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Functional outcome of cervical spine locking plate fixation in traumatic quadriplegics

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Abstract

Introduction: The cervical spine column is extremely vulnerable to injury due to its specific facet joint articulation. The most serious complication quadriplegia occurs in almost 40 to 50% of cases. Surgery is indicated if signs of instability, significant dislocation or neurological deficit are present. Over the last 15 years, the anterior approach has become the gold standard.

Aim of Study: To evaluate the functional, clinical and radiographic results of traumatic cervical spine instability which were treated surgically using Cervical Spine Locking Plate (CSLP) fixation and anterior interbody fusion with tricortical iliac crest bone graft.

Materials and Methods: This is a prospective and retrospective study

23 Patients who attended the Orthopaedics casualty Medical College Kozhikode, with traumatic quadriplegia due to lower cervical spine injury who were treated with anterior cervical locking plate during a period of 2 years from June 2010 onwards were studied. The outcome of the treatment was compared in terms of relief of symptoms, neurological recovery, clinical and radiological stability and improvement of rehabilitation. The cases were followed up for 2 years from the beginning of the treatment.

Analysis and Results: The following observations were made from this study. The youngest patient in the study was 16 and the oldest 65 years. The most common level of injury in this study was C5-C6 (11 patients), Only 9 patients were treated within 72 hours. Neurological recovery was evaluated by preoperative and postoperative FRANKEL and ASIA scores. All patients were densely quadriplegic before surgery, 6 patients had no change in neurology and expired in postoperative period. Excellent neurological recovery was seen in only minimal number of patients. In the postoperative period, for functional outcome measurement, patients were evaluated using modified ODOMS criteria. Out of all the patients, 13 had good fusion status.

Conclusion: The ideal management of traumatic cervical spine instability in lower cervical spine injury is anterior stabilization with cervical spine locking plate. The surgery related complications are relatively very less, and the survived patients had significant improvement in their neurological and functional status. All the patients had good radiological fusion and no complications in union.

Keywords: Cervical Spine Injury, Locking Compression Plate, Anterior Stabilisation, Tricortical iliac crest Grafting

Introduction

The cervical spine column is extremely vulnerable to injury due to its specific facet joint articulation which allows movement in the planes of flexion, extension, lateral bending and rotation. Effective management requires in depth knowledge of many factors including injury detection, injury description, classification and an algorithmic approach to treatment decision making. The most serious complication quadriplegia occurs in almost 40-50% of cases. The objective of surgical treatment is to stabilize the injured motion elements securely, in conjunction with restoring normal anatomy in order to preserve function and prevent secondary neurological damage. Accurate diagnosis making indications for conservative treatment or surgery, performing technically demanding surgery-usually with special instruments- and perioperative management represents the core task of cervical spine injury management. The objective of surgical treatment is to stabilize the injured motion elements securely, in conjunction with restoring normal anatomy in order to preserve function and prevent secondary neurological damage.

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So called stable injuries are treated by conservative means with soft or hard cervical collars and halo fixators. Surgery is indicated if signs of instability, significant dislocation or neurological deficit are present.

Following trauma, lower cervical spine stabilization can be carried out using an anterior, posterior or combined approach. Over the last 15 years, the anterior approach has become the gold standard due to minimal surgical trauma, low intraoperative blood loss and good neck stability allowing early movement and rehabilitation. Various plates and screws for anterior stabilization of the cervical spine have been developed Bicortical screw fixation has been widely replaced with unicortical screw fixation, eliminating the danger of dural injury during fixation. Since 1986, angular stable plates have been used as they provide greater stability.

Aim of the study

The purpose of this study is to evaluate the functional, clinical and radiographic results of traumatic cervical spine instability which were treated surgically using Cervical Spine Locking Plate(CSLP) fixation and anterior inter body fusion with tricortical iliac crest bone graft.

Materials and Methods

Study design

Prospective and retrospective study

Methods of data collection

23 Patients who attended the Orthopaedics casualty Medical College Kozhikode, with quadriplegia due to lower cervical spine injury who were treated surgically with CSLP during a period of 2 years from June 2010 onwards were included in the study. All the variables such as age, sex, level of the injury, degree of neurological deficit, co morbid conditions of these patients were recorded. Those patients with 2 or more vertebral involvement was classified under severe disease. Preoperative realignment of cervical spine was achieved with crutchfield tongs traction followed by operative reduction, decompression and stabilization with anterior interbody fusion with tricortical iliac crest bone graft.

The outcome of the treatment was compared in terms of relief of symptoms, neurological recovery, clinical and radiological stability and improvement of rehabilitation. The cases were followed up for 2 years from the beginning of the treatment.

All cervical spine injuries (CSI) were prepared for fixation with CSLP. But many could not be taken up for surgery due to severely compromised general condition, lack of fitness for anaesthesia or death in early hours of injury Those patients with excellent and stable reduction due to traction were not taken up for surgery if the MRI showed no significant cord compression.

Patients and Methods

Patients were treated by one or two level anterior discectomy and inter body fusion using autologous tricortical iliac crest bone graft and CSLP (cervical spine locking plate). Indications for surgery were traumatic cervical spine instability and quadriplegia. Intra operative parameters such as blood loss and operation time were assessed. Prior to surgery and at follow-up (6, 12, and 24 months), neurological and overall outcome was assessed using the Frankel, ASIA impairment Scale, modified Barthel index and Odom's criteria, respectively. In addition, radiographic evaluation, including plain x-rays, flexion-extension views, and MRI scans was performed. Fusion, segmental mobility, segmental

lordosis or kyphosis and disc space height were determined. Cervical spine follow up evaluation was carried out during the periods of follow up.

Inclusion Criteria

1. Age between 16 and 65 years.
2. Isolated trauma of the cervical spine i.e., no other spine injury
3. Cervical spine instability at C3-C4, C4-C5, C5-C6, and C6-C7.

Exclusion Criteria

1. Patients with multiple zone spinal injury.
2. Posterior cervical spine surgery necessary.
3. Significant metabolic bone disease, such as osteoporosis or osteomalacia.
4. Patients with rheumatoid arthritis
5. Excessive surgical risk.
6. Previous cervical spine surgery.
7. Upper cervical spine injury.

Approach to surgery

The anterior approach is used. The patient is placed supine, often with Crutch-field traction tongs with weights attached. A transverse skin crease neck incision will suffice to access the top to the bottom of the cervical spine. The incision is placed superior or inferior, depending on the level to be operated. We operate always on the left side. The platysma is divided and the medial border of sternocleidomastoid is dissected. The carotid artery is palpated and it should be lateral to the exposure. The sternothyroid and sternohyoid muscles are retracted medially with the underlying trachea and pharynx or oesophagus. The several layers of the prevertebral fascia are divided exposing the longus colli muscles, which are dissected laterally using bipolar coagulation. Self retaining cervical retractors are placed just under the longus colli muscles. Potential damage to the recurrent laryngeal nerve can cause vocal cord palsies and damage to the superior laryngeal nerve may cause difficulty in swallowing. The relative lack of muscle dissection with this approach, makes it well tolerated and less painful than the posterior approach. The fracture of the spine is usually obvious but image intensification is useful to not only confirm the level but to assess on table reduction of the fracture. In cases of anterior column fracture, often the whole vertebral body is disrupted thus necessitating a corpectomy. This has also been termed 'trenching'. This is achieved by using a high-speed drill, which unlike using ronguers puts less pressure on a potentially compromised spine. The disc material is completely removed and the cartilaginous end plates are curetted away. Remnants of the posterior longitudinal ligament are removed using small Kerrison up-cuts. Once spinal canal decompression has been achieved, autologous bone graft from the anterior superior iliac crest is measured, harvested and inserted into the trench or disc space. Our practice is to then plate the adjacent vertebrae. Cervical traction is removed at this stage. We use the shortest Cervical Spine Locking Plate possible to prevent involvement of other vertebral levels. The advantage is that the screws maintain rigid alignment of the bone grafts. The dynamic plates, which allow vertical translocation but prevent lateral and antero posterior translocation, permit the bone graft to collapse or telescope into the bodies, which reduces the likelihood of the screws loosening as the construct matures. Lateral dissection is limited to avoid injury to the vertebral artery.

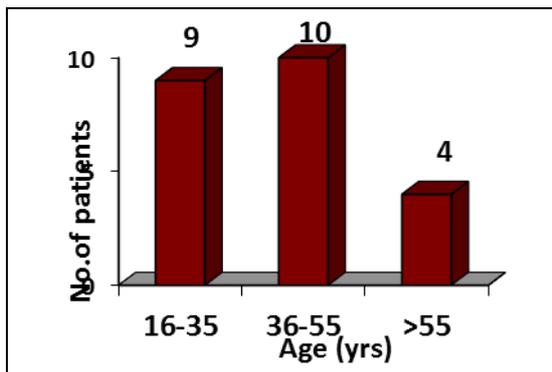
Cervical spine injuries are treated only with Titanium implants in our hospital. The advantages of titanium implant are its better bio compatibility and non-interference with magnetic resonance imaging of the spinal cord in the post operative phase. The structure of spinal cord can be well assessed with the implant in place.

Results and Analysis

The following observations were made from the data collected during this study of cervical spine locking plate fixation in traumatic quadriplegics.

Age Distribution

The youngest patient in the study was 16 and the oldest 65 years. 39.13% of the patients were below 35 years and 43.47% were between 36-55 years and 17.39% were above 55 years of age.



Sex distribution

In this study all the patients were males. The reason may be that head load workers are usually males.

Hospital stay

The minimal number of days of hospital stay is 5 days, and the highest is 45 days.

Mechanism of injury

It is grouped into 3 categories: Fall with head load -20 cases, Road Traffic Accidents - 2 cases and Assault -1 case.

Associated injuries

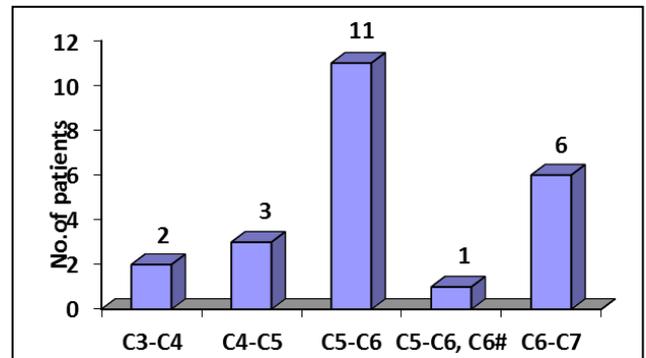
Only two patients had associated injuries, i.e., one had a rib fracture and another one had a metatarsal fracture.

Classification by AO system

Out of 23 patients, 9 patients were B1, 6 patients were B2, 3 patients were B3 and 5 patients were C2. Only B classification

types are usually operated because the other types such as type A are stable and without neurological deficits which are managed conservatively and in type C, the survival chance of the patient is very low.

Level of Injury The most common level of injury in this study is C5-C6 (11 patients), with next highest value for C6-C7 (6 patients).



Delay in surgery

Only 9 patients were treated within 72 hours. All other surgeries were delayed more than 72 hours. The delay in surgery was due to co morbid conditions, and lack of fitness for anaesthesia.

Post op Period

It was uneventful in 17 cases. One patient developed pleural effusion, another had pneumonitis, and 4 persons had cardio respiratory arrest (CRA) and all of them expired. This may be due to severity of spinal cord injury leading to respiratory paralysis. Once the patient had survived the postoperative period death due to trauma and trauma related complications such as postural pneumonia, bed sore or septicemia were rare as early mobilization was possible after surgery.

Neurological Recovery

Preoperative and postoperative FRANKEL and ASIA scores were evaluated. All patients were densely quadriplegic before surgery, 6 patients had no change who expired in postoperative period. Of the survived patients, 3 had postoperative FRANKEL and ASIA scores-E, 3 had postoperative FRANKEL and ASIA scores D, 6 had postoperative FRANKEL and ASIA scores C, 5 had postoperative FRANKEL and ASIA scores B. excellent neurological recovery is seen only minimal number of patients, i.e., D or E in 6 patients.

Table 1: Neurological recovery

	Preop Frankel		Postop Frankel		Preop ASIA		Postop ASIA	
	No.	%	No.	%	No.	%	No.	%
A	23	100	6	26.1	23	100	6	26.1
B	-	-	5	21.7	-	-	5	21.7
C	-	-	6	26.1	-	-	6	26.1
D	-	-	3	13	-	-	3	13
E	-	-	3	13	-	-	3	13

Modified ODOMS criteria

In the post-operative period, for functional outcome measurement, patients were evaluated using modified ODOMS criteria. Only 6 patients had good amount of functional recovery.

BARTHEL Index

It is an activity score of the patients treated in regard to feeding, bathing, grooming, dressing, bowels, bladder, toilet use, transfers, mobility and stairs. It is a score of 0-100. In this study 4 patients got excellent functional recovery. 7 patients

had good, 3 had fair and 9 including the expired patients had poor recovery.

>90=excellent,65-90=good,50-64 =fair, <50=poor

Radiological Fusion

Out of all the patients, 13 had good fusion status, 3 had average and 1 had poor. 6 patients expired in the postoperative period and fusion could not be assessed.

Table 2: Radiological fusion

Radiological fusion	No. of patients	Percentage
Good	13	56.5
Average	3	13.0
Poor	1	4.3
Expired	6	26.1
Total	23	100.0

Bladder Control

Of the 23 patients, 3 had bladder control, 7 does self intermittent catheterisation (SIC), 13 on continuous bladder drainage(CBD) in Foleys catheter In spite of good neurological recovery only 3 patients had achieved good bladder control.

Period of follow up

2 patients had follow up for 24 months, 6 had for 18 months,

5 for 12 months, 1 patient for 6 months, 2 for 3 months and 7 including 6 patients who expired in the post operative period for less than 3 months.

Delay in Surgery

The number of patients undergone the surgery within 72 hours (golden period) is only 9. And there is no significant difference in the survival of early or delayed cases.

Delay in surgery and recovery

There is significant p value in comparison with early versus delayed surgery patients. Early patients had got better recovery in both ASIA and Frankel scores. But there is no significant p value in comparing Barthel index.

Level of injury and recovery

On comparing the level of injury and recovery, i.e., level with that of the Barthel index and post operative ASIA, there is poor recovery with one patient and one with excellent at C3-C4, but the number of patient is only 2. So that value is not significant.7 out of 12 patients at C5-C6 had fair to excellent recovery. Since the number of patients in the total study is only 23, the significance in the value of recovery cannot be counted much as it may vary with large number of patients.

Level and Barthel index

Table 3: Level and Barthel index

Barthel index	C3-C4		C4-C5		C5-C6		C6-C7		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
0	1	50	2	66.7	5	41.7	1	16.7	9	39.1
50							1	16.5	1	4.3
55					2	16.7			2	8.7
60			1	33.3	2	16.7			3	13
65					1	8.3	3	50	4	17.4
90	1	50			2	16.7	1	16.7	4	17.4
Total	2	100	3	100	12	100	6	100	23	100

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.067	15	.447

Level and ASIA score

Table 4: Level and ASIA

ASIA	C3-C4		C4-C5		C5-C6		C6-C7		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
1	1	50	2	66.7	2	16.7	1	16.7	6	26.1
2					4	33.3	1	16.7	5	21.7
3			1	33.3	2	16.7	3	50	6	26.1
4					3	25			3	13
5	1	50			1	8.3	1	16.7	3	13
Total	2	100	3	100	12	100	6	100	23	100

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.650	12	.395

Level and Frankel score

Table 5: Level and Frankel

Frankel	C3-C4		C4-C5		C5-C6		C6-C7		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
1	1	50	2	66.7	2	16.7	1	16.7	6	26.1
2					4	33.3	1	16.7	5	21.7
3			1	33.3	2	16.7	3	50	6	26.1
4					3	25			3	13
5	1	50			1	8.3	1	16.7	3	13
Total	2	100	3	100	12	100	6	100	23	100

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.650	12	.395

Level and BARTHEL after grading as excellent, good, fair and poor

Table 6: Barthel grading

Barthel grading	C3-C4		C4-C5		C5-C6		C6-C7		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Poor	1	50	2	66.7	5	41.7	1	16.7	9	39.1
Fair			1	33.3	4	33.3	1	16.7	6	26.1
Good					1	8.3	3	50	4	17.4
Excellent	1	50			2	16.7	1	16.7	4	17.4
Total	2	100	3	100	12	100	6	100	23	100

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.317	9	.409

There is no significant difference in the p value and 12 out of 23 are in C5-C6 and others had small number of patients so comparison is not significant.

Classification type and recovery

In comparison with the AO classification and the recovery status C2 type had poor recovery in Barthel and ASIA.

Classification and ASIA

No significant difference between the type of injury and neurological recovery when compared with ASIA and Frankel.

Discussion

The aim of surgical intervention in unstable lower cervical spine fractures is to restore stability and alignment of the cervical vertebrae, decompress the spinal cord and nerve roots, relieve pain and allow early movement of the cervical spine for rehabilitation.

To achieve this, the cervical spine can be approached from anterior, posterior or by a combined procedure. Decision as to which approach is best for a certain patient, fracture or surgeon is not easy. Logically it seems that the decision should depend on the type and location of the cervical spine lesion [1]. Posterior lesions, which include ligamentous and capsular disruptions with subluxations or complete dislocations of facet joints, laminae or pedicle fractures, may be stabilized by a posterior procedure. Anterior lesions, vertebral body fractures that need an anterior decompression

or re alignment and reconstruction, should be approached anteriorly and fused.

There are several advantages of anterior plating for lower cervical spine injuries [1]

- The supine position of the patient allows immediate surgery and eliminates the risk of causing additional injury while positioning the patient prone. This may be of benefit especially in poly-trauma patients or in a very unstable lesion where turning and positioning a patient in prone position may be difficult.
- The approach is extremely atraumatic there is no damage to the important paravertebral muscles, and the anterior neck muscles are only minimally involved. Complications of this approach are rare [1].
- Fusion is achieved by an intervertebral tricortical iliac bone graft. The graft is under compression. Depending on how the graft is carved and wedged, this tension banding may even support the lordotic shape of the cervical spine, diminishing the posterior distractive effect in posterior osteo ligamentous lesions. The graft has to be slightly wedge shaped, wider anteriorly, and the anterior plate has to be contoured to fit the anterior aspect of the lordotic spine [1].

Before anterior plating, an exact reduction has to be achieved. This can be obtained by traction or manipulation. If closed reduction is not possible, an open reduction is mandatory.

In this study, 23 patients of cervical spine instability following trauma and become quadriplegic were treated with cervical spine locking plate fixation with iliac crest bone

graft. All patients were treated with crutch-field tongs with appropriate weight in traction, and with Injection Methyl prednisolone if patient reached the hospital within eight hours of injury. It is administered as an initial bolus dose of 30mg/kg body weight followed by an infusion of 5.4mg/kg for 23hours following injury is ^[1]. Out of 23 patients, 17 patients survived and the 6 patients expired in the post op period. One patient developed pneumonitis, one pleural effusion and rest of the patients had cardio respiratory arrest and could not be revived. Only two patients had associated injuries, one had a rib fracture and another had a metatarsal fracture. All the survived patients had good to average radiological fusion except one whose follow up was less than 3 months. None of the patients were dependant on narcotic medication for pain relief and no patient had surgical site infection. No cases of graft failure. No pseudarthrosis in our study. 2 patients had C7 root injury, and no recurrent laryngeal nerve injury. None of the patients had dysphagia, eosophageal injury or vertebral artery injury. 4 patients had donor site pain, 5 patients had crutch field tongs pin site infection which was treated with clean dressings and antibiotics and healed. None of them had CSF leak.

In comparison with the study conducted by FrankKandziora *et al.* ^[2], who had compared the outcome of cervical spine instability treated with CSLP either with allograft or cages, he had 26 patients of 19 men and 7 women with mean age of 34.4, with commonest level of injury C5-C6, whereas in our study we had 23 male patients only, with commonest level C5-C6 in 13 patients including the one with a C6 fracture.

The commonest pattern to get involved in our study is B1 (9 patients), B2 (6 patients), B3 (3 patients) and C2 (5 patients), which is almost comparable with the other study. The number of patients who had donor site pain at the iliac crest is only 4 patients in our study when compared to the 14 patients in the other study ^[3]. The outcome measurement used in our study are Modified Barthel index and ASIA and FRANKEL, whereas the other study used Neck Pain Disability Index (NPDI) and Cervical Spine Functional Score (CSFS). In both studies Neurological and overall outcome was assessed using the ASIA impairment scale, Odom's criteria and in our study we had Barthel index also to assess the functional outcome and also the Cervical Spine Physician Follow-up Evaluation. Fusion was followed up radiographically every 6 weeks. A successful fusion was defined by the absence of lucency around the graft, evidence of trabeculation across the fusion site and absence of movement of the fused segment. In our study there was no cases of pseudarthrosis, no dislocation of the instrumentation or broken plates when compared with the study by M. Vessel ^[3]. In our study, out of 23 patients, in the survived 17 patients, 13 had good fusion, and 3 had average fusion, 1 patient had poor which can be attributed as because the post operative follow up is less than 3 months. In our study, the average period of solid fusion was 3.6 months.

Many papers report good results with anterior fusion and plating in traumatic injuries of the anterior and posterior columns. Aebi *et al.* ^[18] report 86 patients who underwent anterior fusion and plating with no major complications and successful fusion was achieved in all patients after 3-4 months. Ripa *et al.* ^[4] report 92 patients with single anterior fusion and plating for cervical spine injuries of whom fusion occurred within 3.2months postoperatively in 98.9%. Razack *et al.* ^[5] report 22 patients with traumatic cervical bilateral facet fracture dislocation stabilised with unicortical anterior locking plates. Despite one instrumentation-related failure, they report successful solid fusion in all patients. Stulik *et al.*

^[6] report 68 patients with cervical spine injuries all anteriorly plated with monocortical angle stable screws (CSLP). In 16.2% patients the procedure was completed with dorsal instrumentation, because closed reduction of the facet dislocation was not possible. Their fusion rate was 98.5%, and they report one cranial screw breakage, that did not adversely affect the outcome. These results show that successful fusion and cervical spine stability after injury can be achieved with bicortical or monocortical screws, and with angular stable or unstable configuration of plates and screws. Immediate and vigorous exercises may disturb healing of the fusion. For this reason external immobilization with Philadelphia collar is recommended for 4-6weeks ^[4].

One patient developed heterotopic ossification of the left hip at about 6 month follow up period in spite of adequate physiotherapy which was not reported in any other studies mentioned above.

In cervical spine injuries of the lower cervical spine, both anterior and posterior surgical stabilization have certain benefits but also drawbacks ^[7]. An anterior approach allows removal of bone and disk material from the spinal canal and a rigid stabilization targeted to the anterior column, while spinal cord injury, or iatrogenic anterior SEH (Spinal Epidural Hematoma) are potential, but rare complications. Reduction of facet joints can be difficult or impossible from this approach ^[8], and anterior plating is insufficient in the most severe distractive flexion injuries ^[9]. In contrast, posterior approaches allow relatively safe open reduction of facet joints and reconstruction of posterior column stability ^[10], but also require reasonably intact posterior bony structures for fixation. Removal of herniated disk material, which may have herniated into the spinal canal during the open reduction, is impossible from a posterior approach, and spinal canal decompression by laminectomy would increase undesirable instability. Whether anterior or posterior stabilization should be favored in cases without herniated disk material necessitating anterior surgery is controversial ^[8]. Timing of cervical spine surgery may play a critical role in treatment of cervical spine injury patients. Experimental studies on animals have demonstrated the benefits of early (within hours) decompression ^[11]. While the safety of surgery within the first days after trauma has been questioned, an increasing amount of evidence supports the safety of early surgery and—most importantly – supports the hypothesis of early surgical decompression and stabilization as aiding recovery from SCI ^[12].

Early spinal surgical intervention (<72h after injury) was associated with earlier transition from the acute care hospital to rehabilitation and decreased the overall hospital stay, relative to surgery after 72 hours. Costs were higher in the late surgery groups. No significant differences in neurologic or functional changes were noted between surgical groups. Pulmonary complications such as pneumonia and atelectasis appear to have occurred more frequently in those with late surgical intervention ^[13]. The timing of surgery had no effect on neurological recovery in patients with cervical spinal cord injury ^[14, 15]. However, experimental studies showed that early surgery might be associated with improved results ^[16, 17]. Some authors considered early surgery (<72 hours from injury) the best treatment for cervical spinal cord injury ^[18, 19]. Others reported improved neurological outcome after delayed surgery ^[20]. Surgical intervention for cervical injuries is safe, (compared to conservative treatment) may be associated with higher complication rates, particularly within 5 to 7 days of injury. Neurological deterioration was more likely in patients

with unstable spinal injuries and less likely to be related to the timing of surgery. Early surgery gave improved results in patients with cervical spinal cord injury. Internal fixation is often required for immediate mechanical stabilization to decrease post-traumatic complications resulting from immobilization, and to improve the physiological environment and thus maximize neurological improvement. Cranial traction was applied preoperatively in all patients, as immediate reduction (<6 hours after injury) is more important for improving neurological outcome than surgical techniques [15, 20]. Surgery promotes spinal stabilization, facilitates patient mobility and prevents spinal deformity. Early surgery might benefit patients with incomplete injury. Pathologic changes in neural tissue accelerate within 8 hours of injury, and the use of steroids is neuroprotective if administered within that period. Therefore, surgery appears beneficial if performed within 8 hours. Early surgery (<72 hours after injury) may not in fact be early enough for optimal neurological recovery. Surgical intervention for cervical injuries is safe, as no postoperative neurological deterioration was recorded between the early and delayed surgery groups. Neurological recovery may be expected in patients with incomplete spinal cord injury [15]. There was statistically significant difference between the neurological outcomes associated with early versus delayed surgery. Early surgery cases had good scores of neurological recovery when compared with delayed cases in our study. Prospective randomized studies are needed to better document the results according to the timing of surgery.



X-Rays of few cases

Conclusion

- The ideal management of atraumatic cervical spine instability in lower cervical spine injury is anterior stabilization with cervical spine locking plate.
- The surgery related complications are relatively very less, and the survived patients had significant improvement in their neurological and functional status.
- There was statistically significant difference in the early and delayed surgery patients in our study. Those patients who had undergone early surgery (<72 hours) had good scores of recovery in comparison with delayed cases but there is no significant difference in Barthel index.
- In summary, the neurological function of all patients improved at least one grade in muscle strength or ASIA impairment scale during follow-up.
- All the patients had good radiological fusion and no complications in union.
- The advantage of surgical stabilization is that the patient can be made to sit up with a Philadelphia collar within a week after surgery and nursing care, physiotherapy can be done more effectively when compared to conservatively treated cases who are bed ridden in whom the incidence of postural hypostatic pneumonitis,

pressure sores and sepsis are more leading to increased morbidity and mortality rather than the disease per se.

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