ORIGINAL ARTICLE
TRAUMA
http://dx.doi.org/10.1590/S1808-185120222022267378

SPINAL FRACTURES AND THORACOABDOMINAL INJURIES IN POLYTRAUMATIZED PATIENTS: EPIDEMIOLOGICAL EVALUATION

FRATURAS DA COLUNA VERTEBRAL E LESÕES TORACOABDOMINAIS EM PACIENTES POLITRAUMATIZADOS: AVALIAÇÃO EPIDEMIOLÓGICA

FRACTURAS VERTEBRALES Y LESIONES TORACOABDOMINALES EN PACIENTES POLITRAUMATIZADOS: EVALUACIÓN EPIDEMIOLÓGICA

ALAN ANTONELLI[1], ÁLYNSON LAROCCA KULCHESKI[1], ANDRÉ LUIS SEBBEN[1], FELIPE NEGREIROS NANNI[1], PEDRO GREIN DEL SANTORO[1], MARCEL LUIZ BENATO[1], XAVIER SOLER I GRAELLS[1]

1. Hospital Trabalhador, Curitiba, PR, Brazil.

ABSTRACT

Objectives: Establish the frequency of incidences, management, and description of the relationship between thoracic and abdominal trauma and spinal injury. Methods: Observational, retrospective study of quantitative analysis carried out through the analysis of medical records of patients who presented spinal fractures and associated thoracoabdominal injuries. The participants were treated at a reference hospital in trauma care in Curitiba-PR from 2019 to 2021. The data were from patients with spine fractures referring to gender, age, trauma mechanism, fracture classification, associated injuries, Frankel neurological scale, and proposed treatment. Results: There was a predominance of male patients (84.5%) and young, with a mean age of 37.3 years, victims of car accidents. The main vertebrae affected were the lumbar spine (36.8%) and thoracic spine (36.2%). The most prevalent associated injuries were extra vertebral and cervical spine fractures. The most observed thoracic injuries were hemothorax, chest contusion, and fracture of multiple costal arches, while the most observed abdominal injuries were kidney injury, hemoperitoneum/abdominal hematoma, and liver injury. Of the total patients analyzed, 68% had fractures with associated thoracoabdominal injuries. Conclusion: Abdominal and thoracic injuries are frequently associated with spine fractures, with an association of 14.6% and 53.4%, respectively. The production of knowledge on the subject contributes to creating action plans to optimize the management and reduce the morbidity and mortality of these cases. ***Levels of evidence III; Systematic Review.***

Keywords: Spinal Injuries; Abdominal Injuries; Thoracic Injuries; Bone Fractures; Wounds, Gunshot.

RESUMO

Objetivos: Estabelecer a frequência de incidências, manejo e descrição da relação entre traumas torácicos e abdominais com a lesão da coluna vertebral. Métodos: Estudo observacional, retrospectivo de análise quantitativa realizado através da análise de prontuários de pacientes que apresentaram fraturas da coluna vertebral e lesões toracoabdominais associadas. Os participantes incluídos foram atendidos em um hospital referência no atendimento ao trauma em Curitiba-PR no período de 2019 a 2021. Os dados foram de pacientes com fratura de coluna referente a sexo, idade, mecanismo de trauma, classificação da fratura, lesões associadas, escala neurológica de Frankel e tratamento proposto. Resultados: Houve predomínio de pacientes masculinos (84,5%) e jovens, sendo a média de idade de 37,3 anos, vítimas de acidentes automobilísticos. As principais vértebras acometidas foram de coluna lombar (36,8%) e torácica (36,2%). As lesões associadas mais prevalentes foram as fraturas extravertebrais e de coluna cervical. As lesões torácicas mais observadas foram o hemotórax, contusão torácica e fratura de múltiplos arcos costais, enquanto as lesões abdominais mais observadas foram lesão renal, hemoperitônio/hematoma abdominal e lesão hepática. Sendo do total de pacientes analisados 68% apresentavam fraturas com lesões toracoabdominais associadas. Conclusão: Lesões abdominais e torácicas frequentemente estão associadas a fraturas de coluna, com associação de 14,6% e de 53,4% respectivamente. A produção de conhecimento sobre o assunto, contribui para criação de planos de ação para a otimização do manejo e redução da morbimortalidade desses casos. ***Nível de evidência III; Revisão sistemática.***

Descritores: *Traumatismos da Coluna Vertebral; Traumatismos Abdominais; Traumatismos Torácicos; Fraturas Ósseas; Ferimentos por Arma de Fogo.*

RESUMEN

Objetivos: Establecer la frecuencia de incidencias, manejo y descripción de la relación entre trauma torácico y abdominal y lesión medular. Métodos: Estudio observacional, retrospectivo de análisis cuantitativo realizado a través del análisis de historias clínicas de pacientes que presentaron fracturas de columna y lesiones toracoabdominales asociadas. Los participantes incluidos fueron atendidos en un hospital de referencia en atención de trauma en Curitiba-PR de 2019 a 2021. Los datos fueron de pacientes con fracturas de columna con referencia a sexo, edad, mecanismo de trauma, clasificación de fractura, lesiones asociadas, escala neurológica de Frankel y tratamiento propuesto. Resultados: Predominaron los pacientes del sexo masculino (84,5%) y jóvenes, con una edad media de 37,3 años, víctimas de accidentes

Study conducted by the Hospital Trabalhador, Curitiba, PR, Brazil.
Correspondence: Alan Antonelli. Número, João Bonat Street, Curitiba, PR, Brazil. 81050-170. alan.antonelli@hotmail.com

Received on 08/29/2022 accepted on 03/20/2023
Reviewed by: Murilo Daher

automovilísticos. Las principales vértebras afectadas fueron la columna lumbar (36,8%) y la columna torácica (36,2%). Las lesiones asociadas más prevalentes fueron las fracturas extra vertebrales y de columna cervical. Las lesiones torácicas más observadas fueron hemotórax, contusión torácica y fractura de múltiples arcos costales, mientras que las lesiones abdominales más observadas fueron lesión renal, hemoperitoneo/ hematoma abdominal y lesión hepática. Del total de pacientes analizados, el 68% presentaba fracturas con lesiones toracoabdominales asociadas. Conclusión: Las lesiones abdominales y torácicas se asocian con frecuencia a las fracturas de columna, con una asociación del 14,6% y 53,4% respectivamente. La producción de conocimiento sobre el tema contribuye a la creación de planes de acción para optimizar el manejo y disminuir la morbimortalidad de estos casos. ***Nivel de evidencia; Revisión sistemática.***

Descriptores: *Traumatismos Vertebrales; Lesiones abdominales; Lesiones torácicas; Fracturas de hueso; Heridas por Arma de Fuego.*

INTRODUCTION

Trauma in our country is responsible for more than 90,000 deaths a year in our country, leaving more than 200,000 victims a year with sequelae, implying costs of billions reais.[1] The violence generated by trauma, besides having a strong impact on morbidity and mortality rates, has important economic repercussions. In Latin America, it is estimated that the annual economic costs of death and disability resulting from a traumatic episode represent, on average, 20% of each country's total health expenditures.[2] In the case of Brazil, the expression and significance of traffic accidents and homicides must be given.[3]

The epidemiological data from Curitiba show that patients with spinal cord injuries are more prevalent in young men aged 45 years, victims of traffic accidents.[4] A previous study in the United States showed that the estimated annual incidence of spinal cord injury was approximately 12,000 new cases in 2011, and the estimated number of people living with neurological sequelae is 232,000 to 316,000.[5]

From the local perspective in the city of Curitiba, the previous epidemiological studies are concentrated in the early 2000s, with a need for a recent review, given the implementation of the whole--body tomography study in polytrauma patients who are seen in the emergency department, as well as the expansion and improvement of pre-hospital care.[6,7] Therefore, developing more up-to-date knowledge about the population seen in trauma referral services is necessary, as victims of thoracic and abdominal trauma with spinal injury.

The production of knowledge on the subject and the generation of data on the profile of patients treated allows the creation of action plans for the optimization of management and reduction of morbidity and mortality, besides the production of scientific content on the subject, contributing to the broadening of the identification and therapeutic arsenal for the treatment of these fractures.

Thus, the present study aims to identify the epidemiological profile and other associated injuries of polytrauma patients with spinal injuries associated with thoracic and abdominal injuries in a reference hospital. The secondary objectives are to analyze the incidence of spinal fractures and evaluate the management of these incoming patients, noting characteristics relevant to the study. In addition, we aimed to stratify the classification of the fractures found, following the AOSpine classification, as well as the number of affected vertebrae, spine segment, and evaluation of the treatment installed between conservative and surgical.

METHODOLOGY

This is an observational, cross-sectional, retrospective quantitative analysis study by reviewing electronic medical records of polytrauma patients with spinal fractures. The study was conducted in 2021 in the Department of Orthopedics and Traumatology of a tertiary referral hospital in Curitiba-Paraná.

This research was authorized by the proponent institution's Ethics and Research Committee, and the Informed Consent Form was exempted.

For this research, the following inclusion criteria were adopted: medical records between the period January 2019 to December 2020 of male and female patients with abdominal or thoracic trauma associated with spinal fractures. Patients who died before further examinations or who had incomplete records were excluded.

We evaluated the patient's medical records in conjunction with complementary examination reports of CT scans and radiographs. We selected patients with thoracic or abdominal injuries associated with a spinal fracture. The data evaluated were: gender, age, trauma mechanism, vertebrae affected, AOSpine classification, Frankel classification, associated injuries, abdominal injury, thoracic injury, and type of treatment instituted.

The information gathered was organized in a Microsoft Excel® spreadsheet. Statistical analysis was performed using STATA® 11 SE software, and the data were presented in tables with absolute and relative frequency distributions. The statistical significance of the differences in means between the quantitative variables was verified using the unpaired Student's t-test. All analyses were performed at a 5% significance level, and therefore results were considered statistically significant when the *p-value* was less than 0.05, always considering two-tailed alternative hypotheses.

RESULTS

The records of 763 patients with abdominal, thoracic, or spinal fractures admitted to the hospital emergency department were analyzed. After applying the exclusion criteria, 660 records were discarded, generating a sample of 103 patients with evidence of an association between thoracic and abdominal injury and spinal fractures for the study, representing 13.5% of the total sample.

The epidemiological data of these analyzed patients showed a predominance of the male gender (87; 84.5%), with a ratio of 5.4:1. The mean age of the male patients was 37.2±17.0 years, ranging from 16 to 75 years, and the mean age of the female patients was 37.8±16.1 years, ranging from 17 to 78 years, with no statistically significant difference between the ages of each gender. The most affected age group was between 20 and 30 years old, with 31.1%, followed by between 30 and 40 years old, with 18.5%. The data is presented in the table below. (Table 1)

The most frequent trauma mechanism was car accidents, with 34.0%, followed by falls from a height, with 28.2% of the cases, and gunshot wounds, with 23.3%. (Table 2)

Table 1. Gender and Age Ratio.

Gender	Age				P
	Average	DP	Mín	Max	
Male (n=87)	37.2	17.0	16	75	0.898
Female (n=16)	37.8	16.1	17	78	
Total (n=103)	37.3	16.8	16	78	

Source: authors, 2021.

Table 2. Mechanism of trauma.

Mechanism of trauma	n	%
Car Accident	35	34.0%
Fall from Height	29	28.2%
Firearm injury	24	23.3%
Bicycle Accident	5	4.9%
Pedestrian hit by a car	5	4.9%
Crush	3	2.9%
Falling from the same level	1	1.0%
Shallow water diving	1	1.0%
Total	103	100.0%

Source: authors, 2021.

In 51 patients (49.5%), were found multivertebral fractures. Regarding the most affected vertebral segment (Table 3), most patients had fractures in the lumbar spine (36.8%) or thoracic spine (36.2%). Of 26.5%, the involvement occurred in the cervical spine and only 0.5% in the occipital condyle. The most fractured vertebra was L2, with 23 cases (12.4%), and L1, 19 cases (10.3%).

As for neurological status, in (Table 4), Frankel's scale had the highest prevalence observed with type E lesions, with 57 cases (55.9%), followed by type A, with 34 patients (33.3%). One patient had death recorded before Frankel's classification and was therefore not computed.

The fractures were also classified according to the AO group (Table 5). Regarding the total classification, mainly type A1, A3, and C fractures occurred. There was a predominance of type A3 in group A and B2 in group B. The results can be seen in the table below:

The predominant treatment was surgical in 61.2% of the cases, while 38 patients (36.9%) were treated conservatively. Two cases (2.2%) died, due to the severity of the associated lesions, before undergoing definitive treatment. (Table 6)

Extravertebral fractures were frequent in 68 cases (66.0%), with 17 patients (16.5%) having two or more extra vertebral fractures. The highest prevalence was observed in the upper limbs (28.2%). (Table 7)

Table 3. Fractured Vertebra identification.

Vertebra	n	%
Occipital condyle	1	0.5%
Cervical spine		
C1	1	0.5%
C2	2	1.1%
C3	1	0.5%
C4	4	2.2%
C5	14	7.6%
C6	15	8.1%
C7	11	5.9%
C8	1	0.5%
Thoracic spine		
T1	4	2.2%
T2	2	1.1%
T3	5	2.7%
T4	6	3.2%
T5	1	0.5%
T6	6	3.2%
T7	5	2.7%
T8	2	1.1%
T9	4	2.2%
T10	8	4.3%
T11	10	5.4%
T12	14	7.6%
Lumbar spine		
L1	19	10.3%
L2	23	12.4%
L3	7	3.8%
L4	11	5.9%
L5	8	4.3%

Source: authors, 2021.

Table 4. Frankel Scale evaluation.

Frankel Scale	N	%
A	34	33.0%
B	5	4.9%
C	5	4.9%
D	1	1.0%
E	57	55.3%
Death	1	1%
Total	102	100%

Source: authors, 2021.

Thoracic structure lesions were identified in 60 patients. The most prevalent injuries were unilateral hemothorax (31.2%), chest contusion (22.1%), multiple costal arch fracture (13%), and bilateral hemothorax (11.7%). As for abdominal injuries, 13 patients had abdominal injuries associated with spinal fractures. The primary lesions were kidney injury (23.8%) and peritoneal hemoperitoneum/hematoma (23.8%). The data are presented in Table 8.

Among the patients evaluated, 24 had firearm injuries (Table 9). Of these, most had conservative treatment (50.0%), presented

Table 5. Relationship Quantity and AO Classification of Fractures.

AO Classification	N	% of total	% of type
Type A			
A0	10	9.6%	12.7%
A1	16	15.4%	20.3%
A2	14	13.5%	17.7%
A3	31	29.8%	39.2%
A4	8	7.7%	10.1%
Type B			
B1	4	3.8%	40.0%
B2	6	5.8%	60.0%
Type C			
C	15	14.4%	100%

Source: authors, 2021.

Table 6. Treatment for Spine Fracture.

Treatment	N	%
Surgical	63	61.2%
Conservative	38	36.9%
Death before the start of treatment	2	1.9%

Source: authors, 2021.

Table 7. Presence of Associated Fractures.

Associated fractures	n	%
Upper Limbs	29	28.2%
Lower limbs	21	20.4%
Costal arches	21	20.4%
Pelvis	15	14.6%
Other orthopedic injuries	6	5.8%

Source: authors, 2021.

Table 8. Abdominal and Thoracic Injuries Associated with Spinal Fractures.

Associated Lesion	n	% of total
Thoracic		
Bronchoaspiration	1	1.4%
Thoracic contusion	17	22.1%
Subcutaneous emphysema	3	3.9%
Multiple costal arch fractures	10	13.0%
Extrapleural hematoma	1	1.3%
Uni/bilateral hemopneumothorax	5	6.8%
Hemopericardium	1	1.3%
Bilateral hemothorax	9	11.7%
Unilateral hemothorax	24	31.2%
Mediastinal aortic lesion	1	1.3%
Uni/bilateral pneumothorax	4	5.2%
Abdominal		
Kidney damage	5	23.8%
Liver damage	4	19.0%
Bowel Loop Injury	2	9.5%
Psoas muscle hematoma	2	9.5%
Hemoperitoneum/abdominal hematoma	5	23.8%
Diaphragm lesion	1	4.7%
Stomach Injury	1	4.7%
Pneumoperitoneum	1	4.7%

Source: authors, 2021.

Frankel A (58.3%), and had associated thoracic trauma (70.8%) and extra vertebral fracture (75.0%).

In (Table 10), 19 cases (18.4%) corresponded to isolated spinal fractures, while 84 (81.6%) cases presented at least one associated injury. The most prevalent injury found was extra vertebral fractures, with 56 patients (54.4%), followed by thoracic trauma (55 patients; 53.4%) and cervical spine fractures (29 patients; 28.2%).

DISCUSSION

The relationship between thoracoabdominal injury and spinal fractures is frequent in polytrauma patients. This study showed a predominance of young males. These characteristics were also identified in previous epidemiological studies, in which 81.6% of the participants were men, and the mean age was 33.9±13.5 years.[6] These data are in line with results from other studies.[5,7] However, some studies have shown an increased prevalence of spinal trauma in women.[8]

The most frequent causes of spinal injuries are automobile accidents, followed by falls from height, especially in the elderly.[9] According to Graells et al., in 2005, firearm injuries ranked first among the causes of spinal injuries.[5] However, our evaluation of patients with thoracoabdominal injuries and spinal fractures showed that automobile accidents are the main cause, followed by falls from height and firearm injuries.

According to the scientific literature, the main site of vertebral fracture is the thoracolumbar transition, encompassing the T12, L1, and L2 vertebrae, representing 55.93% of the cases of vertebral fracture.[5] Our review confirmed these data: the most fractured vertebra was L2 (12.4%), and L1 (10.3%). In contrast, another study conducted in São Paulo in 2010 that analyzed the profile of spinal fractures found cervical vertebrae as the most affected (45%), followed by thoracic (28%) and lumbar (25%).[10]

Table 9. Characteristics of Firearm Victims' Injuries.

Feature	n	%
Treatment Type		
Surgical	11	45.8%
Conservative	12	50.0%
Death	1	4.2%
Frankel		
A	14	58.3%
B	2	8.3%
C	1	4.2%
E	6	25.0%
Death	1	4.2%
Associated Lesion		
Thoracic Trauma	17	70.8%
Abdominal trauma	8	33.3%
Cranioencephalic trauma	1	4.2%
Soft tissue injury	2	8.3%
Extravertebral fracture	18	75.0%
Pelvic fracture	6	25.0%
Rib fracture	4	16.7%

Source: authors, 2021.

Table 10. Discrimination of Associated Lesions.

Breakdown of associated injuries	n	%
Extravertebral fractures	56	54.4%
Thoracic Trauma	55	53.4%
Cervical spine fractures	29	28.2%
Cranioencephalic trauma	18	17.5%
Abdominal trauma	15	14.6%
Early Systemic Lesions	4	3.9%
Soft tissue injury	3	2.9%

Source: authors, 2021.

After analyzing the tomographic reports, we used the AO classification to segment. We understood the types of fractures of the patients in our study, and the highest rates found were AO A3 type fractures, as well as articles in the international literature.[5,8,10] However, compared to the 2019 article conducted in São Paulo, the most prevalent cervical fractures were type C due to automobile accidents.[11]

We adopted Frankel's classification, and the highest prevalence observed was type E, with 55.9% of the cases, followed by type A, with 33.3%. Other reviews have also published that Frankel E is most often found in patients with spinal fractures.[5,8,10,12]

Regarding conservative versus surgical treatment, in our service, the predominant treatment was surgical intervention in 61.2% of the cases, while 36.9% were treated conservatively. Compared to the epidemiological study from Bahia, we had a lower rate of surgical treatment, where surgical treatment was indicated in 88.2% of a sample of 1,917 patients undergoing treatment for spinal fractures from 1991 to 2010.[12] In a 2021 German literature review, Ulrich Spiegl et al. I analyzed the effect of early versus later surgery on outcome in severely injured patients with thoracic vertebral body fractures by comparing clinical parameters and outcomes of patients with severe thoracic spine injuries when undergoing spinal stabilization within 72 h after trauma or later, and patients who underwent early surgical stabilization had a significantly shorter intensive care unit stay, shorter mechanical ventilation, and shorter hospital stay.[13]

As for the other reality, the treatment of spinal neurotrauma, especially in East Africa, especially Tanzania, relies on both non--operative treatment and open invasive procedures. Macrosurgical exposures are associated with adverse effects, including neuromuscular denervation and increased analgesic demand. In addition, complications specific to resource-limited settings also include higher rates of infection, wound breakdown, and prolonged immobility in bed.[14]

A previous study has identified hemothorax, pneumothorax, and hemopneumothorax as the thoracic injuries most associated with spinal fractures. Among the patients analyzed by this study, 84.84% were observed for hemothorax and 36.36% for pneumothorax. Of these patients, 11 (33.33%) presented both lesions.[5] Our study showed data partially concordant with this statistic, with bilateral or unilateral hemothorax identified in 42.9% of patients, followed by chest contusion in 22.1%, and pneumothorax being used present only in 5.2% of patients.

Patients affected by high-energy trauma can have a combination of the thoracic, abdominal, genitourinary, spinal cord, long bone, and skull injuries.[15] Spinal fracture is a common injury associated with thoracic trauma with a reported prevalence of 19%. In our study, nineteen cases (18.4%) corresponded to isolated spinal fractures, while 84 (81.6%) cases presented at least one associated injury. The most prevalent injury found was extra vertebral fractures, with 56 patients (54.4%), followed by thoracic trauma (55 patients; 53.4%) and cervical spine fractures (29 patients; 28.2%).

The present study showed that the incidence of abdominal lesions mainly affects the kidneys and liver, hemoperitoneum, and abdominal hematoma. Therefore, the importance of the quick indication of complementary imaging exams, such as whole-body tomography, is reinforced.[7]

Spinal fractures caused by firearms are more frequently found in young males,[16] especially in those aged between 21 and 30.[17] Consistent with national studies, the present study found that firearm projectiles caused 23.3% of the spinal fractures associated with associated injuries and were frequently associated with thoracic injuries mainly. Previous international studies have also pointed to firearm injuries as an important cause of spinal fractures, highlighting their relationship with thoracic and abdominal injuries.[18] As for treatment, our study showed that 50% of the cases of firearm injuries are treated conservatively.

The study demonstrates the importance of interdisciplinarity in the initial care of polytrauma patients.–The diagnostic evolution with CT leads to a future projection of a decrease in neglected fractures, especially of the spine associated with abdominal and thoracic

trauma. In addition, a possible awareness of accident prevention would considerably decrease traumatic spinal injuries.

CONCLUSION

The correlation between thoracoabdominal trauma and spinal fracture traces an epidemiological profile that affects males under 34 years of age. The fracture is located in the thoracolumbar transition, the presence of hemothorax, and lesions of abdominal organs, especially kidney lesions.

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

CONTRIBUTIONS OF THE AUTHORS: AA and AS were the main contributors in writing the manuscript. AL and XS performed the surgery, accompanied the patients. MLB evaluated the data from the statistical analysis. PG and FN carried out the bibliographical research, the revision of the manuscript and contributed to the intellectual concept of the study.

REFERENCES

1. Borges LAA. Atendimento inicial ao politraumatizado. In: Nasi LA. Rotinas em pronto-socorro. Porto Alegre: Artmed, 2005. p. 282-83.
2. Mendonça RNS, Alves JGB, Cabral FJE. Gastos hospitalares com crianças e adolescentes vítimas de violência. Cad Saúde Pública. 2002;18(6):1577-81. https://doi.org/10.1590/S0102-311X2002000600011.
3. Brasil. Ministério da Saúde. Portaria MS/GM n.737. Política Nacional de Redução da Morbimortalidade por Acidentes e Violência. Diário Oficial da União 16 mai 2001.
4. Araújo Junior FA, Matsubara A, Pereira LHC, Schmidt EHB, Kondlatsch GLS. Epidemiology of spinal cord injury in references trauma center in Curitiba (Paraná, Brazil). Coluna/Columna. 2021;20(2):123-6. https://doi.org/10.1590/S1808-185120212002240563.
5. Graells XS, Zaninelli EM, Collaço IA, Nasr A, Cecílio WAC, Borges GA. Thoracic injuries andspinal trauma: a complex association. Coluna/Columna. 2008;7(1):8-13.
6. Brito LMO, Chein MBC, Marinho SC, Duarte TB. Avaliação epidemiológica dos pacientes vítimas de traumatismo raquimedular. Ver Col Bras Cir. 2011;38(5):304-9.
7. Agrawal A, Srivastava S, Kakani A. Isolated transverse process fracture of the lumbar vertebrae. J Emerg Trauma Shock. 2009;2(3):217-8.
8. Bucholz RW, Court-Brown CM, Heckman JD, Tornetta III P, McQueens MM, Ricci WM. Fratura em adultos de Rockwood e Green. 5ta. Ed. Barueri, SP: Malone; 2006.
9. Fernandes RB, Gomes EGF, Gusmão MS, Junior DCA, Simões MTV, Gomes JF, et al. Estudo clínico epidemiológico das fraturas da coluna vertebral. Coluna/Columna. 2012;11(3):230-3. https://doi.org/10.1590/S180818512012000300009.
10. Vasconcelos ECLM, Riberto M. Caracterização clínica e das situações de fratura da coluna vertebral no município de Ribeirão Preto, propostas para um programa de prevenção do trauma raquimedular. Coluna/Columna. 2011;10(1):40-3. https://doi.org/10.1590/S1808-18512011000100007.
11. de Oliveira PAC, Gotfryd A, Cafaro MF, Astur N, Mendonça R, Akamine EH, et al. Evaluation of patients with subaxial cervical fractures by the new aospine classification Coluna/Columna. 2019;18(4):268-71. https://doi.org/10.1590/S1808-185120191804193631.
12. Rodrigues LCL, Bortoletto A, Matsuumoto MH. Epidemiologia das fraturas toracolombares cirúrgicas na zona leste de São Paulo. Coluna/Columna. 2010;9(2):132-7. https://doi.org/10.1590/S1808-18512010000200008.
13. Splavski B, Vrankovic D, Saric G, Mursic B, Rukovanjski M. Early management of war missile spine and spinal cord injuries: experience with 21 cases. Injury. 1996;27(10):699-702.
14. Njoku I, Wanin O, Assey A, Shabani H, Ngerageza JG, Berlin CD, et al. Minimally Invasive 2D Navigation-Assisted Treatment of Thoracolumbar Spinal Fractures in East Africa: A Case Report. Cureus. 2016; 8(2):e507.
15. Krueger MA, Green DA, Hoyt D, Garfin SR. Overlooked spine injuries associated with lumbar transverse process fractures. Clin Orthop Relat Res. 1996;(327):191-5.
16. Canale ST, Beaty JH. Campbell's operative orthopaedics. 13ra ed.
17. Pereira ELR, Gomes AL, Rodrigues DB. Epidemiologia do traumatismo raquimedular por projéteis de armas de fogo em um hospital de referência no estado do Pará. Arq Bras Neurocir. 2015;34:13-9.
18. Splavski B, Vrankovic D, Saric G, Mursic B, Rukovanjski M. Early management of war missile spine and spinal cord injuries: experience with 21 cases. Injury. 1996;27(10):699-702.