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Comparative Study of Outcome of Treatment of Traumatic Paraplegia by Hartshill Fixation vs Pedicle Screw Fixation

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Introduction

Epidemiological factors of spinal cord injury in Indian scenario are different from western countries with major cause being fall. The low socio-economic status and younger age group had a major financial, social and psychological impact as majority of the patients were the primary earning members of the family. According to a study (Mathur N et al .2015), among 2716 cases of Spinal cord injury, 1400 were cervical and 1316 thoracolumbar, with male to female ratio of 4.2:1 and 71% in the age group of 20-49 years. Around 79% patients were from rural background. About 23.3% were farmers while 22.9% were laborers. Among the causes of injury, 53% patients had a fall from height and 28% suffered from road traffic accidents. Fall of heavy object over the head and back (10.7%), fall with heavy object over the head (3.0%) and fall following electric shock (4.0%) were uncommon causes. Complete paralysis was found in 20.5% cervical and 23.3% in thoracic injuries. Extremity and rib fractures (10.6%) and head injuries (7.2%) were common associated injuries. About 55% cases were initially attended at non-specialized centres. Proper bladder and bowel management in early phase was lacking. However according to another study conducted at Indian Spinal Injury Centre, New Delhi, the mean, median and mode for the age were 34.4, 32 and 30 years, respectively. Male: female ratio was 5.9:1. RTA was the most common (45%) and fall from height the second most common (39.63%) mode of injury. Overall, 66.67% suffered from paraplegia and 71.18% had complete injuries. The study suggests that the demographics of spinal injury in India differs significantly from that in the developed countries since there was a lower mean age, much larger number of males, married individuals, injuries due to two-wheeler accidents/falls, paraplegics and complete injuries.

In the Delphi process, a panel of scientific experts in the field of acute Spinal Cord Injury (including basic scientists, clinician-scientists, surgeons, rehabilitation specialists, nurses, and clinical epidemiologists) consensually endorsed the recommendation for use of ASIA Standards for assessment of motor and sensory function (based on pin-prick and light-touch sensation) and Visual Analog Scale (VAS) for assessment of pain intensity in patients with acute Spinal Cord Injury. In the modified Delphi process surgical decompression of the injured spinal cord should be performed within 24 hours.

The majority of spinal fractures occur in the thoracolumbar region (T10-L3) presumably as a

result of transition from the relatively immobile thoracic spine to the mobile lumbar spine. Spinal fractures include compression, burst, flexion-distraction and fracture-dislocation injuries, with burst fractures accounting for 10% to 20%.

Nonoperative treatment may include the use of a brace, cast, bed rest, and analgesics. Operative treatment usually involves instrumented intervertebral fusion, with or without spinal decompression. The three major surgical approaches for stabilization are posterior, anterior, or combined AP.

Many controversies are present regarding the outcome of different instrumentation systems for the treatment of traumatic paraplegia. Biomechanical performance of different spinal fixation devices has been studied extensively in laboratories but comparative clinical outcome data are few. This study compares the internal fixation devices Hartshill (based on sublaminar wiring to gain purchase on the posterior column structure alone) and pedicle screw fixation (in which all the three spinal columns may be fixed directly and are able to reduce fractures of these columns by ligamentotaxis). Newer systems and techniques are continuously becoming available and old systems are being modified. Long term follow-up studies in addition to randomized prospective studies are needed to appropriately evaluate the efficacies of these systems. As our knowledge and experience grows, we will be able to better determine the limitations, indications and usefulness of these systems.

In India a developing country, we have followed the same international approach for spinal injuries, but with limited resources.

Aims and Objectives

- To evaluate the outcome of surgical decompression of spinal cord either by Hartshill fixation or pedicle screw fixation.
- Time taken for recovery of neurological functions (sensory, motor, bowel and bladder), blood loss during surgery, duration of surgery.
- Comparison of mechanical stability of implants.
- To compare the incidences of complications, etc.

Material and Methods

- Prospective study done in department of orthopaedics, KMCH, Katihar (Bihar).
- 20 cases of traumatic paraplegia (complete or incomplete).
- Posterior stabilization of the spine was done either by Hartshill or Pedicle screw fixation.
- Duration of study-1year 6months.

Inclusion Criteria

- injury of vertebra of dorso-lumber spine;
- skin condition of operative field-normal;
- proper consent.

Exclusion criteria

- patients with head injury;
- patients unfit for surgery (during pre-anaesthetic check-up).

Investigations

- The ABC (airway, breathing and circulation)of ATLS (Advanced Trauma Life Support is completed first. Then following methods are used :

1) Selection of cases: proper history taken;
2) Full physical examination, examination of spine, neurological examination;
3) Lab investigations like CBC, ESR, Blood sugar etc;
4) ECG.
5) Imaging- X-Rays of spine& chest, MRI, etc.

Results and Analysis

Age and gender distribution

Here we got male : female ratio = 4:1 and highest percentage of casualties belong to age group 26-30 years (25%). Female cases were maximum in 16-20 years age group (10%). 70% cases were reported from rural areas

AGE	NUMBER	MALE URBAN	MALE RURAL	FEMALE URBAN	FEMALE RURAL
16-20	2(10%)	0	0	1 (5%)	1 (5%)
21-25	3(15%)	1 (5%)	2 (10%)	0	0
26-30	5(25%)	1 (5%)	3 (15%)	0	1(5%)
31-35	2(10%)	1 (5%)	1(5%)	0	0
36-40	2(10%)	0	1(5%)	0	1(5%)
41-45	1(5%)	1 (5%)	0	0	0
46-50	1(5%)	0	1(5%)	0	0
51-55	2(10%)	1 (5%)	1(5%)	0	0
56-60	2(10%)	0	2(10%)	0	0

Occupational incidence: (40%) were farmers by occupation and manual labourers (35%).

Occupation	No. of patients
Farmer	8 (40%)
Manual labourer	7 (35%)
Sedentary workers	4 (20%)
Unemployed/housewives	1 (5%)

Mechanism of injury

Mechanism of injury	No of patients
Fall from height/stairs	11(55%)
Road traffic accidents	7 (45%)
Fall of heavy objects over the back/head	1 (5%)
Fall following electric shock	1 (5%)

Vertebra involved

Vertebra	Number of patients
T 9	1 (5%)
T 10	1 (5%)
T 11	2 (10%)
T 12	4 (20%)
L 1	5 (25%)
L 2	4 (20%)
L 3	2 (10%)
L 4	1 (5%)

Type of paraplegia

Type	Number of patients
Complete	11 (55%)
Incomplete	9 (45%)

Initial observation (Asia Impairement Scale)

Grade	Number of patients
A	11 (55%)
B	5 (25%)
C	4 (20%)
D	Nil
E	Nil

Classification of fractures

Type	Number of patients
Dislocation/displacement	2 (10%)
Flexion osseoligamentous disruption	2 (10%)
Flexion chance fracture	2 (10%)
Burst fracture	4 (20%)
Wedge/impaction	10 (50%)

Time elapsed after injury (at presentation)

Days	No of patients
0-3	8
4-7	4
8-11	2
12-15	2
16-19	2
20-24	2

Time of decompression

Days	No of patients
0-3	8
4-7	4
8-11	2
12-15	2
16-19	2
20-24	2

Onset of sensory recovery

Onset of sensory recovery	Number of patients treated by: Hartshill fixation	Pedicle screw fixation
1st week	5 (25%)	4(20%)
2nd week	3 (15%)	4(20%)
3rd week	1 (5%)	1(5%)
4th week	1 (5%)	1(5%)

Onset of motor recovery

Onset of motor recovery (INCOMPLETE PARAPLEGIA)	Number of cases treated by: Hartshill	Pedicle screw fixation
1ST Week	2 (22.2%)	3(33.3%)
2nd Week	2 (22.2%)	1(11.1%)
3rd Week	0	1(11.1%)
4th Week	0	0

Among 9 cases of incomplete paraplegia treated, there was recovery of power mostly from grade 3 to grade 4 or grade 4 to grade 5 in almost all cases as shown in chart.

However out of 11 cases of complete paraplegia 6 were treated by Hartshill fixation & 5 by Pedicle screw fixation. Here power of tibialis anterior, extensor hallucis longus, flexor hallucis longus & gastrosoleus did not return; but there was improvement in hip abductors, quadriceps, hamstrings from grade 0 to grade 2 or 3. Hip flexors improved upto grade 3 or 4. Pattern of improvement was comparatively same for both Hartshill and Pedicle screw fixation.

Bowel & bladder functions recovery

- Autonomic in all cases of complete paraplegia.
- Among the incomplete paraplegics – normal in 4(2 patients treated by Hartshill fixation and another 2 by Pedicle Screw Fixation).
- Hesitancy & incontinence in 5 cases (2 cases by hartshill and 3 cases by Pedicle screw fixation).

Onset of motor recovery (COMPLETE PARAPLEGIA)	Number of cases treated by: Hartshill	Pedicle screw fixation
1st week	0	0
2nd week	1(9.09%)	1(9.09%)
3rd week	2 (18.2%)	3(27.3%)
4th week	2(18.2%)	1(9.09%)
5th week	1(9.09%)	0

Time for bladder recovery	Number of patients treated by: Hartshill	Pedicle screw fixation
2nd week	1	1
3rd week	1	0
4th week	2	2
5th week	0	1
8th week	0	1

Blood loss during surgery

Amount of blood loss	Number of patients treated by: Hartshill	Pedicle screw fixation
500 ml	0	3
600 ml	1	5
700 ml	3	2
800 ml	3	0
900 ml	3	0

Duration of surgery

- Hartshill took 45 minutes to 1 hr more time than pedicle screw fixation.

Cost effectiveness

- Pedicle screw fixation is 8 to10 times costlier than Hartshill fixation.

Stability of implant

- In one patient of Pedicle Screw Fixation, there was loosening of the pedicle screw innie followed by loosening of the rod (in figure below).
- In our study Hartshill provided somewhat more stability for posterior stabilization of the spine (wire tightening should be done cautiously as tensile fatigue of wire leads to breakage).

Complications

Complications	Number of patients treated by: Hartshill	Pedicle screw fixation
Infections	2(10%)	1(5%)
Bed sores	2(10%)	2(10%)
Loosening of implant	0	1(5%)
Post op increase in neuro deficit	1(5%)	1(5%)
Late back/leg pain	6(30%)	5(25%)

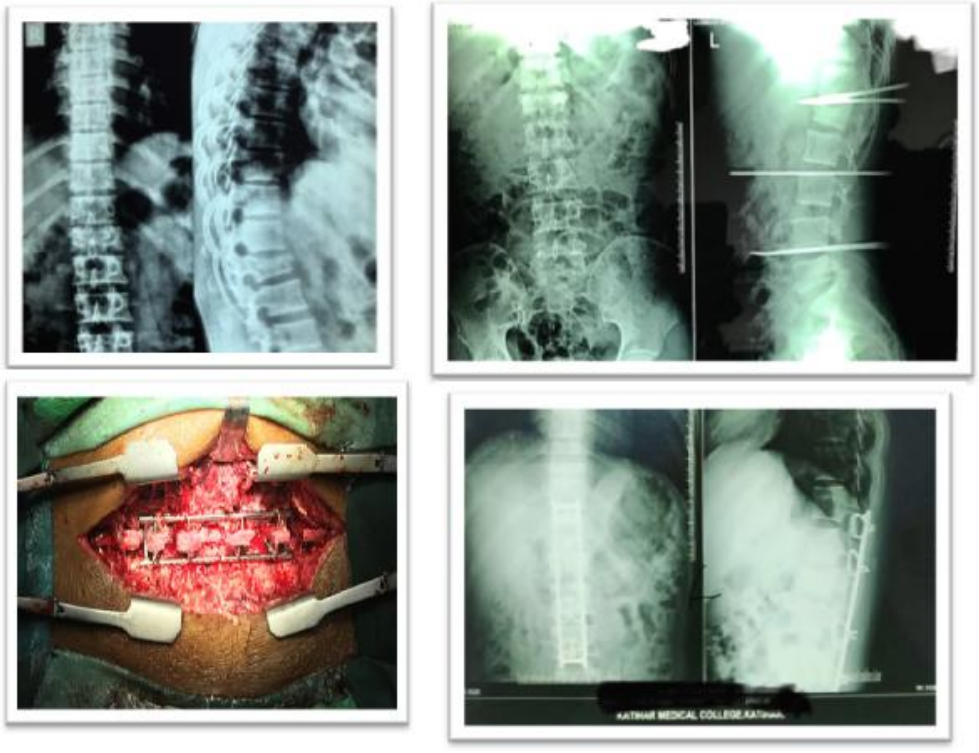
Use of C-Arm

Hartshill fixation needs minimal /no use of c- arm while Pedicle Screw Fixation is fullyc- arm dependent surgery.

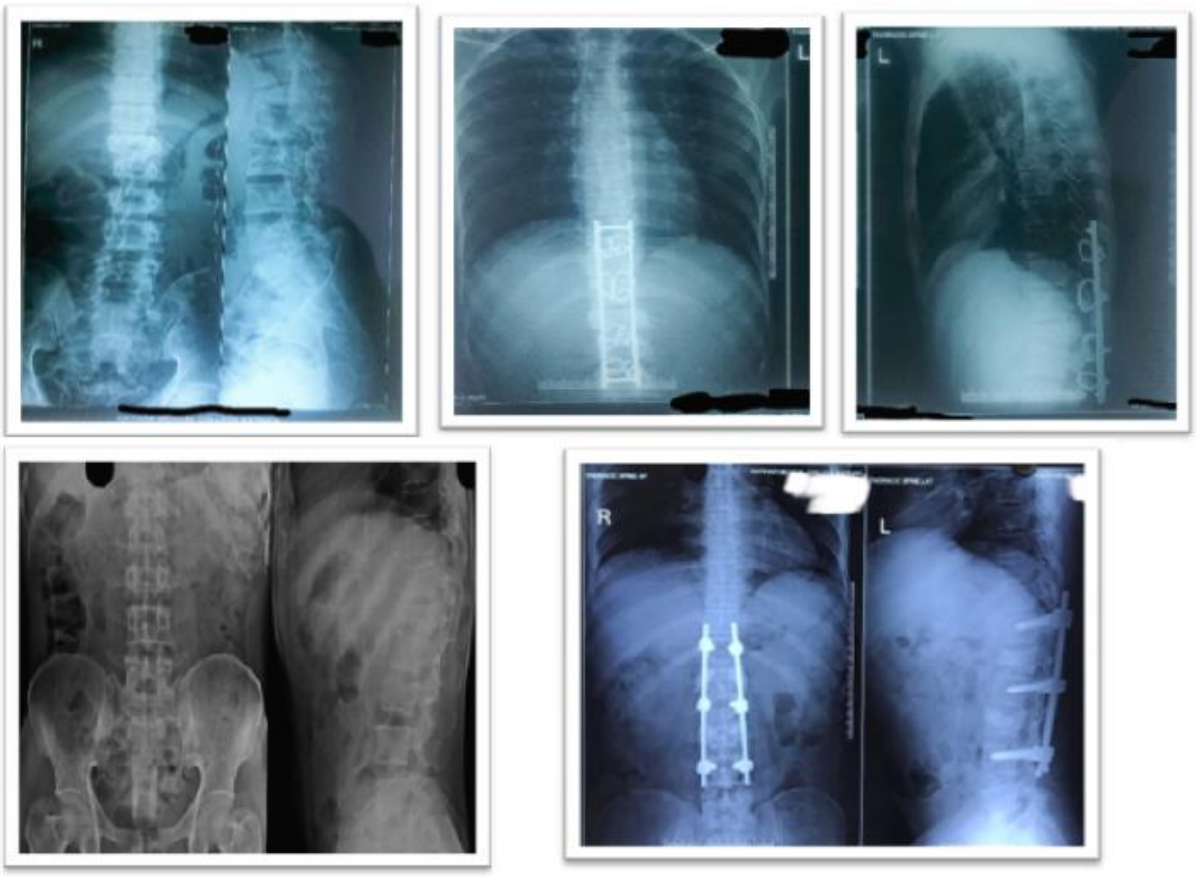
Conclusion

- With respect to sensory/motor recovery Hartshill and pedicle screw fixation gives about similar results.
- Hartshill proves out to be better implant when compared regarding stability in this study.
- More chances of post-operative low back ache and back muscles stiffness in Hartshill.
- With respect to duration of surgery and intra operative blood loss pedicle screw fixation is better option.
- Since Hartshill is much cheaper than pedicle screw fixation so in Kosi region of Bihar, Hartshill is preferred in many cases.
- Over use of C-arm is a concern, so Hartshill (with minimal or no use of c-arm) is better than pedicle screw fixation (c-arm based surgery).
- However, to establish the superiority of one implant over the another, more study is needed.

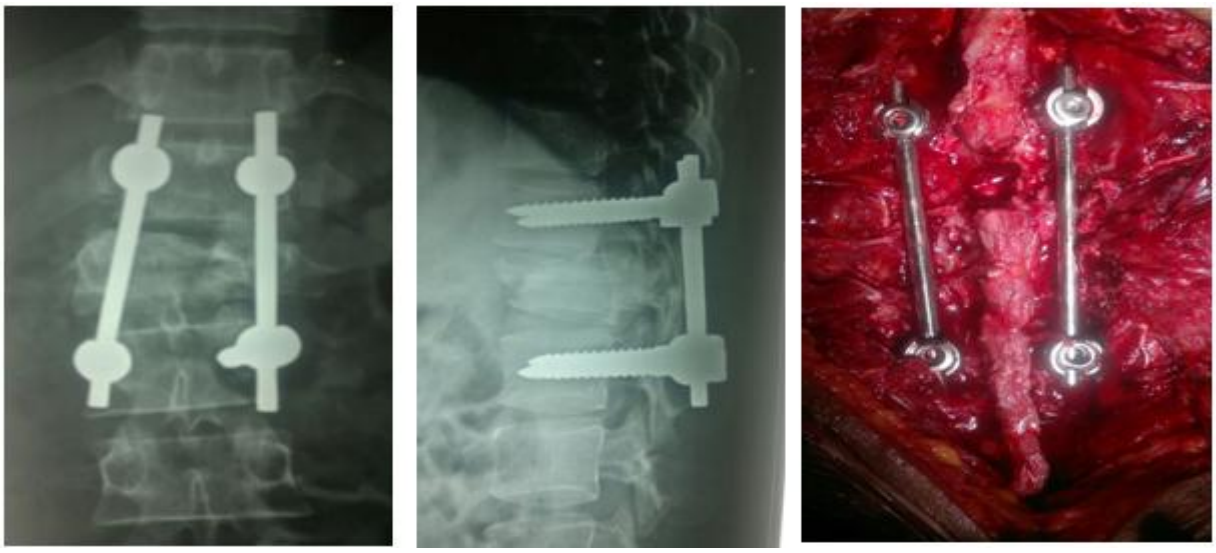
Case 1



Case 2 & Case 3



Case 4



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