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Thoracolumbar distraction fractures in advanced pregnancy: a contribution of two case reports

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Abstract Thoracolumbar trauma in pregnant women is an important topic, though rarely discussed in the pertinent literature. Two consecutive cases of thoracolumbar distraction injuries in advanced pregnancy are presented. Conservative treatment failed in both cases; surgical management was necessary on a delayed basis using compression instrumentation. The similar features of the pattern of injury in the two patients suggest a cushioning effect of the gravid uterus. A theoretical analysis of the pathomechanics is carried out in an

attempt to explain the specificity of flexion-distraction injuries in victims in an advanced stage of pregnancy. The authors suggest that the spine pivots about the fetus, and so is injured more in tension than in compression. The damage is mainly to soft-tissue structures, while anterior column compression and axial loading are less important.

Key words Pregnancy · Thoracolumbar fractures · Flexion-distraction injuries

Introduction

Thoracolumbar trauma in advanced pregnancy is rarely reported. Research of the obstetric literature revealed a considerable number of publications dealing mainly with the problems of pregnancy, labor and delivery in pregnant women with head, chest, intra-abdominal and spinal cord injuries. The main issues tackled are maternal and fetal mortality and morbidity [1, 5, 11–13, 15, 20, 21]. The pertinent orthopedic literature contains only a number of articles on spinal fractures and spinal cord injuries during pregnancy [16, 17], with none on the specific topic of flexion-distraction injuries of the thoracolumbar spine in pregnant women.

Flexion-distraction injuries were first described some 50 years ago [2, 3], but the pathomechanical concepts and classifications are evolving continuously, distinguishing new categories from the usual types of injuries and justifying distinct methods for their treatment [6, 8, 9, 14, 19].

The purpose of this paper is to report two similar cases of thoracolumbar distraction injuries in female patients in

advanced pregnancy, and to present some details of the pathomechanics and pattern of injury of this specific spinal trauma.

Case reports

Case 1

A 20-year-old woman was involved in a motor vehicle accident. At the moment of collision she was seated unbelted next to the driver, and was ejected from the car. She fell on her upper back and shoulders, and the lower part of her body was forcibly flexed forwards. At the time of the accident the patient was in the 7th lunar month of her pregnancy. She was not wearing a seat-belt because of concern that a sudden stop or accident could be harmful to her baby if the belt were to press against her abdomen. She was admitted to the local hospital, where a spinal fracture of T12-L1 without neurologic deficit was diagnosed. The pregnancy was not disturbed. Bed rest and mild spinal extension over pillows were applied. This treatment continued for 12 weeks, and the patient delivered a mature and healthy child by cesarean section. In the following months, the patient suffered increasing back pain with irradiation to the lower abdominal region and lower extremities, associated with intermittent paresthesias. She was transferred to our hospital 11 months after the injury. Plain radiographs revealed a

Fig. 1 Lateral (A) and antero-posterior (B) radiographs of case 1, 11 months after the accident and a failed conservative treatment, documenting a predominantly soft-tissue distraction lesion of T12-L1, with an avulsion fracture of the right transverse process, a split fracture of the left transverse process of L1 and minimal wedge compression of the L1 vertebral body

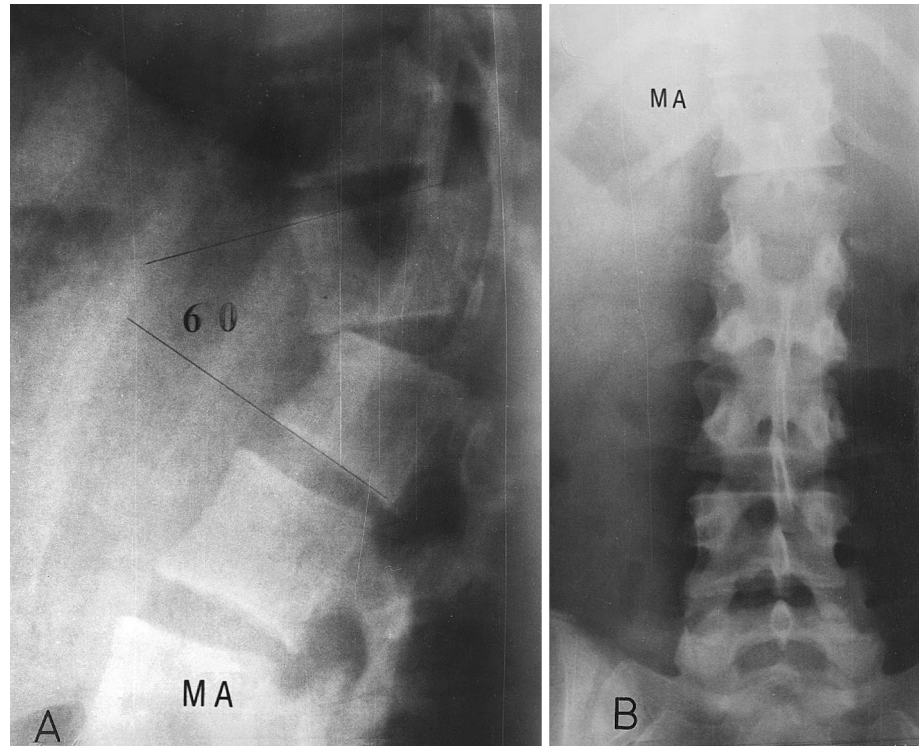
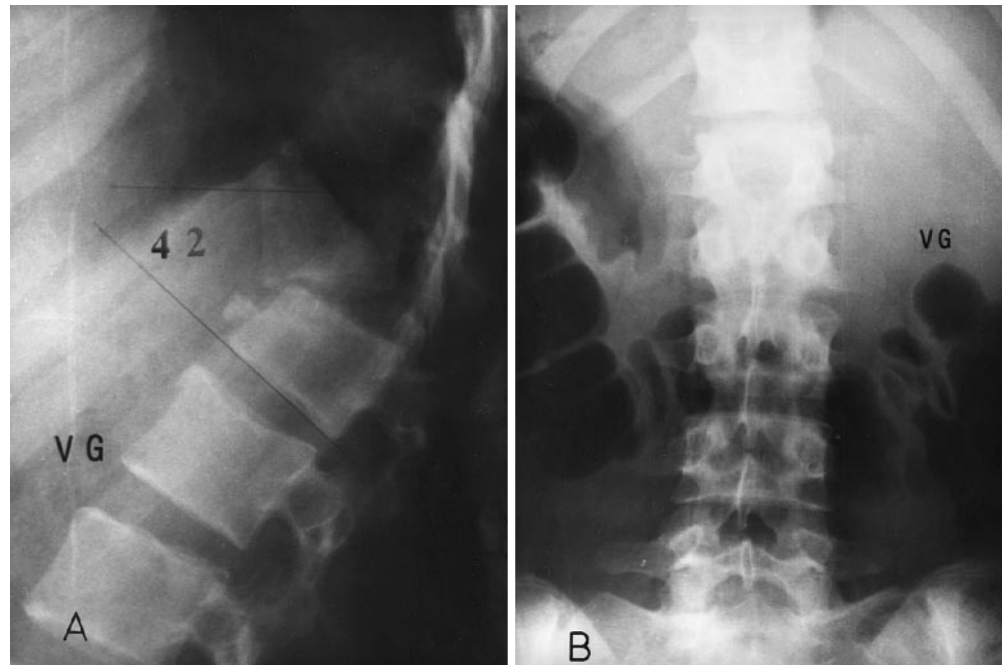


Fig. 2 Lateral (A) and antero-posterior (B) radiographs of case 2, 4 months after the accident and a failed conservative treatment, showing a similar distraction lesion of the same level (T12-L1) as in case 1



highly unstable, predominantly soft-tissue distraction injury of T12-L1, with a concomitant avulsion fracture to the right, and a split fracture to the left, of the L1 transverse processes, and a mild wedge compression of the L1 vertebral body (Fig. 1). We performed open reduction and posterior compression instrumentation. A satisfactory reduction and stability of this inveterate injury was achieved. Posterior fusion with autografts from the iliac crest was also performed. At the last follow-up examination, 18 months after

the operation, the patient had no complaints, and no signs of neurologic compromise were present.

Case 2

A 19-year-old woman suffered a severe automobile accident. She was in the 6th lunar month of pregnancy, and was travelling un-

belted on the back seat. She was ejected from the car and fell on her upper back, rolling over several times. In the emergency department of the nearest hospital, a spinal fracture of T12-L1 was diagnosed. No other injury was found, but within 24 h the patient had a spontaneous abortion. Conservative reduction over pillows and bed rest were implemented. After 8 weeks the patient was allowed to walk with a total-contact thoracolumbosacral orthosis. Lateral and anteroposterior radiographs were taken 4 months after the accident, revealing failure of the conservative treatment and showing a similar inveterate lesion of T12-L1 as was found in case 1. A small avulsed fragment from the anterior rim of the L1 upper endplate was present additionally. Segmental instability with significant kyphotic deformity was evident (Fig. 2). Initial neurologic deficit, including paresthesias and numbness in the lower extremities, was present. The patient was transferred to our hospital and we performed open reduction and posterior stabilization. A posterior fusion with autografts from the iliac crest was also carried out. At the 12-month follow-up examination the patient had no complaints and no neurologic compromise.

Discussion

The flexion-distraction fracture, initially described by Chance [3], was considered a purely bony injury of the spine, in which a horizontal splitting of the vertebral body resulted from a hyperflexion force. The axis of flexion is usually situated anteriorly and the thoracolumbar spine is subjected to large tensile strains. Historically, the seat-belt was accepted to be the typical fulcrum around which rotation occurred during automobile crashes. The bony elements or intervertebral disks and ligaments are ruptured or avulsed, and not smashed, as typically happens in most hyperflexion spinal fractures [6, 7, 9, 10, 19]. Smith and Kaufer [19] believed that this specific transverse pattern of lumbar spine injury is extremely rare in unbelted victims. However, "seat-belt-type injuries" attributed to wearing modern seat-belt devices are rather uncommon today.

The three-column spine concept of Denis [6] in acute spinal trauma is generally acknowledged. However, Denis also recognises the occurrence of partial failure of the anterior parts of the vertebral body under compression in some flexion-distraction fractures. Gertzbein and Court-Brown [8] developed a classification of flexion-distraction injuries, based on identified trauma to both anterior and posterior elements and the resulting axial load failure of the vertebral body (wedge compression or burst fracture) in many cases. Such patterns of injury, which seem to be relatively common (85% in their series), occur in accidents with sudden deceleration of high-gravity forces. The authors assume that in fractures associated with low-gravity forces, the mechanism of injury is that of pivoting around the seat-belt, which results in a typical distraction of the posterior elements and lack of anterior compression of the vertebral body.

The comprehensive classification of thoracic and lumbar injuries proposed by Magerl et al. [14] is primarily based on pathomorphological criteria, and makes a substantial contribution to the detailed identification of spinal

fractures. The authors state that exact recognition of the nature of the lesion, its degree of instability and prognostic aspects are decisive for the choice of the most appropriate treatment.

Trauma during pregnancy is discussed mainly in the obstetric literature [1, 4, 5, 11, 12, 17, 18, 21], but we did not find a single report on flexion-distraction spinal injuries in pregnant women. However, we did find papers questioning compulsory wearing of seat-belts for pregnant women because of the possible damage to the gravid uterus by forced compression in car accidents. It was proposed that seat-belts should be specially constructed for pregnant passengers [18]. Despite a general agreement that seat-belts reduce morbidity and mortality rates, it is well known that passengers and drivers in advanced pregnancy avoid wearing restraints, and thus expose themselves to various injuries. Our patients were also not wearing seat-belts at the moment of the accident. The mechanism of trauma was hyperflexion of the spine. The presence of advanced pregnancy in both cases seemed to determine the similar pathomechanics and pattern of the "pregnant-woman-type injuries" sustained. We carried out a theoretical analysis of the biomechanical situation, which suggested that the pregnant uterus could have a cushioning effect, resulting in decreased forward bending of the thoracolumbar juncture. When a low-energy impact is applied, the inertial force is resisted by the gravid uterus and amniotic fluid. This condition leads to a diminished compression or axial loading on the anterior parts of the vertebral body, and an increased distraction of the posterior and middle columns. All columns fail in tension, and the injury observed affects predominantly soft-tissue structures, i.e., it is a discoligamentous lesion. The accompanying avulsion fractures of the transverse processes are also a result of distractive forces, and constitute another characteristic pathomorphological feature. We believe there is enough evidence to assume that this one-level, soft-tissue distraction lesion (according to the Denis classification [6]) or B1.1 subgroup injury (according to Magerl's classification [14]) is specific to women in advanced pregnancy. However, it must be emphasized that this typical pathomechanical situation depends on the magnitude of the uterus. When its radius is shorter, the bending moment acting on the anterior column is greater. This explains the lack of cushioning effect in the early months of pregnancy, when the patterns of injury may have the features of the usual flexion-distraction fractures. On the other hand, in cases with a bending moment of high energy, the resistance of the gravid uterus can be overcome and serious damage to mother and fetus may occur, including compression and axial overloading of the anterior column. Nevertheless, it may be assumed that, even in such cases, the protective effect of the pregnant uterus may be maintained momentarily, and the damaging forces may be dissipated to some extent.

Although rare, the description of thoracolumbar distraction injuries in these two pregnant patients may be of

practical interest. The two cases sustained a similar trauma and pattern of injury, and would have required a similar treatment approach. The predominance of soft-tissue lesions explains the failure of conservative treatment, because of their poor healing potential, and we conclude from our experience with "pregnant-woman-type injuries" that primary open reduction and stabilization are indicated

in these cases. Posterior compression instrumentation with pedicle screws and posterior fusion to replace the failed tension band system of the spine is the method of choice.

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