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Case Report

Use of Hartshill rectangle with sublaminar wiring for posterior stabilization of D7-D9 tubercular spondylodiscitis with paraplegia: a cost effective treatment

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ABSTRACT

Tuberculosis presents a significant health challenge, with extrapulmonary cases comprising 15-20%. Spinal tuberculosis often leads to neurological deficits, requiring surgical intervention such as Hartshill system fixation. Various posterior instrumentation methods are employed, with sublaminar wiring pioneered by Luque and enhanced by Dove's Hartshill system for superior biomechanical performance. This case underscores Hartshill system's efficacy in stabilizing the spine post-tubercular destruction, offering a cost-effective alternative to pedicle screws. An 18-year-old presented with 6-month upper back pain, progressing weakness in lower limbs, weight loss, and fever. Radiographs revealed D7-D9 vertebral destruction, leading to kyphosis. MRI showed paradiscal bony destruction and abscess, suggestive of tubercular spondylodiscitis. Surgery with Hartshill rectangle and sublaminar wiring provided kyphosis correction. Post-operative Gene-Xpert confirmed tuberculosis. Mobilization and chemotherapy led to limb power restoration within 3 months, with ongoing rehabilitation and consolidation of affected segments with complete recovery by eight months. Instrumented stabilization in spinal TB prevents kyphosis and graft complications; Hartshill loop rectangle and sublaminar wire fixation, cost-effective and suitable for resource-poor settings, offer comparable outcomes to pedicle screws, enabling hybrid fixation, especially in low-income countries.

Keywords: Spinal tuberculosis, Hartshill cage, Hartshill rectangle, Sublaminar wiring, Decompression, Tuberculosis

INTRODUCTION

Tuberculosis poses a significant health challenge in numerous developing nations. While pulmonary tuberculosis remains the predominant form, extrapulmonary tuberculosis constitutes 15%–20% of all tuberculosis cases.[1] While pulmonary tuberculosis is the prevailing form, extrapulmonary tuberculosis makes up 15%–20% of all tuberculosis cases.[2]

The dorsolumbar spine is the site most frequently affected, with 20%–41% of spinal tuberculosis cases resulting in neurological deficits.[3] The primary treatment for tuberculosis of the dorsal spine typically involves ambulatory chemotherapy for most patients. Surgical intervention becomes necessary in cases where there are neurological deficits, an unstable vertebral column, or when conservative management proves ineffective. Surgical options may include anterior, posterior, or combined approaches.[4,5]

A variety of posterior instrumentation methods are utilized for fixation, including techniques such as Harrington distraction rods, wired distraction rods, sub-laminar wiring of L-rods, as well as more recent advancements like pedicle screw fixation.[6-9]

The posterior stabilization of the spine through sublaminar wiring was initially pioneered by Luque in 1984.[10] Luque's technique involved the utilization of wires in conjunction with two distinct rods. Subsequently, in 1986, Dove introduced the Hartshill system, which aimed to enhance rotational stability by integrating the two Luque rods into a rectangular configuration.[11] The rectangular configuration is affixed to the spine utilizing two loops of wire at each level. This arrangement has demonstrated superior biomechanical performance compared to the original single-loop method, as evidenced by our biomechanical tests.[12]

This case highlights the author's utilization of the Hartshill system for fixation of spine following vertebral destruction secondary to tuberculosis accompanied with severe cord compression. The Hartshill system is regarded as a cost-effective alternative for stabilizing the posterior column, especially in light of recent advancements such as pedicle screws, which address all three columns simultaneously.

CASE REPORT

An 18-year-old patient presented with chief complaints of upper back pain persisting for the last 6 months, associated with gradual onset weakness in both lower limbs progressing over the last 4 weeks, and inability to walk for the past 2 days. The patient also complained of a five-kilogram weight loss, along with intermittent fever for the past month. A thorough neurological examination was conducted, revealing the following findings (Table 1).

Table 1: Neurological examination findings at presentation.

Muscle group	Right	Left
Upper limb	5/5	5/5
Hip	0/5	0/5
Knee	0/5	0/5
Ankle-plantar flexion	0/5	0/5
Ankle-dorsi flexion	0/5	0/5
EHL	0/5	0/5
FHL	0/5	0/5
Tone	Spastic	Spastic
Sensory	Normal	Normal
Lower limb reflexes	Exaggerated with clonus	Exaggerated with clonus
Plantar reflex	Up going	Up going

Radiographs of the whole spine were obtained, showing destruction of D7 and D8 vertebrae with collapse leading to severe kyphosis, accompanied by a soft tissue shadow around the affected level (Figure 1). Based on clinical and radiological assessments, a provisional diagnosis of infective affection was suspected.

MRI of the lower dorsal spine with whole spine screening revealed paradiscal bony destruction involving the inferior and superior endplates of T7, T8 and T9 vertebrae, with posterior enhancement on post-contrast images. Additionally, contiguous peri vertebral abscess with subligamentous spread below the anterior longitudinal ligament, extending to the epidural space, resulted in compression of neural structures (Figure 2 and 3). These findings were highly suggestive of infective spondylodiscitis, with the most likely etiology being tubercular infection.

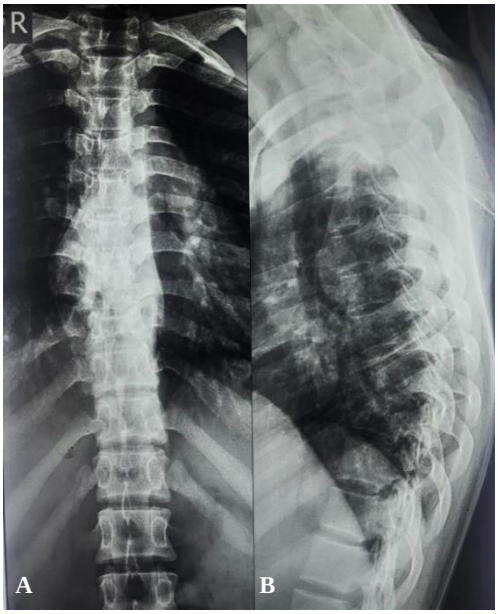

Figure 1 (A and B): Pre-operative radiograph showing D7 to D9 vertebral collapse with kyphotic deformity with fusiform swelling in AP films.

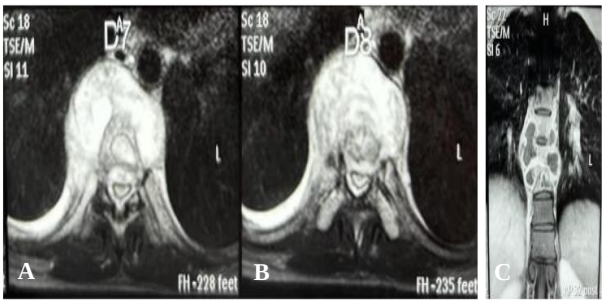

Figure 2 (A-C): MRI axial and coronal cuts show evidence of anteriorly and laterally placed abscess with vertebral destruction and collection from T7 to T10 levels.

Considering the progression of the disease, neurological involvement, and secondary factors such as low socioeconomic status and the patient's general condition, a plan for decompression of the affected segments along with posterior stabilization using the Hartshill rectangle with sublaminar wiring was formulated. Surgery was uneventful, and intraoperative pus samples were collected

and sent for microbiological examination and histopathology.

Immediate post-operative radiographs demonstrated correction of the kyphosis and restoration of the native alignment of the dorsal spine, with rigid fixation and adequate placement of hardware (Figure 4). Gene-Xpert testing was positive for Mycobacterium tuberculosis, and culture showed no antibiotic resistance. Due to adequate fixation, the patient was mobilized from day one with active and passive range of motion exercises for the lower limbs, wheelchair mobilization, thoraco-lumbosacral orthosis (TLSO) with axillary support, and initiation of a four-drug anti-tubercular chemotherapy regimen.

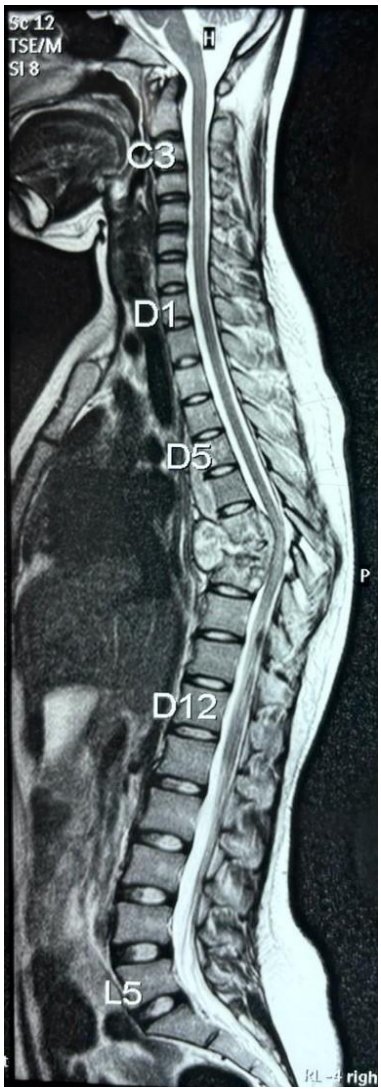

Figure 3: Sagittal cuts of MRI suggestive of T7 to T9 vertebral collapse and complete destruction associated with localized abscess from T5 to T10 levels associated with kyphotic deformity.

At one-month post-surgery, the patient showed restoration of lower limb power, with complete restoration of useful power by three months. Eight months post-operative X-ray revealed ongoing consolidation of affected vertebral segments, with continued chemotherapy and physical therapy and rehabilitation without any hardware-associated complications (Figure 5).

Figure 4 (A and B): Immediate Post-operative radiographs showing correction of deformity with Hartshill rectangle with sublaminar wiring *in-situ*.

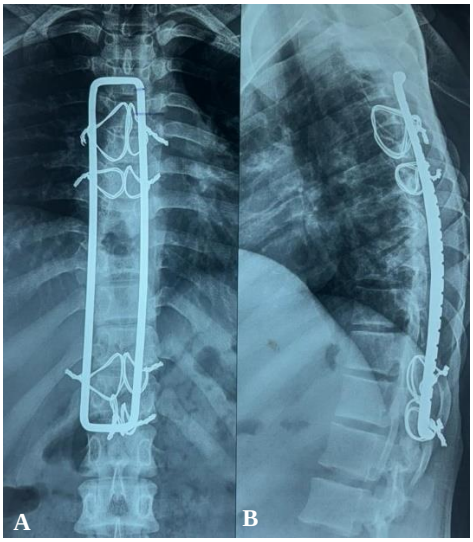

Figure 5 (A and B): Post-operative 8 months radiographs showing consolidation of affected levels without any signs of hardware failure.

DISCUSSION

Pathological fractures in diseased vertebral bodies render the spine unstable, especially in tuberculosis affecting all three columns, leading to neural deficits from spinal column dislocation. Laminectomy, intended for decompression, can worsen neural deficits, potentially causing paraplegia. Tubercular lesions at junctional areas undergo pronounced biomechanical stresses due to transition in spinal curvature. Surgical decompression

exacerbates instability by removing part of the diseased vertebral body for spinal cord relief.[3,13]

With the resurgence of third-generation spinal implants, the relevance of spinal loop rectangle and sublaminar wiring (SLW) has diminished.[14] The Hartshill rectangle and sublaminar wiring constitute a semi-rigid construct characterized by "cold-cured" dual wires secured to the cortices of both laminae and tightened onto contoured stainless-steel dual rods. Particularly in osteoporotic spines, where the cortices of the laminae exhibit greater strength compared to the marrow within pedicles and vertebral bodies, this construct offers sagittal plane stability through contoured dual rods, alongside rotational and/or translational stability facilitated by the cold-cured dual SLWs.[15] However, the drawback of this implant lies in its semi-rigid nature and limited axial stability, allowing vertebral collapse to occur, especially in the absence of anterior column reconstruction.[16]

In a study by Jain et al described anterior decompression with posterior instrumentation, often without posterior column shortening, achieving simultaneous visualization of anterior and posterior spinal columns for decompression and stabilization. Among 54 patients, 15 underwent instrumentation during active disease without kyphosis, while 39 had kyphosis correction. Hartshill rectangle and sublaminar wires were utilized, with mean pre-operative kyphosis of 51.6° corrected to 27°, and main complications were approach-related, including wound dehiscence at the T junction, wire breakage, and loosening.[17]

A study by Srivastava et al involved 143 patients with tuberculosis of the thoracic spine treated surgically using the "Versatile approach." Posterior fixation with sublaminar wires and a Hartshill rectangle was performed in all patients, while anterior reconstruction utilized autologous rib, iliac crest, or fibula bone grafts. Results showed significant improvement in kyphosis, with no deterioration of neurological status post-surgery. Fusion was achieved in all cases, and the visual analog scale score improved markedly. Few complications were observed, including superficial macerations and implant breakage in rare cases. The "Versatile approach" was deemed effective, providing direct visualization for decompression and reconstruction of both anterior and posterior vertebral columns, resulting in excellent long-term clinical outcomes.[18]

In a retrospective observational study by Srivastava et al, patients were divided into two groups based on fixation method (pedicle screw rod vs. Hartshill loop rectangle and sublaminar wires) and evaluated pre- and post-operatively. Functional outcomes between the two fixation methods were comparable, with Hartshill loop rectangle and sublaminar wire fixation found to be more cost-effective. It concluded that while pedicle screws offer a 3-column hold, Hartshill loop rectangle and sublaminar wire fixation provide adequate stabilization when combined with neural decompression and grafting. Despite being less commonly used, Hartshill loop rectangle and sublaminar wire fixation remain valuable, especially in resource-poor settings like certain Asian countries.[19]

In another study conducted by Güzey et al it was concluded that utilizing a posterior approach along with internal fixation and posterior or posterolateral fusion, possibly with the inclusion of posterior interbody grafts, can effectively address infection debridement and provide spinal stabilization in individuals with thoracic and lumbar tuberculous spondylitis. This method offers several advantages, including convenient access to the spinal canal for neural decompression, maintenance of corrected vertebral alignment over time, and promotion of early mobilisation.[20]

Therefore, employing the Hartshill system for spinal stabilization proves to be an effective treatment approach in addressing thoracic tubercular spine conditions. It facilitates prompt rehabilitation and serves as a cost-effective alternative to the prevalent use of titanium pedicle screws, particularly beneficial for patients from developing countries and those with low socioeconomic status.

CONCLUSION

Instrumented stabilization is safe in spinal TB, used selectively to prevent kyphosis deterioration and graft-related complications. Hartshill loop rectangle and sublaminar wire fixation offer adequate stabilization, comparable to pedicle screw fixation, especially when combined with neural decompression and grafting. Despite being less common, Hartshill loop rectangle and sublaminar wire fixation is valuable in resource-poor settings, providing comparable outcomes at lower cost. This technique enables hybrid fixation as a salvage procedure and is suitable for stabilizing the spine during active disease, particularly in low-income countries with limited facilities.

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REFERENCES

1. Fanning A. Tuberculosis: 6. Extrapulmonary disease. CMAJ. 1999;160:1597-603.
2. Fussey SP, Lindsay JG, Fuller C, Perham RN, Dale S, James OF, et al. Autoantibodies in primary biliary cirrhosis: Analysis of reactivity against eukaryotic and prokaryotic 2-oxo acid dehydrogenase complexes. Hepatology. 1991;13:467-7.
3. Jain AK, Kumar J. Tuberculosis of spine: neurological deficit. Eur Spine J. 2013;22Suppl4:624-33.
4. Hodgson AR, Stock FE. Anterior spine fusion for the treatment of tuberculosis of the spine: the operative

findings and results of treatment in the first 100 cases. Bone Joint J Surg. 1960;42:295-310.
5. Upadhyay SS, Saji MJ, Yau ACMC. Duration of antituberculosis chemotherapy in conjunction with radical surgery in the management of spinal tuberculosis. Spine. 1996;21:1898-903.
6. Bostman OM, Myllynen PJ, Riska EB. Unstable fractures of the thoracic and lumbar spine: the audit of an 8-year series with early reduction using Harrington instrumentation. Injury. 1987;18:190-5.
7. Sullivan JA. Sublaminar wiring of Harrington distraction rods for unstable thoracolumbar spine fractures. Clin Orthop. 1984;189:178-85.
8. Ferguson RL, Allen BL. A mechanistic classification of thoracolumbar spine fracture. Clin Orthop 1984;189:77-88.
9. Chang KW. A reduction - fixation system for unstable thoracolumbar burst fractures. Spine 1992;17:879-86.
10. Luque ER. Segmental spinal instrumentation for correction of scoliosis. Clin Orthop Relat Res. 1982;163:192-8.
11. Dove J. Internal fixation of lumbar spine: the Hartshill rectangle. Clin Orthop. 1986;203:135–90.
12. Dove J. Internal fixation of unstable spinal fractures: the Hartshill system. Injury. 1989;20(3):139-44.
13. Jain AK, Maheshwari AV, Jena S. Kyphus correction in spinal tuberculosis. Clin Orthop Relat Res. 2007;460:117–23.
14. Wilber RG, Thompson GH, Shaffer JW, Brown RH, Nash CL. Postoperative neurological deficits in segmental spinal instrumentation. A study using spinal cord monitoring. J Bone Joint Surg Am. 1984;66:1178 87.
15. Coe JD, Warden KE, Herzig MA, McAfee PC. Influence of bone mineral density on the fixation of thoracolumbar implants. A comparative study of transpedicular screws, laminar hooks, and spinous process wires. Spine (Phila Pa 1976). 1990;15:902-7.
16. Mohan AL, Das K. History of surgery for the correction of spinal deformity. Neurosurg Focus 2003;14:e1.
17. Jain AK, Jain S. Instrumented stabilization in spinal tuberculosis. Int Orthop. 2012;36(2):285-92.
18. Srivastava SK, Aggarwal RA, Bhosale SK, Roy K, Nemade PS. The Versatile Approach: A Novel Single Incision Combined with Anterior and Posterior Approaches for Decompression and Instrumented Fusion to Treat Tuberculosis of the Thoracic Spine. Asian Spine J. 2017;11(2):294-304.
19. Srivastava S, Marathe N, Bhosale S, Purohit S, Raj A, Amin A, et al. Golden Wires and Rectangle: A Cost-Effective Treatment for Tuberculosis of the Thoracic Spine. Asian J Neurosurg. 2020;15(2):328-32.
20. Güzey FK, Emel E, Bas NS, Hacisalihoglu S, Seyithanoglu MH, Karacor SE, et al. Thoracic and lumbar tuberculous spondylitis treated by posterior debridement, graft placement, and instrumentation: a retrospective analysis in 19 cases. J Neurosurg Spine. 2005;3(6):450-8.

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