

# CONSERVATIVE TREATMENT FOR THORACOLUMBAR SPINE BURST FRACTURES

TRATAMENTO CONSERVADOR PARA AS FRATURAS TIPO EXPLOSÃO DA COLUNA TORACOLUMBAR

TRATAMIENTO CONSERVADOR PARA FRACTURAS TIPO ESTALLIDO DE LA COLUMNA TORACOLUMBAR

BARAJAS VANEGAS RAYMUNDO<sup>1</sup>, BARAJAS MOTA RAYMUNDO<sup>2</sup>, VILLEGAS DOMÍNGUEZ JOSUÉ ELI<sup>3</sup>, HERNÁNDEZ ÁLVAREZ MARÍA BETTEN<sup>4</sup>

1. Advanced Specialty Medical Unit "Dr. Victorio de la Fuente Narváez" IMSS, Mexico, Distrito Federal.

2. Advanced Specialty Medical Unit, Hospital de Gineco Obstetricia "Dr. Luis Castelazo Ayala" IMSS, Delegación Álvaro Obregón, Mexico, Distrito Federal.

3. Family Medicine Unit, Veracruz, Veracruz Norte, Mexico.

4. Advanced Specialty Medical Unit "Dr. Victorio de la Fuente Narváez" IMSS, Mexico, Distrito Federal.

## ABSTRACT

**Objective:** To identify the category of evidence and the strength of recommendation for the conservative treatment of thoracolumbar spine burst fractures. **Method:** A systematic review was conducted from April 2014 to June 2015, selecting articles according to their prospective design, related to thoracolumbar spine burst fractures and their treatment. These studies were published in the electronic bibliographic databases from January 2009 to January 2015. **Results:** A total of 9,504 articles were found in a free search, of which 7 met the selection criteria and were included for analysis in a study of a total of 435 patients, of whom 72 underwent surgical treatment and 363 received some type of conservative treatment, showing predominantly level of evidence "1b", with strength of recommendation type "A". **Conclusions:** According to the evidence obtained, the conservative treatment is a choice for patients with stable burst fracture in a single level of thoracolumbar spine and with no neurological injury.

**Keywords:** Spinal fractures; Lumbar vertebrae; Thoracic vertebrae; Kyphosis.

## RESUMO

**Objetivo:** Identificar a categoria da evidência e a força de recomendação do tratamento conservador de fraturas tipo explosão da coluna toracolombar. **Método:** Realizou-se uma revisão sistemática de abril de 2014 a junho de 2015, selecionando artigos de acordo com seu formato prospectivo, relacionados com fraturas tipo explosão da coluna toracolombar e seu tratamento. Esses estudos foram publicados nos bancos de dados bibliográficos eletrônicos no período de janeiro de 2009 a janeiro de 2015. **Resultados:** Foi encontrado um total de 9,504 artigos em pesquisa livre, dos quais 7 satisfizeram os critérios de seleção e foram incluídos para análise, num estudo de um total de 435 pacientes, dos quais 72 receberam tratamento cirúrgico e 363 receberam algum tipo de tratamento conservador, mostrando predominantemente nível de evidência "1b", com força de recomendação tipo "A". **Conclusões:** De acordo com a evidência obtida, o tratamento conservador é uma escolha de tratamento para os pacientes com fratura tipo explosão estável em um único nível da coluna toracolombar e sem lesão neurológica.

**Descritores:** Fraturas da coluna vertebral; Vértebras lombares; Vértebras torácicas; Cifose.

## RESUMEN

**Objetivo:** Identificar la categoría de la evidencia y la fuerza de recomendación del tratamiento conservador de las fracturas tipo estallido de la columna toracolombar. **Método:** Se realizó una revisión sistemática de abril de 2014 a junio de 2015, seleccionando artículos según su diseño prospectivo, relacionados con las fracturas tipo estallido de la columna toracolombar y su tratamiento. Estos estudios fueron publicados en las bases de datos electrónicas desde enero 2009 hasta enero 2015. **Resultados:** Se encontró un total de 9,504 artículos en búsqueda libre, de los cuales 7 cumplieron con los criterios de selección y se incluyeron para análisis en un estudio de 435 pacientes, de los cuales 72 recibieron tratamiento quirúrgico y 363 recibieron algún tipo de tratamiento conservador, mostrando predominantemente nivel de evidencia "1b" con fuerza de recomendación tipo "A". **Conclusiones:** De acuerdo a la evidencia obtenida, el tratamiento conservador es una opción de manejo para los pacientes con fractura tipo estallido estable en un solo nivel de la columna toracolombar y sin lesión neurológica.

**Descriptores:** Fracturas de la columna vertebral; Vértebras lumbares; Vértebras torácicas; Cifosis.

## INTRODUCTION

The vertebral fracture is an injury that compromises any part of the vertebra from the vertebral body to the functional spinal unit.<sup>1,2</sup>

In Mexico, the most affected vertebrae are those found between T11 and L1 (in 52% of cases), 45% of which are secondary to burst type lesions caused mainly by falls (in 50.5%).<sup>1, 3-5</sup>

Study conducted at the Instituto Mexicano del Seguro Social, Advanced Specialty Medical Unit in Traumatology, Orthopedics, and Rehabilitation "Dr. Victorio de La Fuente Narváez" Mexico, Distrito Federal. Correspondence: UMAE "Dr. Victorio de la Fuente Narváez" IMSS, Av. Eje Fortuna S/N, Esq. Instituto Politécnico Nacional, Col. Magdalena De Las Salinas, Delegación Gustavo A. Madero. 07760, México, D.F. raybarvan@gmail.com

The diagnosis and classification of fractures of the thoracolumbar spine are conducted just as for other pathologies, starting with a medical history focused on the symptomatology of the patient, identifying the existence of limitations on passive and active mobility, the appearance of abnormal voids between the spinous processes that indicate the suspicion of a fracture, and continuing with the neurological examination, in which the motor and sensory responses and the reflexes are evaluated. Subsequently, the presumptive diagnosis can be supported by imaging studies.<sup>1,3,6</sup> The combination of simple radiographs, computed tomography (CT), magnetic resonance imaging (MRI), and myelography allow the identification of bone, ligament, and nerve lesions. The information obtained from these studies will make it possible to classify the type of osteoarticular injury and identify unstable injuries, as well as to support a therapeutic decision and the appropriate planning for stabilization of the bone elements, depending on the case.<sup>1,3,6,7</sup>

Over time several spine fracture classification systems have been developed, dating from 1929 up to the most recent one established by the AO System, based on morphopathological criteria according to the mechanism of injury and the degree of instability and establishing prognostic considerations in relation to recovery potential.<sup>3, 5, 7-11</sup>

In addition to the AO classification for thoracolumbar spine fractures, two scoring scales are used to determine the degree of severity of the thoracolumbar injury and to make decisions about how to handle it: the first, presented by Vaccaro et al. in 2005, the Thoracolumbar Injury Severity Score (TLISS), and the second, presented in 2013 by the collaborators of AOSpine, the Thoracolumbar AOSpine Injury Score (TL AOSIS). In both scales, conservative management is ruled out for scores greater than 5 points.<sup>3, 5, 7-10</sup>

Burst fractures of the thoracolumbar spine have an incidence of neurological deficit of up to 14% and are present to a great extent in the daily routine of the Orthopedic and Traumatology Services.<sup>12-15</sup> At present, there are two viable treatment options for this pathology: conservative treatment and surgical management, but there is still a lack of information in the Clinical Practice Guides to help us choose between the two management options. This generates controversy within the medical team responsible for the cases, which most often opts for surgical handling, discarding the benefits of conservative management, which is less expensive, reduces comorbidities, and offers good expectations for patient function. However, the recommendations for it differ depending on the current medical context.

For this reason, the objective of this study was to conduct a systematic review of the world literature to enable identification of the level of evidence and the grade of recommendation in the conservative treatment of burst type fractures of the thoracolumbar spine, which will instill confidence in the orthopedic physician for the choice of management.

**METHODS**

A systematic review of the literature published between April 2014 and June 2015 was conducted, according to the orientation and guidelines of the Cochrane Group Method. Two researchers performed an electronic bibliographical search of MEDLINE, OVID, and the Cochrane library for articles published between January 2009 and January 2015. Following the search for articles, the required data were recorded on evaluation forms and each article was evaluated by two collaborators, who reviewed the title and abstract, respectively. Then each collaborator selected those articles that met the selection criteria, the full texts of which were subsequently reviewed. The results obtained were analyzed by means of SPSS Statistics19 software, generating the kappa coefficient for the interpretation of the articles between the two experts. The development of this study considered the required ethical aspects, was based on the recommendation of the Declaration of Helsinki (Seoul 2008) and complies with the regulations for research material. It was presented to, authorized and registered by the Institutional Review Board, which assigned SIRELCIS Registration Number R-2015-3401-4, and informed consent was obtained in verbal form. (Tables 1-5)

**Table 1.** Selection criteria.

Inclusion criteria	Non inclusion Criteria	Exclusion Criteria
Articles related to thoracolumbar spine burst fractures.		
Articles related to the conservative treatment of burst type fractures of the thoracolumbar spine.	Articles that could not be accessed.	Articles published in languages other than English or Spanish.
Articles related to conservative treatment versus surgical treatment of burst type fractures of the thoracolumbar spine.	Articles in non medical magazines.	Articles that do not comply with international bioethics rules.
Articles related to conservative treatment versus surgical treatment for burst type fractures of the thoracolumbar spine, with respect to recovery time, persistence, and/or recurrence of the symptomatology, number of days of hospitalization required, and complications from the treatment. Original articles from indexed magazines.	Summarized articles, with no option to obtain the complete version.	Articles with insufficient description or inadequate methodology.
Articles published from January 2009 through January 2015.	Unindexed magazine articles.	
Articles published in English or Spanish.		
Articles related to the handling of burst fractures of the thoracolumbar spine selected according to their design, i.e., the clinical trials, the pre-experiment studies, prospective cohort studies.		

**Table 2.** Keywords used in this study to search for selectable articles.

Code	Keyword
#1	Burst fracture
#2	Thoracolumbar treatment
#3	Thoracolumbar conservative
#4	Thoracolumbar rehab
#5	Thoracolumbar surgery treatment
#6	Burst fracture Indications
#7	Burst fracture Treatment
#8	Burst fracture and Thoracolumbar treatment
#9	Burst fracture and Thoracolumbar conservative
#10	Burst fracture and Thoracolumbar surgery treatment
#11	Burst fracture or Thoracolumbar treatment or Thoracolumbar conservative or Thoracolumbar rehab or Thoracolumbar surgery treatment

**RESULTS**

A total of 9,504 articles were located in the general bibliographical search of the data bases indicated. Once the study selection criteria were applied, this number was reduced to 3,131, fifteen of which were selected in the short review. Eight of these were rejected during the evaluation of the complete text, dropping the number of articles to be evaluated in the final selection to seven, six of which were from PubMed and one from OVID. Together, these seven articles evaluated in the final selection reviewed a total of 435 patients, 72 of whom were managed surgically and 363 of whom received some type of conservative treatment.

**Table 3.** Study variables.

Study Variables	
Independent variable	Dependent variable
Treatment	Effectiveness Number of days in the hospital Recovery time Recurrence of symptomatology Complications from the treatment Time since the beginning of treatment

In the results of the classification by each one of the reviewers, in terms of the categories of grade of recommendation and level of evidence, there was a predominance of articles categorized with a grade of recommendation of A with a total of six articles (85.7%) and a level of evidence of 1b with a total of six articles (85.7%).

The concordance value obtained by the Kappa method was 1.0 with a p-value of 0.0005, indicating good interobserver consistency.

Of the articles reviewed in the final selection, 14.2% indicated that conservative treatment is equally as effective as surgical treatment for burst fractures of the thoracolumbar spine without neurological damage in the medium term (2 years) and the long term (20 years). This was derived from a study of 47 patients with burst fractures located between T10 and L2, 24 of whom received surgical treatment and 23 of whom received conservative treatment.

Another 14.2% of the articles indicated that minimally invasive treatment is more effective than either conservative treatment or traditional surgical treatment when the three study groups were compared the first group with 30 patients who underwent conservative treatment, the second with 25 patients who underwent minimally invasive surgery, and the third group made up of 23 patients who underwent traditional surgical treatment, showing a statistically significant difference for number of days in the hospital and for the number of patients who

**Table 4.** Characteristics and results from the articles.

Author/ year	Design	Effectiveness of Tx	Number of days in the hospital	Recovery	Recurrence of symptomatology	Complications from the treatment	Time since the start of Tx
Bailey C, Urquart J, et al. 2014	Multicenter blind clinical trial  GR: A LE: 1b	- Conservative Tx with orthosis (TLSO) and conservative Tx without orthosis, equally reliable and effective at 3 months follow up	- 2.5 days for patients with conservative Tx based on orthosis. - 2.6 days for patients with conservative Tx without orthosis	No data	No data	- Radicular pain - Back pain (lumbar) - Need for surgical stabilization for pain - Need for osteotomy in one patient with severe kyphosis	No data
Kumar A, Aujla R, Lee C, et al. 2015	Prospective cohort  GR: B LE: 2b	- Minimally invasive surgery is more effective than open surgical treatment and conservative treatment	- Conservative treatment: 36 (10–104) days - Open surgical treatment: 4 (2–7) days - Minimally invasive surgery: 2 (1–4) days - Value of p<0.05, for any surgical vs. conservative Tx - Value of p<0.05, open surgical Tx vs. minimally invasive	- Time to return to work (months): *Conservative Tx 9 (3–24 months) *Open surgical Tx 4 (0.5-9 months) *Minimally invasive surgery 2 (0.1-6 months)	No data	- Conservative treatment: Posterior correction of kyphosis via surgical approach - Surgical treatment: None	No data
Shamji M, Roffey D, et al. 2014	Randomized blind clinical trial  GR: A LE: 1b	- Conservative Tx with orthosis (TLSO) and conservative Tx without orthosis, showed no difference in the functional results, after 6 months of follow up.	- The TLSO group had 6.3 (+- 2.1) days of hospitalization. - Patients without orthosis had 2.8 (+- 3) days of hospitalization	No data	No data	- Of the patients who received TLSO, 2 needed to be transferred to the rehabilitation service 48 hours after the beginning of treatment. - None of the patients who received treatment without orthosis had to be transferred to the rehabilitation service after the beginning of treatment. - No patient required surgical treatment. - No neurological damage was reported. - There were no hospital complications.	No data

Abbreviations: Treatment (Tx), Strength of Recommendation (FR), Level of Evidence. (NE), Orthopedic Brace Thoracolumbosacral (TLSO).

returned to their normal activities in the minimally invasive surgery group ( $p < 0.05$ ).

Another 57.1% of the articles reviewed evaluated different modes of conservative treatment, studying a total of 239 patients with burst type fractures between T10 and L3, divided into two groups, the first consisting of 116 patients with conservative treatment with orthosis and the second made up of 123 patients with conservative treatment

without orthosis. They concluded that the results were similar between the patients who used orthosis and those who did not.

Finally, for the remaining 14.2% of the articles reviewed, an analysis of the factors associated with non optimal results from conservative management with and without orthosis was conducted for 71 patients, which determined that kyphosis greater than  $25^\circ$  was associated with sub optimal outcomes ( $p < 0.05$ ). (Tables 4 and 5)

**Table 5.** Characteristics and results from the reviewed articles.

Author/ year	Design	Effectiveness of Tx	Number of days in the hospital	Recovery	Recurrence of symptomatology	Complications from the treatment	Time since the start of Tx
Bailey C, Fleming J, Gurr K, et al. 2013	Randomized clinical trial  GR: A LE: 1b	- Conservative treatment has poor results in patients with initial kyphosis greater than $25^\circ$ . For this reason, a surgical option should be included for them	No data	No data	No data	- Presence of kyphosis	No data
Wood K, Buttermann G, et al. 2015	Randomized clinical trial  GR: A LE: 1b	- No clinical difference was between conservative treatment and surgical treatment was reported after 4 years of follow up; however, after 20 years of follow up, the patients who received conservative treatment reported less back pain and better function as compared to those who received surgical treatment.	No data	- 74% of the patients who underwent conservative treatment returned to work 6 months after starting treatment.  - 43% of the patients who underwent surgical treatment returned to work 6 months after starting treatment.	No data	- In the patients treated surgically, there were 19 complications during 24 months of follow up (they were not specified).  - Among the patients with conservative treatment, there were 2 complications during 24 months of follow up (they were not specified).  - Long term back pain.  - After 20 years of follow up, evaluations using the Oswestry, Roland-Morris, analog for pain scales showed better conditions in patients who received conservative treatment when compared to those who received surgical Tx ( $p < 0.05$ ).	No data
Stadhouders A, Buskens E, et al. 2009	Randomized clinical trial  GR: A LE: 1b	- Same effectiveness among the different conservative treatments:  1. Just rehabilitation  2. Orthosis  3. Fixation with cast	No data	No data	- Long term pain (3 years) with any type of conservative treatment	No data	From 3 to 5 days
Bailey C, Dvorak M, Aludino A, Rosas- Arellano M, et al. 2011	Multicenter experiment  GR: A LE: 1b	- There were no statistically significant differences between patients who received conservative treatment with orthosis and those who received conservative treatment without orthosis.	- 4.7 days for patients with Tx based on orthosis. - 5 days for patients with conservative Tx without orthosis.	No data	No data	No data	No data

Abbreviations: Treatment (Tx), Strength of Recommendation (FR), Level of Evidence. (NE).

## DISCUSSION

The evidence found shows a disparity in the general results, in that, while there are data that indicate similar results in patients who underwent surgical treatment (24 patients) and conservative treatment (23 patients) for stable burst fractures at a single level of the thoracolumbar spine without neurological damage, another source of evidence generated from a review of 78 patients divided into three groups indicated that minimally invasive surgery produced better patient results as compared to traditional surgical treatment and conservative management. The is also evidence indicating that for conservative treatment the use of orthosis (116 patients) offers no advantages over conservative treatment without orthosis based on rehabilitation (123 patients).

The data collected with respect to complications in patients with thoracolumbar burst fractures indicate that patients who undergo conservative treatment evolve with fewer complications, while other sources report the opposite, stating that the surgical technique has fewer complications. Based on this, we can say that the evidence is not clearly presented because of the existence of disparate results in the published literature, except in the long term follow up (20 years) of patients who underwent conservative treatment, where fewer complications were reported.<sup>16-22</sup>

There is another discrepancy in the recovery time results, whereby patients with conservatively managed burst type fractures at a single level of the thoracolumbar spine without neurological deficit have a greater tendency to return to work following adequate recovery as compared to those treated with conventional surgery, excepting those who were managed surgically via minimally invasive techniques, who resume work activities sooner.

In a comparison of the different types of conservative treatment in the management of burst type fractures of the thoracolumbar spine at a single level and associated with compression fractures at three years of follow up, similar recoveries were observed when assessed using the visual analog pain scale and the Oswestry Disability Index.<sup>17,20,21</sup>

Hospitalization time was between 2 and 17 days for any of the modes of conservative treatment, although in some cases this lasted as long as 104 days, versus 6 to 27 days for conventional surgery and from 1 to 4 days for minimally invasive surgery.<sup>16-18,20,22</sup>

Regarding treatment costs, conservative treatment is 3 to 5 times less expensive than surgical management and even less expensive when orthosis is used.<sup>16,18,20</sup>

Pain is the symptom with the highest recurrence both in patients managed conservatively and surgically. The main complication of conservative treatment was shown to be residual kyphosis, which in several cases merited surgical correction.<sup>16,18,21</sup>

Finally, a study was identified that shows a statistically significant difference with respect to treatment by minimally invasive surgery, showing greater effectiveness when compared to the other techniques. However, the description of the methodology is not clear and does not define the selection criteria.<sup>22</sup> (Tables 4, 5)

## CONCLUSIONS

The level of evidence that prevails in this review is category 1b with a grade of recommendation of type A. The evidence generated in the last 6 years by primary studies and the total number of patients included in study field is limited (435 patients in 7 primary studies). This indicates that the medical community is still debating the handling

of burst fractures of the thoracolumbar spine, a priority motive for conducting analyses of the evidence generates in new prospective studies on the subject in question.

The evidence obtained, with respect to the effectiveness and the percentage of patients who returned to their work activities, is similar in conservative and surgical treatments of stable burst type fractures of a single level of the thoracolumbar spine without neurological damage. Conservative treatment reported fewer long term complications and costs.

According to the evidence obtained, we can lean towards conservative treatment with orthosis as a management option for the stable burst type fracture of a single level of the thoracolumbar spine without neurological damage.

This work indicates the need to perform an analysis of the evidence generated and to conduct randomized clinical trials with a rigorous methodology in order to provide more higher quality information and to enable a better and more adequate decision to be made based on the evidence with the goal of granting the best treatment option for the patient with a burst type fracture of the thoracolumbar spine.

## ACKNOWLEDGEMENTS/IN MEMORIAM

In memory of and in thanks to each one of the people and beings who have accompanied me in each stage of my life, directly or indirectly, from birth until adulthood, passing from my childhood and basic education to the completion of my graduate studies and beyond, who have contributed part of themselves so that this humble servant might fulfill one of his dreams. In this particular, I thank those who offered their time and dedication to achieving what I have commended to the previous pages and especially to my Father and Friend Josué Eli Villegas Domínguez, through whose great participation we succeeded in achieving this dream. I thank my Life Companion for her support and patience and Rayo and Ruthila for their kindness. I give infinite THANKS to my unequalled "PARENTS", Dr. Raymundo Barajas Mota and Mrs. Yolanda Vanegas Aguilera and "MY FAMILY", Fernando Jair-Elizabeth, Taide Patricia-Oscar-Oscar Jr.-Omar, Mónica Yolanda-Jorge-Constanza, and Diana Miriam-Josué, who are undoubtedly absolutely "GREAT HUMAN BEINGS".

In Very Special Memory of and With Great Admiration for my PaPá, Dr. Raymundo Barajas Mota and my MaMá, Yolanda Vanegas Aguilera, who, thanks to their decision to conceive me, raise me, provide for me, and take care of me, gave me the opportunity to know, understand, live, and feel the meaning of PaPá, MaMá, FaMiLy, LoVe, ReSpEcT, EmPaThY, NoBiLiTy, EqUaLiTy, JuStIce, and LiFe...

A Thousand Thanks to Public Education and Mainly to my Alma Máter, La Universidad Nacional Autónoma de México – Facultad de Medicina – Ciudad Universitaria, "The Spirit Shall Speak for my People".

INFINITE THANKS to each and every one of you, who could not be mentioned personally because of space constraints, but who are without doubt included and present in each word of this manuscript.

---

All authors declare no potential conflict of interest related to this article.

---



---

**CONTRIBUTION OF THE AUTHORS:** This study was conducted at a single medical institution, the Instituto Mexicano del Seguro Social, but with researchers and collaborators affiliated with various medical units of said institution. RBV is the author of the work, together with RBM and JEVD, who collaborated and contributed to the research, bibliographical review, analysis, discussion, results, writing, and editing of the manuscript. MBHA contributed to the bibliographical review.

---

## REFERENCES

1. Consejo de Salubridad General. Diagnóstico y principios del tratamiento quirúrgico de las fracturas de vértebras toracolumbares secundarias a un traumatismo, en adulto: evidencias y recomendaciones. México: Secretaría de Salud; 2013.
2. Consejo de Salubridad General. Diagnóstico y principios del tratamiento quirúrgico de las fracturas de vértebras toracolumbares secundarias a un traumatismo, en adulto: Guía de referencia rápida. México: Secretaría de Salud; 2013.
3. Méndez J. Fracturas de raquis dorsal: síntomas, clasificación, mecanismo de producción, exploraciones clínicas y complementarias. Disponible en: <http://ocv.um.es/cc.-de-la-salud/afecciones-medico-quirurgicas-iii/material-de-clase-1/trabajos-alumnos/fracturas-del-raquis-dorsal-completo.pdf> Última modificación: 22/02/2011. Revisión: 05/01/2015.
4. Villareal M. Fracturas toracolumbares postraumáticas (epidemiología e historia). *Ortho*. 2010;6(2):102-7.
5. Usera MA, Escribano JMA, Reyero MAA, Lera PA, Represa JA, Andrés JA, et al. Lesiones traumáticas de La columna vertebral. In: Alle MA, Boto GR. Cirugía Complutense: libro de texto. Madrid: Universidad Complutense de Madrid, Facultad de Medicina; 2015.
6. Kirkpatrick J. Tratamiento de las fracturas toracolumbares: abordaje anterior. *J Am Acad Orthop Surg*. 2003; 2(6):79-87.
7. Camilo JF, Vives AH, Esguerra ME, Alfredo GA, Orjuela M, Jiménez CG. Entendiendo la clasificación de las fracturas toracolumbares por el sistema 'AO'. *Rev Colomb Radiol*. 2014; 25(2):3942-54.
8. Bazán P, Borri A, Torres P, Cosentino J, Games M. Clasificación de las fracturas toracolumbares: comparación entre las clasificaciones de AO y Vaccaro. *Columna/Columna*. 2010;9(2):165-70.
9. Gahr H, Haessler O, Schmidt O. Cifosis y fracturas vertebrales torácicas. *Patología del Aparato Locomotor*. 2006;4(4):236-46.
10. Tejada M. Clasificación de las fracturas toracolumbares. *Ortho-tips*. 2010;6(2):114-21.
11. Escribá U, Escribá R, Gomar S. Fracturas por estallido toracolumbares: pasado, presente y futuro. *Rev Españ Cir Osteoart*. 2006;22(42):122-30.
12. Pérez AL, Álvarez MO, Acosta FC, Cañadas AC, Godoy TN. Fracturas toracolumbares. *Rev Soc Traumatol Ortop*. 2003;23(2):63-73.
13. López C, Mejía J. Conceptos actuales del manejo conservador de las fracturas toracolumbares. *Ortho-tips*. 2010;6(2):122-30.
14. Mesa FR, Hernández PC, López GM, Mateos DP, Mesa MR, et al. Fracturas estallido de columna toracolumbar. *Rev Españ Cir Ost*. 1999;34(199):157-61.
15. Hartman MB, Chrin AM, Rehtine GR. Non-operative treatment of thoracolumbar fractures. *Paraplegia*. 1995; 33:73-6.
16. Bailey CS, Urquhart JC, Dvorak MF, Nadeau M, Boyd MC, Thomas KC, et al. Orthosis versus no orthosis for the treatment of thoracolumbar burst fractures without neurologic injury: a multicenter prospective randomized equivalence trial. *Spine J*. 2014;14(11):2557-64.
17. Kumar A, Aujla R, Lee C. The management of thoracolumbar burst fractures: a prospective study between conservative management, traditional open spinal surgery and minimally interventional spinal surgery. *Springer Plus*. 2015; 4:204-13.
18. Shamji M, Roffey D, Young D, Reindl R, Wai E. A pilot evaluation of the role of bracing in stable thoracolumbar burst fractures without neurological deficit. *J Spinal Disord Tech*. 2014;27(7): 370-5.
19. Bailey C, Fleming J, Nadeau M, Gurr K, Bailey SI. Factors associates with poor outcome following the nonoperative treatment of thoracolumbar burst fractures. *J Can Chir*. 2013; 56(4 Suppl 2):S54-S78.
20. Wood K, Buttermann G, Phukan R, Harrod C, Mehbod A. Operative compared with non-operative treatment of a thoracolumbar burst fracture without neurological deficit. *J Bone Joint Surg Am*. 2015;97(1):3-9.
21. Stadhouders A, Buskens E, Vergroesen D, Fidler M, Öner FC. Nonoperative treatment of thoracic and lumbar spine fractures: a prospective randomized study of different treatment options. *J Orthop Trauma*. 2009;23(8):587-94.
22. Bailey C, Dvorak M, Nadeau M, Aludino A, Rosas-Arellano M, Boyd M, et al. No orthosis is equivalent to TLSO for the treatment of thoracolumbar burst fractures without neurologic injury: results from a multicenter. *Spine J*. 2011;14(11):1S-173S.