adjacent intact anterior vertebral height. Kyphotic angle was measured by the Cobb technique using one vertebral body above and one below the fractured vertebra. The amount of retropulsion was measured by CT scan and indicated as a maximum percentage occupancy of

the involved canal's sagittal diameter compared with the average of the vertebra cranial and caudal to the fracture [5,17]. All radiographs were evaluated by the same orthopaedic surgeon (TO) who was not involved in the initial treatment of the patients.

Functional outcomes for all patients were analyzed using Oswestry Disability Index (ODI), Short-Form 36 (SF-36), and Visual Analogue Scale (VAS). Functional and radiologic outcomes were reviewed initially and at 1st, 3rd, 6th month, 1st year, and at the final follow-up. The parameters of functional and radiologic outcomes were analyzed using Student's *t*-test and  $\chi^2$ -test. The correlation of improvement in functional outcomes with the improvement in radiologic outcomes at different follow-up periods was calculated by Spearman correlation test. A  $p < 0.05$  value was considered significant.

## Results

At the final follow-up, all patients had definite fracture healing and/or solid bony fusion. The mean bracing period was  $11.9 \pm 2.1$  weeks. The mean hospitalization time was  $10.8 \pm 2.8$  days. The patient with isolated unilateral radiculopathy resolved spontaneously at 18 weeks after injury. None of the patients had late neurological sequelae.

### Radiographic evaluation

The average initial anterior height loss was measured to be  $27.2\% \pm 9.2\%$ . At the final follow-up the mean anterior height was found to be  $23.1\% \pm 6.7\%$ . This improvement in anterior height loss was not found to be statistically significant ( $p = 0.228$ ) (Fig. 1).

The mean initial amount of canal retropulsion was observed to be  $37.4\% \pm 10.2\%$  and at the latest follow-up the average amount of canal retropulsion was measured to be  $19.6\% \pm 7.7\%$ . The improvement in canal remodeling was found to be significant ( $p = 0.042$ ). The advancement in the amount of canal retropulsion was demonstrated in Fig. 2.

The average initial kyphosis were found to be  $-6.8^\circ \pm 3.2^\circ$  initially and  $-4.2^\circ \pm 2.4^\circ$  at the latest follow-up. This change in kyphosis was not measured to be statistically significant ( $p = 0.156$ ). The decrease in kyphosis was shown in Fig. 3.

### Functional outcome

The mean ODI scores initially and at the final follow-up was measured to be  $78.3 \pm 9.6$  and  $26.4 \pm 6.5$ , respectively. This improvement in ODI scores was found to be significant ( $p = 0.032$ ). The average SF-36 scores initially and at the latest follow-up was measured to be  $23.7 \pm 8.9$  and  $68.1 \pm 11.2$ , respectively. The

**Table 1**  
Low lumbar burst fracture injury information-demography of this study population.

Patient no.	Age (yr)	Sex	Level	Cause	Neuro	Brace period (wk)	Follow-up (mo)
1	22	M	L3	MVA	Intact	14	26
2	27	F	L3	Fall	Intact	12	13
3	19	M	L4	Fall	Intact	12	24
4	43	M	L3	MVA	Intact	13	37
5	45	M	L5	Fall	Intact	11	16
6	26	F	L3	MVA	R L3 root	12	32
7	38	M	L5	DB	Intact	12	15
8	49	M	L4	MVA	Intact	13	25
9	20	M	L3	Fall	Intact	14	28
10	24	M	L4	Fall	Intact	12	24
11	31	M	L4	MVA	Intact	12	41
12	32	F	L3	DB	Intact	13	14
13	40	M	L5	MVA	Intact	11	30
14	33	M	L4	Fall	Intact	14	27
15	39	F	L3	MVA	Intact	13	29

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