CHAPTER II
REVIEW OF
LITERATURE
According to current estimates of WHO TB kills approximately 3 million people a year worldwide and India alone accounts for one-fifth of the total cases of TB worldwide. With the advent of HIV, the decrease in the incidence of TB that was noted, due to better public healthcare system, has started to reverse. It is thought that 60% of HIV positive patients will have skeletal TB as compared to 1-2% cases of HIV negative patients. Despite the advent of antitubercular drugs and better public health measures spinal TB still remains endemic in developing countries like India.27,28

The diagnostic work-up for TB of the musculoskeletal system requires patience and determination. Abnormal white cell count or complete blood count does not contribute to the diagnosis.12,24 The finding of elevated erythrocyte sedimentation rate does not substantiate the diagnosis, but may be useful as a follow-up tool during treatment.12 Tuberculosis skin testing when positive is not of much help, especially in endemic areas or with recipients of the BCG vaccine. A negative skin test can be caused by anergy, particularly in immunosuppressed and older patients.12

Acid-fast bacilli may be demonstrated on smear examination. The Ziehl-Neelsen staining is quick and inexpensive method but has a low positivity. Stains require a minimum of $10^4$ bacilli per milliliter, while culture shows a growth with only $10^3$ bacilli per milliliter. Moreover, cultures can be employed to determine drug susceptibilities but the results are available only after a few weeks.12,19 Success rate of isolating the TB organism from lesions does not exceed 50%.12,20

Culture in Bactec radioactive liquid medium and genotype analysis involving amplification by polymerase chain reaction followed by post-amplification analysis of mutation, have reduced the turnaround time to days rather than weeks or months.29,30

A history of TB, a positive skin test, and an elevated ESR are useful diagnostic clues, but these are not uniformly present. Although diagnosis is often complicated by difficulties associated with culturing these fastidious organisms, the use of DNA amplification techniques may allow for more rapid and accurate identification of TB infections in the future.31
Imaging plays a major role in the overall evaluation of these lesions. An ideal modality of investigation is expected to provide information that will help identify the nature of disease, show the location and extent of involvement, suggest the type of infection, guide biopsy and/or drainage procedure, indicate method of therapy and help assess response to therapy.\textsuperscript{19}

Radiographs are the first line of investigations to substantiate or refute a clinical diagnosis of TB of the spine. Over 50\% of the trabecular bone is lost before the lesion is conspicuous on plain film; this process may take up to 6 months. Plain film is limited in evaluation of the posterior arch, particularly in thoracic spine. No specific or pathognomic plain film signs distinguish tuberculous from pyogenic spinal infection, and correlation with the clinical presentation and duration of symptoms is essential.\textsuperscript{11,12} The commonest radiological presentation is the paradiscal lesion. The earliest signs are narrowing of the joint space and loss of definition of paradiscal margin of vertebral bodies. Paravertebral abscesses are evident as a fusiform or globular radio dense shadow or a bulging of the lateral border of psoas shadow. In later stages there may be sclerosis of the surrounding bone and tendency to anterior wedging or fusion.\textsuperscript{14,19,20}

Radiologically two distinct patterns of vertebral osteomyelitis may be seen. The classic finding of spondylodiscitis is characterized by destruction of two or more contiguous vertebrae and opposed end plates, disk infection, and commonly a paraspinal mass or collection; the increasingly more common atypical form of spondylitis without disk involvement is the second pattern. Less commonly posterior elements of the spine may be involved which is reported to occur characteristically in TB and not found in pyogenic infections of the spine.\textsuperscript{28,32}

Most distinguished imaging features of spinal TB is relative sparing of disc and paravertebral abscesses. Calcification with in the abscess is nearly pathognomic for spinal TB but not always present.\textsuperscript{33} The wall of the abscess is characteristically thick and irregularly enhancing on both CT and MRI images and this feature is thought to be diagnostic of tuberculous spondylitis.\textsuperscript{34} Calcifications in paraspinal collections are best seen on CT scanning, which is also best able to demonstrate the numerous small bone
fragments that may remain in the area of destroyed bone. The presence of these bone fragments has been described as a unique characteristic of tuberculous spondylitis, and their presence is said to be due to lack of proteolytic enzyme in mycobacterium tuberculae that would be necessary to lyse bone. CT scanning also best reveals the anatomical extent of bone destruction, particularly the posterior elements.35

Plain film myelographic findings associated with tuberculous spondylitis include displacement or thinning of the column of contrast material because of a mass effect and partial or complete obstruction of the flow of myelographic contrast material. CT myelography is helpful for determining the extent of the epidural abscess and for differentiating between an epidural abscess and bony encroachment of the spinal canal. CT myelography also provides additional anatomic information and may reveal unsuspected paraspinal or regional complications associated with spinal TB.36

Medical research council working party on TB of the spine has used radiographic assessment, made from antero-posterior and lateral radiographs of the whole spine, for recording: a) the number of vertebrae involved; b) the total vertebral body loss, obtained by adding together the losses including fractional losses in all the affected vertebrae; c) the angle of spinal deformity based on that described by Konstam and Blesovsky which gives a simple geometric expression of the angle of kyphosis; and the activity of the disease.37

The council defined inactive (quiescent) disease on radiography as:

a) bony fusion of the affected vertebral bodies, that is: i) continuity of trabeculae between the vertebral bodies, and in case of bone grafts traversing them when they are still detectable or ii) stout bony bridges, usually best seen in the antero-posterior view, projecting up to 2 centimeters wide of the vertebral bodies and showing evidence of trabecular continuity even though they are separated by a small space, often no more than a hair line. b) Sclerosis of the contiguous surfaces of the affected vertebrae with reduction or disappearance of the intervening disc space.37

The radiologic evidence of healing lags behind by three months. In the absence of reliable serological and immunological markers of healing, the “healed status” is
achieved if there is clinical and radiological evidence of healing with no recurrence after two years. Bony fusion of the affected bodies has long been regarded as the surest evidence of healing of Pott's spine, though no actual proof of this belief has ever been produced.

Konstam and Blesovky (1962) described a simple method of measuring the angle of the gibbus deformity. The angle K decreases as the kyphosis increases, while the angle A increases. Angle A was used as a measurement of gibbus deformity by the Medical Research Council Working Party in all of its reports on the subject. In this study angle was made by drawing a line through the superior surface of the first normal vertebra cephalad to the lesion and a line through the inferior surface of the first normal vertebra caudad to the lesion. Perpendiculars were then drawn from these lines and the angle A was measured at their intersection.

Rajasekaran et al in 1987 suggested a strong correlation (correlation coefficient; 0.83) between the initial loss of vertebral body and final gibbus in patients who had tuberculous lesions of the thoracic and thoracolumbar spine. They suggested the formula $y=a+bx$ where ‘$y$’ the measurement of final angle of gibbus deformity, ‘$x$’ is the amount of initial loss of vertebral body, ‘$a$’ and ‘$b$’ are constants 5.5 and 30.5 respectively. Thus with a loss of every whole vertebra 30°-35° of gibbus deformity occurred.

Rajasekaran and Soundarapandian (1989) studied the progression of deformity in TB spine and found that although chemotherapy may inactivate the disease, the vertebral collapse may continue until the vertebral bodies in the region of the kyphosis meet anteriorly or until the caseated material in the region of the vertebral bodies and the highly vascular granulation tissue mature into bone.

According to Boxer et al (1992) sclerosis was present in half of their patients at presentation and in these patients its progression provides little information about disease activity. In those patients with initially purely lytic changes, sclerosis was a feature of healing and should be seen within 5 months. Calcific debris which was seen on serial radiographs to progress to fusion, was seen as early as 3 weeks after initiation of treatment, although it could take up to 27 months for any evidence of fusion to appear.
Radiographically evidenced progression of bone destruction might continue for up to 14 months after effective chemotherapy had been initiated and should not be taken as a sign of treatment failure.\textsuperscript{42}

Parthasarthy et al in 1999 derived an equation to predict angle of kyphosis ($y$) at 10 years from the initial vertebral body loss ($x$) in ambulatory patients. The equation derived was of the form $y=22.1+25.0x$. The correlation coefficient, however, was only 0.50. The predicted angle was within $\pm10^\circ$ of the observed angle.\textsuperscript{43}

Jutte et al in 2007 calculated indexed total bone height loss, a value of 1 being the equivalent of the loss of a total vertebral body. A bone height loss greater than 0.3 on the initial radiograph in combination with a thoracolumbar location indicated 38\% chance of unfavorable outcome versus only a 3\% chance of unfavorable outcome when bone height loss was 0.3 or less in combination with a thoracic location.\textsuperscript{27}

The wide availability of Computerized Tomography (CT) and Magnetic Resonance Imaging (MRI) has increased the use of these modalities in the early diagnosis of TB of spine. CT scanning can determine posterior extension and encroachment of inflammatory tissue, bone or disc material and diagnose posterior spinal disease and involvement of sacroiliac joints and sacrum. It helps in guiding biopsies and planning operative intervention.\textsuperscript{12,20,24,44} Magnetic Resonance scanning is done to detect soft tissue masses, appendicular TB, extent of disease and the ligamentous spread of tuberculous debris. MRI is also useful in evaluation of intramedullary lesions and extradural spread and to differentiate between cord compression by granulation from that by bone and disc. Post therapy follow up also should ideally be done with MRI. Increased signal intensity on T1-weighted images from previously affected vertebrae indicates healing and has been found to correlate well with clinical signs and symptoms.\textsuperscript{12,14,20,24,44-47}

Computed tomography is the most thorough modality for imaging the extent of Pott’s disease. An often surprising degree of involvement of the soft tissue is seen on CT given the relatively mild symptoms. When the typical findings of anterior vertebral body destruction, disc space narrowing and paraspinal abscess are seen in the setting of an indolent or relatively benign clinical course, the diagnosis of pott’s disease can be
strongly suggested. CT scan can aid in guiding percutaneous biopsy and obtaining culture specimens.\textsuperscript{48}

CT will delineate the bone destruction earlier. The bone destruction observed is either fragmentary, osteolytic, subperiosteal or localized and sclerotic. Bone destruction with the shadow of a paravertebral abscess showing bone expansion with heterotopic bone or calcification is considered to be a sign of a tuberculous lesion.\textsuperscript{35}

Features of spinal TB that can be seen on CT scans include anterior vertebral body destruction, vertebral body collapse, disk space narrowing, and large paraspinal soft-tissue masses representing abscess formation. During the course of the infection, a cloaca may be visualized and may result from spontaneous decompression and drainage of the vertebral body abscess. Paraspinal and intraosseous abscesses typically show a thick and irregular enhancing wall on contrast-enhanced CT scans. CT readily shows the extent of abscess formation and can provide guidance for diagnostic and therapeutic procedures. In the early stages of infection, areas of erosion or osseous destruction may be subtle and can be better demonstrated with reformatted sagittal and coronal CT images.\textsuperscript{36}

Moore and Rafii (2001) reported that CT scan was excellent for visualization of end plate destruction, fragmentation of the vertebrae, and paravertebral calcification. Inflammatory collection and masses were best seen after the administration of intravenous contrast. Extension into the spinal canal of epidural abscesses and bony fragments were demonstrated on axial images.\textsuperscript{24}

Joseffer and Cooper (2005) also reported that CT scan best revealed the anatomical extent of bone destruction, particularly the posterior elements. The precise delineation of osseous destruction, when using sagittal and coronal reconstruction, was helpful in surgical planning. Additionally, CT scanning might help to clarify whether spinal cord compromise was caused by bone or soft-tissue involvement.\textsuperscript{44}

It has been reported that CT may provide the earliest signs of regressive inflammation and that this modality corresponds best with an improvement in clinical condition and laboratory markers.\textsuperscript{49}
Spinal TB is indolent and slow growing and can be diagnosed both clinically and radiologically in endemic regions. However the lesions are best seen by MRI rather than by radiologically. The low signal on T1 weighted images and the bright signal on T2 weighted images in affected vertebral bodies, the relative preservation of the disc, the presence of a septate pre- and paravertebral or intra-osseous abscess with a subligamentous extension and breaching of the epidural space, are all characteristically seen on MRI.\textsuperscript{33,50-52}

Many MRI signs have been described in the diagnosis of spinal infection. A non-specific but early finding is bone marrow oedema, which is best recognized on marrow sensitive sequences such as a T1-weighted or short tau inversion recovery (STIR) sequences. Low signal intensity on T1 and high signal on STIR/T2 sequences are seen with marrow oedema. A proton density fat-saturated sequence would also be suitable and would show high signal change. Erosion of the vertebral end plate, with loss of the low signal intensity line has been shown to have a sensitivity of 84% for an infectious process.\textsuperscript{53,54}

The narrowed disk space in tuberculous spondylitis is distinct from degenerative disk disease because it has a high T2-signal intensity due to the infectious character instead of the dehydrated, low T2-signal intensity in degenerative disk disease although a type I degenerative disk may show a slightly elevated T2-signal intensity.\textsuperscript{46}

MRI is considered an ideal modality for making the diagnosis, demonstrating the extent of disease, identifying complications and assessing response to treatment.\textsuperscript{6,18} The earliest finding may be end plate oedema, which is characterized by decreased T1-weighted signal and increased T2-weighted signal on MRI.\textsuperscript{14,19,24,44}

Both CT and MRI are superior to plain radiography in demonstrating the presence of paraspinal abscess. Calcifications in paraspinal collection are best seen on CT scanning, which is also best able to demonstrate the numerous small bone fragments that may remain in area of destroyed bone. The presence of these bone fragments has been described as a unique characteristic of tuberculous spondylitis, and their presence is said
to be due to lack of proteolytic enzymes in mycobacterium that would be necessary to lyse the bone.44,55

MRI demonstrates a smooth margin to the soft-tissue subligamentous spread of pus, differentiating this from pyogenic infection. It can also distinguish pus / granulation tissue (high signal on T2-W) from fibrosis (low signal on T2-W). MRI is not only used for arriving at the diagnosis, but is also used for planning in patients needing surgical decompression, strut grafting and for choosing a thoraco-abdominal approach over a trans-thoracic surgical approach in disease below the level of T2.20,45,47

MRI is ideal for follow up because alleviation of cord compression and decrease in size of the soft-tissue mass are best indicators of improvement. Hyper intense signal on T1 in the setting of chronic infection may be specific to mycobacterium tuberculosis; the signal normalizes with treatment.45 The earliest sign of resolution on MRI is a reduction in the size of any inflammatory soft tissue mass.49

In a study by Al-Mulhim et al (1995), the MRI characteristic of vertebrae in 12 patients were studied and it was found that the thoracic spine was the most commonly involved region (43%). Disc space involvement was apparent in only 46% of the lesions. Paraspinal abscess and epidural extension was noted in 71% and 61% lesions, respectively. Decreased signal intensity on T1W images was demonstrated in 46% cases with increased signal on T2W images seen only in 18%.56

In a study by Gupta et al. (1996) in 60 patients with extradural compressive myeloradiculopathy secondary to vertebral disease to assess the imaging features which may help in differentiating TB from neoplastic disease, it was found that discovertebral disease with or without involvement of the posterior arch was a feature not only of tuberculous spondylitis (30 patients) but also of metastases (6). The presence of an abscess helped in differentiating TB from neoplasia in 22 of the 41 patients with TB and was absent in all with neoplasms. The presence of bone fragments in 16 patients (8 with and 8 without abscess) was found to be specific for TB. In the absence of an abscess or bone fragments, image guided biopsy was essential to establish the diagnosis.57
Wirtz et al (2000) found that by 5-6 weeks, increased osseous consolidation was seen with CT scan, while on MRI signs of regression were more frequently seen after 12 weeks. CT is however of limited value for following up the soft tissue changes.\textsuperscript{58}

In the study conducted by Jain et al (2002) in 43 patients of spinal TB, it was found that spinal cord compression attributable to fluid on MRI scans resolves well with treatment and patients have good neural recovery in comparison with that of patients with mixed or granulomatous (dry) natures showing constriction of cord. Patients with preserved cord volume with edema or myelitis of cord on MRI scans have a good neural recovery. Thinning of cord was associated with myelomalacia and syrinx formation which are always poor prognostic signs for neural recovery.\textsuperscript{59}

In a study conducted on the patterns of MRI in 53 children with TB spine by Andronikou et al (2002), it was found that 83\% of patients had involvement of thoracic spine, with 100\% having disc disease and vertebral destruction, with 85\% having more than contiguous vertebra involved, with 98\% cases having a soft tissue mass and 93\% having an intraspinal mass. The authors found the prevalence of paraspinal abscesses to vary between 55-96\%. They reported that CT scan was inferior to MRI in visualizing the soft tissues, disc and spinal cord, which were essential in making the diagnosis and in determining prognosis.\textsuperscript{45}

Jung et al (2004) conducted a study to determine the accuracy of MRI for discrimination between TB and pyogenic spondylitis. MR images of 52 patients who had MRI of the spine and confirmed spondylitis were retrospectively reviewed. After review of medical records, they compared MRI findings in 20 patients with tuberculous spondylitis and 20 patients with pyogenic spondylitis. The review identified tuberculous spondylitis with sensitivity, specificity, and accuracy of 100\% (20/20), 80\% (16/20), and 90\% (36/40), and pyogenic spondylitis with sensitivity, specificity, and accuracy of 80\% (16/20), 100\% (20/20), and 90\% (36/40), respectively. The patients with tuberculous spondylitis had a significantly higher incidence of MRI findings as follows (p<0.05): a well defined paraspinal abnormal signal (95\% [19/20] in TB vs 25\% [5/20] in pyogenic), a thin and smooth abscess wall (95\% [19/20] vs 15\% [3/20], combination of both the
findings (90% [18/20] vs 0% [0/20], presence of paraspinal or intraosseous abscess (95% [19/20] vs 50% [10/20], subigamentous spread to three or more vertebral levels (85% [17/20] vs 40% [8/20], involvement of multiple vertebral bodies (60% [12/20] vs 25% [5/20], thoracic spine involvement (40% [8/20] vs 10% [2/20], and hyperintense signal on T2-weighted images (95% [19/20] vs 65% [13/20]).

Joseffer and Cooper (2005) found that the imaging features that are indicative of TB rather than pyogenic spondylitis are calcification within paravertebral abscess, large size of paravertebral abscess, >2 levels of involvement, posterior element involvement multicentric disease, subigamentous spread and heterogeneous MRI signal intensity.

Page et al (2006) found that the vertebral lesions detected by MRI and not by CT corresponded to edematous changes in medullar cancellous bone which probably reflects an inflammatory reaction in the bone marrow of patients with spondylodiscitis or spondylitis. They also noticed that the initial edematous signal of the vertebral body gradually converted to a fatty signal; a sign of cure. More importantly many lesions remained visible by MRI at the end of treatment despite the favorable clinical outcome.

In a study conducted on the diagnostic accuracy of MR imaging in TB spondylitis by Nasuda Danchaivijitr et al (2007), 65 MR images of two groups of patients were retrospectively reviewed and sensitivity and specificity of each MR imaging features was calculated. They found that the three most useful MR imaging features with high sensitivity and specificity (>80%) were end plate disruption (100%, 81.4%), paravertebral soft tissue (96.8%, 85.3%), and high signal intensity of intervertebral disc on T2W (80.6%, 82.4%). High sensitivity but low specificity signs in MRI included bone marrow edema (90.3%, 76.5%), bone marrow enhancement (100%, 42.5%), posterior element involvement (93.5%, 76.5%), canal stenosis (87.1%, 26.5%), and spinal cord or nerve root compression (80.6%, 38.2%). Low sensitivity but high specificity features in MRI were intervertebral disc enhancement (63.3%, 84.2%), vertebral collapse (58.1%, 85.3%) and kyphosis deformity (67.7%, 82.4%). Overall, the sensitivity and specificity of MRI for spinal TB were 100% and 88.2% respectively.
Harada et al (2008) studied the MRI finding in tuberculous and pyogenic spondylitis and found that the incidence of following MR imaging finding were significantly higher in patients with tuberculous spondylitis than in those with pyogenic spondylitis: well-defined paraspinal abnormal signal (100% in tuberculous vs. 15.4% in pyogenic, p<0.001), thin and smooth abscess wall (90% in tuberculous vs. 7.7% in pyogenic, p<0.001), presence of paraspinal or intraspinal abscess (100% in tuberculous vs. 53.8% in pyogenic, p<0.05), and thoracic spine involvement (60% in tuberculous vs. 7.7% in pyogenic, p<0.001). The incidence of the following MR imaging findings was significantly higher in patients with pyogenic spondylitis than in those with tuberculous spondylitis: abnormal signal around facet joint (53.8% in pyogenic vs. 0% in tuberculous, p<0.001). There was no significant difference in the following MR imaging findings: subligamentous spread to three or more vertebral bodies (50% in tuberculous vs. 53.8% in pyogenic, p=0.86), involvement of multiple vertebral bodies (90% in tuberculous vs. 84.6% in pyogenic, p=0.71), and disk space narrowing (70% in tuberculous vs. 92.3% in pyogenic, p=0.17).62

In a study conducted on the association between pedicle involvement and anterior column damage and kyphotic deformity by Yusof et al. (2009) evaluation of MRI's of 31 patients was traced from the hospital registry and patient medical records. The radiological abnormalities studied were pedicle involvement, severity of vertebral body and intervertebral disc involvement (percentage of collapse), prevertebral abscess formation (its largest width), and degree of spinal deformity (degree of kyphosis or hypolordosis). They found that spinal TB mostly involved the thoracic level (48.4%). Pedicle involvement was noted in 64.5% of patients, and the highest involvement was at the thoracic level. Disc collapse, kyphosis and prevertebral abscess formation was highest at the thoracic level.63

Evaluation of spinal TB with scintigraphy early in the course of infection is limited by the indolent nature of skeletal TB. Bone scan and gallium studies may not show spinal TB initially, despite the presence of active disease clinically and radiographically. As the infection progresses, extensive osseous changes and attempts at
healing result in increased bony metabolism, manifested as areas of increased radionuclide uptake on bone scans. Gallium imaging is useful in the setting of chronic infection and for monitoring the response to antituberculosis therapy.\textsuperscript{49,64}

A three phase bone scan is thought to be more sensitive, with sensitivities of between 87 and 98%, with a specificity of between 91 and 100%. Bone scan may however be negative in the presence of infection with photopenic areas being seen when there is inadequate blood supply or a lytic lesion with reduction of osseous tissue. Single photon emission computed tomography (SPECT) has been found to increase the diagnostic confidence by indicating the involvement of adjacent vertebral bodies rather than of the pedicles and spinous processes.\textsuperscript{65,66}

In particular the use of Technetium bone scintigraphy in the follow up of patients with proven spinal infection is not recommended. It has been shown that scan can remain positive long after the infection has been successfully treated. Gallium citrate 67 however is thought to be of more use in follow up imaging.\textsuperscript{64}

Bone scan of tuberculous spine involvement is sensitive but nonspecific, providing limited anatomic resolution. Technetium (Tc) 99m bone scan showed increased uptake in 87.5% patients with active TB in the series reported by Desai in 1994. He concluded that scintigraphy is a sensitive method.\textsuperscript{47}

Modic et al (1985) reported that scintigraphy was as sensitive as MRI in the diagnosis of vertebral osteomyelitis.\textsuperscript{67} Beltran et al (1988) reported that scintigraphy is less sensitive than MRI for detection of soft-tissue infection.\textsuperscript{68} Lifeso et al (1985) found \textsuperscript{99m-Tc} bone scanning to be negative in 35% of cases with radiographically demonstrable lesions.\textsuperscript{69} Desai reported that out of 24 patients, 2 patients false negative bone scan results were in those cases with involvement of only the neural arch.\textsuperscript{47}

Post contrast fat-suppressed T1-weighted images have been advocated in the diagnosis of very early cases of spinal infection as strong enhancement is shown in the vertebral body and any extension can be accurately assessed. Post-contrast (Gd-DTPA) T1-weighted imaging is essential in order to differentiate epidural abscess formation from solid granulation tissue. Enhancement is seen in the intervertebral disc, in the adjacent
vertebral bone marrow, at the border of any osteolytic areas and in any inflammatory soft tissue components. Homogenous enhancement is seen on T1-weighted images when granulation tissue is present, whereas peripheral enhancement with central hypointensity corresponds with an abscess with a central fluid collection.49,70,71

According to Kang et al (1992) post gadolinium- DTPA MRI shows either an irregular thick or a uniform thin rim enhancement suggesting either caseation necrosis or a cold abscess in TB; pyogenic abscesses show diffuse enhancement.72

Liu et al (1993) reported that because the necrotic tissue, which mimics the CSF content on T2W1, is effectively enhanced at the margin, canal compromise can be better demonstrated by Gd-DTPA administration. Otherwise Gd-DTPA administration provided no major benefit in the diagnosis.73

Joseffer and Cooper (2005) advised that MRI evaluation of the spine in cases of possible infection should always include Gadolinium (Gd) - enhanced images. Gd best defined soft tissue manifestation, including early subligamentous infection or epidural abscess, either of which might be subtle in early stages.44 After Gd injection, MRI may also reveal a characteristic thick enhancing rim around paraspinal and intraosseous abscess.9,12,18 Calcifications with in the abscess are nearly pathognomic of spinal TB but are not always present. The wall of tuberculous abscess is characteristically thick and irregularly enhanced on both CT and MRI images, and this feature is thought to be diagnostic of tuberculous spondylitis.33,55

Schmitz et al (2001) found that all the cases in their series that had histopathological confirmation of infection had positive FDG-PET imaging. The sensitivity of the technique appears to be high but the number of the patients in this study was small. They also suggested that they were able to identify soft tissue infection as being separate from the osseous process. The main limitation was however that PET does not allow differentiation between infection and tumour. PET may however provide a useful method of differentiating degenerative end plate change and infective end plate change.74

17