

Outcome of Posterior Vertebral Column Resection (PVCR) and Reconstruction Due to Post Tubercular Kyphoscoliotic Deformity

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ABSTRACT

Background: Post-tubercular kyphoscoliotic deformities are a significant complication of spinal tuberculosis, leading to severe functional impairment and neurological deficits. Posterior Vertebral Column Resection (PVCR) and reconstruction offer a surgical solution to manage such complex deformities, aiming to restore spinal alignment and function.

Methods: The study included 15 consecutive patients with severe post-tubercular kyphoscoliotic deformities underwent Posterior vertebral column resection followed by spinal reconstruction between March, 2022 to September, 2024 and all the patient were followed up upto one year. During the operation, the average age was 39.2 years, with a range of 10 to 64 years. Preoperative and postoperative assessments included radiographic measures of deformity correction (kyphotic angle, Cobb angle), neurological function, and clinical outcomes by visual analogue score (VAS), Oswestry Disability index (ODI), and Modified Macnab's criteria. Complications were documented and analyzed.

Results: Posterior vertebral column resection resulted in significant correction of kyphosis and scoliosis, with a marked improvement in spinal alignment. Neurological function showed substantial recovery in most patients. The average blood loss amounted to 2476 millilitres, and the average duration of a posterior vertebral column resection surgery was 273.33 minutes. In cases of scoliosis and kyphosis, the average correction achieved through posterior vertebral column resection was 11.6° and 14.13°, respectively, leading to correction rates of 60.53% and 38.29%. Posterior vertebral column resection complications occurred in 20% of cases overall. Neurological issues were the most common, estimated at 13.3%. There were 6.67% patients suffered from early post-operative wound infection.

Conclusion: Posterior Vertebral Column Resection (PVCR) combined with spinal reconstruction is an effective and reliable surgical technique for correcting post-tubercular kyphoscoliotic deformities. It provides significant deformity correction, functional recovery, and low complication rates, offering a promising solution for patients with severe, deformity-associated disability. Further studies with larger sample sizes and long-term follow-up are warranted to confirm these findings.

Keywords: Posterior vertebral column resection, Spinal deformity, Scoliosis, Kyphosis.

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INTRODUCTION

Approximately 50% of musculoskeletal tuberculous infections are caused by tuberculosis of the spinal column, often known as Pott's disease. With chemotherapy, the infectious organism (*Mycobacterium tuberculosis*) can be eradicated. On the other hand, 3% to 5% of patients with spinal TB experience severe deformities greater than 60°.¹

Haematogenous vertebral inoculation takes place, and the process then extends to the intervertebral disk and, occasionally, to the neighboring vertebra. Direct spread from the vertebral lesion may result in the development of para-spinal abscesses. The primary site of involvement is the thoracic spine.²

While prolonged antibiotic therapy is the gold standard for treating spinal TB, in certain situations, surgery may be the only viable choice. These include those with severe or increasing deformities, spinal instability, or significant neurological deficits. For spinal TB, there are several surgical treatment techniques that have been shown to be successful, including the anterior approach, and the combination approach. However, vertebrectomy is the standard procedure in situations of severe kyphotic deformity. Since the posterior vertical column resection (PVCR) was initially described by Suk et al., this procedure has been demonstrated to be safe because it has a lower morbidity rate than combined vertebrectomy. With PVCR, the kyphotic deformity that frequently accompanies complex spinal tuberculosis can be significantly corrected, and the dural sac can be circumferentially decompressed and the devitalized tissues can be adequately debrided.³

Surgery for vertebral tuberculosis aims to stabilize the spine, drain the abscess by removing the necrotic tissue, anteriorly decompress

the spinal cord, and, secondarily, correct the kyphotic deformity to stop paraplegia from developing. It also aims to improve lung function, reduce pain from the costo-pelvic impact and improve appearance. A vertebrectomy is a suitable procedure that allows for circumferential decompression and kyphosis treatment in cases of severe deformity. For the surgical correction of rigid spinal abnormalities, spine surgeons have been using posterior vertebrectomy or posterior vertebral column resection (PVCR) increasingly in recent years.⁴

The abnormality is clearly seen with the development of posterior based circumferential vertebral column resection (pVCR). Compared to the anterior method, laminectomy's rigid posterior fixation and visualization of the thecal sac enable more precise alignment and controlled bone removal anterior to the cord.⁵

MATERIALS AND METHODS

This Quasi experimental study was carried out at Spine division in Department of Orthopaedic Surgery, BMU, Shahbagh, Dhaka within the defined period. The patients were selected on the basis of the inclusion and exclusion criteria. The patients were diagnosed clinically and radiologically. After taking informed consent of each patient; detailed history was taken and physical examination was done. Plain radiographs, CT- Scan and MRI of whole spine were advised for final diagnosis. All necessary investigations for surgery were completed before operation. A questionnaire was prepared by the researcher considering key variables like age, sex, presenting complaints, preoperative assessment, peri-operative complications & postoperative outcome. Patients were interviewed and case record form was filled up by the researcher himself. Outcome were measured by using visual analogue score (VAS), Oswestry Disability index (ODI), and

Modified Macnab's criteria. All the data were compiled and sorted properly and analyzed statistically by using Statistical Package for Social Science (SPSS-25). The result of quantitative data was expressed as percentage and Mean $\pm$ SD and $p < 0.05$, was considered as statistically significant. Quantitative data was analyzed by paired t-test and Qualitative data was analyzed by chi-square test.

Surgical Technique:

The surgical procedure was performed under general anesthesia and prone knee chest position where abdomen hangs free on a radiolucent table/ Jackson frame.

A. After standard posterior subperiosteal dissection except for the resected levels, pedicle screws were placed segmentally.

B. After securing with a temporary rod on the opposite side, the posterior neural arches, vertebral body, and discs were excised on one side.

C. This resection was then repeated on the opposite side after transferring the temporary rod.

D. Deformity was gradually corrected through compression, in situ bending, and alternating the temporary rods

E. The defect gap in the vertebral column was reconstructed with a titanium mesh cage filled with autosomal cancellous bone graft was usually placed anteriorly to prevent excessive shortening of the spinal column followed by final compression was applied to correct deformity.

Securing hemostasis wound was closed in layer placing one/two submuscular drain tube in situ.

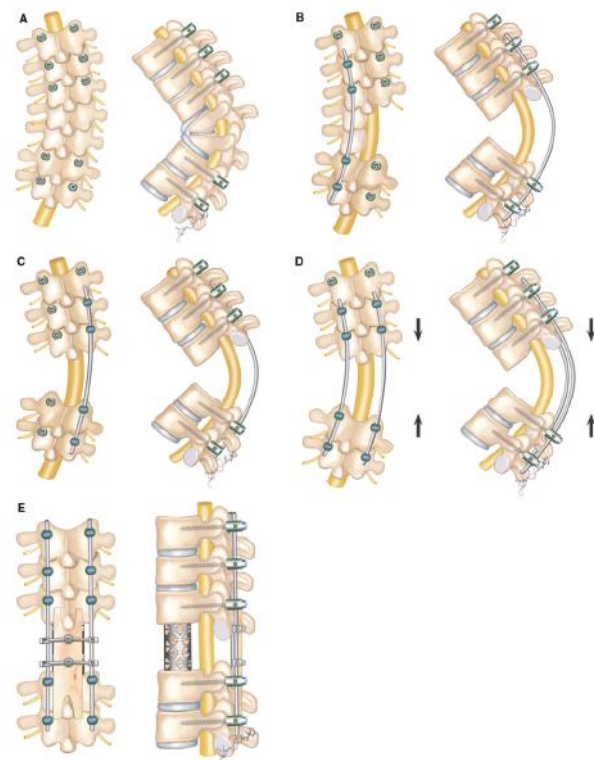


Figure-1: Surgical steps of VCR (6)

Case illustration: Saiful, 13 years old male, a case of Post tubercular kyphoscoliotic deformity of dorsolumbar region involving D7 to D9 vertebral body underwent vertebral column resection (VCR) and reconstruction by posterior only approach on 11/09/2023 in BSMMU.



Figure-2: Preoperative picture of the patient showing the curve



Figure-3: Pre-operative X-ray of D/L spine (A/P and lateral view) showing post tubercular kyphotic deformity at dorso lumbar region.

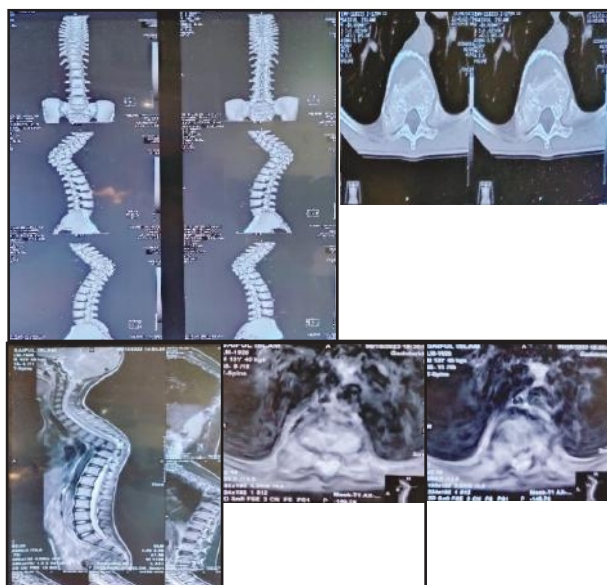


Figure-4: CT-Scan with 3D reconstruction showing disruption of vertebral body.

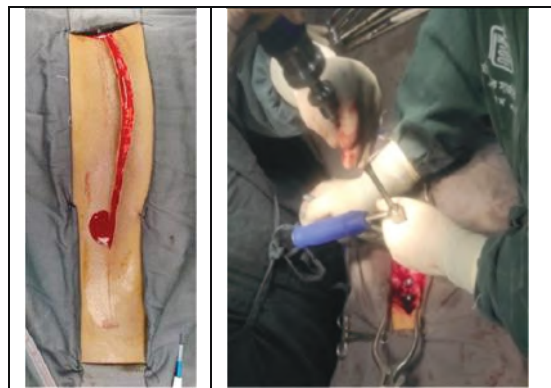


Figure-5: Per-operative photo Showing Incision

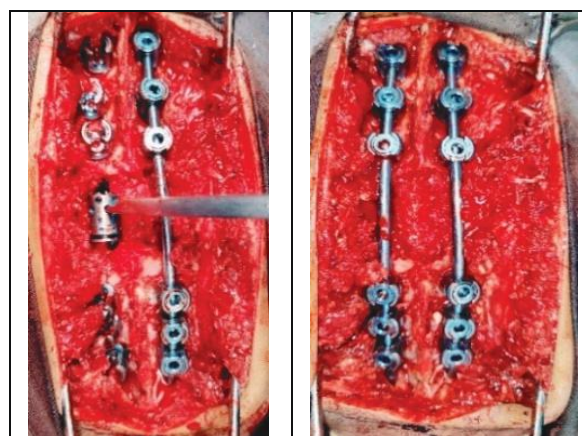


Figure-6: Per-operative photo Showing Pedicle screw and rod and expandable mesh cage placement

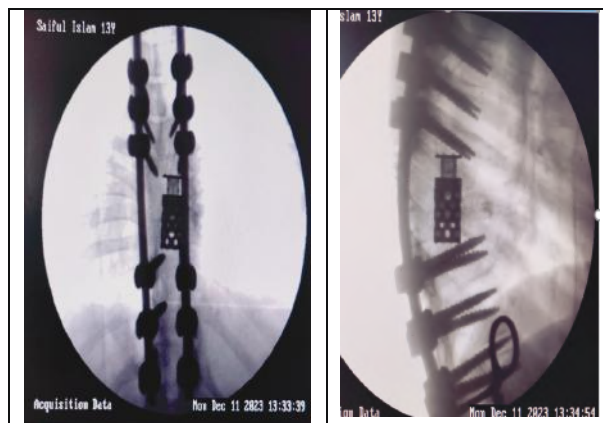


Figure-7: Per-operative C-arm picture

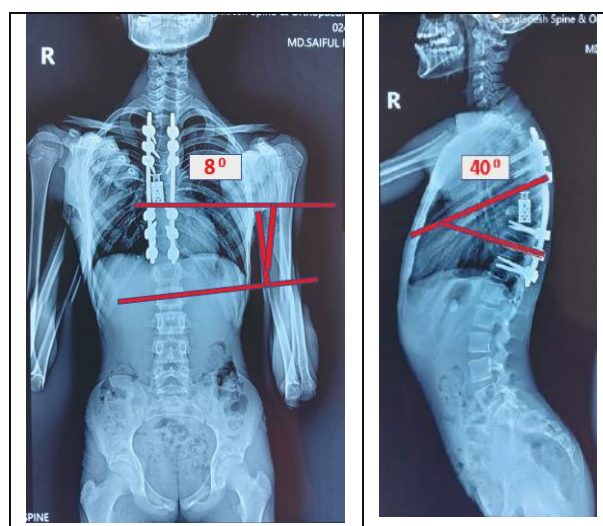


Figure-8: Post Op A/P view & lateral view



Figure-9: Comparison of Pre-Op and post -op picture and X-ray after 12 months of VCR

RESULTS

This Quasi experimental study was carried out in the Spine division of Orthopaedic Surgery Department at Bangabandhu Sheikh Mujib Medical University. Time period was 30 months from March' 2022 to September' 2024 to evaluate the results of PVCr and vertebral column resection for post tubercular kyphoscoliotic deformity. Study population was 15 patients with post-tubercular kyphoscoliotic deformity at dorso-lumbar spine who underwent PVCr and vertebral column reconstruction with the fulfillment of all inclusion and exclusion criteria. All the data were compiled and sorted properly, analyzed statistically and placed in table.

Table-I: Age distribution of patients (n=15)

Age (Years)	Frequency, n (%)	Mean $\pm$ SD	Range
10-21	4 (26.66)		
22-40	4 (26.66)		
41-54	4 (26.66)		
55-64	3 (20.00)		
Total	15 (100)	39.2 $\pm$ 18.36	10-64

Mean age of the patients was 39.2 ± 18.36 years (10-64) where maximum case belonged to 10-21, 22-40 and 41-54 years of age (26.66%).

Table-II: Clinical manifestations of the study population (n=15)

Clinical manifestations*	Frequency, n (%)	Post-op
	Pre-op	
Back pain	15 (100)	0 (00)
Deformity	15 (100)	2 (13.33)
Gait abnormality	11 (73.33)	1 (6.66)
Motor weakness of lower limbs	11 (73.33)	1 (6.66)
Sensory disturbance of lower limbs	6 (40.00)	0 (00)
Bowel and bladder involvement	0 (0)	0 (00)

All the 15 (100%) patients had back pain with deformity. 11 patients (73.33%) had gait disturbance, 11 patients (73.33%) had Motor weakness of lower limbs and 6 patients

(40.00%) had Sensory disturbance of lower limbs.

Table-III: Per operative blood loss (n=15)

Peroperative blood loss (ML)	Frequency, n (%)	Mean $\pm$ SD	Range	P-value
1100-2000	4 (26.66)			
2001-3000	7 (46.66)			
3001-4000	3 (20.00)			
4001-5000	1 (6.66)			
Total	15 (100)	2476 $\pm$ 907.12	1390-4500	<0.001

Average per operative blood loss was 2476 ± 907.12 ml (range 1390-4500 ml).

Table-IV: Assessment of kyphotic angle of study population (n=15)

Time point	Kyphotic Angle ($^{\circ}$) (Mean $\pm$ SD)	Cobb's Angle ($^{\circ}$) (Mean $\pm$ SD)	p value
Pre-operative	46 ± 16.60	18.86 ± 4.71	
Post-operative	31.86 ± 17.03	7.26 ± 2.25	
Correction	14.13 ± 1.18	11.6 ± 3.68	
Percentage of correction	38.29 ± 22.96	60.53 ± 9.97	<0.001

Pre-operative kyphotic angle was $46 \pm 16.60^{\circ}$ and post-operative kyphotic angle was $31.86 \pm 17.03^{\circ}$. Mean correction of kyphosis was $14.13 \pm 1.18^{\circ}$ with percentage of correction $38.29 \pm 22.96^{\circ}$. It indicates significant correction of kyphotic angle (p value < 0.001).

In this study pre-operative Cobb's angle was $18.86 \pm 4.71^{\circ}$ and post-operative Cobb's angle was $7.26 \pm 2.25^{\circ}$. Mean correction of Cobb's angle was $11.6 \pm 3.68^{\circ}$ with percentage of correction was $60.53 \pm 9.97^{\circ}$. It indicates significant correction of kyphotic angle (p value < 0.001).

Table-V: Peri-operative complications (n=15)

Complications	Frequency (n)	Percentage (%)
Per-operative		
Root injury	1	6.67
Dural tear	1	6.67
Post-operative		
CSF leakage	0	0
Wound infection	1	6.67
Implant failure	0	0

In this study, A total of three major complications (20%) were observed. One patient (6%) had nerve root injury, one patient had dural tear (6%). And another one patient (6.67%) patient suffered from Superficial wound infection.

Table-VI: Mean VAS score in all patients at different time points (n=15) and Oswestry Disability Index (ODI) score (n=15)

Time point	VAS Score Mean $\pm$ SD	ODI Score Mean $\pm$ SD	p value
Pre-operative	5.6 ± 0.82	72.08 ± 14.55	
After 01 month	3.73 ± 0.45	68.90 ± 2.92	
After 03 months	2.8 ± 0.56	45.97 ± 1.26	
After 06 months	2.06 ± 0.25	32.16 ± 1.02	
After 12 months	1.73 ± 0.45	17.14 ± 2.52	<0.001

Pre-operatively, mean VAS score of all patients was 6.13 ± 1.20 (5-7) whereas post-operatively VAS score was decreased significantly (after 1, 3, 6 and 12 months of follow up 4.0 ± 0.63 , 2.46 ± 0.49 , 1.86 ± 0.49 and 1.26 ± 0.44 respectively) (p value < 0.001).

Pre-operatively, mean ODI score of all patients was 72.08 ± 14.55 (42-96) whereas post-operatively ODI score was decreased significantly after 1, 3, 6 and 12 months of follow up (68.90 ± 2.92 , 45.97 ± 1.26 , 32.16 ± 1.02 and 17.14 ± 2.52 respectively) compared to pre-operative status (p value < 0.001).

Table-VII: Assessment according to Modified Macnab's criteria (n=15)

Status	After 1 month (%)	After 3 months (%)	After 6 months (%)	After 12 months (%)
Excellent	0 (0)	0 (0)	7 (46.66)	13 (86.6)
Good	12 (80)	14(93.33)	7 (46.66)	2 (13.33)
Fair	3 (20)	0 (0)	0 (0)	0 (0)
Poor	0 (0)	0 (0)	0 (0)	0 (0)

Excellent outcome was significantly increased after 12 months of follow up (86.6%)

DISCUSSION

When spinal TB is neglected or treated later than expected, fixed, strongly angulated kyphosis is frequently observed. Severe kyphotic abnormalities might affect breathing and endanger nearby spinal cords and nerves. In extreme situations, surgery can be required. As surgical techniques and instrumentation have advanced, VCR has become a common surgical treatment for adult spinal deformities, spinal tumors, and congenital and idiopathic scoliosis.¹³

If the kyphosis more than 90°, it causes paralysis or other delayed neurological damage. As a result, surgical orthopedic treatment is typically necessary. SPO, PSO, VCR, MVCR, and other surgical techniques were used to treat the kyphoscoliosis. Single segment SPO can only correct an angle of around 10° to 20°, whereas single segment PSO can correct an angle of 30° to 40°. VCR is the most effective for correcting kyphosis, with a correction range of 49° to 80°. Achieving stable fusion at the instrumented segments is the ultimate goal of spinal deformity repair surgery.¹¹

It is challenging to use the anterior transthoracic technique to reach the concavity of the spine in cases of severe thoracic kyphotic

abnormalities. The primary drawback of the anterior approach (thoracotomy/thoracolumbar) in general is the disruption of a normal bodily cavity and the problems that follow. The morbidity is increased by the patient's frequently observed fibrosis, adhesions, and impaired lung function.¹⁰

A common method for correcting severe, rigid kyphoscoliosis with fixed trunk translation is the indication of VCR. A single-stage anterior-posterior approach for traditional VCR is a difficult treatment that carries a high risk of serious consequences, including vascular and neurological damage. A single posterior vertebral column resection (PVCR) was developed by Suk et al. with the goal of decreasing off operating time and complications. It has been suggested that PVCR can correct sagittal imbalance by up to 47.5 or improve it by 53–55%.¹⁴

The use of a posterior-only technique for simultaneous spinal fusion, debridement, and stabilization of the spine in cases of thoracolumbar TS has been the trend over the last 10 years. While considering intraoperative considerations, the posterior technique resulted in much less intraoperative blood loss than the combined anteroposterior approach; also, kyphoscoliosis correction yields better outcomes than the anterior approach. In spite of the technique's advantages, the main limitation should be noted: a high rate of neurological complications. This is, in our opinion, related to the requirement for excision of one or more spinal roots in order to install an interbody implant, as well as significant traction of the dural sac in order to view the anterior column. According to our clinical data and other authors' published data, the use of neurophysiological intraoperative monitoring can lower these problems, which are

nonetheless common and, based on the literature, can reach 10–12%.¹⁵

CONCLUSION

Posterior Vertebral Column Resection (PVCR) is a highly effective surgical technique for managing post-tubercular kyphoscoliotic deformities. This study demonstrates significant improvements in both deformity correction and neurological function, with a low rate of complications. PVCR provides a reliable option for patients with severe spinal deformities due to tuberculosis and offers the potential for substantial improvement in quality of life. Further studies with larger sample sizes and extended follow-up are needed to fully establish the long-term efficacy and safety of this procedure.

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