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RESEARCH ARTICLE

Injuries to the Spine Mechanics , Anatomical and Orthopedic Aspects

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Abstract

Vertebral injuries can occur as isolated injuries or may be associated with other injuries . Recognition of the level of injury is important along with the mechanism of injury . The article describes the various types of injuries of the vertebral column along with the main mechanisms and the difference between the types of injuries in the vertebral column.

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INTRODUCTION

Vertebral injuries are predictable and the damage depends on the mechanism of injury. recognition of injury pattern is important to predict the outcome. The vertebral column functions as a single unit despite the fact that it is made of 33 separate bones. Primary curves retain their original posterior convexity and are found in the thoracic and sacral regions. Secondary curves are convex anteriorly are found in cervical and lumbar regions. The cervical curve appears when the infant holds its head up after the third month. The lumbar curve develops when the child begins to walk and holds his trunk upright.

Text :

Normal Anatomy of the spine

Cervical Vertebral injuries : The cervical vertebrae are seven in number . There is a foramen in the transverse process called foramen transversarium and the vertebral artery passes through C1-C6 but not that of C7. C1 has no body and it is fused with C2 and is called as odontoid process. The spine of C7 is the longest and is called vertebra prominens. C1, C2, C7 are atypical and the rest are typical. Jefferson¹ described the mechanism of fracture of the first cervical vertebra. This type of injury occurs from an axial load on the top of the head and the force is exerted laterally on the ring of C1, and the arches fracture at the thinnest and weakest points . Here the spinal cord is not

damaged, because the canal of the atlas is normally large; with fracture, the fragments spread outward to further increase the dimensions of the neural canal. Odontoid fractures are not that common.² A fracture through the pedicles of C2 usually occurs from a severe extension injury, such as an automobile accident or a fall³. This injury has been labeled the Hangman's fracture. Cord compression is rare because the neural canal is enlarged with forward displacement of the body of C2. Fractures and dislocations of the lower cervical spine are common. The majority are caused by vehicular accidents, diving into shallow water, falls, and sports injuries.

Thoracic vertebral injuries. The Thoracic vertebrae are twelve in number. There is one or more articular facets on each side of the body for articulation with the head of the rib. These are called rib bearing vertebrae. T1, T9, T10, T11, T12 are atypical and others are typical thoracic vertebrae. High energy rear motor impact results in flexion distraction injuries of thoracolumbar spine.^{4, 5, 6} There may be associated mediastinal widening or in severe cases aortic rupture^{7, 8}

Lumbar vertebral injuries: The Lumbar vertebrae are five in number. These have larger vertebral bodies, but have no articular facets for the ribs. L5 is atypical but all others are typical lumbar vertebrae. It is important to recognize the relationship of the neural elements to the thoracolumbar skeletal structures when evaluating and treating injuries in this location. The spinal cord usually terminates at the lower margin of the L1 vertebra. Caudal to L1, the spinal cord contains only spinal roots, the cauda equina. Whereas the spinal cord occupies nearly half of the spinal canal in the thoracic area, the neural canal has considerable free space below L1. Fractures or dislocations in the lumbar area require considerably more displacement to injure the neural elements than do fractures in the thoracic spine. A bursting fracture in the cervical or thoracic region may cause devastating neurologic loss, whereas a similar fracture in the lumbar area may produce no permanent neurologic deficit.

Sacrum injuries: The Sacrum is formed by the union of five sacral vertebrae and forms an angle of 210 degrees with the rest of vertebral column called as sacro vertebral angle. Sacrum has a base, apex, three surfaces the pelvic, dorsal and lateral. It has also a lateral mass and a sacral canal. The base has sacral promontory and ala on either side. The sacral index is the ratio between the length and the breadth of the sacrum.

Coccyx is the union of four coccygeal vertebrae and is fused with the sacrum to form a single sacro-coccygeal mass.

Mechanisms of Injury :

The main mechanisms of injury are the flexion, extension, shearing and rotator injury.

The flexion injuries are the commonest in case of vertebrae.⁹ Pure flexion injuries are the most common of all thoracolumbar skeletal fractures. Compression anteriorly, with or without distraction of the posterior ligaments, causes an anterior wedge compression fracture of the vertebral body. The extent of injury depends on the impact or force as well as degree of flexion occurring during impact. The injuries can be simply in the form of simple fracture to fragmentation of vertebrae with fragments entering the vertebral canal. There may be associated injuries to ligamentum flavum, interspinous ligaments, posterior longitudinal ligaments or interspinous ligaments. The most severe type of flexion compression injury is the posterior dislocation of the posterior vertebral body in the canal, acute kyphosis and disruption of anterior as well as posterior longitudinal ligament.

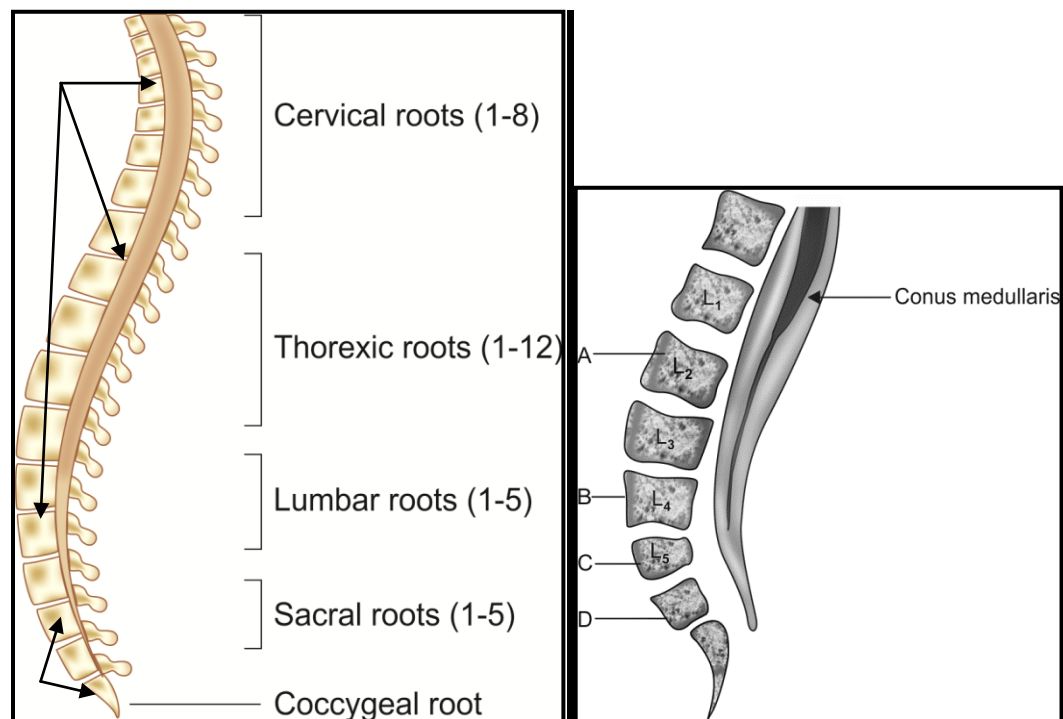
The extension injuries are the commonest in case of cervical vertebrae. The thoracolumbar spine can be involved in ankylosing spondylitis. The extent of injury depends on the impact or force as well as degree of extension occurring during impact. There may be associated injuries to the anterior longitudinal ligaments. Hyperextension of cervical spine is commonly described. There can be widening of disc space, disruption of posterior ligament. Patients with rheumatoid arthritis of cervical spine or ankylosing spondylitis or diffuse interstitial skeletal hyperostosis are particularly vulnerable. There may be associated vertebral artery injuries, pseudoaneurysm formation,

The shearing injuries are the commonest in between T11 and L2 vertebrae. The commonest cause is motor vehicular accidents. There is a characteristic lateral distraction and lateral dislocation. These are unstable types of injuries and need quick management. They classically occur in seatbelt injuries in which the individual is subjected to sudden deceleration and the torso is flexed forward over the restraining belt.¹⁰ Tension failure occurs in the posterior and middle columns. Failure of the anterior column also occurs. The mode of anterior column failure depends on the location of the fulcrum of rotation. If the fulcrum exists within the anterior column, compression failure of that column results. If the failure is anterior to the spine, tension failure of all three spinal columns occurs and the spine is literally pulled apart. These injuries may be associated with marked displacement and are usually very unstable.¹¹

The rotatory injuries are the commonest in thoracolumbar spine. The commonest cause is motor vehicular accidents but where the individual ejects. There may be a characteristic lateral distraction and lateral dislocation associated with severe fragmentation of vertebrae. They are more liable to get dislocated.

Conclusion:

As can be seen it is important to understand the importance of mechanism of injury and the part of the vertebral column involved. The proper diagnosis and assessment of trauma can be done only after having a sound knowledge about the orthopaedic anatomy of spine and understanding the mechanism behind the injuries which if neglected can lead to mortality and morbidity. A thorough look out for other injuries is also warranted.



Figures: Demonstrating different types of injuries of spine



Fig 1 : Burst Fracture C5 Vertebrae



Fig 2: Fracture C4 Vertebrae

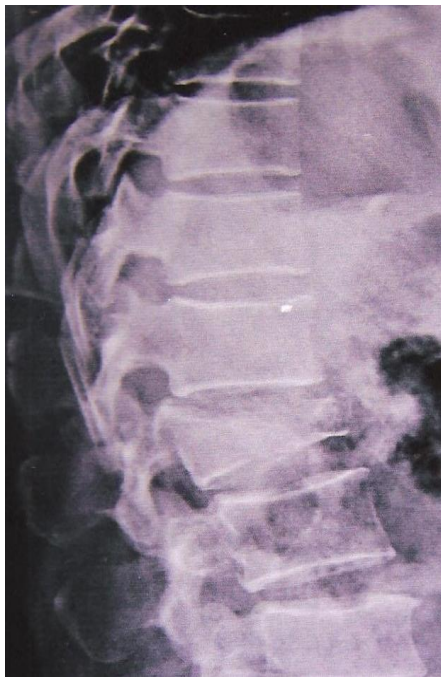


Fig 3: Compression fracture of L2 Vertebrae



Fig 4: Anterolisthesis of L4 over L5



Fig 5: Anterolisthesis of L5 over S1



Fig 6: Compression fracture of Lumbar Vertebrae

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