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Role of cross-sectional imaging in management of occult spinal fractures in ankylosing spondylitis – literature update and a pictorial review.

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ABSTRACT

This pictorial review highlights the importance of having a high index of suspicion when dealing with suspected spinal injury in patients with a history of ankylosing spondylitis. We also include a review of relevant current literature, which emphasises the importance of cross-sectional imaging particularly CT scan to manage such patients. This concise article also includes practical case illustrations.

Ankylosing spondylitis is a seronegative arthritis which leads to spinal syndesmophytosis and fusion of facet joint and intervertebral disc, causing an immobile and minimally compliant spine. The axial skeleton is the most commonly involved site, with sacroiliitis the hallmark of the disease. Bone demineralisation in this condition makes such patients more susceptible to spinal fractures. The altered biomechanics increase the risk of unstable spinal fractures. Therefore, a high index of suspicion for fracture and a multiplanar CT scan might be necessary to identify unstable fractures and direct further management.

INTRODUCTION

Ankylosing spondylitis (AS) is a seronegative arthritis with a prevalence of approximately one in 3001. Patients present between the second to fifth decades with males affected twice as commonly as females[1].

The axial skeleton is the most commonly involved site, with sacroiliitis the hallmark of the disease. This condition may occur with aortitis, uveitis, psoriasis, inflammatory bowel disease (ulcerative colitis and Crohn's disease) and amyloidosis.

CASE ILLUSTRATIONS

A 61 year old male patient with known ankylosing spondylitis fell in hospital, complaining back pain but no neurology. The lumber spine radiograph (Fig.1) demonstrated multilevel marginal syndesmophytes with the classical fused 'bamboo spine'. Radiographs also showed anterior end plate fracture of L3 with a fracture through the anterior syndesmophyte between L3 and L4. Bones were osteopenic and there was fusion of both sacroiliac joints. An urgent multislice CT (MSCT) scan of spine was performed to assess the stability of fracture and to exclude any other injuries in the osteoporotic spine. High resolution multiplanar CT reconstructions in axial, coronal and sagittal planes were obtained.

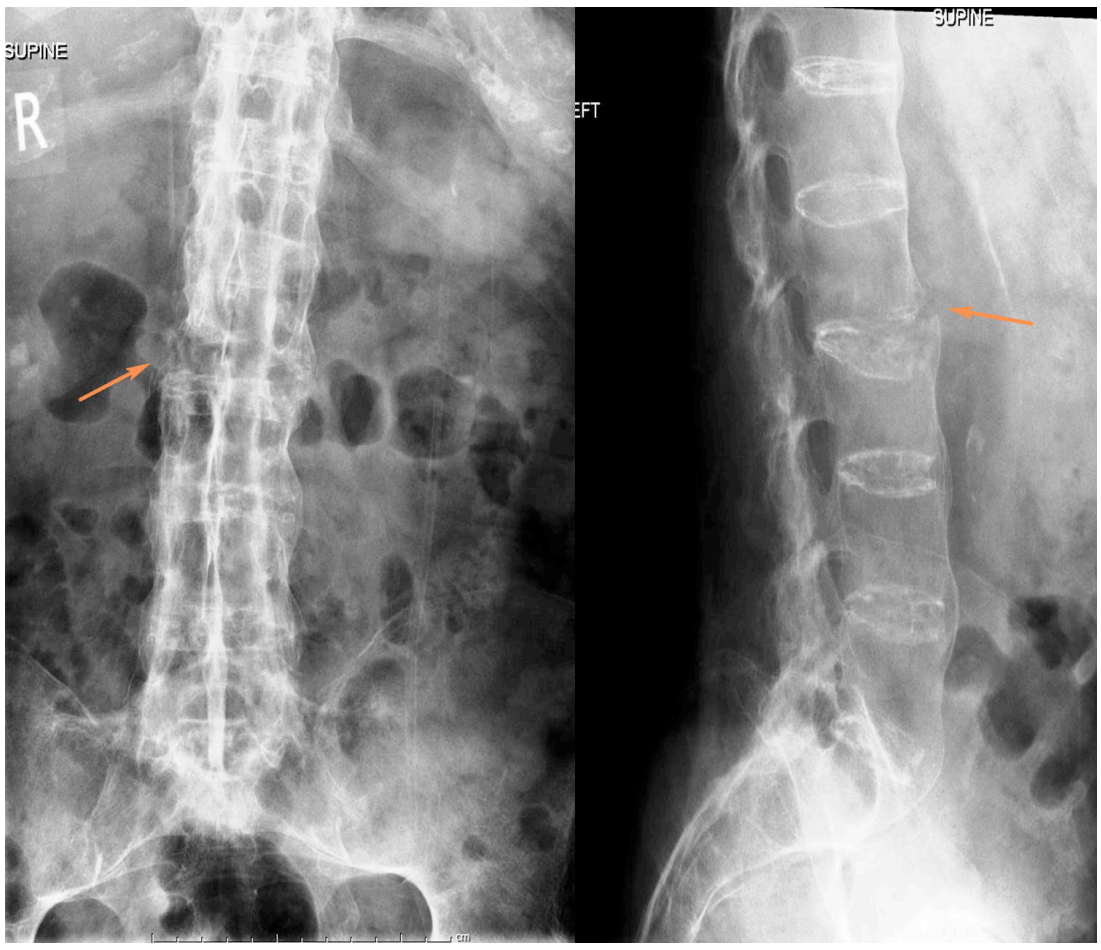

Figure 1: Supine AP (1a) and the left lateral lumber spine radiograph shows fused 'bamboo spine' and anterior end plate fracture of L3 with a fracture through the anterior syndesmophyte between L3 and L4.

Figure 2: Sagittal CT shows a further fracture through the L3 spinous process (arrow A) and the inferior end plate fracture of L2 (arrow B) along with incongruent facet joints at this level

In addition to the above mentioned plain film findings, CT demonstrated a further fracture through the L3 spinous process (figure 2, arrow A) and the inferior end plate fracture of L2 (figure 2, arrow B) along with incongruent facet joints at this level. These CT findings categorised it as an unstable three column spinal injury. The patient underwent urgent surgery with internal spinal fixation rods and screws from L1 – L4. Post-operatively, the patient underwent physiotherapy with careful mobilisation whilst wearing a thoracolumbar sacral orthosis brace (TLSO). Following a period of two months of rehabilitation, a follow up CT demonstrated stability of the spine with unchanged position of the fixation rods and screws (figure 3).

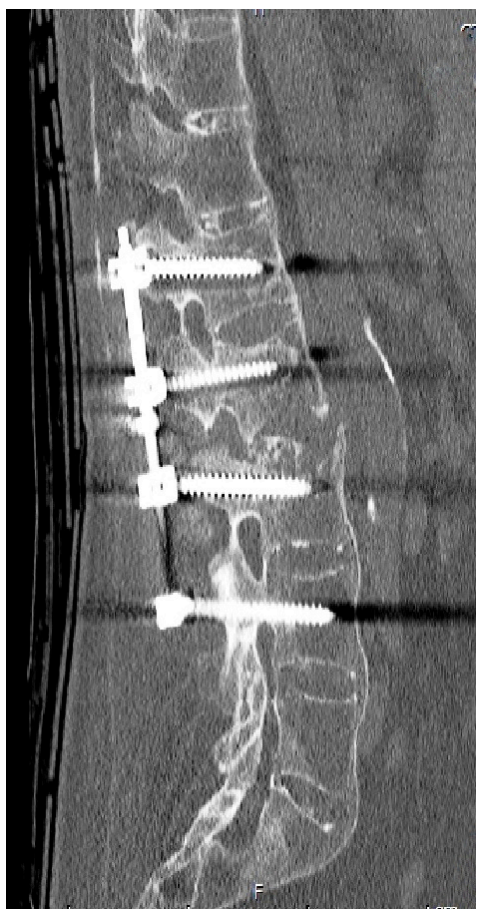

Figure 3: Postoperative follow up CT shows stability of the spine with unchanged position of the fixation rods and screws.

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OTHER CASE ILLUSTRATIONS

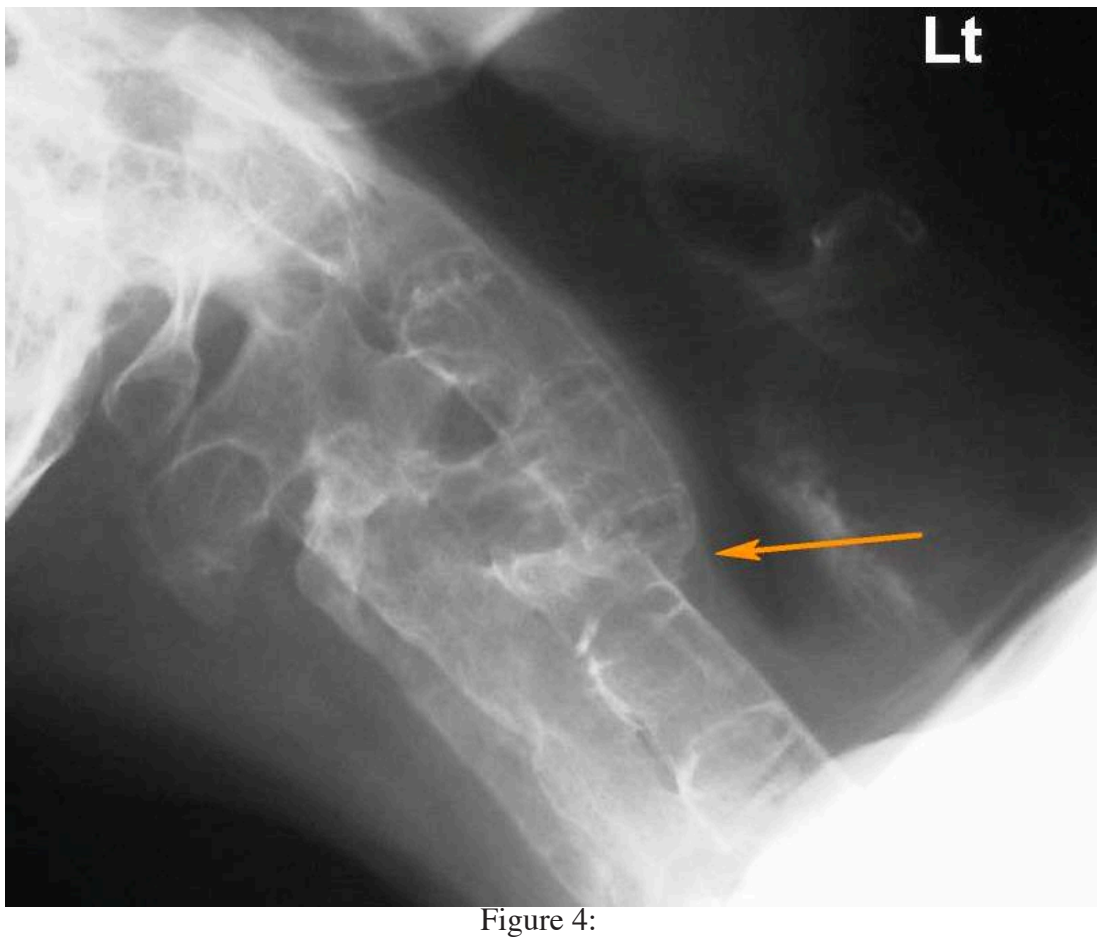

Figure 4:
Lateral radiograph of cervical spine in a different case shows calcified inter vertebral discs, ossified anterior longitudinal ligament and fused vertebrae. There is a horizontal fracture at C5-C6 level. Such fractures, which involve both anterior and posterior elements, are often known as 'carrot-stick fracture'.

Figure 5:
Lateral radiograph of thoracic spine in another patient shows calcified inter vertebral discs, ossified anterior longitudinal ligament and fused vertebrae. There is a horizontal fracture through the intervertebral disc (marked with arrow).

LITERATURE REVIEW AND DISCUSSION

Ankylosing spondylitis (AS) is sometimes also known as Marie Strümpell disease or Bechterew disease [5]. As the name ankylosing spondylitis suggests, it results in ankylosis of joints, particularly the spine and sacroiliac (SI) joints[2]. Fusion of other large (e.g. hip) and small joints can be seen in some cases. In the spine, the disease is characterized by ossification of the spinal ligaments, joints, and disks. The outer fibres of the annulus fibrosus of the intervertebral discs ossify. Syndesmophytes form and bridge the adjacent vertebral bodies leading to spinal fusion. Enteropathic arthritis can mimic AS. In addition to this, in the cervical spine, juvenile rheumatoid arthritis (JRA) and diffuse idiopathic skeletal hyperostosis (DISH) are also differentials[1,2,5].

On imaging, vertebral body squaring and fusion can give a typical 'bamboo spine' appearance (figure 6).

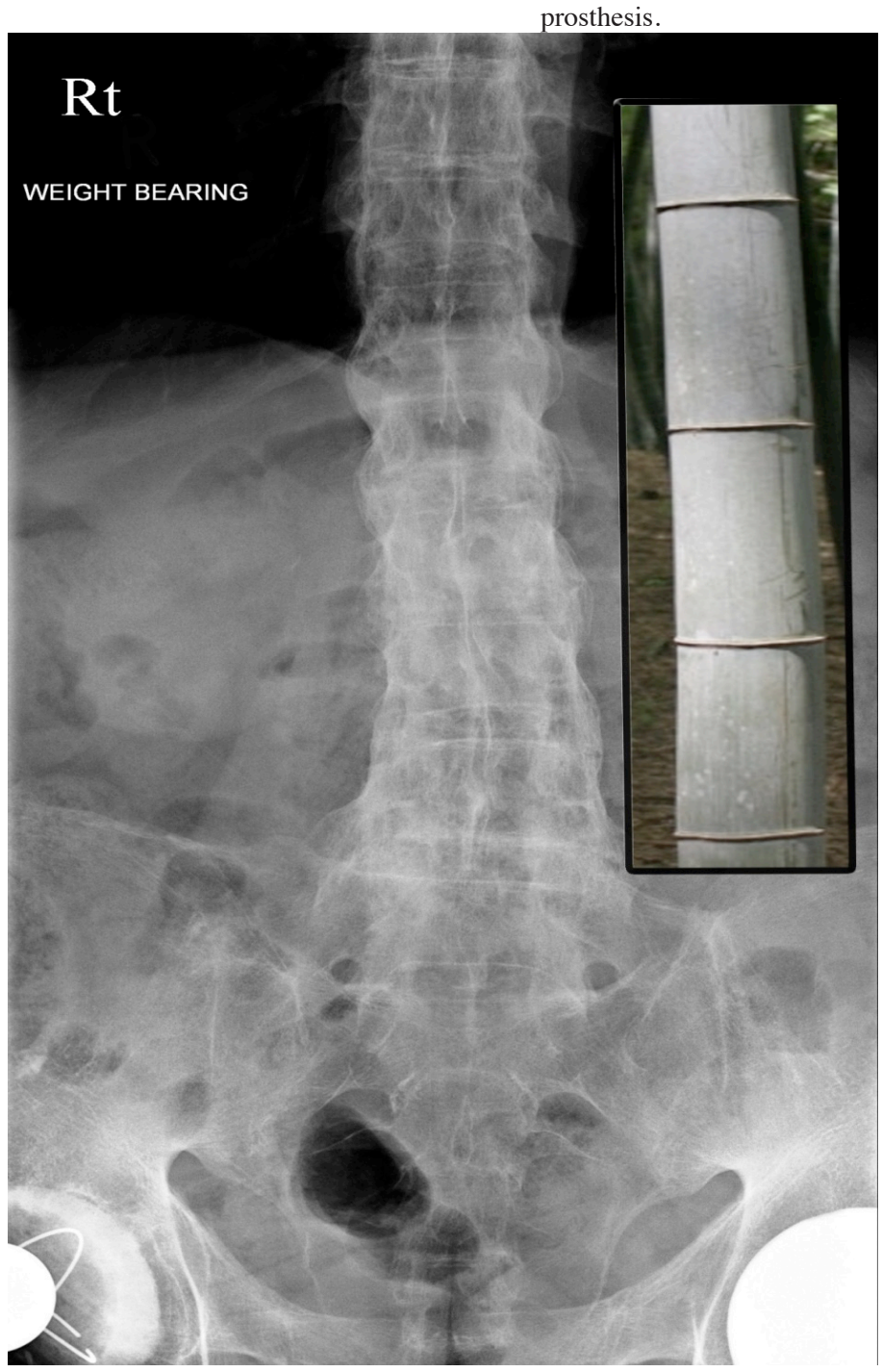

Figure 6: Illustration of 'Bamboo spine' - vertebral body fusion by marginal syndesmophytes and undulating continuous lateral spinal borders on AP spinal radiographs resemble a bamboo stem. Both sacroiliac joints are fused and there are bilateral hip prosthesis.

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Patients with AS tend to present with restricted spinal movement and progressive deformity. CT may be useful in selected patients with normal or equivocal findings on sacroiliac joint radiographs and bony ankylosis are better visualised on CT. MRI is even better in early diagnosis of sacroiliitis. Increased T2 signal correlates with edema or vascularised fibrous tissue. Synovial enhancement on MR correlates with disease activity. Enhancement of the interspinous ligaments is indicative of an enthesitis. MR is also useful in following treatment results in patients with active ankylosing spondylitis

Figure 7: Sagittal T2 weighted MRI scan showing hyperintense (high signal) in oedematous corners of the vertebral bodies..... the “shiny corner sign” or Romanus lesions.

Figure 7 (above) is an example of Romanus spondylitis consisting of inflammatory changes involving the edges of the vertebral endplates. Involvement of the anterior edges is secondary to enthesitis of the anterior longitudinal ligament. MRI can show hyperintense oedematous corners on T2 weighted sequences (Figure 7). T1 post gadolinium images show enhancement of Romanus lesions [10,11].

The most serious complication of ankylosing sponylitis is spinal fracture. This is more common at the thoracolumbar and cervico-thoracic junctions and can occur with even minor trauma because of the rigidity and osteoporotic involvement of the spine. It is important to specifically search for disk space widening and discontinuity of the ossified paraspinal ligaments. Sagittal reformats of CT images should be obtained as axial images poorly assess the transverse fracture plane. At a later stage, pseudoarthrosis may form at fracture sites.

Spinal syndesmophytosis occurs with facet joint and intervertebral disc fusion, causing an immobile, minimally compliant spine [3]. The addition of bone demineralisation makes AS patients four times more susceptible to spinal fractures than the general population3. The altered biomechanics makes unstable spinal fractures more likely [3].

A systematic review of the literature, which analysed seventy-six articles with 345 patients, revealed the majority of spinal fractures in AS patients occurred after low energy trauma – i.e. fall from standing or sitting [4]. This review also revealed that 67% AS patients with spinal fractures have a neurological deficit at presentation and a further 13% developing subsequent neurology. One particularly significant finding was a 3 month mortality rate of 18% for AS patients with spinal fractures, versus 0.4% for the general population. Thoracolumbar injuries in AS patients may also be associated with injury to the aorta either due to direct mechanical trauma or to blunt forces associated with the spinal fracture. It is postulated that aortic laceration may be a result of pathophysiological changes that cause the aorta to become firmly adherent to the anterior longitudinal ligament and subject it to shearing forces during fracture dislocation [4].

Cross-sectional imaging is vital to the management of AS patients with suspected spinal fractures [6]. 3D-CT has particularly higher sensitivity over conventional radiography in identifying posterior longitudinal, spinous process and facet fractures.

MR is indicated when cord or ligamentous damage is suspected [6]. Our case report and examples reiterate the importance of early cross-sectional imaging when suspecting spinal fractures in AS patients.

PROGNOSIS AND TREATMENT

No definite disease-modifying treatment is presently available for AS7. Early diagnosis and physiotherapy is therefore essential. Once joints ankylose, mobility cannot completely return. Over the counter (OTC) drugs such as aspirin and ibuprofen can relieve pain. Researchers are also looking at use of tumour necrosis factor (TNF) blockers [7]. Surgical intervention is generally reserved to stabilise the fracture and prevent neurologic deficit[7]. Robinson et al. reviewed outcome of 990 patients with AS who had 1131 spinal fractures[8]. Surgically treated patients had a greater survival than those treated non-surgically (HR = 0.79, p = 0.029). Spinal cord injury was the major factor contributing to mortality. The study concluded that even though surgical treatment is associated with a considerable complication rate, it improved the survival of AS patients with spinal fractures[8].

Nayak et al. used an O-arm intraoperative CT scan and, minimally invasive (MIS) stabilization procedures to reduce blood loss, physiologic stress, and perioperative morbidity. Their results confirmed that MIS stabilisation can be used to manage spinal fractures in the patients with AS and can preserve a good postoperative quality of life [9].

KEY LEARNING POINTS

The combination of bone demineralisation and altered biomechanics, results in patients with ankylosing spondylitis being four times more susceptible to spinal fractures than the general population and the incidence of unstable spinal fractures is also increased.

Clinicians need to maintain a high index of suspicion for fracture in AS patients, even if there is a history of minimal trauma.

In osteoporotic spine, reporting Radiologists should have a low threshold to perform a CT scan to identify unstable fractures and direct treatment appropriately.

Sagittal reformats of CT images should be obtained as axial images poorly assess the transverse fracture plane.

Intraoperative CT scan can help in minimally invasive (MIS) surgical stabilisation to reduce blood loss, physiologic stress, and perioperative morbidity.

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