Child's Nervous System (2019) 35:195–197
https://doi.org/10.1007/s00381-018-3966-8

CASE REPORT

# Treatment of pediatric multilevel cervical spine fractures in resource-limited settings: a case report

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Received: 15 August 2018 / Accepted: 27 August 2018 / Published online: 5 September 2018


## Abstract

**Aim of the study** The main purpose of this study was to highlight the therapeutic approach of pediatric multilevel noncontiguous cervical spine fractures in resource-limited settings.

**Case presentation** We report the case of a 15-year-old teenager with C1, C2, C4, C6, and C7 fractures following fall from height treated with a modified external fixator. At final follow-up, he fully recovered neurologic functions with bone healing.

**Conclusion** The modified external fixator is a therapeutic modality for pediatric multilevel noncontiguous cervical spine fractures.

**Keywords** Multilevel · Cervical spine · Modified external fixator

## Introduction

Spinal column trauma is relatively uncommon in the pediatric population, representing 1–2% of all pediatric fractures, and most of these injuries involve the cervical spine. The reported incidence of multilevel spine injury ranges from 6 to 50% in pediatric patients with spine injury [1]. Multilevel injuries are classified as "noncontiguous" if there is preservation of at least one uninjured articulation between the injuries [2]. The purpose of this observation was to highlight the therapeutic approach of pediatric multilevel cervical spine fractures in resource-limited settings.

## Case presentation

A 15-year-old teenager, American Spinal Injury Association (ASIA) grade D, presented with neck pain following a fall headfirst from a 6-m-high tree while harvesting leaves for livestock. The axial computed tomography (CT) scans showed left lateral mass and posterior arch of C1 fracture; body, left articular surface and both lamina of C4 fracture; left articular surface of C6 fracture; and left transverse process of C7 fracture (Fig. 1). The sagittal CT-scan of cervical spine showed a posteriorly displaced C-2 type II odontoid fracture (Fig. 2). Due to the marked instability of C2 fracture, a modified external fixator made of halo ring, Ilizarov apparatus and plaster of Paris (Fig. 3) was performed under local anesthesia. At the last follow-up, the neurological status had improved to normal (ASIA grade E) with bone healing on CT-scan (Fig. 4).

## Discussion

The leading mechanism of injury, similar to the pattern of injury, is related to the age of the child. The majority of studies have found that pediatric cervical spine injuries occur in younger children aged between 0 and 9 as a result of motor vehicle collisions, while a fall is seen for ages 10–17. These can be falls from great heights (> 10 ft), which are often fatal. The mean number of vertebral levels injured is 3.2 [3, 4]. In our case, the age is 15 years. The cause of injury is the fall headfirst from a tree to an assumed height of about 6 m. The mechanisms of injury are axial loading which explains the fractures at the levels of C1–C4–C5–C6 vertebrae and hyperflexion responsible of fracture dislocation of C2 vertebra with posterior displacement. The number of injured vertebra is 5.

Unstable pediatric spinal injuries are increasingly being treated operatively with a dilemma of both appropriate

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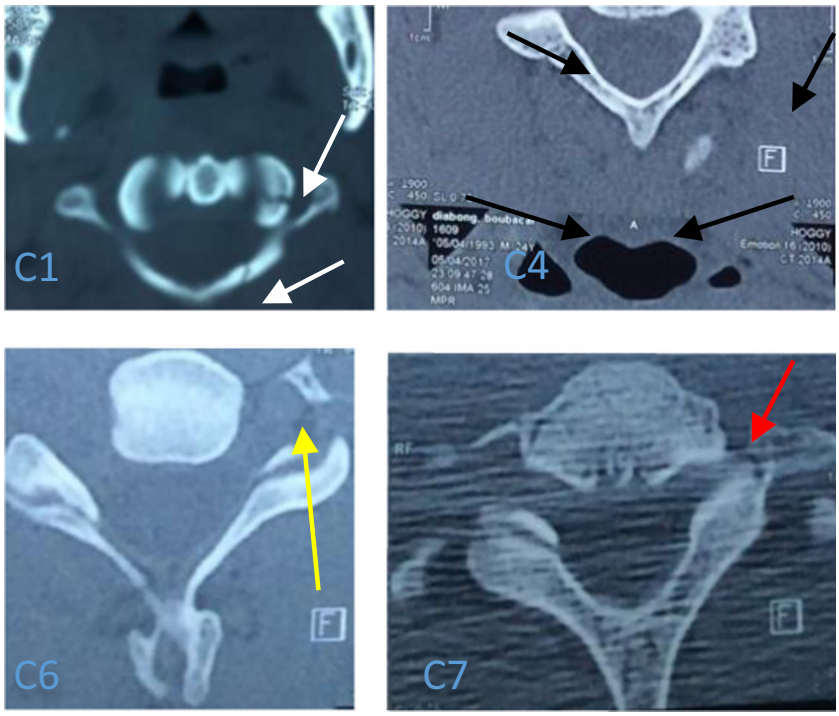


**Fig. 1** Preoperative axial CT scans showing fractures of left lateral mass and posterior arch of atlas or C1 (white arrows); fractures of vertebral body, left articular surface, and both lamina of C4 (black arrows); fracture of left articular surface of C6 (yellow arrow) and fracture of left transverse process of C7 (red allow)

implants and instrumentation [5]. In a study of unstable upper cervical pediatric spine injury by Duhem et al. [6], 21 of 28 children were treated conservatively. The indications for surgery were persistent instability in spite of halo traction, neurological deterioration, and irreducible fracture-dislocation. Parisini et al. [7] noted that conservative treatment was successful in stable fractures but failed in unstable injuries. The C-2 type II odontoid fracture is unstable fracture and internal fixation would often be recommended in such situation. However, nonoperative management with rigid external immobilization with a halo has been described in numerous series [8–10]. In our case, as we did not dispose appropriate implants for internal fixation, conservative treatment by modified external fixator has been performed. The Ilizarov fixator carries many advantages over a standard halo in the treatment

**Fig. 2** Preoperative sagittal CT scan showing fracture of odontoid process type II of Anderson and D'Alonzo with posterior displacement (pink arrow)

**Fig. 3** Modified external fixator composed of halo ring, Ilizarov apparatus and plaster of Paris

**Fig. 4** A one-year control CT scan showing bone healing

of multilevel cervical spinal fractures. One of the main advantages is complete anatomic reduction with stable fixation due to the modular design of the apparatus that allows the frame to be custom built for each individual patient. The adjustability of the Ilizarov apparatus allowed control of bone angulation, rotation, translation, and compression at injured C2 vertebra simultaneously and consecutively. We adjusted the settings on the device two times under the C-arm until correct bone alignment was obtained. The impact was maximum bone compression which provided faster healing time and speedier recovery. At last follow-up, he fully recovered neurologic functions (ASIA grade E) and CT-scan showed bone healing.

## Conclusion

As well as the global good results, and given the local and general surgical environment, one can agree for taken option of modified external fixator in the management of pediatric multilevel cervical spine fractures.

**Acknowledgements** We would like to thank Miss Larissa Musaninyange Mahoro for English language editing.

## Compliance with ethical standards

**Conflict of interest** We, authors of this article, declare that we have no conflict of interest.

**Ethical approval** This article does not contain any studies with human participants or animals performed by any of the authors.

**Informed consent** Informed consent was obtained from all individual participants included in the study. The informed consent was obtained from the child's parents to publish the information, including his photograph.

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