

# McCORMACK'S CLASSIFICATION AND KYPHOTIC DEFORMITY IN THORACOLUMBAR BURST FRACTURES

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## SUMMARY

The increasing incidence of thoracolumbar kyphosis after conservative treatment of burst fractures is a complication reported by several authors. We performed a retrospective study on a consecutive series of 33 patients with thoracolumbar burst fractures treated with cast or brace immobilization between 1992 and 2004 to check for a correlation between thoracolumbar kyphosis and Load Sharing Classification, which provides fracture severity scores according to body comminution, vertebral body fragments displacement and the amount of kyphosis

correction delivered after treatment. After an average of 30 months of follow-up we found a correlation between Load Sharing Classification scores (also known as McCormack's Classification), and the sagittal kyphotic deformity on these patients ( $p < 0.05$ ;  $r = 0.65$ ). Despite of being described for assessing sagittal deformity after surgical treatment, the applicability of this Classification can be considered for patients with thoracolumbar burst fractures submitted to conservative treatment.

**Keywords:** *Spinal cord injuries; Spinal fractures/therapy; Lumbar vertebrae.*

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## INTRODUCTION

Holdsworth et al.<sup>(1)</sup>, in 1963, classified thoracolumbar fractures based on the two-spine model, divided by posterior longitudinal ligament, also describing the "burst"-type fracture as being an injury secondary to vertebral body rupture following axial load. Denis<sup>(2)</sup>, in 1983, re-defined those fractures using three spines: anterior, medial and posterior spine. The burst fracture showed failure on medial and anterior spine.

There is no consensus about how to treat those fractures, particularly in patients without neurological deficit. In these cases, the risk of sagittal collapse - which is a worsening of the thoracolumbar kyphosis - is one of the complications of conservative treatment. Thus, one advantage of surgical treatment is providing better outcomes concerning post-trauma kyphosis<sup>(3,4)</sup>. The possibility of anticipate a sagittal collapse may, thus, help on establishing a given treatment<sup>(5,6)</sup>.

A number of classifications were developed, such as the one by Denis<sup>(2)</sup> and by Gertzbein<sup>(7,8)</sup> intending to determine the best treatment suggestion<sup>(3,6,9)</sup>, but the McCormack's Classification, known on international literature as Load Sharing Classification, shows that the comminution of the vertebral body, the displacement of fracture fragments and kyphosis correction are elements that influence metal instrumentation failure by sagittal collapse on these fractures<sup>(3)</sup>. Following, Aligizakis et al.<sup>(4,6)</sup> show the applicability of this classification for predicting post-trauma kyphosis and the functional outcome of patients with these fractures submitted to conservative treatments.

This study intended to assess the correlation between McCormack's Classification and vertebral collapse at sagittal plane in patients with thoracolumbar "burst" fractures treated conservatively with the use of plastered casts or TLSO orthosis in hyperextension.

## MATERIALS AND METHODS

A retrospective study was conducted by assessing medical files of the Filing Service of the Department of Orthopaedics, Medical College, Santa Casa de São Paulo (SAME-SCSP) of a period comprehending 1992 and 2004 after approval by the Committee of Ethics in Research on Human Beings of our Institution. A total of 33 patients with thoracolumbar burst fracture from T10 to L2 were treated with plastered cast or TLSO orthosis in hyperextension with a minimum follow-up time of six months. X-ray images - at anteroposterior and lateral planes - and computed axial tomography (CAT) - axial and sagittal planes - were reviewed. Neurological deficit was assessed based on Frankel's scale<sup>(10)</sup>. Most of the reduction was made by traction and hyperextension of the thoracolumbar region with support fulcrum on the orthopaedic traction table in cases submitted to cast immobilization. Individuals with untreated fractures for more than 10 days after trauma, pathologic bone fractures or subjects with incomplete documentation were excluded from the study.

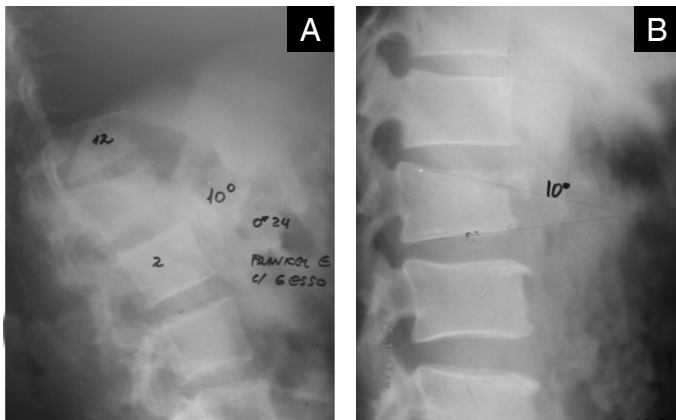
We assessed the scoring by McCormack et al.<sup>(3)</sup>. (*Load Sharing Classification*), according to X-ray and CAT findings by the time of admission in hospital, which evaluates: - the amount of vertebral comminution at sagittal plane; - the shift position of fracture fragments at tomography axial plane (Figures 1 and 2); L; the amount of deformity correction in hyperextension by Cobb's method<sup>(11)</sup> (Table 1).

The outcomes were assessed by SPSS (Statistical Package for Social Sciences) software, version 13.0. We applied the Pearson's Correlation in order to correlate the Load Sharing score with the kyphosis worsening (sagittal collapse) angle value. We adopted a significance level of 5% (0.050).

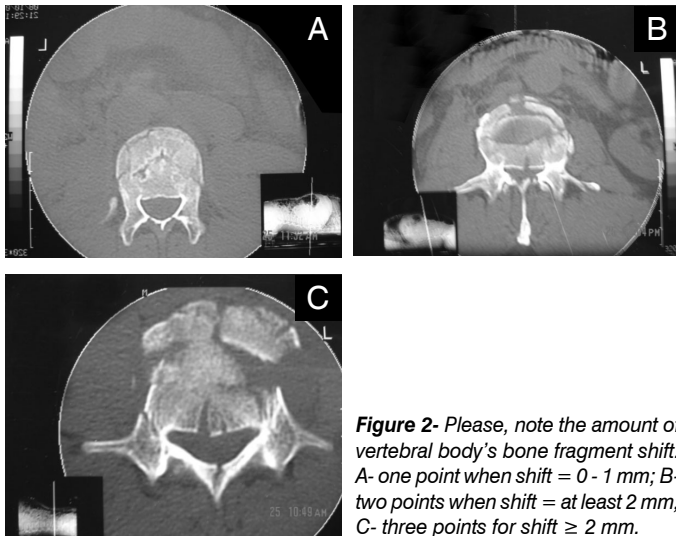
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**Figure 1-** Load Sharing scores concerning fracture comminution: A- (one point) 30% of vertebral body; B- (two points) 30% - 60% of vertebral body, and; C- (three points) when > 60% of vertebral body.



**Figure 2-** Please, note the amount of vertebral body's bone fragment shift: A- one point when shift = 0 - 1 mm; B- two points when shift = at least 2 mm; C- three points for shift ≥ 2 mm.

Score	1 point	2 points	3 points
Sagittal collapse	30%	>30%	60%
Shift	1mm	2mm	>2mm
Correction	3 degrees	9 degrees	10 degrees
Total	3 points	6 points	9 points

**Table 1-** McCormack's classification ( Load Sharing).

## RESULTS

The mechanisms of trauma found in the study were the following: car accident (64%) and high falls (36%). T10 vertebra was injured in two patients (6%), T11, in two (6%), T12, in five (15%), L1, in 16 (49%) and, L2, in eight (24%). With a

prevalence of male patients (22 patients), the average age was 43.6 years, ranging from 12 to 65 years. Follow-up time ranged from 6 to 168 months, in an average of 30 months. All patients were neurologically intact at the moment of hospitalization.

The average Load Sharing score value was five points, ranging from three to six points. Sagittal collapse (worsening of the Cobb's angle) ranged from one to 13 degrees, with average of five degrees (Table 2).

Patient	Gender	Fracture Level	Age	Score	Follow-up	Kyphosis loss (in degrees) in the end
1	F	L1	30	5	6	9
2	M	L2	56	5	13	3
3	F	L1	43	5	12	6
4	M	L1	32	5	46	3
5	M	T12	44	3	10	3
6	M	T12	46	4	18	5
7	M	L2	24	3	12	2
8	F	L1	35	3	24	1
9	F	L2	49	5	132	6
10	M	L2	62	5	78	3
11	M	L1	56	3	27	2
12	M	L2	19	3	10	4
13	M	L2	44	4	60	5
14	M	L1	37	5	22	3
15	M	L1	50	6	8	13
16	M	L1	12	6	60	5
17	F	T12	52	4	10	3
18	F	T12	58	6	24	6
19	M	L1	42	5	6	6
20	F	L1	52	5	18	7
21	M	L1	31	6	17	11
22	F	L1	62	5	36	6
23	M	T10	53	6	6	6
24	M	L1	52	4	8	2
25	M	L1	42	6	7	7
26	M	T11	65	5	32	13
27	F	T11	30	3	13	1
28	F	T10	53	6	26	4
29	M	L2	52	3	27	2
30	M	L2	26	3	7	3
31	F	T12	42	5	34	4
32	M	L1	50	3	12	2
33	M	L1	38	6	168	8

SOURCE: SAME- SANTA CASA DE SP.

**Table 2-** Load Sharing scores for individuals with thoracolumbar burst fractures treated at ISCMSP between 1992 and 2004.

We found a significant correlation between Load Sharing score and vertebral collapse. As the correlation coefficient signal is positive (Table 3), we can infer that the higher the score, the higher the vertebral collapse value at the end of follow-up.

Variable	Statistics	Load Sharing
Sagittal collapse	r	0.652
	p	< 0.001
	n	33

SOURCE: SAME- SANTA CASA DE SP.

**Table 3-** Correlation between sagittal collapse (kyphosis worsening) and Load Sharing score in individuals with thoracolumbar burst fractures treated at ISCMSP between 1992 and 2004.

## DISCUSSION

The distribution of these fractures predominantly at L1 and L2 is similar to reports found in other studies. McCormack et al.<sup>(3)</sup>, in 1994, in a study with 28 individuals with thoracolumbar burst fractures, indicated that the vertebra most frequently involved was L1 (40%). In 1993, Mumford et al.<sup>(12)</sup> found this kind of fracture especially at T12 (15%), L1 (30%) and L2

(15%). Weinstein et al.<sup>(13)</sup>, in 1987, assessed 42 fractures conservatively treated, where 64% were found between T12 and L2. In our study, T10 was involved in two cases (6%), T11, in two (6%), T12 in five (15%), L1 in 16 (49%) and L2 in eight cases (24%).

The prevalence of these fractures in male subjects was expected, since men are most commonly involved in accidents<sup>(3,6,12)</sup>, particularly car accident, which was the major cause of fractures in our study. Mumford et al.<sup>(12)</sup>, in 1993, described a men/women ratio of 2:1. The mean age in our study was 43.6 years, ranging from 12 to 65 years. For comparison purposes, Mumford et al.<sup>(12)</sup>, in 1993, reported a mean age of 38.5 years, ranging from 15 to 60 years, while in the case series by Weinstein et al.<sup>(13)</sup>, in 1987, the mean age was 43 years, ranging from 28 to 70 years.

In long-bones fractures osteosynthesis, load sharing between implant and host bone is a basic principle seen in any internal fixation, allowing for bone union and avoiding implant failure<sup>(3,8)</sup>. When treating long-bones fractures with cast apparatus, the apposition of bones, the comminution degree, and the deformity on the fracture interfere on load sharing passing through fracture site. The Load Sharing Scale uses that very principle in thoracolumbar fractures<sup>(3)</sup>.

Many authors assessed the applicability of the Load Sharing scale in patients submitted to surgical treatment of thoracolumbar fractures aiming to determine the extension and access port of the arthrodesis area<sup>(4)</sup>. In our study, we assessed the usefulness of this scale in the conservative treatment for these fractures. These data can influence the selection of a given therapy for these patients, since kyphosis is an undesirable complication after plastered cast or orthosis in hyperextension<sup>(3,4)</sup>.

McCormack et al.<sup>(3)</sup>, in 1994, developed the Load Sharing classification by assessing 28 patients with thoracolumbar burst fractures surgically treated. For these authors, this classification system can predict failures on implant materials for these fractures after posterior arthrodesis. Similarly,

our study shows the correlation between the Load Sharing scale with sagittal vertebral collapse in cases submitted to conservative treatment.

Hadjipavlou et al.<sup>(6)</sup> in 2002, reported functional outcomes of 100 patients with thoracolumbar fractures conservatively treated. These authors show excellent results in cases with Load Sharing scores of three to four points. Patients with five or six points, in turn, present with pain and difficulties to return to professional activities.

Jeffrey et al.<sup>(5)</sup>, in 2000, assessed the applicability of the Load Sharing classification in the selection of anterior or posterior port in 51 patients with thoracolumbar fractures surgically treated, and demonstrated that thoracolumbar fractures scored with up to 6 points were appropriately treated from a posterior port, while the cases with seven or more points evolved satisfactorily after anterior and posterior approach. That finding may be explained by a more significant instability inherent of highly scored fractures. In our study, we evidenced a positive correlation of vertebral collapse with Load Sharing scores. This finding suggest that, in highly scored cases, a greater comminution of the vertebral body and the distance between fracture fragments change the property of vertebral load transport thereby occurring a greater sagittal thoracolumbar collapse. Furthermore, the correction of kyphotic deformity in hyperextension determines failure on the anterior region of the vertebra, favoring vertebral collapse.

The lack of dynamic evaluation of images, of the posterior capsuloligamentar injury severity, and of the presence of neurological deficit are some limitations of this classification. Additionally, the correlation between post-trauma kyphosis and function in these patients is widely discussed in literature<sup>(12)</sup>. However, the high reproducibility among independent investigators and the usefulness for assessing a correlation between increased thoracolumbar kyphosis and severity of skeletal injuries assessed by this classification can justify its applicability after selecting a conservative treatment for these patients<sup>(6,14)</sup>.

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