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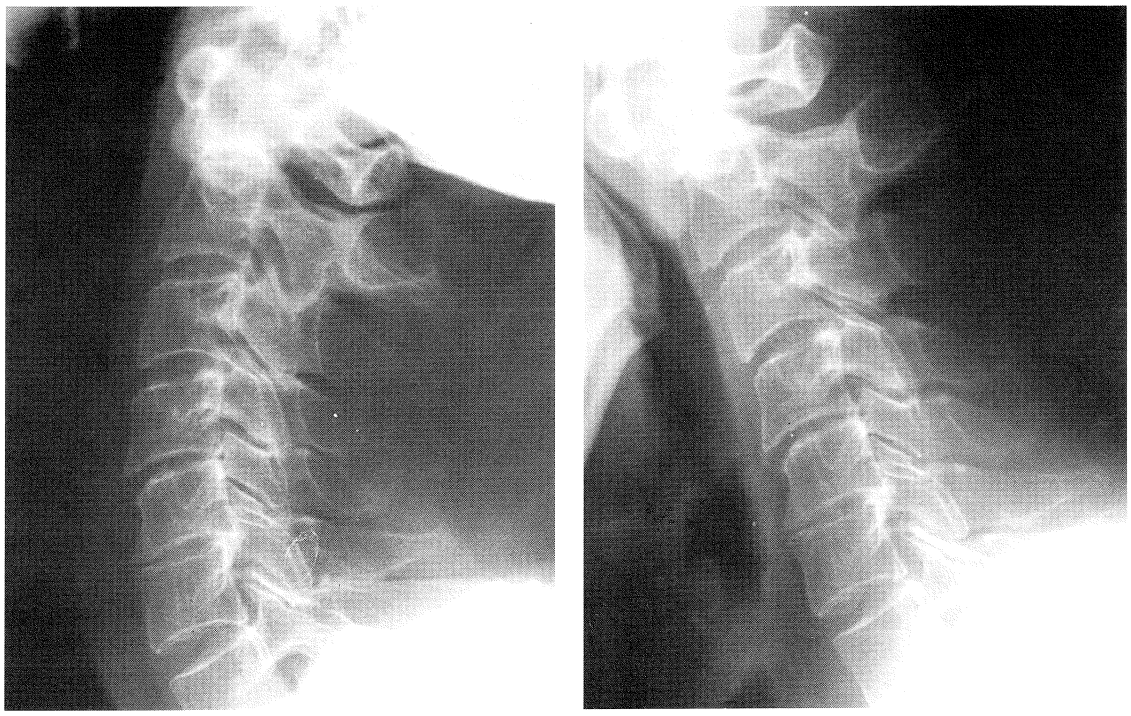

(a) (b)

Fig 1 - Lateral radiographs of the cervical spine taken in (a) extension and (b) flexion

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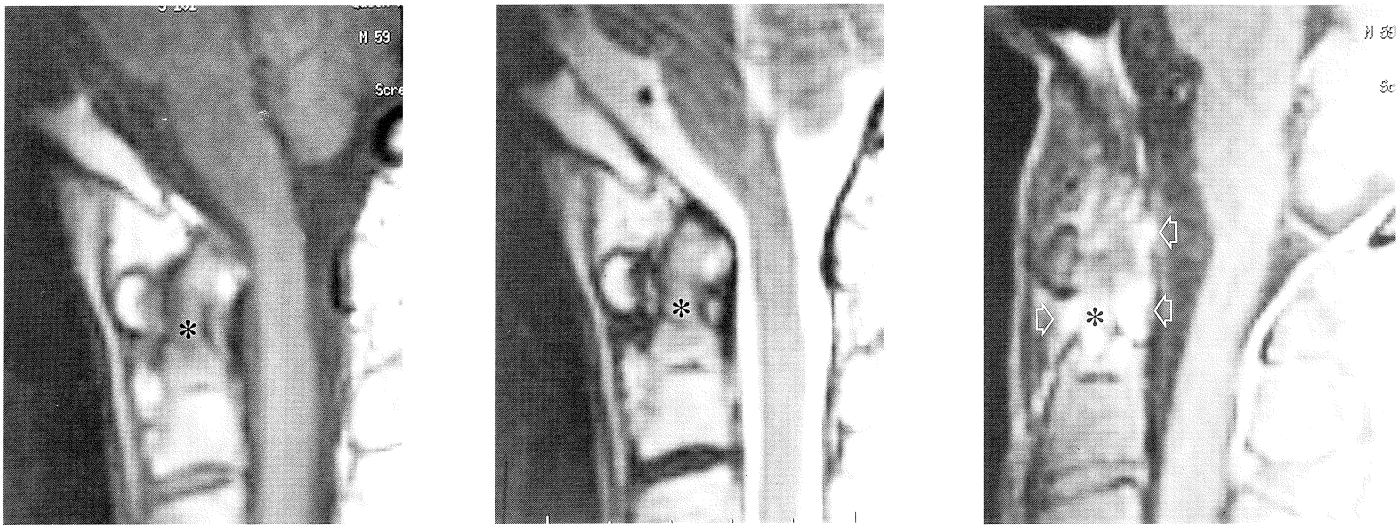
CASE REPORT

A 59-year-old Chinese man presented with a one and-a half-year history of progressive neck pain, made worse by rotation. It was associated with mild numbness over the dorsal aspects of both hands and the planter aspects of the feet. He had been experiencing joint pains at multiple sites, including both wrists, ankles, knees and the lower back, for the past 20 years. He was however completely independent in his activities of daily living.

On examination, the patient was wearing a neck collar. He was able to walk, though speed was limited by pain. Passive range of movements of his neck was decreased, with no definite motor or sensory deficit. There were bilateral symmetrical deformities of both wrists, with ulnar deviation of the digits. The metacarpophalangeal and proximal interphalangeal joints of both hands were symmetrically swollen. Biochemical investigations, including complement levels, ESR and rheumatoid factor, were normal.

Extension (Fig la) and flexion (Fig lb) lateral radiographs of the cervical spine were performed. What do these show? What further investigation would be useful in further delineating the abnormality?



(2a) (2b) (2c)

Fig 2 - Sagittal MRI scans of the upper cervical spine. (a) T1- and (b) T2-weighted images show an abnormally tapered odontoid tip (asterix), surrounded by largely isointense pannus. The cervicomedullary junction is kinked by the pannus mass. (c) Following IV gadolinium, there is marked heterogeneous pannus enhancement (open arrows). The patient was imaged with the neck in a more extended position in the post-contrast scan, hence the cervicomedullary junction appears less angulated.

IMAGE INTERPRETATION

Lateral radiographs of the cervical spine showed generalised decrease in bone density. There was increased distance between the anterior arch of C1 and the odontoid process (10 mm), with further widening during flexion (Fig 1). Abnormal tapering and ill-definition of the odontoid process due to erosions were apparent. Typical changes of established rheumatoid arthritis were seen on hand radiographs. Magnetic resonance imaging (MRI) of the cervical spine demonstrated erosion of the odontoid process by a surrounding soft tissue mass. This lesion was isointense on T1 images, hypo-to isointense on T2 images and brightly enhancing after intravenous Gadolinium(Gd)-DTPA (Figs 2 and 3). There was mild compression of the spinal cord at the cervico-medullary junction, particularly in a flexed position.

DIAGNOSIS

Cervical spine instability in seronegative rheumatoid arthritis.

CLINICAL COURSE

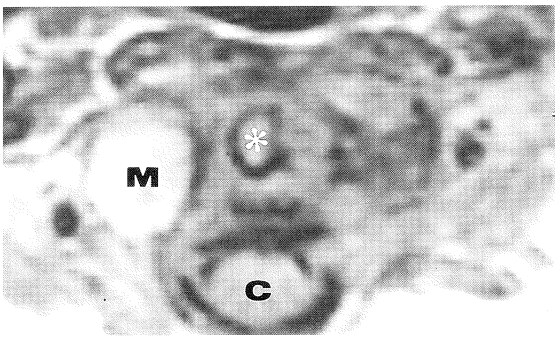
Based on the clinical and imaging findings of cervical spine instability with cord involvement, C1/C2 fusion was performed 2 weeks later (Fig 4). The patient made a good post-operative recovery, underwent rehabilitation supervised by physiotherapists, and has remained well to date.

DISCUSSION

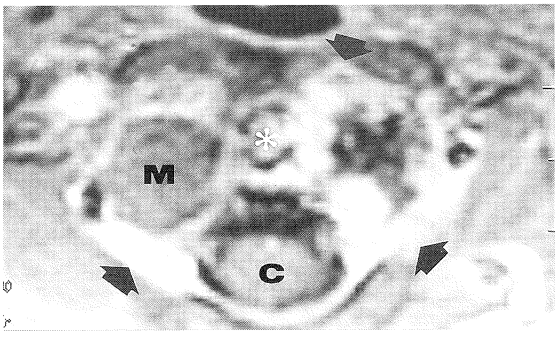
Rheumatoid arthritis is a common multi-organ disease estimated to affect 1% of the population. It has a female to male ratio of 3:1 in patients under 40 years of age, with the sex incidence reversing to 2:3 after 64 years of age. Rheumatoid factor is positive in 50%-70% of outpatients with rheumatoid arthritis. In the musculoskeletal system, the disease is characterised by synovial inflammation, followed by pannus formation, leading to cartilaginous, tendoligamentous and bony destruction. Cervical spine disease warrants special attention for at least two important reasons, namely its involvement in the majority of patients with rheumatoid arthritis and its associated neurological complications[1,2].

Cervical involvement in rheumatoid arthritis can be broadly divided into the following categories:

1. atlantoaxial instability
2. vertical subluxation of the axis
3. subaxial subluxation
4. less common types of instability
5. cord compression



(3a)



(3b)

Fig 3 - Axial (a) unenhanced and (b) enhanced T1-weighted images of the odontoid peg base (asterix). The extent of pannus formation (arrows) is much better appreciated following contrast administration [Right lateral mass of C2 = M; Spinal cord = C].

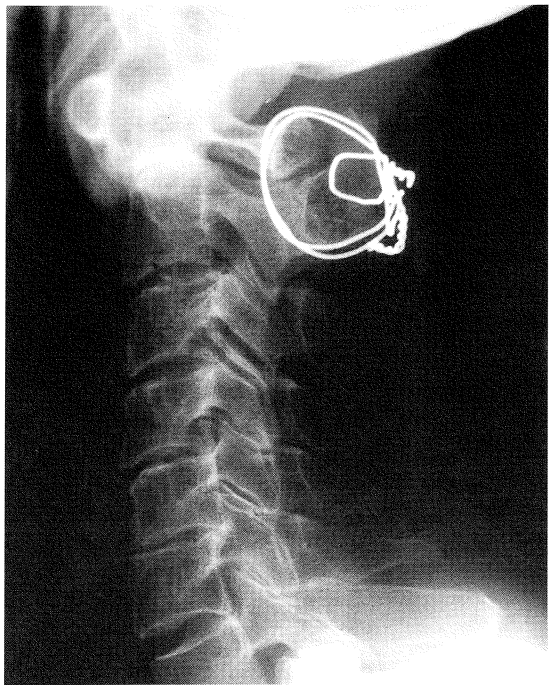


Fig 4 - Lateral radiograph of the cervical spine taken following C1/2 posterior spinal fusion

Atlantoaxial involvement may manifest radiologically as atlantoaxial subluxation or odontoid peg erosions. Anterior subluxation of atlas is the commonest type of instability, occurring in 50%-75% of patients with cervical spine disease. It should be suspected if the distance between the posterior cortex of the anterior arch of the atlas and the anterior cortex of the odontoid peg exceeds 3 mm. In patients with rheumatoid arthritis, the atlantoaxial distance may increase between flexion and extension, therefore both these radiographic projections are mandatory for diagnosis. Vertical subluxation of the odontoid peg is less common, and has recently been found to be part of the natural progression from initially reducible, then irreducible, anterior atlantoaxial subluxation[3]. On lateral cervical spine radiographs, vertical subluxation is diagnosed when the perpendicular distance from the centre of the pedicles of the axis to the line connecting the anterior and posterior arches of the atlas is less than 13 mm[3] (Fig 5). Erosions of the odontoid peg occur secondary to synovial inflammation. Sites lined by synovium, that is, adjacent to the C1 arch and the transverse ligament, are particularly affected. As a consequence, pathological fracture and even total destruction of the peg may occur (Fig 6).

Subaxial subluxation may affect any two or more vertebrae from C3 to C7 levels. They are less common than atlantoaxial involvement, having an incidence of about 22% of cervical spine lesions[3]. On lateral cervical spine radiographs, subaxial subluxation is diagnosed when the distance between the posterior borders of adjacent vertebral bodies exceeds 3 mm or more (Fig 5). Anterior subluxation is best seen on flexion radiographs while posterior subluxation is best seen on extension radiographs. Irreducible subaxial subluxation has been found to be associated with the multilating and erosive types of rheumatoid arthritis[3].

Less commonly recognised involvement of the cervical spine may present radiologically in several different ways. Narrowing and erosions of apophyseal joints and vertebral end plates are best seen on the lateral radiographs. Intervertebral disc space narrowing and erosion of the discovertebral junction may occur. Added trauma and/or associated apophyseal abnormality may result in intraosseous displacement of discal material or cartilaginous node formation. Erosive tapering of the spinous processes of the lower cervical and upper thoracic spine may occur in up to 11% of patients with rheumatoid arthritis. Multilevel disc space collapse associated with vertebral collapse, apophyseal joint destruction and spinous process erosions may lead to axial shortening of the lower cervical spine[4].

For the above-mentioned cervical spine abnormalities, initial plain radiographs often give sufficient information regarding the bony lesions, although overlapping projection of the mastoid process, the mandible and teeth may sometimes make visualisation of the odontoid peg poor. The presence of decreased bone density from osteoporosis often aggravates this problem. A recent study has recommended operative stabilisation based on radiographic criteria of atlantoaxial subluxation, basilar invagination, subaxial subluxation and spinal canal narrowing[5]. Tomography, in both the anteroposterior and lateral projections, is useful for further assessing the C1/C2 joints. This technique has largely been superceded by computed tomography (CT), with sagittal reformatted images being particularly helpful in defining the relationship of the upper cervical spine to the occiput.

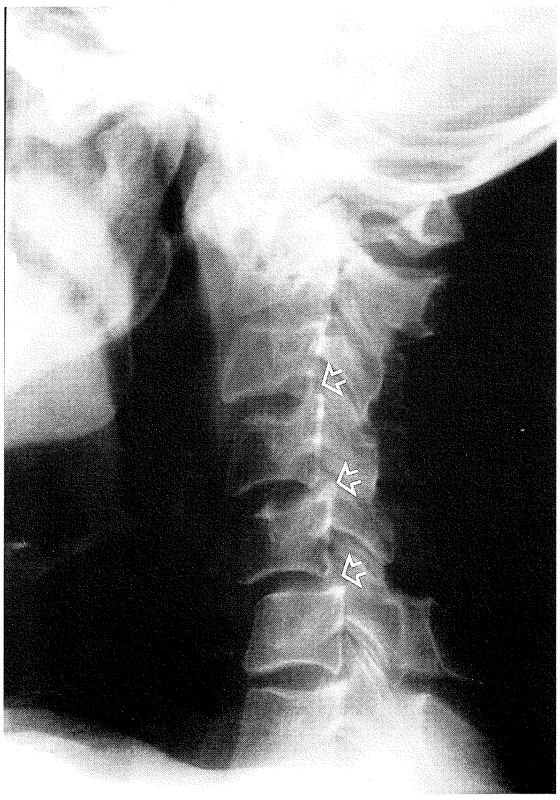
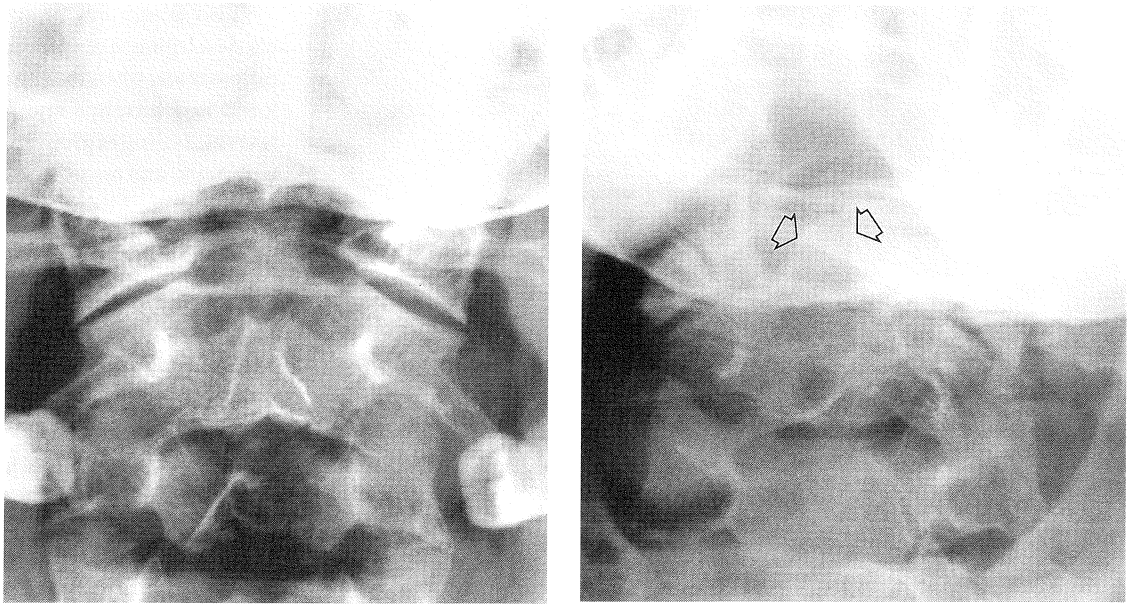
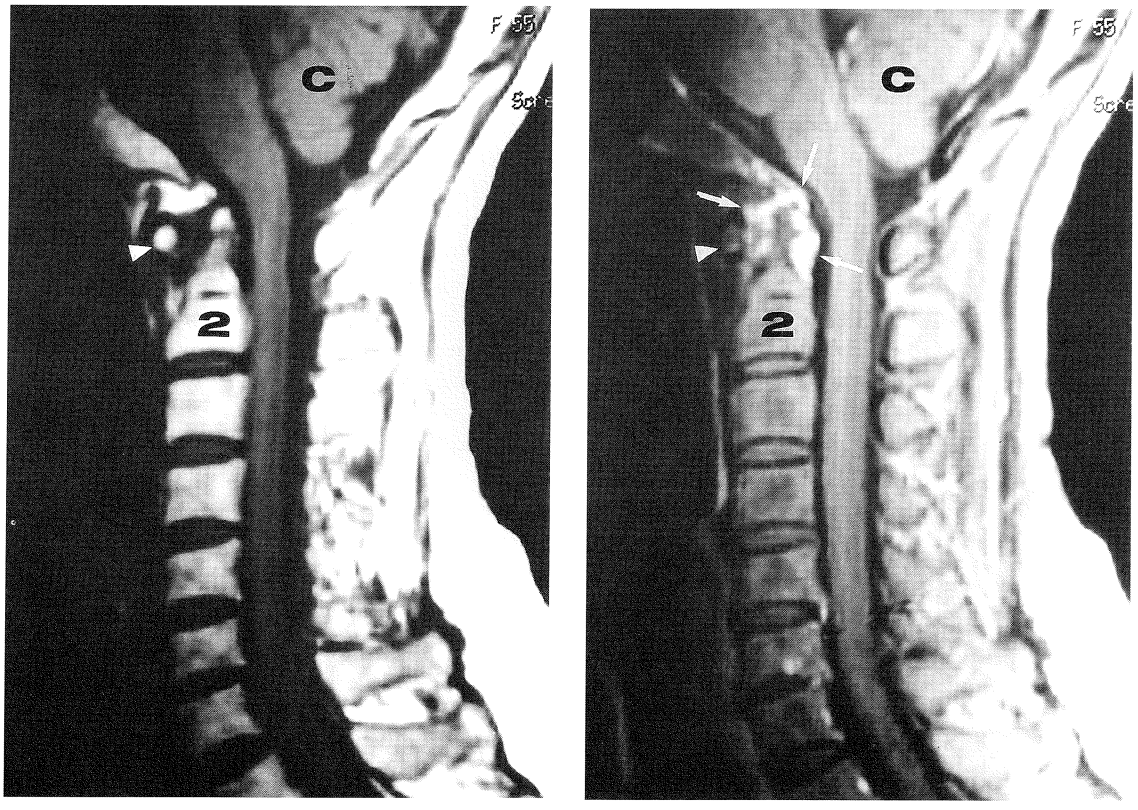


Fig 5 - Lateral cervical spine radiograph of a 58-year-old man with rheumatoid arthritis. In addition to vertical subluxation of the odontoid peg, note step-like subaxial subluxations at C3-6 levels (open arrows)



(6a) (6b)

Fig 6 - Open mouth radiographs of 2 different patients with rheumatoid arthritis showing (a) extensive erosions, seen as ill-definition of the cortical outline, and (b) tapering (open arrows) of the odontoid peg.



(7a) (7b)

Fig 7 - Sagittal MRI scans of a 55-year-old woman with rheumatoid arthritis. (a) On the pre-contrast image, widening of the atlanto-axial space is apparent between the bright fatty marrow signal intensity of the anterior arch of atlas (arrowhead) and the tapered odontoid peg. (b) Following contrast administration, the pannus mass surrounding the eroded odontoid peg is highlighted (arrows). [Body of 2nd cervical vertebra = 2; Cerebellum = C].

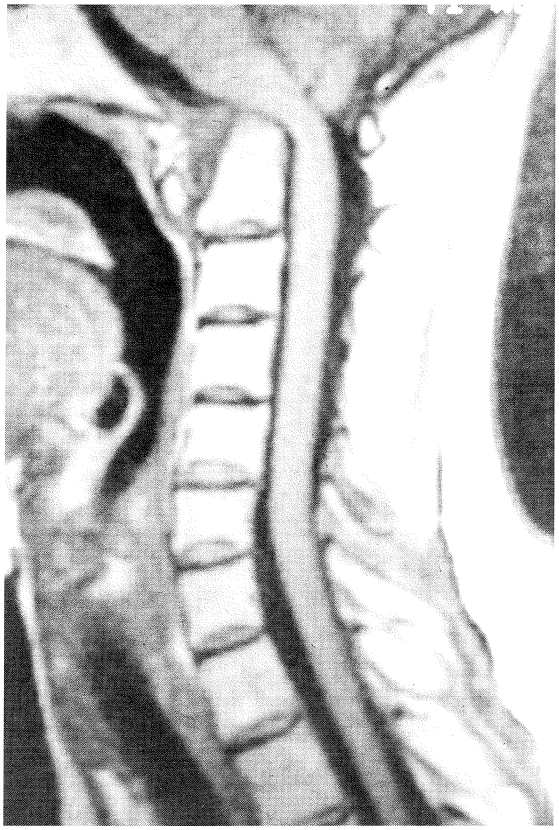


Fig 8 - T1-weighted sagittal MRI scan of a 44-year-old woman with rheumatoid arthritis. There is vertical subluxation of a truncated odontoid peg, which causes moderately severe kinking and abnormal angulation (125 degrees) of the cervicomedullary junction. She eventually underwent an occiput-C3 spinal fusion.

Cord compression cannot be adequately assessed on plain radiographs, although it is unlikely to occur when the atlantoaxial interosseous distance measures less than 9 mm. In the subaxial location, cord compression has been shown to have a strong association with spinous process erosion, axial shortening and spinal canal narrowing[5]. The spinal cord may be compressed by bone, soft tissue pannus or both[6,7]. The degree of thecal sac and cord compression can be assessed on CT following the introduction of intra-thecal contrast. Cervical spinal cord involvement is seen as indentation of the sac or cord, most often at the C1/C2 level or the cervicomedullary junction. The degree of peg erosion and subluxation is well demonstrated on CT, especially on sagittal reformatted images. However, positioning a patient with a potentially unstable rheumatoid cervical spine may be difficult, and even hazardous, following myelography.

MRI is the preferred method for imaging the spinal cord and brainstem, and is indicated in patients who require more than radiographic evaluation. MRI has the advantages of multiplanar imaging ability, lack of ionizing radiation and does not require intra-thecal injection of contrast. Unremitting pain, progressive or severe subluxations, and cord or brainstem compressions are among the common indications for MRI of the cervical spine in rheumatoid patients. Besides imaging the spinal cord directly, contrast-enhanced MRI can discriminate between joint effusion and various forms of pannus (Figs 2,3 and7). Although some studies have shown poor correlation between MRI findings and clinical features[7,8], others have found that a cervicomedullary angle of less than 135° correlates highly with clinical myelopathy and paralysis[9] (Fig 8). MRI has been found to be useful in selecting surgical candidates and in surgical planning. A recent development is dynamic imaging where MRI scans are performed with the neck in flexed and extended positions (Fig 2). Although this technique appears to have certain advantages, its role in rheumatoid arthritis of the cervical spine is currently still under debate[10].

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