

**Prospective study on functional and radiological outcome of Tuberculosis
of Dorsal and Lumbar spine-Anterior reconstruction and Posterior
stabilization through Posterior only approach**

**Dissertation submitted in partial fulfillment of the regulation for the award
of M.S. Degree in Orthopaedic Surgery
Branch II**

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CERTIFICATE

This is to certify that the work **“Prospective study on functional and radiological outcome of Tuberculosis of Dorsal and Lumbar spine- Anterior reconstruction and Posterior stabilization through Posterior only approach** “which is being submitted for M.S. Orthopaedics, is a bonafide work of **Dr. P.BHARATHIRAJA**, Post Graduate Student at Department of Orthopaedics, Madurai Medical College, Madurai.

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DECLARATION

I, **Dr.P.BHARATHIRAJA** solemnly declare that the dissertation titled **“Prospective study on functional and radiological outcome of Tuberculosis of Dorsal and Lumbar spine-Anterior reconstruction and Posterior stabilization through Posterior only approach”** has been prepared by me. This is submitted to **“The Tamil Nadu Dr. M.G.R. Medical University”**, **Chennai**, in partial fulfillment of the regulations for the award of M S degree branch II Orthopaedics.

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INTRODUCTION

Tuberculosis being universally prevalent affects nearly 30 million people globally of which 3 million people die. In our country there are 6 million cases. Lately the surge in incidence is attributed to coincidence with HIV and the emergence of drug resistance. 1 to 3 % of the tuberculosis cases have skeletal system involvement of which Spinal Tuberculosis (50%) is the most common variety.

The treatment of spinal Tuberculosis has been metamorphosed from Pre-antitubercular era to Postantitubercular era and from Radical surgery through Middle path regimen. Since the vertebral bodies and discs are involved conventionally the Anterior Approach is Gold Standard as it gives direct access to the diseased parts of vertebra, allowing drainage of surrounding soft tissue, abscess, wider decompression and defect reconstruction.

In thoracolumbar region anterior approach(thoracotomy,retroperitoneal) has high rate of complications and morbidity as it involves opening of body cavities.The stability provided by anterior instrumentation proved to be weaker due to osteoporosis associated with infection in a diseased anterior column. In exposing the upper dorsal spine anteriorly there is always a requirement for thoracic surgeon. Scarring of the lungs and adhesions to pleura excludes anterior approach.

Although a combined Posterior stabilisation and anterior debridement could solve stability related issues but it adds to the morbidity; in both staged and single event surgery as it is essentially two separate hits and can be resorted to only in patients with significant deformity. The extra pleural approach used in posterior approach could give access to anterior and lateral column. Posterior approach is excellent for circumferential spinal cord decompression, which allows multilevel instrumentation for a stronger stable construct and is relatively less morbid . It is more commonly(familiar approach) used and patients can be rehabilitated earlier.

REVIEW OF LITERATURE

- 1) Tuberculosis is probably as old as man-kind. Tuberculosis is first described in the Hebrews who eat flesh of the tuberculous animals. In the time period 3700B.C to 1000B.C, there reported Thirty one cases of skeletal and mummy pathology resembling tuberculosis and were reviewed by Morse et al (1964).
- 2) Sunshine and “Sipudru”, a herbal preparation were used in the ancient periods of Atharvans(1800-1000 B.C) to treat cases of skeletal tuberculosis. Numerous hymns in Atharva Veda refer to pathology of spinal tuberculosis.
- 3) “In pre-columbian bronzes from Peru, in effigy water bottles and from the pictographs of the cliff dwellers, all pre –Columbian, the picture of Pott’s Disease is portrayed” (Webb,1936). In the Greeco- Roman period, Hippocrates(9), Celsus and Caelius, Aurelianus have written on tuberculosis (Sharpe1962). Possible relationship between the spinal deformity and pulmonary disease (Bick 1948) was described by The Hippocrates in his textbook on “Articulations” Later the kyphotic deformity due to spinal caries by manual pressure, traction and mechanical appliances correction was tried by Hippocrates and Galen, but with little success.
- 4) Dalechamps (1513) a French Surgeon and an editor of Galen, redescribed vertebral caries. He described caries and paralysis

of lower extremities in 1570 antedating Percival Pott (1779) by a little over two centuries.

- 5) Percival Pott in 1779 published his famous monograph in which he pointed out that the destruction of the vertebral bodies was the cause of paraplegia in spinal tuberculosis. He laid the foundation of surgical treatment of the condition when he wrote: “the remedy for this most dreadful disease consists merely in procuring a large discharge of matter”.
- 6) Procedure of Laminectomy was used by Chipault in 1896 in patients with Pott’s paraplegia which is an basically an unsound procedure. Fraser later on performed the operation of laminotomy which was mechanically even less adequate than laminectomy and finally in 1937 abandoned the operation altogether as later results were disappointing (Griffiths et al 1956)
- 7) Menards in 1894 developed costo- transversectomy which fell into general disrepute because of high incidence of sinus formation and of secondary infection and was finally given up even by Menard.
- 8) In 1906 Anterior approach to spine was introduced by Muller. For Pott’s Paraplegia posterior spinal fusion management concept was introduced by Albee and Hibbs in 1912. Henderson in 1917 drew attention to the fact that posterior fusion does nothing to the diseased

focus: to quote him “neither the Hibbs nor the Albee type of operation for ankylosing the diseased area in tuberculosis of the spine is in any sense a radical operation for the extirpation of the focus of the disease”- an observation as true to-day as then. Trans thyrohyoid approach to C2-C4 and transoral approach to C1 and C2 was introduced by Fang and Ong. Obalinski performed posterior mediastinotomy for the evacuation of tuberculous Paravertebral abscess. Fraser in 1914 stated regarding the pathogenesis of Potts spine that healthy bone has greater resistance to tuberculous infection and where healthy bleeding bone is close to the tuberculous focus. The bone with yellow marrow which Fraser postulated was devitalized by an exotoxin produced by the tubercle bacillus is really bone which has undergone aseptic necrosis.

- 9) Calve in 1917 devised a method to aspirate the contents of an abscess without sinus formation. Girdlestone in 1923 gave a lucid description of the spinal joints and emphasized that the Hibbs and Albee fusions are posterior spinal fusions and that they can only prevent flexion if the lateral columns of the spine are intact. Ito et al 1934 devised an approach similar to anterolateral

decompression for the curettage of the vertebral body for tuberculosis.

- 10) Seddon(12) in 1938 analyzing his results with ninety two patients – thirty two treated by spinal fusion and sixty conservatively came to the conclusion that adult tuberculosis of the spine is best treated conservatively and that provided there is no associated visceral lesion the prognosis is good. Dott and Alexander evolved the operation of anterolateral decompression, a modification of Capener's operation, his approach being a little more anterior and involving removal of a part of the body of the vertebra to gain access to the spinal canal, no part of the lamina was removed.
- 11) Bosworth and compos in 1955 felt that most reliable treatment is immobilization and early posterior spinal arthrodesis.
- 12) Paus in 1964 reported complete working capacity in 35 percent of 37 cases treated by ambulatory regime with anti-tubercular drugs. Of 86 cases treated by him by radical operation and anti- tuberculous drugs, 88 percent had complete working capacity.
- 13) Somerville and Wilkinson in 1965 treated 130 lesions by direct operation and achieved sound healing in 92 percent and

reported relapse or recurrence in 12.5 percent of healed cases. J.R. Donaldson(13) and C.E.Marshall in a series of 560 operated cases came to the conclusion that posterior fusion is in no way a radical procedure for tuberculosis of the spine but it is a safe procedure.

14) Donaldson and Marshall also suggested that direct approach to the bodies of the vertebra is necessary when any of the following condition are present 1. When in doubt as to the diagnosis 2. When there is very large abscess. 3.When the disease is present in a child. 4.When there is a sequestrum that interfere with osteosynthesis of the bodies.5. When a posterior fusion has been done and failed.

15) In Friedman's (1966) series spontaneous recovery from paraplegia was seen.

16) In Tuli's series (1969) spontaneous recovery of neural complication was observed in 48 percent of cases on anti tubercular drugs and bed rest alone. Medical research Council Working Party on Tuberculosis of the spine has given four reports in the treatment of Pott's spine.

- i. The First report (1973a) described a study in Masan, Korea Where the objective was to compare in-patient and out-patient chemotherapeutic treatment. The groups were compared three

years after treatment started and it was found that there was no significant difference of response either between in-patients and out-patients or in those treated with three drugs as compared with two.

- ii. The second report(1973b) based on the study in Pusan(14) , Korea was to assess the effect of plaster of paris jacket on ambulatory out-patients. A random allocation was made to chemotherapy with streptomycin for three months and PAS plus isoniazid for 18months (SPH) or to PAS plus isoniazid for 18 months (PH). At the end of three years the results for patients with a plaster jacket and for those without such support were closely similar.
- iii. The Third report is based on a study in Bulawayo Rhodesia(15), in which 130 African patients with a diagnosis of tuberculosis of the spine were allocated at random to operation of a simple debridement of the spinal focus or to ambulatory treatment from the start. A second random allocation was made with chemotherapy either with PAS plus isoniazid for 18 months with a streptomycin supplement for the three months (SPH) or no such supplement (PH). There was little difference in progress between the SPH and PH

series, at three years 84 percent of 45 SPH and 86 percent of 44 PH patients has a favourable response.

iv. The Fourth report is based on a study in Hong Kong which is a controlled trial of anterior spinal fusion(8) and debridement in the surgical management of tuberculosis of the spine in patients on standard chemotherapy. 150 Hongkong patients with a diagnosis of tuberculosis of the thoracic or lumbar spine were allocated at random to operation by radical resection of the spinal lesion and insertion of autologous bone graft (rad. Series) or by simple debridement of the spinal focus (Deb. Series).

17) All the patients were treated with isoniazid plus PAS for 18 months and daily streptomycin for the first 3 months. At 18 30months 89 percent of the Rad and 79 percent of the Deb patients had a favourable response to the originally allocated treatment. The corresponding percentages at 3years were 87 and 86 percent.

18) Adendorff et al (1987) in general observed that potential of neural recovery was related to the degree of cord compression. They treated majority of their adult patients with neural deficit or even those without neural deficit by anterior operation combined with bone grafting.

- 19) Hsu et al (1988) reviewed 22 patients 7 years after treatment by anterior decompression and fusion in patients suffering from paraplegia of late onset. The response to anterior decompression was better in patients who had evidence of active disease 9 out of 12 recovered completely and 3 significantly.
- 20) In Tuli's series of 400 patients (1987-2000) operated according to the criteria middle path regime show much better neural recovery. At one year after the operation, outcome was complete recovery in 85 percent, partial recovery enabling ambulation with some support in 8 percent and negligible recovery (wheel chair bound) in 7 percent.
- 21) Upadhyay(17) et al (1994) and Moon et al (2002) found no difference in the results of deformity in the lumbar spine between the group that had anterior radical surgery" and the group that was treated by anterior curettage and debridement.
- 22) Moon et al (2002) in one of the recent analysis of lumbar spine disease treated by modern anti-tubercular drugs obtained spontaneous inter-corporal bone block formation in nearly 70 percent of patients at 18 months and in 88 percent at 36 months.

AIM OF THE STUDY

In this study we clinicoradiologically evaluated the outcome of debridement, decompression, reconstruction using bone graft/cage, stabilisation with pedicle screws and fusion for tuberculosis of dorsal and lumbar spine through posterior only approach

ANATOMY

A Typical vertebra is constituted by anterior body & posterior neural arch enclosing the spinal canal between them, housing the spinal cord, meninges with its vascular supply. On either side the neural arch has paired structures the broad laminae , narrower pedicles, transverse processes, superior and inferior articular facets. Both the laminae unite posteriorly forming the single spinous processes.

Pedicles are short, thick, rounded posterior projections from the superior part of the body at the junction of its lateral and posterior surfaces. The vertebra is formed of cancellous bone with red marrow and reticuloendothelial deposits. More commonly the TB infection initiates close to epiphyseal plates. The zygapophyseal or facetal joints are synovial joints with capsule which is loose to permit sliding movement between the adjacent facets (inferior articular facet of the cephalad vertebra and superior articular facet of caudal vertebra).

A true tubercular synovitis occurs in the facetal joints of C0-C1 or C1-C2 joints. The intervertebral discs lies in the space between the vertebral bodies of successive vertebrae. Every disc has a central notochordal remanant - the nucleus pulposus and peripheral annulus fibrosus, together functioning as effective shock absorbers. Being avascular in adults the disc derives its nourishment from the adjoining vertebral end plates by diffusion of fluids.

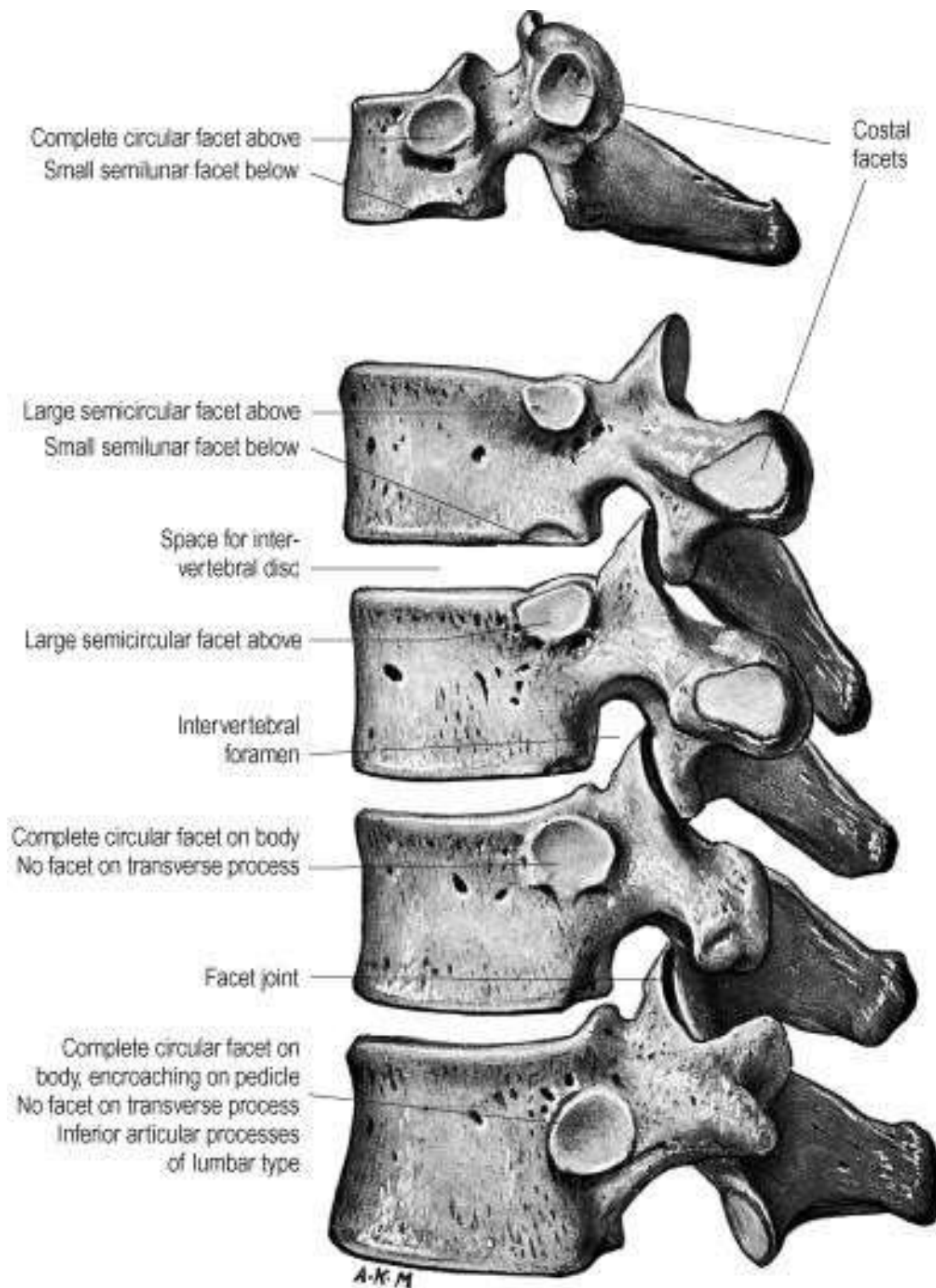


Fig 1. Thoracic vertebra9

Embryology:

A vertebra is formed by the caudal half of cranial pair of sclerotome and cranial half of caudal pair of sclerotome . The vasculature of the vertebrae follows its developmental anatomy, i.e., every segmental thoracic or lumbar vertebra supplies the adjacent halves of 2 vertebrae with a sandwiched intervertebral disc. These arterioles terminate as tortuous loops below the physal end plates without any anastomosis between them functioning as end arteries(Somerville and Wilkinson,1965).

Arterial Supply

On either side, the trunk of the Posterior intercostal or lumbar artery winds the vertebral body, giving off branches

1. Primary periosteal
2. Equatorial branches to the body, and
3. A major dorsal branch.

The dorsal branch gives a spinal branch which enters the intervertebral foramen. As they enter the vertebral canal the spinal arteries divide into post central, prelaminar and radicular branches.The post central branch is the main nutrient arteries to the vertebral bodiesand to the periphery of the intervertebral discs.

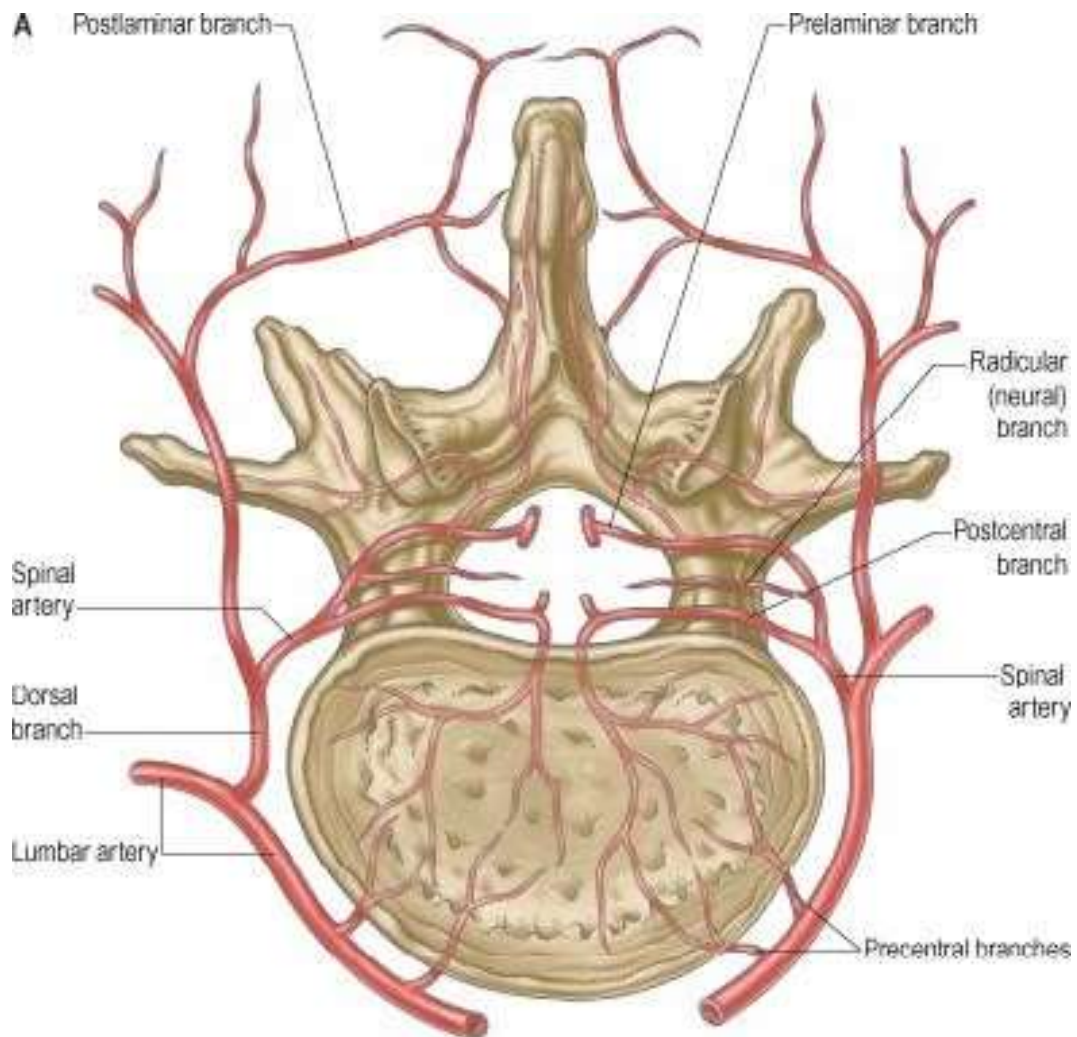


Fig 2. Blood supply of a vertebra

Venous drainage:

The venous blood from the vertebral bodies drain into the external vertebral venous plexus via tributaries. The internal vertebral venous plexus receive drainage from the spinal cord and bones of vertebral column. The basivertebral veins are large tortuous in the body and come out of the dorsal foramina of the body. Both these vertebral plexuses form anastomotic columns throughout the vertebral column and are devoid of valves. The intervertebral veins accompany the spinal nerves in the intervertebral foramina connecting these plexus with the lumbar, posterior intercostal, and lateral sacralveins.

The basivertebral veins are valveless and their blood flow can be reversed. They constitute the valveless Batson's venous plexus. Retrograde flow of blood from the pelvic venous plexus to the perivertebral venous plexus may be responsible for the spread of infection and tumor from the diseased organs to the vertebral column.

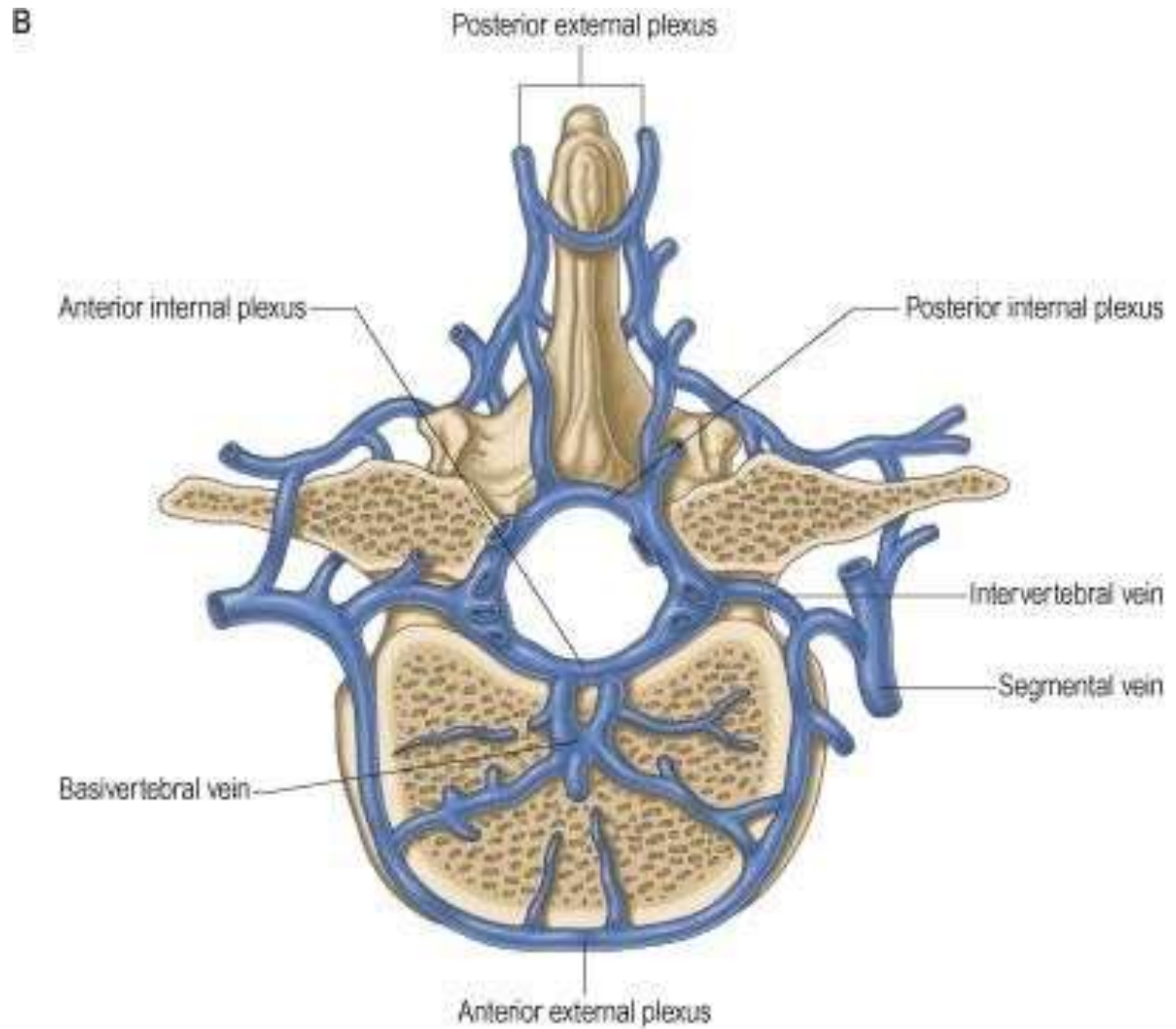


Fig 3. Venous drainage of a vertebra

Lymphatic drainage:

Chylosteron chyliferum is located to the right of aorta behind the right crus of diaphragm on the L2 body (may vary between T12 - L2). This situation explains the spread of infection to these vertebral bodies.(Hodgson et al.1969). Chylosteron chyliferum is the lymphatic pouch that is formed by both lumbar trunks, lower most intercostal trunks and the intestinal trunks; and progresses superiorly as the thoracic duct.

Biomechanics of Spine:

The anatomy of vertebral column is such that it provides stability, mobility, weight transmission and protection to internal neural structures whatever its attitude is however there is considerable variation in the stability and mobility provided by the different segments of the column. The dynamic muscular control adds to much of its stability. The bony and ligamentous architecture provides static stabilisation. The most mobile levels are least stable. The least stable segments are those with higher ratio of intervertebral disc height to vertebral body height. Vertebral collapse and deformity may result from chronic infections like TB which can affect their function of protecting the inner neural structures. The intervertebral discs have deformable elasticity that permits lateral flexion and axial rotation inbetween the vertebral bodies. It also helps to decrease the vertical accelerations of the head. The important shock absorbing function of the vertebral column arise from its primary & secondary

curvatures which rise and fall during movement against the controlled tension of the muscles of torso. The elastic strain energy in the stretched tendons absorbs the shock. The ligaments of the vertebral column and zygapophyseal joint capsules make the column stable. The tough anterior longitudinal ligament prevents shear displacement and extension of the column. The posterior ligamentous complex prevents flexion and rotation. Its intactness decides the available range of movements. The articular surface of the zygapophyseal joints first makes the column stable by preventing shear gliding and rotational movements. Secondly the orientation of the zygapophyseal joint both decides and restricts the movements. The entire vertebral column is stabilised by the long musculatures connecting the pelvic and pectoral girdles, head and the appendicular skeleton. Mainly the erector spinae provides a bow string / guy rope or staying effect deciding the posture and movements. The small and deep muscles of the back fine adjust the movements of spine. They are effectively resisting the intervertebral gliding mainly by the inclination they have to the long axis of the spine.

Pathology

Skeletal TB is always secondary to primary foci most often in the lungs or else in the GI tract or lymph nodes. The bacilli reach the spine through Batson's venous plexus, hematogenous spread or lymphatic spread.

Depending on the focus in the vertebral skeleton spine TB is classified as,

1. Paradiscal (commonest),
2. Central,
3. Anterior,
4. Appendicular and
5. Synovial.

The vertebra is predisposed to spinal TB because of its high vascularity. Each vertebra develops from Sclerotome which lies on either side of Notochord. Because of the developmental anatomy (embryological), paradiscal type is the most prevalent. The cephalad half of lower vertebra and caudal half of upper vertebra arise from the same pair of sclerotome and have common blood supply.

They are disc sparing lesions of the end plate which may develop further to form classical spondylodiscitis. The body and intervertebral disc will be further destroyed causing collapse of the body according to the biomechanical forces acting along the vertebral column, causing local kyphosis in the dorsal region. It heals by bony fusion leading to deformity. If the deformity is severe, there is

stretching of the spinal cord over the deformity, which in turns leads to late onset neurological deficit.

Tuberculosis in lumbar region differs considerably from that of the dorsolumbar region in that the telecoping collapse and lordosis usually result in minimal kyphosis that is evident as foreshortening of the trunk rather than kyphosis. **Central type** lesions are defined by the involvement of only one vertebral body without involvement of adjacent disc or body which progresses with complete collapse of the body with gibbus deformity leading to concertina type of collapse or vertebra plana. These lesions are associated with spread through Batson venous plexus.

The lesions that involve the anterior part of the vertebral body are called **anterior or periosteal type** and is because of the spread of cold abscess below the anterior longitudinal ligament. “**Scalloping effect**” seen in this type is due to periosteal stripping and aortic pulsation. In **Appendicular type** there is isolated involvement of the spinous process, lamina, facets and the pedicles and is primarily by spread of infection through the blood. These lesions if alone donot cause any deformity on healing. Facetal and pedicular destruction may cause instability. Synovial type is the true tubercular arthritis and is seen in the atlantoaxial and atlantooccipital joints.

Cold abscess:

It is defined as abscess without usual signs of inflammation (eg : dolor, rubor, calor). Cold abscess results from collection of pus & tubercular debris from diseased vertebra. It is deeply seated, not warm, sterile abscess. The abscess is composed of Serum, WBC, Bacilli, Granulation and caseous material. They track along the fascial planes or neurovascular bundles and become symptomatic as paraspinal abscess, prevertebral abscess or epidural abscess.

Tubercle:

Once the tubercle bacilli reach the vertebral bodies, there is a reaction characterized by the accumulation of the polymorphonuclear cells from the reticuloendothelial deposits. These cells are replaced by the monocytes and the macrophages. These cells ingest and phagocytosis the tubercle bacilli. These leads to dispersion of lipids in their cytoplasm leading on to the formation of epitheloid cells which coalesce to form the langerhan cells. These cells are surrounded by the cuff of lymphocytes. They form a nodule which is characteristically called as “Tubercle”. Caseation necrosis occurs in the center of the tubercle forming “**Soft tubercle**” which is characteristic of Tuberculous lesion.

BACTERIOLOGY

Mycobacterium tuberculosis is a slender, straight or slightly curved bacillus, nonmotile, nonencapsulated and does not form spores. It is an obligate

aerobe growing most successfully in tissues with high oxygen content, such as lungs. They are slow growing that divides every 18 to 24 hours and is sensitive to heat(pasteurization) and ultraviolet light.

It is hydrophobic with high lipid content in the cell wall. Because the cells are hydrophobic and tend to clump together, they are impermeable to the usual stains, e.g.Gramstain. They are called Acid fast because they resist decolourisation with the acids. It is a facultative intracellular pathogen usually infecting mononuclear phagocytes. It grows in optimum pH of 6.4-7.0, optimum temperature of 37 degrees in aerated medium. The addition of 0.5% glycerol improves the growth.

Immunodeficiency and tuberculosis:

People with AIDS virus(or persons with CD4+ lymphocyte count less than 100/mm³) are being infected with atypical tuberculous bacilli and many of these strains already show resistance to a large number of antituberculous drugs.HIV infected persons due to dysfunction of the host immune system, have very high risk of getting primary tuberculosis, reactivation of the previous tuberculous lesion in the body, and concomitant infection by another strain of tuberculous bacillus by the exogenous route. The incidence of tuberculosis in patients with AIDS is almost 500 times the incidence in the general population. Patients with HIV and tuberculosis are a potential source for the spread of drug resistant strains of tuberculous bacilli to the other members of the society.

Prolonged use steroids, methotrexate and immunosuppressive drugs may also lead to immunodeficiency.

CLINICAL FEATURES

Spinal tuberculosis is more common during first three decades of life. As with other forms of the tuberculosis, the frequency of the spinal tuberculosis is related to the socioeconomic factors and the endemic exposure to the infection.

The disease equally affect both the sexes. Spinal tuberculosis most commonly affect the thoracolumbar region followed by the thoracic and the lumbar spine. The predilection for the thoracolumbar region has been attributed to the close proximity to the cistern chyli and the kidneys, more spongy tissue, the biomechanical transition between a fixed thoracic spine and the mobile lumbar spine. Lower thoracic vertebra are the most common area of involvement(40-50%),followed closely by the lumbar spine(35-45%).

Signs and symptoms:

The presentation of the spinal tuberculosis depends upon the stage of disease, the region of the spine affected and the development of complications such as neurologic deficits, abscesses or the sinus tracts. The reported average duration of symptoms at diagnosis is 4 months but can be considerably longer due to nonspecific presentation of chronic back pain in some of the patients.

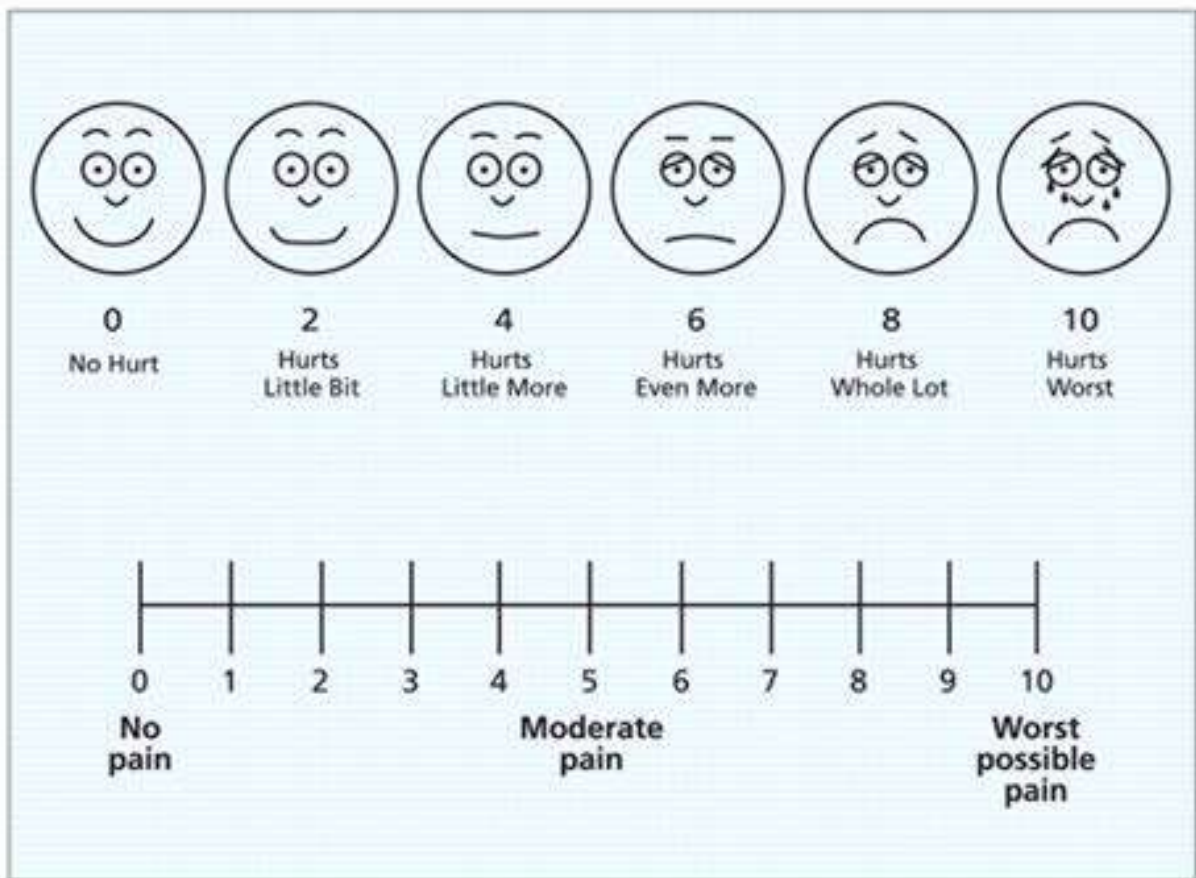
Constitutional symptoms like malaise, loss of feeling of wellbeing, loss of appetite and weight loss, evening rise of the temperature with occasional night sweats are present. The commonest presenting symptom is progressive local back pain for weeks to months, with or without muscle spasm and rigidity.

The back pain in tuberculosis is due to the chronic inflammation, segmental instability, distension due to abscess and pressure on neighboring structures.

Presence of regional muscle spasm could be an indication of instability. In the thoracolumbar region, bilateral muscle spasm leads to prominence of the midline furrow with prominent paraspinal muscles on either side. Patients with unilateral muscle spasm presents with a sciatic list. Patient may need to support their trunk by placing their hands on the knee which is called Tripod sign. Patient is typically worse during night (night cries) as reduction in muscle spasm unmasks the instability, waking the patient from sleep.

Compression due to abscesses and free bony fragments can cause radicular pain along the nerve roots. Radiating pain from dorsal roots present as girdle pain or Intercostal neuralgia and from lumbar roots as pain to groin & abdomen.

VISUAL ANALOGUE SCALE



Cold abscess:

Presence of a cold abscess usually indicates active disease. The cold abscesses are well defined, smooth with regular margins and fluctuant. The skin over the abscess was stretched and shiny. The classical features of pyogenic abscess are absent and hence called Cold abscess. Superficial abscess will slowly weaken the subcutaneous and dermal tissues and burst leaving a discharging sinus. The tubercular pus is white or pale yellow with no specific smell and has ambient body temperature. The consistency of pus varies from thin water like rice soup to thick porridge. Sometimes, the

lesions may get secondarily infected with other pyogenic organisms and the abscess may present with signs of acute or active infection. Most deep abscesses, except those which are very small, those within the thorax and anterior and anterolaterally formed abscesses are clinically palpable. Some posterior compartment abscesses and those from sacroiliac joints may be difficult to palpate. They may present as a tender fullness elevating the overlying muscles.

The cold abscess slowly dissect the surrounding areolar tissues and spread along the natural tissue planes far away from the primary focus. They track along the muscle planes, perineural, perivascular, subpleural, subperitoneal and natural areolar tissue spaces.

Deformity:

Spinal deformities occur as a result of destruction during the active stage of the disease, following surgical debridement and decompression of the tuberculous lesion, or during healing and growth in children. Depending upon the number of vertebral bodies involved, the patient develops varying magnitudes of kyphosis. Localised kyphosis due to collapse of one vertebral body is called **Knuckle** deformity. Kyphosis resulting due to collapse of one or two vertebral bodies is called **Gibbus** deformity and collapse of more than three vertebral bodies results in **Angular kyphosis**.

Rajasekaran, who described the “**spine at risk signs**” has stated that the kyphotic deformity is “dynamic in continuum” and needs surveillance till the

entire growth potential is completed. In childhood spinal tuberculosis, patient who have subluxation of facet joints during active stages of the disease can develop severe spinal deformities during growth.

Untreated severe post tubercular kyphotic deformities can result in neurological deficits. Rajasekaran and Shanmugasundaram (1987) calculated that future (Y) of kyphotic deformity in tuberculosis could be reasonably predicted by using the formula $Y = a + bx$ where x is the initial loss of vertebral bodies and a and b are the constants 5.5 and 30.5 respectively.

ANGLE OF KYPHOSIS:

Angle of kyphosis (K) is measured by drawing a line along the posterior margins of the bodies of the healthy vertebrae above and below the site of disease (Dickson 1967). Another method is by determining the angle between the upper end-plate of the normal vertebra proximal to the affected vertebrae and the lower end-plate of the normal vertebra distal to the affected vertebrae.

Angle of Kyphosis

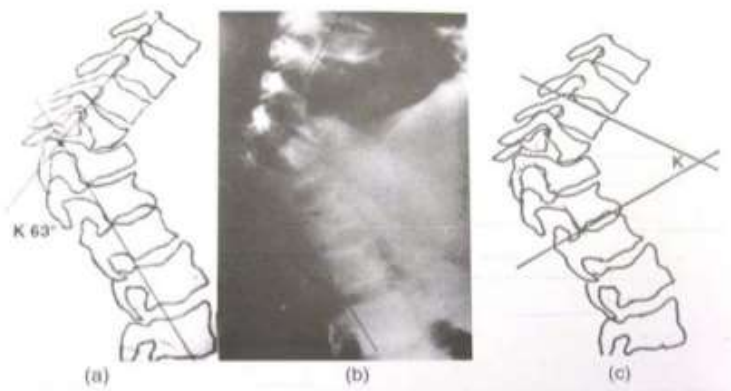


Fig.4, Angle of Kyphosis

Neurological deficits:

The incidence of neurological involvement in Potts disease is 20-40%. Paraplegia rarely occurs in the tuberculous affection below L1 as the cord terminates at L1 where the spinal cord is capacious and contain only caudaequina. The presentation of patients with neurologic complications varies from subtle gait disturbances to complete deficits with bladder and bowel involvement.

In a typical anterior disease of the vertebral column, the compression starts anterior to the spinal cord by abscess formation. This is manifested clinically as gradual increase in the spasticity. As compression increases, patients start losing motor power gradually. By the time compression is severe enough to cause complete block to the nerve conduction and anterior column, lateral spinothalamic tracts are also affected thus producing some reduction of sensation.

When the compression is further increased, even posterior column is also affected leading to complete loss of sensation and disturbances of sphincters. In long standing compression, the spasticity is replaced by flexor spasms and flaccidity.

Classification:

The neurological deficit associated with spinal tuberculosis is traditionally divided into two types 1 (Griffith, Seddon and Roaf, 1956).

Group A: Paraplegia of early onset:

It occurs with the active stage of the disease usually within first two years. The extrinsic causes were granulation tissue, abscess, tubercular debris, tuberculous caseous tissue, internal gibbus and pathological subluxation of vertebra. The intrinsic causes were inflammatory edema and infective thrombosis/endarteritis of spinal vessels.

Group B: Paraplegia of late onset:

It normally occurs after many years and after apparent quiescence of the disease. The extrinsic causes were transverse ridge of bone anterior to the spinal cord producing pressure and constricting scar around dura. The intrinsic causes were inflammatory edema and stretching of spinal cord.

Based upon degree of motor weakness, **Kumar** classified the tuberculous paraplegia into four grades:

I	The patient does not appreciate weakness but clinician notices clumsiness of gait and signs suggestive of upper motor neuron lesion (plantar extensor and ankle clonus).
II	Patient has motor weakness and signs of upper motor neuron lesion, but has sufficient power that he/she manages to walk (motor power grade 3 or above).
III	Bedridden (severe motor weakness) with signs of paraplegia but sensory loss less than 50%,paraplegia in extension
IV	Complete motor weakness with loss of sensation more than 50% and/or bladder bowel involvement and/or flaccid paraplegia and/or paraplegia with flexor spasms.

Frankel (1969)¹² has classified the neural deficit in spinal tuberculosis into five grades:

A	Absent motor and sensory function below the segmental level.
B	Sensation present, absent motor function
C	Sensation present, some motor power present below the level of the lesion but not useful to the patient (Grade <3/5)
D	Sensation present, motor function present and patient could walk with or without aids (Grade 3,4/5)
E	Normal motor and sensory function. Abnormal reflexes may be present.

JAPANESE ORTHOPAEDIC ASSOCIATION (JOA) SCORING SYSTEM

Motor

Lower extremity
0 - Unable to stand up or walk by any means
0.5 - Able to stand up but cannot walk
1 - Unable to walk without a cane or other support on a level surface
1.5 - Able to walk without a support but with a clumsy gait
2 - Walks independently on a level surface but needs support on stairs
2.5- Walks independently when going upstairs, but needs support when going downstairs
3 - Capable of fast but clumsy walking
4 - Normal

Sensory

Trunk
0 - Complete loss of touch and pain sensation
0.5 - 50 % of normal sensation or below and/or severe pain or numbness
1- Over 60 % of normal sensation and/or moderate pain or numbness
1.5 - Subject numbness of a slight degree without any objective deficit
2 –Normal
Lower extremity
0 - Complete loss of touch and pain sensation
0.5 - 50 % of normal sensation or below and/or severe pain or numbness
1 - Over 60 % of normal sensation and/or moderate pain or numbness
1.5 - Subject numbness of a slight degree without any objective deficit
2 - Normal

Bladder function

0 - Urinary retention and/or incontinence
1 - Sense of retention and/or dribbling and/or thin stream and/or incomplete continence
2 - Urinary retardation and/or polyakiuria
3 - Normal

Total score for a healthy person is 11. We use JOA score in our study to assess neurological status of the patients

LABORATORY DIAGNOSIS

BLOOD INVESTIGATIONS:

Cell counts:

The cell count (Total count and Differential count) are elevated. Lymphocytosis present in differential count.

Erythrocytes sedimentation rate (ESR):

The ESR is elevated generally above 20 mm/hr. It is used to monitor the response to treatment. It generally normalizes within three months of treatment. Failure to normalize after treatment should arouse suspicion regarding primary drug resistance or alternative etiology. Though simple, ESR lacks specificity.

C-Reactive protein (CRP):

C-Reactive protein has been found to be elevated in spinal tuberculosis up to 71 %.It is more specific for infectious and inflammatory lesions.It takes two weeks while Erythrocyte sedimentation rate takes about four weeks to register a change and thus helps in monitoring the treatment response.

TUBERCULIN SKIN TEST:

It is considered as a corroborative evidence for tuberculosis. An induration of more than or equal to 10 mm is considered positive. The role of tuberculin skin test as a diagnostic tool is often circumspect. Also it may be false negative in immunocompromised individuals and in miliary tuberculosis. It can be considered as a corroborative evidence for tuberculosis; negative evidence of which does not necessarily rule out tuberculosis.

SEROLOGICAL TESTS:

Serological tests using ELISA have tested antibody response to various TB antigens. There will be fall of IgM titer and rise of IgG titer following three months of treatment. It was considered as screening test rather than diagnostic tool. In equivocal cases of spinal infection, serological tests for brucellosis must be carried out in view of striking similarity in the presentation of both diseases. Serological tests for brucellosis are considered positive if the antibody titre is more than 1:80.

TISSUE DIAGNOSIS:

The most conclusive means of reaching diagnosis in spinal tuberculosis is histopathological examination and AFB culture. It is done through transpedicular or posterolateral route with bone biopsy needle such as Jamshidi or Cooke needle. In case of multiple skeletal site involvement, tissue for diagnosis can be retrieved from the most easily accessible region.

Smear examination:

The two common staining methods used to identify bacillus are Ziehl-Neelson method and Auramine-Rhodamine staining.

Culture:

The most common solid medium was Lowenstein-Jensen, an egg based medium. Positive detection rate with this method in spinal tuberculosis has been ranged from 0 to 75%, albeit less in pulmonary tuberculosis in view of paucibacillary nature. Its major drawback is prolonged time taken for identifying growth. Another method for rapid detection of growth was BACTEC method.

Histopathological examination:

Typically, caseating granulomas and epitheloid giant cells present in tuberculous tissue. Histopathological diagnosis available within 7 to 10 days. It is positive in 62 to 92.5% of cases. Thus, this has a higher percentage of positive diagnosis and will take a relatively shorter time than culture. It helps to rule out noninfectious etiology such as neoplasm. However, it cannot identify drug resistance unlike a culture test.

MOLECULAR DIAGNOSIS:

CR and Genotyping have helps in faster diagnosis and differentiating between typical and atypical mycobacteria, as well as identification of drug resistance. The basic principles of PCR are amplification of the target genes, such as IS986, IS6110 and p34.12 The PCR technique can be used directly on the tissue sample or can be used secondarily on the cultured growth as well. Tissue PCR has sensitivity of 60 to 75% and specificity of 94 to 100% in extrapulmonary tuberculosis.

Recently, a rapid type of PCR technique called the multiplex real time PCR has been introduced. The overall sensitivity and specificity of the multiplex PCR were 93.3% and 90% respectively, with an accuracy of 92%. These results suggest that multiplex real time PCR is more sensitive than conventional cultures, and this, together with its speed, makes this technique a very valuable investigatory modality.

GeneXpert test

It is molecular test for tuberculosis. It diagnoses TB by detecting the presence of tuberculous bacteria as well as testing for resistance to rifampicin. It is also known as CB-NAAT test (Cartridge based Nucleic acid amplification test).It detects DNA in TB bacteria which uses sputum sample and can give result in less than 2 hours. It can also genetic mutations associated with resistance to the drug rifampicin.

RADIOLOGY

Xrays:

Anteroposterior and lateral views of the involved part and Chest Xray are needed. In the dorsal spine paravertebral abscess appear as a fusiform or globular radiodense shadow called the bird nest appearance. Long standing abscesses will form concave erosions along the anterior margin making the aneurysmal phenomenon.Paradiscal lesion is the commonest radiological lesion. Its earliest signs were disc space narrowing and indistinct paradiscal borders of the vertebral bodies. Central type of tuberculous disease is associated with areas of destruction and concertina type of collapse. Anterior type of tuberculous disease shows anterior border of vertebral body erosion called scalloped appearance and is more common in children. Appendiceal disease involves posterior arches. It can be easily missed by conventional radiography.

CT and MRI:

CT scan used to determine posterior extension and encroachment of inflammatory disease, bone and disc material. Additionally, it helps in diagnosing the involvement of sacroiliac joints and sacrum and posterior spinal disease. It is useful in CT-guided biopsy. MRI is the most sensitive tool for early diagnosis of spinal tuberculosis. The lesion appears hypointense and hyperintense respectively in the T1 and T2 weighted images. MRI is superior to CT in showing soft tissue compression,

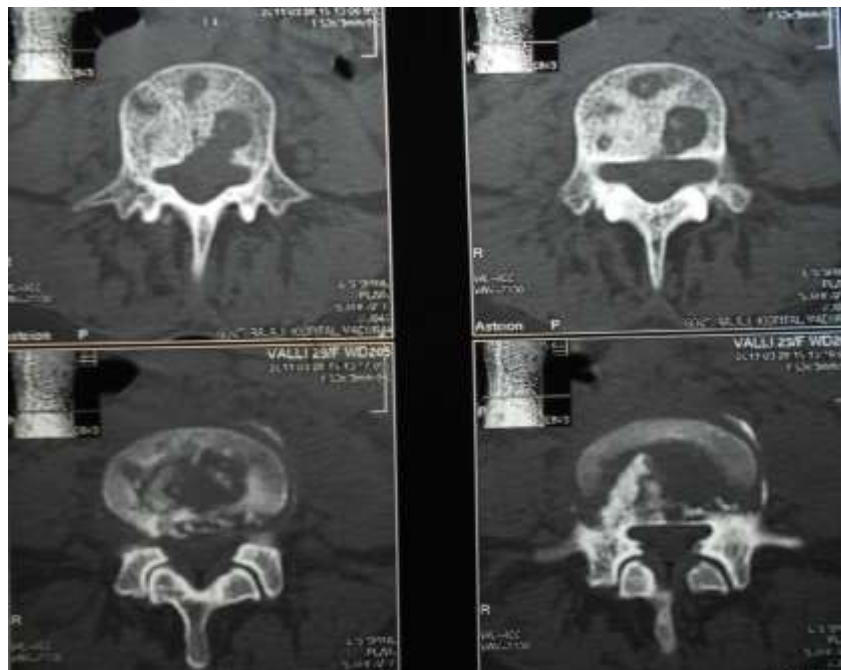


Fig.5 CT of D12-L1 Tuberculosis of spine tuberculous arachnoiditis and extradural and intradural spread of the abscess orgranulation tissue



Fig.6 MRI of D12-L1 Tuberculosis of spine

Ultrasound:

Ultrasound helps in identifying the shape and extent of the cold abscess. It shows quantity of the abscess and also useful in ultrasound guided aspiration.

Bone scan:

Technetium-99m methylene diphosphonate and Gallium-67 isotope scanning are used but neither of them is specific enough for routine use as diagnostic tool. It helps to localize the area of involvement. Patients with active disease will show increased uptake, whereas in avascular segments and abscesses have decreased uptake.

CLASSIFICATION OF RADIOGRAPHIC ACTIVITY

1. ACTIVE DISEASE

- a. loss of cortical outline.
- b. Rarefaction of the affected bodies.

2. INACTIVE (QUIESCENT) DISEASE.

a) Bony fusion of the affected vertebral body, 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, best seen in the antero-posterior view, projecting up to 2 centimetres wide of the vertebral bodies and showing evidence of trabecular continuity even though separated from the bodies by a small space, often no more than a hairline.

b). Sclerosis of the contiguous surfaces of the affected vertebrae with reduction or disappearance of the intervening disc space.

3.DISEASE OF DOUBTFUL ACTIVITY:

a). The appearance of marginal sclerosis where there had been so much destruction of the vertebral bodies that there was no close apposition of the vertebrae above and below the focus of disease.

DIFFERENTIAL DIAGNOSIS

Infections:

Bacterial:

- Pyogenic spondylitis
- Typhoid spine
- Brucella spondylitis
- Syphilitic infections
- Mycotic infections:
 - Actinomycosis
 - Blastomycosis
 - Candidiasis
 - Cryptococcosis
 - Histoplasmosis

Parasitic infections:

- Hydatid disease

Tumorous conditions:

- Multiple myeloma
- Lymphoma
- Secondaries
- Histiocytosis X

Scheuermann's disease

Traumatic conditions

Tuberculosis can be a differential diagnosis for almost every spine lesion. Since tubercular and other lesions closely resemble each other, one should be cautious not only during the initial assessment but also throughout the duration of treatment. The plain radiographs and the CT scan may show destruction, loose bony fragments or sequestra, bony encroachment into the spinal canal and soft tissue abscesses. Radioactive scans can show local biological activity. However, biopsy with bacteriological studies and histological confirmation can only give the final verdict.

Pyogenic spinal osteomyelitis starts with acute onset of severe pain, marked spasm and high fever. The clinical course of the disease is usually rapid with severe systemic symptoms. The hasty clinical course and MRI imaging features help in differentiating from tuberculous infections. An early well-localized tubercular disc infection may be diagnosed as disc herniation.

Vertebral compression fractures should raise suspicion for spinal tuberculosis in patients with appropriate risk factors. Primary neoplastic lesions, like lymphoma and various other metastatic lesions are frequently confused with tubercular destruction. Deterioration of immunity due to malignant disease and chemoradiotherapy may play a role in reactivation of old tuberculosis or acquiring a new infection.

CONSERVATIVE TREATMENT:**Conservative treatment is based on the principles of H O THOMAS:**

Rest–enforced, uninterrupted, and prolonged. In most cases Anti-tubercular therapy along with bedrest alone have been found sufficient including early cases of paraparesis. Till the general condition of the patient improves and the pain and the muscle spasm disappear, patient is advised for complete bed rest for 4-6 weeks. They are then allowed to get up for 6-8 weeks with braces in situ.

The chemotherapy is continued for 18months and is similar to intracranial tuberculosis. Drugs include Rifampicin 10mgs/kg, Isoniazid 10mgs/kg, Pyrizanamide 25mgs/kg and Ethambutol 15mgs/kg for 18 months.

SURGERY:

Indications for the surgical decompression of Pott's spine includes the following situations.

- 1) Neurological complications which do not start showing signs of progressive recovery to a satisfactory level after a fair trial of conservative therapy (4-6weeks)
- 2) Patient with neurological complications which become worse while they are undergoing therapy with antituberculous drugs and bedrest.
- 3) Patients with spinal caries during the conservative period in whom neurological complications develop.

- 4) Patient with prevertebral cervical abscesses, neurological signs and difficulty in deglutition and respiration.
- 5) Patients who have recurrence of neurological complication
- 6) Advanced cases of neurological involvement such as marked sensory and sphincter disturbances, flaccid paralysis or severe flexor spasms.
- 7) Older patients with neural complications require earlier operative decompression to avoid hazards of prolonged recumbency and immobilization.

The various surgical procedures in the management of Pott's Spine done are:

- 1) Cold Abscess – Incision and Drainage
- 2) Laminectomy.
- 3) Posterior lateral decompression-costotransversectomy.
- 4) Anterior Stabilisation Procedure–Corpectomy +cage fixation with rib graft.
 - a. Trans thoracic – Trans pleural Approach.
 - b. Trans thoracic – extra peritoneal Approach.
 - c. Anterior Cervical Approach.

MATERIALS & METHODS

Patients with Tuberculosis of Dorsal and Lumbar spine admitted at Govt Rajaji Hospital ,Madurai In Department Of Orthopaedics And Traumatology will be taken up for study after obtaining informed consent between October 2017& October 2019. All patients were treated with posterior approach and stabilised with Pedicle screw system, reconstruction using bone graft/ cage

STUDY DESIGN:

Prospective study

Objectives of the Study:

- (a) To study the effectiveness of posterior decompression, stabilisation with pedicle screws and fusion, reconstruction using bone graft/cage for tuberculosis of dorsal and lumbar spine.
- (b) To study the improvement in the angle of kyphosis.
- (c) To show that posterior surgery allows early mobilisation.
- (d) To evaluate that posterior surgery associated with reduced morbidity and mortality.

Selection criteria:**Inclusion criteria**

- Tuberculosis of Dorsal and Lumbar Spine.
- Age 20-60yrs, mild to moderate amount of cold abscess. No improvement with conservative treatment and worsening of neurological deficit.
- Paradiscal, Anterior and Central Varieties Tuberculosis Spine
- Involvement of minimum 2 or 3 vertebral bodies with destruction of vertebral bodies more than 30%.
- COBB'S ANGLE >40*

Exclusion Criteria

- Patient with co morbidities not permitting major surgical procedure
- Age <20 &>60 yrs
- Late onset of Tuberculosis spine.

- During study age of patient, mode of presentation, Level of the lesion and associated co morbid condition are considered. Anti tuberculous therapy started.

Pre operative planning:

Pain evaluated by Visual analog score. Neurological status documented by JOA scale. Radiographic examination includes AP view, Lateral view of the dorsal or lumbar spine, CT scan and MRI.

Per operative evaluation:

During surgery operative blood loss, operative time are noted

CHOICE OF IMPLANT:

Pedicle screw system.

**INSTRUMENTS**



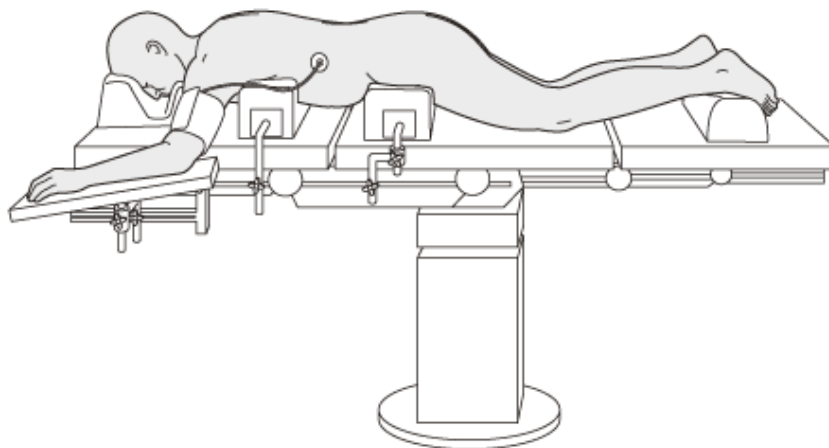
METHODS

Anaesthesia:

General anaesthesia.

Position of the Patient:

Prone position. Bolsters are kept longitudinally under the patient's sides to allow the abdomen to be entirely free. Pressure points must be carefully padded. Surgical site is prepared and draped. Tumescent solution is infiltrated into skin and subcutaneous tissue.



Incision: Midline longitudinal incision made over the spinous processes, extending from the spinous process above to the spinous process below the pathologic level. The length of the incision depends on the number of levels to be explored.

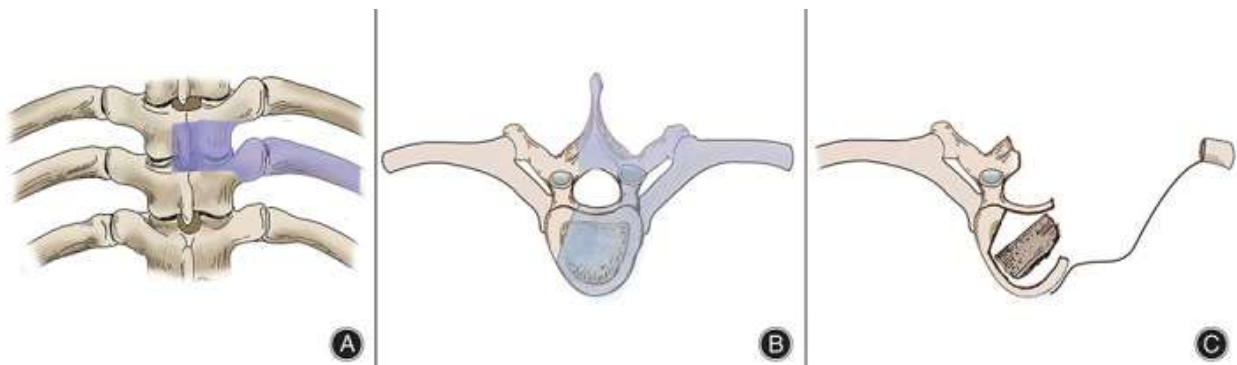
Internervous Plane:

The internervous plane made between the two paraspinal muscles (erector spinae), each of which is supplied by segmental nerve from the posterior primary rami of the lumbar nerves.

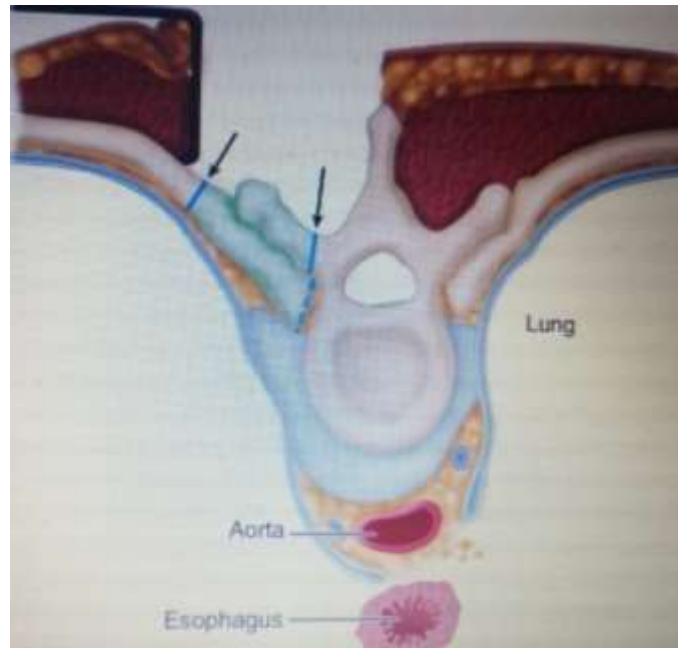
Superficial Surgical Dissection:

Deepening of incision through fat and fascia in line with the skin incision until the spinous process itself is reached. Paraspinal muscles detached subperiosteally as single unit from the bone. Self-retaining retractors are placed to maintain tension on soft tissues during exposure.

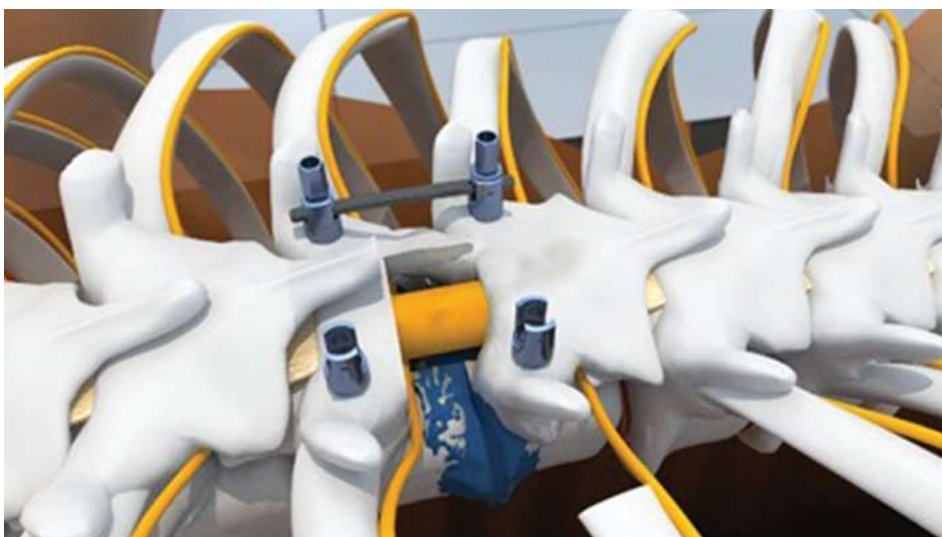
- Among the three techniques for localization of the pedicle namely (1) the intersection technique, (2) the pars interarticularis technique, and (3) the mammillary process technique, we use the intersection technique which is a point between the line from transverse process and lateral aspect of facet joint.
- Once pedicle screws are inserted, temporary stabilisation done with rod on one side.

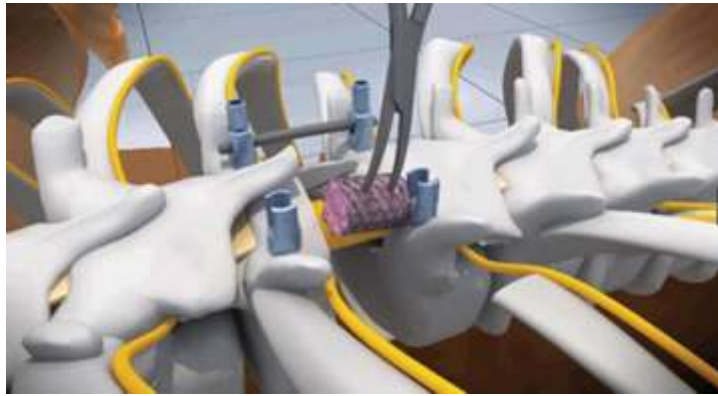


- Through transpedicular approach, body was approached posteriorly and decompression done for dorsal spine. If necessary root is sacrificed for better exposure in dorsal spine. Transpedicular and posterior decompression done for lumbar spine.



- Next, the disc space was distracted. Thorough debridement of the infected end-plate, disc, soft tissue, necrotic debris and abscess done and sent for biopsy and culture and sensitivity





- Interbody fusion was done with iliac iliabone graft/cage with meshed bone graft/rib graft, voids were filled with graft & drain kept.

Intraoperative Technique



Fig 7.Exposure and Transpedicular decompression



Fig.8 Evacuation of Pus and Granulation Tissue



Fig-9 Harvesting graft from posterior iliac crest

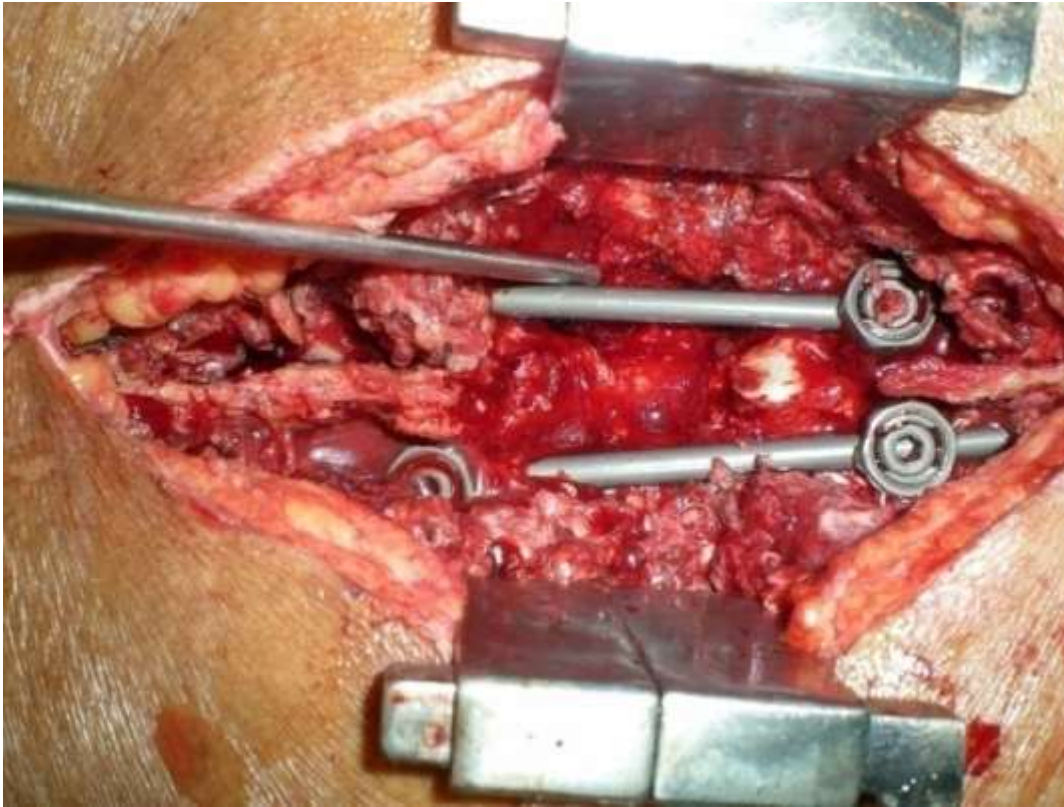


Fig-10 Stabilization with Pedicle screw system.

Post-op protocol :

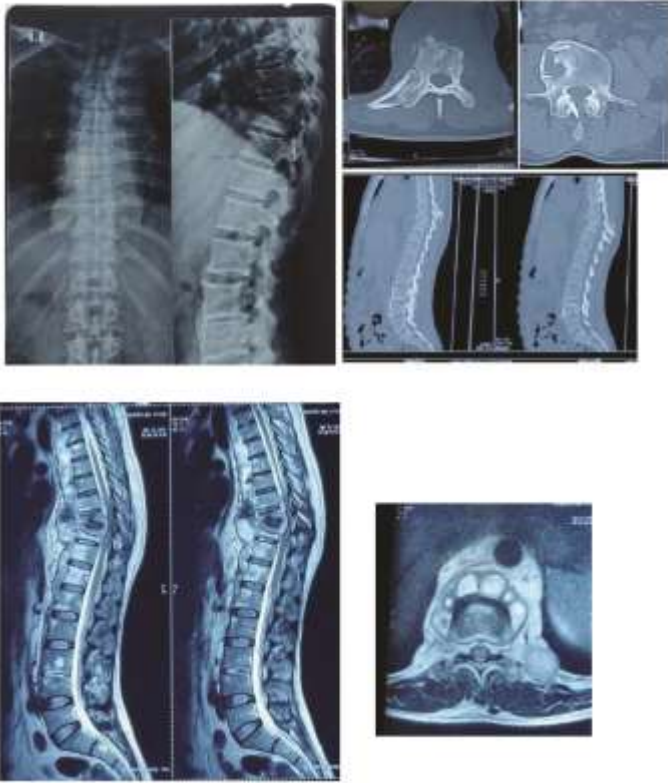
- ❖ Antituberculosis therapy for at least 12 months
- ❖ The drainage tube was removed when the drainage volume < 50 ml/day.
- ❖ Bedside mobilization immediately after surgery for 3 weeks.
- ❖ Rehabilitation with a bracing (sitting with support, walking with walker if lower limb power is > grade 4) 3 weeks after surgery.
- ❖ Muscle strengthening exercises as soon as the pain subsides.
- ❖ Forward and backward bending after radiological healing.

Post-op follow up :

The patients are followed up at 3 months, 6 months, 1 year and every 6 months and evaluated for the Visual analogue pain scale and the functional outcome evaluated using ESR, Angle of kyphosis, JOA score.

CASE 1

PRE OP RADIOGRAPHS



INTRA OP



6 MONTH



1 YEAR

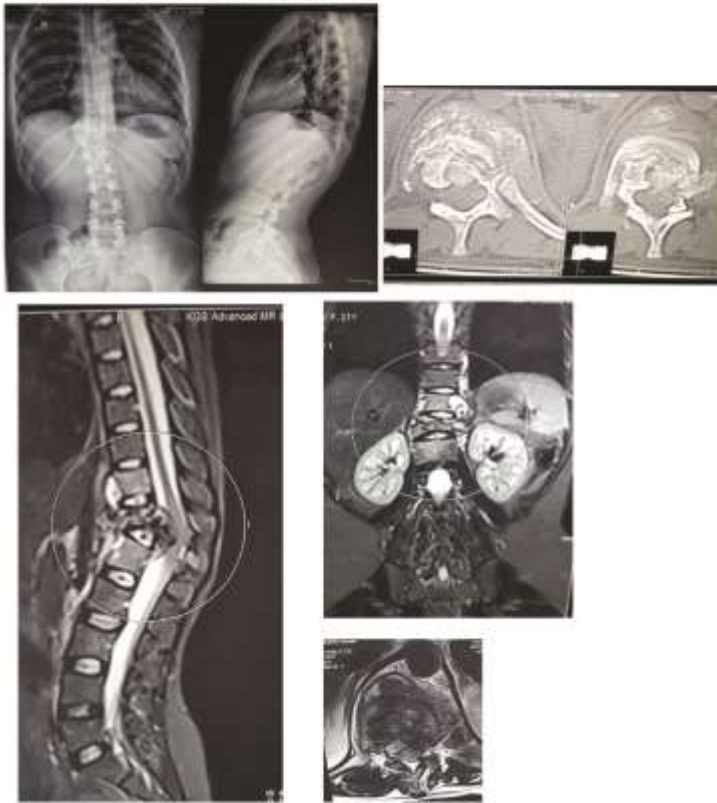


1 YEAR FOLLOW UP



CASE 2

PRE OP RADIOGRAPHS



INTRA OP



6MONTH



1 YEAR



POST OP SCAR

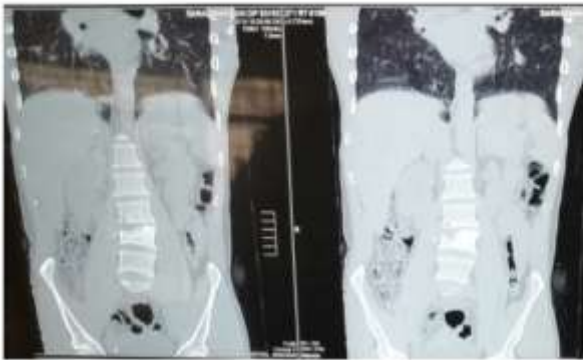


1 YEAR FOLLOW UP



CASE 3

PRE OP RADIOGRAPHS



6MONTHS



1 YEAR



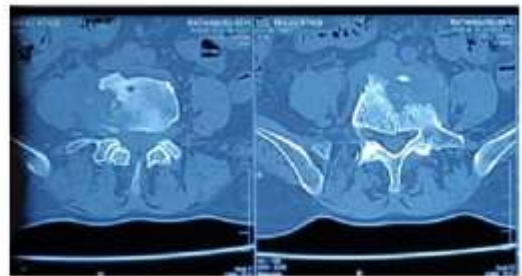
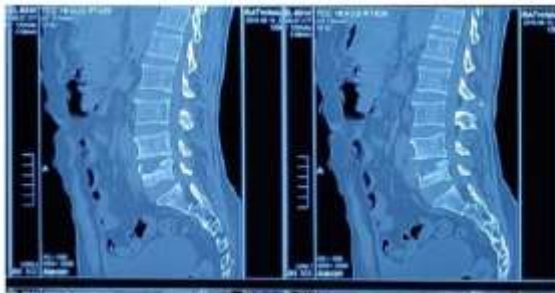
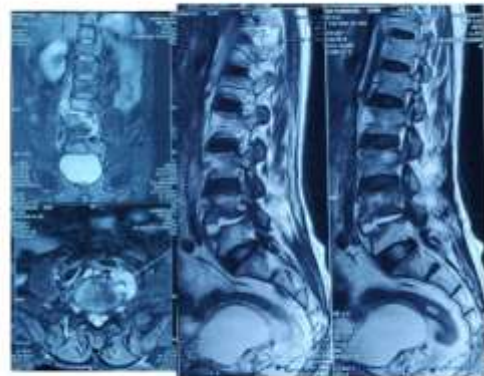
1 YEAR FOLLOW UP



PRE OP RADIOGRAPHS



CASE 4



6MONTHS



1 YEAR



POST OP SCAR

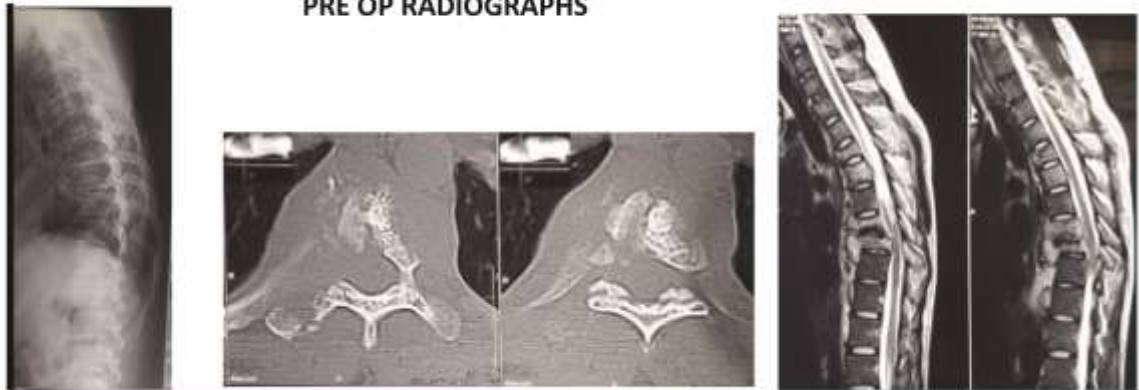


1 YEAR FOLLOW UP

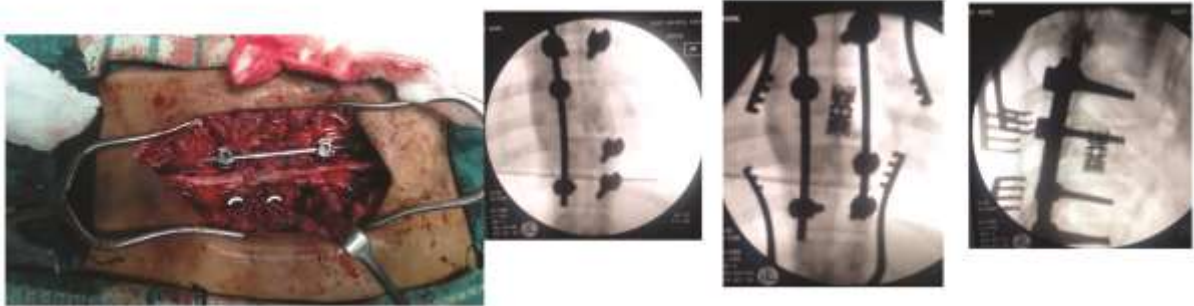


CASE 5

PRE OP RADIOGRAPHS



INTRA OP



6MONTHS



1 YEAR



1 YEAR FOLLOW UP



Statistical analysis

Statistical analysis were performed with IBM SPSS version 16(SPSS Inc., Chicago, IL). Descriptive statistics was computed. The results were presented as mean, standard deviation median and inter quartile range for continuous data and as frequency and percentages for categorical data. Data were tested for normality using Shapiro wilks normality test. Since the data levels were skewed, Preoperative and postoperative measurements at various intervals based on levels of lesion were compared using Mann whitney U test. The results were considered significant with p value less than 0.05.

The non parametric Friedman test was used to compare median VAS scores, ESR values, JOA scores, COBB's angle of one group measured at various occasions. A post hoc Wilcoxon signed rank test was used for pairwise comparison at all possible combinations to examine where the differences actually occur. Thus it is a multiple comparison bonferroni correction [p value/ no. of. wilcoxon test used] has been done.

RESULTS

AGE OF INVOLVEMENT	FREQUENCY	PERCENT
20-30 yrs	8	40
31-40 yrs	5	25
41-50 yrs	2	10
51-60 yrs	5	25

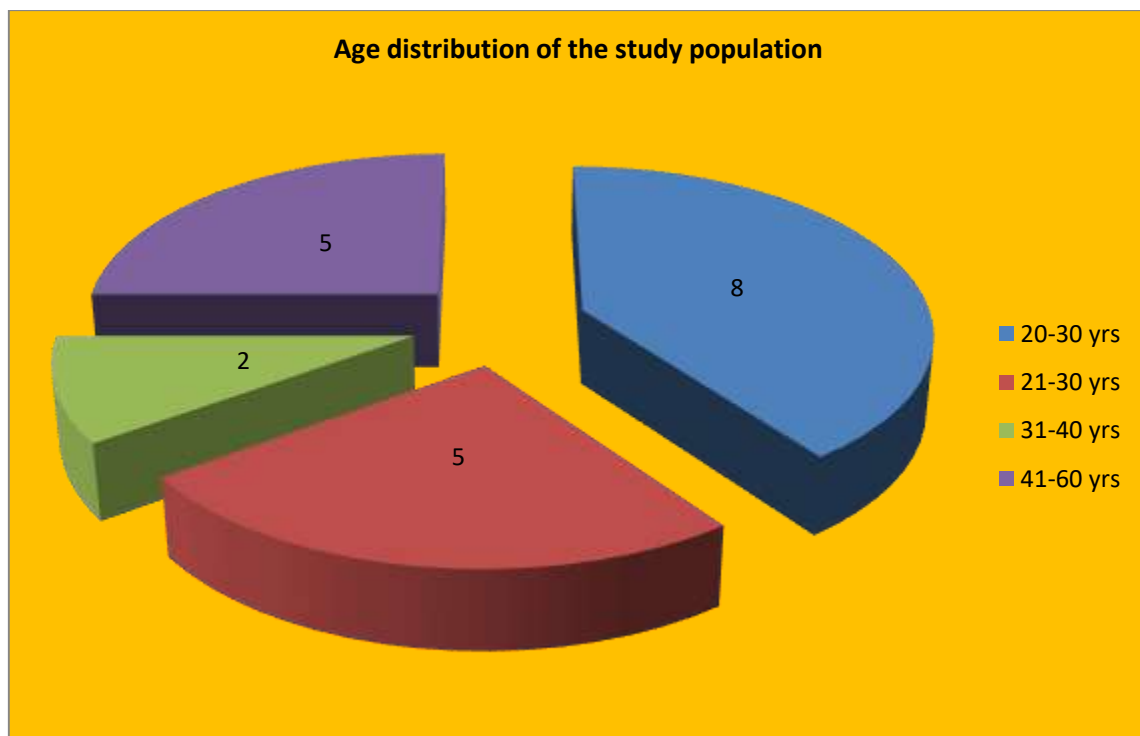


Fig 11. Age of involvement

SEX RATIO	FREQUENCY	PERCENT
Males	13	65
Females	7	35

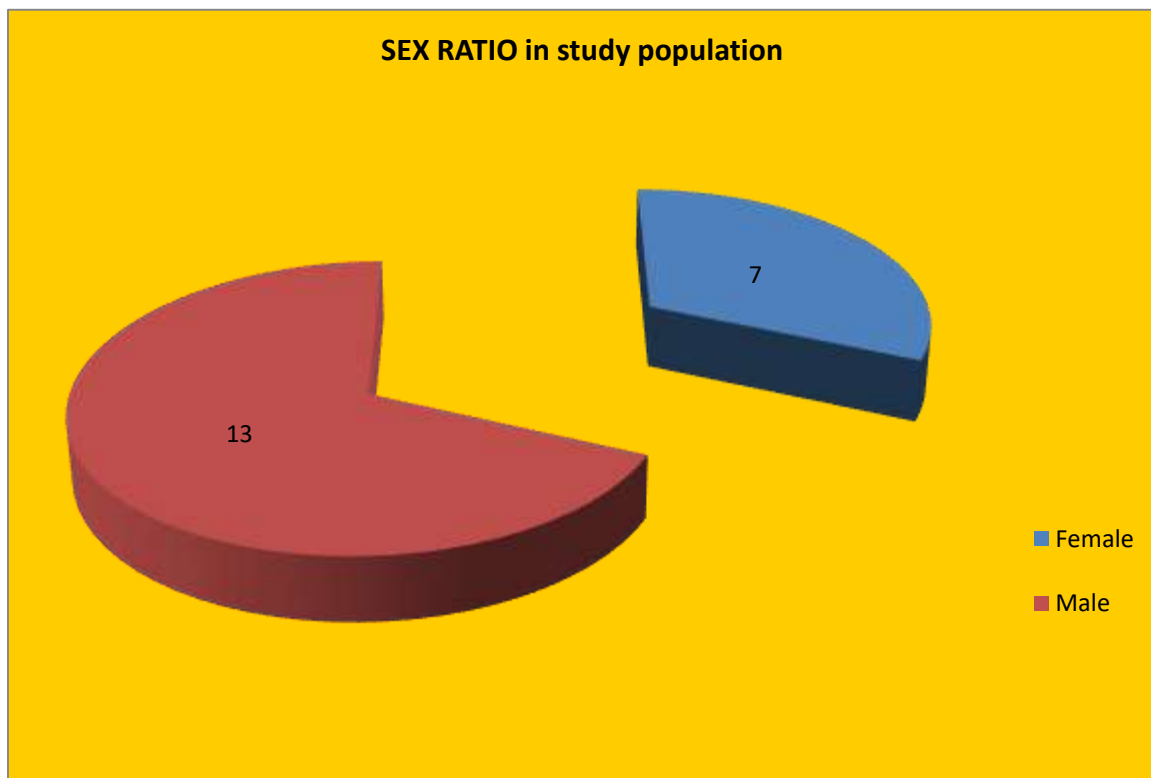


Fig 12. Sex ratio

LEVEL OF LESION	FREQUENCY	PERCENT
D1-D10	8	40
D11-L2	7	35
L3-L5	5	25

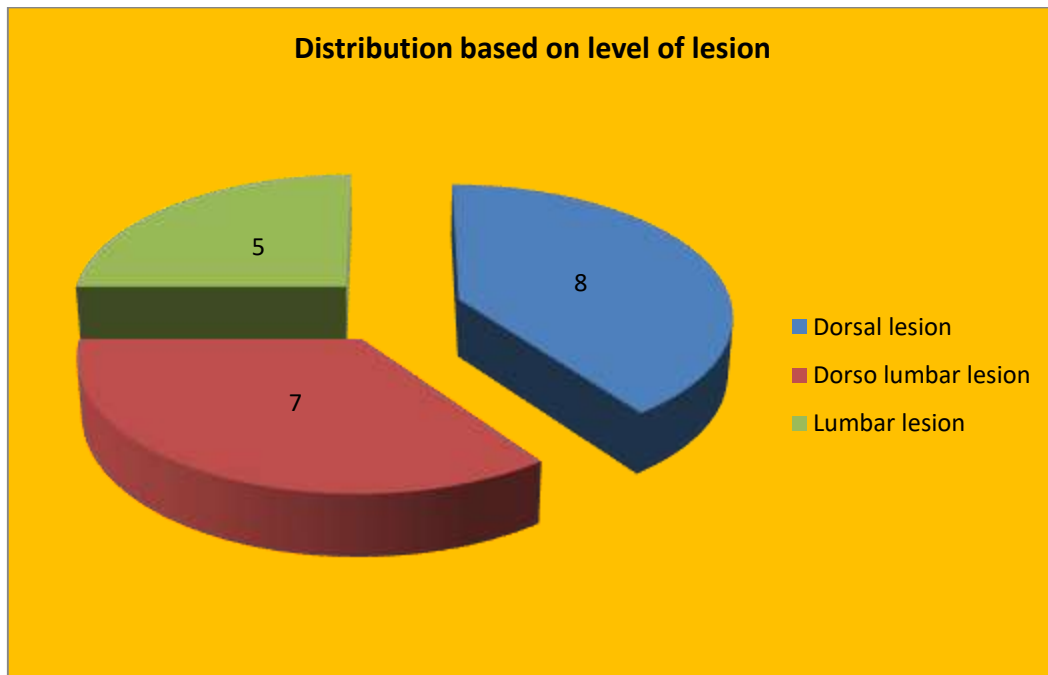


Fig 13.Level of the lesion

RECONSTRUCTION MATERIAL	FREQUENCY	PERCENT
CAGE MESHED WITH BONE GRAFT	6	30
ILIAC GRFT	7	35
RIB GRAFT	7	35

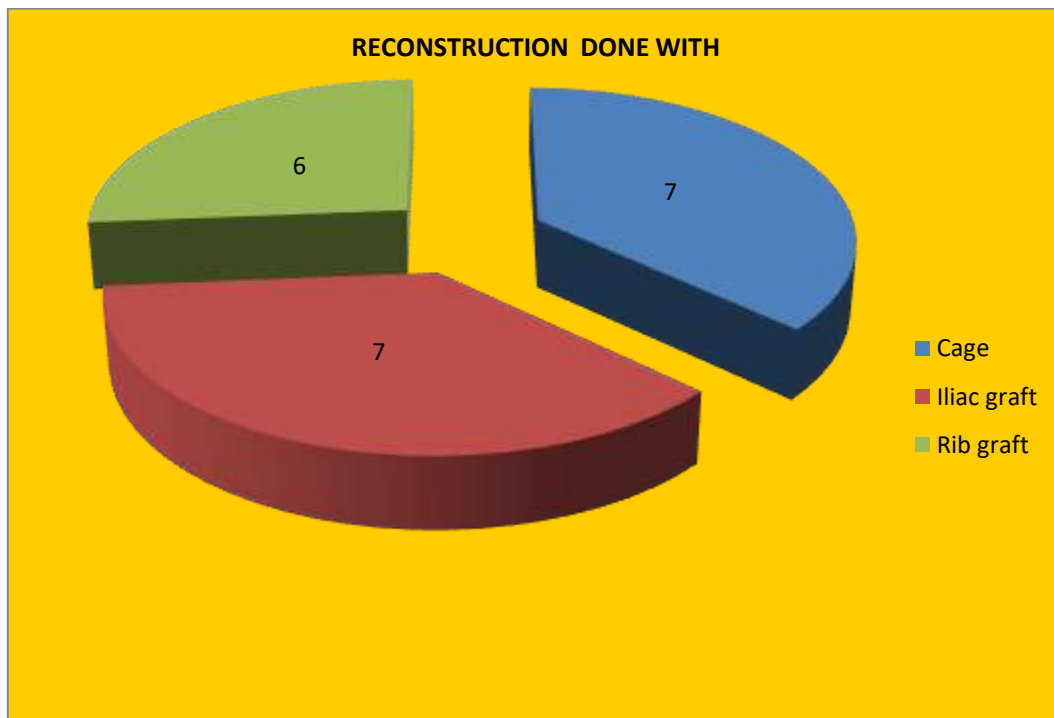


Fig-14, Reconstruction Material

Post OP complications		
No major complication	18	90
Implant loosening	1	5
Neurological deficit	1	5

- In our study one patient had implant loosening, one patient had postoperative neurological deficit..No other complications like superficial and deep infection, graft slippage, graft related problems were noted. There is loss of follow up of one patient after 6 months of study

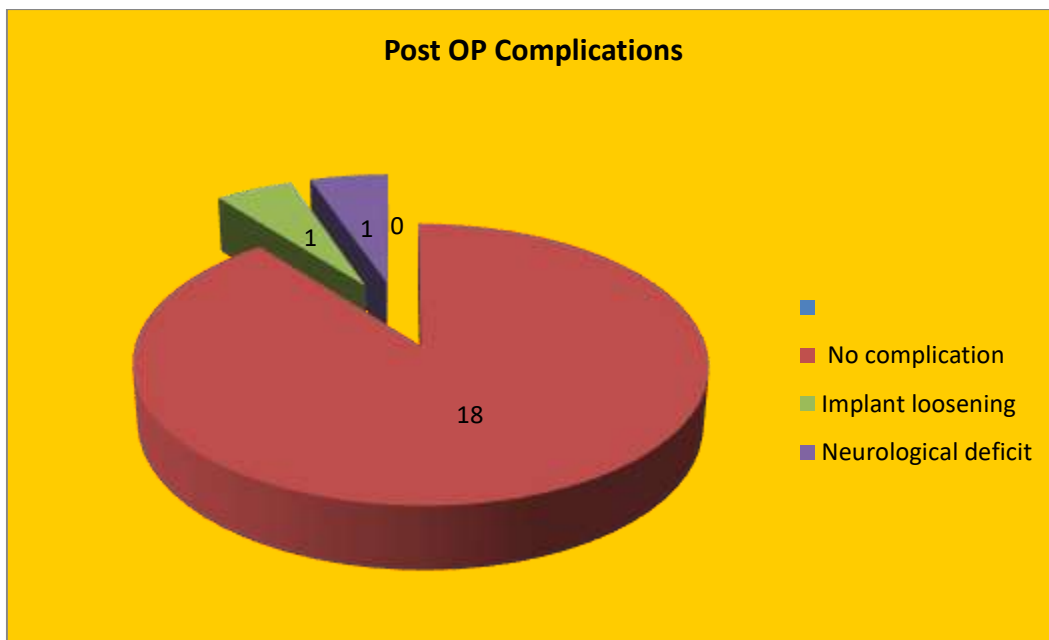


Fig -15, Post OP Complications

IMPLANT LOOSENING

PRE OP



POST OP



• 6months



1 year



Descriptive statistics showing distribution of VAS score, ESR value , JOA score, COBB's angle

Parameters	Mean	Std. Deviation	Median	IQR	Minimum	Maximum
VAS at Pre op	8.68	.478	9.00	1	8	9
VAS at 6 month follow up	1.47	.697	1.00	1	1	3
VAS at 1 year follow up	1.33	.767	1.00	1	0	3
ESR at Pre op	116.63	20.530	111.00	34	88	158
ESR at 6 months follow up	40.21	9.132	40.00	12	27	59
ESR at 1 year follow up	26.44	7.610	25.00	8.5	18	49
JOA score at Pre op	5.42	2.0901	5.750	3	1.0	8.0
JOA score at 6 months follow up	8.92	2.8736	10.0	2	2.0	11.0
JOA score at 1 year follow up	9.33	2.521	10.00	1.25	2	11
COBB's Angle at Pre op	29.4	10	31.00	14	10	46
COBB's Angle at 6 months follow up	14.05	5.854	15.00	7	3	21
COBB's Angle at 1 year follow up	14.05	5.646	15.00	7.5	3	21

Comparison of Preoperative and repeated measurements of postoperative VAS score over a period of time

	Mean Rank	Median	P value
VAS at Pre op	3.00	9	
VAS at 6month follow up	1.53	1	0.001**
VAS at 1 year follow up	1.47	1	

Friedman Test; **shows (p< 0.001)

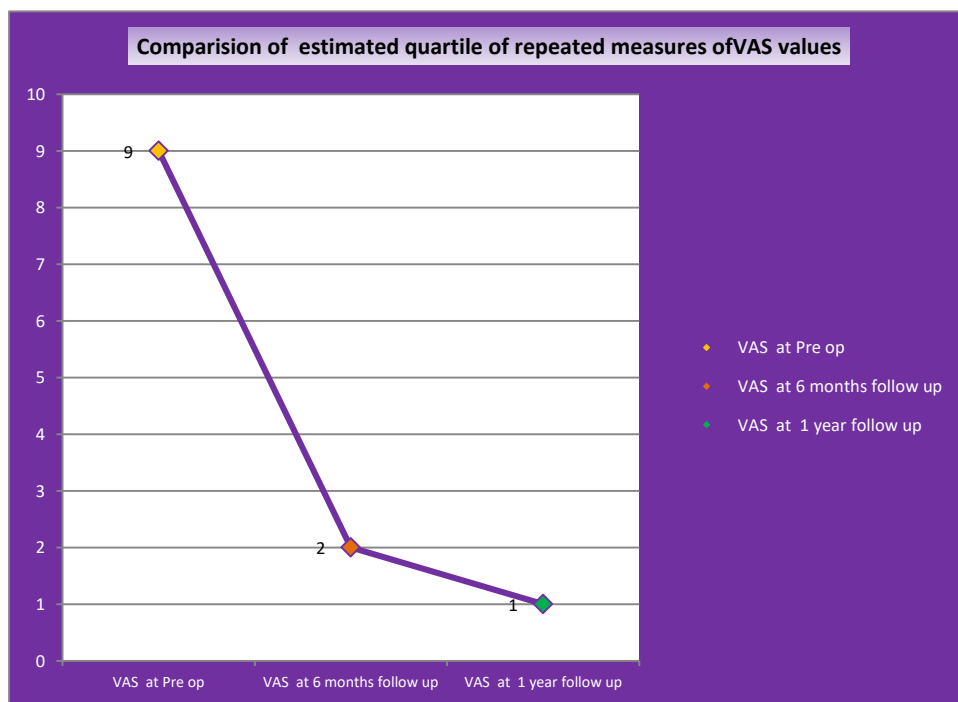
There was a statistically significant difference in median Pre OP and repeated measures of post OP VAS scores, $\chi^2 (2) = 34.140$, $p = 0.001$.

Post hoc pairwise multiple comparison of VAS scores

	Z score	P value
VAS at Pre op–6month follow up	-3.926 ^a	0.001**
VAS at 6month - 1 year follow up	-.577 ^a	0.564
VAS at Pre op -6month follow up	-3.794 ^a	0.001**

Wilcoxon signed rank Test with bonferroni correction; **shows (p< 0.016)

Post hoc analysis with Wilcoxon signed-rank tests was conducted with a Bonferroni correction applied ($0.05/3$), resulting in a significance level set at $p < 0.016$. However, there was a statistically significant change in repeated measures of VAS score, JOA score, COBB's angle scores till 6 months follow up and the 6month values remain static at 1 year follow up. But ESR values significantly decreases in each follow up at pre OP, at 6months and 1 year ($p < 0.001^{**}$) as given in post hoc wicoxon signed ranks table.



Comparison of Preoperative and repeated measurements of postoperative ESR value over a period of time

	Mean Rank	Median	P value
ESR at Pre op	3.00	116.00	
ESR at 6 months follow up	2.00	40.00	0.001**
ESR at 1 year follow up	1.00	25.00	

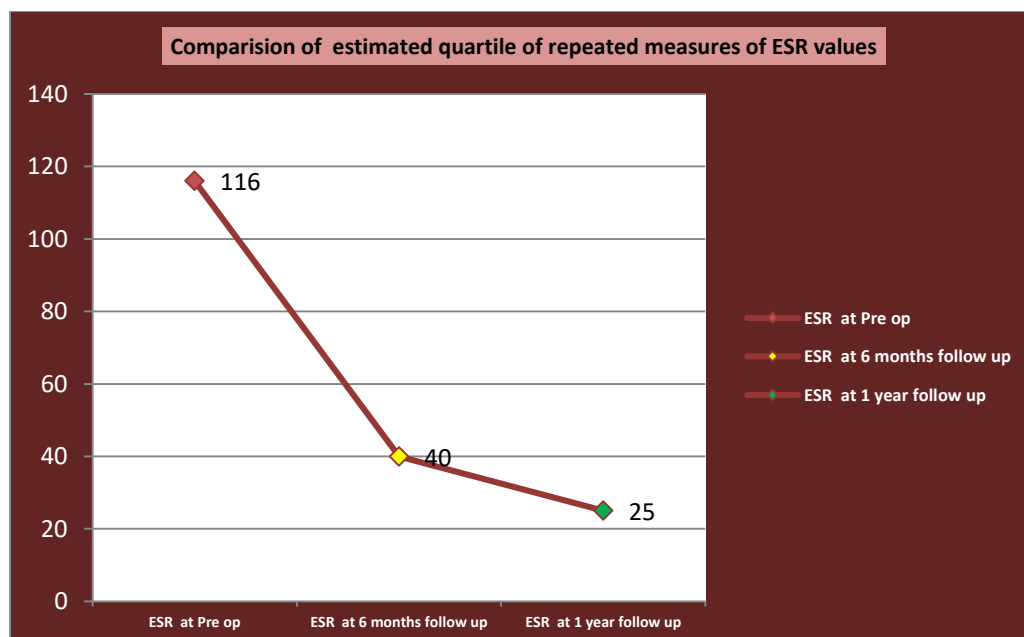
Friedman Test; **shows ($p < 0.001$)

There was a statistically significant difference in median Pre OP and repeated measures of post OP ESR value, $\chi^2(2) = 36.000$, $p = 0.001$.

Post hoc pairwise multiple comparison of ESR value

	Z score	P value
ESR at Pre op–6months follow up	-3.823 ^a	0.001**
ESR at 6month–1year follow up	-3.726 ^a	0.001**
ESR at Pre op -1year follow up	-3.644 ^a	0.001**

Wilcoxon signed rank Test with bonferroni correction; **shows ($p < 0.016$)



Comparison of Preoperative and repeated measurements of postoperative JOA score over a period of time

	Mean Rank	Median	P value
JOA score at Pre op	1.11	6.0	
JOA score at 6months follow up	2.36	10.0	0.001**
JOA score at 1year follow up	2.53	10.0	

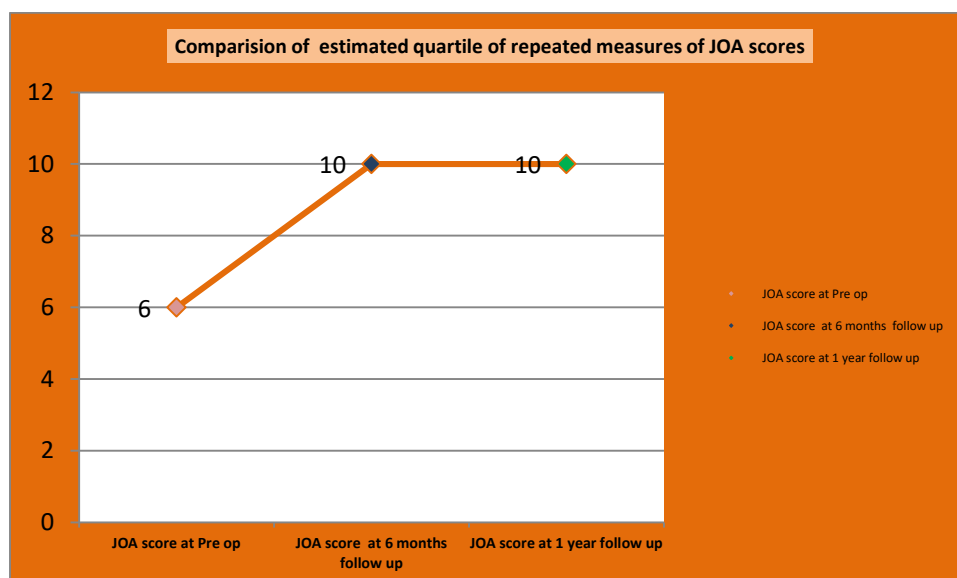
Friedman Test; **shows (p< 0.001)

There was a statistically significant difference in median Pre OP and repeated measures of post OP JOA scores, $\chi^2(2) = 27.20$, $p = 0.001$.

Post hoc pairwise multiple comparison of JOA score

	Z score	P value
JOA score at Pre op – 6month follow up	-3.826	0.001**
JOA score at 6month - 1 year follow up	-1.000	0.317
JOA score at Pre op -1 year follow up	-3.727	0.001**

Wilcoxon signed rank Test with bonferroni correction; **shows (p< 0.016)



Comparison of Preoperative and repeated measurements of postoperative COBB's angle over a period of time

	Mean Rank	Median	p value
COBB's Angle at Pre op	3.00	30.00	
COBB's Angle at 6 month follow up	1.47	15.00	0.001**
COBB's Angle at 1 year follow up	1.53	15.00	

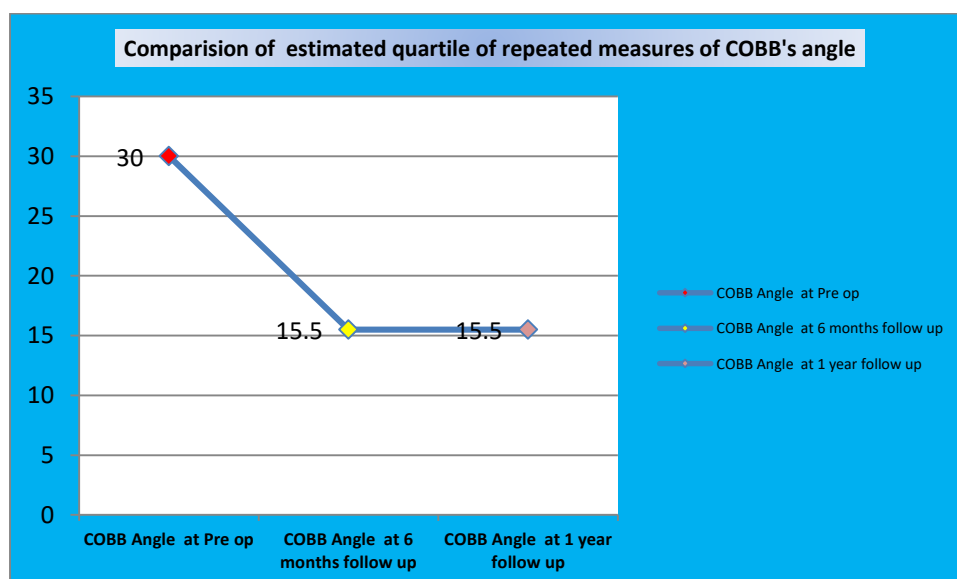
Friedman Test; **shows (p < 0.001)

There was a statistically significant difference in median Pre OP and repeated measures of post OP COBB's angle, $\chi^2(2) = 35.382$, p = 0.001.

Post hoc pairwise multiple comparison of COBB's angle

	Z score	p value
COBB's angle at Pre op – 6 month follow up	-3.826	0.001**
COBB's angle at 6 month – 1 year follow up	-1.000	0.317
COBB's angle at Pre op - 1 year follow up	-3.727	0.001**

Wilcoxon signed rank Test with bonferroni correction; **shows (p < 0.016)



RESULTS

- ❖ Pott's spine is more common in males (65%) in our study
- ❖ The most common age group affected was 2nd and 3rd decade (40%).
- ❖ The most common mode of presentation is pain (66.7%).
- ❖ The dorsal spine is most commonly affected (40%) followed by dorsolumbar junction (35%)
- ❖ The mean duration between surgery and onset of symptoms was 7.2 months (range 5-10months).
- ❖ The mean surgical time was 2 hours 2 minutes (range 1h 45 min-4hr 10 min).
- ❖ The average blood loss was 300 ml (250 ml – 500ml).
- ❖ The mean preoperative Visual analog score was 8.68 (range8-10) which improved to 1.33(1-3) at final follow up implying better pain score postoperatively.
- ❖ The mean preoperative ESR value was 116.63 which improved to 26.44 at final follow up which indicates improvement in disease activity.

- ❖ Before surgery, 5 patients had JOA score 7 ,4 patients had score of 5.5 .After surgery, all patients with score >5 improved to almost normal(10-11). Totally 5 patients in our study after one year follow up improved to score of 11. Only 1 patient in our study with score 8 deteriorated to score 2 postoperatively. There is significant improvement in function and neurology in all other patients.
- ❖ The mean preoperative kyphosis in the thoracic and thoracolumbar spine was 29.4 degrees which was corrected to a mean of 14.05degrees in the final follow up radiographs implying better correction and maintenance of kyphosis.

DISCUSSION

The treatment of tuberculosis of spine consists of conservative methods or surgical management. Conservative method comprises Bed rest with or without Plaster casts, Chemotherapy, Supervision with Imaging and blood markers every 3 months followed by resumption of activity with braces. It needs long period of immobilization which will lead to complications of prolonged recumbency like deep vein thrombosis, bed sore and chest infection. It cannot prevent the progression of kyphotic deformity. To circumvent the problems associated with conservative management and those who did not show signs of progressive recovery, development of neurological problems, neurological worsening during conservative therapy, advanced cases and in the elderly, surgery is indicated.

The goals of surgery in Tuberculosis of Thoracic and Lumbar spine are adequate decompression, adequate debridement, maintenance and reinforcement of stability and correction and to stop the progression of Kyphosis.

Among the various types of decompression, Anterior approach is considered the gold standard for debridement and decompression in Pott's spine. Anterior radical surgery was popularized by Hodgson and Stock in 1960. Advantages of the traditional anterior approach are ability to directly access the disease and perform decompression, better correction of deformity,

less muscle dissection and the ability to place a graft under compressive load for fusion.

The disadvantages of anterior approach are :

- ✓ morbidity and mortality associated with the transpleural and retroperitoneal approach like atelectasis, chest infection, pneumothorax and postoperative ileus,
- ✓ increase in spinal instability after surgical decompression in the immediate postoperative period.
- ✓ Also when the patient has coexisting pulmonary pathology, the approach may be difficult.
- ✓ The structural bone graft in anterior approach does not give initial stability and graft related problems occur more often when the graft spans more than two-disc space. The tricortical iliac crest graft is associated with donor site morbidity. The rib grafts are readily available after thoracotomy but they are structurally weak and do not contain cancellous bone.
- ✓ The stability of anterior instrumentation may not provide adequate fixation as there is concomitant inflammation associated with infection and the anterior bones are hyperemic and porous.
- ✓ Implant holding is a problem and there might be risk of graft subsidence and graft slippage. It was during 1970's that the modern spinal instrumentation was developed and came to use.

There was an initial apprehension to use the metal implants in active infection.

Oga et al.²⁴ studied the adherence capacity of *Mycobacterium tuberculosis* to stainless steel and concluded that adherence was negligible and the use of implants in regions with active tuberculosis infection may be safe and the tubercle bacilli, unlike pyogenic organisms do not adhere to metal and form any biofilm.

Posterior instrumentation with anterior decompression and fusion can be performed in one or two stages. This surgery is more radical but recurrence rate is low. However, if performed in single stage, the procedure has higher morbidity. When anterior decompression and bone grafting performed as a first stage procedure, there is a risk of graft slippage and neural deterioration while waiting for second stage stabilization. In the second stage, only in situ stabilization will be performed. When the posterior procedure is performed first, it will be only in situ stabilization followed by second-stage decompression, so kyphus correction will be minimal.

Guven and coworkers after using posterior instrumentation in the form of pedicle screw or hook system for thoracolumbar tuberculosis of the spine have found clinical and radiological evidence of stable fusion in all their patients.

In this study, we used transpedicular screws with Moss Miami system, with cage with bone graft/ilic graft/rib graft because it has been found to be a

good method for stabilizing thoracolumbar and lumbar spine. During pedicle screws instrumentation in dorsal and the lumbar spine, we inserted the screws into the healthy pedicles adjacent to the areas of bone destruction. There is a quick relief of instability in patients treated with early stage spinal tuberculosis with transpedicular instrumentation. This posterior approach has a special advantage in that it avoids contact with the infectious focus, because the tuberculous infection usually involves the anterior column. The fact that tuberculous lesions may heal in spontaneous fusion makes this posterior approach feasible. The transpedicular instrumentation helps in maintaining the spinal alignment and stabilization of the involved vertebra. The posterior instrumentation acts as a spacer and allows the healing of the anterior mass and supports the anterior column.

Posterior instrumentation has been shown to be quite effective in preventing graft related complications and kyphosis progression. The main advantage of posterior instrumentation is that it can provide good fixation through posterior elements as the disease pathology is anterior. Posterior fixation also helps in correcting pre-existing kyphosis effectively. Posterior approach utilizing only extra pleural approach, as described by Jain et al.,² is an effective option. Extra pleural approach allows decompression of spinal cord under direct vision and supplemented with a stable posterior instrumentation, which has the multilevel flexibility to be extended above and below if needed. The cord was decompressed by excising a pedicle in order to

allow access to the anterior debris. A limited debridement was undertaken to decompress the cord without creating a large defect. The exposure for the decompression may be improved by sacrificing a spinal nerve root at the level of the excised pedicle in the thoracic spine. This does not significantly affect the morbidity because of the overlap of the dermatomes and circumvents the problems related to a thoracotomy. The transpedicular route for decompression is preferable to the transthoracic procedure since it allows an adequate global removal of the anterior, lateral and posterior cuff of tissue, posterior stabilisation is possible through the same approach and chest complications related to thoracotomy in these patients are avoided.

The posterior instrumentation allows early mobilisation, thus avoiding the complications of prolonged recumbency. The stability provided by posterior fixation, particularly transpedicular fixation, protects the vertebral correction, and patients are able to return to normal activities within a short period of time. Poor sagittal spinal correction has been documented following anterior approach alone. While anterior instrumentation may prevent progression of kyphosis during treatment, it is not so effective in correcting pre-existing kyphosis. Addition of posterior instrumentation has shown to improve correction of sagittal alignment.

Reported kyphosis correction ranges from initial 30° – 35° to 15° – 18° postoperatively with an average followup of 12 months. In our case series also, the kyphosis correction was significantly better with posterior approach alone.

BhavukGarg et al. in a retrospective analysis of 70 patients with thoracic and lumbar tuberculosis compared the clinical, radiological and functional outcome of anterior versus posterior debridement and stabilization concluded that though the anterior approach is an equally good method for debridement and stabilization, kyphus correction is better with posterior instrumentation and the posterior approach is associated with less morbidity and complications.

GD Sunderraj et al.²⁷ in a prospective study of patients with tuberculosis of dorsal, dorsolumbar and lumbar spine combined with anterior or posterior instrumentation surgery concluded that adjuvant posterior stabilization allows early mobilization and rehabilitation. Graft related problems were fewer and the progression and the maintenance of correction of the kyphosis were better than with anterior surgery alone. Even when large amount of pus present there is no implant related risk.

Moon et al.⁷ retrospectively analysed 124 patients with spinal tuberculosis in children and concluded that posterior instrumented stabilization alone could correct and prevent progress of kyphosis.

Lee et al.⁸ in a retrospective case series using single stage Transpedicular decompression and posterior instrumentation of thoracic and thoracolumbar tuberculosis concluded that it can be an alternative treatment method of less involved spinal tuberculosis especially for patients in early phase of bone destruction or ones with mild kyphosis.

We prefer a posterior approach because familiarity of the approach and the complication rate is low. The benefits of our approach are:

- ✓ early ambulation,
- ✓ decreased morbidity,
- ✓ good access to dural abscesses, sequestered bone and small abscesses in the anterior spine.
- ✓ Posterior instrumentation can be used to correct deformity and any concurrent spinal stenosis in elderly patients can be treated simultaneously.

The results of our study show that thoracic and lumbar tuberculous spondylitis can be successfully treated through the posterior approach by meticulous debridement of necrotic bone and the infected disc. It allows easy access to the spinal canal for neural decompression, prevents loss of correction of vertebral alignment, and facilitates early mobilisation.

CONCLUSION

1. The posterior approach (extracavitary approach) gives a reasonable access to the lateral and anterior aspects of the cord for an equally good decompression of the cord.
2. It is a less morbid approach and avoids problems associated with thoracotomy and laprotomy.
3. It facilitates early mobilization and avoids problems of prolonged recumbency.
4. It provides better functional outcome and significantly better sagittal plane and kyphosis correction.
5. Posterior approach preferred because of its familiarity, its simplicity, and its low complication rate.

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PROFORMA

Name of the Patient :

Age / Sex :

Occupation :

Past H/o :

Complaint/ Duration :

Diagnosis :

Procedure :

Date of admission:

Date of surgery :

Date of discharge:

Pre-operative:

(a) ESR :

(b) Mantoux test :

(c) TC, DC :

(d) Visual Analogue pain scale value :

(e) Neurological status (Frankel grading) :

(f) Preoperative JOA Score :

(g) RADIOLOGICAL

Xray-AP & Lat view

-Preoperative kyphosis (Dickson method) :

CT scan :

MRI :

Post-operative (Evaluation at 6 months, 1 year, every 6 months)

(a)ESR :

(b) Visual Analogue pain scale value :

(c) Neurological status :

(d) Postoperative JOA SCORE :

(e) Postoperative kyphosis (Dickson method) :

(f) Complications :

Table 1:

Site of involvement (Dorsal/ Dorsolumbar/ Lumbar)	
Age 10-20 21-30 31-40 41-50 51-60 61-70	
No. of Vertebra involved	

	Pre op	Post op	3 months	6 months	9 months	12 months
VAS						
ESR						
COBB'S ANGLE						
JOA SCORE						

CONSENT FORM**FOR OPERATION/ANAESTHESIA**

I _____ Hosp. No. _____ in my full senses hereby give my full consent for _____ or any other procedure deemed fit which is a diagnostic procedure / biopsy / transfusion / operation to be performed on me / my son / my daughter / my ward _____ age under any anaesthesia deemed fit. The nature, risks and complications involved in the procedure have been explained to me in my own language and to my satisfaction. For academic and scientific purpose the operation/procedure may be photographed or televised.

Signature/Thumb Impression

Name of Patient/Guardian:

Guardian Relation ship

MASTER CHART

S. NO	NAME	AGE	SEX	IP_NO	PERIOD	LEVEL OF LESION	PROCEDURE	VAS		ESR		JOA SCORE		COBB'S ANGLE		OPERATING TIME	BLOOD LOSS	COMPLICATION			
								PRE Op	6 month	1 year	PRE Op	6 month	1 year	PRE Op	6 month						
1	KANIMOZHI	21	F	8931	01.10.18	D11-D12	ILIAC GRAFT	8	1	1	132	51	36	2	3.5	4	46	18	108	260	NIL
2	POONGOTHAI	56	F	9211	04.10.18	D11-D12	ILIAC GRAFT	9	1	1	114	32	24	5.5	10	10	33	21	125	320	NIL
3	MOHAMMED	20	M	9215	04.10.18	D8-D9	CAGE	9	2	2	108	44	18	4	10	10	26	11	131	340	NIL
4	VENKATESAN	41	M	10122	11.10.18	D9-D10	CAGE	9	1	1	158	39	19	1	11	11	31	21	133	380	NIL
5	SARAVANAN	28	M	10214	14.10.18	L3-L4	CAGE	9	1	0	99	49	23	8	11	11	29	18	111	240	NIL
6	RATHINAVEL	60	M	10358	17.10.18	L4-L5	ILIAC GRAFT	8	1	2	98	41	29	7	11	11	14	8	114	230	NIL
7	KADHAR	36	M	10567	25.10.18	L5-S1	ILIAC GRAFT	9	1	1	126	44	29	7	11	11	11	3	105	260	NIL
8	MURUGAN	48	M	10609	27.10.18	L1-L2	CAGE	9	3	3	118	59	49	6	9	9	22	5	128	280	IMPLANT LOOSENING
9	PREM ANAND	40	M	10683	29.10.18	D6-D7	CAGE	9	2	2	98	28	24	2	10	10	38	12	118	320	NIL
10	GNANASEKAR	24	M	10705	30.10.18	D2-D3	RIB GRAFT	8	1	1	128	27	19	7	10.5	11	28	16	138	310	NIL
11	JAYAPAL	40	M	10799	02.11.18	D7-D8	CAGE	9	2	2	103	38	28	5.5	10	10	22	12	135	290	NIL
12	MURUGAN	37	M	10828	05.11.18	D11-D12	RIB GRAFT	8	1	1	88	41	19	7	10	10	36	15	130	310	NIL
13	AYESHA	55	F	11006	09.11.18	D12-L1	CAGE	9	3		108	56		3	3		25	13	140	360	NIL
14	RITHIKA	20	F	11145	13.11.18	D11-D12	ILIAC GRAFT	9	1	1	97	42	26	7	10	10	34	20	114	290	NIL
15	ALAGARSAMY	51	M	11198	15.11.18	L2-L3	ILIAC GRAFT	8	1	0	136	38	21	6.5	10	10	29	18	105	300	NIL
16	ANBUMATHI	21	M	11267	19.11.18	D8-D9	RIB GRAFT	8	1	1	123	29	27	5.5	9.5	10	38	13	130	210	NIL
17	ARICHANDRAN	35	M	11358	21.11.18	L5-S1	ILIAC GRAFT	9	2	2	149	36	25	5	7	7	10	3	112	210	NIL
18	GANDHIMATHI	58	F	11399	23.11.18	D10-D11	RIB GRAFT	9	2	2	143	41	35	8	2	2	43	18	155	520	NEUROLOGICAL
19	MUTHUMANI	29	F	11481	25.11.18	D6-D7	RIB GRAFT	9	1	1	90	29	25	6	11	11	34	20	118	265	NIL
20	LUSAINIYA	23	F	11579	29.11.18	D11-D12	RIB GRAFT	8	1	1	97	26	15	5.5	10	10	36	15	106	270	NIL



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**ETHICS COMMITTEE
 CERTIFICATE**

Name of the Candidate : Dr.P.Bharathiraja
 Course : PG in MS. Orthopedics.
 Course of Study : 2017-2020
 College : MADURAI MEDICAL COLLEGE
 Research Topic : Prospective study on functional
 and Radiological outcome of
 Tuberculosis of Dorsal and
 Lumbar spine-Anterior
 Reconstruction and Posterior
 stabilization through posterior
 only approach
 Ethical Committee as on : 11.10.2018

The Ethics Committee, Madurai Medical College has decided to inform
 that your Research proposal is accepted.

Member Secretary

Chairman

Dean / Coordinator

Prof Dr V Nagaraajan
 M.D., MNAMS, D.M., Dsc. (Neuro), Dsc (Hons)

CHAIRMAN
 IEC - Madurai Medical College
 Madurai

Madurai Medical Coll
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Urkund Analysis Result

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Submitted By: bharathir72@gmail.com
Significance: 16 %

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