Effect of Physiotherapy Exercises on Quality of Life of Pott's Spine Survivors

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Abstract
Background: Pott's spine, or tuberculous spondylitis, is a severe extrapulmonary manifestation of Mycobacterium tuberculosis infection that primarily affects the vertebrae and intervertebral discs. Representing approximately 2% of all tuberculosis (TB) cases, 15% of extrapulmonary TB, and nearly 50% of skeletal TB, it remains a major cause of spinal deformity and neurological deficits in developing regions. Early diagnosis and multidisciplinary management are crucial for preventing complications. Physiotherapy-based rehabilitation forms an integral component of treatment, aiming to restore function, alleviate pain, and enhance patients' quality of life.
Aim: This review evaluates the impact of physiotherapy exercises on the quality of life of individuals diagnosed with Pott's spine.
Methodology: A comprehensive literature search was conducted across PubMed and Google Scholar databases between 2012 and 2024 using specific keywords—spinal tuberculosis, Pott's spine, quality of life, and physiotherapy—with Boolean operators "AND" and "OR" applied. Out of 38, 695 initially retrieved studies, 20 met the inclusion criteria and were analyzed for methodological quality and clinical relevance.
Results: The reviewed studies demonstrated that physiotherapy interventions, including range of motion and strengthening exercises, postural correction, balance training, respiratory reconditioning, and sensory re-education, substantially improved functional independence, cardiorespiratory capacity, and overall quality of life among Pott's spine survivors.
Conclusion: Rehabilitation remains essential throughout the disease trajectory, contributing to pain reduction, neurological recovery, and prevention of disability. Continued research is warranted to standardize physiotherapeutic protocols and enhance the evidence base for spinal tuberculosis management.

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Keywords: Spinal Tuberculosis, Pott's Spine, Physiotherapy, Quality of Life, Rehabilitation.

Introduction

Spinal tuberculosis (TB), also referred to as Pott's disease, is a destructive form of extrapulmonary tuberculosis caused by Mycobacterium tuberculosis, predominantly affecting the vertebral bodies and intervertebral discs. It remains one of the most debilitating and prevalent musculoskeletal infections, contributing significantly to the global TB burden [1]. Despite advancements in diagnostics, therapeutics, and infection control, the incidence of spinal TB continues to rise, with millions of new cases reported annually across developing and developed regions alike. The disease is of particular concern due to its potential to cause neurological impairment, severe spinal deformity, and long-term disability, all of which markedly affect patients' quality of life [2].

The resurgence of tuberculosis worldwide is closely associated with several biological and social determinants, including the human immunodeficiency virus (HIV) epidemic, widespread malnutrition, substance abuse, overcrowded living conditions, inadequate infection control measures, and the emergence of drug-resistant strains of Mycobacterium tuberculosis. The coexistence of HIV and TB has compounded disease progression and systemic dissemination. In spinal tuberculosis, infection typically involves the vertebral column, often extending to adjacent soft tissues, resulting in the characteristic presentation known as Pott's spine [2].

Pathophysiologically, spinal TB develops following inhalation of Mycobacterium tuberculosis-infected droplets, which initially colonize the pulmonary system before spreading hematogenously to other organs, including the spine [1]. The highly vascular cancellous bone of the vertebral bodies serves as a favorable site for bacillary proliferation and caseous necrosis. The disease may also spread from latent foci in organs such as the kidneys or lymph nodes through lymphatic channels or Batson's paravertebral venous plexus. Early detection and prompt management are critical to prevent neurological compromise, severe spinal deformity, and systemic dissemination [3].

Clinically, patients often present with back pain, localized tenderness, deformity, gibbus formation, or limb weakness, accompanied by constitutional symptoms such as fatigue, loss of appetite, weight loss, evening pyrexia, and night sweats [3]. The disease frequently affects two contiguous vertebrae, although multiple or discontinuous lesions—known as skip lesions—are occasionally observed [2]. The thoracolumbar region is most commonly involved, with kyphotic deformities arising from anterior vertebral body collapse. The narrowing of the spinal canal contributes to neural compression, resulting in paraplegia or quadriplegia in severe cases [4].

Radiological assessment plays an essential role in confirming the diagnosis. Conventional radiographs, computed tomography (CT), and magnetic resonance imaging (MRI) are widely used to identify typical features of vertebral destruction, abscess formation, and disc involvement. However, atypical imaging patterns may occur, emphasizing the importance of comprehensive evaluation and correlation with clinical and laboratory findings [5].

Management of Pott's spine requires a multidisciplinary approach involving anti-tubercular therapy, surgical decompression when indicated, and structured physiotherapy rehabilitation to optimize recovery and minimize residual disability [3, 4]. Physiotherapy plays a vital role in enhancing functional outcomes by improving spinal mobility, postural alignment, respiratory capacity, muscle strength, and neuromuscular control. Rehabilitation techniques such as core stabilization, postural retraining, respiratory exercises, gait training, and sensory re-education have demonstrated efficacy in reducing pain, restoring functional independence, and improving overall well-being [4, 6-8].

Although medical and surgical management remain the mainstays of spinal TB treatment, the complementary role of physiotherapy in restoring function and improving the quality of life has not been extensively quantified. There is a need for systematic evaluation of physiotherapy protocols and their measurable impact on the physical, psychological, and social domains of patients' lives.

The present study therefore seeks to address this gap by investigating the effects of physiotherapy exercise interventions on the quality of life among individuals recovering from Pott's spine.

Methodology

Study Design

The present study was designed as a comprehensive literature review aimed at synthesizing existing evidence on the role of physiotherapy in improving the quality of life among individuals with spinal tuberculosis (Pott's spine). The review focused on identifying, analyzing, and summarizing relevant research published between 2012 and 2024, ensuring that findings reflected current trends in rehabilitation, clinical outcomes, and therapeutic approaches for Pott's disease.

Search Strategy

A systematic search of electronic databases, including PubMed and Google Scholar, was conducted to identify relevant peer-reviewed articles. The search incorporated combinations of key terms such as "spinal tuberculosis," "Pott's spine," "quality of life," and "physiotherapy", utilizing Boolean operators AND and OR to refine results and ensure inclusivity. Only studies directly related to the research objective were considered. Secondary sources such as review articles, meta-analyses, and reference lists of key papers were also screened to capture additional relevant literature. Publications written in English and available in full text within the defined period (2012–2024) were included for detailed evaluation.

Study Selection Process

The process of article selection followed a structured, multi-stage screening approach. Initially, titles and abstracts were screened to exclude irrelevant studies. Subsequently, full-text assessments were conducted to confirm eligibility based on the study design, participant characteristics, and relevance of interventions. A PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram was used to illustrate the selection process and enhance transparency. Studies were retained based on predefined inclusion and exclusion criteria, ensuring methodological rigor and consistency across the review.

Inclusion Criteria

Studies involving male and female participants diagnosed with Pott's spine.

- Participants aged 18 years and above.
- Articles published in English language and available in full text.
- Studies incorporating physiotherapy interventions as part of management for Pott's spine, irrespective of study design.

Exclusion Criteria

Studies involving patients with additional comorbidities or concurrent unrelated conditions.

- Articles including non-physiotherapy-based treatment protocols.
- Publications containing incomplete, irrelevant, or non-English data.

Data Extraction and Synthesis

From each eligible study, essential data were systematically extracted, including the title, author, year of publication, study design, sample size, demographic and clinical characteristics (mean age, sex ratio), and diagnostic details. Information related to outcome measures such as the SF-36, WHOQOL-BREF, FIM, VAS, ASIA scale, Barthel Index, and depression scales was recorded. Study outcomes pertaining to quality of life, pain intensity, functional independence, neurological improvement, muscle strength, and activities of daily living (ADL) were analyzed and synthesized narratively. Since this review utilized previously published studies, ethical approval was not required.

Ethical Considerations

All stages of data collection and analysis adhered to ethical standards governing secondary data use. Proper acknowledgment and citation of original authors were maintained throughout the process, ensuring academic integrity, transparency, and compliance with ethical research practices.

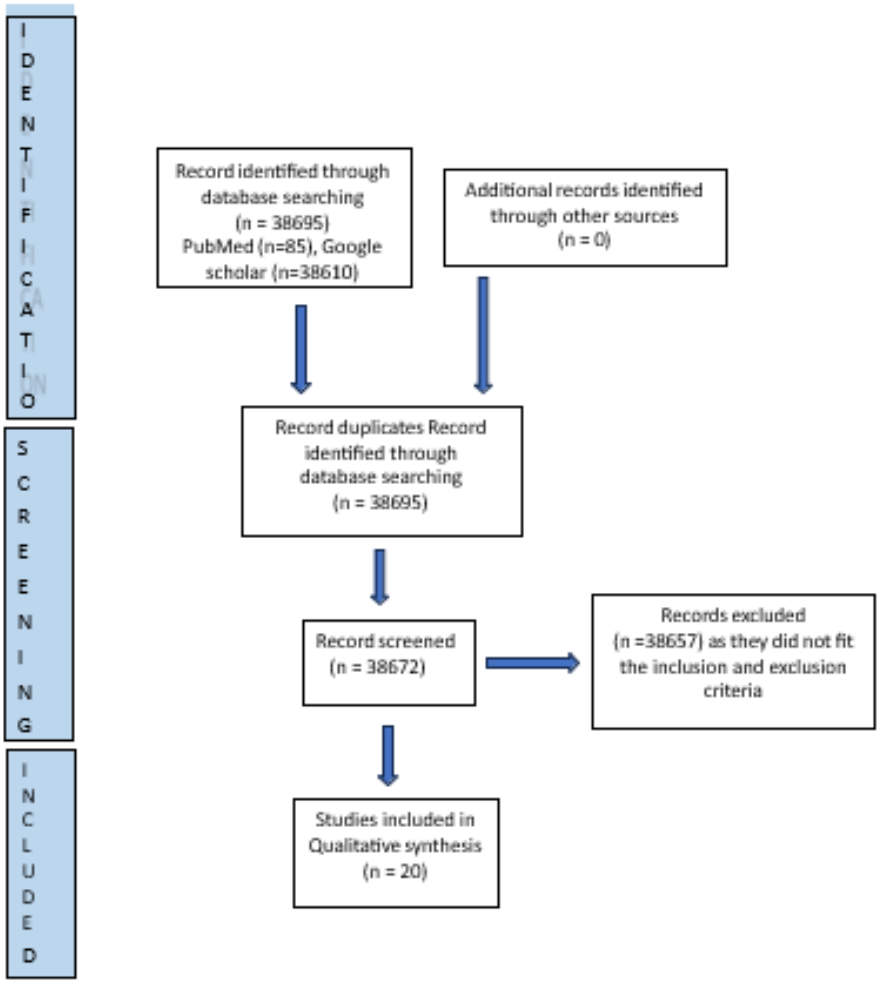

Fig 1: Flow diagram of search, Screening and included studies

Results

A total of 38, 695 studies were identified through the electronic database search. Following the removal of 23 duplicate records, 38, 672 articles remained for initial screening. After title and abstract review, 38, 657 articles were excluded as they did not meet the inclusion and exclusion criteria. Ultimately, 20 studies were found eligible for inclusion, focusing on the effects of physiotherapy exercise interventions on the quality of life of individuals with Pott's spine. The study selection process was summarized using a PRISMA flow diagram, outlining the stepwise screening and inclusion stages. The included studies comprised various designs, including case reports, retrospective studies, literature reviews, and case studies.

Outcome Measures [7-31]

The selected studies employed a range of standardized assessment tools to evaluate quality of life, functional independence, neurological recovery, pain perception, muscle strength, and psychological well-being.

The SF-36 Health Survey and WHOQOL-BREF were each used in one study to assess overall health-related quality of life. The SF-36 evaluates eight domains—physical functioning, vitality, social functioning, and mental health—on a 0–100 scale, with higher scores indicating better well-being. The WHOQOL-BREF includes 26 items covering physical, psychological, social, and environmental dimensions, scored on a 5-point Likert scale.

For assessing mental health and emotional status, multiple instruments were employed. The Geriatric Depression Scale (GDS) demonstrated sensitivities ranging from 74% to 85% and specificities between 71% and 77%, effectively screening depressive symptoms. The Beck Depression Inventory (BDI), a 21-item self-report tool, and the

Depression Anxiety Stress Scale (DASS)—including its shorter 21-item version—were utilized to evaluate depression, anxiety, and stress-related responses.

Functional outcomes were primarily measured using the Functional Independence Measure (FIM) and Barthel Index, appearing in four and two studies, respectively. Both tools assess the level of independence in activities of daily living, with higher scores reflecting greater autonomy. Neurological status was examined through the ASIA Impairment Scale in seven studies, while pain intensity was evaluated using the Visual Analogue Scale (VAS) in three studies. The Oswestry Disability Index (ODI) was used in two studies to quantify disability associated with spinal or back pain.

Physiotherapy Interventions

A variety of physiotherapy modalities were reported across the reviewed studies. Electrotherapy techniques—including Interferential Therapy (IFT), Transcutaneous Electrical Nerve Stimulation (TENS), and ultrasound—were commonly applied to relieve pain and muscle spasms. Respiratory exercises, such as deep breathing, thoracic expansion, and pursed-lip breathing, were integrated to enhance ventilation and pulmonary function. Strengthening exercises targeted the core, back, and lower limb muscles, emphasizing isometric and isokinetic training to restore stability. Postural correction involved exercises like shoulder shrugs, scapular retraction, and cat-camel movements.

Aerobic and endurance training included treadmill walking, cycling, and jogging under supervised conditions to improve cardiovascular fitness and tolerance. Balance and coordination were enhanced using Frenkel exercises, weight-shifting, and sit-to-stand routines, while sensory re-education involved graded tactile stimulation. Hydro-kinesiotherapy in saline water at 36°C for 20-minute sessions improved gait and joint mobility, and bilateral electrostimulation assisted lower limb activation.

Additionally, telerehabilitation and community-based rehabilitation programs demonstrated effectiveness in maintaining continuity of care in low-resource or remote settings, improving adherence, functional outcomes, and overall quality of life among Pott's spine survivors.

Table 1: Characteristics of the included studies

Author & Year	Population	Method	Intervention	Outcome Measure	Conclusion
Zore *et al.* 2024 [22]	61-year-old male diagnosed with Pott's spine on December 30, 2023	Case report	Psychosocial support and education; therapeutic exercises (10 reps × 3 sets); manual therapy (10 reps × 3 sets); pain management (IFT 15 min); assistive devices; mobility training (as tolerated); Frenkel coordination exercises (10 reps × 3 sets); functional restoration; QoL enhancement	FIM, MMT, GDS, Tinetti, LEFS, 5-point MRC scale	Multidisciplinary approach with pharmacological and tailored physiotherapy significantly improved pain, mobility, and functional capacity
Wanjari *et al.* 2024 [23]	35-year-old male diagnosed with Pott's spine on January 20, 2024	Case report	Education; dyspnea reduction (breath hold 5–7 s); fatigue minimization (energy conservation); strength/posture (holds 5 s, 10 reps × 1 set); pain/spasm reduction (hot fomentation 15 min); ADL return (self-paced 10-m walk with assistance)	Dyspnea scale, VAS, 6MWT, HADS, WHO-QOL	Structured physiotherapy enhanced QoL, mobility, stability, functional independence, and endurance
Mandhane *et al.* 2023 [3]	20-year-old female	Case report	ROM exercises (10× BID); pain/spasm relief (heat pack, TENS 15 min, cryotherapy 10 min); postural correction; breathing exercises (hold 5 s); strengthening (10–20 reps, 0.5–2 kg); sensory re-education (textured fabrics); ambulation training	ASIA, MMT, goniometer ROM, tenderness grading scale	Goal-oriented physiotherapy + medications promoted early recovery, mobility, stability, strength, independence, and QoL
Neha *et al.* 2023 [24]	66-year-old female with upper back pain [5 months); diagnosed with Pott's spine 1 month later	Case report	Education; avoid complications; ROM (4×/day, 10 reps); Rood's protocol (8 min tone normalization); segmental breathing (7 reps × 3/day); sensory integration (3 reps/dermatome); proximal strengthening (1 kg); muscle integrity (galvanic stim quadriceps 3×30); bowel/bladder retraining; sit-to-stand ambulation (10 reps × 3 sets)	MMT, ASIA, reflex grading scale	Physiotherapy maintained function and improved QoL
Lakhwani *et al.* 2022 [2]	35-year-old male (June 16, 2021]	Case report	Education; maintain strength (10-s hold × 5 reps); positioning (q2h); ventilation (10 reps × 2 sets); ambulatory training (knee bends, lateral shifts 10×1 set); ROM/core strength (McKenzie, cat–camel); QoL improvement	MRC, MMT, LEFS	Rehabilitation restricts/compensates limitations and handicaps in Pott's disease
Al-Mahmood *et al.* 2022 [26]	21-year-old female	Case report	Bed rest ≥2 months; exercises (10 reps 2–3×/day); warm moist compression & TENS; breathing/relaxation; ADL correction	VAS, tenderness grading scale	Early diagnosis, drugs, and customized rehab yield near-full recovery
Sakshi Sadhu *et al.* 2021 [28]	20-year-old male diagnosed 2013; recent exacerbation	Case study	Pain reduction (IFT 12 min, US pulse 5 min); strength (McKenzie back exercises); stretching (hamstrings, piriformis, calf); flexibility; functional independence (FITT principle)	NPRS, MMT, ODI	Physiotherapy reduced pain and functional disability
Yong *et al.* 2020 [7]	Studies 2010–2019	Review	Surgical/conservative + rehab: isometric → strengthening (spinal extensors, isotonic	ODI, JOA, MBI, FIM, SF-	Evaluates prognostic tools and functional outcomes of

			abdomen/pelvis/LL); gradual mobility/ADL retraining (BID sessions)	36	rehab
Toulgui *et al*. 2016 [29]	29 patients, mean age 46.7 years, sex ratio 1.1	Retrospective	Muscle strength, bladder/sphincter, QoL recovery; mean 32-day stay, BID rehab	FIM, MMT	Rehabilitation crucial for QoL improvement
Zaoui *et al*. 2012 [31]	9 patients (2000–2008), mean age 43.8 years, sex ratio 5.4	Retrospective	Bed rest with supports; position changes; nursing; early mobilization; breathing; spasticity inhibition; CV endurance; ambulatory training; 47-day rehab, BID tailored PT	ASIA, FMI, intermittent sounding, micturition calendar	Rehabilitation limits/compensates disability and handicap in Pott's disease

Discussion

This review highlights the pivotal role of physiotherapy interventions in improving the quality of life (QoL) among survivors of Pott's spine. The findings consistently demonstrate that early and structured rehabilitation significantly enhances physical functioning, reduces pain, and restores independence in activities of daily living. Rehabilitation strategies in spinal tuberculosis primarily emphasize pain management, postural correction, and mobility restoration, achieved through a combination of bracing, analgesic modalities (such as electrotherapy and massage), and targeted exercise regimens [1, 3, 4].

Comprehensive physiotherapy protocols integrate range of motion, spinal stabilization, muscle strengthening, and balance re-education to address musculoskeletal and neurological complications. Cardiorespiratory conditioning further contributes to improved respiratory capacity, endurance, and overall fitness, enhancing QoL and minimizing long-term disability. For patients with neurological involvement due to spinal cord compression, rehabilitation also incorporates mobilization, urodynamic retraining, and functional strengthening to mitigate bed-rest complications [1, 3, 4].

Several studies have reported the efficacy of Active Cycle Breathing Techniques (ACBT) and Pulmonary Rehabilitation (PR) in enhancing ventilation and facilitating mobility. Similarly, hydro-kinesiotherapy in hypertonic saline water, bilateral electrostimulation, and nano-pulsed electromagnetic field therapy have demonstrated beneficial effects on muscle reactivation, circulation, and diaphragmatic function [6]. Complementary interventions, including galvanic baths, ultrasound, lymphatic drainage, and kinetic respiratory exercises, further support mobility and functional recovery [6, 24].

Tele-rehabilitation and community-based rehabilitation (CBR) approaches have emerged as cost-effective strategies to improve access and continuity of care in under-resourced or remote areas. These models enhance patient adherence, pulmonary outcomes, and independence while reducing hospital dependency [6, 24]. Nevertheless, implementation challenges such as limited digital access, inadequate training, and infrastructure constraints remain significant barriers in low-resource settings [6, 27].

Despite encouraging outcomes, several limitations were identified, including small sample sizes, heterogeneous methodologies, and inconsistent outcome measures [8, 11, 19]. Additionally, the ASIA score, though commonly used, may not fully capture the spectrum of neurological deficits in spinal tuberculosis, particularly among patients presenting with spasticity [19].

Future research should emphasize the standardization of rehabilitation protocols, integration of psychosocial and nutritional support, and exploration of advanced technologies—including robotics, AI, and mobile health tools—for individualized rehabilitation monitoring. Large-scale, high-quality randomized controlled trials (RCTs) are warranted to validate the long-term efficacy of these interventions and establish evidence-based physiotherapeutic guidelines for managing Pott's spine across diverse populations [6, 7, 23, 24].

Conclusion

Physiotherapy-based rehabilitation plays an essential role in the management of spinal tuberculosis by addressing neurological, musculoskeletal, and cardiorespiratory impairments, thereby enhancing functional independence and quality of life. Early intervention through individualized exercise programs—encompassing strengthening, postural correction, respiratory training, and sensory re-education—optimizes recovery and prevents disability. Even in severe cases, multidisciplinary rehabilitation demonstrates significant postoperative improvements. Future large-scale and long-term studies are warranted to establish standardized, evidence-based physiotherapy protocols for improving outcomes in patients with Pott's spine.

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