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The complexity of seat belt injuries including spinal injury in the pediatric population: a case report of a 6-year-old boy and the literature review

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We present, along with a literature review, the case report of a 6-year-old boy, involved in a high-speed motor vehicle accident, who sustained a seat belt injury of the lumbar spine. We discuss the clinical presentation of thoracolumbar fractures in children, the sensitivity of clinical examination and radiographic evaluation and the associated abdominal injuries that are commonly present with seat belt spinal injuries. Computerized tomography is limited in the detection of soft tissue spinal fractures because these fractures occur in the plain of the section. Plain lateral x-rays of the lumbar spine and computerized tomographic three-dimensional reconstruction images can be helpful but they cannot evaluate the extent of the soft tissue injury. The magnetic resonance imaging scan is the best diagnostic tool to provide the diagnosis. *European Journal of Emergency Medicine* 00:000–000 © 2007 Lippincott Williams & Wilkins.

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Introduction

In 1948, Chance [1] reported three unusual fractures of the lumbar spine in which horizontal splitting of the spinous process and the neural arch occurred. The next report of such an injury was in 1965 by Howland *et al.* [2] and it related this fracture to a car lap belt.

Thoracolumbar spine fractures are considered to be uncommon in the pediatric population; however, they might result in significant morbidity, necessitating a prompt diagnosis [3]. The purpose of this report is to promote the awareness of spinal and associated injuries in the pediatric patients.

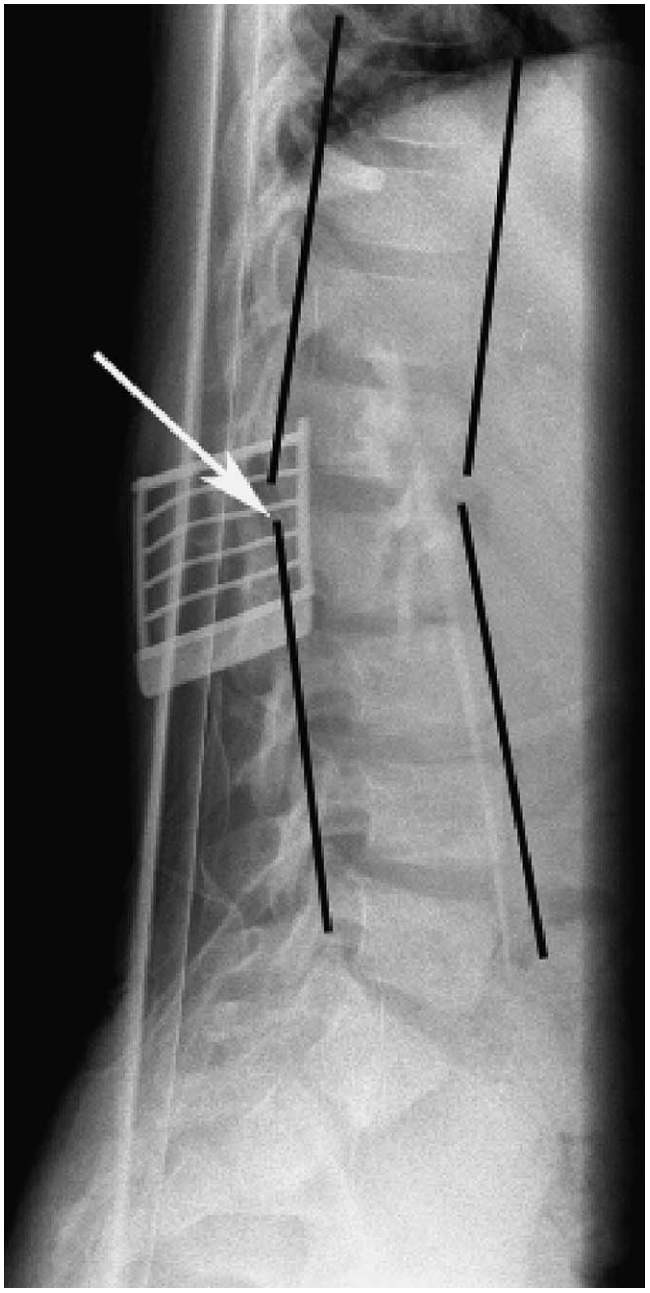
Case report

A 6-year-old boy, rear-seat passenger was involved in a high-speed motor vehicle accident (MVA). One of the passengers was killed on the spot, and two others sustained multiple injuries. Upon arrival at the accident and emergeny unit, this boy was alert and oriented (Glasgow coma scale: 15/15) with no chest or abdominal signs, and no obvious 'seat belt' sign. He had an obvious deformity to his right tibia and on log roll he had a large lumbar haematoma. Neurological examination was normal. Imaging performed shortly after the child's arrival included a plain film of the chest, pelvis, cervical spine, tibia and a lateral of the lumbar spine. The plain films revealed a spiral fracture of the proximal tibia and a possible disruption of the anterior and posterior column arcs at the L1/L2 level of the lumbar spine (Fig. 1). A computerized tomographic (CT) scan of the abdomen and the lumbar spine followed, but did not reveal any abdominal or bony pathology. The CT three-dimensional (3-D) reconstruction of the thoracolumbar spine revealed a widening of the facet joints at L1/L2 level with a possible abnormal rotation and sublaxation indicating ligamentous and facet joint disruption secondary to a hyperflexion injury but no fracture was identified (Figs 2 and 3). The subsequent magnetic resonance imaging (MRI) scan of the lumbar spine demonstrated significant soft-tissue and ligamentous injury at the L1/L2 level, showing oedema in the paraspinal soft tissues in relation to the posterior elements (Fig. 4), with facet-joint malalignment and high signal in relation to facet joints within the spinal canal (Fig. 5). The patient was transferred to the local spinal injuries unit for further management. Three days after the injury, he developed signs of abdominal peritoneal irritation for which he underwent exploratory laparotomy, which showed mesenteric tears at the ileum.

Discussion

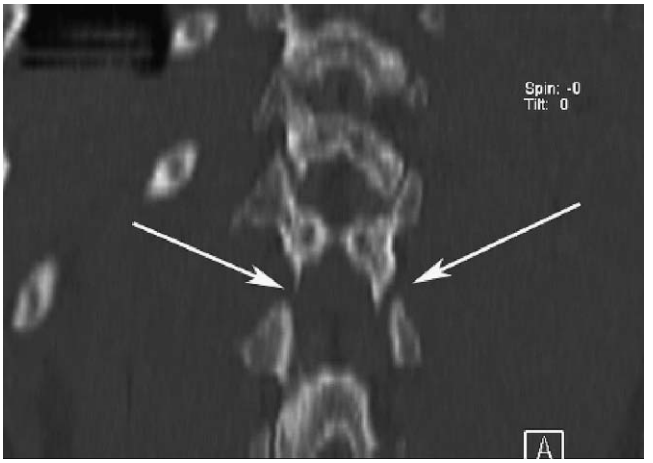
The use of seat belts significantly reduces the risk of injury or death in a collision by preventing ejection from the car and by increasing the rate of deceleration; but, because they change the distribution of forces they may be the cause of other injuries (seat belt syndrome). The spectrum of injuries included in the seat belt syndrome

Fig. 1



A marker is placed overlying the soft tissue swelling in the lower right back. The plain films reveal a possible disruption of the anterior and posterior column arcs at the L1/L2 level.

Fig. 2



The computerized tomographic three-dimensional reconstruction of the thoracolumbar spine revealed a widening of the facet joints at L1/L2 level with a possible abnormal rotation and sublaxation, indicating ligamentous and facet-joint disruption that is secondary to hyperflexion injury; but no fracture is identified.

Fig. 3

The computerized tomographic three-dimensional reconstruction of the thoracolumbar spine revealed a widening of the facet joints at L1/L2 level with a possible abnormal rotation and sublaxation, indicating ligamentous and facet-joint disruption that is secondary to hyperflexion injury; but no fracture is identified.

is: abdominal contusions, intra-abdominal injuries and distraction-type lumbar–spine injuries [4–8]. The mechanism of such injuries is that the rapid deceleration caused by the seat belt results in the compression of the abdomen and in the flexion of the upper body [4,5]. Since its original appearance [2], safer versions of seat belts (three-point restrains) have been introduced. Even if, a three-point restrain seat belt is ill-fitting (loose), a young patient can 'submarine' beneath it so that the seat belt acts as a lap belt, with the axis of rotation located near the umbilicus [5,7]. Children have a higher centre of

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Fig. 4

Evidence of significant soft-tissue and ligamentous injury exists at the L1/L2 level showing oedema in the paraspinal soft tissues in the relation to the posterior elements, with facet-joint malalignment and high signal in relation to facet joints within the spinal canal.

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gravity than adults, which increases the lever-arm movement around the axis of rotation, thus causing greater destruction [9], and making them especially susceptible to seat belt injuries of the spine. Four distinct types of seat belt injuries of the spine have been described [10].

Seat belt injuries of the spine in young children share some common features. Over 75% are associated with a head-on MVA [1,4,9–12] in which the patient had been a rear-seat passenger. In 50% of the accidents of them other passengers have been killed [10]. Almost all have also seat-belt contusions [9] and about 50% of them have an intra-abdominal injury [6,7,10,13], with 15% being reported as being paraplegic [10]. The level of the injury

Fig. 5

Evidence of significant soft-tissue and ligamentous injury exists at the L1/L2 level showing oedema in paraspinal soft tissues in the relation to the posterior elements, with facet joint malalignment and high signal in relation to facet-joints within the spinal canal.

in children is usually between L2 and L4 [4,10] with type-B injury (avulsion of the posterior elements with facet-joint disruption or fracture and extension to the apophysis of the vertebral body) being the most common [10]. Delay in the diagnosis, which can lead to higher morbidity and mortality [3], has been described [3,10,11].

Evaluation of patients with suspected seat belt injuries should include a thorough physical examination based on advanced trauma life support principles, a plain radiographic evaluation of the lumbar spine, and a CT of the abdomen with contrast. Each of these investigations has its own limitations. In particular scope of the CT is limited in the detection [14,15] of spinal soft tissue chance fractures (type B), because they occur in the plain of the section. CT 3-D reconstruction images can be valuable, but the gold standard for the diagnosis remains the MRI scan. The high-suspicion index regarding the mechanism of the injury is invaluable for its correct diagnosis.

Conclusion

Seat belt injuries can be life threatening and challenging in their management. As the pediatric population shares common factors such as being rear-seat passengers, this increases the risk of the improper use of seat belts, which, with a higher centre of gravity, puts the children at a greater risk of sustaining such injuries. Overlapping of clinical signs and symptoms such as the pain from the

lumbar spine injury masking the intra-abdominal pathology, the inherent difficulty of examining children with multiple injuries and the limitations of diagnostic imaging make these injuries challenging. Emergency physicians must be aware of these seat belt-related injuries in the initial evaluation of any child involved in a motor vehicle crash who had been restrained with the vehicle seat belt to evaluate such a complex injury correctly. Plain lateral x-rays of the lumbar spine and CT 3-D reconstruction images can be helpful but they cannot evaluate the extent of the soft tissue injury. The MRI scan is the best tool to provide the diagnosis.

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