Section: Orthopaedics

Original Research Article

CLINICORADIOLOGICAL OUTCOME OF SHORT SEGMENT VERSUS LONG SEGMENT POSTERIOR PEDICLE SCREW FIXATION IN D10 TO L2 DORSOLUMBAR VERTEBRAL FRACTURE

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Key Words: TLICS Score, Kyphosis, LS & SS long segment and Short Segment

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ABSTRACT

Background: THORACOLUMBAR vertebral fractures are becoming increasing trend in recent times which accounts 90% of all vertebral fractures. Spine trauma mostly caused by fall from height and RTA. There is a long-standing controversy for better course of treating spine fractures between short & long segment fixation which is still for debate. There are numerous studies and trails being conducted to compare clinical and radiological outcome between short and long segment posterior pedicle instrumentation. With the same background, our research was conducted to compare the better clinic-radiological outcome of short versus long segment posterior pedicular fixation for thoracolumbar spine fractures. **Aim & Objective:** This study was aimed to determine the better clinical & radiological outcome between SHORT SEGMENT versus LONG SEGMENT posterior pedicle screw fixation in D10 to L2 Thoracolumbar vertebral fractures.

Materials and Methods: It is a Retrospective and prospective study conducted at Department of Orthopaedics in Government Thiruvarur Medical college and Hospital, Thiruvarur between April 2022 to march 2024. This study includes 30 Thoracolumbar spinal fracture patients. 15 patients underwent short segment posterior stabilisation. 15 patients underwent Long segment posterior stabilization. **Inclusion Criteria**: ♦ Age more than 18 and less than 75 ♦ Fractures of dorsal & lumbar spine (D10 to L2) which may require fixation ♦ Fractures with or without neurological deficit ♦ Patients without any serious infections ♦ TLICS >3 ♦ Patient willing to participate in this study. **Exclusion Criteria**: ♦ Age less than 18 & more than 75 ♦ Spinal deformities ♦ Pre-existing uncontrolled medical illness ♦ Infection over local site ♦ Pre-existing vertebral body lesion ♦ Birth defects & spinal malformation ♦ TLICS <3 ♦ Metabolic bone disease ♦ Patient not willing to participate in this study.

Results: In this study of 30 patients with one year follow up, statistically there is no significant difference in kyphotic collapse between short and long segment. In terms of blood loss and procedure time, short segment with or without intermediate screw favours more compared to long segment fixation. long segment fixation provides decreased back pain and improved work function compared to short segment fixation. There are studies showing implant failure [pull out] among short segment fixation. The choice selection between short segment and long segment fixation should be opted based on patient selection and patient's necessity.

Keywords: Words: TLICS Score, Kyphosis, LS & SS long segment and Short Segment

INTRODUCTION

THORACOLUMBAR vertebral fractures accounts for 90% of spinal fractures, in recent times, which becoming increasing trends. Fall from height & road traffic accidents are most common leading causes of vertebral trauma. Compression, shearing & rotational forces acting on well extended or flexed vertebrae producing thoraco-lumbar fractures. Apart from mortality, weakness due to neurological impairment causing morbidity linked to 10%.[1]

In last few decades, due to contribution of radiological advancement, status of soft tissues like ligaments, nerves, discs and fracture pattern, along with pre-op, intra-op, post-op assessment were made possible. Owing to this, early diagnosis and better prognosis were made possible these days.[2]Steroids implementation reduces edema that decreased the impact of secondary injuries to nervous system were proven by many literatures.[3-6] Various modalities of surgical treatmentfor vertebral fractures were in practice such as posterior stabilization with pedicle screw fixation in long and short segment modality, anterior vertebral corpectomy and cord decompression to add an extra hands to the orthopedic surgeons for treatment of spinal fractures.[7,8]

Short segment versus long segment posterior stabilization is still in controversy in terms of better outcome which is a long history debate.[9,10] Long segment posterior fixation – involves fusion of two segments above and below the fractured vertebra. Short segment posterior fixation – involves, with or without intermediate pedicle screw in fractured vertebra, fusing / fixing one vertebra above & one vertebra below the fracture.[11,12] Each has its own advantage & disadvantages. pedicle screws and rods are employed Spine fixation. Long segment though stable results in more strain on adjacent vertebral discs and short segment fixation resulting in kyphotic collapse fixation failure.[13]Functional and radiological outcome of LS & SS posterior pedicle fixation were & are being analyzed by various studies.[14,15] our research was conducted, With the me background, to compare the better functional & radiological outcome of SS posterior fixation versus long segment posterior pedicular fixation for thoracolumbar vertebral fractures.

MATERIALS AND METHODS

It is a Retrospective and prospective study conducted at Department of Orthopaedics in Government Thiruvarur Medical college and Hospital, Thiruvarur between April 2022 to march 2024. After admission in trauma ward, initial evaluation and stabilization done using TLSO brace. Thorough survey of patient were done for head, chest, abdomen injury along with associated fractures. After clinical and radiological evaluation of patient, pt taken for posterior stabilization pedicle screw fixation.

This study includes 30 Thoracolumbar spinal fracture patients.

15 patients underwent short segment posterior stabilisation.

15 patients underwent Long segment posterior stabilisation.

Inclusion Criteria

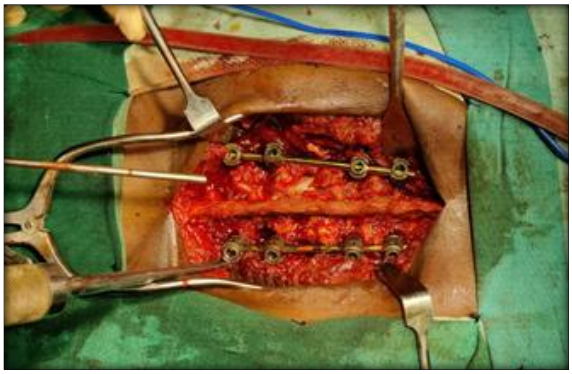
1. Age More than 18 and less than 75
2. Fractures of dorsal & lumbar spine (D10 to L2) which may require fixation
3. Fractures with or without neurological deficit or weakness.
4. Patients without any serious chronic infections.
5. TLICS >3 score [more than or equal to 4].
6. Patient willing to participate for procedure study.

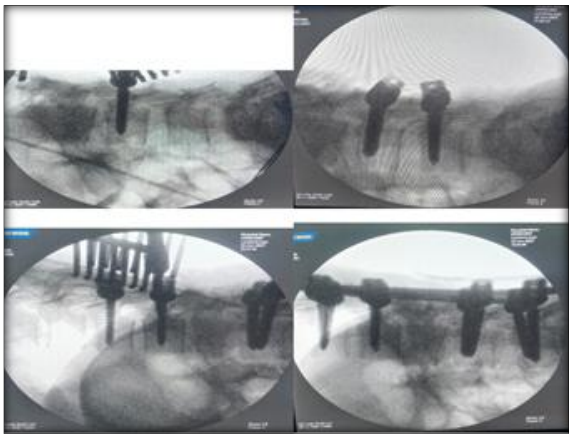
Exclusion Criteria

1. Age less than 18 & more than 75
2. Spinal deformities
3. Pre-existing uncontrolled medical illness
4. Infection over local site
5. Pre-existing vertebral body lesion
6. Birth defects & spinal malformation
7. TLICS </= 3
8. Metabolic bone disease

Operative Technique

A standard posterior approach was employed, with an incision made to access the spinous processes of the affected vertebrae. The surgical plane was established between the spinous processes and the paraspinal muscles. These muscles were elevated using a Cobb spinal elevator and reflected laterally with self-retaining retractors. Pedicle identification was based on the intersection between the mid-transverse process line and the longitudinal axis of the superior facet. Pedicle screws were inserted with the aid of an image intensifier. 1)Long Segment Fixation: Fixes two levels above and below the fracture, offering substantial stability but requiring fusion of a larger segment. 2)Short Segment Fixation with Index Vertebra: Involves fixation from a level above to a level below the fracture. After decompression, Connecting rods were placed and secured with screws.





Follow up:

atients were assessed post operatively using DENIS PAIN & WORK SCALE for clinical outcome; Plain radiograph for radiological outcome. Patient advised to review and follow up on

1. 12th POD (if discharged earlier)
2. Post operative one month
3. Every month till 6 Months Post op
4. Every two or three months till one year post op (depending upon patient compliance)

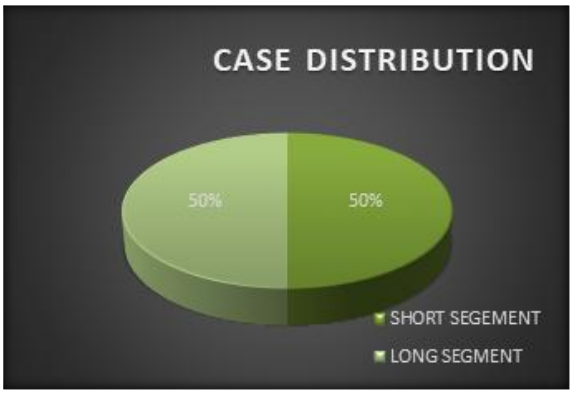
Statistical Analysis

Data were organized using MS Excel (Microsoft) and analysed with SPSS version 16 (IBM). Numerical variables, including age, Beck's index, and Cobb's angle, were summarized as means and standard deviations. Categorical variables, such as gender, mode of injury, diagnosis, and ASIA impairment scale, were reported as frequencies and percentages. Comparisons between independent and dependent variables were conducted using

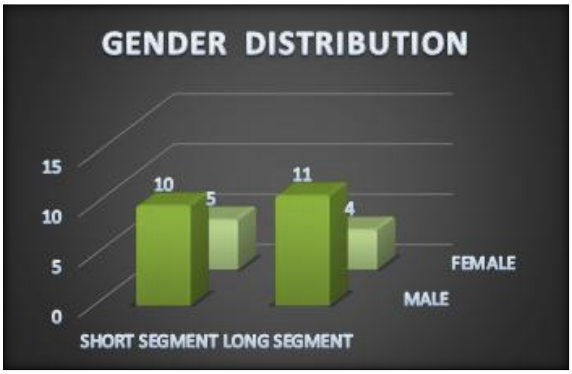
independent t-tests for numerical data and chi-square tests for categorical data. Timelines within each group were analysed using repeated measures analysis of variance (RMANOVA).Graphical representations of the data were created using pie charts, bar charts, and box-and-whisker plots. A p-value of less than 0.05 was considered statistically significant. A p-Value of more than 0.05 was considered to be statistically insignificant.

RESULTS

Among the 30 patients, 15 underwent short segment fixaton& 15 patients went for long segment pedicle screw fixation.

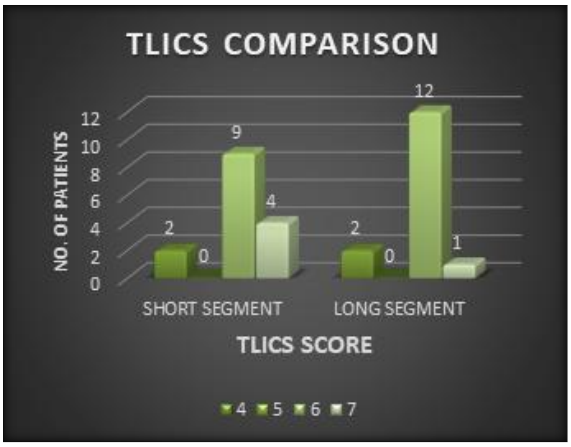


The mean age of short segment participants is 38.2 (± 12.9) years and 44 (± 14.3) in long segment group. The comparison is statistically insignificant meaning equal distribution among groups.

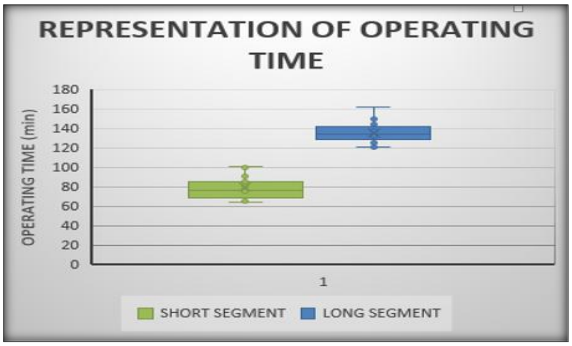


Most of the patients were male in both the group. The comparison of gender in both group was statistically insignificant inferring equal distribution between groups.

Among mode of injury, majority due to RTA in both the groups. The comparison among groups is statistically insignificant inferring equal distribution.

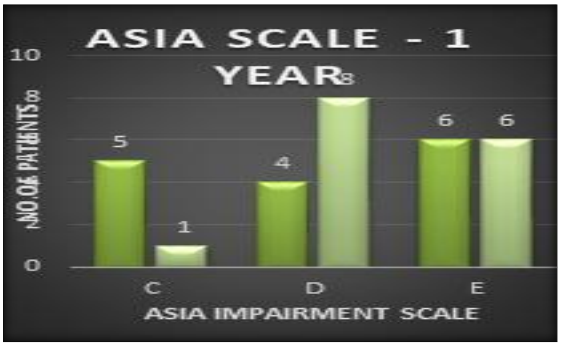


The comparison of TLICS among the groups shows, majority of the cases have TLICS score of 6 (SS-60%, LS -80%). This is statistically insignificant meaning equal distribution among groups.

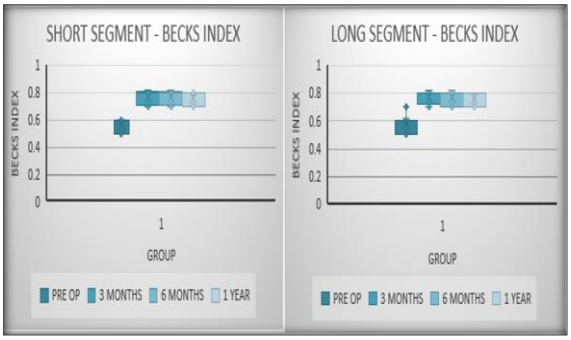


The procedure time for short segment was 79.4 (± 11.7) minutes and long segment was 136.1 (± 11.31) minutes. The time taken for procedure is shorter for short segment compared to long segment. Statistically significant (p value < 0.01) among groups.

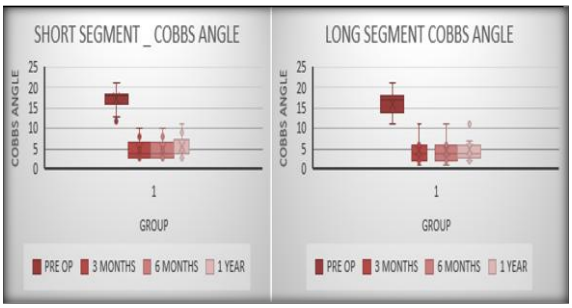
The blood loss in short segment was 876.7 (±189.8) & long segment was 1263.3 (±151.74) ml. The comparison between groups were statistically significant (p value <0.05). THE amount of blood loss is minimal in short segment compared to long segment.



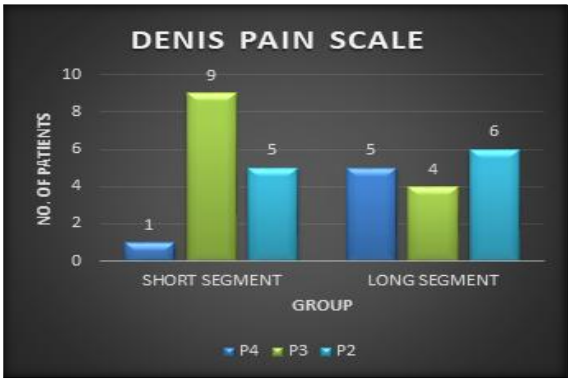
The comparison of ASIA impairment on pre op period,3, 6 & 12 months were depicted in above chart illustrating majority cases were in group D in all timeline. However, it is statistically insignificant among groups inferring equal distribution.



The beck's index of short segment & long segment depicted in above table & chart. The comparison between the groups is statistically insignificant inferring equal distribution among the groups.



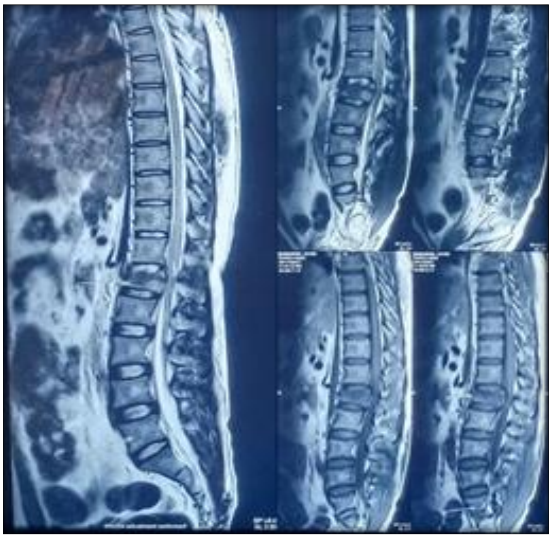
The Cobbs' angle of short segment & long segment depicted in above table & chart. The comparison between the groups is statistically insignificant inferring equal distribution among the groups.



In comparison of groups, majority of patients in long segment have P2 in Denis pain scale & W3 in work scale and majority of patients in short segment have P3 in Denis pain scale & W4 in work scale. Long segment patients perform well compared to short segment group.

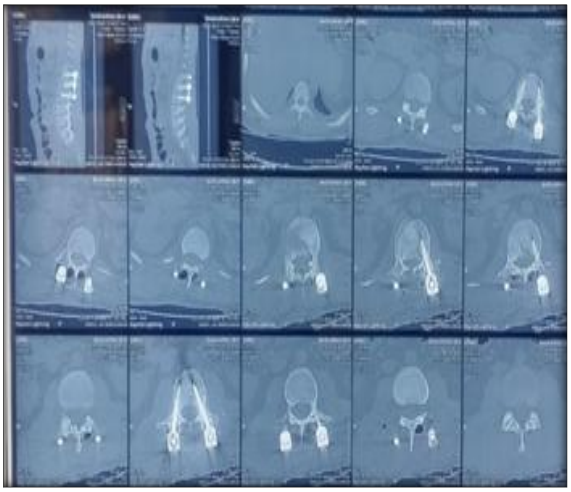
Long segment patient mobilised earlier compared to short segment groups with support. 2 patient in short segment group and 1 patient in long segment group were pareplegic& not entertained the mobilisation till hospital stay. However, all the patients were mobilised on subsequent follow up with or without support. Some of them in wheel chair mobilisation.

CASE ILLUSTRATION
CASE 1 - SHORT SEGMENT FIXATION

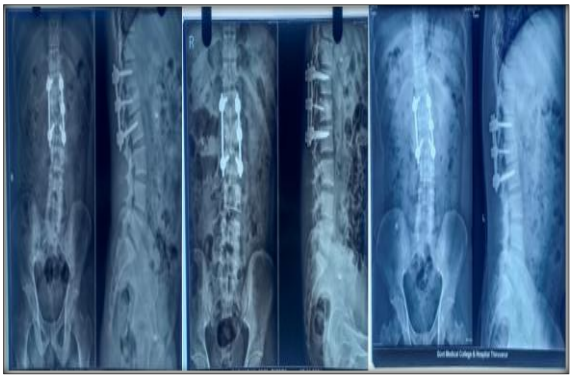


IMMEDIATE POST OP X RAY & CT IMAGES

1 MONTH POST OP X RAY



6 MONTH12 MONTH



CASE 2 - LONG SEGMENT FIXATION

6 MONTH POST OP 12 MONTH POST OP

IMMEDIATE POST OP X RAY1 MONTH POST OP

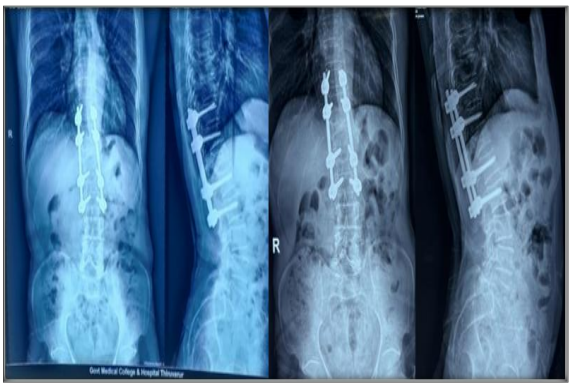


Table 5: Intervention distribution among the patients [n=30]

n = 30	NUMBER	PERCENTAGE
SHORT SEGEMNT STABILIZATION	15	50%
LONG SEGMENT STABILIZATION	15	50%

Tab 6: Age distribution among the groups [n=30]

AGE	GROUP	
	SHORT SEGMENT [n=15]	LONG SEGMENT [n=15]
MEAN	38.2	44
MEDIAN	39	45
MODE	20	42
STANDARD DEVIATION	12.9	14.3
P VALUE	>0.05 [INSIGNIFICANT]	

Tab 7: Gender distribution among the groups [n=30]

GENDER	GROUP, n [%]		
	SHORT SEGMENT (n = 15)	LONG SEGMENT (n=15)	p VALUE> 0.05 [INSIGNIFICANT]
MALE	10 [66.7%]	11 [73.33%]	
FEMALE	5 [33.3%]	4 [26.7%]	

Tab 8: Mode of injury among the groups [n=30]

MODE OF INJURY	GROUP, n [%]		
	SHORT SEGMENT (n = 15)	LONG SEGMENT (n=15)	p VALUE> 0.05 [INSIGNIFICANT]
RTA	8 [53.3%]	9 [60%]	
FALL FROM HT	5 [33.3%]	6 [40%]	
SELF FALL	2 [13.4%]	0	

Tab 9: Comparison of TLICS among the groups [n=30]

TLICS	GROUP [n %]		p VALUE
	SHORT SEGMENT (n=15)	LONG SEGMENT (n=15)	
4	2[13.3%]	2[13.3%]	0.328
5	0	0	

6	9 [60%]	12 [80%]	>0.05
7	4[26.7%]	1 [6.7 %]	[insignificant]

Tab 10: Comparison of procedure time among the groups [n=30]

OPERATING TIME	GROUP		p VALUE
	SHORT SEGMENT [n=15]	LONG SEGMENT [mins]	
MEAN	79.4	136.1	<0.001
MEDIAN	77	134	
STANDARD DEVIATION	11.7	11.31	

Tab 11: Comparison of blood loss among the groups [n=30]

BLOOD LOSS	GROUP		p VALUE
	SHORT SEGMENT [n=15]	LONG SEGMENT [n=15]	
MEAN	876.2	1263.3	< 0.001
MEDIAN	800	1250	
STANDARD DEVIATION	189.8	151.74	

Tab 12: ASIA impaiment scale in different time line among the groups [n=30]

ASIA IMPAIRMENT SCALE		GROUP, n %		p VALUE
		SHORT SEGMENT (n=15)	LONG SEGMENT (n=15)	
PRE-OP	C	6 (40%)	8 (53.3%)	0.751
	D	8 (53.3%)	6 (40%)	
	E	1 (6.7%)	1 (6.7%)	
3 MONTHS	C	6 (40%)	5 (33.3%)	0.809
	D	8 (53.3%)	8 (53.3%)	
	E	1 (6.7%)	2(13.3%)	
6 MONTHS	C	5 (33.3%)	2(13.3%)	0.297
	D	6 (40%)	10(66.7%)	
	E	4 (26.7%)	3 (20%)	
1 YEAR	C	5 (33.3%)	1 (6.7%)	0.135
	D	4 (26.7%)	8 (53.3%)	
	E	6 (40%)	6 (40%)	

Tab 13: Comparison of Beck's index among the groups [n=30]

BECKS INDEX	GROUP (SD)		p VALUE
	SHORT SEGMENT [n=15]	LONG SEGMENT [n=15]	
PRE OP	0.6[.05]	0.6[.07]	0.541
3 MONTHS	0.77[.05]	0.77[.048]	0.828
6 MONTHS	0.8[.05]	0.8[.05]	0.886
1 YEAR	0.76[.049]	0.77[.047]	0.74

Tab 14: Comparison of cobb's angle among the groups [n=30]

COBBS ANNGLE	GROUP (SD)		p VALUE
	SHORT SEGMENT [n=15]	LONG SEGMENT [n=15]	
PRE-OP	17.2 (2.70)	16.1 (3.09)	>0.05 [INSIGNIFICANT]
3 MONTHS	5.1 (2.43)	4.5 (2.50)	
6 MONTHS	5.1 (2.43)	4.6 (2.56)	
1 YEAR	5.6 (2.72)	4.8 (2.46)	

Tab 15: Comparison of DENIS pain & work scale among the groups [n=30]

		GROUP, n %		p VALUE
		SHORT SEGMENT (n=15)	LONG SEGMENT (n=15)	
DENIS PAIN SCALE	P4	1 (6.7%)	5 (33.3%)	0.096
	P3	9 (60.0%)	4 (26.7%)	
	P2	5 (33.3%)	6 (40.0%)	
DENIS WORK SCALE	W5	2 (13.3%)	1 (6.7%)	0.863
	W4	7 (46.7%)	6 (40.0%)	
	W3	5 (33.3%)	7 (46.7%)	
	W2	1 (6.7%)	1 (6.7%)	

Tab 16: Comparison of complications among the groups [n=30]

COMPLICATIONS	GROUP [n%]		p VALUE
	SHORT SEGMENT [n=15]	LONG SEGMENT [n=15]	
UTI	1	1	>0.05 [INSIGIFICANT]
WOUND SITE INFECTION	1	2	
BED SORE	2	1	
NIL	11	11	

Tab 17: Comparison of mobilisaton day among the groups [n=30]

MOBILISATION DAY	SHORT SEGMENT [n=15]	LONG SEGMENT [n=15]
<2 DAY	2	4
2-14 DAYS	6	8
< 14 DAYS	4	2

DISCUSSION

Several studies have highlighted a significant failure rate associated with short-segment pedicle instrumentation, despite its perceived advantages. Notable failures include: progressive kyphosis due to screw bending, kyphosis resulting from vertebral collapse or translation without hardware bending, and segmental kyphosis following the fracture of a caudad screw in the lumbar construct. The high failure rate has been linked to factors such as pre-stressing screws during rod shaping and untreated anterior instability,[73,74,82,83] Altay et al,[72] suggested that increasing the length of the construct by incorporating four pairs of screws (two above and two below the fracture) could enhance stability and effectively reduce kyphotic deformity. For certain thoracolumbar junction fractures, short-segment posterior fixation can yield positive clinical and radiological results. However, to prevent implant failure and ensure adequate anterior column support, careful patient selection for short-segment fixation is crucial.[72]Peters et al,[87] conducted a biomechanical comparison between long and short-segment fixation and found that long-segment fixation was stiffer under all loading conditions, whether or not anterior column augmentation was used. Additionally, the use of screws two levels above and below the fracture not only increased stability but also effectively reduced kyphotic deformity.[88]

Surgical intervention for thoracolumbar fractures aims to minimize disruption to patients' lives, with pain relief and radiological correction being key outcomes. According to patient assessments using the Denis Pain and Work Scale, both short and long-segment posterior fixation methods were evaluated. While pain and return-to-work scores improved less in the short-segment group, the differences were not statistically significant, allowing for comparison between the two groups. Our research noted kyphosis progression in both fixation groups, although no significant difference was observed at the final follow-up.

CONCLUSION

In this study of 30 patients with one year follow up, statistically there is no significant difference in kyphotic collapse between short and long segment. In terms of blood loss and procedure time, short segment with or without intermediate screw favours more compared to long segment fixation which will be more optimal for high risk, uncontrolled co-morbid patients. Despite procedure time, complication rates are providing comparable results between both groups. But clinically, long segment fixation provides decreased back pain and improved work function compared to short segment fixation. There are studies showing implant failure [pull out] among short segment fixation.

In conclusion, even though, kyphotic correction between short and long segment fixation found to be statistically insignificant, long segment fixation provides better clinical results in terms of working capability and back pain. The choice selection between short segment and long segment fixation should be opted based on patient selection and patient's necessity. Further studies with long term follow-up and larger sample sizes would be needed for definite conclusion.

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