Chance Fracture in Three Brothers: A Case Report

Fratura de Chance em três irmãos: relato de caso

Lucídio Duarte de Souza Filho1,
Geraldo Vitor Cardoso Bicalho1,
Bernardo Drummond1,
Rafael Stein Rosseto1,
Rodrigo Moreira Faleiro2,
Newton José Godoy Pimenta3

1Neurosurgery Resident of Fundação Hospitalar do Estado de Minas Gerais (FHEMIG), Hospital João XXIII, Belo Horizonte, MG
2Neurosurgery Division Coordinator of Hospital João XXIII, Belo Horizonte, MG
3Neurosurgeon of Hospital João XXIII, Belo Horizonte, MG.

ABSTRACT

Chance fracture, suggestive of a flexion-distraction mechanism, is an uncommon type of injury in the pediatric population. Its occurrence, with associated intra-abdominal lesions, has increased with the widespread use of seat belts. Since this type of fracture presents subtle variations on common image examinations, its diagnosis may be delayed increasing the probability of subsequent neurologic deficits. In this paper we report the case of three siblings, victims of a motor vehicle head-on collision, either presenting seat belt fracture or Chance fracture. They were treated in the Hospital João XXIII, Belo Horizonte. The case reported reinforces the hypothesis describing the fracture mechanism and associated intra-abdominal injuries.

Key words: Chance fracture; Seat belt syndrome; Thoracic-lumbar fracture

INTRODUCTION

Thoracic-lumbar fracture caused by flexion-distraction mechanism is regarded as rather uncommon in the pediatric population1,16,20. Actually, these injuries were virtually unknown before the widespread use of lap seat belts as a mean of restraint and were first formally described in 1948 by Chance2,21. Since this time, these injuries have alternatively been referred to as Chance fracture (CF) and/or seatbelt-type injuries9.

CF was originally described as a “horizontal splitting of the spine and neural arch”3,17. However, this lesion is now recognized as a flexion-distraction type injury presenting the splitting of either soft tissue or bone tissue or even both10.

This type of injury is usually followed by the called seat belt syndrome, i.e., closed abdominal trauma5,18.

In this paper we report the occurrence of CF in three siblings, victims of a motor vehicle collision (a car-truck frontal collision in a highway) admitted to Hospital João XXIII, Belo Horizonte.

Case 1

Tree-year-old male. Rear-seat occupant restrained by a two-point seat belt. Admission exam showed clinical signs of acute abdomen. Neurological exam showed no alterations. Computed Tomography (CT) showed Chance-type fracture in the second lumbar segment of the spinal cord and concomitant free fluid in the abdominal cavity (Figure 1).

Exploratory laparotomy was performed and found: caecum, ascendant colon, and terminal ileum injuries as well as mesentery and diaphragm rupture. The subject was hospitalized for 36 days due to abdominal lesion. Afterwards, he was immobilized in a Thoracic Lumbar Sacral Orthosis (TLSO). The orthosis
was removed three months after the patient’s admission. Nowadays, he is on ambulatory control due to a non-severe kyphosis, as displayed by radiographic examination.

Case 2

Twelve-year-old male. Rear-seat occupant restrained by a three-point seat belt. During admission the subject complained of lombalgy and presented abdominal traumatic lesions. Neurological exam showed no alterations. Abdominal ultrasonography displayed free fluid. CT displayed Chance-type fracture in the second lumbar segment of the spinal cord (Figure 2). Urgent laparotomy revealed splenic and renal trauma as well as mesentery. The subject remained hospitalized for 15 days. Immobilization in a TLSO was the procedure chosen. Radiographic examination displayed fracture consolidation.

Case 3

Sixteen-year-old male. Rear-seat occupant restrained by a three-point seat belt by the time of the accident. Neither motor nor sensitive deficits were found by the neurological exam. The subject complained of abdominal pain during admission. Ultrasonography displayed free fluid in the abdominal cavity. CT images showed Chance-type fracture in the second lumbar segment of the spinal cord (Figure 3). Laparotomy confirmed liver, spleen, kidneys and diaphragm traumas. Surgical procedure was chosen due to the subject’s loss of height and retropulsion of vertebral body within the spinal canal. The subject underwent posterolateral lumbar arthrodesis L1-L3 with transpedicular screw fixation. The subject was discharged from hospital 7 days later with a TLSO. Ambulatory examination has demonstrated good fusion and alignment.
Classifications have been categorizing these injuries in terms of flexion-distraction fractures\(^1\)\(^6\)\(^7\). Denis, for instance, described four subtypes of spinal column injury based on fracture morphology: compression fractures, burst fractures, seat-belt type fractures, and fracture-dislocations\(^8\)\(^18\). In Magerl's classification (AO Spine), system spinal column injuries were differentiated based on mechanism: Type A injuries were related to compression, Type B to distraction, whereas Type C to multidirectional injury, often with translation\(^9\)\(^11\)-\(^17\). However, based on individual features, fractures could be divided into further subcategories: regarding injuries secondary to a mechanism of distraction, B1 injuries primarily involve underlying ligamentous damage, B2 damage to the bony elements and B3 predominant anterior distraction\(^9\).

Although lumbar spine fractures due to seat belts are well-acknowledged in adolescents and adults, there are few reports of such injuries in young children\(^6\)\(^7\). In overall, this type of fracture presents low incidence of neurological deficit\(^1\)\(^5\)\(^7\) and accounts for 5 to 15% of all thoracic lumbar injuries\(^2\)\(^9\)\(^13\). In children, the segment most frequently injured is the L2 - L4 segment\(^17\). Non-contiguous injuries can be present in 15% of the cases\(^13\).

Since visceral lesions tend to call more attention, vertebral lesions diagnosis may go unnoticed\(^5\). Therefore, every suspected case of CF must be exhaustively evaluated in order to rule out associated intra-abdominal lesions\(^2\). Delayed diagnosis in spinal fractures contributes to neurologic deficit in 10.5% compared with only 1.4% diagnosed at initial screening\(^2\).

Intra-abdominal lesions are encountered in 30% to 50% of Chance fracture patients\(^8\)\(^11\). The most frequent are perforation or transection of small bowel, and mesenteric lacerations, but reports also include colonic perforation, splenic, pancreatic, kidney, liver, and gravid uterine rupture\(^2\).

Two tentative explanation of mechanisms for intra-abdominal injuries have been proposed: first, direct compression between the seat belt and the spine; second, entrapment of bowel above or below the level of flexion effectively generating a closed loop obstruction in the setting of increased intra-abdominal pressure\(^3\). Children are especially susceptible to Chance fractures due to an increased head-to-body ratio causing a higher center of gravity and thereby increasing the lever arm moment around the axis of rotation\(^16\)\(^16\)-\(^18\). Also, in children the iliac crests are not developed enough to serve as anchor points.
for a lap belt, which tends to slide onto the abdomen due to exaggerated lumbar lordosis.

Evaluation of patients with suspected seat belt injuries should include a thorough physical examination based on advanced trauma life support principles\(^\text{13}\), a plain radiographic evaluation of the lumbar spine, and a CT of the abdomen with contrast\(^\text{17}\). Each of these investigations has its own limitations\(^\text{17}\).

Flexion-distraction injuries are associated with significant instability and, not infrequently, subtle radiologic findings on computerized tomography (CT) imaging\(^\text{2,9,16}\). A plain lumbar radiography is the first exam to be performed. One of the alterations which may contribute to early diagnosis is the widening of posterior elements\(^\text{5}\). However, to depict fractures of the thoracic lumbar spine, CT is superior to conventional radiography due to its removal of overlapping osseous structures\(^\text{1}\). CT accurately shows vertebral column damage - specifically, the integrity of the critical middle column - and helps identify patients at risk of acute neurologic compromise\(^\text{1}\). The “dissolving pedicle sign” has been described in 76% of flexion-distraction injuries and defined as a gradual loss of definition of the pedicles at the level of the fracture\(^\text{2,9}\). Another feature known as the “naked facet sign” – representing uncovering of the articular facets secondary to distraction injury – was found in 40% of patients\(^\text{2,4,9}\). The gold standard for the diagnosis remains the Magnetic Resonance Imaging (MRI) scan\(^\text{6,17}\). MRI evaluation provides information regarding the integrity of the posterior and middle column ligaments, annulus fibrosis, and spinal cord in neurologically injured patients\(^\text{2,12,14}\). MRI may also reveal the presence of disk herniations and epidural hematomas\(^\text{2,6}\).

CF is considered unstable and requires stabilization procedures either by internal or external fixation\(^\text{2,22}\). Focal kyphosis > 30 degrees and/or loss of height >50% are suggestive of compromised posterior ligamentous complex and instability in these fractures\(^\text{9}\). The treatment of this type of fracture depends not only on the severity of the injury but also on the fracture pattern\(^\text{16}\). Conservative treatment is indicated for lesions in patients without neurological deficits\(^\text{5}\). Immobilization is done either with a plaster extended castor a TLSO from three to five months, until signs of bone consolidation are observed\(^\text{8}\). Indications for operative management may include significant soft tissue (ligamentous) injury, displaced fractures, progressive kyphosis, or appreciable initial kyphosis\(^\text{5}\). Surgical procedure with open reduction, internal fixation, and fractured segment arthrodesis allow deformity correction and early mobilization while avoiding the use of orthesis as well as preventing faulty alignment and late neurological lesions\(^\text{8}\). Surgical modalities include short fixation, transpedicular screw fixation, posterolateral arthrodesis and medullary decompression when needed\(^\text{11}\).

**CONCLUSION**

The cases reported reinforce hypotheses on Chance fracture mechanisms and associated abdominal trauma. The location of the fractures for all 3 cases also confirms the prevalence of lumbar spinal lesions. Moreover, it had been observed that younger patients with less body mass presented less severe fractures, allowing for a conservative treatment attempt. The heavier patient, i.e., the one with higher body mass presented a more complex fracture which required surgical intervention. Although we have not found any relations between body mass and trauma severity, this study, due to its peculiarity – a three-brother case, all injured at the same time with the same mechanism trauma – allow us to conclude that the single factor contributing to the variation in the level of severity must be the body mass, being it the possible factor why such fractures are commonly rare in children.

**REFERENCES**


/comments
The authors report an unusual situation of three brothers with the same type of fracture. Both the occurrence and the treatment lead to discussion of two facts regarding the Chance’s fractures:
1. The biomechanical aspects of an injury related to seat belt in high-impact car crashes. 2. The different options of treatment. Although “unstable” situations (type B1, or distraction fractures according to AO), these are pure osseous injuries, and therefore able to consolidation through the fracture line. Thus, immobilization with an extension corset can lead to good clinical and radiological results, as in two of the reported cases. Surgical treatment is an option not only in higher risk injuries (as supposed to be the third case reported) but also to avoid pseudoartrosis and to provide early mobilization. For some authors, this is a routine even in paediatric population.


jerônimo buzetti milano

Corresponding Author
Lucidio Duarte de Souza Filho Neurosurgery Resident Fundação Hospitalar do Estado de Minas Gerais (FHEMIG) Hospital João XXIII, Belo Horizonte, MG lucidioduarte@yahoo.com.br