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# Occult vertebral fractures in ankylosing spondylitis

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**Study Design:** A retrospective review of patients with ankylosing spondylitis involved in blunt trauma.
**Setting:** Patients referred to two Level I trauma centers.
**Objectives:** To determine the incidence and clinical sequelae in this patient population where vertebral injury was diagnosed on a delayed basis.
**Summary of Background Data:** The ankylosed spine is at increased risk for fracture and spinal cord injury. Radiological identification of injury is more difficult than in the normal spine.
**Results:** Over a 5 year period, 21 patients were identified with seven having an occult vertebral fracture not recognized as the primary injury or occurring as a second non-contiguous injury level. In these cases, delay in diagnosis of the occult injury was from 3 to 22 days. Development of secondary neurological deficits occurred in three patients.
**Conclusions:** A high index of suspicion and an appreciation of the extreme instability of a fracture in ankylosing spondylitis must be present.

**Keywords:** ankylosing spondylitis; fracture; spinal cord injury

## Introduction

Ankylosing spondylitis has a prevalance of 1–3 per 1000 in the general population.[1] The incidence of spine fracture in ankylosing spondylitis is four times that of the normal population.[2] It is not uncommon for patients being treated with ankylosing spondylitis to have radiologic evidence of previous vertebral body fractures despite having no history of trauma.[3] It is well recognized that ankylosing spondylitis patients are more prone to spinal injury due to the rigidity of the spinal column and osteoporosis.[4] Seventy-five per cent of all fractures occur in the lower cervical spine.[5] Severe neurologic sequelae occur in 57% of the cases and the mortality rate is 35%.[6] When reviewing a normal population, Reid *et al*.[7] noted an increased incidence of secondary deficits with a missed spine fracture (10.5%), compared to those individuals whose fractures were identified on initial screening (1.4%).

We reviewed a cohort of patients with ankylosing spondylitis who were involved in blunt trauma with emphasis on occult spinal injuries.

## Clinical data

A retrospective review between 1985 and 1995, was performed from two centers, Sunnybrook Health Science Center, Toronto, Canada and Harborview Medical Center, Seattle, Washington. Twenty one patients with ankylosing spondylitis and spinal fracture were identified through the respective trauma databases. There were 14 males and seven females. The average age was 68 (range 52–87). Mechanism of injury was by fall or motor vehicle accident (commonly low velocity). A cervical level injury was initially diagnosed in 62%, a thoracolumbar injury in 38% and two level non-contiguous injuries initially identified in two patients.

In seven patients a vertebral fracture, was identified on a delayed basis. These occult injuries were diagnosed from 3 h to 22 days later (mean 5 days). Table 1 summarizes the clinical and radiologic data.

### *Diagnosis of occult fracture*

In the subgroup of patients with an occult injury, three patients were neurologically intact, one patient had weakness in the left arm and three had complete spinal cord injuries, (two with an epidural hematoma). Diagnosis of occult fracture was made using myelography followed by computed axial tomography in three patients, by computed axial tomography alone in one patient, by repeat plain radiographs in one patient and by magnetic resonance imaging (MRI) in two patients. In obtaining these further tests, four patients had neurologic signs or symptoms discordant with the known vertebral fracture level.

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**Table 1** Summary of occult fractures

| *Patient* | *Age/sex* | *Initial diagnosis* | *Occult injury* | *Delay in diagnosis* | *Diagnostic test* | *Initial neurologic status* | *Neurologic deterioration* |
|---|---|---|---|---|---|---|---|
| NM | 68/F | L3 fract/disl | T12 burst# | 22 days | CT-myelo | intact | No |
| PB | 69/M | T12/L1 fract/disl | T4 fract/disl | 3 hr | CT-myelo | T4 incomplete | No |
| HB | 62/M | C6/7 fract/disl | T9 compression | 3 days | CT-myelo | T9 complete | No |
| WD | 52/M | T7/8 fract/disl | C7/T1 fracture | 2 days | CT | C6 complete[1] | No |
| WE | 52/M | C7/T1 fract/disl | T9/10 fract/disl | 2 days | MRI | intact | Yes[2] |
| CH | 75/F | C2 fracture | T5/6 fract/disl | 2 days | MRI | intact | Yes[2] |
| ER | 62/M | nil | C4/5 fract/disl | 3 days | X-ray | C5, C6, C7 radiculopathy | Yes[2] |

[1]Previous injury resulting in C6 quadriplegia; [2]see text

*Delayed neurologic deficits*
Three patients had deterioration in their neurological status directly attributable to the occult injuries. Two patients were intact at the time of initial assessment and one patient had transient weakness in the left arm with radiculopathy. All developed complete spinal cord injuries following displacement of the occult fracture.

(1) Patient C.H: A 75 year-old female was involved in a low velocity motor vehicle accident. Initial radiographs of the cervical, thoracic and lumbar spine clearly identified a posteriorly displaced Type II odontoid fracture and the presence of ankylosing spondylitis. Despite complaints of mid thoracic and retrosternal chest pain, the rest of the spine revealed no fracture or malalignment. A cardiac work-up was negative. A halo ring and vest was applied. On day three, while being turned in bed, she developed a complete T6 paraplegia. MRI revealed a T5–6 fracture dislocation with posterior displacement. Urgent decompression and fusion was performed from T3–12. She remained a complete lesion. (Figure 1).
(2) Patient W.E: A 52 year-old was involved in a low velocity motor vehicle accident. Complete spine radiographs revealed a fracture subluxation at C7–T1 without neural compromise. He underwent posterior cervicothoracic fusion from C5–T2. One week later the patient developed a thoracic level paraplegia and a fracture-dislocation was identified on MRI at T9–10. A second operative procedure was performed with extension of the fusion from C3–L3.
(3) Patient E.R: A 62 year old male had been drinking and fell striking his forehead. He complained of neck pain and left arm parasthesia. There was transient weakness in the muscles of the elbow and wrist. Cervical radiographs were interpreted as chronic changes of ankylosing spondylitis without acute fracture. Three days later he had onset of a complete C4 quadriplegia with radiographs demonstrating C4–5 fracture dislocation.

## Discussion

In ankylosing spondylitis, the difficulty in making the diagnosis of a fracture on the initial presentation is well recognized. Radiographs may not delineate the fracture for several reasons: (1) There is surrounding osseous proliferation with distortion of anatomy,[8] (2) there is increased density of the ossified spinal ligaments, (3) the disc spaces are poorly outlined, (4) the bone is frequently osteopenic in ankylosing spondylitis,[6,9] (5) there may be a history of relatively minor trauma and lack of displacement,[10] (6) the cervical-thoracic junction may be hard to visualize and (7) there may be the presence of multiple non-contiguous fractures.[11]

Multiple non-contiguous vertebral fractures have been well recognized in ankylosing spondylitis.[12,13] This incidence in the normal spine is reported to be from 4–8%.[14] Their incidence is unknown in the ankylosing spondylitis population. This determination is difficult since many fractures are unrecognized or are not reported.[3] In our cohort of patients multiple non-contiguous injuries were present in nine out of 21 patients.

A high index of suspicion and an appreciation of the extreme instability of a fracture in the ankylosed spine must be present. Spinal ankylosis results in long lever arms, with stresses concentrated at the fracture site. Prompt rigid immobilization by either surgical or external means is required.[10,11] The consequence of delayed diagnosis of a spinal fracture in this population of patients is illustrated in two series by Trent *et al*. and Broom and Raycroft. In the former, six of seven cases had diagnoses missed on initial examination and two of these developed a complete paraplegia.[9] In the latter series, four of five patients had delayed diagnoses with resulting neurologic sequelae in three. This series included a simultaneous non-contiguous occult fracture at C6–7 which went on to displace causing a complete paraplegia.[11]

Given the difficult diagnosis with plain radiographs, other imaging studies have been useful in delineating spinal injuries in the ankylosed spine. Computed axial tomography with myelography has been previously

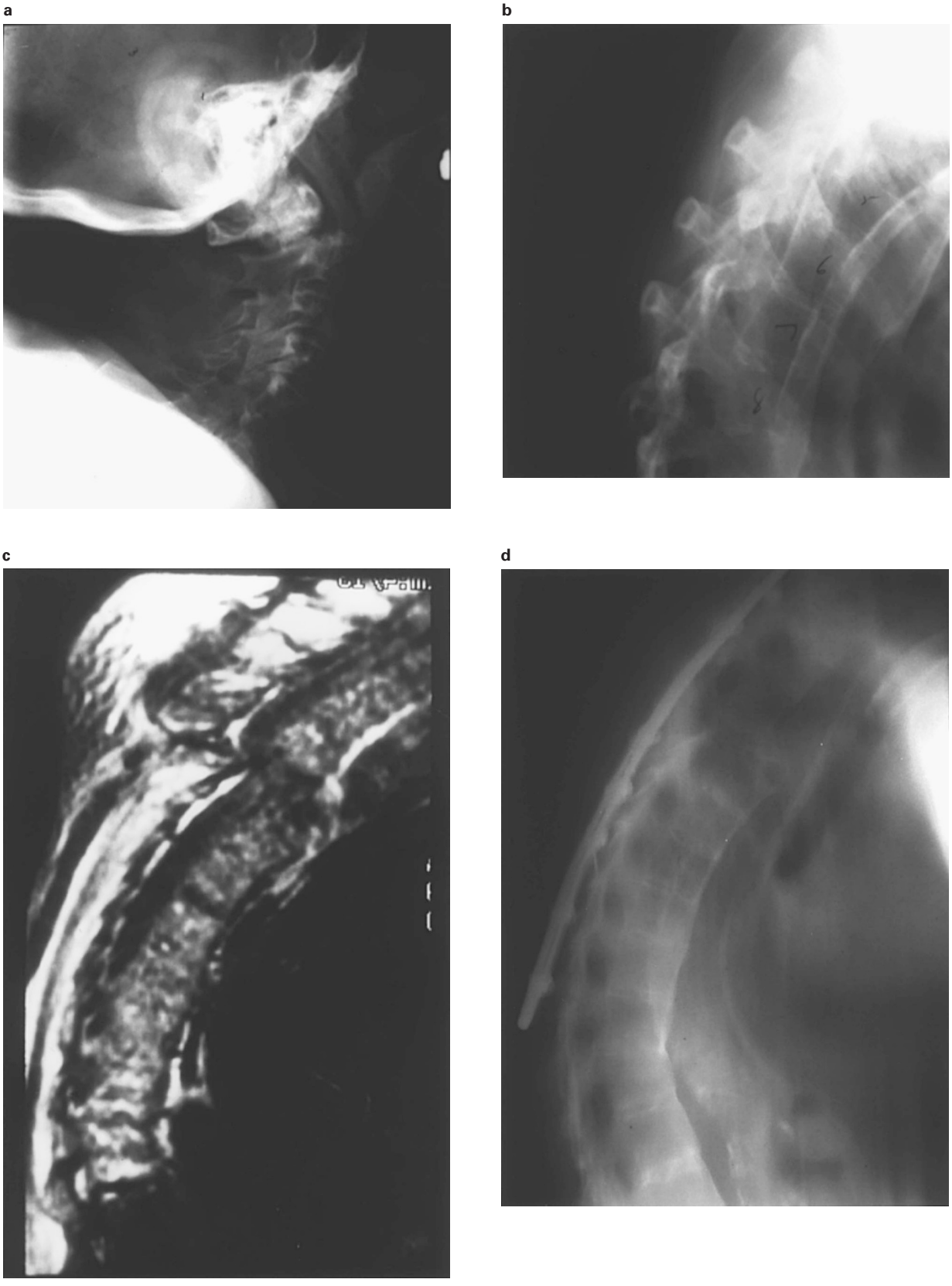


**Figure 1** (**a**) Cervical spine lateral radiograph with posterior displaced Type II odontoid fracture. (**b**) Lateral thoracic spine centred at T6 demonstrating ankylosing spondylitis without obvious fracture or dislocation. (**c**) Following neurological deterioration, MRI demonstrates fracture dislocation at T5–6. (**d**) Post-operative lateral radiograph following decompression and instrumentation

used. This technique is useful for scanning a known area of injury and for evaluating spinal canal compromise. There is a risk however with moving an unstable spine several times. Trent *et al*.[9] note the possibility in displacing a fracture by placing the patient in the lateral or a supine position when a pre-existing kyphosis exists. Bone scan is also useful in detecting a suspected acute fracture.[8] This modality is poor at differentiating degenerative changes from acute trauma.[15]

In our experience, MRI has been a reliable test for detecting occult fractures in ankylosing spondylitis. MRI is often cost prohibitive and as such we have begun using a screening protocol which utilizes one third the magnet time of routine MRI evaluation of the spine. A screening MRI involves a single midline stir sequence using a large field of view. The cervical and upper thoracic spine are included in one image and lower lumbar spine in the second. Although MRI does not directly demonstrate bony fracture, intramedullary edema associated with fracture, disc space injury, spinal cord injury and epidural hematoma are well shown. Long segment alignment is easily evaluated and MRI is not restricted in its interpretation by the presence of osteopenia and distorted anatomy.[16] The use of a screening MRI protocol has been validated for lumbar disc disease but has not been used for trauma.[17]

The objectives in management of a vertebral fracture in ankylosing spondylitis include: (1) reduction of the fracture and realignment to relieve or prevent spinal cord injury,[6] (2) patient transfers and investigations should be minimized due to the risk of further injury and (3) stabilization should be performed in a timely manner. As missed injuries in this population of patients are potentially devastating, a screening MRI may be a useful adjunct in allowing for identification of occult injuries.

Occult fractures in ankylosing spondylitis can occur as an unrecognized primary injury or as a second non-contiguous fracture of the spinal column. The potential for delayed neurological deficits is significant with these injuries. A modified MRI protocol may be useful in detecting occult fractures with greater certainty.

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