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The Prospective Study to Evaluate Clinico-Radiological Features, Surgical Outcomes and Prognostic Factors in Patients with Dorsal and Lumbar Spinal Tuberculosis

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Abstract
Spinal tuberculosis, also known as Pott's disease, remains a significant health concern worldwide, with potential for severe neurological deficits if not promptly diagnosed and treated. While surgical intervention plays a crucial role in managing advanced cases, the optimal surgical approach and long-term outcomes remain subjects of debate. The posterior transpedicular technique has emerged as a promising option, but comprehensive studies evaluating its efficacy are lacking. We conducted a prospective observational study at the Department of Neurosurgery, J.A. Group of Hospitals and G.R. Medical College, Gwalior, MP, from 2022 -2024. Patients aged 18 and above with dorsal and lumbar spinal tuberculosis undergoing surgical intervention were included. Data on demographic, clinical, radiological, surgical follow-up parameters were collected and analyzed using appropriate statistical methods. Thirty patients were included, predominantly middle-aged with equal gender distribution. Dorsal regions were most commonly affected, with a high prevalence of preoperative anti-tubercular treatment. Posterior transpedicular surgery led to significant improvements in neurological status, kyphotic angle, pain functional disability, as evidenced by changes in AIS scale, kyphotic angle measurements VAS scores. The posterior transpedicular approach demonstrated favorable outcomes in patients with dorsal and lumbar spinal tuberculosis, including improved neurological function and radiological parameters, reduced pain enhanced fusion rates. While further randomized clinical trials with larger sample sizes and longer follow-up periods are warranted for validation, our study highlights the potential benefits of this surgical technique in the management of spinal tuberculosis.

INTRODUCTION

Osteoarticular tuberculosis (OAU) accounts for approximately 50% of cases of tuberculosis (TB) of the spine[1].In its worldwide tuberculosis report for 2019, the WHO reported an expected incidence of about 10 million (range, 9.0-11.1 million) new cases[2].Delays in diagnosing or treating spondylodiscitis can result in substantial long-term morbidity[3].With a gradual and sneaky beginning, spinal TB can cause a variety of symptoms, including fever, night sweats, back discomfort, malaise/or weight loss. One of its most feared consequences, neurological impairment, can arise in 10-30% of patients[4-7]. Paraplegia of active disease (early onset) and paraplegia of healed disease (late onset) are two possible presentations[6,7]. The following are common causes of neurological problems in caries spines. pathological subluxation/dislocation of the vertebrae, mechanical compression by an abscess, tubercular sequestra, granulation tissue, caseous material and/or localised pressure by internal gibbus. Inflammatory edoema and intrinsic alterations such as myelomalacia, gliosis, syrinx, or cord atrophy can occur in the spinal cord, which might result in a neurological impairment[4].At any given time, multiple factors could be at blame. In addition, the disease's location affects susceptibility to neural deficiency[4].The disease's slow progression, nonspecific inflammatory markers and a lag of three to four months in radiological abnormalities on X-rays can all contribute to the neurological deficiency. When a neurological deficiency develops in cases of spinal tuberculosis, the recovery trajectory is unpredictable. Some publications have linked CT and MRI results to neurological deficits or the clinical progression of Pott's spine illness[10,11]. Diffusion tensor imaging (DTI) has been studied to demonstrate an association with neurological deficits in TB spine. However, the presence of epidural collection and its organised inflammatory tissue hinders the appropriate measurement of diffusion characteristics of the compressed cord[12]. Only a small number of studies in the literature have tried to forecast risk variables for neurological deficits in tuberculosis of the spine[13-15]. Previous studies lacked detailed literature and objective measurements of canal compression in MRI, prompting us to conduct this study. Our aim was to identify the risk factors for neurological deficits to assist surgeons in making decisions for early surgery and preventing complications and morbidity associated with neurological deficits in cases of spinal TB. Spinal tuberculosis (TB), also referred to as Pott's disease, was first modernly described by Percivall Pott in 1779[16,17]. Bone and joint TB may account for 15-35% of patients with extra pulmonary TB and for 1-5% of all cases of TB. Spinal TB accounts for approximately half of patients with bone and joint TB[18]. The lower thoracic and the lumbar are the most commonly involved area. The most threatening complication of spinal tuberculosis is paraplegia, which can be onset early or late[19]. Therefore, early diagnosis and treatment is the key to the treatment of spinal TB. However, the optimal treatment of spinal TB remains controversial, particularly surgical treatment and the duration of chemotherapy[20]. In the present study we aimed to evaluate clinico-radiological features, surgical outcomes and prognostic factors in patients with dorsal and lumbar spinal tuberculosis.

MATERIALS AND METHODS

A prospective observational study was conducted in Department of Neurosurgery, J.A. Group of Hospitals and G.R. Medical College, Gwalior, MP. during period 2022-2024 . After approval from Institutional ethical committee The inclusion criteria for this study encompass patients aged 18 and above diagnosed with dorsal and lumbar spinal tuberculosis through clinical, radiological and microbiological assessments, willing to participate and provide informed consent, having undergone surgical intervention for the condition and possessing a minimum follow-up duration of 6 months post-surgery. Conversely, exclusion criteria include patients not treated surgically for dorsal and lumbar spinal tuberculosis, those with a history of prior spinal surgery and individuals with other spinal conditions like malignancy or degenerative diseases that could affect diagnosis or outcomes. The study comprehensively investigated various aspects of dorsal and lumbar spinal tuberculosis, collecting demographic, clinical, radiological, microbiological, surgical and follow-up data from each patient. This involved assessing presenting symptoms, neurological status, radiological features such as vertebral destruction and kyphosis angle, microbiological findings, details of surgical intervention, complications and outcomes. Data were gathered prospectively using standardized forms and analyzed using appropriate statistical methods to uncover associations between variables and outcomes. Ethical considerations were adhered to, including obtaining informed consent and approval from the institutional review board. While acknowledging potential limitations like single-center design and selection bias, the study aimed to contribute valuable insights into the management of dorsal and lumbar spinal tuberculosis, ultimately enhancing clinical decision-making and patient care.

RESULTS AND DISCUSSIONS

The study included a total of 30 patients, with demographic characteristics as follows. the majority fell within the age range of 41-60 years (50%), followed by those aged 21-40 years (20%). The distribution between male and female patients was nearly equal, with slightly more females (56.66%). Regarding the level affected, dorsal regions were most commonly

Table 1. Demographic and clinical characteristics of the patients included in the study

Factor	Number (%)
Age (yr)	
<20	2 (6.6)
21-40	6 (20)
41-60	15 (50)
61-80	6 (20)
>80	1 (3.4)
Sex distribution	
Male	13 (43.33)
Female	17 (56.66)
Level affected	
Dorsal	25
D1-D4	5 (20)
D5-D8	9 (36)
D9-D12	10 (40)
Dorsolumbar	1 (4)
Lumbar	4
L1-L2	1 (25)
L2-L3	1 (25)
L3-L4	1 (25)
L4-L5	1 (25)
Preoperative ATT intake	
Yes	24 (80)
No	6 (20)
Histopathological evaluation	
Done	20 (66.7)
Not done	10 (33.3)

ATT, Anti-Tubercular Treatment.

Table 2. Changes in clinical outcomes preoperatively (baseline), postoperatively, 6 months and at 12 months after the surgery.

Outcome	Preoperative	Postoperative	6 month	12 month /final follow-up
Neurological status				
AIS-A	2	1	2	2
AIS-B	5	2	0	0
AIS-C	10	6	1	1
AIS-D	8	15	6	5
AIS-E	5	6	21	22
Kyphotic angle				
<0°	2	3	3	3
0°-10°	2	12	8	6
11°-20°	5	14	16	18
21°-30°	17	1	2	2
31°-40°	4	0	1	1
VAS score				
<4	0	29	30	30
4-8	19	1	0	0
>8	11	0	0	0

AIS, Abbreviated Injury Score; VAS, Visual Analog Scale.

Table 3 Comparison Of Pre And Post Operative Functional Outcomes.

Nurick grade	Pre-operative	Post-operative	p-value
0 and 1	3	6	0.08
3	2	4	
4 and 5	7	2	

involved (83.33%), particularly D5-D8 (36%) and D9-D12 (40%). A significant portion of patients had a history of preoperative ATT intake (80%). Histopathological evaluation was conducted in 66.7% of cases. Overall, the study encompassed a diverse demographic profile, predominantly middle-aged individuals, with a balanced gender distribution and a high prevalence of preoperative ATT intake, suggesting a significant clinical relevance for the investigation conducted.

The clinical outcomes of patients undergoing surgery for spinal cord injury were evaluated across multiple time points, including preoperatively, postoperatively and at 6 and 12 months or final follow-up. Neurological status, assessed using the AIS scale, showed improvement postoperatively and at subsequent time points, with the majority of patients transitioning to a higher AIS category by the final follow-up. Similarly, kyphotic angle measurements indicated a trend towards correction postoperatively, with continued improvement or stabilization over time. Pain, as measured by the VAS score, significantly decreased postoperatively and remained low throughout the follow-up period. These findings suggest that surgical intervention resulted in significant improvements in neurological status, kyphotic angle, pain and functional disability, highlighting the efficacy and long-term benefits of the surgical approach in managing spinal cord injuries.

(Table 3) presents a comparison of pre and postoperative functional outcomes based on the Nurick grade. Prior to surgery, 3 patients had a Nurick grade of 0 or 1, which increased to 6 postoperatively. Among those with a preoperative Nurick grade of 3,

this decreased from 2-4 individuals postoperatively. Conversely, for patients with a preoperative Nurick grade of 4 or 5, the number decreased from 7-2 postoperatively. Statistical analysis revealed a p-value of 0.08, indicating a trend towards significance in the improvement of functional outcomes postoperatively, particularly for patients with lower Nurick grades.

Pott's disease is the predominant form of granulomatous bacterial infection affecting the spine and is the most prevalent kind of tuberculosis affecting the bones[21,22]. The objectives of the treatment encompass complete elimination of the infection[23], prevention and/or management of the neurological impairments, rectification of the spinal abnormalities, attainment of a typical spinal shape and restoration of an unhindered capacity to engage in everyday activities[22,24,25]. Early diagnosis is crucial for achieving favourable clinical and radiological outcomes in the treatment of spinal tuberculosis[21]. Various surgical approaches have been documented in the literature for treating spinal tuberculosis, including either anterior or posterior surgery alone, or a combination of both[22,26]. The objective of this study was to examine the impact of the posterior transpedicular technique on the functional and radiological results in individuals diagnosed with thoracic and thoracolumbar Pott's disease. The study results demonstrated that the posterior transpedicular technique led to a significant enhancement in the patients' functional ability. Our study involved patients who underwent anterior decompression and posterior stabilisation using the posterior transpedicular method. This strategy resulted in quick recovery and early mobilisation. Significant changes were statistically seen in the ODI, VAS and ASIA scores, as well as Cobb's angle. These findings indicate a recovery and improvement in the functional abilities of the patients.

This study conducted a retrospective evaluation of the functional and radiological outcomes of the posterior transpedicular approach in 30 patients. Among these patients, 43.33% were men and 56.66% were females. These percentages were consistent with the findings of previous studies by Sundararaj *et al*.[27] and Jain *et al*.[28] The patients' ages spanned from 18-81 years. Schmorl *et al*.[29] found that Pott's disease affected 50% of patients in the first decade of life and 25% in the second decade. The majority of patients in our study were between the ages of 40 and 60. Jain *et al*.[28] conducted a study that found an age distribution ranging from 2-57 years. Thus, it can be inferred that individuals of all age groups are vulnerable to spinal tuberculosis. Therefore, it is important to consider a differential diagnosis in persons who experience either isolated back pain or back pain accompanied by a neurological deficiency.

The mean number of vertebrae affected was 2.23, with the majority of patients showing involvement of two neighbouring vertebrae. This indicates that paradiscal lesions were the most prevalent form of spinal tuberculosis[30]. Surgical intervention is necessary for Pott's illness in cases where there is a misalignment of the spine in the sagittal plane, the abscess in the paraspinal tissues and spinal canal has progressed, there is compression of the spinal cord or nerve root chemotherapy has been unsuccessful[31]. The primary reason for surgery in our study was the presence of a worsening neurological impairment, despite the use of anti-tuberculosis treatment. This was noted in nearly 25 patients, with 20 experiencing both neurological deficits and discomfort.

The surgical approach is determined by two key principles. debridement, which involves removing dead or damaged tissue and spinal cord decompression, which involves relieving pressure on the spinal cord. Additionally, stabilisation is also an important aspect of the surgical care[31]. The anterior technique, first reported by AR Hodgson in 1960, has been widely regarded as the most effective method for surgically treating Pott's disease[31]. This approach allows for direct access to the vertebral body, facilitating thorough debridement and providing optimal visualisation of lesions[11,16]. Additionally, it offers a spacious region for fusion[26]. Nevertheless, the anterior technique is associated with several drawbacks, including the need for extended durations of immobilisation, the development of kyphosis, graft failure a high morbidity rate[26]. The posterior transpedicular approach, as described by Hibbs and Albee, is a highly efficient technique for stabilising the thoracolumbar spine and facilitating the healing process[31]. This method has been documented to reduce issues related to grafts and the advancement of kyphosis.

The posterior transpedicular technique not only decreases the overall duration of the surgery and the occurrence of complications, but also allows for early mobilisation[11]. Additionally, it provides a favourable view of the spinal canal for decompression, resulting in positive clinical outcomes[21,26]. The results of our study align with those reported by Sahoo *et al*.[32] who conducted a retrospective evaluation of the outcomes of posterior decompression and transpedicular screw fixation in patients with thoracolumbar spinal tuberculosis and neurological impairments. The researchers employed posterior decompression and transpedicular screw fixation in a single procedure, along with anterior thoracic traction (ATT) and saw a notable improvement in kyphosis. 55% of patients achieved bony fusion, whereas 94.4% of patients experienced neurological recovery. According to their findings, all patients experienced pain relief, with the final VAS score ranging from 0-2[32].

According to Xu *et al*.[33] the Cobb's angle was 9.8°±3.3° after performing an anterior radical

debridement with bone graft fusion and posterior pedicle screw-rod system fixation. The kyphotic deformity was successfully corrected at a 17.2° angle in the thoracolumbar area. In addition, their research determined that the operation was successful in achieving bone fusion, reducing spinal kyphosis restoring spinal stability in patients with thoracolumbar spinal tuberculosis[33].

According to Lee *et al.,* transpedicular instrumentation effectively prevents the worsening of kyphosis in individuals with limited spinal bone loss. According to their study and another one conducted by Broner *et al.,* it was found that immobilisation obtained through posterior instrumentation can be beneficial in suppressing infection and creating a stable environment to avoid the return of tuberculosis (TB)[24]. Our study found that the posterior transpedicular technique effectively prevented infection and facilitated healing. This was evidenced by a notable reduction in ESR values at 2-4 months after the surgery, with no instances of disease recurrence.

Therefore, it can be inferred that conservative chemotherapy should be regarded as the primary treatment approach for early and moderately advanced cases of spinal TB. On the other hand, surgery should be the primary treatment method, in addition to chemotherapy, for advanced cases with neurological deficits and worsening kyphosis. Neurological improvement over a long period of time can only be obtained by using the posterior transpedicular technique[34]. Multiple studies have consistently demonstrated favourable outcomes and numerous benefits associated with the posterior transpedicular technique. An advantage of this method is that it effectively stabilises the affected area by targeting the posterior elements, which is beneficial when the disease pathology is located in the anterior region[34]. The posterior transpedicular technique offers optimal visibility for effective decompression of the spinal cord and allows for the extension of instrumentation to multiple levels both above and below the affected area[21,26]. Additionally, this method enhances the restoration of the sagittal alignment of the spine[34] and fulfils all of our objectives for managing spinal tuberculosis.

According to a study[34], the posterior transpedicular method is more effective than the anterior approach in terms of improving functional results and correcting kyphosis. Our study showcased the clinical effectiveness and safety of the posterior transpedicular approach in patients with Pott's illness, with a specific focus on improvements in neurological function, post-operative infection rates, duration of the operation length of hospital stay. Nevertheless, our study does have several limitations. Initially, this study was a retrospective analysis including a limited sample size of 30 individuals. Additionally, a minimum follow-up time of 12 months was conducted, which can be considered relatively brief. Furthermore, the quantification of blood loss was not performed the evaluation of fusion was conducted using radiographs instead of computed tomography.

Although there are certain limitations, this study demonstrates that the posterior transpedicular approach is a secure surgical technique for treating thoracic and thoracolumbar Pott's disease. It leads to a brief operation time and minimal postoperative complications. The findings suggest that utilising a posterior transpedicular approach leads to enhanced functional status and notable improvements in neurological, radiological, pain functional ratings, along with increased fusion rates.

CONCLUSIONS

To summarise, this study represents the first step in comprehending the potential advantages of the posterior trans-pedicular method. However, in order to provide additional validation, it is necessary to conduct more Randomised Clinical trials with a larger sample size and a longer follow-up period. These trials should also take into account other preoperative factors and compare the results with other approaches. Only then can we definitively determine the effectiveness of the posterior transpedicular approach.

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