MULTIPLE VERTEBRAL FRACTURES AT THE "DR. MANUEL DUFOO" SPINE CLINIC

FRATURAS VERTEBRAIS MÚLTIPLAS NA CLÍNICA DE COLUNA "DR. MANUEL DUFOO"

FRACTURAS VERTEBRALES MÚLTIPLES EN LA CLÍNICA DE COLUMNA "DR. MANUEL DUFOO"

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ABSTRACT

Objective: To establish the frequency of presentation of multiple vertebral fractures and evaluate the relationship between the postsurgical condition and the initial neurological lesion, as well as to report the associated injuries in this group of patients. Methods: We conducted a review of patients with spinal trauma and a diagnosis of multiple vertebral fractures who were admitted to the "Dr. Manuel Dufoo Olvera" Spine Clinic of the Secretary of Health of Mexico City from January 1, 2014 to June 30, 2017. The multiple fractures were classified as either contiguous or non-contiguous, according to the number of vertebral bodies and levels affected. The statistical analysis was conducted using formulas of descriptive statistics and the information was then tabulated and graphed to assess the relationship between the anatomical classification and the degree of neurological injury. Results: We observed 530 patients, of whom 47 met the criteria. Thirty-one (65.95%) of the cases corresponded to contiguous fractures and 16 cases (34.05%) to non-contiguous fractures. Fourteen patients (29.78%) with neurological integrity were classified as ASIA D, 20 patients (42.58%) with complete lesion as ASIA A, 7 seven patients (14.89%) as ASIA B, and 6 patients (12.76%) with partial injury as ASIA C. Conclusions: The correlation between the classification of vertebral injuries and the presence of neurological lesion did not show significant differences between contiguous and non-contiguous fractures. ***Level of Evidence II; Retrospective.***

Keywords: Multiple fractures; Trauma; Injuries.

RESUMO

Objetivos: Estabelecer a frequência de apresentação de múltiplas fraturas vertebrais e avaliar a relação de sua condição pós-cirúrgica e a lesão neurológica inicial, bem como relatar as lesões associadas neste grupo de pacientes. Métodos: Uma revisão dos casos com traumatismo espinhal e diagnóstico de fratura vertebral múltipla, que entraram no Spine Clinic " Dr. Manuel Dufoo Olvera " Secretário da Cidade do México saúde da coluna vertebral, durante o período de 1 de janeiro de 2014 a 30 de Junho de 2017. A classificação divide fraturas múltiplas como contíguas e não contíguas, seguido pelo número de pessoas afetadas e os corpos de nível. A análise estatística foi realizada utilizando fórmulas statística descritivas, então tabuladas e as informações representadas graficamente. Para avaliar a relação entre a classificação anatômica e do grau de lesão neurológica. Resultados: 530 Pacientes foram observados, dos quais 47 apresentaram os critérios necessários. 31 pacientes (65,95%) do estudo foram classificados com fraturas adjacentes contíguas e 16 casos (34,05%) como não contíguas. 14 doentes (29,78%) foram classificados com integridade neurológica ÁSIA D, 20 doentes (42,58%) apresentaram lesão completa ÁSIA A, sete doentes (14,89%) na ASIA B e seis doentes. (12,76%) com lesão incompleta ÁSIA C.Conclusão: A correlação entre a classificação das lesões da coluna vertebral e a presença de lesão neurológica não mostraram diferenças significativas entre fraturas adjacentes e não adjacentes. ***Nível de Evidência II; Restrospectivo.***

Descritores: Fraturas múltiplas; Trauma; Lesão.

RESUMEN

Objetivo: Establecer la frecuencia de presentación de las fracturas vertebrales múltiples y evaluar la relación de su condición postquirúrgica y la lesión neurológica inicial, así como relatar las lesiones asociadas en este grupo de pacientes. Métodos: Se realiza una revisión de los casos con traumatismo raquimedular y diagnóstico de fractura vertebral múltiple que ingresaron a la Clínica de Columna "Dr. Manuel Dufoo Olvera" de la Secretaría de Salud de Ciudad de México del 1º de enero de 2014 al 30 de junio del 2017. La clasificación divide las fracturas múltiples como contiguas y no contiguas, acorde al número de cuerpos afectados y el nivel.. El análisis estadístico se realizó utilizando fórmulas de estadística descriptiva, para después tabular y graficar la información, para evaluar la relación entre la clasificación anatómica y el grado de lesión neurológica. Resultados: Fueron observados 530 pacientes, de los cuales 47 presentaron los criterios necesarios. Treinta y un pacientes (65,95%) del estudio fueron clasificados con fracturas contiguas y 16 casos (34,05%) con no contiguas. Catorce pacientes (29,78%) fueron clasificados con integridad neurológica ASIA D, 20 pacientes (42,58%) presentaron lesión completa ASIA A, siete pacientes (14,89%) en ASIA B y seis pacientes (12,76%) con lesión incompleta ASIA C. Conclusiones: La correlación entre la clasificación de lesión de columna vertebral y la presencia de lesión neurológica no mostró diferencias significativas entre fracturas contiguas y no contiguas. ***Nivel de Evidencia II; Retrospectivo.***

Descriptores: *Fracturas múltiples; Trauma; Lesión.*

Study conducted at the "Dr. Manuel Dufoo Olvera" Spine Clinic of the Secretariat of Health of Mexico City, México
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INTRODUCTION

Multiple vertebral fractures are the result of high-energy trauma. It is a little-known pathology and there is a scarcity of literature on the subject in Mexico. These may be contiguous when there is evidence of the fracture of two or more adjacent vertebral bodies and non-contiguous when the fracture of two vertebral bodies occurs in locations separated by at least one healthy vertebral body.[1-3]

The monetary impact of these devastating injuries has not been calculated but it is estimated that in healthcare expenses and lost productivity it amounts to about 4 billion dollars per year.[3] A review of the literature published over the last 30 years reflects an apparent increase in the incidence of multiple vertebral fractures, however it is a little described pathology.[4,5]

METHODS

This was a retrospective, level of evidence II study of the population with multiple fractures who underwent surgical intervention for multiple vertebral fractures between 1 January 2014 and 30 June 2017 at the "Dr. Manuel Dufoo Olvera" Spine Clinic of the Secretariat of Health of Mexico City. The protocol number from the Institutional Review Board is 2030102317.

We reviewed 47 cases diagnosed with and treated for multiple vertebral fractures. We included all patients older than 18 years of age who had multiple vertebral fractures and complete medical files (patients who underwent complete surgery and who received follow-up and rehabilitation) at the "Dr. Manuel Dufoo Olvera" Spine Clinic of the Secretariat of Health of Mexico City, all of whom were diagnosed with multiple vertebral fractures evidenced by imaging studies and in clinical exams, as well as all patients who had fractures in two or more vertebral bodies from C1 to the sacrum.

The statistical analysis of the information was conducted using descriptive statistical formulas in SPSS and was later tabulated and graphed. Finally, the information obtained in the study was compared with the published literature.

RESULTS

During our study, 47 patients presented multiple vertebral fractures at the "Dr. Manuel Dufoo Olvera" Spine Clinic of the Secretariat of Health of Mexico City from the first of March 2014 to the thirtieth of June 2017, of whom 89% were men and the remaining 11% were women (Figure 1). The main cause was falls from a height of more than two meters during work (mostly construction workers at 68%) followed by being run over (29%), and only 3% did not know the cause because they were under the influence of alcohol. (Table 1)

The average age of the patients for both sexes was 48 years, ranging from a minimum of 28 to a maximum of 62 years of age. (Table 2).

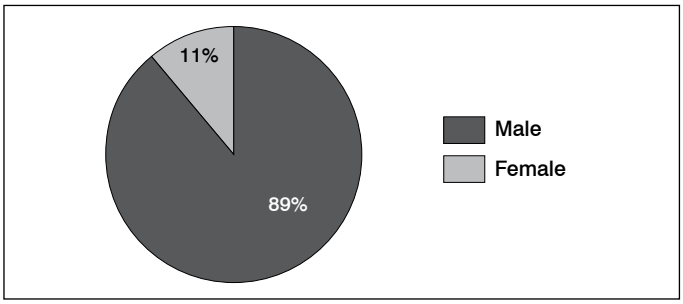

Figure 1. Sex of the patients.

Table 1. Sex of the patients.

		Frequency	Valid percentage
Valid	Male	42	89.0
	Female	5	11.0
	Total	47	100.0

The presentation of contiguous fractures was significantly higher in terms of frequency than non-contiguous fractures at 65.95%. (Table 3)

In terms of the ASIA scale applied at admission, most patients (42.55%) had a presentation classified as ASIA A, which indicates full neurological deficit, both at the motor and sensory levels, and demonstrating issues with sphincter control and with sacral segments S4 and S5. (Table 4)

We found a total of 55 injured segments at different levels of the spine. This is extremely important for non-contiguous fractures due to a double or even multiple injury, the predominant site of involvement being the lumbar region. (Tables 5 and 6)

Among the vertebral bodies affected by this type of injury, we observed the following distribution: cervical C1 (2%), C5 (15%), C6 (9%); thoracic T7 (2%), T8 (4%), T9 (5%), T10 (7%), T11 (2%), T12 (2%); lumbar L1 (20%), L2 (16%), L3 (15%); and sacral (2%) among the levels that presented any involvement. (Figure 2)

Of the surgeries performed, 40.2% were based on TLIF arthrodesis by posterior approach only. Those that required more than 3 interventions were associated with complications and the need for

Table 2. Age of patients operated at the CC de la SSa CDMX.

N	Valid	47
Mean		47.87
Median		46.00
Mode		46
Range		35
Minimum		28
Maximum		63

Table 3. Percentage of presentation based on the type of multiple vertebral fracture.

	Frequency	% of the total
Contiguous	31	65.95%
Non- contiguous	16	34.05%
Total	47	100.0%

Table 4. ASIA based on the initial multiple vertebral fracture.

	Frequency	% of the total
A	20	42.58%
B	7	14.89%
C	16	12.76%
D	14	29.78%
E	0	0%
Total	47	100.0%

Table 5. Classification and number of multiple vertebral fractures by spinal segment.

	Frequency	% of the total
Cervical	9	16.30%
Thoracic	19	34.53%
Lumbar	26	48.27%
Sacral	1	1.0%
Total	55	100.0%

Table 6. Classification of multiple vertebral fractures by spinal segment and number of segments operated in each patient.

Multiple vertebral fracture	Frequency	% of the total
Segments operated		
1 Segment	19	40.42%
2 Segments	25	53.19%
3 Segments	3	6.39
TOTAL	47	100.0%

surgical flushing with the VAC system. Two patients (4.25%) were submitted to three and four flushings, respectively, due to surgical site infection and they also required the removal of the autologous graft used in the arthrodesis, extending the average hospital stay of 15 days to 48 and 66 days, respectively. (Table 7)

Regarding the patients with multiple fractures, there was associated trauma to the cranial complex in two cases, rib fractures or unstable thorax in seven cases, and abdominal lesions requiring surgery during the same hospitalization in two patients, one for a liver injury, who required prior treatment of the pelvis, and the other for an injury of the spleen, who required external fixation for a fracture of the right tibia and fibula.

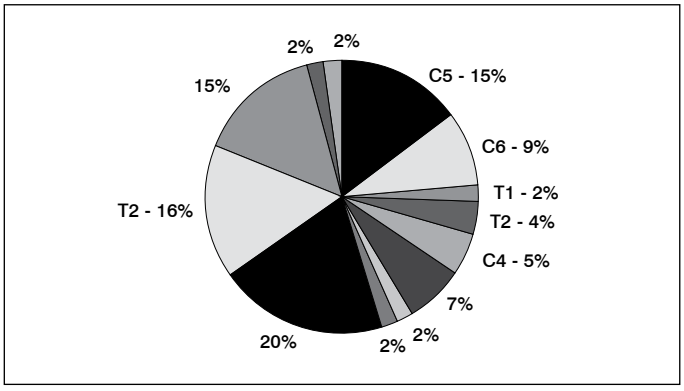

Figure 2.

Table 7. Complications of multiple vertebral fractures.

Complications	Frequency	% of the total
Infected ulceration	1	2.12%
Graft revision	1	2.12%
Bleeding	1	4.25%
Infection	2	2.12%
Total	5	10.61%

DISCUSSION

It is clear that the most frequently affected population is of productive age and this type of lesions occurs more frequently in males with a ratio of 8.4:1 males to females affected.

The main cause observed was falling from a height of more than two meters, which differs from the mechanism of action in the published literature where automobile accidents account for 45%, falls from heights 20%, outcomes of violence 15%, and the rest from various causes.[6,7]

Fourteen patients (29.78%) had no neurological injury and the remaining 70.22% had some type of injury, either complete or partial. This tells us that in most of the cases the prognosis is unfavorable according to Jorjersen et al.[8] We took into account that the patients with partial spinal cord type neurological damage retain better motor function that those with a complete lesion, however, this indicates a high degree of disability and generates changes in the biopsychosocial environment of the patients and the means to perform their work, which is similar to the global literature where authors report a frequency of neurological damage in this group of patients of up to 70%.

For Keenen et al.,[9] the most important factor in determining the existence of neurological damage is the severity of the lesion that the neural tissue undergoes at the time of the trauma. It is a matter of establishing a relationship between the extent of the compromise to the vertebral canal in a radiographical projection and the severity of the neurological deficit that can cause confusion because the reality is that the degree of displacement of the fragments that occurs at the time of the injury cannot be determine in a radiographical study. The cascade effect of events that occurs secondarily to the initial lesion (dimensions of space and blood supply) increase this discrepancy even more.[10-13]

We could not establish a statistical correlation between contiguous and non-contiguous fractures and neurological injury, so we must deduce that the presence or absence of the latter is independent of the type of fracture. Rovinovici et al.[14] comment that the diagnostic studies are related to it, finding a higher frequency of neurological damage in patients with contiguous fractures of up to 68%, as compared to our study with 65.95%, than for patients with non-contiguous fractures, with a frequency of 32%, as compared to our 34.05%.[5, 9]

However, we did observe a direct, statistically significant relationship between the severity of the bone lesion and the spinal cord damage caused in all those lesions that involved fractures at the cervical or thoracic levels versus those in which the lesion occurred below the medullary cone, regardless of the injury or the complexity of the fracture.[15]

According to the global literature, the bone levels affected with greater frequency are T11 to L4, peaking at T12 to L1 according to Reid et al.[16] However, our study found a prevalence of the predominant lumbar segment at the L1-L2 junction. Currently, the type of neurological and vertebral damage is established depending on the magnitude of and direction in which the force was applied, as well as the specific structural properties of the segment subject to the load. The thoracic spine segment, with its facet joints oriented in a coronal plane and its costal joints, is relatively stable when subjected to torsional forces, however, the kyphotic alignment in the sagittal plane places the center of gravity at a point anterior to T7, making it more susceptible to injuries from forces of flexion and compression. Unlike the lumbar spine with its lordosis in the sagittal plane, it experiences greater movement. These anatomical and mechanical differences join in the thoracolumbar region, making this region highly prone to injuries.[16]

It is evident that vertebral fractures and in particular multiple fractures are injuries that in almost half of the cases are accompanied by lesions to the vital organs that can put the life of the patient at risk.

The categorization of these lesions, as we have suggested, has great clinical importance from the prognostic point of view, since it permits us, first of all, to locate the group to which the pattern of the fracture belongs and later to establish the probability that the individual has neurological injury or not with 12% variability. Unlike what is reported in the literature about the frequency of neurological lesions that accompany these fractures, in our group we observed that the number of neurologically intact patients was only 29.78% (14/47 patients), while 42.58% of them presented complete neurological injuries, which would be reflected in the subsequent disability that they would suffer and the difficulty in reintegrating into the work environment.

We believe that this categorization provides the basis for the study and documentation of patients with multiple vertebral fractures and is of great value from the prognostic point of view.[17]

CONCLUSIONS

The handling of multiple vertebral fractures presents more complexity to both the medical team and the family and social environment in which the patient lives. Its assessment implies the making of decisions that are still being discussed in the international medical literature. It is a much more common pathology than is believed to be and the need for specialists with the ability of resolve this type of fracture is of utmost importance.

The satisfactory clinical evolution presented by the patient, both in their neurological recovery and in their reincorporation into their daily work, as well as the results observed radiographically, permit a recommendation of surgical management of multiple fractures, customizing each case and deciding about the approach in accordance with the characteristics of each fracture, which can be expected to achieve favorable results. Rehabilitation will not offer changes in neurological status, however it will allow patients to adapt themselves to their new condition in a better way. Early recognition of this type of lesion is essential for an appropriate therapy and to reduce morbidity and mortality, especially for the associated complications and the elevated probability of multi-organ involvement, which on several occasions is

not discovered by the first contact physician in emergency services. In injured patients, the conventional neurological exam may be impossible due to shock, unconsciousness, or associated injury, and it is recommended that the spine be studied in its entirety, initially with radiographs, as soon as possible in all patients who suffer a significant level of vertebral trauma. Special attention must be paid to the craniocervical junction since a lack of knowledge about the anatomical region and its diagnostic complexity may favor an easily overlooked diagnosis associated with fractures in this region.

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REFERENCES:

1. Allen BL, Ferguson RL, Lehman TR, O´Brien RP. A mechanistic classificationof closed, indirect fractures and dislocations of the cervicalspine. Spine (Phila Pa 1976).1982;7(1):1-27.
2. Crenshaw AH. Campbell Cirugía Ortopédica. México: Ed Medica Panamericana; 2015.
3. Gupta A, el Masri WS. Multilevel spinal injuries: Incidence, distribution and neurological patterns. J Bone Joint Surg Br. 1989;71(4): 692-5.
4. Inamasu J, Guiot BH. Thoracolumbar junction injuries after motor vehicle collision: are there differences in restrained and nonrestrained front seat occupants? J Neurosurg Spine. 2007;7(3):311– 4.
5. Magerl F, Aebi M. A comprehensive classification of thoracic and lumbar injuries. In: Aebi M, Thalgott JS, Webb JK, eds. AO ASIF Principles in Spine Surgery. Berlin: Springer; 1998. p.20–41.
6. American Spinal Cord Injury Association. International Standards for Neurological Classifications of Spinal Cord Injury Revised 2000. Chicago: ASIA; 2000.
7. Hadden WA, Gillespie WJ. Multiple level injuries of the cervical spine. Injury 1985;16(9):628-33.
8. Jorgensen DR, Joseph J Jr. Multiple noncontiguous spine fractures at four levels in a neurologically intact patient. J Trauma. 1996;41(4):750-3.
9. Henderson RL, Reid DC, Saboe LA. Multiple noncontiguous spine fractures. Spine (Phila Pa 1976). 1991;16(2):128-31.
10. Keenen TL, Antony J, Benson DR. Non-contiguous spinal fractures. J Trauma. 1990;30(4):489-91.
11. Magerl F, Aebi M, Gertzbein SD, Harms J, Nazarian S. A comprehensive classification of thoracic and lumbar injuries. Eur Spine J. 1994;3(4):184-201.
12. McCullen G, Vaccaro AR, Garfin SR. Thoracic and lumbar trauma: rationale for selecting the appropriate fusion technique. Orthop Clin of North Am. 1998;29(4): 813-28.
13. Maynard FM Jr, Bracken MB, Creasey G, Ditunno JF Jr, Donovan WH, Ducker TB, et al. International standards for Neurological and functional classification of spinal cord injury. Spinal Cord. 1997;35(5):266-74.
14. Rabinovici R, Ovadia P, Mathiac G, Abdullah F. Abdominal injuries associated with lumbar spine fractures in blunt trauma. Injury. 1999;30(7):471-4.
15. Reid DC, Henderson R, Saboe LA, Miller JD. Etiology and clinical course of missed spine fractures. Trauma. 1987;27(9):980-6.
16. Korres DS, Katsaros A, Pantazopoulus T, Hartofilakidis-Garofalidis G. Double or 986. multiple-level fractures of the spine. Injury. 1981;13(2):147-52.
17. Saboe LA, Reid DC, Davis LA, Warren SA, Grace MG. Spine Trauma and associates injuries. J Trauma. 1991;31(1):43-8.