

RESEARCH ARTICLE

Clinical Results of Harms Technique in Atlantoaxial Instability Treatment

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Abstract

Objective: The aim of this study is to present the clinical experience and results in the application of atlantoaxial stabilization performed with Harms technique to contribute to the literature.

Methods: Archive files of adult patients who underwent C1-2 stabilization using Harms technique with the diagnosis of atlantoaxial instability for 2015-2020 were examined. Clinical and radiological findings of 15 patients with at least 6 months of follow-up were evaluated. Preoperative clinical and radiological records, preoperative observations, postoperative complications, and clinical responses were evaluated.

Results: 15 patients included in the study; 10 were men and 5 were women. The age range was 25-82 (mean: 58.7). There were 6 patients (40.0%) who had Anderson and D'Alanzo classification type 2 odontoid fracture 2 patients (13.3%) with Jefferson fracture, 2 patients (13.3%) with C2 extension type tear drop fracture, 2 patients (13.3%) with narrowing in the level of craniocervical junction, 1 patient (6.7%) with upper cervical region tumor and 2 patients (13.3%) was in the form of hangmans fracture. Screw malposition was not observed in the postoperative period. Bone fusion developed in all patients after surgery. No vertebral artery damage or neurological damage was observed. Wound infection was not observed in any of these patients. Visual analog scale (VAS) reduction and Japanese orthopedic (JOA) scores were increased in all postoperative patients.

Conclusion: Surgery of atlantoaxial instability is a pathology requiring adequate surgical experience due to the complicated anatomical structure. Using the Harms technique, sufficient stability is provided with a low complication rate. With this method, improvement in the clinical findings of the patients and high bone fusion were obtained.

Key words: C1-2 screw fixation, cervical trauma, odontoid fracture.

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Introduction

The level of C1 (Atlas) and C2 (Axis) vertebrae, called upper cervical vertebrae, have a unique anatomical structure. There is no corpus, pedicle and spinous process on C1 vertebrae. In addition, there is odontoid process on C2 vertebrae different from other vertebrae. Vertebral arteries traverse through the transverse vertebral foramen into the cranium through the posterior arch of C1 vertebrae. The axial load of the weight of skull is transferred from the occipital condyles to the masses of the C1 vertebra, and from there to the C1-2 facet joints and the C2 lateral masses. The load is then distributed to the subaxial region with the disc and facet joints of C 2-3. The atlantoaxial joint consists of 4 synovial joints. The first one is between the back of the anterior arch of C1 vertebra and the dens and the second one is between the odontoid process and the transverse ligament. Two of them are between the facet joints on both sides (Chen et al., 2020). The atlantoaxial joint is the most mobile region of the spine and makes 38.9% of the axial rotation movement (Badhiwala et al., 2017). It also performs a small amount of flexion-extension and lateral bending motion.

Approximately 25-35% of cervical fractures in an adult concern the first three cervical vertebrae. In these fractures, 45-60% neurological deficits can be encountered (Anderson and D'Alanzo, 1974- Çağlar et al., 2005). Due to upper cervical traumas (traffic accidents, falls from height, diving, etc.), instability may develop in the atlantoaxial joint. According to the classification made by Anderson and D'Alanzo, type 2 odontoid fractures are considered unstable (Anderson and D'Alanzo, 1974). In addition, it has been reported that 25% of patients with rheumatoid arthritis may have instability due to chronic inflammation (Kim and Hilibrand, 2005). It has also been reported that instability may develop with Marfan syndrome and Grisel's syndrome (Dagtekin et al., 2011). Regardless of the cause, atlantoaxial instability becomes an important mortality and morbidity problem (Isik et al., 2018). Neurological findings, radiological findings showing pressure and instability on neuronal structures, additional diseases and age that will affect morbidity are important in the planning of treatment. The purpose of treatment is to provide adequate neuronal decompression, providing stability, preservation of sagittal alignment and formation of bone fusion.

The aim of this study is to present the clinical experience and results in the application of atlantoaxial stabilization performed with Harms technique to contribute to the literature

Methods

This study was conducted with the approval of Ordu University Clinical Research Ethics Committee number 129.

Between January 2016 and January 2020, patients who were diagnosed with atlantoaxial instability in our clinic regardless of their etiology and applied screw fixation with Harms's technique were scanned and file data were obtained. All patients were evaluated in terms of complaints, diagnosis, preoperative and postoperative images, complications and fusion. Average follow up period is 24.6 months (6-48 months).

Patients with C1-2 screw fixation using the Harms technique and clinical follow-up data of at least 6 months were included in the study. Anterior route stabilization applications and patients with clinical follow-up less than 6 months were excluded from the study.

According to the clinical complaints, a suitable neck collar was worn to the patients who applied for trauma. Then all patients underwent cervical radiography, cervical computed tomography and cervical MRI examination. Angiography examination for the position of the vertebral artery was made in the preoperative period.

Surgical Procedure

Under general anesthesia, the prone position was taken to the operation with head holder. After cleaning and covering the surgical field; the skin was opened with a midline skin incision from theinion to the required cervical segment, then the paravertebral muscles were lateralized. C1 lateral mass and C2 pedicle screw were placed in accordance with the Harms's technique with intraoperative fluoroscopy. Lateral mass screw was placed according to the Magerl technique planned to extend stabilization according to the level of lesion. Then, the system was stabilized with the help of cervical lordotic inclined rods.

Bone grafts were placed after the posterior elements were decorticated with the aid of a drill for fusion purposes, and the layers were closed anatomically.

All patients were evaluated for screw malposition and cervical alignment by pulling cervical CT on Day 1 after the operation. Preoperative Visual pain score (VAS) and Japanese Orthopedic Score (JOA) at 6th postoperative month were compared for clinical evaluation. Bone fusion was evaluated by dynamic radiographs and coronal sagittal plane CT examination at 6th postoperative month.

Results

Ten (66.7%) of the 15 patients included in the study were male and 5 (33.3%) were female. The average age was found to be 58.7 (25-82). There were 6 patients (40.0%) who had type 2 odontoid fracture according to Anderson and D'Alanzo classification, 2 patients (13.3%) with Jefferson fracture, 2 patients (13.3%) with C2 extension type tear drop fracture, 2 patients (13.3%) with narrowing in the level of craniocervical junction, 1 patient (6.7%) with upper cervical region tumor and 2 patient (13.3%) was in the form of hangmans fracture. Patient distributions are given in Table 1. Two of our patients (13.3%) had preoperative myelomalacia. Other patients did not have preoperative myelomalacia. Preoperative average JOA scores were 16.4 and average VAS scores were 7.2. There was no postoperative complication in all patients. No screw malposition was observed in the tomography examination

performed in the postoperative period. Clinical worsening was not observed in any of our patients. It was observed in the postoperative 6th month follow-up that the JOA score increased by 17.8 and the VAS score decreased to 1.2. None of our patients had vertebral artery injuries and wound infection was not developed.

Case Illustration (Case 13)

Type 2 odontoid fracture was observed in the 81-year-old female patient due to a traffic accident. In his neurological examination, the Glasgow coma scale was 15 points. There were no motor and sensory deficits. The patient underwent posterior C1-3 stabilization. No postoperative complications were seen. During the follow-up, the patient was discharged without any neurological disorders (Figure 1).

Table 1. Patient distributions

Case No	Age	Sex	Follow Up	Application Reason	Diagnosis	Stabilized Segments
1	72	Male	15	Falling from high	C2 extension type tear drop fracture Left C2 lamina fracture	C1-3
2	80	Female	44	Falling from high	Type 2 odontoid fracture	C1-4
3	25	Male	40	Firearm injury	Type 2 odontoid fracture	C1-2
4	45	Female	42	Neck pain	Recurrent cervical meningioma	C1-3
5	64	Male	36	Traffic accident	Jefferson fracture	C1-2
6	49	Male	24	Traffic accident	Jefferson fracture	C1-2
7	33	Male	48	Traffic accident	C2 extension type tear drop fracture Right C1 lateral mass fracture	C1-3
8	47	Female	36	Neck pain	Os odontoideum	C1-2
9	71	Male	10	Falling from high	Hangman fracture C1 anterior arch fracture C2 cervical contusion	C1-4
10	81	Male	11	Falling from high	Type 2 odontoid fracture C1 anterior & posterior arch fracture	C1-3
11	82	Male	13	Traffic accident	Type 2 odontoid fracture	C1-2
12	73	Male	7	Traffic accident	Type 2 odontoid fracture C5-6 spinous process fracture C5-6 cervical contusion	C1-7
13	81	Female	12	Falling from high	Type 2 odontoid fracture	C1-3
14	43	Female	25	Neck pain	Narrowing of the craniocervical junction, Ankylosing spondylitis	C1-5
15	40	Male	6	Falling from high	Hangman Fracture C3 corpus fracture	C1-4

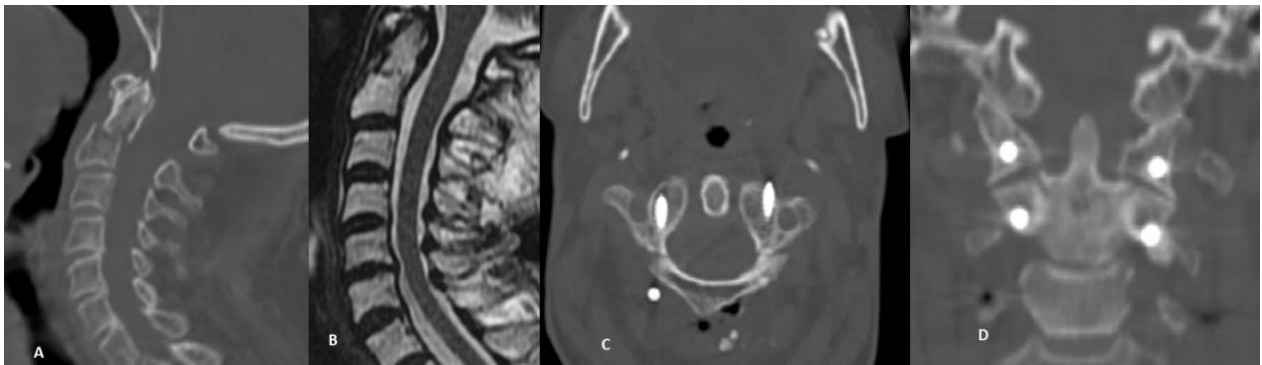


Figure 1: A: Sagittal CT image of Type 2 odontoid fracture, B: Preoperative T2 Cervical MR image, C: C1 lateral mass screw image on postoperative cervical CT axial plane, D: C1-2 lateral mass screw image on postoperative cervical CT coronal plane.

Discussion

Due to the complicated anatomical structure of the Atlas and axis and the location of the vertebral artery in this region, it makes the surgical treatment of the instability of the region difficult. Wiring fixation of C1-2, defined by Hadra in 1981, was used with various modifications (Gallie, 1939; Brooks et al., 1978; Coyne et al., 1995; Dickman et al., 1998). In order to reduce the neurological complications that may occur during wiring, interlaminary clamping known as halifax technique has been defined and developed as an apofix method by Honess and Back (Holness et al., 1984). However, it was observed that it was not sufficient especially in rotational stability (Huang et al., 2015). The C1-2 transarticular screw fixation technique defined by Magerl and Seeman in 1987 solved the fusion problem (Magerl and Seemann, 1987; Low and Redfern, 2002). However, it has been reported that spinal cord injury, vertebral artery injury, and hypoglossal nerve injury are observed in relation to this method (Dobran et al., 2016; Rajinda et al., 2017). This situation prompted researchers to develop methods with lower complication rates and higher fusion rates. Therefore, Goel and Laheri were first described as segmental screw flexion in 1994. In addition to the high fusion rate with this method, the risk of vertebral artery injury decreases, however, C2 root must be sacrificed during C1 lateral mass screw application (Goel and Lahari, 1994). Harms and Melcher showed that the root does not need to be sacrificed during screw application (Harms and Melcher, 2001). In this study, we used Harms technique to treat atlantoaxial instability of all our cases. In a study that conducted by Rajinda et al., in a series of 60 patients operated with C1 lateral mass and C2 pedicle screw fixation, 97% fusion rate and significant improvement in VAS and JOA scores were reported (Rajinda et al., 2017). C2 ganglion was not required to be sacrificed in any of our patients. Neurological complications or

vertebral artery injuries due to this method were not observed in any of our patients. Bone fusion in all our patients developed at 6 months. No neurological damage, vertebral or internal carotid artery injury were not observed due to 30 C1 lateral mass, 30 C2 pedicle screws, 36 C3-C6 lateral mass and 2 C7 pedicle screws that we used in the stabilization of our cases. Significant decrease in all VAS scores and increase in JOA scores was observed.

This study is conducted by a single neurosurgeon to contribute to the literature by using Harm's technique.

Limitation

This study is limited in several ways. The most significant limitation was the fact that the population of the study was a small group because upper cervical traumas are rarely seen incidents. This study is conducted by single surgeon and this is also another reason of the above mentioned limitation. In addition, there was no comparison with other techniques that defined to treat atlantoaxial instability.

Conclusion

Surgery of atlantoaxial instability is a pathology requiring adequate surgical experience due to the complicated anatomical structure. Using the Harms technique, sufficient stability is provided with a low complication rate. With this method, improvement in the clinical findings of the patients and high bone fusion are obtained.

Ethics Committee Approval: This study was conducted with the approval of Ordu University Clinical Research Ethics Committee number 129.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept- DOK, Design- DOK, Supervision- DOK, Analysis and/or Interpretation- DOK, Literature Review- DOK, Writing- DOK, Critical Review- DOK.

Conflict of Interest: No conflict of interest was declared by the authors.

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