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Clinical Article

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The Management of Bilateral Interfacetal Dislocation with Anterior Fixation in Cervical Spine : Comparison with Combined Antero-Posterior Fixation

Objective : Combined antero-posterior fixation has been a standard method for bilateral interfacetal dislocation in cervical spine. The purpose of this study is to evaluate the efficacy and complication of anterior cervical stabilization in treatment of bilateral interfacetal dislocation.

Methods : A total of 65 cases of traumatic bilateral interfacetal dislocation in cervical spine who were managed in our institution, from Mar. 1997 to Feb. 2006, were included in this study. Closed reduction was tried in all cases before operation. If closed reduction was accomplished successfully, only anterior cervical fixation was performed (Group I), and attempted to place screws bicortically as possible with unicortical screws. If failed, posterior open reduction with fixation was first tried, followed by anterior cervical fixation (Group II). All patients were evaluated for neurological outcome and radiological evidence of healing.

Results : The Group I included 47 patients and the Group II, 18 patients. The improvement of Frankel grade and increase of mean cervical lordosis angles were not statistically different between two groups. Screw-plate system used did not influence the outcome. On follow up, solid bone fusion was evident and there were no cases of instability in both groups.

Conclusion : Our study demonstrated that anterior cervical fixation on BID is safe and effective in comparison with combined antero-posterior cervical fixation.

KEY WORDS : Cervical spine · Dislocation · Antero-posterior · Fixation · Stabilization.

INTRODUCTION

Bilateral interfacetal dislocation is usually the result of a forceful hyperflexion of the neck. Excessive anterior dislocation of one vertebra on another often causes extensive spinal cord damage, like transection or nerve root avulsion, with devastating neurological deficit.

Bilateral facet injuries are unstable and have poor potential to heal if not adequately stabilized. Methods described to treat these patients have included prolonged cervical traction, immobilization with a Halo thoracic brace, posterior cervical wiring or lateral mass plates, anterior cervical fixation with cervical screw-plate and combined antero-posterior stabilization[1,4,8,10,20-23]. Traditionally, the disruption of the posterior ligaments in bilateral cervical interfacetal dislocation has lead one to combined antero-posterior fixation with immobilization using a hard collar or Halo thoracic brace. However, combined antero-posterior fixation has several disadvantages such as prolonged operation time, more bleeding loss, poor wound heeling and difficulty in changing position.

The greater stability afforded by anterior instrumentation has led some surgeons to prefer anterior approach. Because of the advantages of low morbidity and the easy positioning in anterior approach, it has become increasingly popular over the past decade. In this study, we assessed efficacy and complication of anterior fixation and combined antero-posterior fixation in patients who sustained cervical bilateral interfacetal dislocation.

MATERIALS AND METHODS

From March 1997 to February 2006, 65 patients were admitted to our institution due to traumatic bilateral cervical interfacetal dislocation at one level. We reviewed retrospectively the patients' charts for clinical variables such as age, sex, mechanism of injury, level of injury,

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associated injuries, kind of screw-plate system used, level of neurological compromise and follow up period. The dislocations associated with vertebral body injury, such as tear drop fracture, wedge compression fracture or burst fracture were excluded.

Neurological and radiological evaluation

Neurological status was recorded by a team of physicians and qualified physiotherapists. The levels of neurological compromise determined according to Frankel grade on admission and last follow up examination. All patients showed an evidence of anterolisthesis of one vertebral body over another on lateral cervical spine radiograph on admission, along with evidence of bilateral interfacetal dislocation. In addition to cervical spine radiographs and computed tomographic scans of the cervical spine, all patients were taken a preoperative cervical magnetic resonance examination to determine the degree of spinal cord injury and the presence of cervical disc herniation and ligamentous disruption. The degree of subluxation was assessed radiologically using lateral cervical spine radiographs. The local lordosis angle (Cobb's angle) and C2-7 lordosis angle were also measured in all patients[9] (Fig. 1). Follow up flexion and extension radiographs were obtained after surgery in all patients. The radiographs were also evaluated for instrumentation failure (such as screw back out and screw-plate breakage), pseudoarthrosis and evidence of new bone formation between the bone graft and the host bone.

Procedure

Closed reduction

Closed reduction was attempted in all patients to correct subluxations at the emergency room or in the intensive care unit. After clinical assessment and radiological evaluation of the patients, Gardner-Wells tong traction was applied and traction was started with 10 pounds of weight. The traction weight was increased gradually with neurological monitoring and radiological assessments of degree of subluxation using lateral cervical spine radiographs, until either achieving reduction or reaching maximum 40 pounds of traction. Small doses of narcotics and muscle relaxants were given when needed. A trial of additional reduction was attempted under general anesthesia in patients whose cervical dislocation failed to be corrected by method described above[14].

Anterior fixation

After closed reduction was completed, standard ventral approach to cervical spine was performed. Once adequate exposure was obtained, discectomy was followed. An iliac crest autograft was used to promote bone fusion at the site of dislocation in all cases. The anterior cervical screw-plate was used for stabilization. We inserted screws to vertebral bodies bicortically as possible using long unicortical locking screws (ABC, Atlantis and Orion screw-plate system). Bicortical insertion was verified by fluoroscope during operation and by lateral radiographs postoperatively.

Combined antero-posterior fixation

If cervical dislocation was not reduced in spite of several trials of cervical retractions, posterior open reduction was performed. A standard midline posterior incision was made, exposing bilateral facets at the level of injury. Then, some proportion of the locked superior and inferior facet usually had to be drilled away to allow reduction. Open posterior reduction was then performed, followed by posterior fixation with lateral mass screws and rods or interspinous wiring

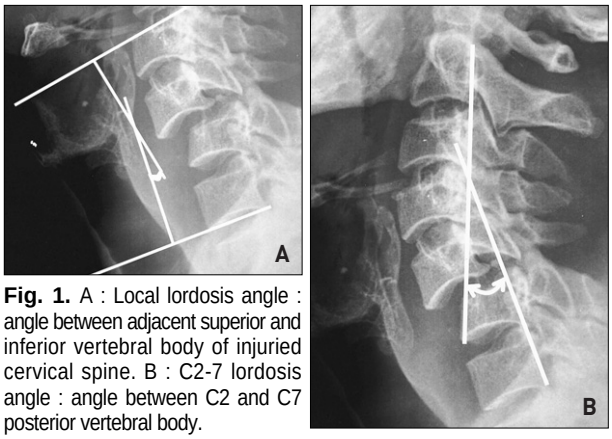

Fig. 1. A : Local lordosis angle : angle between adjacent superior and inferior vertebral body of injuried cervical spine. B : C2-7 lordosis angle : angle between C2 and C7 posterior vertebral body.

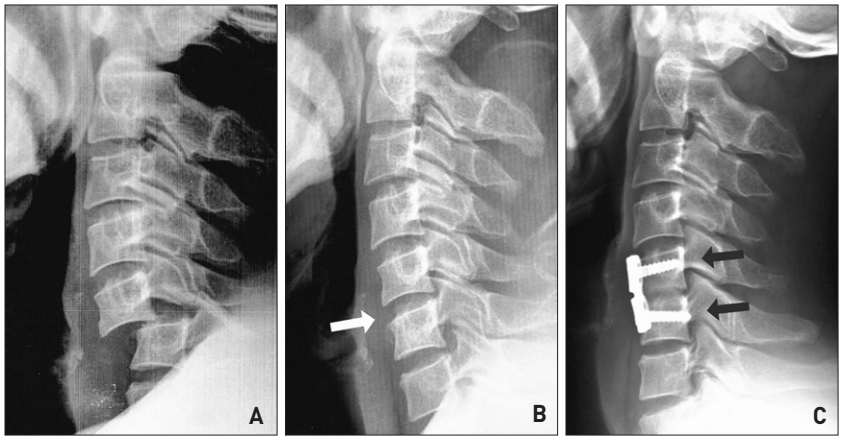

Fig. 2. A : A lateral cervical spine radiograph showing a C5-6 bilateral interfacetal dislocation with kyphotic deformity. B : Dislocation is reduced by 35 pounds of traction. (white arrow) C : Stabilization is performed through anterior cervical fixation with discectomy and fusion using autograft and ABC screw plate. The screw is seen to penetrate through the posterior margin of vertebral body. (black arrow).

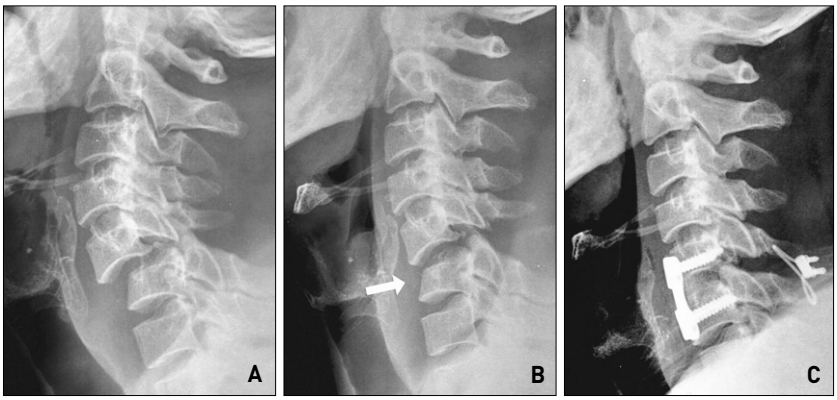

Fig. 3. A : Lateral plain radiograph, showing bilateral interfacetal dislocation at C5-6. B : Dislocation could not be corrected even after 40 pounds of traction. (white arrow) C : Post-operative plain lateral radiograph, showing maintained stabilization using anterior fixation with ABC screw plate and posterior fixation with interspinous wiring.

technique. The fusion was completed by adequate cancellous bone from autologous iliac crest. After this, anterior fixation and fusion were performed as described.

RESULTS

Population

All 65 patients were divided into two groups as the patients given anterior fixation, Group I, and combined antero-posterior fixation, Group II. Group I consisted of 47 patients and group II, 18 patients. The mean age of group I was 57.4 years, and that of group II was 43.3 years. Cervical injury was caused by a car accident in 27 cases (group I : 20 /group II : 7), fall from height in 19 (14/5) cases, bicycle accident in 9 (7/2) cases, slip down in 8 (5/3) cases and work related in 2 (1/1) cases. Plain lateral radiographs and cervical CT with sagittal and coronary reconstruction were obtained in all patients and demonstrated bilateral facet locks at C2-3 in one patient (group I : 1 /group II : 0), C3-4 in 6 patients (4/2), C4-5 in 14 patients (11/3), C5-6 in 18 patients (13/5), C6-7 in 23 patients (16/7) and C7-T1 in 3 patients (2/1). The most common level of dislocation was C6-C7. The duration of follow up ranged from 5 to 51 months (mean, 13.8 months) (group I : 10.5 months. group II : 14.9 months) (Table 1).

Table 1. Clinical data for patients with bilateral interfacetal dislocation

	Group I	Group II
No. of Patients	47	18
Mean Age (years)	57.4	43.3
Sex (no. of patients)		
Male	36	12
Female	11	6
Level (no. of patients)		
C2−3	1	0
C3−4	4	2
C4−5	11	3
C5−6	13	5
C6−7	16	7
C7−T1	2	1
Injury mechanism (no. of patients)		
Car accident	20	7
Fall down	14	5
Bicycle accident	7	2
Slip down	5	3
Work related	1	1
Mean follow up period (months)	10.5	14.9

Clinical outcome

In the group I, 14 of 45 patients were Frankel grade B on admission. Twelve patients were grade C, 13 grade D and 8 grade E. There was no grade A. On last follow up, 14 patients (29%) were improved by at least one Frankel grade.

In the group II, 7 of 18 patients were Frankel grade B on admission. Grade C, D were 4 and 7 each. There were no grade A and E. Five patients (27%) showed improvement by at least on Frankel grade on last follow up (Table 2).

Patients of group I and II patients were all improved on the clinical assessment after operation. However, the improvement of Frankel grade between two groups was not statistically significant ($p>0.05$).

Radiological outcome

Radiological improvement was assessed by comparing local lordosis angle and C2-7 lordosis angel measured by lateral cervical radiographs and lateral flexion-extension radiograph

Table 2. Neurological improvement between pre-operation and last follow up by Frankel grade (Group I)

Pre−operation \ Last follow up	A	B	C	D	E
A	0	0	0	0	0
B	0	10	2	2	0
C	0	0	4	7	1
D	0	0	0	11	2
E	0	0	0	0	8

(Group II)

Pre−operation \ Last follow up	A	B	C	D	E
A	0	0	0	0	0
B	0	6	1	0	0
C	0	0	2	2	0
D	0	0	0	5	2
E	0	0	0	0	0

Table 3. Radiological results by local lordosis angle and C2-7 lordosis angle

	Local lordosis angle		*p*-value	C2-7 lordosis angle		*p*-value
	Group I	Group II		Group I	Group II	
Pre-operation	−9.53	−6.45	–	9.76	10.14	–
Post-operation	7.32	9.59	–	17.18	18.84	–
Last follow up	5.94	8.04	–	18.15	17.56	–
Final increase of angle	15.47	14.49	>0.05	8.39	7.42	>0.05

of each patients taken on pre-operative, post-operative and last follow up.

In group I, the mean local lordosis angle of pre-operation was -9.53 degree, (so called kypohosis angle 9.53 degree) post-operation 7.32 and last follow up 5.94. And, the mean C2-7 lordosis angle was 9.76 at pre-operation. Those of post-operation and last follow up were 17.18 and 18.15, respectively. Both mean local lordosis angle and mean C2-7 lordosis angles were increased at post-operation. However, mean local lordosis angle was decreased in the last follow up and only mean C2-7 lordosis angle was increased. However, there wasn't statistically significant difference between post-operative and last follow up ($p>0.05$). Consequently, after operation, group I gained statistically significant radiological improvement (Table 3).

In group II, the mean local lordosis angle of pre-operation was -6.45, post-operation 9.59 and follow up 8.04. The mean C2-7 lordosis angle was 10.14, 18.84 and 17.56 at each of pre-operation, post-operation and last follow up. Compared with post-operation, follow up lordosis angle was decreased, but it was not statistically significant ($p>0.05$). After operation, all patients in group II showed improvement in radiological assessment (Table 3).

Finally, patients in both groups presented improvement in radiological assessment. However, there was no statistical difference between group I and II in the final increase of radiological angle ($p>0.05$).

Serial flexion-extension radiographs were used to assess the anatomical results as well as the stability of the fusion. In all patients, there was no instability on flexion-extension view and solid bone fusion was evident on the last follow up lateral radiographs.

There were 12 cases of facet fracture on injury level, 5 cases of adjacent spinous process fracture, 2 cases of lamina fracture of distant level, and 1 case of atlas dense fracture. Except facet fracture, other associated fractures were not related to the level of interfacetal dislocation. Seven of 12 cases of facet fractures were included group I. On the last follow up radiological image, all of these 7 cases were not found to have instability.

Type of instrument

We used several different types of anterior screw-plates : namely Caspar unlocking screw-plate, in 31 patients (group I : 18/ group II : 13); ABC locking screw-plate, in 28 patients (22/6); Atlantis locking screw-plate and Orion locking screw-plate, in 3 patients each(3/0)(3/0). Atlantis and Orion screw-plate were used only in the Group I. However, type of screw plate used in this study did not influence the clinical and radiological outcomes statistically. Among the group II, interspinous wiring was used in 12 patients and vertex screw, in 6 patients. Likewise, there was not significant difference in clinical and radiological outcome.

Complication

No surgical or neurological complication was observed in this series. And, at the last follow up, no hardware failure was observed and none of the patients complained of relevant neck pain. In the group I, there were 4 cases of severe bilateral interfacetal dislocation with complete cord injury (Frankel grade B), where cerebrospinal fluid leakage was observed just after dissection of platysma muscle and fascia. The site of leakage was sealed with fibrin glue (Tissel®) and leakage was stopped without any other complications. However, in the group II, wound infection occurred in two cases on dorsal operated site. So, these patients received intraveous antibiotic therapy for prolonged time and one of these patients underwent revision operation due to infection.

DISCUSSION

Bilateral interfacetal dislocation certainly requires adequate stabilization. However, the issue on the best method of stabilization remains controversial. Combined antero-posterior fixation has been traditional approach. However, several authors suggest that anterior fixation alone also provides acceptable stabilization. In this study, there was no difference in clinical and radiographic outcome between anterior cervical fixation group and combined antero-posterior cervical fixation group in bilateral cervical interfacetal dislocation. The improvement on Frankel grade was not different between two groups at pre-operation and last follow up. Also, in radiological outcome, local lordosis angle and C2-7 lordosis angle were increased on both groups after operation. However, they were not significantly different. Moreover, in all patients, there was clear evidence of bone fusion without instability on the last follow up lateral radiographs.

There also have been reports on biomechanical comparison of three surgical approaches in bilateral cervical facet dislocation[3,5,11]. In the study by Kim et al, posterior transpedicular fixation with an anterior interbody graft revealed to guarantee

the most effective biomechanical stabilization, followed by the posterior wring procedure after anterior fusion, anterior screw/plate fixation after anterior cervical discectomy and fusion. They concluded that anterior screw/plate fixation after anterior cervical discectomy and fusion provided high stability and a relatively effective stabilization in bilateral cervical facet dislocation when assisted by the aid of brace. Our result was concordant with their conclusion.

Razack et al.[18] evaluated that single level anterior cervical discectomy and stabilization for bilateral facet fracture and dislocation using unicortical anterior plates. All patients that could be aligned with traction were stabilized using an anterior fusion with bone graft and titanium unicortical locking plate. At last follow up, one patient has plate fracture, however, there was no instability on lateral radiographs in any patients. In this study, we confirmed that anterior fusion on cervical facet fracture and dislocation with unicortical anterior plates could be an excellent treatment option. Stabilization was well preserved with unicortical screws though they were thought to be weaker than bicortical ones. But, there was no control group to compare with. This is one of several limitations in this study.

Among various anterior screw-plate systems used in this study, namely Caspar, ABC, Atlantis and Orion screw-plate system, only the Caspar unlocking screw-plate system had bicortical screw. However, all the other screw-plate systems were locking unicortical screws[16,18]. When we placed screw into the vertebral body during operation, we made efforts to insert the screw bicortically as possible in spite of being unicortical screw (except Caspar screw-plate system) in all patients. In most of the patients, bicortical insertion of screw was certified by lateral radiographs during and after operation. Currently, many surgeons are applying unicortical screw fixation resulting in fairly good outcomes. However, there also have been few reports insisting bicortical screws that provided better outcome[12]. Therefore, in the anterior fixation group of bilateral interfacetal dislocation with posterior ligament injury, more strength for stabilization may be required, and that bicortocal insertion would provide better stabilization.

There were several reports on method where open anterior reduction was given from the beginning without trial of closed reduction[15,17]. Payer M[17] reported treatment option about immediate open anterior reduction and combined antero-posterior fixation/fusion for bilateral cervical facet fracture and dislocation. In this study, the author insisted that combined antero-posterior fixation/fusion was safe and reliable, and also can save the patients from time loss and discomforts of attempted closed reduction by traction. Also, immediate anterior open reduction doesn't require complicated closed reduction[6]. However, if closed reduction is performed at first, cervical stabilization is possible to be preserved only by anterior fixation and posterior fixation is not need by based on our result. So, the trial to do reduction in bilateral interfacetal dislocation counts for much. In case when closed reduction was failed, we performed open posterior reduction immediately as several authors reported that open anterior reduction yield good results when reduction was failed[15,19].

According to the statistical result in our study, there were clinical improvements in only 29% in group I and 27% in group II by Frankel grade. However, most of these patients experienced improvement in motor power and sensory changes especially among the patients with incomplete cord injury (Frankel grade C, D). Because Frankel grade was composed of just five grades, we consider that minute clinical improvement may not be reflected. And, all procedure (reduction and operation) were finished within 24 hours. Early decompression of spinal cord and stabilization could be attained clinical improvement[2]. Also, there was no complication associated with early operation.

To evaluate the stabilization in the anterior fixation group by other method, we subdivided group I into two groups, the ones who were able to ambulate and ones who were not. The patients who were able to ambulate over Frankel grade D were 21 of all 45 patients (44%) in the group I. After operation, Frankel grade of all these patients increased and improved clinically at last follow up period. During ambulation period, there were no complication, such as, neurological compromise, fusion failure and hardware failure. The result suggests that only anterior fixation in bilateral interfacetal dislocation provides enough stabilization could make certain as mentioned.

Traumatic interfacetal injury may accompany with many other combined fractures[7,13,24]. So we reviewed and evaluated other associated fractures on the patient of cervical bilateral interfacetal dislocation. As result, all of seven cases with fact fracture had great stability in the group I. This result is in agreement with our finding suggesting that anterior fixation provide acceptable stabilization on the cervical bilateral interfacetal dislocation compared with combined antero-posterior fixation even in cases combined with facet fractures.

CONCLUSION

Deciding the optimal treatment of bilateral cervical interfacetal dislocation is sometimes difficult. Our study demonstrated that anterior cervical fixation on bilateral interfacetal dislocation is safe and effective compared with combined antero-posterior cervical fixation.

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