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CASE REPORT

Thoracolumbar spinal injuries following speedboat accidents
Is it time to change the safety regulations?

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Introduction

Recreational water sports have increased in popularity in recent years. Water sport accidents have been documented extensively in the literature with peak incidences reported in coastal countries during summer time holidays.[2,14,29,30,33] However, there have been no reported cases have been documented of thoracolumbar spinal injuries following speedboating accidents nor the actual mechanism of injury encountered during these accidents.

In this article we are reporting uncommon cases of thoracolumbar spinal injuries following speedboat accidents. Between 2000 and 2002 a total of four patients who sustained these injuries received primary treatment in the trauma unit of our institution. All the victims were passengers on board a speedboat travelling at high speed and were taking no safety measures at the time of the accident. We report on their injury patterns and outcomes following treatment and discuss the current law regarding safety regulations applied to people on board speedboats.

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Case report and management

Case 1

A 39-year-old male was involved in a speedboat accident in July 2000. He was an unrestrained passenger on board the speedboat travelling at a speed of 60 mph when a large wave hit the boat and forced it to halt suddenly. The force of the impact pushed the patient out of his seat and immediately back. He experienced a sudden onset of back pain and was unable to mobilise. He received primary treatment at the scene by fully qualified paramedics with full spinal protection.

At the trauma room, following ATLS assessment and radiological evaluation (including AP and cross table lateral thoracolumbar spine plain radiographs), he was diagnosed with an isolated compression fracture of the twelfth thoracic vertebra (T12) (AO, A1.2)[22] (Fig. 1a). Clinical assessment did not reveal any neurological deficit or bowel or bladder compromise. He was admitted to our spinal unit where he underwent further radiological investigations including MRI scan which did not show any signs of spinal canal injury, nerve root encroachment, or posterior ligamentous complex injury. During his stay he was treated conservatively including bed

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Figure 1 (a) AP—lateral view of thoracic spine illustrating a T12 anterior wedge fracture. (b) AP—lateral view of thoracic spine (at 24 months follow up) illustrating a healed T12 fracture.

rest with continuous spinal cord monitoring. During this period he remained stable. At 7 days post injury he was fitted with an external spinal brace and was discharged home. At regular follow up, 6 and 12 weeks post discharge he remained stable and there was no further collapse of the fracture. The fracture healed and the brace was discarded at 3 months when he was allowed to walk freely with regular physiotherapy treatment and monitoring. At the final follow up (24 months) (Fig. 1b) the patient demonstrated a good range of movement of his spinal column without further sequelae encountered from his injury. He was satisfied with his outcome and was able to participate fully in his daily activities.

Case 2

A 34-year-old female was admitted to our spinal unit following a speedboat accident in August 2000. She was an unrestrained passenger standing at the front of the speedboat travelling at 40—50 mph when a large wave forced the boat to a sudden halt. The force of the impact forced the patient to be thrown

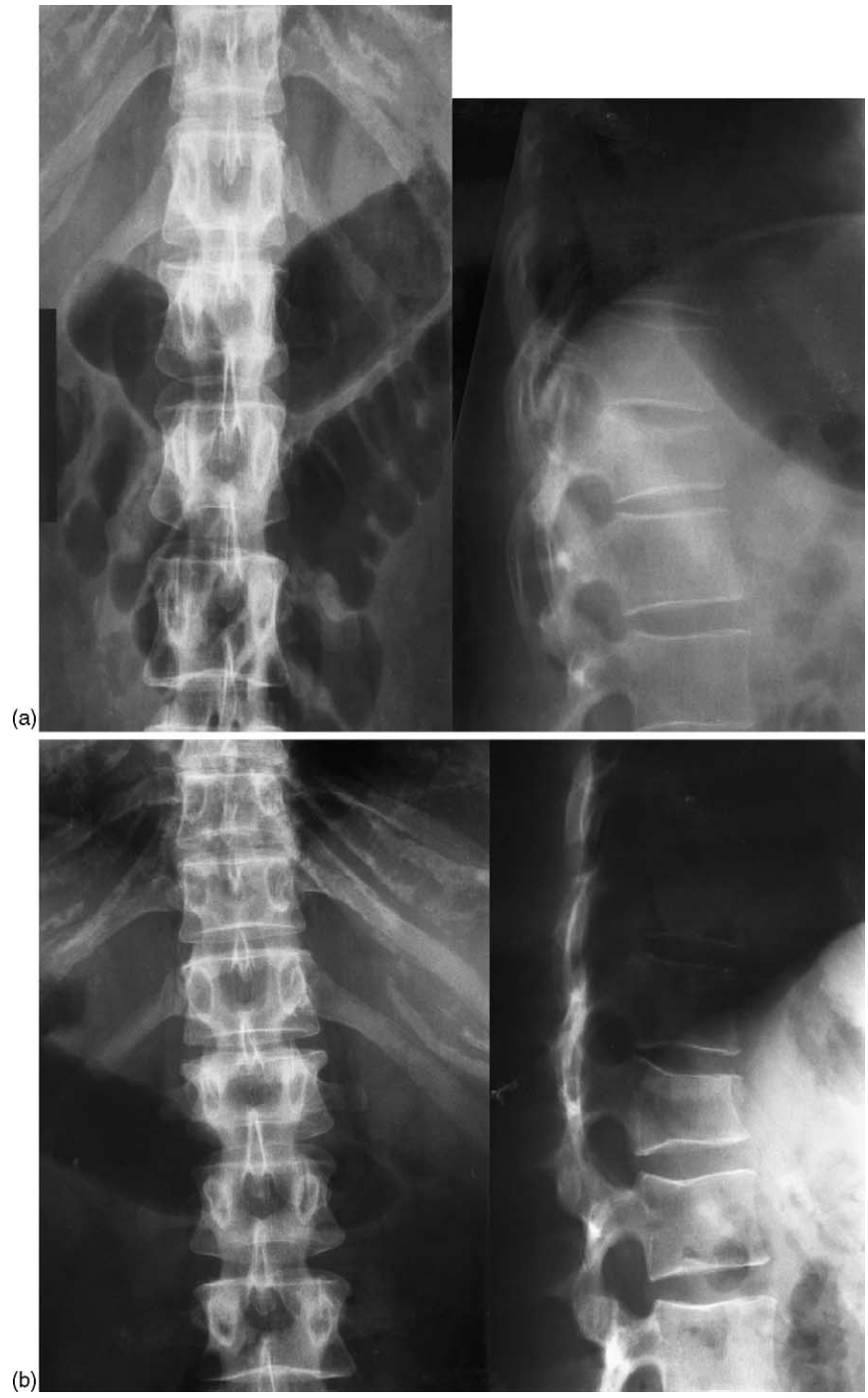

Figure 2 (a) AP—lateral view of thoracic spine illustrating a T12 anterior wedge fracture. (b) AP—Lateral view of thoracic spine (at 24 months follow up) illustrating a healed T12 fracture.

back in her seat. She complained of sudden back pain. She was able to mobilise and was brought to the accident and emergency department at our hospital by her husband in his car. At primary assessment the index of suspicion was raised of spinal injury. Full and thorough ATLS assessment was performed which revealed an isolated, stable anterior wedge compression fracture of the first lumbar vertebra (T12) (AO, A1.2)[22] (Fig. 2a). Further clinical evaluation did not demonstrate any neurological deficit. The patient was admitted to our spinal unit where her injury was treated conservatively including bed rest, analgesia and use of an external spinal brace. She was discharged 2 days later and regular follow up was arranged in both outpatient and physiotherapy departments.

At 3 months the fracture had healed and the brace was removed. Following a further period of 2 months of intensive physiotherapy the patient was able to engage fully in her daily activities with no further adverse outcomes from her injury. At final follow up (Fig. 2b) she had returned to her recreational activities and she was symptom free.

Case 3

A 26-year-old female was an unrestrained passenger on board a speedboat travelling at 50 mph offshore when the boat was forced to a sudden halt by a large moving wave. She was thrown out of her seat and landed heavily onto the front of the boat. She complained of severe back pain and was unable to mobilise initially. Following a period of rest she was helped by her colleagues on board the speedboat and was brought to the accident and emergency department at our institution. Following a comprehensive clinical examination and radiological evaluation she was diagnosed with an uncomplicated anterior compression fracture of the first lumbar vertebra (L1) (AO, A1.2)[22] (Fig. 3a) without neurological deficit. Her management consisted of bed rest, analgesia and use of an external spinal brace. She was discharged home on the 5 day post injury. At 12 weeks follow up she had made an excellent recovery and the brace was discarded. She returned back to work at 4 months and at the final follow up (20 months) (Fig. 3b), the patient returned fully in her normal daily activities.

Case 4

A 28-year-old female, unrestrained passenger was on board a speedboat moving at a speed of 55 mph when the boat was forced to a sudden halt by a moving wave. During the momentum of the accident she was thrown forcefully out of her seat and then backwards. Her injury involved an anterior wedge fracture of the first lumbar vertebra (L1) (comparable with case 3) without neurological compromise. She received primary and definitive conservative treatment at our unit consisting of bed rest for 4 days followed by a period of 10 weeks of external spine bracing. She made a satisfactory recovery and was able to engage fully in her daily activities at 12 weeks post injury. At final follow up (24 months) she had resumed all her recreational activities and she was symptom free.

Discussion

Thoracolumbar spinal fractures are the most common types of spinal column fractures.[18,19,23] They

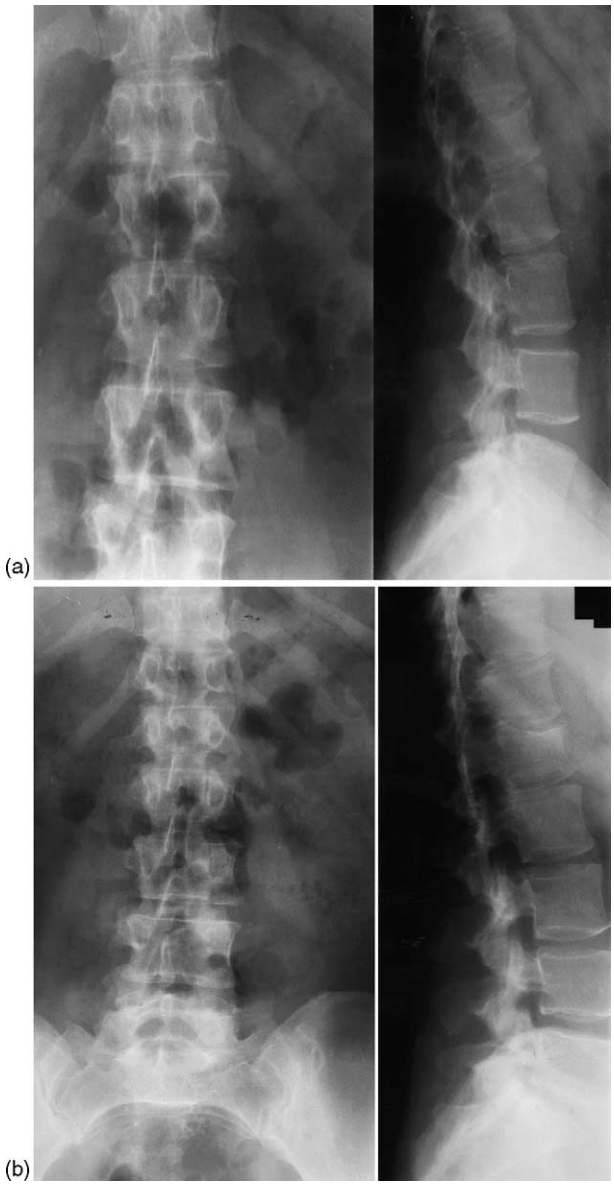

Figure 3 (a) AP—lateral view of thoracic spine illustrating a L1 anterior wedge fracture. (b) AP—lateral view of thoracic spine (at 24 months follow up) illustrating a healed L1 fracture.

are complex in their aetiology and management.[20] A well-founded knowledge in functional spinal anatomy contributes to accurate evaluation of the mechanism of the fracture and its optimal management. The transitional zone of the thoracolumbar junction accounts for the majority of thoracic and lumbar spine fractures with 90% of these injuries occurring between T11and L4 vertebrae.[15,19,23]

Thoracolumbar spinal fractures are frequently common following a fall and high velocity automotive accidents with a higher incidence among unrestrained occupants.[13,16,20,26]

In water sports however, the incidence of thorocolumbar spinal fractures is less common and have

only been reported following diving,[30,32] and water skiing accidents.[2,14]

A fracture classification, based on the three-column theory reported by Denis[6,7] and more recently by the AO group[22] is essential for the further understanding of thoracolumbar spine fractures. Rigid internal fixation which has been recently favoured in unstable injuries is considered to be the optimal method of treatment.[3,9,18] The unstable spine is one in which progressive anatomic deformity or neurological deficit will occur under continued stress.[6,7] By definition, any fracture involving the middle column (posterior portion of the vertebral body, posterior longitudinal ligament, and the posterior annulus fibrosis) is inherently unstable.[6] None of these features were observed in our patients, who all had A-type fractures.[22]

These compression injuries, as observed in our cases, represent a failure under compressive forces on the anterior column. In our patients (Type A1 injuries) the middle column remained intact acting as a hinge. The posterior vertebral bodyline was maintained and there was no subluxation. Compression injuries are the most common injury to the thoracolumbar spine, representing 48% of all thoracolumbar spine fractures and 58% of all major spinal injuries.[6,7]

Speedboat accidents are uncommon. The inherent danger of orthopaedic injury is little recognised in this popular water sport. Speed boating has been associated with pontomedullary tear with devastating outcomes,[1] and propeller injuries.[28] Literature review did not reveal any documented cases of thoracolumbar spinal injuries as a result of speed boating accidents. To our knowledge these are the first reported cases of their kind.

Thoracolumbar spinal fractures following Road Traffic accidents are mostly flexion injuries.[4] Thoracic injury in the unrestrained motorcyclist is thought to occur as the result of hyperflexion of the spine on impact with objects,[8] with maximal loading and injury at the level of the mid thoracic vertebrae (T4—T7).[16,27] The higher incidence of low levels of thoracic spinal injury in car occupants may reflect protection of the thoracolumbar spine afforded by the seat and seat belt.[25]

In our series the mechanism of the injury involved a series of events including flexion of the thoracolumbar spine during the boat's climbing on to the wave followed by deceleration of the boat that resulted in sudden flexion and axial compression loading of the thoracic spine. This mechanism was observed in all of the reported cases, which resulted in compression fractures at different levels of the thoracolumbar spine of the unrestrained speedboat victims.

The optimal management of thoracolumbar spinal fractures includes vigilance in patient assessment and accurate use and interpretation of the available investigations. AP and cross table lateral radiographs of the thoracolumbar spine are fundamental in the initial evaluation of these traumatised patients. Conventional radiography and computed axial tomography can add additional information regarding posterior element integrity and spinal canal encroachment.[19] MRI can also be useful in that it directly images the effects of the fractures on the spinal cord[12] and the ligamentous integrity of the posterior elements.[31] The prevalence of the posterior ligamentous complex injury of the spine has been reported as high as 40% in burst fractures and 25% in compression spinal fractures.[25] The stability of the vertebral column fractures can be misdiagnosed on both plain radiographs and CT.[24] Therefore, for thoracolumbar injury diagnosis, especially in high energy trauma, the routine use of CT has been advocated as well as MRI examination, especially the fat-suppressed T2-weighted sagittal sequence, in order to differentiate between spinal compression fractures and burst fractures, which can be inherently unstable. It is important to assess the integrity of the posterior ligamentous elements which in turn might have a detrimental effect on the accurate selection of treatment options.[5,17]

In our study, we acknowledge that the series of our patients did not follow the diagnostic algorithm currently recommended in clinical practice apart from one patient who had had MRI examination because the accuracy of the fracture pattern and the stability of the fracture were in doubt following the initial plain radiographs.

The majority of thoracolumbar spinal fractures are stable injuries and are managed conservatively.[9,18] However, they can also be associated with catastrophic outcomes with long-term morbidity.[25,26] The treatment of thoracolumbar fractures, conservative versus operative, varies depending on the age of the patient, the fracture pattern, spinal cord involvement and co-morbid conditions[3,9,18] with current practice favouring conservative treatment in stable, isolated thoracolumbar fractures.[18] In our series, the patients' injuries were treated conservatively as they were inherently stable with no neurological compromisation and the degree of kyphosis in all cases was less than 20 degrees.[10,11]

Conclusion

Prevention is by far the best method of treatment. As the use of some sort of restrain is not mandatory in the current safety laws of speed boating,[21] we

feel that it is time for this to be reconsidered, and that all occupants be restrained when on board speedboats. Failure to do so may result in further cases with these injuries with unpredictable outcomes.

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