

Retrospective Study of Magnetic Resonance Imaging (MRI) Findings in Pott's Spine

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ABSTRACT

Tuberculosis is the very communal infection found globally and can nearly all parts of the human body can be affected by it, mostly affect the chest. Among the tuberculosis of the skeletal system; 50% of cases affect the spinal cord. Tuberculosis infection of the spinal cord results in Gibbus deformity, edema, involvement of intervertebral discs, epidural abscess, paravertebral abscess and edema with bone destruction and vertebrae collapse in the soft tissue planes. The most valuable diagnostic tool is MRI as it can clearly show all of the above results in the spine tuberculosis affected patients.

Aim: The objective of this research was to know the pattern of incidence and to analyzed the several Pott's spine pathological processes by means of the MRI scan.

Study Design: A Retrospective study.

Place and Duration: In the Radiology Department of HMC Peshawar and Orthopedic Department of BKMC Swabi from August 2021 to January 2022.

Methods: This study analyzed MRI scans of 90 identified patients of spinal tuberculosis performed at the Radiology Department to govern the pattern of the several pathological lesions.

Results: This study institute Pott's spine to be more common in the 21-50 age group, mostly among men. The lumbar and dorsal vertebrae are often affected and several vertebrae are affected frequently, with the most common affected is the L3 vertebra. The involvement of Intervertebral disc and para and pre-vertebral collections were communal, with epidural collection happening in > 75 of patients. 13.3% of the patients have cord oedema.

Conclusions: MRI is very sensitive in detecting various Potts spine pathological processes, and the occurrence patterns of these findings were assessed in this research. As the prevalence and incidence of tuberculosis depends on several sensitive epidemiologically parameters, this research could deliver a standard conclusion against which further results could be compared in future studies.

Keywords: Tuberculous spondylitis, lumbar abscess, Gibbus

INTRODUCTION

Tuberculous spine infection, Pott's disease or tuberculous spondylitis was initially defined in 1779 by Percival Pott and was identified in mummies of ancient era from Peru and Egypt^{1,2}. It is instigated by the bacterium *Mycobacterium tuberculosis*, spread often by the blood-borne infection through the Batson venous plexus^{3,4}. Conferring to the WHO, about 20 million individuals, or approximately 1/3 of the global populace, suffered from TB in 2006, and 6 million of them fell ill each year, and 200,000 died from the disease universally⁵. It remainders to be the leading infection causing augmented mortality and morbidity among under-developing states in compactly populated area⁶. The tuberculosis incidence has decreased in the Western states, but has revealed a renaissance among these non-endemic inhabitants in recent years. Its global incidence has also increased, predominantly in patients who are immunocompromised, at a frequency of 1.1% approximately in a year⁷⁻⁸. The drug addiction, malnutrition, human immunodeficiency virus (HIV) epidemic, the emergence of drug-resistant tuberculosis strains, alcoholism, and ineffective control programs of tuberculosis appear to be the main causes of the rise in TB incidence worldwide⁹⁻¹⁰. Approximately 11.2 million persons globally are infected with tuberculosis and HIV¹¹. Therefore, tuberculosis is related closely to epidemiologically parameters which are sensitive, and may change the incidence of several pathological processes of tuberculosis. The process of infection in the vertebrae generally begins in the vertebral body at its cancellous bone part, which is beneath the periosteum anteriorly, and then spreads to the other vertebral parts and intervertebral disc¹²⁻¹³. The presenting Pott's spine symptoms comprise fever of low-grade with rise in the evening, weakness, lethargy, loss of appetite, night sweats, and loss of weight which are typical of any tuberculous contamination¹⁴. The characteristic Pott's spine symptoms are limited range of motion, local tenderness and severe spinal deformity (acute kyphotic flexion) in advanced stages

of the disease¹⁵. The grave spinal tuberculosis complications are quadriplegia or paraplegia, monoplegia or hemiplegia, with a paraparesis frequency of 28%-47%. The utmost communal reason of non-traumatic paraplegia is tuberculosis in many parts of the world. The tuberculosis presentation on MRI exhibits many additional pathological progressions and can be classified as neoplastic or infectious lesions¹⁶. The main D/Ds comprise low-grade infections such as brucella, fungal infections, atypical mycobacteria and tumours such as multiple myelomas, metastases and lymphomas. The intervertebral discs are usually involved in these infections preserving them in tumors¹⁷. The objective of this research was to know the pattern of incidence and to analyzed the several Pott's spine pathological processes by means of the MRI scan.

METHODS

This study was held at the Radiology Department of HMC Peshawar and Orthopedic Department of BKMC Swabi from August 2021 to January 2022. The MRI of all proven Pott's spine cases was assessed retrospectively by two consultant radiologists, and the disagreements were resolved later by harmony. This research comprised 90 tuberculosis cases detected histopathologically and suspicion of Pott's spine proven before or after MRI. Both genders and patients of all age-group were enrolled in the analysis, and patients done with repeated scans of the same subjects were not included. T1W and T2W sequences and the fat suppressed inversion recovery (STIR) sequence in the sagittal and axial planes were taken. The structures of bone were recognised and any collapse or deterioration was noted and considered in the T2W sequence as hyperintensity and hypointense in the T1W sequence [Table / Fig. one].

Edema of the spinal cord was manifested by a weak signal in the sequence of T1W and a hyperintensity in the sequence of STIR. The vertebral bodies posterior margins were carefully

observed for bone fragments or posterior displacement in the epidural space [Table / Fig. 2].

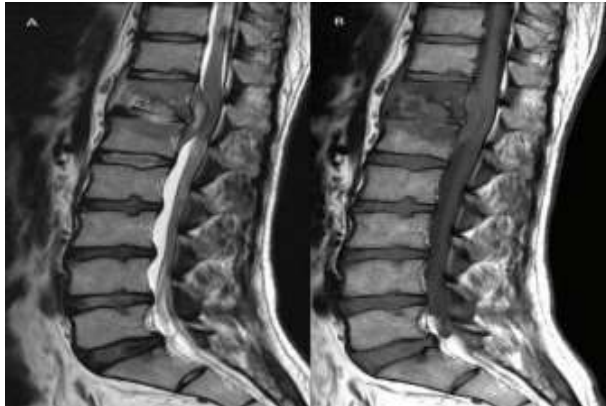


Fig-1: T2W (A) and T1W (B) images in sagittal plane showing erosion and destruction of end plates of L1 and D12 vertebral bodies with D12-L1 disc involvement, epidural and prevertebral collection causing compression of the nerve. The necrotic component of epidural collection seems as hyperintensity in T2W images core (A) with isointense peripheral granulation tissue

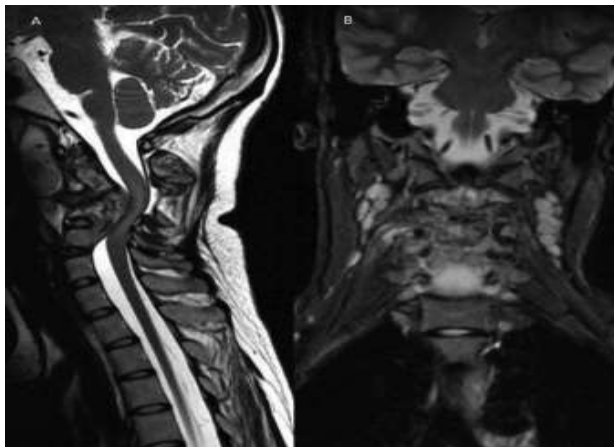


Fig-2: T2W sagittal (A) and STIR coronal (B) images viewing cervical vertebral column destructive lesion with minimal epidural collection and large prevertebral with gibbus causing cord edema and cord kinking appearance as bright signal in images of T2W (A). Lymphadenopathy is distinguished in neck planes on STIR image as bright round lesions (B).

The cerebrospinal fluid column was monitored for any accumulation in the epidural space that manifested as hypointense with heterogeneity in the sequence of T1W, signifying the existence of granulation tissue and necrotic material causing the subarachnoid space invasion and dura mater elevation. The level of this accumulation was recorded and > 75% decrease in the CSF column thickness was measured as important and caused compression of nerve. A comparable collection in the psoas muscles and Para/ pravertebral planes proposed to be an abscess, and an examination of the entire spine was performed to recognise skip lesions [Table / Figure 3A and B].

The posterior component of the bone was carefully assessed for bone marrow destruction or edema [Table / Figure 3C]. Spinal edema was definite in the sequence of T2W as a hyperintensity and the curvature alteration was recorded [Table / Figure 2]. Tuberculosis is usually related with a local periosteal reaction or no or little reactive sclerosis, which aids to distinguish it from spinal pyogenic infections. The collection aspiration under the control of CT or USG of pathological or paraspinal bone tissue was collected and culture-sensitivity was done. The histopathological

examination of the sample for caseating granulomas, detecting acid-fast mycobacteria by Ziehl Neelsen staining.

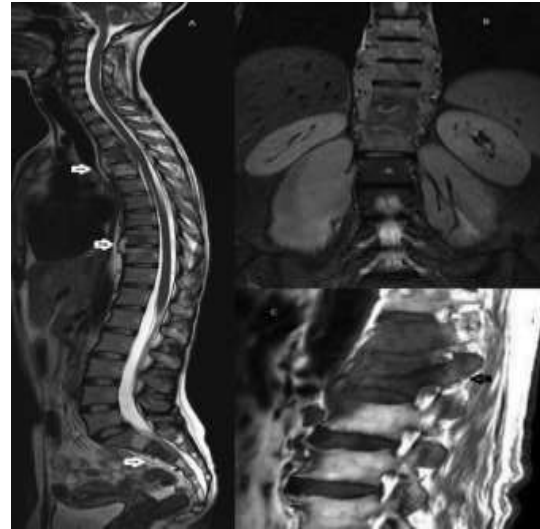
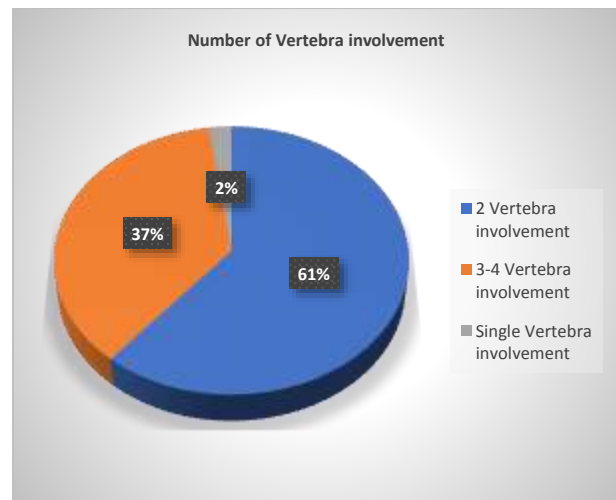


Fig-3: the Pott's spine Skip lesions in T2W sagittal image (A) in sacrum and dorsal region (arrows). STIR coronal image (B) viewing multiple dorsolumbar vertebrae engrossment of paravertebral and bilaterally seen psoas abscess. T1W parasagittal image (C) presenting posterior component of bone (arrow) engrossment.

RESULTS

The study included 90 cases of Pott's spine, 52 (57.8%) men. While 33 (43.3%) patients were 11-30 and the majority were female, 58 (64.4%) patients were 21-50.



In most cases, more than one vertebra was involved, in most cases 2 vertebrae 55(61.1%) were involved, then 3-4 vertebrae 33(36.7%), in two cases, a single vertebra was involved.

Table-1: Sex and age distribution of tubercular spondylitis cases

AGE	<10	11-20	21-30	31-40	41-50	51-60	61-70	71<	Total
Male	4	5	11	8	8	4	10	2	52
Female	-	3	14	9	8	2	-	2	38
Total	4	8	25	17	16	6	10	4	90

The dorsal spine was affected in 44 (48.9%) cases, and the lumbar spine vertebra in 46 (51.9%) cases. Of these, 14 had lumbar and dorsal involvement of vertebrae.

Table-2: Level of spine involvement

Dorsal Spine Involvement	44 (48.9%)
Lumbar Spine Involvement	46 (51.9%)
Both	14(15.5%)
Cervical Spine Involvement	5(5.5%)
L3 involvement	42(46.7%)
Change in curvature	21 (23.3%)
Skip Lesions	3 (3.3%)

Two dorsal vertebrae involvement in cases were related to the cervical vertebrae, and one case was related to the sacrum of the lumbar vertebra. The involvement of cervical spine vertebrae includes 5 total cases, 4 were < 30 years of age. 3 (3.3%) cases had Skip lesions. In most cases, the vertebral body involved is L3 42(46.7%). In 21 (23.3%) cases a change in curvature was observed, mainly in the gibbus, caused by the collapse of the vertebrae.

Table-3: Complications of the spine

Collection in the epidural space	69 (76.7%)
thecal sac indentation	53(58.9%)
Neuron damage due to posterior dislocation or gibbus deformation	19(21.1%)
Altered Nervous state	18(20%)
Cord oedema	12(13.3%)
Lumbar abscess	29 (32.2%)

The involvement of the intervertebral disc was a common symptom in 78 (86.7%) patients. A paravertebral and prevertebral collection was observed in all but 1 case, while collection in the epidural space was found in 69 (76.7%) patients. The collection in epidural space caused the thecal sac indentation in 53 cases, while cord compromise due to deformation of the gibbus or posterior dislocation of bone fragments was reported in 19 patients. The grouping of the epidural collections and gibbus damaged neurons in 16 patients. The size of the canal has been reduced by 75.5% which is considered serious. Worsening of the nervous state was observed in 18 (20%) cases. 12(13.3%) of the patients have cord oedema. 29 (32.2%) cases had Lumbar abscess with bilaterally contribution in 12 cases. Of the 17 patients with psoas abscess on unilateral side, 8 had left sided and 9 had right sided. In 13 (17.8%) cases, 12 of which had pedicle involvement, destructive process or cord edema extending to the posterior bone components.

DISCUSSION

Skeletal tuberculosis accounts for 1-5% of tuberculosis cases, 50% of which affect the spine. Osborn stated that it is common at an early age in developing countries, while in the Western world it is middle-aged (40-45 on average). Sinan et al. institute 44% of patients in the 30-49 years of age group in their study¹⁸. In our study, the majority of cases were 21-50 years of age (mean 37.9 + 18.2), which was comparable to the Mirsaedi et al findings, whose mean age was 39 + 16 years. Although Osborn does not suggest a gender preference, most of the previously published series have found that spinal tuberculosis is more common in men than in women¹⁹. Although Pott's spine is generally more common in men, we have seen a predominance of women (81.5%) between the ages of 21-50, where Pott's spine is more common. 36.8% of patients in the 21-30 age group were women. 36.7 + 15.1 years was the mean age of women, and of men 40.5 + 20.1 years. This recommended that during the female's productive spell, women most commonly have Pott's spine²⁰⁻²¹. The upper lumbar and lower thoracic regions have been supposed to be the maximum affected region in most studies²². Similar to the findings of Sinan et al in our study, it most often concerned the lumbar vertebrae, followed by the thoracic vertebrae. In a study by Sinan et al., he found involvement of intervertebral disc in 74% of cases, and in our study, there was 86.7% of them²³⁻²⁴. Gibbus, which transpires mainly in the dorsal spine, was seen in 28.2% of the patients testified in only 1/3rd of the patients in the African study²⁵. Gibbus'

late appearance in the sequence of the disease in several numbers of patients is because delay in referral from inadequate health care systems in rural areas of India, as in African region²⁶. 80% of the patients have epidural involvement, which is a result comparable to this analysis (76.7%). Mirsaedi et al. detected a lumbar abscess in 14.3% of cases, and in our study, they found a lumbar abscess in 32.2% of patients²⁷. MRI with Contrast and gadolinium chelates improves the identification of abscesses that appear as developed peripheral and necrotic nuclei²⁸. Tuberculosis was positive in the Ziehl Neelsen staining of the cases included in this study or in the culture of pathological tissue aspirates. However, the results of these studies were negative in some cases of tuberculosis, and therefore some cases of spinal tuberculosis were excluded from this study²⁹.

CONCLUSION

MRI is the significant way of early detection of disease and the method of choice for identifying the extent and activity of infection. It can additionally serve as a surgical treatment guide for tuberculosis of the spine. As the prevalence and incidence of tuberculosis depends on several sensitive epidemiologically parameters, this research could deliver a standard conclusion against which further results could be compared in future studies.

REFERENCES

- Hu W, Zhang X, Yu J, Hu F, Zhang H, Wang Y. Vertebral column decancellation in Pott's deformity: use of Surgimap Spine for preoperative surgical planning, retrospective review of 18 patients. *BMC Musculoskeletal Disorders*. 2018 Dec;19(1):1-9.
- Sharma A, Chhabra HS, Chhabra T, Mahajan R, Batra S, Sangondimath G. Demographics of tuberculosis of spine and factors affecting neurological improvement in patients suffering from tuberculosis of spine: a retrospective analysis of 312 cases. *Spinal Cord*. 2017 Jan;55(1):59-63.
- Singh S, Dawar H, Das K, Mohapatra B, Prasad S. Functional and radiological outcomes of anterior decompression and posterior stabilization via posterior transpedicular approach in thoracic and thoracolumbar Pott's Disease: a retrospective study. *Asian spine journal*. 2017 Aug;11(4):618.
- Huang Y, Hu W, Li J, Wang T, Liu H, Zheng G, Zhang X, Wang Y. Transpedicular bi-vertebrae wedge osteotomy in treatment of post-tubercular spinal deformity: a retrospective study. *BMC Musculoskeletal Disorders*. 2021 Dec;22(1):1-8.
- González Saldaña N, Macías Parra M, Xochihua Díaz L, Palavicini Rueda M, Carmona Vargas AJ, Castillo Bejarano JI, Veloz Corona Q, Juárez Olguín H, Chavez Pacheco JL. A 20-year retrospective study of osteoarticular tuberculosis in a pediatric third level referral center. *BMC Pulmonary Medicine*. 2021 Dec;21(1):1-6.
- Chung TT, Ko HJ, Lau CS, Chung HY. A retrospective study on the risk of tuberculosis in patients with rheumatoid arthritis. *Rheumatology International*. 2020 Jun;40(6):983-90.
- Du X, She Y, Ou Y, Zhu Y, Luo W, Jiang D. A scoring system for outpatient orthopedist to preliminarily distinguish spinal metastasis from spinal tuberculosis: a retrospective analysis of 141 patients. *Disease Markers*. 2021 May 29:2021.
- Yin XH, He BR, Liu ZK, Hao DJ. The clinical outcomes and surgical strategy for cervical spine tuberculosis: a retrospective study in 78 cases. *Medicine*. 2018 Jul;97(27).
- Kalluri AG, Sukumaran M, Nazari P, Golnari P, Ansari SA, Hurley MC, Shaibani A, Jahromi BS, Potts MB. Retrospective review of 290 small carotid cave aneurysms over 17 years. *Journal of neurosurgery*. 2019 Oct 18;133(5):1473-7.
- Yang S, Yu Y, Ji Y, Luo DJ, Zhang ZY, Huang GP, He FY, Wu WJ, Mou XP. Multi-drug resistant spinal tuberculosis-epidemiological characteristics of in-patients: a multicentre retrospective study. *Epidemiology & Infection*. 2020;148.
- Musali SR, Karla R, Gollapudi PR, Mohammed I, Nandigama PK. Anterolateral versus posterolateral decompression and spinal stabilization in thoracolumbar Potts spine: a comparative study. *British journal of neurosurgery*. 2020 Nov 12:1-3.
- Zhang Z, Hao Y, Wang X, Zheng Z, Zhao X, Wang C, Zhang X, Zhang X. Minimally invasive surgery for paravertebral or psoas abscess with spinal tuberculosis—a long-term retrospective study of 106 cases. *BMC Musculoskeletal Disorders*. 2020 Dec;21(1):1-9.
- Chan AK, Bisson EF, Bydon M, Glassman SD, Foley KT, Potts EA, Shaffrey CI, Shaffrey ME, Coric D, Knightly JJ, Park P. Women fare

- best following surgery for degenerative lumbar spondylolisthesis: a comparison of the most and least satisfied patients utilizing data from the Quality Outcomes Database. *Neurosurgical focus*. 2018 Jan 1;44(1):E3.
14. Yin XH, Liu ZK, Hao D. The reasons and clinical treatments of postoperative relapse of Pott's disease. *Medicine*. 2018 Sep;97(39).
 15. Zhang YH, White I, Potts E, Mobasser JP, Chou D. Comparison perioperative factors during minimally invasive pre-psoas lateral interbody fusion of the lumbar spine using either navigation or conventional fluoroscopy. *Global Spine Journal*. 2017 Oct;7(7):657-63.
 16. Al Nokhatha S, AlKindi F, Al Yassi S, Hashmey R. Musculoskeletal brucellosis in adults in the United Arab Emirates: a retrospective study. *Eur Med J*. 2021.
 17. Yin H, Wang K, Gao Y, Zhang Y, Liu W, Song Y, Li S, Yang S, Shao Z, Yang C. Surgical approach and management outcomes for junction tuberculous spondylitis: a retrospective study of 77 patients. *Journal of Orthopaedic Surgery and Research*. 2018 Dec;13(1):1-8.
 18. Gbeneol TJ, Nwachukwu AC. A Retrospective Study of the Prevalence of Pressure Sores: the University of Port Harcourt Teaching Hospital Experience. *The Nigerian Health Journal*. 2021 Mar 31;21(1):34-43.
 19. Shlobin NA, Mitra A, Prasad N, Azad HA, Cloney MB, Hopkins BS, Jahromi BS, Potts MB, Dahdaleh NS. Vertebral artery dissections with and without cervical spine fractures: analysis of 291 patients. *Clinical Neurology and Neurosurgery*. 2020 Oct 1;197:106184.
 20. Zhu Y, Qiu H, Liu Z, Wang J, Yang D, Pei Y, Ma S, Du C, Sun H, Wang L. Detecting Long-Term Deformation of a Loess Landslide from the Phase and Amplitude of Satellite SAR Images: A Retrospective Analysis for the Closure of a Tunnel Event. *Remote Sensing*. 2021 Nov 29;13(23):4841.
 21. Liao Y, Ye R, Tang Q, Tang C, Ma F, Luo N, Zhong D. Is It Necessary to Perform the Second Surgery Stage of Anterior Debridement in the Treatment of Spinal Tuberculosis?. *World Neurosurgery*. 2020 Feb 1;134:e956-67.
 22. Guillouzoic A, Andrejak C, Peuchant O, Hery-Arnaud G, Hamdad F, Lanotte P, Gaborit B, Bernard L, Bémer P. Treatment of bone and joint tuberculosis in france: a multicentre retrospective study. *Journal of Clinical Medicine*. 2020 Aug 5;9(8):2529.
 23. Yin X, Liu P, Liu YY, Fan WL, Liu BY, Zhao JH. Utilization of ring-shaped bone allograft for surgical treatment of adolescent post-tubercular kyphosis: A retrospective study. *Medicine*. 2017 Jun;96(24).
 24. Garg B, Batra S, Dixit V. India contribution to Spine Surgery: 15 most influential articles. *Journal of clinical orthopaedics and trauma*. 2017 Apr 1;8(2):181-4.
 25. Boushab BM, Kone N, Basco LK. Contribution of computed tomography scan to the diagnosis of spinal tuberculosis in 14 cases in Assaba, Mauritania. *Radiology Research and Practice*. 2019 May 2;2019.
 26. Sun Y, Gu C, Shi J, Fang W, Luo Q, Hu D, Fu S, Pan X, Chen Y, Yang Y, Yang H. Reconstruction of mediastinal vessels for invasive thymoma: a retrospective analysis of 25 cases. *Journal of Thoracic Disease*. 2017 Mar;9(3):725.
 27. Tripathi S, Ajit Kumar VK. Comparison of morphologic findings in patients with dextrocardia with situs solitus vs situs inversus: a retrospective study. *Pediatric Cardiology*. 2019 Feb;40(2):302-9.
 28. Li M, Zhang L, Ding C, Li W, Luo H, Liao M, Xu Q. Retrieval of historical surface displacements of the Baige landslide from time-series SAR observations for retrospective analysis of the collapse event. *Remote Sensing of Environment*. 2020 Apr 1;240:111695.
 29. D'souza AR, Mohapatra B, Bansal ML, Das K. Role of posterior stabilization and transpedicular decompression in the treatment of thoracic and thoracolumbar TB. *Clinical spine surgery*. 2017 De