Available online at www.medicinescience.org

ORIGINAL ARTICLE

Medicine Science International Medical Journal

Medicine Science 2021;10(1):207-11

Management of subaxial cervical spine trauma: Clinical results of early surgical decompression

Serhat Yildizhan, Adem Aslan, Mehmet Gazi Boyaci, Usame Rakip, Kamil Anil Kilinc

Afyonkarahisar Health Sciences University, Department of Neurosurgery, Afyonkarahisar, Turkey

Received 22 December 2020; Accepted 01 February 2021
Available online 22.02.2021 with doi: 10.5455/medscience.2020.12.260

Abstract

Traumatic injuries of the subaxial cervical spine (C3-7); considered among the most common and most damaging injuries to the axial skeleton. Decompression of the spine is standard approach after cervical spinal cord injury.In this study, 72 patients who underwent early decompression with the decision of surgery according to the classification system with the Subaxial Injury Classification and Severity Scale (SLICS) among 212 patients who developed spine fractures as a result of acute traumatic subaxial cervical trauma were examined.ASIA scoring system was used for neurological examination evaluation.Patients were included in the rehabilitation program, which lasted at least six months after the operation.Neurological recovery results were evaluated with ASIA scores obtained after the rehabilitation program.It has been shown that early surgery for subaxial cervical spine fractures contributes significantly to the patient's neurological recovery.

Keywords: Cervical trauma, spinal cord injury, early decompression

Introduction

The lower cervical region (C3-C7) is called the subaxial cervical region.1/3 of all spine injuries occur in the cervical region [1]. 70% of all cervical traumas are subaxial traumas [2]. This region is responsible for 50% of cervical flexion, extension and rotation [3].The cervical region is vulnerable to injury due to this range of motion.Trauma-induced injuries of the subaxial region (C3–7) are currently among the most common and most mortal injuries of the spine [3,4]. It occurs mostly at younger ages and is associated with high-energy motor vehicle accidents in this age group [5]. It can also occur in older age groups with lower-energy traumas such as falls [6]. The cervical spine is one of the anatomical regions that should be evaluated first in patients with multiple trauma because it causes mortality [7,8]. Many classification methods have been proposed for these injuries from past to present [9]. Currently the most ideal is the Subaxial Cervical Spine Injury Classification (SLICS) scoring system [9].

***Corresponding Author:** Serhat Yildizhan, Afyonkarahisar Health Sciences University, Department of Neurosurgery, Afyonkarahisar, Turkey
E-mail: serhatyildizhan07@gmail.com

Computed tomography (CT) is the best imaging method for showing subaxial cervical fractures and dislocations because it shows the bone structure well. After subaxial cervical injuries, clinical conditions ranging from minor ligamentous injuries to very severe burst fractures can be encountered. Emergency management of such injuries is based on an accurate clinical history, careful physical examination and detailed radiological evaluation. Although decompression of the cervical spine is a standard treatment approach, a universally accepted protocol could not be established [10]. Debates continue about the preoperative application of traction, the appropriate surgical approach, and the ideal timing for decompression [11–13]. In this study, we reported the results of neurological recovery after long-term follow-up in patients who underwent early surgery (<24 hours) (anterior, posterior or both methods) after subaxial cervical spine injury in our clinic.

Materials and Methods

The study was conducted with the approval of the Afyonkarahisar Health Science University Clinical Research Ethics Committee on 03.07.2020 and protocol number 2020/289.With this study, 212 patients who were admitted to our clinic with subaxial (C3-7) traumatic injuries between January 2012 and December 2019, who were followed up and treated were retrospectively analyzed.

During this examination, patient files were accessed by using the information processing system of the hospital.Patients with subaxial cervical spine injuries who were operated due to spinal tumors, rheumatologic diseases and similar non-traumatic reasons were not included in the study.All patients were performed cervical computed tomography (CT) and cervical magnetic resonance imaging (MRI) to examine bone and ligament damage. Radiological and clinical findings of the patients were evaluated with the internationally accepted "Subaxial Injury Classification System" (SLIC). American Spine Injury Association (ASIA) scoring system was used for neurological examination evaluation. Control cervical CT was performed in patients who underwent surgery, and the positions of the stabilization materials were checked.Patients with post-operative neurological deficits were included in a physical therapy and rehabilitation program for at least 6 months. ASIA scores were re-evaluated after 6 months.

Results

72 patients out of 212 patients with subaxial cervical trauma were operated. The age range of these patients was between 15 and 79 (mean: 45.58). 53 of the patients were male and 19 were female. When etiologically examined, the most common 40 patients were found to be an in-vehicle traffic accident, and at least four patients with sports injuries. While 28 patients were neurologically in ASIA E class before the operation, 20 patients were in ASIA D and 10 patients were in ASIA A category. 52 patients were taken to surgery within the first 24 hours. Of these patients, 20 patients were ASIA E and neurologically stable, while 32 patients had neurological loss. Among the patients who underwent early surgery, 22 patients had ASIA E after the first 24 hours, while a total of 32 patients were found to have ASIA E at the sixth month after rehabilitation (Table 1). Among the patients who underwent late surgery, preoperative eight patients were ASIA E, nine patients were evaluated as ASIA E at the first 24-hour examination after the operation, and 10 patients as ASIA E at the sixth month after rehabilitation (Table 2). Of the 72 patients operated, 40 had compression or burst fractures, and the most common were C5 with 12 patients and C7 with 11 patients. Fracture-dislocation was present in 32 patients and it was most frequently observed at the C6-7 level with 13 patients.When SLIC classification was examined, it was determined that 32 patients got five points, 22 patients received four points, 12 patients received six points, and six patients received seven points and the decision of surgery was made.40 patients underwent only anterior surgery (figure 1). Surgery was performed in 14 patients with a posterior intervention (figure 2).Eighteen patients underwent both anterior and posterior surgery (figure 3).Ten of 44 patients with neurological deficits preoperation were evaluated as ASIA E in the first 24 hours postoperatively. Twenty-two out of 32 patients with continuing neurological loss received a rehabilitation program. Six months later, 10 of these patients showed neurological complete recovery, while 12 patients had an improvement of at least one point in ASIA scores.Multiple level cervical fracture was observed in 11.1% of the patients, while thoracic or lumbar fracture was associated with 16%. Only one level of cervical fracture was detected in 72%. In addition, 22% of the patients had postoperative pneumonia and medical treatment was applied. Ten patients (13.8%) died in the intensive care unit due to complications.

Table 1. Neurological evaluation of 52 patients who underwent early surgery (first 24 hours) after follow-up (Note: 3 patients died during follow-up)

ASIA	Pre-operation	Post-operation (24h)	Post-operation (6.month)
A	5	2	1
B	7	4	3
C	6	6	3
D	14	18	10
E	20	22	32
Total patient	52	52	49

Table 2. Neurological evaluation of 20 patients who underwent late surgery (after first 24 hours) after follow-up (Note: 7 patients died during follow-up)

ASIA	Pre-operation	Post-operation (24h)	Post-operation (6.month)
A	6	4	-
B	2	1	-
C	2	3	1
D	2	3	2
E	8	9	10
Total patient	20	20	13

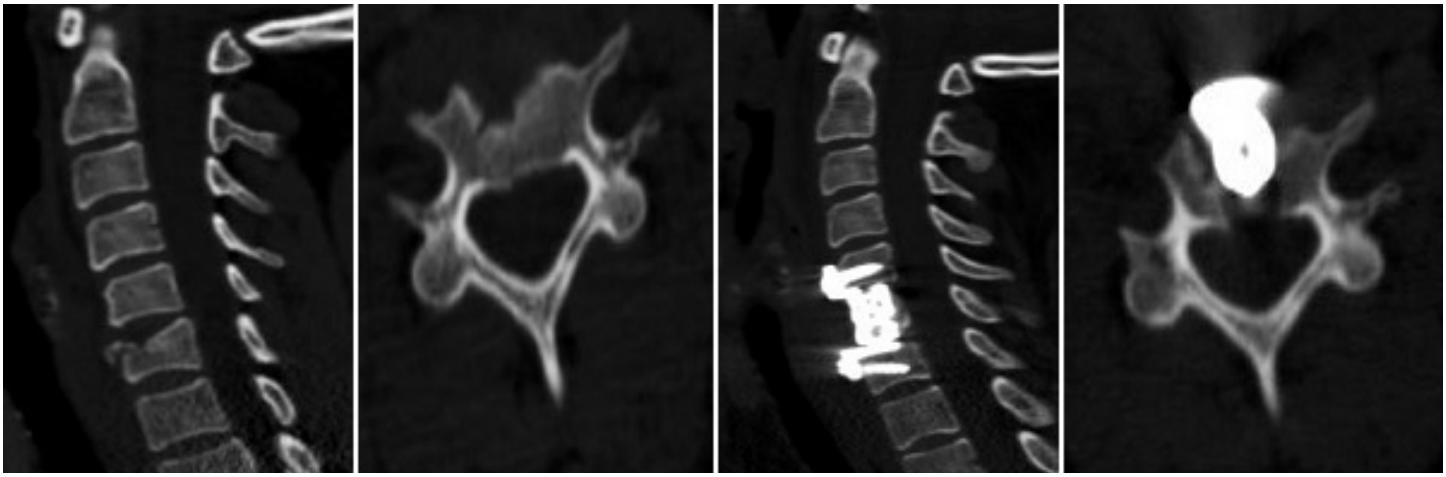

Figure 1. 33-year-old female patient AITK, C6 burst fracture, CT image after C6 corpectomy + Anterior cage application.

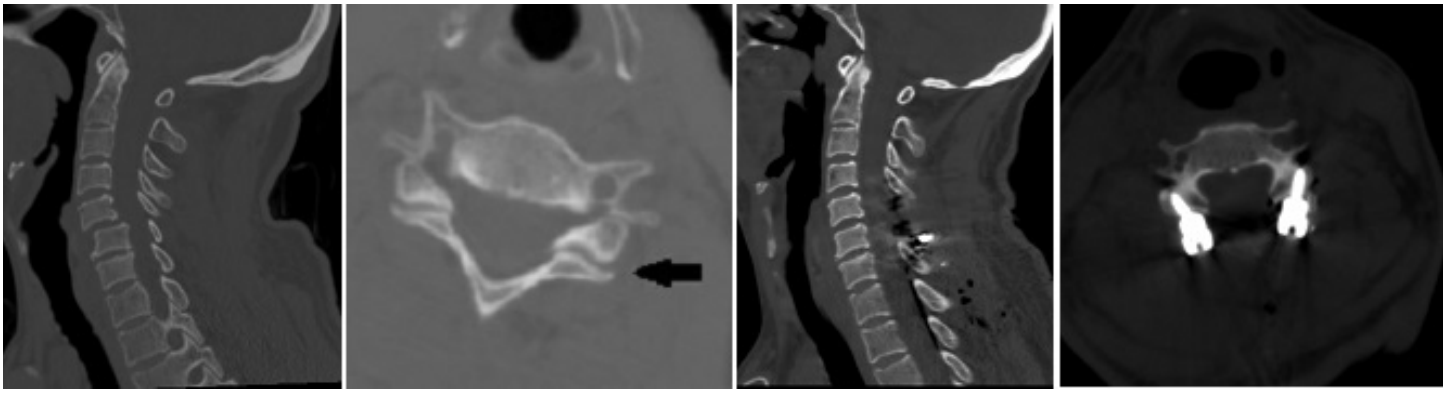

Figure 2. 58-year-old male patient C5-6 listesis and facet locking after a fall. CT image after posterior fixation and C5-C6 total laminectomy with C4-5-6-7 lateral mass.

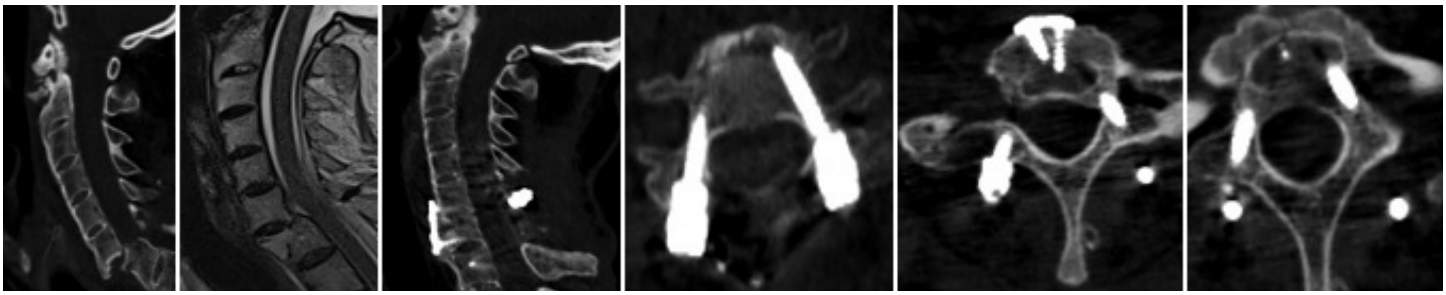

Figure 3. 57-year-old male patient after falling from height, C6-7 fracture dislocation, Posterior C5-6-7 instrumentation, C5-C6 laminectomy after anterior C6-C7 plate-screw fixation.

Discussion

The worldwide annual incidence of acute spinal cord injury is known to be 15–40 per million [14]. In our country, this number is reported as 1600-2000 annually [15]. Spinal cord injury is often seen in healthy 15-35 year olds and the clinical consequences are more dramatic.Male / female ratio is 5/1. In our study, the mean age of the patients was 45.58 (between 15-79 years) and the male / female ratio was 2.78.The most common causes of spinal cord injury are motor vehicle accidents (50%), falls and work accidents (30%), violent crimes (11%) and sports injuries (9%) [16]. In our study, 66% of the cases were motor vehicle accidents.

Approximately 35% of spinal traumas occur in the cervical region. Neurological deficits are observed in more than half of these patients.This is because this region has a thinner pedicle structure and narrower spinal canal transverse and sagittal diameter compared to the thoracic and lumbar region [17]. In addition, the fact that this region is very flexible and mobile, and that it does not have bone support around it as in the abdominal or chest wall [18-20]. These anatomical features lead to both severe clinical results and difficulties in surgical planning after trauma.Therefore, the clinical and radiological findings of this region trauma should be evaluated meticulously [11,21]. Of the 72 operated patients, 40 had compression or burst fractures, and the most common were C5 with 12 patients and C7 with 11 patients.Fracture-dislocation was present in 32 patients, and it was most frequently observed at the C6-7 level with 13 patients.In terms of surgical decision making, it is important to use a classification system that surgeons can rely on.In this way, it is important in terms of allowing studies to be conducted between different clinics in which clinical care and education can be compared [22,23]. For this purpose, the Subaxial Injury Classification System (SLIC) has been proposed by the Spinal Trauma Study Group and has been widely accepted [4,9,23-25]. Therefore, in our study, we used the SLIC scoring system.In this scoring system, patients with a score of three or less were considered stable and were followed up with conservative

treatment. On the other hand, 72 patients with SLIC scores of four and above were deemed to be unstable and the operation decision was made.

The system recommended by ASIA was used for degrees of spinal cord injury.In our study, while 28 patients were ASIA E in the preoperative classification, 44 patients had neurological loss. Out of 52 patients who underwent early surgery, 10 patients had ASIA E, while 42 patients had neurological deficits.After the postoperative follow-up and at least 6 months of rehabilitation, a significant increase was observed in ASIA scores (Table 1). No significant change was observed in ASIA scores in 20 patients who underwent late surgery (Table 2). Although decompression of the cervical spine is a standard treatment approach for subaxial cervical trauma, a universally accepted protocol has not been established [10]. Some surgeons believe that in patients currently undergoing delayed surgery (> 72 h), improvement is equal to or greater than patients undergoing early surgery [26,27]. Today, the vast majority agree that decompression and stabilization operations should be performed within the first 24 hours if the general condition of the patient is appropriate [11,24]. For example, Fehlings et al. found in a systematic review and prospective research study that 80.0% to 96.4% of spine surgeons generally prefer decompression within the first 24 hours, and the majority want to decompress within six hours [28]. This is consistent with the notion that the benefits of decompression are greater when the compression time in the spinal cord is shorter and that secondary neurological impairment is reduced [10,29]. In another study, after six months of follow-up, 20% of patients who underwent early surgery had an improvement of at least two points in ASIA, while this rate was only 9% in patients who underwent late surgery [30]. In another study, it was reported that 70% of the patients who were operated within six hours had at least one point improvement in ASIA scores, while those who were operated after the sixth hour had a recovery rate of 12% [24]. In our study, 52 patients (72.2%) were operated within the first 24 hours. 20 patients (27.7%) with multiple trauma and additional pathologies were operated late. Anterior decompression and stabilization were performed in 40 patients, posterior decompression and stabilization in 14 patients, and decompression and stabilization with a combined approach in 18 patients.When all spine traumas were examined, it was reported that two or more vertebral segments were damaged in at least 20% of the patients, and the cervical region was damaged in 80% of these patients [24,30]. Multilevel cervical fracture was observed in 11.1% of the patients operated in our clinic, while thoracic or lumbar fracture was associated with 16%. Only one level of cervical fracture was detected in 72%.

In addition, pneumonia was observed in 22% of the patients in the postoperative period. Ten patients (13.8%) died due to metabolic problems.

Subaxial cervical traumas are among the most important causes of morbidity and mortality in the world in terms of their consequences. Serious morbidity and labor losses are seen as a result of neurological damage, especially in the young age population.Early decompression and stabilization should be applied to patients with suitable general conditions and the immobile time should be kept as short as possible.In our study, a significant improvement was observed in the ASIA scores and neurological conditions of the patients after early decompression and subsequent rehabilitation treatments.

Conflict of interests
The authors declare that they have no competing interests.

Financial Disclosure
All authors declare no financial support.

Ethical approval
The study was conducted with the approval of the XXX University Clinical Research Ethics Committee on 03.07.2020 and protocol number 2020/289.

References

1. Wilson JR, Grossman RG, Frankowski RF, et al. A clinical prediction model for long-term functional outcome after traumatic spinal cord injury based on acute clinical and imaging factors. J Neurotrauma. 2012;29:2263–71.
2. Klein GR, Vaccaro AR: Cervical spine trauma: upper and lower. Vaccaro AR, Betz RR, Zeidman SM (eds), Principles and practice of spine surgery, Philadelphia: Mosby, 2003;441-62.
3. Kwon BK, Vaccaro AR, Grauer JN, et al. Subaxial cervical spine trauma. J Am Acad Orthop Surg. 2006;14:78-89.
4. Vaccaro AR, Hulsert RJ, Patel AA, et al.The subaxial cervical spine injury classification system: a novel approach to recognize the importance of morphology, neurology, and integrity of the disco-ligamentous complex. Spine (Phila Pa 1976). 2007;32:2365-74.
5. Uhrenholt L, Charles AV, Hauge E, et al. Pathoanatomy of the ower cervical spine facet joints in motor vehicle crash fatalities. J Forensic Leg Med. 2009;16:253-60.
6. Lowery DW, Wald MM, Browne BJ, et al. Epidemiology of cervical spine injury victims. Ann Emerg Med. 2001;38:12-6.
7. Hadley MN, Walters BC, Aarabi B, et al. Clinical assessment following acute cervical spinal cord injury. Neurosurgery. 2013;72:40-53.
8. Hoffman JR, Mower WR, Wolfson AB, et al. Validity of a set of clinical criteria to rule out injury to the cervical spine in patients with blunt trauma. National Emergency X-Radiography Utilization Study Group. N Eng J Med. 2000;343:94-9.
9. Aarabi B, Walters BC, Dhall SS, et al. Subaxial cervical spine injury classification systems. Neurosurgery. 2013;72:170-86.
10. Carlson GD, Gorden CD, Oliff HS, et al. Sustained spinal cord compression: Part I: Time-dependent effect on long-term pathophysiology. J Bone Joint Surg Am. 2003;85:86–94.
11. Feuchtbaum E, Buchowski J, Zebala L. Subaxial cervical spine trauma. Curr Rev Musculoskelet Med. 2016;9:496–504.
12. Koller H, Reynolds J, Zenner J, et al. Mid to long-term outcome of instrumented anterior cervical fusion for subaxial injuries. Eur Spine J. 2009;18:630–53.
13. Park JH, Roh SW, Rhim SC. A single-stage posterior approach with open reduction and pedicle screw fixation in subaxial cervical facet dislocations. J Neurosurg Spine. 2015;23:35–41.
14. Sekhon LH, Fehlins MG. Epidemiyology, demographics and pathophysiology of acute spinal cord injury. Spine. 2001;26:2-12.
15. Karamehmetoglu SS, Unal S, Karacan I, et al. Traumatic spinal cord injuries in Istanbul, Turkey. An epidemiological study. Paraplegia. 1995;33:469-71.
16. Ho CH, Wuermser LA, Priebe MM, et al. Spinal cord injury medicine. 1. Epidemiology and classification. Arch Phys Med Rehabil 2007;88:49-54.
17. Canbek I, Korkmaz S, Rakip U, et al. Morphometric measurements performed by computed tomography on lower cervical vertebra pedicles. Bozok Med J. 2019;9:77-83.
18. Ciftdemir M. Cervical spine injuries. J Turk Spinal Surg. 2007;18:43-50.
19. Eubanks JD, Gilmore A, Bess S, et al. Clearing the pediatric cervical spine following injury. J Am Acad Orthop Surg. 2006;14:552-64.
20. Mirza SK, Bellabarba C, Chapman JR. Princeple of spine trauma care. In: Bucholz RW, Heckman JD, Court-Brown C. (Eds.). Rockwood and Green's

Fracture in Adults. 6th ed. Philadelphia: Lippincolt Williams & Wilkins Co. 2006;1402-21.

21. Joaquim AF, Patel AA. Subaxial cervical spine trauma: evaluation and surgical decision-making. Global Spine J. 2014;4:63-70.

22. Magerl F, Aebi M, Gertzbein SD, et al. A comprehensive classification of thoracic and lumbar injuries. Eur Spine J. 1994;3:184–201.

23. Allen BL, Ferguson RL, Lehmann TR, et al. A mechanistic classification of closed, indirect fractures and dislocations of the lower cervical spine. Spine. 1982;7:1–27.

24. O'Dowd JK. Basic principles of management for cervical spine trauma. Eur Spine J. 2010;19:18-22.

25. Marino RJ, Barros T, Biering-Sorensen F, et al. International standards for neurological classification of spinal cord injury. J Spinal Cord Med. 2003;26:50–6.

26. Fehlings MG, Tetreault LA, Wilson JR, et al. A clinical practice guideline for the management of patients with acute spinal cord injury and central cord syndrome: Recommendations on the timing (≤24 hours versus>24 hours) of decompressive surgery. Global Spine J. 2017;7:195–202.

27. Wilson JR, Tetreault LA, Kwon BK, et al. Timing of decompression in patients with acute spinal cord injury: A systematic review. Global Spine J. 2017;7:95–115.

28. Fehlings MG, Rabin D, Sears W, et al. Current practice in the timing of surgical intervention in spinal cord injury. Spine. (Phila Pa 1976) 2010;35:166–73.

29. Fehlings MG, Wilson JR. Timing of surgical intervention in spinal trauma: What does the evidence indicate? Spine. (Phila Pa 1976) 2010;35:159–60.

30. Fehlings MG, Vaccaro A, Wilson JR, et al. Early versus delayed decompression for traumatic cervical spinal cord injury: results of the Surgical Timing in Acute Spinal Cord Injury Study (STASCIS). PLoS One. 2012;7:32037.