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Original Research Article

Extended lateral approach for surgical treatment in tuberculosis of spine

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ABSTRACT

The selection of anterior versus posterior approach for surgical treatment of thoracic or lumbar tuberculosis is still a matter of debate. The extra pleural anterolateral approach which has less morbidity compared with two stage approach provides simultaneous exposure of both anterior and posterior parts of the spine and allows anterior decompression of the spinal cord along with posterior stabilisation and anterior and posterior fusion in one stage through a single approach.

Materials and Methods: The study included 45 patients with TB spine who have undergone modified extended lateral decompression and posterior instrumentation between Jan 2016 to Jan 2020. Qualitative evaluation was done with help of ODI scoring for the entire patient. Radiologically all patients were evaluated for the fusion and correction of kyphosis post operatively and progression of kyphosis over period of 2 years.

Results: The average preoperative ODI score was 21.47 (range 12 to 34 and standard deviation of 6.868) and 4.44 post operatively (range 0 to 14 and standard deviation of 3.042). The average value of preoperative angle of kyphosis was 25.73º (range 11-51º). The average values of angles at immediate postoperative, at 6 months postoperative, one year post-operative and at the end of two years post operative were 9.76º (range 2º to 26º), 11.58º (range3º to 28º), 12.51 (range 4 to 31)and 12.58º(range 4º to 30º) respectively.

Conclusion: Decompression of spine tuberculosis through extended Lateral approach using bone graft for fusion along with posterior instrumentation as a single stage procedure is an ideal procedure to treat spinal tuberculosis which requires surgical management.

1. Introduction

Back ground: Spinal tuberculosis is considered to be the most dangerous form of skeletal tuberculosis because of its ability to cause bone destruction, deformity and neurologic deficitsTB spine more often affects Thoraco lumbar spine.[1] Tuberculosis of the spine involves the vertebral body in 98% of cases and isusually treated by anterior decompression, fusion and posteriorstabilization.[2]

2. Aims and Objectives

The aim of this study is to

1. To analyze the qualitative and radiological results obtained in the surgical decompression of tuberculosis of dorsolumbar spine through extended lateral approach and decompression along with posterior instrumentation as a single stage procedure.

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3. Materials and Methods

3.1. Patient selection

All patients with Tuberculosis of Dorso Lumbar spine Who have undergone single staged surgical decompression and posterior instrumentation through modified extended lateral approach form January 2016 to January 2020.

Equipments: X-rays and Oswestry Disability Index questionnaire for preoperative and post operative scoring.

3.2. Study design

This is a study of 45 patients with TB spine who have undergone modified extended lateral decompression and posterior instrumentation between Jan 2001 to Dec 2008. All patients were evaluated with biplanar X-ray and MRI preoperatively. Of these 45 patients 27 were males and 18 were females (Table). They were from age group of 20 to 71 years (Table). The diagnosis of spinal tuberculosis was done by clinical examination, x rays and MRI. Four senior level faculties have performed all of the procedures. An independent examiner evaluated all the patients using preoperative and pot operative clinical symptoms and score of the ODI. Radiologically all patients were evaluated for the fusion and correction of kyphosis post operatively and progression of kyphosis over period of 2 years. Qualitative evaluation was done with help of ODI scoring for the entire patient. Patients were treated first conservatively in the form of anti-tubercular drugs and rest for at least six weeks. When they did not improve symptomatically by the same they were advised operative management. Patients under went extended lateral decompression with posterior instrumentation as a single staged procedure. All the patients were informed before surgery about the duration of stay in hospital following surgery, subsequent rehabilitation protocol & interval for follow up following surgery. Minimum follow up of 2 years was available. Postoperative clinical and radiological assessment and scoring was done at the time of 3, 6 and 12 months and then at every yearly follow up.

3.3. Surgical technique

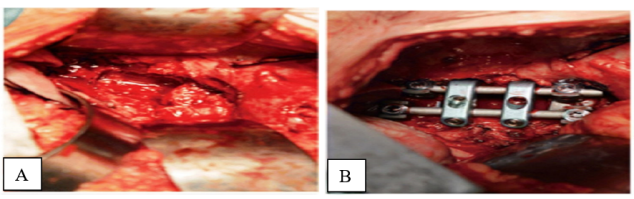


Fig. 1:

3.4. Modified extended lateral decompression

All the procedures were performed under general anesthesia with the patient prone on Wilson's frame. All the patients received one dose of prophylactic intravenous antibiotics at the time of the induction of anaesthesia (Injection Cefuroxime 1.5 gm loading dose). Radiographic confirmation of the correct interspace was obtained with a radiopaque skin marker (Sterile needle placed in the appropriate level under image intensifier control). Subcutaneous tissues and muscles were infiltrated with 1:500000 adrenaline solution.

Operative technique.

Anaesthesia: GA

Position: Prone

Incision: Fallen T incision horizontal limb to Lt. Side

The patients are placed in the prone position.

A fallen T incision is used centering the apex of the kyphosis in the midline of about 15cm in length with its horizontal limb of about 8cm to the Lt. starts in the midline with the apex of the kyphosis as its centre. The skin, subcutaneous tissue and the deep fascia are incised in the same line. To make it to a fasciocutaneous flap. The trapezius, latissimus dorsi and Perscapular muscles are divided in a T-shaped manner. Through the above incision diseased vertebra and adjacent vertebra above and below exposed. Pedicle screws inserted on both sides [2 screws on each side] into one vertebra above and below the diseased vertebra, and temporarily held with a rod on the contra lateral side [Rt.side] before the decompression. The Lt side, corresponding 3 ribs at the apex of the kyphosis were identified and marked and the periosteum of each rib is incised in the long axis of the Rib and elevated. Intercostals muscles attached are dissected in the axilla Between muscle fibers and the rib is divided lateral to its angle, about 8 cm Away from the tip of the transverse process and is freed to its head. The paraspinal muscles are divided transversely in the line of each rib. Dissection between the transverse process and the head of the rib dividing the cost transverse ligaments. The transverse process is removed from its base and the rib including its head is detached. The transverse process is removed from its base and the rib including its head is detached, two corresponding ribs are removed in a similar manner. The intercostals artery and the nerve are ligated and divided as close to the Cord as possible. All the loose bony sequestra, sequestrated disc tissue, pus and granulation tissue is removed. The vertebral body is breached at the junction of the pedicle and the transverse process and the bone is removed bit by bit until the lateral and anterior wall of the spinal canal is decompressed. The lateral and anterior surface of vertebral body is exposed through above approach and the diseased vertebral bodies were sufficiently derided to decompress the spinal cord which was exposed over the whole length of the diseased segment. Once the debridement is completed the defect is

filled with the excised rib and graft taken from iliac crest. Rod applied on the same side. The screws connected with a rod contoured into kyphosis and tightened in compression. DTT applied in distraction. Wound closed in layers after complete homeostasis and after inserting a drain. (Figure 1)

3.5. Postoperative protocol

In the immediate post-operative period patients were kept in surgical intensive care unit for one day. After check X rays they were mobilized with the help of brace on 3^{rd} post operative day. The suction drain was removed once it was below 100ml. The prophylactic intravenous antibiotics were given for patients till drain removal. Patients were discharged on 7^{th} post operative day. At the time of discharge patients were advised not to lift heavy weights, not to travel sitting for long distance and avoid strenuous activities for six weeks. The sutures were removed on 14^{th} day. Patients were mobilized with the help of brace for six weeks from surgery.

3.5.1. Physiotherapy

At six weeks review intensive, standardized medical exercise training were started

Stage 1: Patients were first started on flexion exercises of spine for one month.

Stage 2: Followed by that they were started on extension exercises for one month.

3.6. Patient evaluation

An independent observer evaluated and scored all patients.

3.6.1. Clinical evaluation

The complete medical records of all patients were available and were reviewed to determine demographic data, the primary diagnosis, clinical results, and postoperative complications. Clinical results were assessed with use of the scoring system proposed by the Oswestry Disability Index (Annexure C). Briefly, the ODI is based on the rating of pain from 0-5 on 10 sections and then added up (max. total = 50).

Following formula is used to calculate the percentage of disability.

$$\frac{Patient's\ Score}{No.\ of\ sections\ completed\ x\ 5} \times 100 = \% —Disability$$

Post operatively patients were evaluated at 3, 6 and 12 months and yearly thereafter. To get uniformity in the postoperative analysis the one-year score was taken into consideration for all the patients.

Radiological evaluation

Angle of kyphosis (Cobb's angle)-

The Cobb method of measurement consists of three steps:

1. Locating the superior end vertebra,
2. Locating the inferior end vertebra, and
3. Drawing intersecting perpendicular lines from the superior surface of the superior end vertebra and from the inferior surface of the inferior end vertebra.

The angle of deviation of these perpendicular lines from a straight line is the angle of the curve. Following figure 2 shows the method of measurement of angle of kyphosis (Cobb's angle)

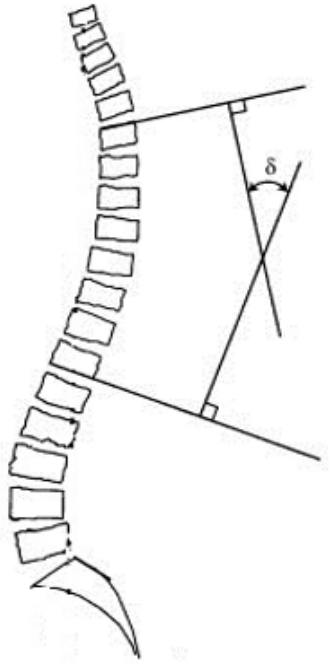


Fig. 2: δ is angle of kyphosis

3.7. Statistical analysis

ANOVA test was used for statistical analysis. Statistical analysis was done using SPSS software on personal computer (Annexure B).

4. Results

4.1. Profile of the patients

Table 1: Age statistics

Mean	43.87
Std. Deviation	15.264
Range	51
Minimum	20
Maximum	71

Table 1 explains about the age distribution of the patients. The average age was reported to be 43.87 years with a standard deviation of 15.264. The patient who is having 20

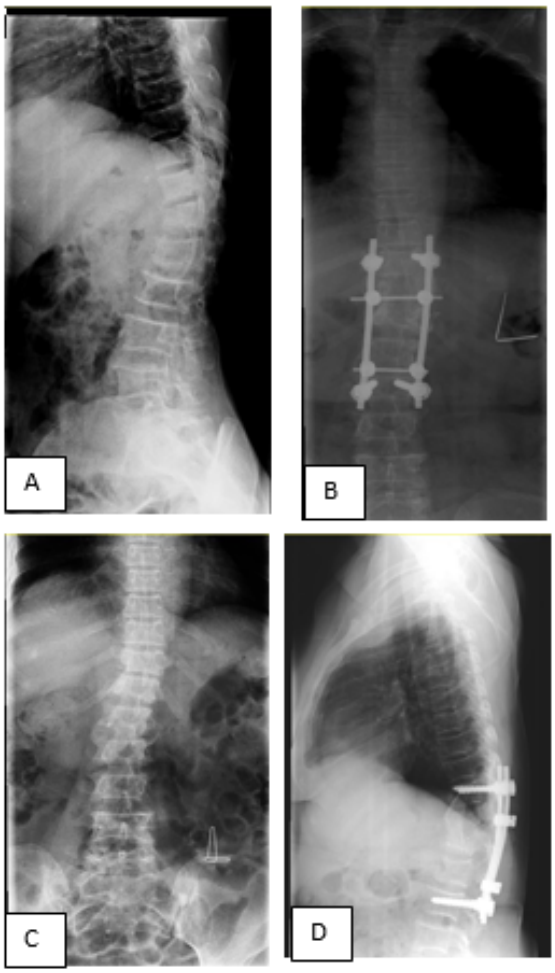


Fig. 3: Pre operative and Post operative x-ray

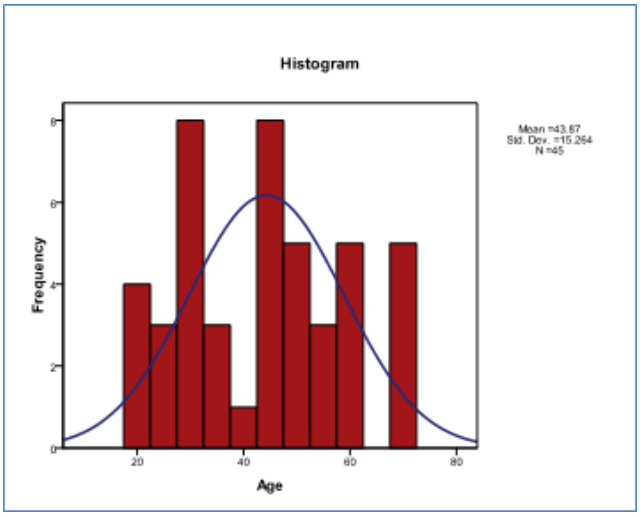
years of age was the youngest and the eldest reported case is 71 years. The histogram and the normal curve of the age distribution is furnished in Graph 1.

Table 2 explains about the age grouping of the patients. 24.4% of the patients were below 30 years of age, 57.8% were in between 30 to 60 years of age and only 17.8% belongs to the senior citizen category.

Table 2: Age group

Age	Frequency	Valid Percent	Cumulative Percent
< 30 Years	11	24.4	24.4
30 to 60 Years	26	57.8	82.2
Above 60 years	8	17.8	100.0
Total	45	100.0	

The male to female ratio of the patients is 60: 40 (Table 3)



Graph 1:

Table 3: Gender

	Frequency	Percent	Valid Percent	Cumulative Percent
Male	27	60.0	60.0	60.0
Female	18	40.0	40.0	100.0
Total	45	100.0	100.0	

4.2. Oswestry disability index

The Oswestry Disability Index (Oswestry Low Back Pain Disability Questionnaire) is an extremely important tool that researchers and disability evaluators use to measure a patient's permanent functional disability. The scoring on this disability index is interpreted in the following way. If the score is in between 0 and 20 it is regarded as minimal disability: The patient can cope with most living activities. If the score is in between 21 and 40 it is regarded as moderate disability: The patient experiences more pain and difficulty with sitting lifting and standing. Travel and social life are more difficult and they may be disabled from work. Personal care sexual activity and sleeping are not grossly affected and the patient can usually be managed by conservative means. If the score is in between 41 and 60 it is considered as severe disability. Pain remains the main problem in this group but activities of daily living are affected. These patients require a detailed investigation. If the score is in between 61 and 80 it is considered as crippled. Back pain impinges on all aspects of the patient's life. Positive intervention is required. If the score is in between 81 and 100 \these patients are either bed-bound or exaggerating their symptoms. The mean score of the patients was found to be 21.47 with a standard deviation of 6.86. If we take 5% trimmed (from both the ends) mean, there is not much difference from the original mean(21.47 and 21.36). This means that there are no extremities in the disability score. If we take the mean of 21.47, we can say that the mean lies in the second stage of

disability. That is in between 21 and 40 and it is regarded as moderate disability. Hence the minimum disability score recorded in this study is 12 and maximum 34, we can conclude that patients belonging to minimal and moderate disability are found.

Table 4: Preop oswestry disability index descriptives

	Statistic	Std. Error
Mean	21.47	1.024
5% Trimmed Mean	21.36	
Variance	47.164	
Std. Deviation	6.868	
Minimum	12	
Maximum	34	
Range	22	

1. Pre Operation ODI variations among Patients

   (a) Gender

Table 5 explains about the Pre Operation ODI variations among gender. It was found that the difficulty level was more for female (Mean = 21.78 std dev = 6.75) as compared with male (Mean = 21.26 std dev = 7.22). The statistical significance of this variation is tested by applying an Independent sample t test. The result of the test is furnished in Table 6.

Table 5: Group statistics

	Sex	N	Mean	Std. Deviation	Std. Error Mean
Pre OP Oswestry Disability Index	Male	27	21.26	6.752	1.299
	Female	18	21.78	7.224	1.703

Hypothesis 1

H_0: The Pre Operation ODI score is same for both the genders

H_1: The Pre Operation ODI score is not same for both the genders

The Levene's Test for Equality of Variances was found to be not significant ($p > 0.05$). Hence we consider the significance of Equal variances assumed.

That was also not found to be significant ($p > 0.05$). Hence the hypothesis is accepted and can conclude that the difficulty levels faced by patients belonging to both the genders are almost same even though there is a slight variation in the pre ODI score

4.2.1. Age group

Table 7 explains about the pre operation ODI variations among different age group. It was found that the difficulty level was more for patients below 30 years (Mean = 26.36, std dev = 6.68) as compared with 30 to 60 group (Mean = 20.15 std dev = 6.32) and above 60 group (Mean = 19.00 std dev = 6.23). The statistical significance of this variation is tested by applying ANOVA test. The result of the test is furnished in Table 8.

From the results of ANOVA furnished in Table 8, it can be interpreted that the test was found to be significant at $F = 4.36$, $p < 0.05$. Hence the hypothesis is rejected and can conclude that The Pre Operation ODI score is not same for all the age groups.

That means the observation made under Table 6 is true. The maximum difficulty is faced by patients who are below 30 years of age and the difficulty level is decreasing with respect to increase in age. The graphical representation of the variations in difficulty level can be drawn from the means plot exhibited under figure 6.

4.3. Post operative ODI score

Post operative ODI score was measured one year after the operation. The post operative ODI score mean was found to be 4.44 with a standard deviation of 3.04 (Table 9). The minimum ODI score was found to be zero and the maximum was found to be 14. A score mean of 4.4 is in between 0 and 20 it is regarded as minimal disability. The maximum value is also under the upper limit of minimal disability according to Oswestry Disability Index.

1. Comparison of Pre and Post operation ODI Scores

The pre operative ODI score (Table 10) was found to be 21.47 with a standard deviation of 6.86 and the post operative ODI score after one year from the surgery date was found to be 4.44 with a standard deviation of 3.04. From mere observation, it can be interpreted that the operation was successful because the mean ODI score after the operation is comparatively lesser than pre operative ODI score. But the statistical significance has to be tested by using a paired sample t test. The test results are furnished in Table 12.

Table 11 explains about the correlation between pre and post ODI score. The correlation coefficient was found to be 0.473, which states that there is a positive correlation between pre and post ODI scores and the correlation coefficient was found to be significant at $p<0.05$.

The paired sample t test (Table 12) was found to be significant at $t = 18.86$, $df = 44$, $p<0.05$. Hence the hypothesis is rejected and can conclude that the Pre and post ODI score are not same. That means there is significant difference between the Pre and post ODI scores. Since the post operation ODI score is less (Mean = 4.44 with a standard deviation of 3.04) than pre ODI score

(Mean 21.47 with a standard deviation of 6.86) we can conclude that the operation was very much effective.

5. Pre and post kyphosis

The pre operative Kyphosis (Table 13) was found to be 25.73 with a standard deviation of 10.33 and the post

Table 6: Independent samples test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Pre OP Oswestry Disability Index	Equal variances assumed	.008	.929	-.245	43	.807	-.519	2.112	-4.779	3.742
	Equal variances not assumed			-.242	34.840	.810	-.519	2.142	-4.867	3.830

Table 7: Descriptives

	Pre OP Oswestry Disability Index							
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
< 30 Years	11	26.36	6.682	2.015	21.87	30.85	12	34
30 to 60 Years	26	20.15	6.323	1.240	17.60	22.71	12	32
Above 60 Years	8	19.00	6.234	2.204	13.79	24.21	12	30
Total	45	21.47	6.868	1.024	19.40	23.53	12	34

Hypothesis 2

H_0: The Pre Operation ODI score is same for all the age groups

H_1: The Pre Operation ODI score is not same for all the age groups

Table 8: ANOVA

	Pre OP Oswestry Disability Index				
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	357.270	2	178.635	4.367	.019
Within Groups	1717.930	42	40.903		
Total	2075.200	44			

Table 9: Post op oswestry disability index

Mean	4.44
Std. Deviation	3.042
Range	14
Minimum	0
Maximum	14

Table 10: Paired samples statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre OP Oswestry Disability Index	21.47	45	6.868	1.024
	Post OP Oswestry Disability Index - 1 Yr	4.44	45	3.042	.453

Table 11: Paired samples correlations

		N	Correlation	Sig.
Pair 1	Pre OP Oswestry Disability Index & Post OP Oswestry Disability Index - 1 Yr	45	.473	.001

		N	Correlation	Sig.
Pair 1	Pre OP Oswestry Disability Index & Post OP Oswestry Disability Index - 1 Yr	45	.473	.001

Hypothesis 3
H_0: The pre and post ODI score are same.
H_1: The Pre and post ODI score are not same.

Table 12: Paired samples test

Pre OP Oswestry Disability Index - Post OP Oswestry Disability Index – 1 Year	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
	17.02	6.05	.903	15.20	18.84	18.86	44	.000

operative Kyphosis was found to be 9.96 with a standard deviation of 6.09. From mere observation, it can be interpreted that the operation was successful because the mean Kyphosis after the operation is comparatively lesser that pre operative Kyphosis. But the statistical significance has to be tested by using a paired sample t test. The test results are furnished in Table 15.

explains about the correlation between pre and post Kyphosis. The correlation coefficient was found to be 0.782 and significant at $p<0.05$

Hypothesis 4

$H_{0:}$ The pre and post Kyphosis are same.

H_1: The Pre and post Kyphosis are not same.

The paired sample t test (Table 15) was found to be significant at $t = 15.69$, $df = 44$, $p < 0.05$. Hence the hypothesis is rejected and can conclude that the Pre and post Kyphosis are not same. That means there is significant difference between the Pre and post Kyphosis.

Since the post operation Kyphosis is less (9.96) than pre Kyphosis (25.73) we can conclude that the operation was very much effective.

6. Clinical Results

6.1. ODI score

The average preoperative ODI score was 21.47 (range 12 to 34 and standard deviation of 6.868) and 4.44 post operatively (range 0 to 14 and standard deviation of 3.042) (Table 1). There was statistically significant difference between pre operative and post operative ODI scores.

6.2. Radiographic results

6.3. Angle of Kyphosis (Cobb's angle)

The average value of preoperative angle of kyphosis was 25.73º (range 11-51º). The average values of angles at immediate postoperative, at 6 months postoperative, one year post-operative and at the end of two years post operative were 9.76º (range 2º to 26º), 11.58º (range3º to 28º), 12.51 (range 4 to 31)and 12.58º(range 4º to 30º) respectively (Table 2). There was statistically significant difference in angle of kyphosis between preoperative and one year post operative values. There was no statistically significant difference found in postoperative angle of kyphosis at immediate postoperative, 6 months, 1 year and 2 years postoperative period.

6.4. Complications

6.4.1. Instrumentation failure

Only In 1 patient there was implant failure and progression of kyphosis.

6.4.2. Infection

No deep infections were reported, 2 patients developed superficial infection.

Totally there are only 6.6% of complications reported after surgery.

It is very important to note that 93.4% of the cases didn't develop any complications.

7. Discussion

The aim of the treatment in spinal tuberculosis is to eradicate the disease and to correct any kyphosis.[3] The goals of surgery in TB spine are adequate decompression and debridement, maintenance and reinforcement of

Table 13: Paired samples statistics

	Mean	N	Std. Deviation	Std. Error Mean
Pre op Kyphosis	25.73	45	10.338	1.541
Post Op Kyphosis	9.96	45	6.098	.909

Table 14: Paired samples correlations

	N	Correlation	Sig.
Pre op Kyphosis & Post Op Kyphosis	45	0.782	.000

Table 15: Paired samples test

Pre op Kyphosis - Post Op Kyphosis	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
	15.778	6.745	1.005	13.751	17.804	15.692	44	.000

stability and correction and prevention of deformity.[4] Decompression of the spinal cord is usually required and this is usually undertaken anteriorly since it is the vertebral body which is affected.[2] Stabilization of the spine is usually indicated for instability developing after the debridement especially in a pan vertebral disease or in long segment disease after cord decompression and correction of the kyphus.[5] The graft is able to provide sufficient stability and structural support in only 41% of patients with a short defect.[6] If the graft is long (more than 5cm) it has to be supported to prevent graft related complications such as fracture, increase in kyphosis due to displacement of the graft and increase in neurologic deficit etc.[7] The advantage of posterior instrumentation is that good fixation can be achieved in healthy posterior part of the vertebrae even when anterior body is affected by the disease.[8] The instrumentation only needs to extend one healthy segment above and one below[8] Moon et al.[9] have described two-stage surgery in which the spine was stabilised by posterior instrumentation first followed by transthoracic anterior decompression and bone grafting two to three weeks later. In later cases they performed both procedures in one stage. Transthoracic and transdiaphragmatic approaches to access dorsolumbar spine is associated with significant morbidity as it violates thoracic cavity, requires cutting of diaphragm and a separate approach for posterior instrumentation.[7] So the ideal surgical procedure in the treatment of spinal tuberculosis is a single-stage anterior decompression followed by posterior instrumented stabilisation and anterior grafting. We present an analysis of 45 patients with Tuberculosis of Dorsolumbarspine who were treated with the anterior decompression and posterior instrumentation as a single staged procedure through modified extended lateral (extra pleural) approach which allowed us to decompress the spinal cord anteriorly under direct vision and at the same time to stabilize the spine with posterior instrumentation. Since the approach to the vertebral body was extra pleural, respiratory function was not compromised hence this approach can be used even in patients with concomitant pulmonary tuberculosis and compromised pulmonary function.[10]

In our study the mean pre-operative kyphus of 25.73° was corrected to 9.96° at the final follow-up, from mere observation it can be interpreted that the operation was successful because the mean kyphosis after operation is comparatively lesser than the Preoperative kyphosis. Statistical significance was tested with paired samples test; statistical Table 15 explains about the correlation between pre and post kyphosis. The correlation coefficient was found to be 0.782 and test was found to be significant ($p< 0.05$), that means there is significant difference between Pre and Postoperative kyphosis. The mean pre-operative ODI score (Table 10) was found to be 21.47 and the mean post-operative ODI was found to be 4.44, statistical significance was tested by using a paired sample t test (Table 12). Table 11 explains about the correlation between Pre and Post operative ODI score. The correlation coefficient was found to be 0.473, which states that there is a positive correlation between pre and post op ODI scores and the Correlation coefficient was found to be significant at $p<0.05$. These statistical analysis shows that the surgery is very successful.

8. Conclusion

1. Decompression of spine tuberculosis through extended Lateral approach using bone graft for fusion along with posterior instrumentation as a single stage procedure is an ideal procedure to treat spinal tuberculosis which requires surgical management.
2. Since the approach is extra pleural, respiratory function was not compromised hence this approach can be used even in patients with concomitant pulmonary tuberculosis and compromised pulmonary function.

3. The incidence of graft-related problems and the progression of the kyphosis is significantly less when posterior instrumentation is done along with anterior bone grafting in treatment of spinal tuberculosis.

9. Source of Funding

No funding was received for this study from any institute or company.

10. Conflict of Interest

None declared.

11. Permission from IRB

Yes.

References

1. Papadopoulos SM, Fessler RG. Thoracic spine; anatomy and surgical approaches, exposures of vertebral column. In: Benzel's spine surgery techniques, complications avoidance and management. Elsevier; 2005. p. 281–93.
2. Five-year assessments of controlled trials of ambulatory treatment, debridement and anterior spinal fusion in the management of tuberculosis of the spine. Studies in Bulawayo (Rhodesia) and in Hong Kong. Sixth report of the Medical Research Council Working Party on Tuberculosis of the Spine. *J Bone Joint Surg Br*. 1978;60-B(2):163–77.
3. Altman GT, Altman DT, Frankovitch KF. Anterior and posterior fusion for children with tuberculosis of the spine. *Clin Orthop*. 1996;325:225–31.
4. Garg B, Kandwal P, Upendra BN, Goswami A, Jayaswal A. Anterior versus posterior procedure for surgical treatment of thoracolumbar tuberculosis: A retrospective analysis. *Indian J Orthop*. 2012;46:165–70.
5. Lee JC, Shin BJ. Safety and Efficacy of Pedicle Screws and Titanium Mesh Cage in the Treatments of Tuberculous Spondylitis of the Thoracolumbar Spine. *Asian Spine J*. 2008;2(2):64–73.
6. Moon MS, Woo YK, Lee KS. Posterior instrumentation and anterior interbody fusion for tuberculous kyphosis of dorsal and lumbar spine. *Spine*. 1995;20:1910–6.
7. Rezai AR, Lee M, Cooper PR, Errico TJ, Koslow M. Modern management of spinaltuberculosis. *J Neurosurg*. 1995;36:87–97.
8. Laheri VJ, Badhe NP, Dewnany GT. Single stage decompression, anterior interbody fusion and posterior instrumentation for tuberculous kyphosis of the dorso-lumbar spine. *Spinal Cord*. 2001;39:429–36.
9. Jain AK, Maheshwari AV, Jena S. Kyphus correction in spinal tuberculosis. *Clin Orthop*. 2007;460:117–23.
10. Goel VK, Konz RJ, Chang HT, Grosland NM, Grobler LJ, Chesmel KD. Hinged-dynamic posterior device permits greater loads on the graft and similar stability as compared with its equivalent rigid device: a three-dimensional finite element assessment. *J Prosthet Orthot*. 2001;13:17–20.

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