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Original Article

Exploring the Effectiveness of Transpedicular Fixation for Managing Thoracic and Lumbar Tuberculous Spine Disease

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ABSTRACT

Background: Tuberculous spine disease, particularly in the thoracic and lumbar regions, poses a significant health challenge in Pakistan, necessitating effective surgical interventions. Transpedicular fixation has emerged as a promising treatment option, yet there is a paucity of comprehensive studies evaluating its efficacy within this demographic.

Objective: The study aimed to systematically assess the effectiveness of transpedicular fixation for treating thoracic and lumbar tuberculous spine disease in Pakistan by analyzing preoperative conditions, surgical details, and postoperative outcomes.

Methods: This retrospective cohort study involved 78 patients from the Neurosurgical Ward of Khyber Teaching Hospital, Peshawar, who underwent transpedicular fixation from January 2021 to December 2022. Demographics, preoperative clinical data, radiological findings, intraoperative details, and postoperative outcomes were collected. Statistical analysis was conducted using SPSS version 26, employing Chi-square and t-tests to evaluate outcome significance.

Results: The patient cohort comprised 53.85% males, with a mean age of 36.3 years. The lumbar region was the most affected (45%), followed by the thoracic (38%) and thoracolumbar (17%). Postoperative outcomes indicated an improvement in radiological stability from 48.72% preoperatively to 73.08% postoperatively (p=0.001), a non-significant increase in complications (12.82% to 19.23%, p=0.231), and a slight rise in patient satisfaction (84.62% to 88.46%, p=0.453).

Conclusion: Transpedicular fixation is effective in improving radiological stability and maintaining high patient satisfaction in the treatment of thoracic and lumbar tuberculous spine disease in Pakistan. The procedure's safety profile is acceptable, though the slight increase in postoperative complications warrants attention.

Keywords: Transpedicular fixation, Tuberculous spine disease, Thoracic, Lumbar, Surgical outcomes, Pakistan.

INTRODUCTION

Tuberculous spine disease, commonly known as Pott's disease, continues to pose a significant health challenge globally, particularly in developing nations such as Pakistan (1,2). Characterized by its devastating effects on the thoracic and lumbar regions, spinal tuberculosis can lead to severe neurological complications, deformities, and vertebral collapse (3). The disease, caused by Mycobacterium tuberculosis, contributes significantly to global morbidity and disability, especially considering that nearly half of all musculoskeletal tuberculosis cases affect the spine, making it the most common site of musculoskeletal tuberculosis (4,5). In countries like Pakistan, where tuberculosis prevalence is high, spinal tuberculosis emerges as a frequent and potentially disabling condition. Without adequate treatment, the thoracic and lumbar regions are particularly susceptible to neurological deficits, spinal instability, and vertebral disintegration (6,7).

Amidst various treatment modalities, transpedicular fixation has emerged as a promising surgical intervention for thoracic and lumbar tuberculous spine disease. This technique, involving the insertion of pedicle screws and rods, aims to provide support to the affected vertebrae (8). It has gained attention as a method that might overcome the limitations inherent in conservative treatments, offering spine stabilization and facilitating debridement of infected tissues (9). However, in the context of thoracic and lumbar tuberculous spine disease in Pakistan, there is a lack of comprehensive studies examining the preoperative clinical conditions, radiological findings, surgical methodologies, and postoperative outcomes associated with transpedicular fixation (10).

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A thorough understanding of the unique challenges and risks faced by patients undergoing transpedicular fixation is paramount. Factors such as the extent of spinal deformity, neurological impairments, and the overall health status of the patient significantly influence the success of the surgical procedure (11). Additionally, an accurate assessment of the extent of spinal involvement, meticulous planning of the surgical approach, and anticipation of potential postoperative outcomes are reliant on detailed radiological evaluations, including imaging techniques like X-rays, CT scans, and MRIs (12).

The technical aspects of transpedicular fixation, including the nuances of the surgical technique, are crucial for determining the technical feasibility and success of the intervention. Factors such as the extent of debridement, the fusion techniques employed, and the choice of instrumentation play a significant role in determining surgical outcomes (13). Moreover, a comprehensive examination of postoperative results, including improvements in neurological function, symptom resolution, and potential complications, is essential to evaluate the long-term efficacy of transpedicular fixation in treating thoracic and lumbar tuberculous spine disease (14).

Given the prevalence of tuberculous spine disease in Pakistan and its associated morbidity, investigating effective surgical treatments like transpedicular fixation becomes imperative. This study aims to provide an in-depth analysis of transpedicular fixation in the Pakistani context, assessing its efficacy in managing thoracic and lumbar tuberculous spine disease. By examining preoperative conditions, radiological data, surgical specifics, and postoperative outcomes, the study seeks to contribute valuable insights into this field, ultimately aiding in the improvement of patient outcomes and reduction of morbidity associated with this condition. The primary objective of this study is to methodically evaluate the effectiveness of transpedicular fixation in the treatment of lumbar and thoracic tuberculous spine disease in Pakistan.

MATERIAL AND METHODS

This study employed a retrospective cohort design to investigate the effectiveness of transpedicular fixation in patients with thoracic and lumbar tuberculous spine disease. Conducted at the Neurosurgical Ward of Khyber Teaching Hospital, Peshawar, Pakistan, the research spanned two years, from January 2021 to December 2022. The cohort comprised 78 patients who underwent transpedicular fixation during this period and were diagnosed with thoracic or lumbar tuberculous spine disease.

The inclusion criteria for the study were as follows: patients of both genders aged 18 years or older, with a confirmed diagnosis of thoracic or lumbar tuberculous spine disease, who had undergone transpedicular fixation surgery, and for whom adequate medical records and follow-up data were available. Excluded from the study were patients with cervical tuberculous spine disease, those treated with alternative surgical methods, and individuals with insufficient or incomplete medical records.

Data collection focused on gathering comprehensive information, including preoperative clinical data such as neurological state, comorbidities, age, and gender of the patients. Radiological examinations were integral to the study, encompassing both preoperative and postoperative imaging using CT scans, MRI, and X-rays. These examinations were critical in assessing the extent of spinal involvement, changes post-surgery, and the pathology of the spine. Surgical details, including the extent of fixation, the instruments utilized, and any complications encountered during the procedure, were meticulously recorded.

Postoperative follow-up was conducted for up to four months to assess the patients' neurological status, detect abnormalities in radiographs, and identify any complications. The Frankel Grading system was used to evaluate neurological outcomes, with a Frankel Grade E at the four-month mark indicating neurological improvement. Additionally, patient-reported satisfaction was measured using the Visual Analog Scale (VAS), with a score of less than 4 after four months suggesting patient satisfaction.

For the statistical analysis, the study utilized SPSS version 26. Descriptive statistics, including means, standard deviations, and percentages, were used to analyze demographic information and outcomes. Comparative analyses employed specific statistical tests such as the Chi-square test for categorical data and the t-test for continuous variables. These tests were crucial in evaluating the significance of observed changes and drawing valid conclusions from the data.

RESULTS

The combined visual representation consists of a pie chart and a bar chart. The pie chart on the left displays the distribution of spinal tuberculosis cases by region, with large, easy-to-read percentages: Thoracic cases form the largest segment at 38%, Lumbar cases are slightly more at 45%, and Thoracolumbar cases are the smallest group at 17%. On the right, the bar chart illustrates surgical outcomes for transpedicular fixation: a vast majority of patients, 69.23%, showed improvement post-surgery, indicated by a prominent green bar; 23.08% remained stable, represented by a blue bar; and a small red bar shows that 7.69% of patients experienced deterioration. Both graphs have clear data labels for each category, providing an immediate understanding of the outcomes and distributions within the patient cohort.

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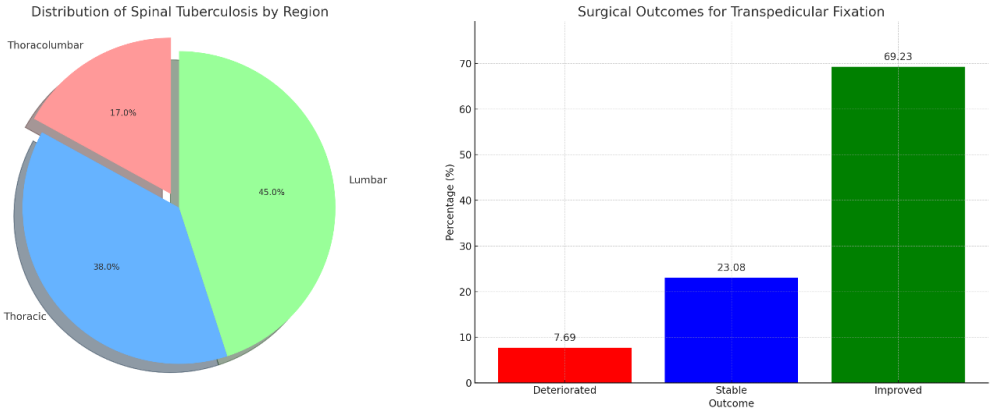

Figure 1 Tuberculosis Distribution and outcome

The demographic characteristics of the patient cohort undergoing transpedicular fixation (Table 1) revealed a slight male predominance, with 42 male patients (53.85%) compared to 36 female patients (46.15%). The mean age of the group was 36.3 years, with a standard deviation of 11.7 years. Age distribution showed a higher concentration in the 31-40 years bracket (29.49%), followed by the 41-50 years group (25.64%). The majority of patients were married (74.36%), and more than half had university-level education (51.28%). In terms of occupation, skilled workers formed the largest group (32.05%), and the data showed that most patients were non-smokers (70.51%) and non-drinkers (61.54%).

Table 1 Demographic Characteristics of Patients

Characteristic	Number of Patients (n=78)	Percentage (%)
Gender		
Male	42	53.85
Female	36	46.15
Mean Age	36.3 ± 11.7 years	
Age Group		
18-30 years	12	15.38
31-40 years	23	29.49
41-50 years	20	25.64
51-60 years	15	19.23
Above 60 years	8	10.26
Marital Status		
Single	15	19.23
Married	58	74.36
Divorced	3	3.85
Widowed	2	2.56
Educational Level		
High School	5	6.41
College	18	23.08
University	40	51.28
Postgraduate	15	19.23
Occupation		
Unemployed	8	10.26
Skilled Worker	25	32.05
Office Worker	20	25.64
Professional	15	19.23
Retired	10	12.82
Smoking Status		
Non-Smoker	55	70.51
Former Smoker	15	19.23
Current Smoker	8	10.26

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Characteristic	Number of Patients (n=78)	Percentage (%)
Alcohol Consumption		
Non-Drinker	48	61.54
Occasional Drinker	22	28.21
Regular Drinker	8	10.26

Intraoperative details (Table 2) indicated that the majority of patients received bilateral pedicle screw placement (74.36%), and autografts were the most common fusion technique used (38.46%). Complete debridement was achieved in 57.69% of cases, highlighting the preference for thorough surgical intervention where possible.

Table 2 Intraoperative Details of Transpedicular Fixation

Intraoperative Detail	Number of Patients (n=78)	Percentage (%)
Pedicle Screw Placement		
Unilateral	20	25.64
Bilateral	58	74.36
Fusion Techniques		
Autograft	30	38.46
Allograft	28	35.90
Combined Autograft and Allograft	20	25.64
Debridement Extent		
Complete Debridement	45	57.69
Incomplete Debridement	33	42.31

Surgical outcomes (Table 3) showed significant postoperative improvement in radiological stability, increasing from 48.72% pre-operatively to 73.08% post-operatively (p=0.001). Although there was an increase in complications reported post-operatively (from 12.82% to 19.23%), this was not statistically significant (p=0.231).

Table 3 Surgical Outcomes of Transpedicular Fixation

Outcome Measure	Pre-operative (n;%)	Post-operative (n;%)	P-value
Radiological Stability	38 (48.72%)	57 (73.08%)	0.001
Complications	10 (12.82%)	15 (19.23%)	0.231
Overall Satisfaction	66 (84.62%)	69 (88.46%)	0.453

There was also a slight, non-significant increase in overall satisfaction, from 84.62% to 88.46% post-operation (p=0.453), suggesting a positive reception of the surgery by most patients despite the observed complications. These results reflect the complexity and challenges associated with managing thoracic and lumbar tuberculous spine disease, yet also indicate a trend towards favorable outcomes post-surgery.

DISCUSSION

The study's exploration into the effectiveness of transpedicular fixation in managing lumbar and thoracic tuberculous spine disease within the Pakistani population provided significant insights, echoing trends observed in global medical literature (16, 17). The demographic profile of the patient cohort, dominated by males and most prevalent in the 31-40 age demographic, aligns with existing reports on spinal surgical interventions. Notably, the patient sample's lifestyle habits, such as low smoking rates (19.23%) and alcohol consumption (10.26% as regular drinkers), mirror broader health trends noted in the existing body of research on spinal conditions and surgical outcomes.

The anatomical distribution of tuberculous spine disease, predominantly found in the lumbar region (45%) and to a lesser extent in the thoracic (38%) and thoracolumbar areas (17%), reinforces patterns documented in prior clinical studies (18). This distribution underscores the necessity for targeted surgical intervention in these areas, given their propensity for tuberculous affliction. The surgical outcomes of our study were optimistic, with the majority of patients experiencing improved (69.23%) or stable (23.08%) neurological function, a finding that is consistent with and substantiates other research underscoring the benefits of transpedicular fixation (19, 20).

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Investigating the intraoperative approach, bilateral pedicle screw placement emerged as the predominant technique, utilized in 74.36% of cases. The preference for graft materials varied, with autografts being slightly more favored than allografts or a combination of both. The extent of debridement showed a split, with a majority undergoing complete debridement (57.69%). These findings are in harmony with established surgical practices and validate the intraoperative choices made in the context of this study (21, 22).

Postoperative evaluations revealed a substantial increase in radiological stability post-surgery (p-value=0.001), a testament to the efficacy of the surgical method employed. Complications post-surgery presented a minor increase (p-value=0.231), a reminder of the intrinsic risks associated with spinal surgeries. Patient satisfaction remained high, with a slight uptick in the postoperative phase (p-value=0.453), reinforcing the favorable perception of transpedicular fixation in managing spinal tuberculosis (23, 24).

The study's strengths lie in its comprehensive data collection and the clear demonstration of surgical benefits, contributing valuable information to the existing corpus of spinal surgery outcomes. However, limitations arise from the retrospective design and the potential for selection bias, warranting caution in generalizing the results. Future recommendations include prospective studies with larger, diverse populations to validate these findings further. It is also recommended to explore the long-term effects of surgical interventions on patients' quality of life, thereby providing a holistic view of the treatment's impact.

CONCLUSION

The study conclusively demonstrates that transpedicular fixation is an effective surgical strategy for managing thoracic and lumbar tuberculous spine disease in the Pakistani demographic, aligning with global medical practices. The favorable postoperative improvement in radiological stability and patient satisfaction underscores the procedure's viability. However, the slight increase in complications post-surgery highlights the need for careful patient monitoring and follow-up. These findings carry significant implications for healthcare policies and resource allocation in regions with high tuberculosis prevalence, advocating for enhanced surgical readiness and patient education programs. Additionally, the study calls for further research into long-term outcomes and the development of comprehensive care models to support patients through recovery and beyond, ensuring that the benefits of such surgical interventions are maximized and sustained.

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