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Temporary Fusionless Occipitocervical Fixation of Bilateral Occipital Condylar Avulsion Fractures in an Adult

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Learning Point of the Article:

The main learning point of this article is to illustrate interesting and effective management by the orthopedic trauma team to manage a rare injury.

Abstract

Introduction: Occipital condyle fractures (OCFs) are rare injuries presenting with neurologic sequelae that may be debilitating or even fatal. Treatment options for unstable OCFs include fusion or halo placement. Fusion of the occipitocervical junction is associated with a significant loss of motion.

Case Report: This study presents a case of bilateral occipital condylar fractures with C1-C2 rotatory subluxation treated with temporary fusionless occipitocervical fixation.

Conclusion: This is a rare case of bilateral OCFs with atlantoaxial instability that underwent fusionless instrumentation and subsequent hardware removal. Treatment resulted in excellent radiographic and clinical outcomes regarding pain and motion at the most recent follow-up.

Keywords: Occipital condylar fracture, occipitocervical junction, fusion, unstable cervical spine, atlantoaxial instability, open reduction, temporary fixation.

Introduction

Occipital condyle fractures (OCFs) are uncommon, comprising about 1–3% of high-energy trauma to the head and neck and affecting the integrity of the craniocervical junction (CCJ) [1, 2,3,4,5,6]. Ligamentous attachments to the occipital condyles support craniocervical stability. The alar ligaments originate from the dens and insert onto the occipital condyles. They act in tandem to limit lateral rotation and tilt, leading to instability of the CCJ if disrupted. It is critical to stratify the stability of these injuries as they are at risk for spinal cord injury with resulting neurologic deficits [5,6,7,8].

This injury resulted in bilateral occipital condyle avulsion fractures. Anderson and Montesano classified this as a type III injury [6,7]. In most unilateral OCFs, conservative management is indicated because the occipitocervical junction remains relatively stable; however, in cases of bilateral avulsion, the increased potential for atlantoaxial stability requires more extensive management [6,9,10].

This study describes a rare presentation of bilateral OCFs managed with occipitocervical instrumentation without fusion for the goal of motion presentation versus the gold standard of arthrodesis or fusion. Once the fractures healed, the construct was removed. The patient ultimately regained a full painless range of motion of the cervical spine. This case was documented with consent by the patient that it would be submitted for publication.

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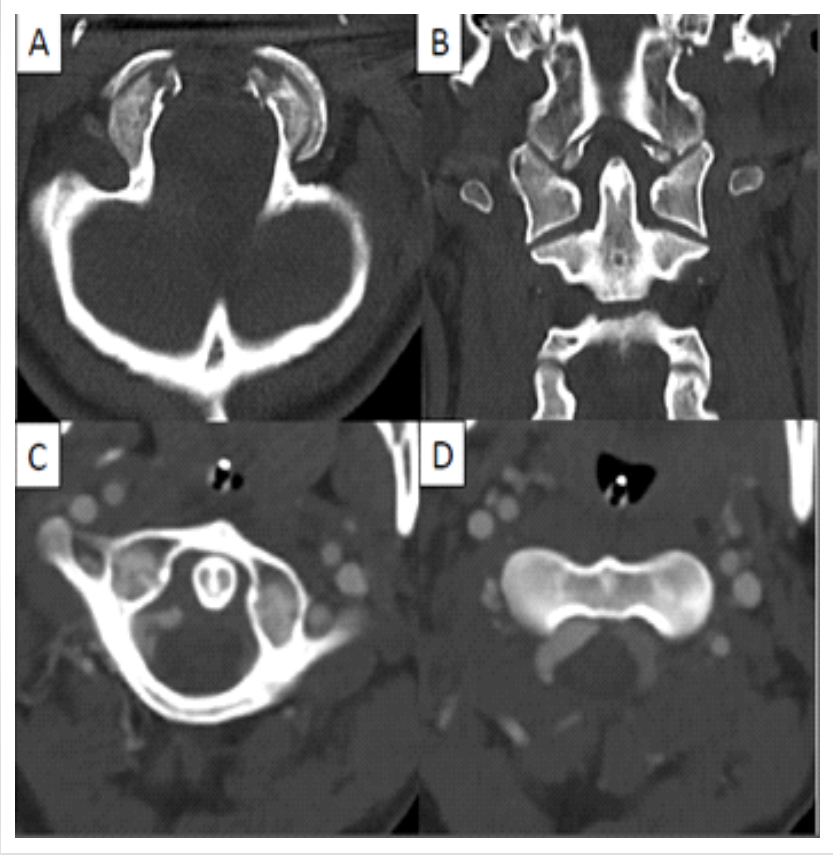

Figure 1: Computed tomography scan of the cervical spine showing bilateral occipital condyle avulsion fractures on the axial [A] and coronal cuts [B] with associated atlantoaxial (C1-C2) rotatory subluxation [C and D].

Case Report

Patient is an 18-year-old male who presented to the emergency department through ambulance following a high-speed motorcycle crash. On arrival, the Glasgow Coma Scale was 14. A rigid cervical collar had been placed by emergency medical services. There were deformities of his left thigh and left forearm, and he reported cervical spine tenderness. Neurological examination revealed intact motor strength and sensation of his bilateral upper and left lower extremities. Examination of the right lower extremity revealed motor weakness with grade 1 out of 5 strength for ankle dorsiflexion, great toe extension, and ankle plantarflexion. Sensation was decreased over the L4, L5, and S1 compared to the contralateral extremity.

A computed tomography (CT) scan of the cervical spine demonstrated bilateral occipital condyle avulsion fractures with atlantoaxial rotatory subluxation (Fig. 1a, b, c, d). Other injuries included an unstable pelvic ring injury, bilateral acetabular fractures, open left midshaft femur fracture, closed left clavicle fracture, closed left upper extremity and hand fractures.

The patient was admitted to the surgical intensive care unit (ICU) with strict spine pre-cautions and instructions to maintain his cervical collar at all times. Three days after the initial injury, the patient was taken to the operating room to address his cervical spine injury. Once in the operating room, general anesthesia was induced, and then biotronic monitoring was placed for electromyography (EMG), somatosensory evoked potential (SSEP), and motor evoked potential (MEP). Gardner-Wells tongs were placed, and the patient was subsequently positioned prone on the Orthopedic Systems Inc. spine frame. The bookwalter retractor system and radiolucent Hohmann retractors were then used during exposure. After obtaining posterior exposure of the occiput to C3, lateral mass screws were placed in C3 and pedicle screws in C2 using fluoroscopic imaging. An occipital plate was then placed with three screws. The construct was connected to the cervical screws with two curved rods and tightened. Final fluoroscopic images were obtained to confirm appropriate hardware placement. Post-operative radiographs are shown in Fig. 2. The incision was subsequently closed, and sterile dressings were applied. MEPs and SSEPs were normal throughout the case. The patient was placed in a cervical collar and returned to the surgical ICU in stable condition.

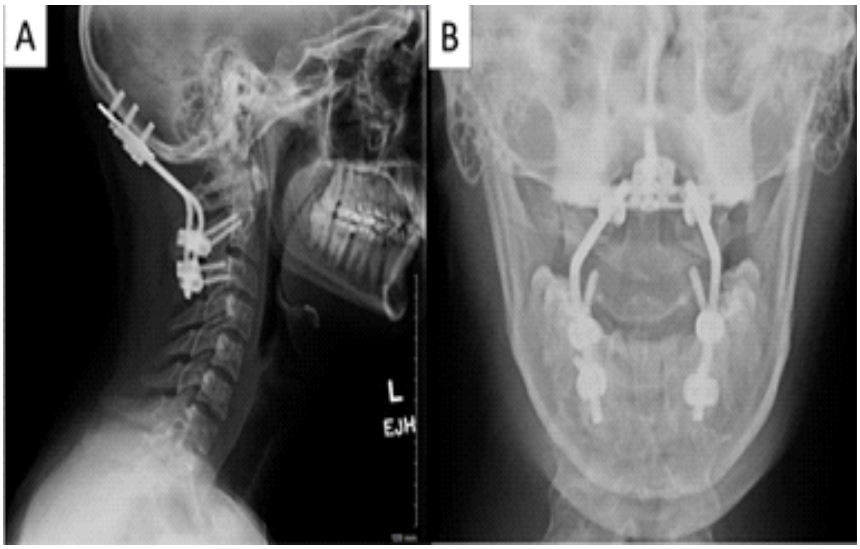

Figure 2: Post-operative lateral c-spine [A] and open-mouth odontoid [B] radiographs showing the occipital to C2-3 fixation.

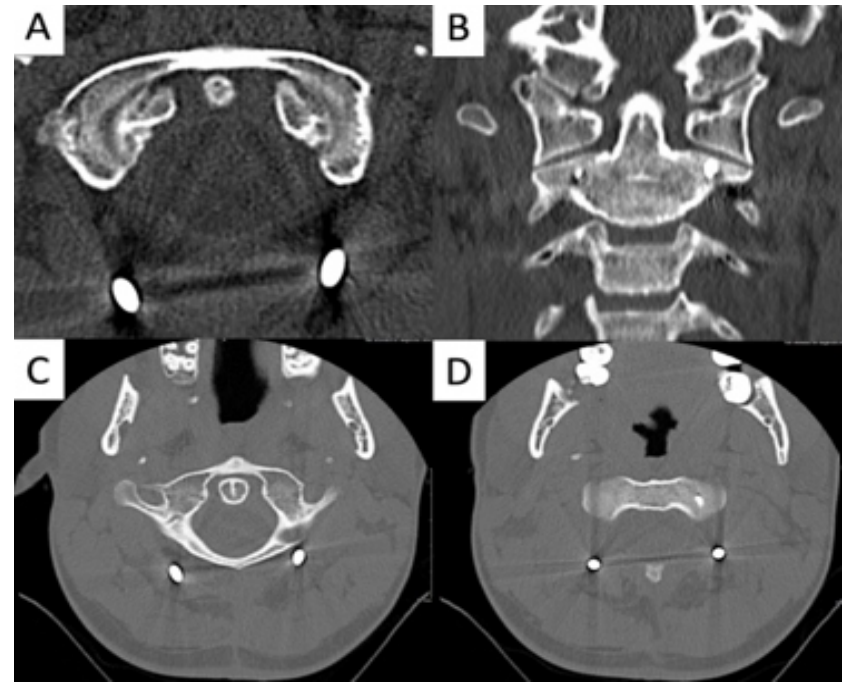

Figure 3: Computed tomography of the cervical spine, 10 months from the initial surgery, showing healed bilateral occipital condyle avulsion fractures [A and B] without atlantoaxial rotatory subluxation [C and D].

Post-operative course was unremarkable, and the patient underwent rehabilitation for his other orthopedic injuries while remaining in a cervical collar. Post-operative visits demonstrated intact occipitocervical hardware with interval fracture healing. Neurologic examination remained unchanged, with motor and sensory deficits of his right lower extremity due to a peripheral sciatic nerve injury confirmed on EMG. Examination of the cervical spine showed a limited range of motion in all planes.

A CT scan of the cervical spine performed 10 months post-operatively demonstrated well-healed OCFs and maintained reduction of the atlanto-occipital and atlantoaxial articulations (Fig. 3). Due to complaints of limited cervical motion, the decision was made to remove the occipitocervical hardware to improve his mobility. One year after his initial surgery, the patient underwent removal of the occipital plate, cervical screws, and connecting rods (Fig. 4). Post-operatively, the patient remained stable without changes in his neurologic status and was discharged to home. At 4 weeks following removal of hardware, and approximately 13 months from the original trauma, the patient had regained full pain-free range of motion of the cervical spine (Fig. 5). He was pleased with the outcome, with plans to return to work.

Discussion

The CCJ is stabilized by the alar ligaments, the occipital condyle joint capsules, and the tectorial membrane. Fractures of the occipital condyles can result in severe instability, leading to neurologic deficits in over a third of affected patients [2,4,8]. Established recommendations to guide treatment of OCFs are limited [2,3,5,7,8,9].

Accepted classification systems consider the biomechanics, anatomy, and fracture morphology of the CCJ and define stable versus unstable injuries [5,6,7]. Anderson and Montesano stratify OCFs as Types 1 and 2, being stable with intact alar ligaments and tectorial membrane. Conversely, Type 3 OCFs, according to the above classification, include avulsion of the occipital condyle and thus injury to the alar ligament, suggesting fracture instability [7]. Tuli et al. established treatment stratification based on the structural integrity of OCFs that provides recommendations for management. They postulate that the need for open instrumentation of OCFs is dictated by the presence of craniocervical misalignment or occipitoatlantoaxial instability [5].

Bilateral OCFs are not addressed in existing classification systems. This is an uncommon presentation, which in cases of avulsion fractures, atlanto-occipital dissociation is likely to be present and must be evaluated carefully [8,10]. Notably, authors discussing treatment of bilateral avulsion of the occipital condyles have described that the concomitant

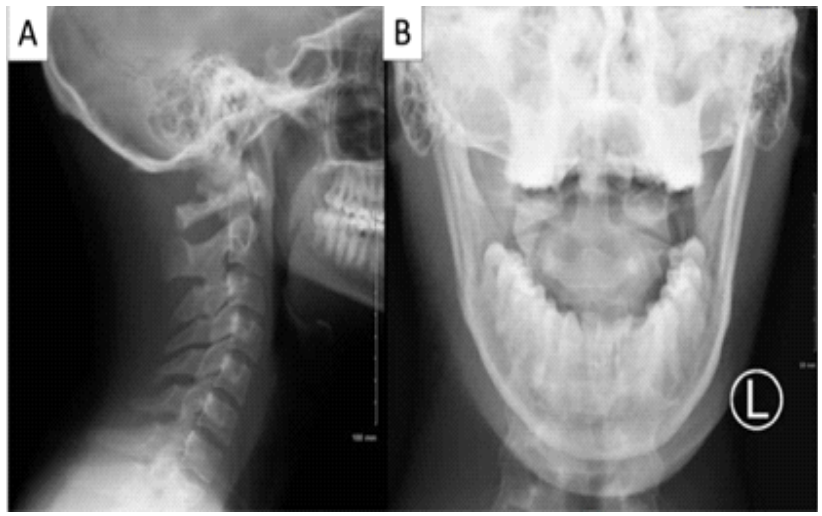

Figure 4: Post-operative lateral c-spine [A] and open-mouth odontoid views [B] radiographs following hardware removal.

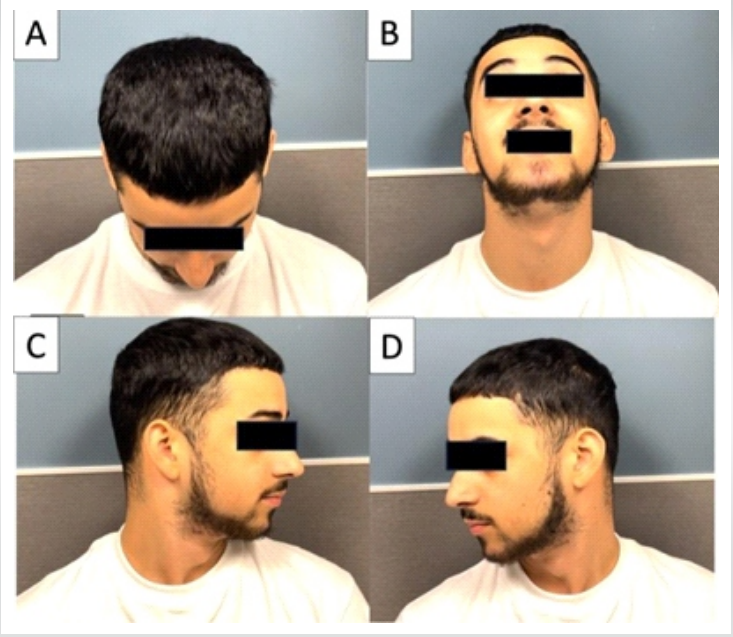

Figure 5: Patient 13 months out from initial injury, and 4 weeks from removal of occipitocervical instrumentation. Clinical pictures demonstrating full cervical range of motion in both flexion [A], extension [B], and axial rotation [C and D].

disruption of the alar ligaments due to this fracture pattern results in CCJ instability [6,8,11,12,13,14]. It follows that rigid cervical immobilization is recommended for bilateral OCFs in the form of internal or external fixation; although, there is insufficient evidence in the literature to determine which type of intervention is more appropriate [2 3 5,8].

Isolated case reports report successful closed treatment of CCJ fracture patterns that include the bilateral occipital condyles, among other structures. Patients were subject to 12–18 weeks of rigid external stabilization with a halo vest [15,16,17]. Open treatment for these injuries has also been successful, consisting of O-C1 or O-C2 posterior occipitocervical fusion in a few cases [14,18,19,20,21].

When considering surgical intervention, CCJ instability is a primary indication for posterior occipitocervical fusion in adults – resulting in immediate post-operative stability [22,23]. However, young active adults who undergo posterior fusion typically have a significant decrease in range of motion, translating to long-term functional limitation and a decreased quality of life [22,23,24]. Furthermore, while a halo vest is effective in limiting cervical motion, common concerns include increased patient discomfort caused by the external apparatus, lack of mobility, and risk of pin site infection or loosening. In addition, contraindications to the use of a halo vest include polytrauma, chest trauma, obesity, scalp injury, and infection [25,26]. Alternatively, a rigid collar is easily placed and does not possess operative morbidity, but immobilization of the cervical spine is limited as compared with surgical stabilization or even a halo vest [25, 27].

In the case presented, bilateral OCFs were successfully managed with temporary occipitocervical fixation without fusion, followed by hardware removal. Instrumentation and fixation were performed to provide stability to the fractures, allowing for bony union through callus formation. Preservation of motion upon removal of hardware is of significant benefit, as O-C2 joints are responsible for most of the flexion-extension and rotational motion of the neck when compared to subaxial levels. This is imperative as fusion of the higher cervical levels may be associated with a decreased quality of life and a significant loss of motion of the cervical spine [26,28,29]. While this technique has not been applied to bilateral OCFs in literature, temporary bridge fixation to address unstable atlas or odontoid fractures has yielded solid bone union, high levels of patient satisfaction, and resulted in preserved neck motion [30,31,32,33,34,35].

Conclusion

OCFs are rare injuries that may compromise the stability of the CCJ. Clinical presentation varies among patients, with up to a third resulting in neurologic deficits. Literature recommends surgical intervention in the form of occipitocervical fusion or halo vest immobilization for unstable injuries with associated atlanto-occipital instability. This case report demonstrates a motion-preserving technique for unstable bilateral OCFs. Fracture healing was accomplished using a temporary occipitocervical construct, with return of full cervical motion upon hardware removal. Further investigation is warranted to determine the most optimal protocol to address bilateral OCFs, as recommendations are not yet provided in present clinical guidelines.

Clinical Message

This article describes the decision-making that resulted in the successful novel treatment to address an otherwise debilitating injury of unstable bilateral occipital condylar fractures with temporary fixation.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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