Orthopaedics & Traumatology: Surgery & Research 101 (2015) 833–837

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Original article

Initial disc structural preservation in type A1 and A3 thoracolumbar fractures

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ARTICLE INFO

Article history:
Received 10 December 2014
Accepted 27 August 2015

Keywords:
Intervertebral disc
Vertebra
Thoracolumbar fracture
Spine injury
MRI

ABSTRACT

Purpose: Despite a sizable amount of literature, the optimal management of thoracolumbar fractures remains controversial and many authors assume the existence of disc lesions in Magerl type A fractures. The purpose of the study was to assess the intervertebral discs in these fractures at the time of trauma. The hypothesis was that there was no change in shape and signal intensity of the discs initially.
Methods: Fifty-one patients diagnosed with 87 types A1 and A3 thoracolumbar fractures were enrolled in a prospective study. MRI analysis involved evaluation of disc signal, height and morphological modifications according to Oner's classification.
Results: No signal intensity modification was identified on MRI. Disc morphology was either normal or altered with creeping of discal tissue in the vertebral endplate depression. Overall, 98% of the discs were either type 1 or type 3. Mean disc height on MRI was 1.03 ± 0.36 initially.
Conclusions: In this study, MRI showed that no loss of height occurred in discs adjacent to fractured vertebra and that there was no major alteration of the disc in terms of signal intensity and morphology. Therefore, the intervertebral disc should not be removed in Magerl type A fractures.
Level of evidence: Level IV, therapeutic case series.

1. Introduction

Thoracolumbar spine fractures are frequent and may lead to poor functional outcome especially in case of neurological compromise. Although a large number of papers have been published, the optimal management remains controversial [1–3]. The main controversy involves Magerl type A thoracolumbar fractures. No consensus exists about the criteria of severity, therapeutic options, surgical approaches, criteria of effective reduction and causes of loss of reduction. A significant but unsolved problem is to identify which fracture patterns could be managed conservatively, and which ones demand surgical procedure to avoid a posttraumatic kyphotic deformity, with potential long-term sequelae.

We know that mid-term follow-up shows cyphotic evolution. Both disc degeneration and body collapsus are involved in this process [4,5].

Several classification systems have been proposed in order to provide a morphological pattern of those fractures and therapeutic guidelines [6–10]. Those classifications, initially based on plain radiographs, became gradually more accurate and exhaustive with tomodensitometry. CT-scan allowed a better analysis of the posterior arch and the comminution of the vertebral body. MRI then enabled analysis of the ligaments and the intervertebral disc. In 1998, Oner reported a series of patients with thoracolumbar fractures and placed emphasis on MRI changes of the intervertebral disc [5]. He proposed a classification, which combines alteration of disc morphology and signal intensity. Many other authors assume the existence of disc lesions in Magerl type A fractures and support a surgical removal of the disc [5,11–17]. Based on our experience, the intervertebral discs may not be damaged in types A1 and A3 thoracolumbar fractures. The purpose of our study was to assess on MRI the intervertebral discs in these fractures at the time of

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http://dx.doi.org/10.1016/j.otsr.2015.08.008
1877-0568/

trauma. The hypothesis was that there was no change in shape and signal intensity of the discs initially.

2. Materials and methods

A prospective non randomized non comparative study was carried out in order to analyze disc signal and morphological modifications and to measure intervertebral disc heights. One hundred and two patients were diagnosed with thoracolumbar fractures in our department between February 2008 and July 2010.

The inclusion criteria were: patients aged from 18 to 65 years, with Magerl types A1 and A3 thoracolumbar fractures diagnosed on CT-scan, located from T5 to L5. The exclusion criteria were: Osteoporotic or pathological fractures, fractures in consecutive vertebral bodies, type A2, B and C fractures (based on Ct-scan and MRI analysis). A2 split fractures were excluded because of the acknowledged associated disc injuries. MRI was not possible in cases of polytrauma requiring emergency intervention before imaging could be obtained.

Radiological evaluation consisted of performing MRI initially before treatment. T1-weighted (TR 400; TE 11), T2-weighted (TR 2500; TE 50) and Fast Spin Echo (FSE) images were obtained with a 1.5 T Philips healthcare Achieva MRI. Images were transferred to a PACS workstation. Then, radiological measurements were blinded and performed by an orthopaedic spine surgeon and by a musculoskeletal radiologist. Measurements were made using digitalized tools in the PACS system, Impax (Agfa, Gevaert N.V.) in the global Magerl A group but also in the A1 and A3 sub-groups.

Sagittal T2-weighted MRI was performed for the evaluation of disc signal, height and morphology modifications. Intervertebral disc heights adjacent to the fracture were measured in millimeters on midline sagittal images. Overall disc height was calculated as the average of anterior, middle and posterior disc heights. Disc height index was defined as the ratio between cranial and caudal disc heights. Disc signal and morphological modifications were analyzed according to Oner's classification [5].

Prior to study measurements, both observers participated in training sessions using 5 MRIs from an independent collective of patients managed prior to the study. In this session, the observers were instructed about measurements and classifications used in the present study. Measurements were performed at two different times. Interobserver reliability was evaluated in the first measurement. Intraobserver reliability was evaluated from the mean results of the first and second measurement. MRI parameters were measured twice at 2-week intervals. In order to assess inter- and intraobserver reliability, the data sets of both observers were compared and mean values were analyzed.

3. Statistical analysis

Calculations and the statistical analysis were done using Microsoft Excel 2010 (Microsoft Corp., Redmond, WA). The intra- and interobserver reliability values were calculated using Cohen's weighted kappa and interpretation of strength of agreement was done according to the criteria of Landis and Koch [18].

Informed consent was obtained from all patients. Described 1 research adhered to the tenets of the Declaration of Helsinki. The IRB considered this study as "standard care" and did not require further reviews.

4. Results

Of the one hundred and two patients with thoracolumbar fractures, fifty-six patients were excluded from the study. Thus, sixty-nine fractures in forty-six patients (24 male and 22 female patients) were included allowing the analysis of 138 intervertebral discs. The median age of patients was 43.4 (range 19–60). Falls from a height ($n = 29$, 63%) were the predominant cause of injury, followed by traffic accidents ($n = 8$, 17%), ordinary falls ($n = 6$, 13%) and sport injuries ($n = 3$, 7%). In 28 patients (61%), only one level was affected by the injury. Two levels were affected in 14 patients (30%), three levels in 3 patients (7%), and four levels in 1 patient (2%).

Table 1
Clinical and demographic data.

	Number	% of total
Sex		
Male	24	52
Female	22	48
Age		
Mean	43.4 ± 17.3	
Min	19	
Max	60	
Cause of injury		
Falls from a height	29	63
Traffic accidents	8	17
Ordinary falls	6	13
Sport injuries	3	7
Fracture level		
Thoracic	17	25
Thoracolumbar junction	31	45
Lumbar	21	30
Magerl subtypes		
Type A1	38	55
Type A3	31	45
Number of levels		
1	28	61
2	14	30
3	3	7
4	1	2

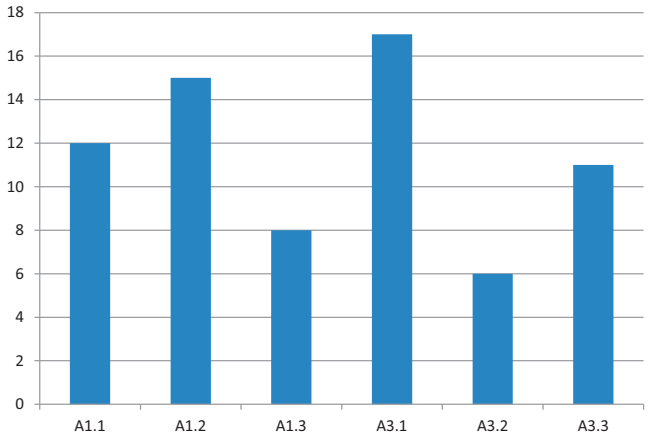

Fig. 1. Distribution of the fracture types according to Magerl.

Table 1 displays the cohort's main data. The distribution of the fracture types according to Magerl is shown in Fig. 1.

The overall inter- and intraobserver variabilities of Oner's classification were assessed with kappa values of 0.60 and 0.77, respectively, delineating good agreement.

4.1. Disc signal and morphology analysis

Distribution of the disc types according to Oner are summarized in Fig. 2. With the exception of three discs graded type 2, suprajacent 1 discs were either normal (type 1) or presenting a depression of the superior vertebral endplate responsible for an increased disc