Gaucho's fracture: An unusual mechanism of lumbar burst fractures in horse riders

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ABSTRACT
We discuss two cases of lumbar burst fractures at the fourth lumbar spine vertebra (L4) in patients engaging in a type of horse-riding activity known as *jineteada gaucha*, in which the horse falls on its back, holding the rider against the ground.
Keywords: Vertebral fractures; lumbar spine; horse riders; *gaucho*.
Level of Evidence: IV

Fractura del gaucho. Mecanismo inusual de fracturas lumbares bajas de tipo estallido

RESUMEN
Comunicamos dos casos de fracturas lumbares bajas de tipo estallido con compromiso de la cuarta vértebra lumbar (L4), en pacientes que desarrollan la actividad conocida como "jineteada gaucha", quienes sufrieron una caída de tipo "voleo", en la cual el caballo cae hacia atrás sobre su dorso aprisionando al jinete contra el suelo.
Palabras clave: Fractura vertebral; lumbar; mecanismo lesional; jineteada; gaucho.
Nivel de Evidencia: IV

INTRODUCTION

Fractures of the lower lumbar spine are relatively uncommon and have specific characteristics. The most common fractures of the spinal column are located in the thoracolumbar junction (T10–L2), which comprises the transition between the rigid thoracic spine and the mobile lumbar spine.[1] Unlike the thoracolumbar junction fractures, the lower lumbar (L3–L5) fractures represent <4% all spine fractures.[2-4]

In relation to lumbar burst fractures, published series consider as the main mechanism of injury motor vehicle accidents, falls from a height, and, to a lesser extent, direct trauma.[2-8]

Numerous publications address spinal injuries associated with horseback riding and other equestrian activities.[9-18] Some articles consider horse riding overall injury risk similar to motorcycle racing and collision sports, such as rugby.[9]

Additionally, several sport and cultural activities involving horses entail different specific risks. There are American publications that address rodeo activities. Boham and O'Connell reported an unusual mechanism of injury in rodeo athletes that results in a thoracolumbar Chance fracture.[10]

We present 2 cases of fractures at the fourth lumbar vertebra (L4) caused by a "flip-over" fall—where the horse falls on its back and imprisons the rider against the ground—during the *jineteada gaucha*, a characteristic and traditional horse taming activity in the gaucho culture and folklore of Argentina, Paraguay, Uruguay, and southern parts of Brazil.

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Both patients were treated by our team, between January and October 2016. The surgical treatment was performed through a single posterior approach, with posterolateral decompression, dural sac repair, and using a long spinal fusion.

We described the following variables: 1) classification of spinal fractures (according to the AO Classification);[19] 2) neurological status at admission, according to the American Spinal Injury Association (ASIA) scale;[20] 3) spinal canal occupation ratio on a CT transverse section, taking as reference the canal area at the third healthy lumbar vertebra, the area occupied by the retropulsed bony fragments of the posterior wall (AFL4) was measured and its percentage ratio was calculated (canal occupation percentage ratio = AFL4/ACL3 X 100%);[21] measurement of segmental kyphosis through the Cobb method by measuring the angle formed between a line drawn parallel to the superior endplate of the vertebra above the fracture and a line drawn parallel to the inferior endplate of the vertebra below the fracture;[22,23] vertebral body compression percentage, defined as the percentage ratio between the anterior height of the fractured vertebra and the average anterior height of the healthy adjacent vertebral bodies;[22] 6) patient's postoperative evolution (6 months) for clinical outcome, using the Visual Analog Scale (VAS) and the Oswestry disability index (ODI).[24]

We described in detail the mechanism of injury shared by both patients and its association with the *jineteada gaucha*.

CASE 1

A 24-year-old male horseback rider, who is a participant of the "Doma y Jineteada Gaucha" festivals, was competing in an event, in the district of Dolores, Buenos Aires province, Argentina. During his performance, the horse stood up on his back legs and fell backwards—accident known as horse "flipping over"—and imprisoned the rider against the ground, compressing and flexing the rider's trunk (Figure 1).

Figure 1. Case 1. Mechanism of injury.

The patient was transported to the regional hospital emergency department from where he was referred to our center through his health insurance provider. At admission, the patient was alert and lucid (Glasgow Score was 15/15), hemodynamically stable and had incomplete cauda equina syndrome (grade B according to the ASIA scale).[19] CT scans and X-rays were taken of the cervical, thoracic, and lumbar spine. Imaging revealed lumbar burst fractures at L4, with a large retropulsed fragment of the posterior wall into the spinal canal and dural sac impingement. MRI showed no lesions to the posterior ligament complex, thus, according to the AO classification, we classified the L4 fracture as A3, N3, M0 (Figures 2 and 3). There was no significant kyphotic deformity and the vertebral body compression was <50%. After establishing the presence of an associated liver injury, the patient underwent an emergency laparotomy and then remained in the ICU.

Figure 2. Case 1. CT transverse section.

Figure 3. Case 1. CT sagittal section.

The surgery consisted in a posterior lumbosacral approach, with direct posterolateral decompression using the eggshell procedure, L4 posterior arch resection and reduction of retropulsed fragments.[25-27] A long lumbosacral fusion (L2-S1) was performed (Figures 4 and 5).

Figure 4. Case 1. Postoperative radiographic assessment (profile).

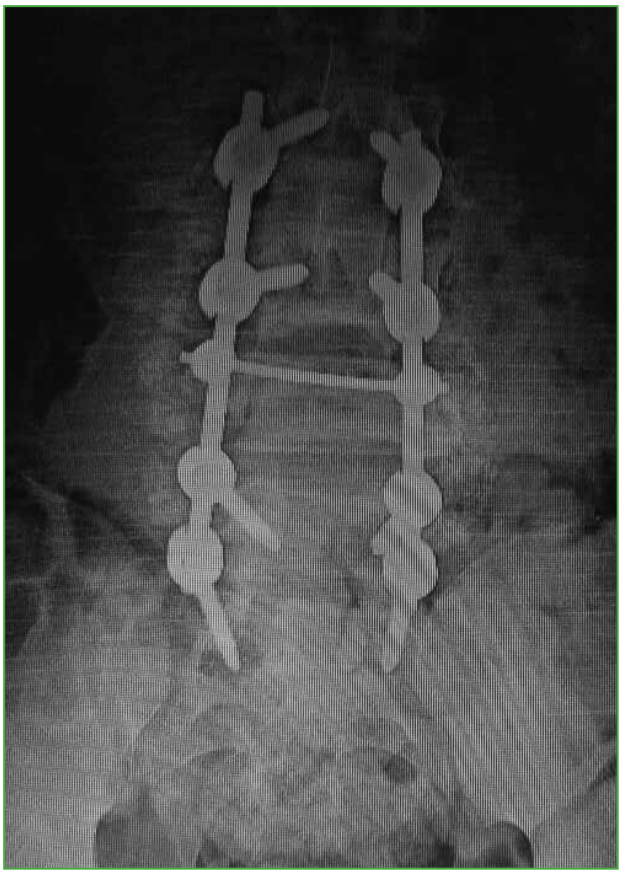

Figure 5. Case 1. Postoperative radiographic assessment (anteroposterior).

The patient had a favorable course with a healed surgical wound. Rehabilitation therapy is instituted in the immediate postoperative period. At 6-month postoperative follow-up, segmental kyphosis correction was confirmed by radiographic measurement (Cobb L3-L5: 33°; Lumbar Lordosis [LL]: 44°; Pelvic Incidence [PI]: 44°; PI-LL: 0°; Pelvic Inclination: 18°). The patient regained full sensibility and evolved with a residual partial motor deficit on L4 left nerve roots, and active extension of the foot (grade 3: movement against gravity). The 2-year follow-up CT showed bone healing (Figure 6). The patient was able to ride horses again (Figure 7 and video ▶).

Figure 6. Case 1. Postoperative CT assessment.

Figure 7. Case 1. Return to daily activities.

CASE 2

A 17-year-old male farmhand and horse rider. The patient is admitted to the emergency department (of another center) for a spine trauma caused by a mechanism of injury similar to the one patient 1 sustained, al "flip-over" fall from his horse during a *jineteada gaucha* (Figure 8).

Figure 8. Case 2. Mechanism of injury.

At admission, the patient was alert and lucid (Glasgow Score was 15/15), and hemodynamically stable. The neurological examination reveals paresthesia in both lower limbs (grade D according to the ASIA scale). X-rays, CT and MRI scans were taken of the cervical, thoracic, and lumbar spine and showed a burst fracture of the L4 vertebral body with multiple large fragments of the posterior wall in the spinal canal and a L3-L4 subluxation, According to the AO classification, we classified the injury as type C: L3-L4 (L4: A3, N3) (Figures 9 and 10).

Figure 9. Case 2. Initial radiography (profile).

Figure 10. Case 2. CT transverse section.

The surgery consisted in a posterior lumbosacral approach, with direct posterolateral decompression using the eggshell procedure, reduction and long lumbosacral fusion (L2-S1) (Figures 11 and 12).

Figure 11. Case 2. Postoperative radiographic assessment (anteroposterior).

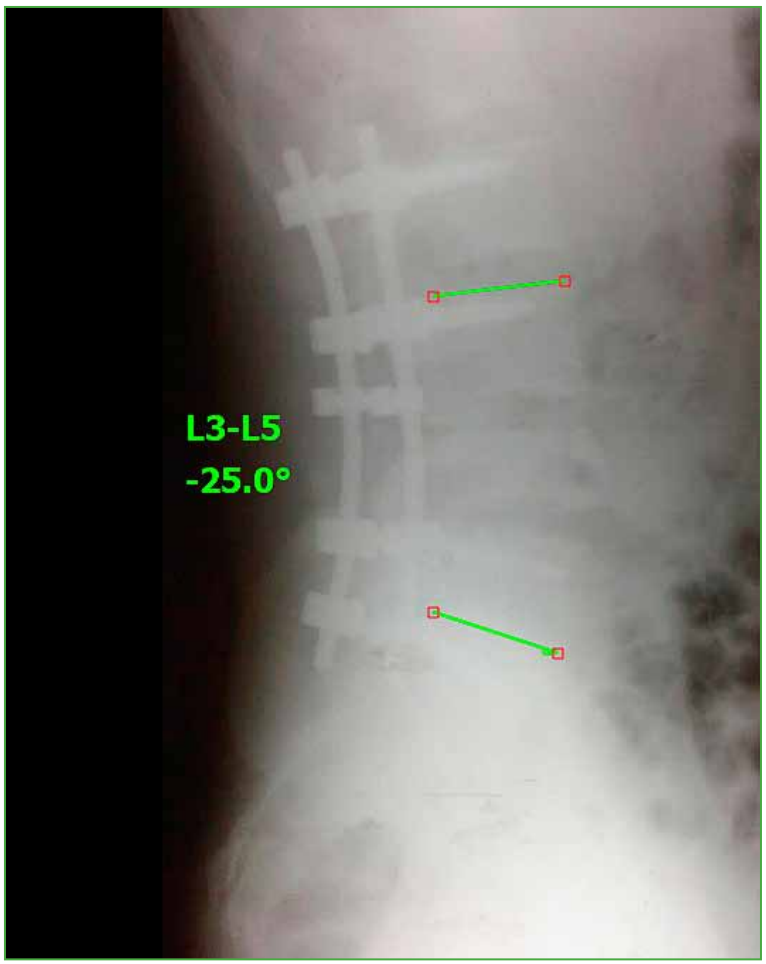

Figure 12. Case 2. Postoperative radiographic assessment (profile).

The patient had a favorable course with full neurological recovery. At 6-month postoperative follow-up, segmental kyphosis correction was confirmed by radiographic measurement (Cobb L3-L5: 25°; Lumbar Lordosis [LL]: 39°; Pelvic Incidence [PI]: 40°; PI-LL: 1°; Pelvic Inclination: 8°).

Table 1 shows the outcomes with respect to the AO classification, the ASIA scale, the spinal canal occupation ratio, the L3-L5 segmental kyphosis, and the VAS and ODI at 6-month postoperative follow-up.

Table 1. Patients' characteristics

Patient	Classification	ASIA scale	Canal occupation ratio (%)	Vertebral body compression (%)	Segmental kyphosis L3-L5*	VAS* score	ODI*
1	L4: A3; N3	B	100	40	-33° (lordosis)	3	23
2	C:L3-L4 (L4: A3; N3)	D	95	50	-25° (lordosis)	2	26

*At 6-month follow-up. ASIA = American Spinal Injury Association; ODI = Oswestry Disability Index; VAS = Visual Analogue Scale.

MECHANISM OF INJURY: "SACROPELVIC IMPACTOR"

In both cases, the patients sustained trauma secondary to a fall impact of both rider and horse when the horse "flipped over" backwards, falling on its back and imprisoning the rider against the ground. The riders were trapped between the saddle and the ground with their lumbopelvic region forced into upward hyperflexion, thus bearing the animals' weight on their ischium and sacrum. As the patient in hyperflexion remained still with S1 superior vertebral plate parallel to the ground (Figures 13 and 14), his pelvis and sarcum acted as a true impactor where the combined forces of the animal's weight and its fall on the low lumbar spine are focused resulting in L4 burst fracture.

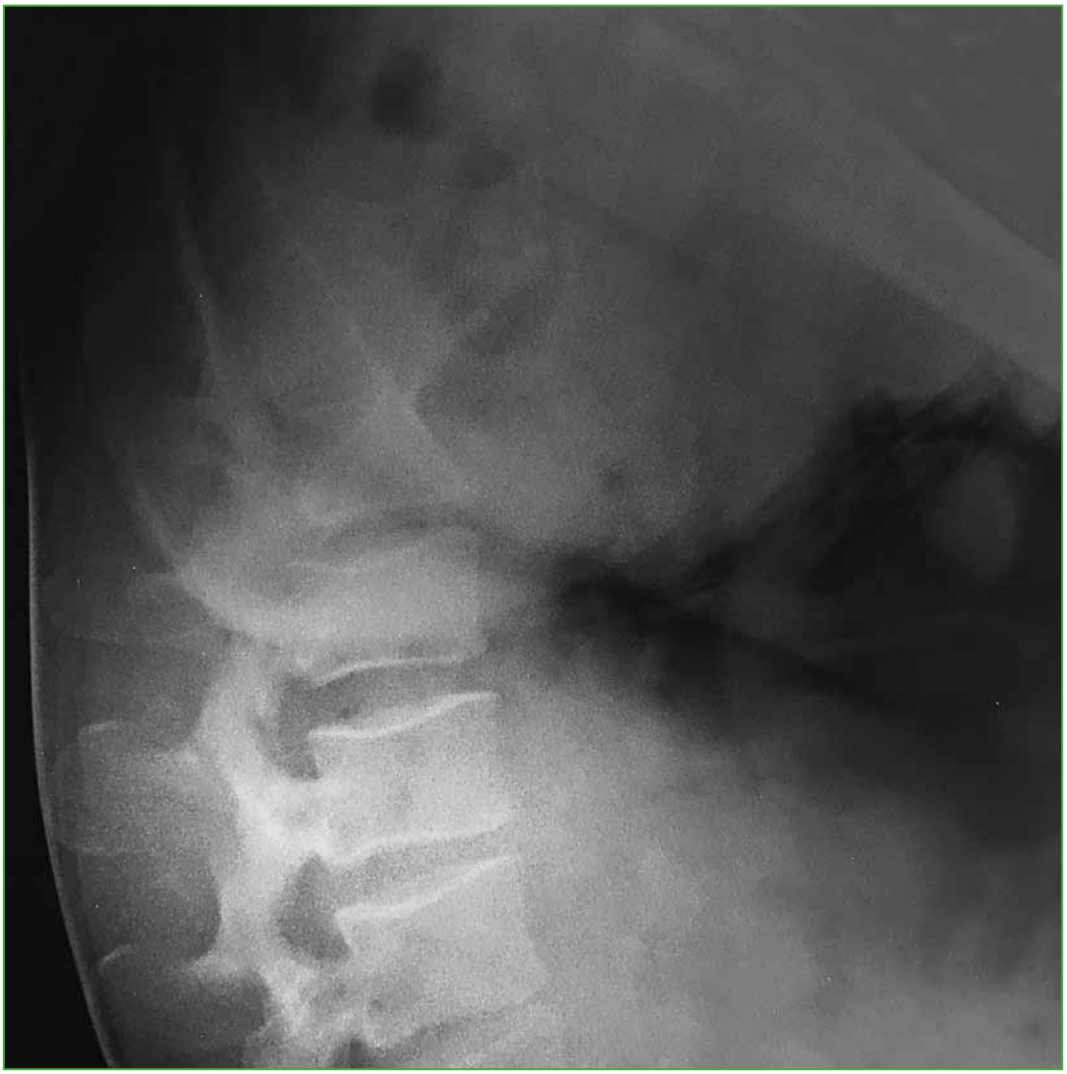

Figure 13. Radiographic assessment of the mechanism of injury.

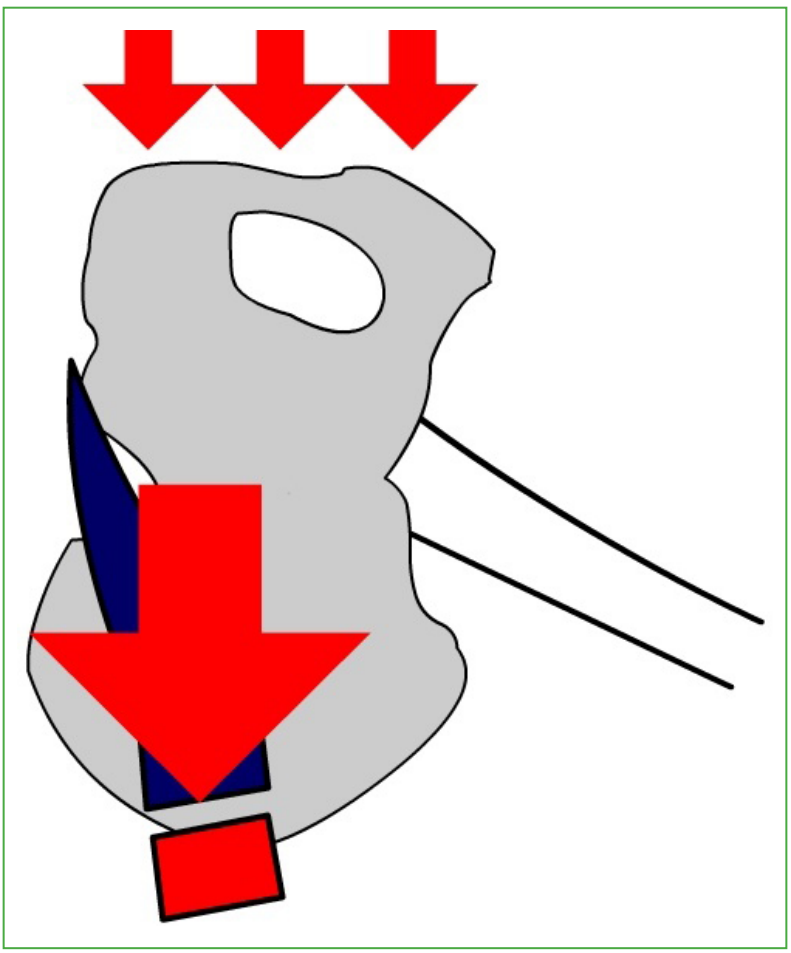

Figure 14. Proposed mechanism of injury.

DISCUSSION

The *jineteada gaucha* has its roots in the *gauchos'* ranching activities and rural work, and is a blend of folklore traditions. The *jineteada gaucha* is part of the folklore of Argentina, Paraguay, Uruguay, Brazil and Chile, and is linked to the regional, cultural features of the *gaucho*. The objective of this equestrian activity is for the rider to stay on the back horse for a specified time. When this time elapses, a bell rings. The four factors judges consider are: the rider, the horse, the spurs, and the elegance. Riders must wear regulation clothing so as to preserve *gauchos*' traditions. Among the *jineteada gaucha* tournaments, one of the most important is the "Festival Nacional e Internacional de la Doma y Folcklore de Jesús María," which takes place once a year, in January, in the province of Córdoba.[28]

Horse related sports entail a risk of spine injury similar to that of motorcycle racing, according to recently published series. Such risk may be due to the weight and biomechanical differences between humans and horses; horses can weigh up to 500 kg, their speed can range from 50-65 km/h and their kick generate a force up to 1.8 times their body weight.[9]

Several published series have estimated a greater morbidity and mortality rate associated with the axial skeleton: skull, thorax, and spine. The amount of spine injuries vary between 13% and 17%. Siebenga *et al*. studied a series of spine fractures in 32 horse riders and found that most of the spine fractures occur at the thoracolumbar junction, that the most common mechanism was compression, and only three cases of lower lumbar fracture.[9]

The lower rate of low lumbar spine fractures may be associated with distinct biomechanical characteristics: greater mobility in the flexion-extension plane, stability provided by the iliolumbar ligaments and the pelvic brim.[3]

The relevance of these type of injuries lies on the potential neurological damage in the cauda equina, the impact on the physiological lordosis and the potential sagittal imbalance.[3,5]

The treatment plan proposed in the literature includes the following techniques: indirect reduction, short posterior fusion, long posterior fusion, anterior corpectomy, and intersomatic fusion; and the following complications have been reported: flat-back syndrome, pseudarthrosis, and implant failure.[2,8]

Based on what has been stated, we considered our cases to be of interest since they involved serious injuries with spinal canal involvement and dural injuries at the cauda equina level, where our execution of the single posterior approach allowed us to treat the injury in its entirety: fracture reduction, decompression, extraction of intradural bony fragments of the posterior wall, duraplasty, physiological lordosis recovery, and stabilization, with a good evolution at the 2-year follow-up.[29,30]

We have photographic records of both cases showing the identical mechanism of injury caused by the horse flipping over backwards and the lumbopelvic compression. Therefore, we consider it is worth making a specific description that may be useful for assessing the array of injuries sustained by people who practice equestrian sports such as the *jineteada gaucha* and the American rodeo.

Boham and O'Connell described an unusual mechanism of injury in rodeo athletes that produces a thoracic spine fracture when the horse bucks resulting in an alternate flexion-extension of the rider's trunk.[10]

Kaufman *et al*. described a similar mechanism in lumbar burst fractures as a result of horizontal frontal motor vehicle crashes and the direct axial compressive force transmitted through the pelvis and the ischium to the seated driver's lumbar spine.[31]

This type of lesion should be considered in accidents where animals flip over and imprison riders.

It should be acknowledged that further biomechanical studies should be conducted to corroborate the occurrence of an axial force transmitted from the pelvis and the sacrum to the low lumbar spine, and to confirm our "sacropelvic impactor" hypothesis.

Conflict of interest: Authors claim they do not have any conflict of interest.

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