

## ORIGINAL ARTICLE

## Anterior Decompression and Anterior Instrumentation of Tuberculosis of Cervicothoracic Spine by Cervicomansubrial Approach

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**Abstract:** *Background:* Evaluation of result of anterior cervical approach with manubriectomy and anterior instrumentation in tuberculosis of cervicothoracic spine in terms of the neurological recovery, reconstruction of spine and prevention of deformity along with relief of pain. *Materials and Methods:* All five patients with cervicothoracic caries spine had surgery through anterior cervical approach with manubriectomy in our hospital and underwent excision of the involved vertebrae and intervertebral discs followed by anterior spinal reconstruction with titanium spacer cage filled with cancellous iliac crest bone graft and Orion plate with locking screw. Antitubercular drugs were administered for 12 months. The follow-up period ranged from 12 to 36 months. *Results:* Analysis of result was done on the basis of clinical and radiological criteria. Clinical assessment based on Frankel grade and modified JOA score showed significant improvement from preoperative findings. Radiological assessment showed osteointegration, no spinal instability and no progression of the deformity. The pain control, based on visual analog scale changed from a pre-operative average of 7.5 to 2 at the last follow-up thereby indicating significant improvement and all patients returned to preoperative functional status. One patient had transient hoarseness of voice. No other complication had been encountered in the immediate post operative and during the follow-up period. *Conclusions:* Our study showed that anterior cervical approach with manubriectomy and anterior insertion of titanium cage, filled with autogenous bone graft, secured with locking plate instrumentation has a successful role in the eradication of infection, neurological recovery, segmental spinal reconstruction and it also reduces surgical time, blood loss, and surgical complications and approach related comorbidity in follow up period. Level of Evidence- Level 4, Case series

**Keywords:** Tuberculosis of cervicothoracic spine, anterior cervical approach, manubriectomy, anterior instrumentation

### Introduction

Spinal tuberculosis is the commonest form of skeletal tuberculosis accounting for about 50% of all cases of skeletal tuberculosis and tuberculosis of cervicothoracic spine accounts for 5% of spinal tuberculosis [1]. Therefore; this is a rare site of affection even in endemic regions. Neurological impairment and spinal deformity are the major concerns with spinal tuberculosis [2-4]. It has been proved that in spinal tuberculosis under the cover of modern antitubercular drugs, decompression of the spinal cord followed by spinal stabilisation by appropriate implants leads to neurological recovery, correction and prevention of progression of deformity in selected patients.

The major concern with tuberculosis of cervicothoracic spine in comparison to spinal tuberculosis of other areas of spine is that this is a junctional region between two curves which imparts more deforming force, leading to more kyphotic collapse and being an obscure area radiological diagnosis is made late and the patients more often present with paralysis. The approach for decompression and appropriate instrumentation is not still defined in the literature. On search of literature scarce reports are there for optimal approach for stabilization for two or more level destruction in cervicothoracic spine of cervicothoracic junction treated with debridement and anterior instrumentation [5-7]. Our study emphasizes on the evaluation of result of anterior cervical approach with manubriotomy for decompression and anterior instrumentation in spinal tuberculosis affecting D1-D3 vertebrae in terms of neurological recovery, reconstruction of the spine for correction and prevention of deformity and pain relief.

### Material and Methods

During the period 2006 to 2009, five patients of tuberculosis of cervicothoracic spine underwent surgery in our institution. The mean age was 41 years (range 18 yr to 66yrs) with minimum follow up period 12 months (range 12 to 36 months). The indication for surgery in these patients were neurological deficit not responding or worsening with anti-tubercular drugs at initial presentation or rapidly progressive gross neurological deficit at initial presentation and bony destruction leading to kyphotic deformity (>30 degrees). Clinical assessment were based on Frankel grading [8] and modified JOA score [9-10] in preoperative and in follow-up period. Routine hematology investigations included an erythrocyte sedimentation rate and C - reactive protein. All patients were evaluated with plain radiography and magnetic resonance imaging. The destruction of the vertebrae and disc was easily identified in both sagittal and axial images .It showed the involvement of both the columns however no significant kyphotic deformity was seen [Figure-1&2]. All five patients underwent decompression, debridement of necrotic tissue through anterior cervical approach with manubriotomy and anterior instrumentation using titanium spacer cage filled with cancellous bone iliac graft and titanium locking plate (Orion) with locking screw.

Fig-1: a) Sagittal T2 and b) Sagittal T1 weighted MRI image suggestive of potts spine involving D1 to D3 Vertebra with compressive collapse of D2-D3 vertebra along with prevertebral and intraspinal collection causing compression of the spinal cord

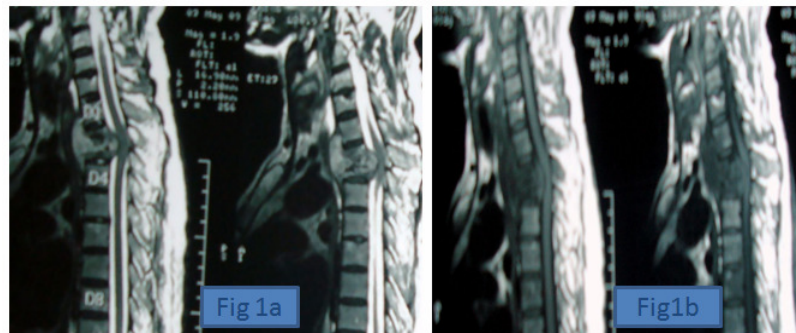
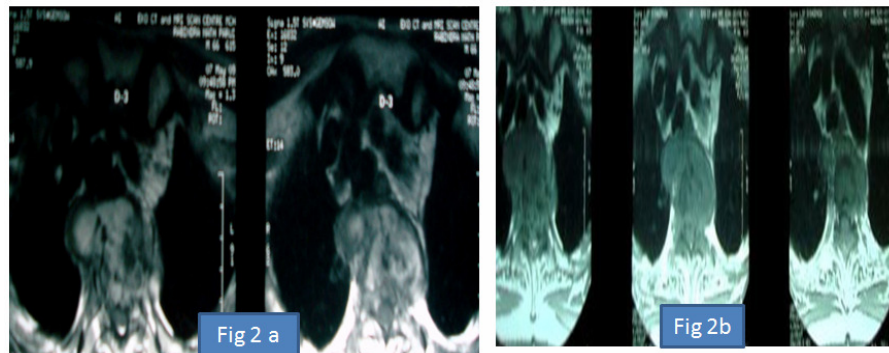
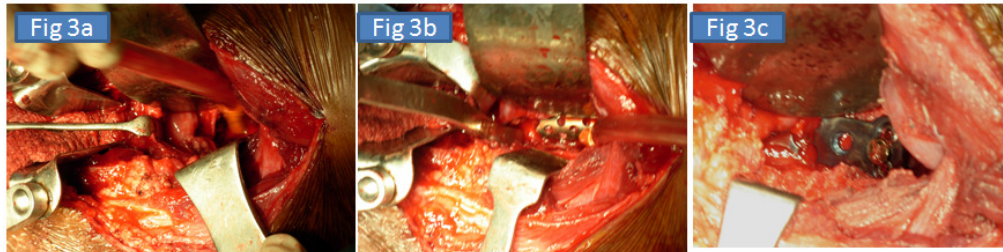


Fig-2: a) Axial T2 and b) Axial T1 weighted MRI image showing panvertebral involvement from D1 to D3 Vertebra with spinal cord compression.



*Surgical technique:* The patient is positioned supine with a sandbag placed between the scapulae to facilitate retraction of the shoulders and neck extension. The neck is turned to the right side. Left side approach is preferred because the senior author (g.b) is used to approach the cervical spine from left side. A vertical incision is made along the medial aspect of the sternocleidomastoid muscle extending along the midline of the sternum from the manubrial notch to the manubriosternal angle. Cervical part of operation is performed first as in the approach described by Southwick and Robinson. The skin flap over the sternum is raised laterally together with the soft tissue including pectoralis major until the medial 1 cm of the ribs are exposed. Strap muscles which was split to expose the plane between left sternocleidomastoid and the thyroid are split down along the carotid sheath and cut at the suprasternal notch to expose the undersurface of the sternum. With blunt dissection with a finger, the posterior surface of the manubrium is freed from parietal pleura. The osteotomy is made with an oscillating saw in midline from suprasternal notch to manubriosternal angle. A self retaining retractor is placed between the vertical cuts of the manubrium to expose the cephalad part of the anterior mediastinum. After mobilizing the retrosternal tissues and the thymus, the great vessels are identified. The U shaped midline space is bordered on the left side by the common carotid artery, on the right by the brachiocephalic artery and vein, and caudally by the innominate vein. The trachea and the esophagus form the floor of this space, which can easily be retracted to the right side. The prevertebral space is reached by retracting the trachea, esophagus medially and the carotid sheath laterally. Longus coli muscle and the anterior longitudinal ligaments are dissected with monopolar electrocautery. The left innominate vein is retracted distally and it was not cut and ligated for approaching upto D4. Decompression and debridement is done with excision of the diseased vertebral body and disc and stabilisation is done with placement of proper size titanium spacer cage filled with cancellous iliac bone graft and Orion plate and locking screw under c-arm guidance. Diseased material was sent for AFB stain, Culture and sensitivity and histopathological examination. A deep suction drain is inserted during closure, and the manubriotomy is approximated with flexible steel wires [Figure-3]

Fig-3: a) Perioperative photograph showing manubriosternal approach b) placement of titanium spacer cage filled with bone graft c) application of titanium orion locking plate



The average duration of surgery/ blood loss in our study groups was 250 mins/400cc, 230 mins/350cc, 210 mins/ 300cc, 230mins/300cc and 260 mins/400 cc. All patients had a single general anesthesia. All patients had drain removal on the second day and were made to sit up. Chest and limb physiotherapy was started and when the neurology permitted, they were out of bed from that day onwards. Stitch removal was done on the 14<sup>th</sup> day and an average postoperative hospitalization was 21 days. They were advised immobilization of the neck using a Philadelphia collar for 4 weeks and a soft collar for 4 more weeks. This regime leads to early mobilization, shortened hospital stay, low morbidity, rapid resolution of neurological symptoms and good patient satisfaction. Of the five patients the Z-N stain and culture of the organisms was positive in only two patients. This was possibly due to prolonged anti-tubercular chemotherapy prior to surgical intervention. Patients were followed up at the end of 1, 3, 6, 9 and 12 months and thereafter. All patients had a full antitubercular chemotherapy (4 drugs for 3 months, 2 drugs for 9 months). Patients were also advised against any excessive physical activity for a period of two years.

*Source of Funding:* There was no external source of funding for this study. Consent was taken from each patient that his/her data may be submitted for publication

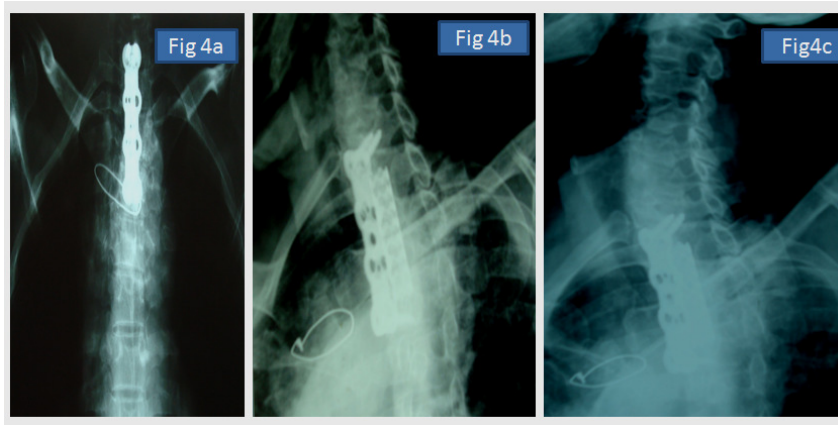
### Results

Results were recorded on the basis of clinical & radiological criteria, pain control parameters and functional status in the follow up period. Clinical assessment was based on Frankel grade and modified Japanese orthopaedic association score. At the last follow-up examination, the neurological status improved from Frankel grade A to D, B to E, B to E, A to D and A to D respectively in each patient. The average modified JOA score improved to 16.5 from preoperative 7.5. The average recovery rate based on modified JOA score was significant improvement from preoperative finding [Table-1]. Radiological evaluation was never convincing of complete bony fusion but spinal stability on flexion-extension radiographs and correction and no progression of deformity [Figure-4] and no sign of implant displacement and absence of pain were indirect evidences of bony healing. The pain control based on a visual analog scale changed from a pre-operative average of 7.5 to a significant value of 2 at last follow-up. All patients were very satisfied, completed their anti tubercular chemotherapy of one year and returned to preoperative functional status.

Table-1: Summary of five patients of cervicothoracic caries spine											
Case No	Age	Level	ASI Level <sup>+</sup>	Follow up (months)	Frankel grade		Modified JOA score <sup>#</sup>		Visual analogue scale		
					preop	postop	preop	postop	preop	postop	
1	66yr/ male	T2-T3 T1focal	C7-T4	36	A	D	7	16	8	2	
2	18yr/ male	T2-T3	T1-T4	22	B	E	8	17	7	2	
3	50yr/ female	T2-T3 T1focal	T1-T4	20	B	E	8	17	7	2	
4	40yr/ male	T2-T3	T1-T4	18	A	D	7	16	8	2	
5	35yr/ male	T2-T3 T1focal	C7-T4	12	A	D	7	16	7	2	

+ - Anterior spinal instrumentation, # - Modified Japanese orthopaedic association score

Fig-4: a) anteroposterior b) lateral view radiograph in flexion c) in extension 24 months after anterior decompression and anterior instrumentation indicating bony fusion without progression of deformity.



None of the patients had any significant approach related complications like dysphasia, recurrent laryngeal nerve palsy, deep vein thrombosis and nor had any recurrence, implant failure in last follow up. However one patient developed keloid along the line of the incision which was managed with local injection of triamcilone.

**Discussion**

Spinal tuberculosis is common in developing country with major concern in developed country in near future because of increased incidence of tuberculosis in immunocompromised patients [11-12].



Spinal tuberculosis is an age old disease of mankind which causes bony destruction, deformity and paralysis [13]. The development of modern imaging, specific antituberculous drugs, surgical facility and instrumentation has revolutionized the treatment of patients with spinal tuberculosis and has allowed us to expect excellent outcomes. Spinal tuberculosis involves the body of vertebra in about 98% of cases [14] hence anterior surgical decompression is needed along with stabilization with appropriate instrumentation in cases where there is paralysis, instability and deformity. Anterior approach of the cervicothoracic junction, particularly from the seventh cervical to the fourth thoracic vertebrae is a difficult area because of the deep surgical field (as the cervical spine is normally mobile and lordotic while the upper thoracic segments provide a rigid kyphosis) and vital anatomical structures around it. Besides no implant suitable for fixation of this area has yet been designed. Most of the anterior approaches for cervicothoracic spine described in literature are either inadequate [15-19] or unnecessarily extensive [20-26] associated with high surgical stress, potentially high blood loss, long operative time, and increased morbidity in postoperative period. The manubriotomy approach provides good exposure of the cervicothoracic junction without full median sternotomy, clavicle resection and sternomastoid muscle splitting for debridement and instrumentation. Anterior instrumentation has been shown to be associated with low complication rate, increased correction rate of kyphosis and high fusion rate in comparison to posterior instrumentation [5, 27-29].

On search of literature very scarce report was found on modified manubriosternal approach for caries spine of cervicothoracic junction treated with debridement and anterior instrumentation. Cauchoix et al [20] in 1957 first attempted full median sternal splitting approach for cervicothoracic caries for decompression only. Tamura et al [26] through transsternoclavicular approach decompressed and debrided three patients of cervicothoracic caries spine without any instrumentation. Ramani et al [5] reported eight cases of cervicothoracic caries spine where debridement and anterior reconstruction using plate and locking screw was done through transclavicular approach. This approach provided wide lateral exposure however at the cost of significantly increasing the complexity of the exposure, risk of injury to the subclavian vessels and innominate vein, high blood loss, long operative time and increased morbidity in postoperative period. Basu et al [6] reported three patients of cervicothoracic caries where through manubrial splitting anterior decompression /debridement with anterior plating and strut bone graft was carried out. Bapat et al [7] reported 42 cases of cervicothoracic tuberculosis using modified anterior cervical approach and divided the patients in long and short neck group. They carried out manubriotomy only in short neck group. All the complication reported in their case series amongst long neck group was probably due to inadequate exposure (as manubriotomy was not performed) although they had operated for a single level vertebral involvement and had applied only anterior plate with bone graft. Anterior decompression with strut bone graft does not always provide satisfactory result because of high incidence of graft failure due to fracture, subsidence and migration [30-31]. In literature very few studies [5] mention the application of titanium spacer cage.

Ramani et al [5] have mentioned about placement of cage in cases of cervicothoracic caries spine through transclavicular approach. On search of literature, to our knowledge no study in the literature has reported anterior decompression through modified manubriectomy and stabilisation of cervicothoracic caries spine by anterior instrumentation with titanium plate, locking screw and titanium spacer cage filled with bone graft. The anterior cervical approach with manubriectomy in cervicothoracic caries spines provides enough exposure of the cephalad cervical to the caudad thoracic vertebrae and can be extended cranially to the upper cervical vertebra and caudally to the fifth thoracic vertebra. The dissection is performed between tissue planes and no major structures are resected. The lateral extent of the exposure is adequate for instrumentation and osteotomy of the clavicle is not needed. Caries spine of cervicothoracic junction treated by anterior stabilisation with titanium spacer cage and locking plate provides firm segmental construction and prevents graft failure and kyphotic deformity. Our study showed that this procedure had a beneficial influence on the eradication of infection, on spinal reconstruction and fusion and that it reduces the surgical time, blood loss and surgical complications. So we recommend the use of modified anterior cervical approach with manubriectomy and anterior instrumentation with locking plate and titanium spacer cage in selected cases of tuberculosis of cervicothoracic spine specially involving two or more vertebral level in this junctional region.

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