ORIGINAL ARTICLE

Anterior Versus Posterior Stabilization in Thoracolumbar Spinal Trauma

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ABSTRACT:

Objective: *Spinal Injuries are one of the major neurotrauma challenges that every neurosurgeon has to face in a busy neurosurgical department. With Recent advances in the field of neurospinal instrumentation it is mandatory to understand the mechanism of injury and the biomechanics of spinal instrumentation for the ultimate care and best outcome in these unfortunate patients[1]. The objective of study was to determine, any difference in radiological, clinical and functional outcome, when patients of thoracolumbar trauma are treated by posterior approach or by anterior approach. This study looks into the different factors responsible in stabilization of these injuries by studying anterior versus posterior instrumentation.*

Study duration: *We are presenting a series of 100 cases of dorsolumbar injuries managed surgically at the Department of Neurosurgery Lahore General Hospital Lahore during the past* ***three years (Dec 2004 to Nov 2007)****.*

Study Design: *Comparative and observational.*

Material and Methods: *This is a review of 100 cases of thoraco-lumbar injuries admitted in the Department of Neurosurgery Unit II, PGMI / Lahore General Hospital Lahore. Most of the patients were admitted through emergency, remaining from OPD or referred cases. A special performa was filled for each case and operative procedure was recorded after personal discussion of senior consultants. Special consultation was give to neurological deficit, hospitals stay, deformity and canal compromize.*

Results: *Mostly patients were in their second and third decade of life, although males were predominant. Patients were divided into three groups. In* ***group I****, neurologically intact patients with radiological evidence of instability were included. Trans-pedicular screw stabilization (Stryker system) and bony fusion was done in all twenty patients. In* ***group II*** *were complete paraplegic patients with bony injury. In all thirty patients again, Trans-pedicular screw stabilization (Stryker system) and bony fusion was done. In* ***group III*** *included* ***incomplete*** *neurological injury patients. Among them twenty five patients were operated by* ***posterior*** *approach while other twenty five were operated by* ***anterior decompression, cage and plating****. The clinical and radiological outcome was discussed along with literature review and controversies in the management of such injuries.*

Conclusion: *Our study shows that patients with either no neurological deficit or having complete neurological deficit should be operated through posterior approach. The patients with incomplete or partial deficit, should be operated through anterior or posterior approach. All patients having canal compromise more than 50% and kyphotic deformity more than 20% were operated by anterior approach by anterior decompression and fixation using titanium cages that were further augmented by plates and screws. While all patients having canal compromise less than 50% and kyphotic deformity less than 20% were operated by posterior approach through transpedicular fixation with rods and screws by using stryker system.*

Key Words: *Thoracolumbar Injuries, Spinal Trauma, Anterior and Posterior stabilization.*

INTRODUCTION

Spinal column fractures are common entity seen by neurosurgeons. Approximately 50,000 spinal column fracture occurs per year in USA. This kind of trauma is also quite common in our setup. Thoracic and Thoracolumbar junction is the commonest site of spinal injury[2]. The biomechanics of thoracolumbar junction make this area prone to trauma. Thoracolumbar junction is a site of structural and functional transition and it acts like a fulcrum while transfer of energy from dorsal to lumbar spine[3]. Thus majority of thoracic and lumbar spinal column fractures occur at thoracolumbar junctional zone from T10 to L4.And almost 75% occur at $D_{12} – L_1$ area.

Harrington in 1940's at Jefferrson Davis City county hospital tried to correct the scoliotic curvature in poliomyelitis patients by correcting the position of the facet joints by using screws. The initial results were encouraging, but long term results were poor. During this period the techniques advanced from use of **facet screws** alone to the placement of hooks on posterior elements, followed by combined use of stainless steel hooks and rods[4]. Gradually with passage of time engineers worked to develop metals that could undergo more repetitive stress, as previously used metal instrumentation failed for long term use. Later on concurrent **fusion techniques** with **bone graft** to supplement fixation strength were used. In this way through efforts of Harrington and colleagues, these procedures were used to treat spinal deformity, including traumatic fractures, spondylolisthesis, and idiopathic scoliosis. This idea of using internal stabilization to correct spinal deformity marks the beginning of modern era of spinal instrumentation. Then dwyer, Moe Kaneda Aebi and many more contributed a lot for **spinal instrumentation**[5].

Despite the fact that thoracolumbar spinal fractures are common, there are various opinions regarding selection of approach for management of unstable injuries. Some surgeons favored that optimal surgical approach should be from **direction of compressive mass**. If compression is anterior, anterior approach should be adopted while in case of posterior compression posterior approach should be selected. Those who favor strictly **anterior approach**, claimed complete canal clearance and decompression, followed by reconstruction and fixation just by anterior approach. Likewise supporters of posterior approach claimed same results with more safe and more precise posterior instrumentation and **fusion**. No doubt the selection of surgical approach is a hard task for neurosurgeons, as many and many times, the surgeons are biased.

MATERIAL AND METHODS

This was a comparative and observational study, conducted at department of Neurosurgery Unit II Lahore General Hospital Lahore and Post graduate Medical Institute Lahore. Duration of study was 3 years from Dec. 2004 to Nov. 2007. **We included all patients of thoracolumbar spinal trauma who presented within ten days after injury** (irrespective of their age and sex). In all patients routine investigations were performed. X-rays of spinal column and C.T Scan with saggital reconstruction and MRI of spine were also investigation of choice. Anterior versus posterior approach was selected depending upon type of injury, level of injury, degree of kyphotic deformity, vertebral body collapse, spinal canal compromise and neurological status (Frankle Grade) of patients. Outcome measures were assessed in terms of hospital stay, cost, operative time, blood loss, restoration of alignment (radiographic results) and neurological functional, pain outcome, and post operative complications.

RESULTS

Grouping and Surgical Procedure:

We divided our patients into three groups according to their neurological status.

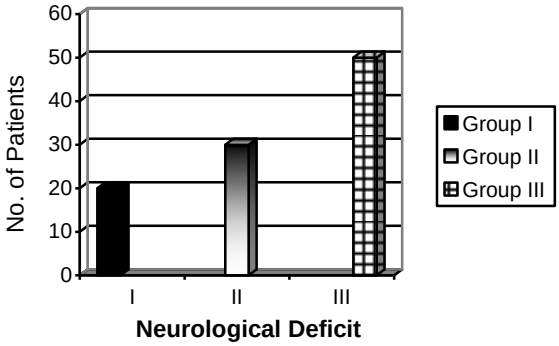
Group I: In group I included neurologically **intact** patients having radiological evidence of instability. All twenty patients were operated by **posterior approach**.

Group II: In group II included all **complete paraplegic** patients and all thirty patients were operated again by **posterior approach**.

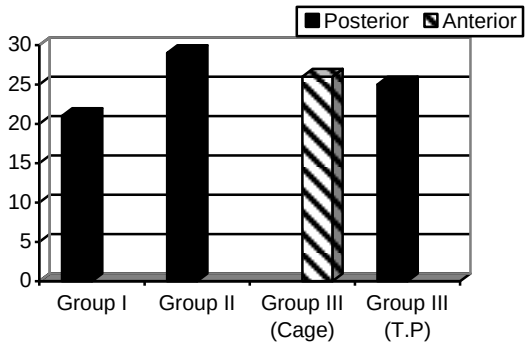
Group III: In group III comprised of partial injury patients, half of them were operated by posterior approach while other half by anterior approach (Table I), (Graph IA and 1B).

Table I: *Neurological Status and grouping of the patients.*

Group I	Group II	Group III
Intact	Complete Deficit	Partial Deficit
Posterior Approach	Posterior Approach	Posterior/Anterior Approach



Graph 1A: *Thoracolumbar Spinal Injuries (grouping depending upon Neurological deficit).*



Graph 1B: *Selected Surgical Approach.*

Age Incidence

In all three groups mostly patients were **young adults**. Most of the patients were between **20-40 years** of age as below:

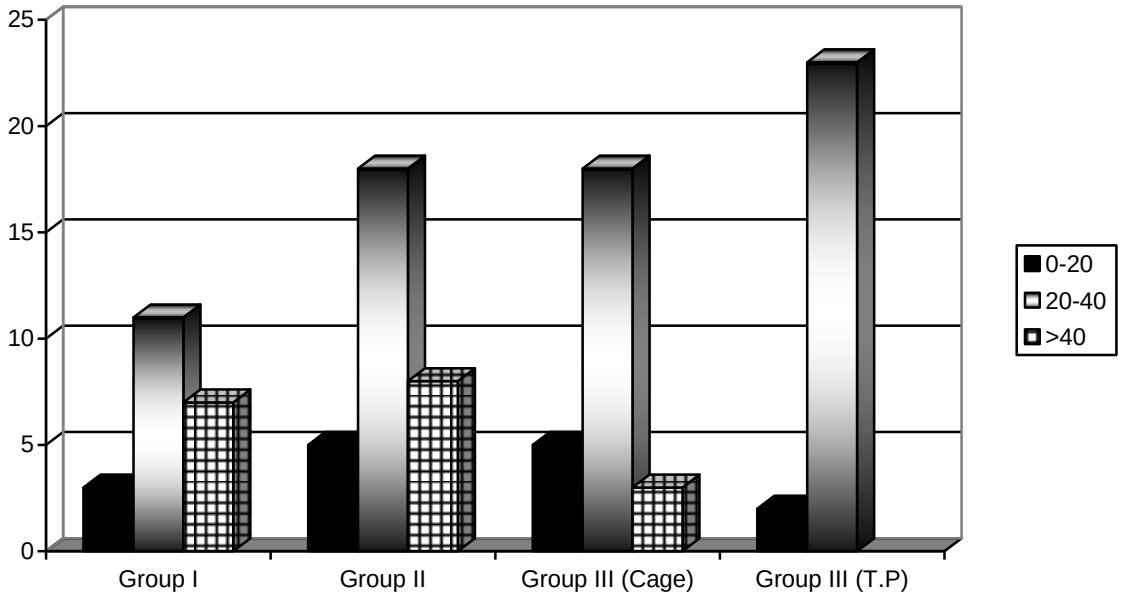
In group I eleven (55%).

In group II seventeen (56.66%).

In group three cage fixation subgroup seventeen (68%), and in T.P fixation subgroup twenty three (92%) patients (Table 2), (Graph 2) were between the age of 20-40 years of age.

Table 2: *Age Range.*

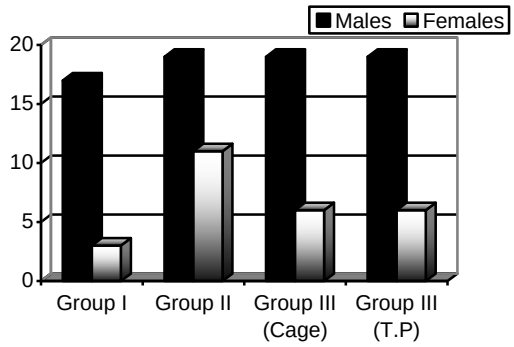
Groups	Total Patients	0-20 years	20-40 years	>40 years
Group I	20	3	11	6
Group II	30	5	17	8
Group III (Cage)	25	5	17	3
Group III (T.P)	25	2	23	0



Graph 2: *Age Range.*

Table 3: *(Sex Incidence).*

Groups	Total Patients	Males	Females
Group I	20	17	3
Group II	30	19	11
Group III (Cage)	25	19	6
Group III (T.P)	25	19	6
	Grand Total	74	26



Graph 3: *Sex Incidence.*

Sex Incidence;

Males were predominant in all three groups. Among 100 cases 74 were male and 26 cases were female.

Group I: Among neurologically intact patients, out of twenty, seventeen (85%) were males and three (15%) were females.

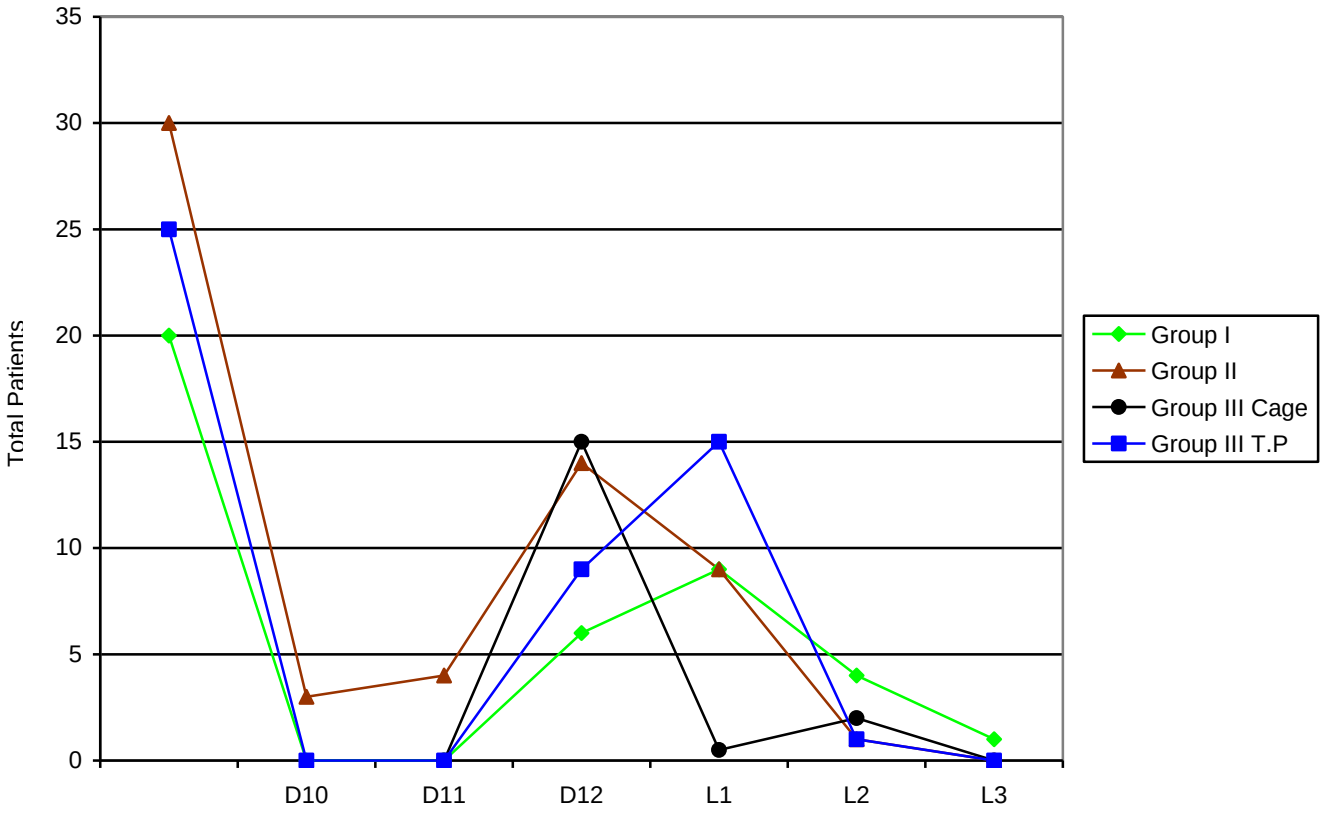
Group II: Among complete paraplegic patients out of thirty patients, nineteen (63.33%) were males and eleven (36.66%) were females.

Group III: Similarly in partial injury patients nineteen (76%) were males and six (24%) were females **in each subgroup**, operated by cage and T.P Fixation respectively (Table 3), (graph 3).

Fracture Site;

Fracture D_{12} and L_1 forms the main bulk of fracture involved in all groups, and **fracture L_1** is the main culprit in most groups.

Group I: Among neurologically intact patients L1 involved in nine (45%) patients followed by D_{12} (30%), L_2 (20%) and L_3 (5%) vertebrae.



Graph 4: *Vertebrae involved and number of patients in various groups.*

Group II: In complete paraplegic patients D_{12} involvement was most common in fourteen (46.66%) patients, followed by L_1 (30%), D_{11} **(13.33%) and D_{10} (10%) vertebrae**.

Group III: In the same way L_1 was involved in fifteen (60%) patients each in both subgroups of partial injury patients (Table 4), (graph 4).

Table 4: *Involved Fracture Vertebrae.*

Groups	Total Patients	D_{10}	D_{11}	D_{12}	L_1	L_2	L_3
Group I	20	0	0	6	9	4	1
Group II	30	3	4	14	9	0	0
Group III Cage	25	0	0	7	15	3	0
Group III T.P	25	0	0	9	15	1	0

Type of Fracture

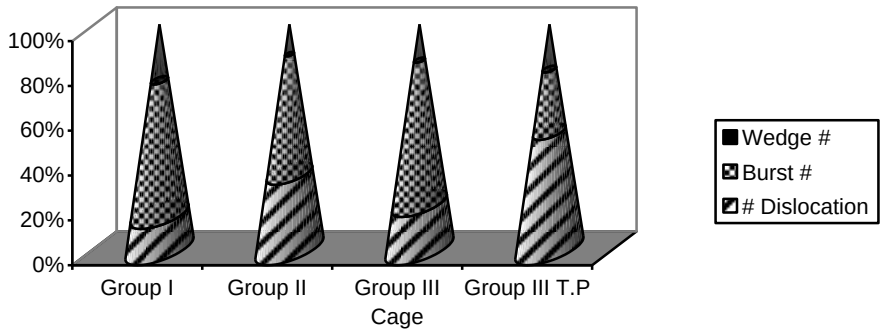
Burst fractures and fracture dislocation were the most commonly found fractures than simple wedge fractures in almost all groups. In group I patients burst fracture was found in twelve (60%) patients, followed by wedge fracture (25%) and fracture dislocation (15%).

In group II patients, burst fracture was most commonly found in sixteen (53.33%) patients than fracture dislocation (33.33%) and wedge fracture (13.33%).

Group III: In this group patients, among cage fixation subgroup burst fracture was the culprit in sixteen (64%) patients followed by fracture dislocation (20%) and wedge fracture (16%). While in T.P fixation subgroup fracture dislocation was most commonly found in thirteen (52%) patients, followed by burst fracture (28%) and wedge fracture (20%) patients, (Table 5), (Graph 5).

Table 5: *(Type of Fracture).*

Groups	Total Patients	Wedge #	Burst #	# Dislocation
Group I	20	5	12	3
Group II	30	4	16	10
Group III (Cage)	25	4	16	5
Group III (T.P)	25	5	7	13
Total	100	18	51	31



Graph 5: *Type of Fracture.*

Canal Compromize and Kyphotic Deformity

The main selection criteria in group III, was canal compromise and kyphotic deformity, to decide whether to operate patient by anterior or posterior approach.

Criteria for Anterior Approach (Group III) Partial Deficit

All patients having canal compromise more than 50% and kyphotic deformity more than 20% were operated by anterior approach by performing corpectomy (decompression) and then by fixation using titanium cages that were further augmented by plates and screws.

Criteria For Posterior Approach

In group III all patients having canal compromise less than 50% and kyphotic deformity less than 20% were operated by posterior approach through transpedicular fixation with rods and screws by using stryker system.

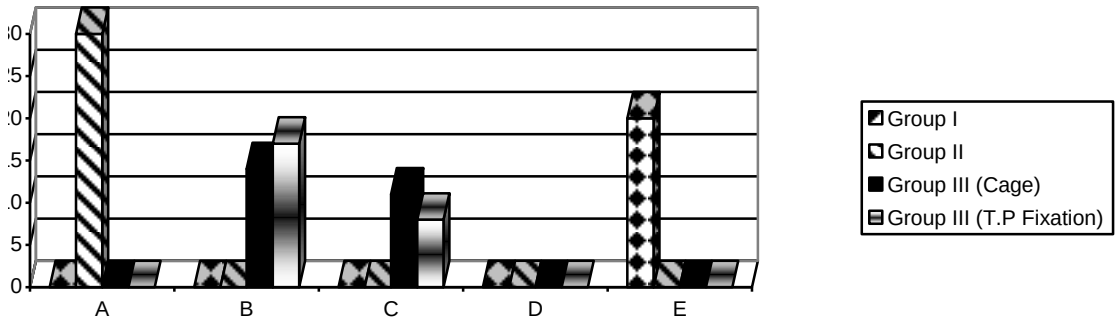
Table 6A: Frankel Grading used in Spinal Injuries.

Grade	*Description*
A	*Complete range of Neurological status preserved only Neuchal pain*
B	*Radicular pain or deficit*
C	*Incomplete tetra-paraparesis but able to walk*
D	*Incomplete tetra-parapresis and unable to walk*
E	*Paraplegia or Tetraplegial*

Table 6B: *Frankle Grading of Patients.*

Group	No of Patients	A	B	C	D	E
Group I	20	0	0	0	0	20
Group II	30	30	0	0	0	0
Group III (Cage)	25	0	14	11	0	0
Group III (T.P)	25	0	17	8	0	0

In **group I and group II** patients all patients were operated by **posterior approach** through transpedicular fixation irrespective of canal compromise and kyphotic deformity.



Graph 6: *Frankle Grade.*

As in group I five (25%) patients have canal compromise more than 50%, and in one (5%) patient kyphotic deformity was more than 20%. Likewise in group II canal compromise was more than 50% in twenty (66.66%) patients and kyphotic deformity waste more than 20% in eight (26.66%) patients, but all of them were operated by posterior approach.

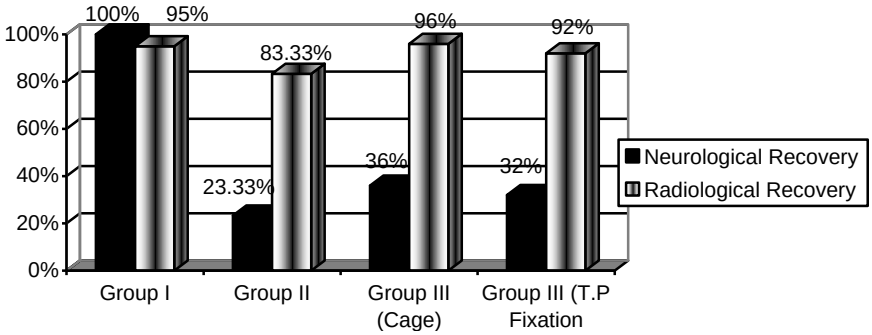
Table A shows the Frankle grading and Table 6B shows number of patients according to Frankle grading system.

Table 7: *(Post operative Recovery).*

Group	No of Patients	Neurological Recovery	Radiological Recovery
Group I	20	100%	95%
Group II	30	23.33%	83.33%
Group III (Cage)	25	36%	96%
Group III (T.P)	25	32%	92%

Frankle Grade

In **group I** we included all patients having frankle grade E, means neurologically **intact** patients. **In group II** we included all patients having frankle grade **A**, means patients having **complete deficit**. Among **group III** patients were those having frankle grade B, C and D. By chance we did not receive a single patient having frankle grade D. In cage fixation subgroup fourteen (56%) patients have frankle grade B and eleven (44%) patients have grade C.



Graph 7: *Post operative Recovery.*

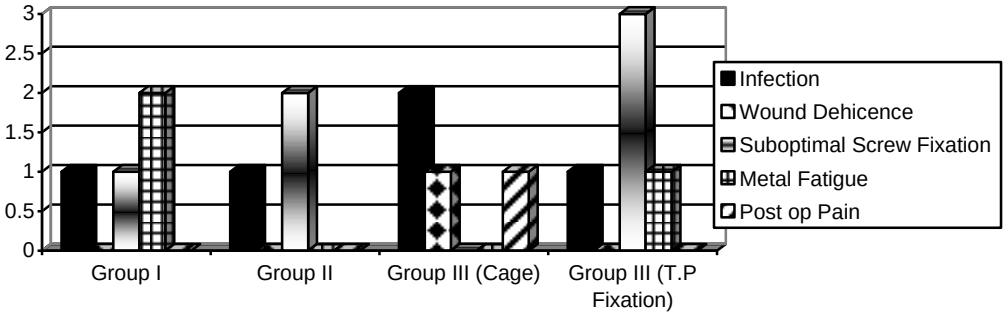
While in transpedicular fixation subgroup seventeen (68%) patients have grade B and eight (32%) patients have grade C.

Post operative Recovery; Post operative follow-up revealed neurological **recovery of at least one frankle grade** in

many patients of group II and group III. Group I patients were already neurologically intact, however radiological alignment seen in 95% pat-ents. Among group II patients' neurological recovery was seen in seven (23.33%) patients and radiological recovery in twenty five (83.33%) patients. In group III cage fixation subgroup, neurological recovery observed in nine (36%), and radiological recovery in twenty four (96%) patients. In T.P fixation subgroup, neurological recovery was seen in eight (32%) and radiological alignment in twenty three (92%) patients (Table 7), (Graph 7).

Table 8: *(Post operative Complications).*

Group	No of Patients	Wound Infection	Wound Dehiscence	Suboptimal screw Fixation	Metal Fatigue	Post op Pain
Group I	20	1	0	1	2	0
Group II	30	1	0	2	0	0
Group III (Cage)	25	2	1	0	0	1
Group III (T.P)	25	1	0	3	1	0



Graph 8: *Post operative Complications.*

Post operative Complications

Some post operative complications were seen in different groups.

Group I: Among neurologically intact patients, wound infection seen in one (5%) patient and metal fatigue (screw broken post operatively due to mobility forces) in two (10%) patients. Suboptimal screw fixation (screw track partially outside the redicle) without pedical breech seen in one (5%) patient.

Group II: In complete paraplegic patients wound infection in one (3.33%) and suboptimal screw fixation in two (6.66%) patients were seen.

Group III: Among cage fixation subgroup of group III, wound infection in two (8%), wound dehiscence in one (4%), and persistent post operative pain seen in one (4%) patient respectively.

In transpeducular (T.P) fixation subgroup wound infection in one (4%), suboptimal screw fixation in three (12%), and broken screw was seen in one (4%) patient respectively, (Table 8), (Graph 8).

Other Outcome Measures

1. *Duration of Surgery*

The duration of operation in Transpedicular fixation was average two hours, while in cage fixation it is three hours.

2. *Blood Loss*

The blood loss was 1 pint in T.P Fixation as compared to two pints in cage fixation.

Table 9: *(Outcome Measures).*

Group	Duration of Operation	Blood Loss	Post operative Hospital Stay
T.P Fixation	2 Hours	1 Pint	4 Days
Cage Fixation	3 Hours	2 Pint	7 Days

3. *Hospital Stay*

Posteriorly operated patients were discharged on fourth post operative day, in comparison with cage fixation patients, who were discharged on seventh post operative day.

DISCUSSION

The selection of surgical approach for instrumentation and stabilization has been a hard soil for neurosurgeons. Criteria for choosing operative approach for thoracolumbar spinal injuries remain controversial.

A. **Posterior Approach**

Kaya and Ayden from Istumbul Turkey documented that adequate neural canal decompression can be achieved by transpedicular approach for surgical treatment of severe thoracolumbar fractures[6], their results are quite comparable with our study, we operated all patients who were neurologically intact or having complete paraplegia with posterior approach. Another study concluded that absolute majority of injuries of thoracolumbar spine may be treated from posterior by using internal fixator and only few patients required complementry anterior approach in first or second step[7]. Payer demonstrated improved outcome by posterior fixation for unstable thoracic fractures[8]. A study from Germany concluded improved radiological and clinical outcome after posterior instrumentation and transpedicular bone grafting[9]. Most of these studies are comparable with our work, as we operated our **majority** of patients especially all patients of group I and II by **posterior approach** by using **Stryker System**. It is one of the efficient pedicular system providing immediate rigid segmental fixation, early mobilization with out need of post operative bracing. It eases nursing care. System includes polyaxial titanium screws and rods. Unique distractor devise augment correction of kyphotic deformity. Moreover we use bony graft posteriorly for long term bony union.

B. **Anterior Approach**

Kirkpatric from Birmingham university favored **anterior surgical approach** for **thoracolumbar burst fracture** in patients with neurological deficits. According to him surgery is often **indicated** for patients with **incomplete deficit**, with **large retropulsed fragment**, severe canal compromise and marked anterior communition[10]. Sasso, Best and Reilly from Indianal spinal group concluded from their forty patients of thoracolumbar injury that anterior spinal instrumentation and reconstruction techniques are enough for three column thoracolumbar spinal injuries without the need of supplemental posterior instrumentation[11]. These studies reflect same criteria and same results which we have selected in our partial injury patients, as we also operated our all **partial injury** patients, having **severe canal** compromise and **kyphotic deformity** by **anterior approach**. Davis and Tribus also supported the effectiveness of anterior corporectomy, strut grafting and Z plate fixation in thoracolumbar spinal injuries[12], Davis strategy is again like us in partial injury patients, however we use **corporectomy**, **cage fixation**, and **anterior titanium plate fixation with screws**. Tezar and Oztuck assessed the complication and radiological outcome of patients with cage fixation and found that in seventeen % patients cage settling can occur[13], Luckily so far we did not see even a single case of cage settling, However other complications are comparable. A school of biomedical engineering consider the effectiveness of **bioabsorbable** anterior lumbar **plate fixation** along with **cage** assisted **anterior interbody fusion**[14].

C. **Combined Approach (Anterior and Posterior)**

Payer from Switzerland found that **posterior** bisegmental transpedicular fxation and **staged anterior** corporectomyand titanium cage implantation is safe and reliable surgical treatment for thoracolumbar spinal injuries[15], compare to Payers work we did not operate a single patient by concurrent anterior and posterior approach.

Siebena and Vincent concluded in their multicenter prospective randomized study that spinal fractures without neurological deficit managed with short segment **posterior stabilization** will show improved radiographic outcome along with same functional outcome. This study is absolutely the same what we have done in our group I patients. Been and Bouma from university of Amsterderm Netherland compared **combined** anterior and posterior stabilization versus posterior instrumentation and found **similar** clinical outcome in both groups[16]. Another study from General Hospital Greece by Korovessis and Baikousis compared combined anterior and posterior versus posterior approaches. It also concluded that short segment transpedicular fixation offered similar radiological and better clinical results with burst fracture[17]. But short segment transpedicular fixation is not recommended for operative stabilization with **severe kyphotic deformity**. Our work also favored same policy. Scheen and Ansell also documented almost same criteria[18]. Certain new advancement seen in thoracolumbar spinal stabilization as Barnas, Dudziah and others used posterior **keyhole corporectomy** with percutaneous trans-pedicular fixation[19].

CONCLUSION

Our study shows that:

1. Patients with either no neurological deficit or having complete neurological deficit should be operated through posterior approach.
2. Patients with **incomplete or partial deficit**, should be operated through anterior or posterior approach depending upon canal compromize and kyphotic deformity.

All patients having canal compromise more than 50% and kyphotic deformity more than 20% were operated by anterior approach by anterior decompression and fixation using titanium cages that were further augmented by rods and screws. While all patients having canal compromise less than 50% and kyphotic deformity less than 20% were operated by posterior approach through transpedicular fixation with rods and screws by using stryker system.

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