Comparison of outcome of surgical and nonsurgical methods in the treatment of unstable traumatic lesions of the lower cervical spine

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ABSTRACT

Objectives: To compare the success rate and capacities of nonsurgical (halo cast) versus surgical management of lower cervical spine injury.

Methods: Forty patients admitted to hospitals affiliated with Shiraz University of Medical Sciences in Shiraz, Iran, from August 2002 to August 2004 with unstable cervical injuries were divided into 2 equal groups (halo versus surgery), and in each group, patients were divided into 3 categories based on the type of lesion. The percentage of sagittal subluxation and degree of sagittal angulation were chosen as criteria for treatment outcome, and each was measured on radiological images and recorded at the time of admission and after 6 months.

Results: Members of both groups showed significant improvements in the criteria after treatment. The amount of correction in subluxation was not significantly different between the 2 groups; however, the surgical approach resulted in a significantly better correction of angulation.

Conclusion: The nonsurgical approach can be an acceptable alternative to surgical correction in selected patients with various lower cervical spine injuries and yielded comparable results; however, a larger sample size and longer follow-up may be necessary for verification.

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Spinal column injury, especially at the level of the cervical spine, is one of the common causes of death due to trauma, and timely diagnosis and management of these patients can significantly decrease the associated mortality.[1-3] Injury to the cervical spine can result from different mechanisms, including hyperflexion, flexion rotation, hyperextension, and extension rotation.[4-6] One of the important issues in the diagnosis and treatment of patients with trauma to the cervical spine is the stability of the injured segment of the vertebral column. Stability can be defined from both clinical and radiological aspects.[7-8] Clinically, stability of the vertebral column is indicated by the absence of subluxation and misshaping after the introduction of a physiologic force or during the recovery period, and the lack of pressure on and injury to neural tissues at the time of trauma or during recovery. From the radiological viewpoint, instability is indicated by the presence of 5 out of the following 6 criteria including destruction of the anterior or posterior part of vertebrae, sagittal angulation in excess of 11°, sagittal subluxation more than 3.5 mm, spinal cord injury, nerve root injury or narrowing of the disk space, and significant stress to the cervical vertebrae.[9-11] Surgical and nonsurgical methods, or a combination, have been used for almost a century in patients with unstable cervical spine lesions. Crutchfield introduced skull retraction

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with Halo in 1932. Despite its limitations and the need to hospitalize patients for a relatively long time, it is still widely used as a primary nonsurgical therapy and adjunct treatment to spinal surgery. The surgical approach to cervical spine injury, aims at re-alignment of the vertebrae, decompression of the nervous tissue, and providing stability for the injured bony spine. It is performed in either an anterior or posterior approach.[9-11] The purpose of this study was to compare the success rate and capacities of the nonsurgical versus surgical approach in the management of unstable lower cervical spine lesions and their sequels.

Methods. Among the individuals admitted to teaching hospitals affiliated with the Shiraz University of Medical Sciences in Shiraz, Iran between August 2002 and August 2004 with the diagnosis of unstable cervical spine injury, 40 patients were selected. All the cases had undergone anteroposterior and lateral cervical x-rays, cervical CT scan and cervical MRI. All patients were found to have more than a 3.5 mm subluxation and above 11° angulation. None of the patients had an absolute indication for spinal surgery, so both modalities of management could be selected. It should be noted that the presence of hematoma or a portion of bone or disc in the spinal canal absolutely mandates for surgical treatment. All patients initially underwent cervical traction (5 lbs per vertebral level) for re-alignment of the vertebral column. Afterwards, 20 of them were randomly selected for halo treatment (halo group) and the rest for surgical approach (surgery group). At the time of admission to the ward, the amount of the upper-to-lower subluxation, and the degree of sagittal angulations between the involved vertebrae were measured on the radiographic images. In order to minimize the effect of the differing degrees of magnification of radiographic images and anatomical variations, the amount of subluxation was recorded as a percentage. In the halo group, most patients suffered from injury at the C3-C4 level. Patients in the halo group underwent treatment with halo cast for 3 months, and a monthly radiography was performed for each patient during this period. After removal of the halo cast and 3 months later, dynamic radiographic studies were repeated. The amount of subluxation and angulation in the last x-ray was compared with that in the initial image obtained at the time of admission. In the surgery group, the anterior cervical approach was taken for 18 patients and the posterior approach for 2 patients. In the anterior approach, patients underwent discectomy, corpectomy, and interbody fusion with iliac bone graft using plate-screw in 17, and not using it in one. In the posterior approach, sublaminar wiring was used in one and laminar hook in the other patient. A radiographic study was performed after the operation and 3 months later, and the amount of subluxation and angulation in the last x-ray was compared with that in the initial image obtained at the time of admission. In order to compare the success rate between the 2 groups, injuries to the cervical spine were divided into 3 categories: 1. Ligament injury, 2. Locked facet with or without posterior element fracture, and 3. Fracture of body and subluxation/angulation with or without fracture of posterior element.

Levene's test was applied to data from both groups as a test of equality. Angulation values were compared using t-test. Subluxation data did not have a normal distribution, so Mann-Whitney test was used to compare data of the 2 groups. In each group, Wilcoxon test was used to compare angulation and subluxation data before and after treatment. The obtained data was statistically analyzed by SPSS Windows Version 11.5 software. A p-value less than 0.05 was considered significant.

Results. The halo group included 18 men and 2 women, with the age ranging from 15-65 years (36 years on average). The surgery group constituted of 17 men and 3 women, with age ranging from 18-65 years (37.5 years on average). The level of injury among both groups was shown in (**Table 1**). The average amount of subluxation was 25.75% and the average angulation was 14.5°. In the surgery group, the largest number of patients had injury at C4-C5 level. The average amount of subluxation was 26.5% and the mean angulation was 14.5°. Five patients in the halo group belonged to category 1. The average subluxation at time of admission was 26%, and the average angulation was 14.8°, which changed to 3% and 5.4° 6 months later (3 months after removal of the halo cast). Seven patients in the surgery group belonged to category 1. The average subluxation at the time of admission was 27.1%, and that for

Table 1 - Level of injury among the halo and surgery group.

Level of injury	Number of patients	
	Halo group	Surgery group
C3-C4	10	3
C4-C5	2	8
C5-C6	4	6
C6-C7	3	3
C7-T1	1	0

angulation was 14.4°; these values changed to 0% and 2.1°. Within each group, the decrease in the amount of subluxation and the degree of angulation was significant before and after treatment. Comparing the results of treatment between the 2 groups, it was statistically found that although no significance was present regarding the subluxation (*p*-value=0.202); the decrease in the degree of angulation was significantly different (*p*-value=0.010). Category 2 included 5 patients from the halo group. One of these, one patient had a relapse of locked facet after treatment with halo, so surgery was performed to stabilize the vertebra. The other 4 cases had a change in subluxation from 26% to 2.5% and in angulation from 15.5° to 2.5°. Seven patients from the surgery group belonged to category 2, 6 of which underwent the anterior approach, and one the posterior. In these cases, the average angulation decreased from 14.4° to 2° and the average subluxation from 27.8% to 1.7%. No statically significant difference was observed in the treatment results between the 2 groups (*p*-value of 0.755 for both angulation and subluxation). Ten patients in the halo group belonged to category 3. One of these patients experienced a relapse of the subluxation/angulation after the removal of halo cast. In the other 9 cases, the average subluxation changed from 25.5% to 5.8% and the angulation from 14° to 5.6°. In the surgery group, 6 patients belonged to category 3. In these cases, the change in the average subluxation was from 24.1% to 3.3%, and that in the average angulation was from 14.6° to 3°. Statistical analysis of improvements in the angulation values showed that there was a significant difference between surgeries versus the halo group (*p*-value=0.000). The improvement in subluxation was not significantly different between the 2 groups (*p*-value=0.428).

Discussion. Trauma to the cervical spine can result in different injuries, many of which can have serious sequela and must be managed promptly. Treatment of cervical spine injuries can be accomplished using both surgical and nonsurgical approaches. Although some lesions necessitate surgical management, for others either approach can be selected.[6-8] Outcomes and complications of nonsurgical and surgical methods in the management of various cervical spine injuries have been the subject of many studies, some focusing on a specific category of spine injury. Hosssain et al,[4] reviewed 104 patients with cervical spine injury managed with halo cast alone or surgery. They found a failure rate of 10% for primary halo immobilization. The highest rate of failure occurred in patients with fracture/subluxation (15%). Overall, they decided that halo is an effective non-surgical treatment for the injured cervical spine at both upper and lower levels. Vieweg and Schultheiss[10] reviewed 35 relevant studies involving in total 682 patients with 709 different types of injuries to determine the outcomes after immobilization in a halo vest. Studies were analyzed according to the type of injury pattern and in terms of the treatment outcomes following primary treatment with a halo vest. An overall healing rate of 86% was observed, and they concluded that this treatment continues to be a good alternative to operative stabilization of bone injuries to the upper cervical spine.[10]

In subluxation/angulation injuries, which are caused by trauma to ligaments, the lesion tends to be stable, but some progress to more pronounced subluxation or angulation.[8] Cooper et al[2] presented that by adjusting the rod connecting the body jacket and halo ring, increase in the subluxation during treatment can be arrested and recorrected; however, Sears and Fazl[7] reported a 75% fusion rate in this type of injury, with additional surgery for those lesions which are not stabilized enough. In our study, patients with ligament injury, who had been treated with halo cast had a significant correction of subluxation and angulation, similar to the results observed in those who underwent surgery, in other words, both surgical and nonsurgical approaches were satisfactory regarding the management of ligament injuries. However, the degree of correction of angulation was significantly higher in the surgery group compared to the halo group. Since our cases were only followed for 6 months after trauma, the clinical significance of this difference could not be evaluated in the present study.

Facet dislocation and locking is a more serious lesion, from the view of both its management and neurological complication of injury. Sears and Fazl[7] found a success rate of 44% in the management of locked facet with halo cast. However, Lifeso and Colucci[6] observed that in this category, the nonoperative management was uniformly unsuccessful in 32 cases. In the present study, 5 patients were treated with halo cast; surgery was performed later in one case due to failure of halo to arrest the instability. The other 4 patients showed an acceptable improvement in both the subluxation and angulation (80% success rate). Statistical analysis showed no significant difference between the 2 groups regarding the level of improvement. It must be noted that all patients assigned to either group had a unilateral locked facet. Whether the same results will be obtained in patients with bilateral locked facet with no absolute indication for surgical correction, which indicates a more severe

trauma to spine and is expected to be associated with more extensive injury and a higher risk of cord injury, is a matter for further study.

Management of patients with fractures of vertebrae subluxation/angulation is more difficult than other categories. Although many patients ultimately need surgical correction of the spinal lesion, halo cast remains a choice in selected patients. Studies have yielded differing results on this subject. Cooper et al[2] observed an acceptable fusion rate in approximately 80% of a series of patients. The study by Koivikko et al[5] on 9 patients with burst fractures showed a higher success rate and more acceptable subluxation correction with surgery compared to halo cast. Fisher et al[3] found that surgery with an anterior approach for teardrop fractures was significantly superior to halo for restoring and maintaining sagittal alignment. Bucci et al[1] reached the same conclusion in a study on 49 patients. In our study, among 10 patients with complex fracture assigned to the halo group, one patient required surgery after halo cast due to failure to stabilize however, in the other 9 patients an acceptable fusion was accomplished (90%). In the halo group, the correction in subluxation did not significantly differ from the surgery group; however, the amount of correction in the angulation was significantly greater in the surgery group.

In conclusion, although a limited number of patients were included in this study, results indicate a reasonably high success rate for treatment with halo cast compared with surgical correction. The criteria used to compare the 2 methods, percentage of subluxation and degree of sagittal angulation, have also been used in other studies. The difference in the correction of angulation between the 2 groups needs further work to assess its clinical significance. Although it is reasonable to consider surgery at the first step for spinal lesions that look more severe or more unstable, using halo can be an acceptable alternative in certain situations, such as the lack of appropriate operative facilities. Of course, a larger sample with a longer follow-up period may be required to verify the results of this study for more extensive injuries.

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