THORACOLUMBAR BURST FRACTURE: STRUCTURAL CHANGES AND CLINICAL OUTCOME OF TREATMENT

FRATURA TORACOLOMBAR TIPO EXPLOSÃO: ALTERAÇÕES ESTRUTURAIS E RESULTADO CLÍNICO DO TRATAMENTO

FRACTURA TORACOLUMBAR TIPO EXPLOSIÓN: CAMBIOS ESTRUCTURALES Y RESULTADOS CLÍNICO DEL TRATAMIENTO

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ABSTRACT

Objective: To evaluate the correlation between structural changes in burst fractures of thoracic and lumbar spine with clinical outcome of the treatment. Methods: A retrospective study in 25 patients with fractures of thoracic and lumbar spine burst fractures without neurological deficit. Eleven patients underwent conservative treatment and for the remaining the treatment was surgical. All patients were followed up for at least 24 months. The cases were evaluated by a protocol that included: posttraumatic measurement of kyphosis, vertebral body collapse and narrowing of the spinal canal, the visual analog scale of pain, and the quality of life questionnaire SF-36 at the follow-up. For statistical analysis, the significance level was 5% and the software SPSS 18.0 was used. Results: No statistically significant difference was observed when comparing the clinical outcomes of one treatment over another. Similarly, there was no statistically significant correlation between kyphosis and post-traumatic narrowing of the spinal canal with clinical worsening in the follow-up, regardless of the treatment used. We found a positive correlation ($p<0.05$) between initial collapse and SF-36 domains in both groups (operated and non-operated). Conclusion: There was no significant superiority of one treatment over the other, and no correlation was found between kyphosis and spinal canal narrowing in burst fractures of the thoracic and lumbar spine without neurological deficit. However, there was correlation between initial collapse and clinical outcome in some domains of the SF-36 questionnaire.

Keywords: Spinal injuries; Spinal fractures; Spine; Quality of life; Kyphosis; Spinal stenosis; Spinal canal.

RESUMO

Objetivo: Avaliar a correlação entre as alterações estruturais das fraturas da coluna torácica e lombar tipo explosão com o resultado clínico do tratamento. Métodos: Foi realizado estudo retrospectivo em 25 pacientes, com fraturas da coluna torácica ou lombar tipo explosão sem déficit neurológico. Onze pacientes foram submetidos ao tratamento conservador e, nos demais, o tratamento foi cirúrgico. Todos os pacientes foram acompanhados por, no mínimo, 24 meses. Os casos foram avaliados por um protocolo que incluiu: aferição pós-traumática da cifose, colapso do corpo vertebral e estreitamento do canal vertebral e escala visual analógica de dor e questionário de qualidade de vida SF-36 no seguimento. Para a análise estatística dos resultados foi considerado nível de significância de 5% e utilizou-se o programa PASW 18.0. Resultados: Não foi evidenciada diferença estatisticamente significativa ao comparar os resultados clínicos de um tratamento sobre outro. Da mesma forma, não houve correlação estatisticamente significativa entre cifose e estreitamento pós-traumático do canal vertebral com piora clínica no seguimento, independentemente do tipo de tratamento adotado. Encontramos correlação positiva ($p < 0,05$), entre colapso inicial e domínios do SF36 em ambos os grupos (operados e não operados). Conclusão: Não foi evidenciada superioridade de um tratamento sobre o outro, assim como não foi encontrada correlação entre cifose e estreitamento do canal vertebral nas fraturas da coluna torácica e lombar tipo explosão sem déficit neurológico. Porém, verificou-se correlação entre colapso inicial e desfecho clínico em alguns domínios do questionário SF36.

Descritores: Traumatismos da coluna vertebral; Fraturas da coluna vertebral; Coluna vertebral, Qualidade de vida; Cifose; Estenose espinal; Canal vertebral.

RESUMEN

Objetivo: Evaluar la correlación entre los cambios estructurales en las fracturas de la columna vertebral torácica y lumbar del tipo explosión con el resultado clínico del tratamiento. Métodos: Estudio retrospectivo de 25 pacientes con fracturas de la columna vertebral lumbar o torácica de tipo explosión y sin déficit neurológico. Once pacientes fueron sometidos a tratamiento conservador y en los demás, el tratamiento fue quirúrgico. Todos los pacientes tuvieron seguimiento mínimo de 24 meses. Los casos fueron evaluados por un protocolo que incluyó: evaluación de la cifosis postraumática, colapso del cuerpo vertebral y el estrechamiento del canal espinal y la escala analógica visual de dolor y el cuestionario SF-36 durante el seguimiento. Para el análisis estadístico, se consideró el nivel de significación del 5% y se utilizó el programa PASW 18.0. Resultados: No se observaron diferencias estadísticamente significativas al comparar los resultados clínicos de un tratamiento sobre otro. También no hubo correlación estadísticamente significativa entre la cifosis y estrechamiento postraumático de canal espinal con empeoramiento clínico en el seguimiento, sin importar el tratamiento utilizado. Se encontró una correlación positiva ($p < 0,05$) entre el colapso inicial y dominios SF36 en ambos grupos (operados y no operados). Conclusión: No hubo superioridad significativa de un tratamiento sobre el otro y no se encontró correlación entre la cifosis y estrechamiento del canal espinal en las fracturas de la columna torácica o lumbar del tipo explosión sin déficit neurológico. Sin embargo, hubo correlación entre el colapso inicial y el resultado clínico en algunos dominios del cuestionario SF36.

Descriptores: Traumatismos vertebrales; Fracturas de la columna vertebral; Columna vertebral; Calidad de vida; Cifosis; Estenosis espinal; Conducto vertebral.

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INTRODUCTION

Burst fractures of the thoracic and lumbar spine usually occur in young individuals of working age. They are the result of high-energy axial compression, which generates anterior-posterior comminution of the entire vertebral body. As a result, retropulsion of bone fragments into the vertebral canal is evidenced.[1]

Various structural changes that occur in the fractured vertebra, such as kyphosis, collapse, and narrowing of the spinal canal, caused by fragments of the vertebral body, have been described in the literature as factors of great importance that interfere in the conduct to be adopted to treat these fractures.[2] The location of the segment of spine in which the fracture occurs, and the presence of lamina fracture, can also interfere in the form of treatment to be carried out.[3]

Although various classifications have been proposed to assist the physician in defining the best therapeutic conduct, these fail to take into consideration the quantification of the abovementioned structural changes that affect the fractured vertebra.

Fractures with associated neurological deficit are indicated for surgery.[4] However, most burst fractures of the thoracic and lumbar spine do not cause changes in neurological function.[5] Therefore, no clear and precise definition is found in the literature, as regards the conduct to be adopted for these fractures, in which the patient presents normal neurological function (FRANKEL E).[6,7] This lack of a clear definition partially explains why, to date, there is still no universally accepted treatment for this type of lesion.[8,9]

In view of the above, this study aims to evaluate the clinical results obtained in the follow-up of patients with burst fractures of the thoracic and lumbar spine type who underwent conservative or surgical treatment, taking into consideration the initial structural changes that occurred in the fractured vertebra.

METHODS

A retrospective study was conducted of 25 patients with burst fractures of the thoracic or lumbar spine, without associated neurological deficit, treated and in follow-up for at least 24 months, by the Spine Group of the Hospital Ortopédico de Passo Fundo (Passo Fundo Orthopedic Hospital) in the state of Rio Grande do Sul (RS). These patients were initially seen by the Emergency Departments of the Hospital do Cidade and Hospital São Vicente de Paulo, in Passo Fundo, RS. The clinical follow-up was conducted at Hospital Ortopédico, Passo Fundo - RS, in the period January 2002 to December 2011.

The authors of this study signed a Term of Commitment to maintain the confidentiality of the data used, and the study only began after the research project had received the approval of the Research Ethics Committee of the University of Passo Fundo (CEP/UPF), under opinion number 242,895.

The classification used to define the fractures as burst-type was proposed by the AO Group.[10]

Of the 25 patients evaluated, 14 underwent surgical treatment (Group 1) and 11 cases underwent conservative treatment (Group 2). It should be emphasized that the previous criterion for adopting surgical treatment, in cases where neurological function was normal, was an angle of kyphosis of more than 30 degrees, collapse of the vertebral body of more than 50%, or narrowing of the spinal canal of more than 50%. Some patients with multiple trauma who underwent surgical treatment, but who did not fit the above criteria, were also surgically treated due to the need for early mobilization, seeking to minimize the risk of thromboembolic events and pulmonary infections. The patients who received surgical treatment were submitted to bone fusion with instrumentation in the vertebrae adjacent to the fracture, while those who received conservative treatment used a Jewett type spinal brace for a period of 16 to 24 months. (Table 1)

All cases had radiographs of the column in the anterior-posterior and profile views, a computed tomography, with axial, sagittal, and coronal sections (bone window). The scans were filed at the Medical Records Department of the Hospital Ortopédico, Passo Fundo - RS. These images were evaluated in order to correctly classify the fractures. We also measured the angle of kyphosis, the percentage of collapse of the vertebral body, and percentage of spinal canal narrowing.[11] (Table 2)

Table 1. Profile of the sample, with 25 patients evaluated.

Patient	Sex	Age: in trauma	Treatment	Follow-up time (months)	Level of the fracture	ASIA	Etiology	AO Class
1	M	50	Surgical	60	T12	E	Fall	A3
2	M	34	Surgical	102	L1	E	Direct trauma	A4
3	M	46	Surgical	108	T8	E	Fall	A3
4	M	52	Surgical	51	L1	E	Fall	A4
5	M	61	Surgical	75	L1	E	Fall	A4
6	M	27	Surgical	68	T12	E	Fall	A3
7	M	39	Surgical procedure	52	L3	E	Fall	A3
8	M	49	Surgical	31	L2	E	Fall	A4
9	M	49	Surgical	52	L1	E	Fall	A4
10	F	56	Surgical	96	L2	E	Traffic Acc.	A4
11	M	41	Surgical	65	L2	E	Fall	A4
12	M	69	Surgical	76	L1	E	Fall	A3
13	M	61	Surgical	96	L3	E	Fall	A4
14	M	36	Surgical	89	L1	E	Fall	A4
15	M	22	Clinical	86	T5	E	Traffic Acc.	A3
16	M	37	Clinical	71	L2	E	Traffic Acc.	A3
17	M	47	Clinical	33	L3	E	Fall	A3
18	F	24	Clinical	39	T12	E	Traffic Acc.	A3
19	M	48	Clinical	26	L1	E	Traffic Acc.	A4
20	F	54	Clinical	27	L1	E	Fall	A3
21	M	61	Clinical	26	T12	E	Fall	A4
22	F	36	Clinical	33	L1	E	Fall	A3
23	M	40	Clinical	48	L2	E	Direct trauma	A3
24	F	62	Clinical	64	L2	E	Fall	A3
25	M	56	Clinical	24	L2	E	Fall	A4

Source: Medical files of the Hospital Ortopédico de Passo Fundo, RS.

Table 2. Acute structural changes in the fractured vertebrae.

Patient	Initial local kyphosis (Degrees)	Initial collapse of the vertebral body (%)	Retropulsion to the vertebral canal (%)
1	34	35.0	30.0
2	16	43.9	42.0
3	35	66.7	15.0
4	2	32.3	35.0
5	13	55.2	67.0
6	26	46.7	20.0
7	-4	5.1	70.0
8	12	40.5	64.0
9	30	60.0	60.0
10	3	53.1	50.0
11	25	40.0	55.0
12	4	50.0	27.0
13	0	56.9	45.0
14	10	54.9	45.0
15	24	40.0	10.0
16	12	31.2	35.0
17	-10	31.4	20.0
18	23	21.9	10.0
19	13	36.8	42.0
20	9	20.0	20.0
21	14	25.3	35.0
22	3	15.9	12.0
23	4	21.7	20.0
24	6	13.8	15.0
25	4	22.0	25.0

Source: Medical files of the Hospital Ortopédico de Passo Fundo,RS.

All patients were evaluated during a minimum 24-month follow--up, using the visual analogue scale (VAS) and the quality of life questionnaire Short Form-36[12] (SF-36). (Table 3)

For the statistical analysis of this study, a level of significance of 0.05 (α=5%) was used, and descriptive levels (p) lower than this value were considered significant and represented by $p < 0.05$. The Mann-Whitney test and Spearman's correlation analysis were also applied. The PASW program, version 18.0, was used for the analysis and to obtain the results.

RESULTS

The results were obtained for: (a) demographic data; (b) relationship between treatment received and clinical outcome; (c) relationship between initial angle of kyphosis and clinical outcome; (d) relationship between initial collapse of the vertebral body and clinical outcome, and (e) relationship between initial narrowing of the vertebral canal and clinical outcome.

Demographic data

Twenty of the patients were male (80%) and 5 were female (20%). In relation to the etiology of the trauma responsible for the fracture, it was found that falling from a height was the cause in 18 cases (72%), traffic accidents in five cases (20%) and direct trauma in only two cases (8%).

Table 3. The visual analogue scale (VAS) and domains of the SF-36 questionnaire in the minimum two-year follow-up.

Patient	VAS	Functional Cap.	Lim. due to physical aspects	Pain	EGS *	Vitality	Social aspects	Lim. due to emotional aspects	Mental health
1	8	70	25	52	42	50	50	33	48
2	6	55	0	30	57	60	63	0	56
3	4	95	25	74	67	70	38	100	52
4	7	30	0	32	52	45	75	0	60
5	5	60	25	10	67	50	50	33	36
6	6	15	0	32	57	50	38	33	56
7	3	30	0	52	77	55	63	0	64
8	7	10	0	10	42	75	38	0	36
9	3	100	25	74	62	75	50	100	52
10	9	45	0	10	70	35	50	0	48
11	10	0	0	0	80	50	63	0	32
12	0	20	75	10	77	60	25	100	60
13	5	60	100	52	62	65	63	100	60
14	4	60	50	10	52	60	50	100	48
15	7	65	0	74	80	55	88	0	56
16	9	70	0	30	62	55	75	0	48
17	4	85	100	84	52	50	50	67	64
18	4	85	25	62	67	60	50	67	56
19	4	45	25	74	72	55	38	0	52
20	8	35	0	10	77	45	50	0	40
21	8	25	25	10	67	65	50	0	52
22	9	55	25	10	72	50	63	0	48
23	4	55	100	62	57	60	63	67	56
24	5	20	0	10	57	25	25	0	48
25	1	65	0	74	77	55	50	0	56

Source: Medical files of the Hospital Ortopédico de Passo Fundo, RS. *general health status

In regard to the spine segment affected, the majority of cases occurred in the thoracolumbar transition (T12-L1), with 13 cases (52%). There were 10 (40%) cases in the lumbar region (L2 to L5), and only two cases (8%) in the thoracic region (T1 to T11).

In terms of recommended treatment, of the 25 patients studied, 14 (56%) were treated surgically and 11 (44%) were treated conservatively. The median age at the time of trauma (percentile 50) was 49 years for the surgically treated patients and 47 years for the patients treated conservatively.

Analysis of the fractures by the AO classification showed that of the operated patients, 35.7% of the cases were type A3 and 64.3% were type A4. In the patients treated conservatively, 72.7% of the injuries were type A3 and 27.3% were type A4.

Relationship between treatment received and clinical outcome.

Based on the evaluation method used, no statistically significant difference ($p<0.05$) was found, in the comparison of clinical results (VAS and Domains of the SF36) obtained in the minimum 24-month follow-up, between the surgically treated patients and those treated conservatively. (Table 4)

Relationship between initial kyphosis and clinical outcome

No statistically significant correlation ($p<0.05$) was found between the initial and VAS kyphosis or domains of the SF-36, both in patients conservatively and in those treated surgically. (Table 5)

Relationship between collapse of the vertebral body and clinical outcome.

There was no statistically significant correlation ($p<0.05$) between initial collapse of the vertebral body and VAS, whether in the patients treated conservatively or those treated surgically.

In patients treated surgically, the correlation between collapse and SF-36 questionnaire was statistically significant only for the domains functional capacity ($p=0.022$), limitations due to physical aspects ($p=0.019$), and limitations due to emotional aspects ($p=0.002$). In the patients treated conservatively, the correlation between vertebral collapse and the SF-36 questionnaire was statistically significant only for the domain pain ($p=0.012$). (Table 5)

Relationship between vertebral canal narrowing and clinical outcome

There was no statistically significant correlation ($p<0.05$) between vertebral canal narrowing and VAS or the domains of the SF-36, either in the patients treated conservatively or in those treated surgically. (Table 5)

DISCUSSION

The treatment of burst fractures of the thoracolumbar spine is a topic of debate and discussion in the literature. The majority of

Table 4. Relationship between VAS and the SF-36 Domains, and the treatment carried out.

Variable	Median		P**
Domains of SF36	Surgical	Conservative	
Functional capacity	50.0	55.0	0.395
Limitation due to physical aspects	12.5	25	0.836
Pain	31	62	0.248
Overall health status	62	67	0.258
Vitality	57.5	55	0.436
Social aspects	50	50	0.648
Limitation due to emotional aspects	33.33	0	0.115
Mental health	52	52	0.867
VAS	5.5	5	0.83

**The correlation is significant when $p<0.05$

Table 5. Relationship between structural changes of the fractured vertebra, and VAS and SF-36 Domains

Variables		Initial kyphosis		Initial collapse		Narrowing of the canal	
SF36 domains	Treatment	Spearman's correlation	P*	Spearman's Correlation	P*	Spearman's Correlation	P*
Functional capacity	Surgical	0.343	0.231	0.606	0.022	-0.111	0.707
	Conservative	-0.050	0.883	0.435	0.181	-0.241	0.475
Limitation due to physical aspects	Surgical	0.019	0.949	0.618	0.019	-0.219	0.452
	Conservative	-0.332	0.319	0.074	0.830	0.045	0.896
Pain	Surgical	0.233	0.422	0.215	0.460	-0.252	0.386
	Conservative	-0.045	0.896	0.725	0.012	0.067	0.845
Overall health status	Surgical	-0.190	0.515	0.135	0.646	0.210	0.470
	Conservative	0.414	0.206	0.183	0.589	-0.112	0.744
Vitality	Surgical	0.201	0.490	0.465	0.094	0.060	0.837
	Conservative	0.473	0.142	0.369	0.264	0.211	0.534
Social aspects	Surgical	-0.414	0.142	-0.398	0.159	0.335	0.242
	Conservative	0.098	0.774	0.258	0.444	-0.262	0.437
Limitation due to emotional aspects	Surgical	0.261	0.366	0.749	0.002	-0.375	0.186
	Conservative	-0.226	0.503	0.000	1.000	-0.295	0.379
Mental health	Surgical	-0.472	0.089	-0.131	0.655	-0.287	0.319
	Conservative	-0.052	0.880	0.504	0.114	-0.165	0.628
VAS	Surgical	0.124	0.673	-0.415	0.140	0.004	0.988
	Conservative	0.143	0.675	-0.178	0.601	-0.450	0.9

*The correlation is significant when $p<0.05$. In bold, evidenced statistically significant values.

patients with this type of fracture do not present neurological deficit or direct criteria of instability, making it difficult to define the therapeutic conduct.[13-15] In general, surgical treatment is proposed for patients with associated neurological damage.[16] However, doubt remains as to the best conduct to be adopted when the patient presents normal neurological function. Should we classify this type of fracture as unstable, in order to justify a surgical indication? We must remember that bone instability alone, after acute trauma, ceases to exist after consolidation of the fracture. The severity of burst fracture without associated neurological deficit could be expressed by comminution of the fractured vertebral body, the presence of lamina fracture, increased kyphosis, and collapse, and narrowing of the spinal canal due to bone fragments from the fracture.[17] But is the presence or extent of the factors mentioned above related to the final outcome of the treatment?

Observational studies in patients with burst fractures of the thoracic and lumbar spine and normal neurological function have not shown any differences in the functional results in the long term, independently of whether they received surgical or conservative treatment.[18-20] The authors that defend surgical treatment do so based on the good results obtained, shorter hospitalization times, early mobility, better correction of kyphosis, and the possibility of direct decompression of the vertebral canal, which would prevent possible subsequent neurological deterioration.[21-24]

In a prospective, randomized study, Wood et al.,[25] compared the results of surgical treatment and conservative treatment in 47 patients with thoracolumbar burst fractures (24 treated surgically and 23 with a brace or plaster cast). Radiographic analysis showed similar results in relation to the kyphosis (mean of 10.1º on admission and residual of 13º), narrowing of the spinal canal (mean of 39% on admission and residual of 22%), in both operated and non-operated patients. The final scores in the SF-36 and Oswestry questionnaires were similar for both groups, although there was a certain trend in favor those treated conservatively. Complications were more frequent in the group treated surgically. In another study of the meta-analysis type, Sonali et al.,[26] assessed four clinical trials on the treatment of thoracolumbar burst fractures, with a total of 79 patients (41 with surgical treatment and 38 with conservative treatment). The mean follow-up ranged from 24 to 118 months. Differences were found between the groups in terms of the improvement in kyphosis in the group treated with surgery. However, the surgical treatment did not show any superiority in relation to pain or the rate of return to work. They therefore concluded that surgical treatment of thoracolumbar burst fractures without neurological deficit can improve the residual kyphosis, but does not improve the pain, and is associated with higher rates of complications and costs. Yi et al.,[27] in another meta-analysis, found similar results. Avanzi et al.,[28] in a retrospective analysis, also evaluated the correlation between narrowing of the vertebral canal and clinical outcome in patients with thoracolumbar burst fractures without neurological deficit who underwent conservative treatment only. In their review of the SF-36, they also found no correlation between narrowing of the vertebral canal narrowing poorer clinical outcomes. Also in relation to narrowing of the vertebral canal, Munford et al.[29] And De Klerk et al.,[30] observed, in their work on thoracolumbar burst fractures of the spine without associated neurological deficit, remodeling of the spinal canal in the medium and long terms, in patients submitted to conservative treatment. This fact is what leads us to question the possible late neurological deterioration, when surgical decompression of vertebral canal is performed in cases of significant narrowing of the canal. In our study, we also did not find a statistically significant correlation between initial kyphosis and narrowing of the vertebral canal, and clinical outcome, both in patients treated surgically and those treated conservatively, even though our sample selected cases with generally greater kyphosis and narrowing of the vertebral canal, to undergo surgery.

This study also evaluated the relationship between vertebral collapse and clinical outcome obtained in the follow-up (VAS and SF-36), both in patients treated conservatively and in those treated surgically. A positive correlation was found in the group that underwent surgery, in some areas of the SF-36 (functional capacity, limitation due to physical aspects, and limitation due to emotional aspects) and, in the group treated conservatively, in the domain pain. In these areas, we found values of $p<0.05$ and a positive Spearman's coefficient of correlation, i.e. patients with a higher percentage of initial collapse presented better clinical outcomes in some domains of the SF-36. Our hypothesis for this apparently paradoxical result is that patients with higher values for initial collapse benefit from surgical treatment, perhaps because it minimizes the effects of possible discopathies caused by the high-energy axial trauma, lesions that are difficult to diagnose on admission. However, there was no similar outcome when correlating VAS and collapse of the vertebral body. (Table 5) There is a lack of studies, in the current literature, evaluating collapse of the vertebral body and its correlation with the clinical outcome.

Therefore, although our results are consistent with the literature, in the majority of the findings, the fact that we found a weak correlation between collapse of the vertebral body and clinical outcome indicates a need for further studies correlating vertebral collapse are needed, in order to clarify the factors related to the collapse (such as disc and interfacet injuries), which could influence the clinical results obtained in the follow-up.

With respect to the standardization of treatment conduct for this type of lesion, we suggest that more prospective studies be conducted, with bigger samples, and with a selection protocol that allows the inclusion of patients with injuries that are more alike. Until that happens, the concerns of the spine surgeon faced with this problem will remain, requiring good sense and individualized treatment for each case, when indicating treatment.

CONCLUSION

Regardless of the type of treatment adopted, patients with burst fractures of the thoracic or lumbar spine without associated neurological deficit presented similar clinical results in the follow-up, in both the SF36 and VAS questionnaires.

Neither were any significant correlations with clinical outcome found in relation to acute kyphosis and narrowing of the vertebral canal.

Initial collapse of vertebral body showed a statistically significant correlation with clinical outcome in only some domains of the SF36. The same correlation was not evidenced with the VAS. We note that there is a need for more studies, with a larger number of cases, to determine the real influence of initial vertebral collapse on clinical outcome, regardless of the treatment indicated.

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