

Conservative treatment by halo vest for a 63-year-old male with traumatic spondylolisthesis of the second cervical Levine-Edwards type 2 (hangman's fracture): A case report

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ABSTRACT


The hangman fracture is used to describe the traumatic spondylolisthesis of C2. The management strategies and surgical indications for executioner fractures are still controversial. However, conservative treatment has usually been effective in stable and neurologically normal patients when treated with appropriate immobilization in an extended position. We reported a case of a 63-year-old male patient with a hangman fracture on the second cervical vertebra that was treated with conservative treatment using a halo vest. After 1 month of halo vest application, the pain was decreased without neurological deficit evidence. The halo vest was released and a soft collar neck application was done. Three months after the removal of the halo vest and soft collar application, there were no pain and neurological deficit. We found evidence of displaced fracture of processus spinosus of the first and sixth cervical vertebrae and union of the third cervical vertebrae, union fracture of the pars interarticularis second vertebrae, and osteophytes on the anterior body fifth and seventh cervical with narrowing disc fifth-sixth cervical.

Key words: Hangman's fracture, Halo vest, Conservative, Management

A fracture of the second cervical spine should not be regarded as an isolated bone injury due to the complex bone and ligament structures in the occipitocervical connection. The second cervical spine has the largest vertebral body. The atlantoaxial joint complex provides about 50% of the rotation of the entire cervical spine. While the second-third neck joint offers limited flexion, tilt, and rotation. The axis has wide pedicles and is relatively stronger than the rest of the body, especially at the point of connection with the body and the odontoid base. The second cervical pedicles are located just below the upper articular process. The laminae of the second cervix are thick and strong, with large vertebral foramen, but still smaller than that of the atlas. The second cervix has very small transverse processes, each of which ends in a single tubercle and is perforated by the transverse foramen with lateral and upward oblique directions. The anterior longitudinal ligaments of the second cervical vertebra attach to the anteroinferior part of its vertebral body. It can trigger an anteroinferior fragment of the second cervical vertebra if a significant hyperextension is maintained [1,2].

The hangman fracture has been used to describe the traumatic spondylolisthesis of the second cervix since it was developed by

Schneider *et al.* It is defined as fractures of the lamina, the facets of the joints, the pedicles, or the pars of the spine [1,2]. Hangman fractures were classified based on the stability of the fragments or the fracture morphology. In the current study, the classification systems for evaluating the percentage of non-operative and operative treatment of executioner fractures and results were described by Effendi *et al.* and Levine and Edwards [2,3]. Levine *et al.* classification consists of four types of fracture patterns, which are based on the lateral X-rays. Type I fracture has a displacement of <3 mm without angulation. The type II fracture shows a displacement of the second to third cervical spine and a slight angulation by more than 3 mm. The atypical subtype is a type IIa fracture that has a slight or no translation but a strong angulation. A type III fracture shows severe fracture displacement and angulation with an associated unilateral or bilateral facet dislocation. It is the classification described by Francis that classified the injury into five types of fracture based on the degree of fracture displacement and angulation (Figure 1 and Table 1). A recent study showed that the Francis classification system had a significant correlation with the Levine system [2]. Conservative treatment is usually effective in patients with stable and neurologically intact fractures when treated with appropriate immobilization in an extended neck position [4]. The

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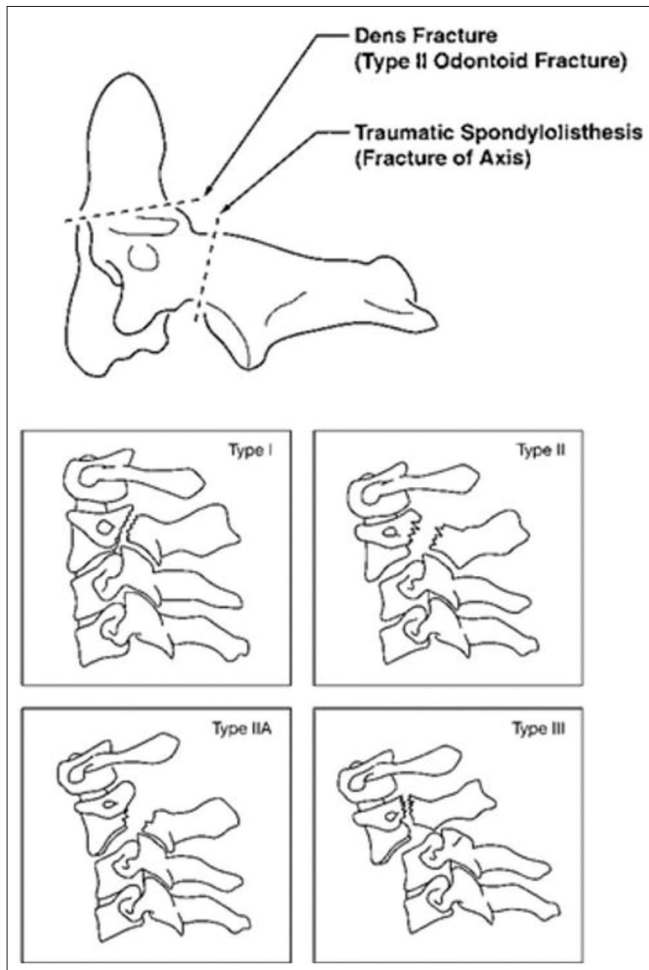


Figure 1: Classification of Francis grades

Table 1: Criteria of Francis grades

Francis grade	C2–C3 displacement	C2–C3 angulation (degrees)
I	<3.5	<11
II	<3.5	>11
III	>3.5; <0.5 (vertebral width)	<11
IV	>3.5; <0.5 (vertebral width)	>11
V	Disk disruption	

results of this study showed that most type I, Effendi Type II, and Levine-Edwards Type II fractures do not require surgery. After the postmortem examination, the fractures are usually extended by the upper facet joint, which consists of well-vascularized spongy cancellous bone [5]. The narrowing of the intervertebral disc space with osteophytes has often been observed in the film of hangman fractures involving combined damage to the intervertebral disc and the ligaments, and in severe cases, this can lead to spontaneous fusion [6].

CASE REPORT

A 63-year-old male presented with acute neck pain for 24 h. Tenderness on the backside of his neck was present along with the numbness on both the upper extremities. There was no sign

of intracranial involvement. History of trauma revealed that he fell from a tree of approximately 4 m height 8 years ago. At that time, there were no neurological deficits and he was capable of the normal ambulatory. Physical examination revealed only minimal swelling and tenderness around the posterior neck with neurological deficits. Despite normal motoric strength for all extremities, hypoesthesia was found on the left C6 dermatome.

From the cervical X-ray, we found a broken alignment from the anterior and posterior vertebral line with translation between second-third cervical and sixth-seventh cervical and evidence of a displaced fracture of processus spinosus of the first, third, and sixth cervical vertebrae, displaced fracture of the pars interarticularis with fracture line from the cranial to the caudal side of base lamina second vertebrae, and osteophytes on the anterior body fifth and seventh cervical with narrowing disc at the fifth-sixth cervical. Translation between the sixth and seventh cervical suggesting an old fracture-dislocation or spondylolisthesis was also seen (Figure 2a).

In the emergency department, we perform stabilization of the fracture with Gardner-Wells tongs (GWT) with gradually increased of weight and followed by a plain X-ray evaluation (Figure 2b). After the translation, confirmed reduction with X-ray evaluation was done. Then, we performed the application of the halo vest (Figure 3) followed by further evaluations with cervical magnetic resonance imaging (MRI) and computed tomography (CT) scan. Cervical MRI showed semi-straight cervical vertebrae (muscle spasm) and translation of the sixth-seventh cervical accompanied by intervertebral disc protrusion, intraspinal swelling at the sixth cervical (Figure 4). CT scan showed anterior translation less than 25% at the level of sixth-seventh cervical, displaced fractures on both posterior arches of C1, fractures of the left and right pedicle and transverse process of the second cervical, a fracture of the spinal processes of the third, fifth, and sixth cervical, and fractures of both lamina of the fifth and sixth cervical, and a fractured vertebral body of the seventh cervical (Figure 5).

We assessed the patient with traumatic spondylolisthesis of the second cervical Levine-Edwards type 2 (hangman’s fracture) with concomitant fractures of the posterior arches of the first cervical, spinous process of the third and sixth cervical, and a neglected fracture-dislocation, or traumatic spondylolisthesis of the sixth-seventh cervical. Non-operative treatment with the application of the halo vest was performed.

After 1 month, the halo vest application evaluation was done and vital signs were normal. There were no abnormalities in the general examination, and the pain was decreased without neurological deficit evidence. The halo vest was released and a soft collar neck application was done. Three months after the removal of the halo vest and the application of a soft collar neck, there were no pain and neurological deficit. The patient range of motion on flexion position about 45° and extension about 30°, left bending about 20°, and right bending about 20° is shown in Figure 6. From the cervical X-ray, there was good alignment from the AP view, and from the lateral view, there was a slight translation from the second-third cervical and sixth-seventh cervical (old listhesis). We found evidence of displaced fracture of processus

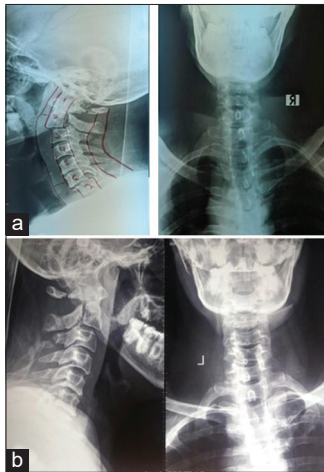


Figure 2: (a) Pre-Gardner-Wells tong X-ray; (b) post-Gardner-Wells tong X-ray



Figure 3: Clinical picture of patient with halo vest



Figure 4: Cervical magnetic resonance imaging

spinous of the first and sixth cervical vertebrae and union of the third cervical vertebrae, union fracture of the pars interarticularis second vertebrae, and osteophytes on the anterior body of the fifth and the seventh cervical with narrowing disc of the fifth-sixth cervical (Figures 7 and 8).

DISCUSSION

The aspects of treating the executioner’s fractures are still controversial. No evidence-based study has been carried out that would be very valuable. The current study showed that the

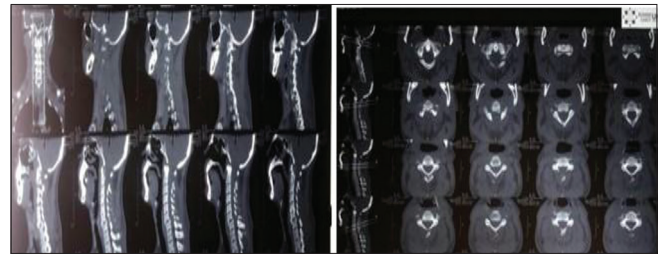


Figure 5: Cervical computed tomography scan



Figure 6: Cervical range of motion of patient post halo vest (a) front view; (b) side view

classification system proposed by Effendi *et al.* and modified by Levine and Edwards, may be more suitable as a guide for the treatment of executioner fractures [3,7]. Conservative treatment is usually effective in stable and neurologically normal patients when treated with appropriate immobilization in the extended position [4]. The results of this study showed that the type I, Effendi Type II, and Levine-Edwards Type II fractures do not require surgery. After the postmortem examination, the fractures are usually through the upper facet joint, which was full of well-vascularized spongy cancellous bone [5]. The narrowing of the intervertebral disc space with osteophytes was frequently observed in the film of executioner fractures for the combined damage to the intervertebral disc and ligaments, which in severe cases usually led to a spontaneous fusion [6].



Figure 7: Post halo vest X-ray



Figure 8: X-ray cervical anteroposterior and lateral

Clinical practice has found that it has been common to observe the spontaneous association of executioner fractures that could not be affected by the initial displacement or angulation [8]. Healing in a malunion position with anterior displacement has been common and cannot be harmful. According to a systematic review conducted by Waqar *et al.*, 20 articles (62.5%) agreed that the primary therapy for all executioner fractures should be conservative, and 11 of the remaining patients suggested that conservative treatment was appropriate for some stable fractures. For Type I, Effendi Type II, and Levine-Edwards Type II fractures, conservative treatment was used in excess of 70%, and the healing rate of each type of fracture was 100% for Type I, nearly 90% for Effendi Type II, and 60% for Levine-Edwards type II fractures in patients with conservative management [9].

Tong traction was used at the earliest stage in the methods of conservative treatment in most published articles. The fracture is reduced by forceps traction and the stability of the fracture site was achieved after 3–6 weeks of traction. Tong traction is safe and comfortable for a long period of time and was particularly useful when there were associated injuries. Rigid immobilization is strongly recommended for Type IIa and III Levine-Edwards fractures. Non-rigid external fixation is only used in some Type I and Levine-Edwards Type II fractures, which is often supplemented by rigid immobilization. It is concluded from the

results of this study that rigid immobilization may be required for most of the hangman's fractures. Only with a few stable fractures of type I, Effendi type II, and Levine-Edwards type II, a non-rigid immobilization in combination with or without rigid immobilization could be a choice if a careful inspection is carried out [8].

Surgical interventions are divided into anterior, posterior, and anterior-posterior approaches. The posterior approach has been used more often than other approaches. The posterior approach could correct local kyphosis and prevent flexion deformity. Levine-Edwards type II, IIa, and III fractures were most likely unable to bend due to C2–C3 disc space and posterior longitudinal ligament disruption and were, therefore, best treated with posterior stabilization. For type III fractures, posterior fixation and fusion of the second and third cervical vertebrae were recommended because the only remaining stabilizing structure could be reserved [10]. According to Dussault *et al.*, Type III lesions must be examined and surgically reduced using a posterior approach, while the anterior approach was indicated for later instabilities after type III fractures [11]. A frontal approach can avoid the acquisition of the atlas and thus maintain a certain rotational movement by protecting the atlantoaxial articulation [12]. Effendi *et al.* presented a retrospective series of 131 patients with executioner fractures that were treated surgically [4]. Francis *et al.* believed that surgery is only required if there is chronic instability due to executioner fractures. In their series of 123 fractures, only seven patients were fused anteriorly or posteriorly [13]. Levine and Edwards suggested that type III injuries require surgical stabilization for gross instability [10]. Patients with Type IIa and III Levine-Edwards fractures should be the candidates. Samaha *et al.* recognized that surgery should be performed in patients with severe lesions of the mobile segment of C2–C3 with a displacement of more than 3 mm anterior translation and a local kyphosis of more than 15 degrees or lordosis of more than 5 degrees. They concluded that patients with Levine-Edwards type IIa and III fractures could be candidates for surgical stabilization and fusion [8].

CONCLUSION

Although the management strategies and surgical indications for executioner fractures are controversial, conservative treatment is usually effective in stable and neurologically normal patients when treated with appropriate immobilization in an extended position.

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