Outcome of conservatively treated occipital condylar fractures – A retrospective study

ABSTRACT

Introduction: Occipital condyle fracture (OCF) is rare. It may, however, pose a serious threat to the patient due to destabilization of the craniocervical junction. Correct diagnosis and effective treatment are essential to prevent long-term complications. The aim of this study was to retrospectively investigate our current treatment program with focus on the functional outcome. Diagnosis and classification systems were evaluated for their usefulness in the clinical practice.

Materials and Methods: We retrospectively reviewed all patients treated conservatively for an occipital condylar fracture from 2010 to 2015 at our department. Fracture classifications were performed according to three established systems. The patients were followed up with clinical examination and plain radiographs at weeks 2, 6, and 12 with the addition of a dynamic flexion-extension X-ray at week 14.

Results: Totally 24 patients met the inclusion criteria. One was lost to follow-up and two ended treatment before completing the full treatment program due to a clinical decision. Fracture displacement was neither detected nor was any neurological deficits observed. Most patients were pain free after 6 weeks. After 14 weeks' treatment, two patients still had neck pain; the rest were pain free.

Conclusions: Our data suggest that twelve weeks' conservative treatment is not necessary for unilateral OCFs without atlanto-occipital dissociation (AOD). We recommend 6 weeks of conservative treatment, with clinical control and flexion-extension radiographs before ending treatment. Plain radiography is of limited value in the clinical control of this fracture type. Anderson and Montesano and Tuli *et al.* classification systems fulfill an academic role. We found the classification system by Mueller *et al.* to be more helpful in everyday clinical practice.

Keywords: Craniocervical junction, occipital condyle fracture, outcome

INTRODUCTION

Occipital condylar fractures (OCF) are rare[1-4] but may pose a serious threat to the patient due to its anatomical relation to foramen magnum and the risk of destabilizing the craniocervical junction.[5-14] The injury is usually a result of a high-energy trauma[15,16] and may be accompanied by serious complications including lower cranial nerve palsy.[17,18] Being practically impossible to detect on plain radiographs,[15,19,20] Computed tomography (CT) scans are now widely used in the diagnosis of OCFs.[2,3,21-23] Magnetic resonance imaging can be used to outline the ligamentous instability of the craniocervical junction.[21] Several classification systems and treatments have been suggested including Anderson and Montesano, Tuli *et al*., and more recently, by Mueller *et al*.[16,22,24] Maserati *et al*. constructed a treatment algorithm[1] for the management of OCFs. Although a consensus has not entirely been reached, a conservative approach with stiff collar is generally recommended. In more severe cases, surgical treatment is indicated with either decompression of the brainstem or occipitocervicalfixation.[1-3,16,25,26]

Currently, patients with OCFs at our department are treated with a stiff collar for 12 weeks, with clinical control

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and conventional X-rays after 2, 6, and 12 weeks. After 12 weeks, the stiff collar is removed, and a final dynamic flexion-extension radiograph is taken at week 14. This standardized treatment program has made handling of this patient category simple and similar to other cervical fractures. However, there is a risk of over treatment. Our standardized clinical follow-up and radiology program provide a platform for systematically and retrospectively to investigate the outcome after conservatively treated cervical fractures.

The purpose of this study was to investigate the current treatment protocol and the outcome of occipital condylar fractures being treated conservatively. In addition, we investigated the usefulness of three classification systems[16,22,24] in clinical practice.

MATERIALS AND METHODS

Cross-sectional data

Patients included in the study were all patients treated for an OCF at our department from 2010 to 2015, identified using ICD-10 code Z094 and S12x. The individual patient's records were retrospectively examined. The following characteristics were collected: age and gender, Glasgow coma scale (GCS), concomitant cervical fracture, mechanism of trauma and neck pain. High-energy trauma was defined as a fall from more than six meters, bicyclist/pedestrian hit by a car, person thrown from car/motorcycle, car turned over, person trapped for >20 min or larger deformity of the car. Low-energy trauma was defined as a result of falling from standing height or less. Fracture classifications were performed using Anderson and Montesano, Mueller *et al*., and Tuli *et al*. classification systems[16,22,24] by reviewing the initial trauma CT scan of each patient.

The study was approved by the Danish Health Authority (3-3013-1507/1) and Danish Data protection Agency (16/3426).

Follow-up data

The medical records for each patient were analyzed and data collected including X-rays from visits at the neurosurgical outpatient clinic at 2, 6, 12, and 14 weeks. Outcome data were collected as presented in Table 1. Due to the retrospective design, the existing data did not allow for grading of the neck pain, but only allowed a simpler approach with Yes/No. Some patients were initially intubated or immobilized to an extent that they were not able to attend the first visits at the outpatient clinic. They were included in the subsequent follow-up. Patients, who did not complete all visits being lost to follow-up or being discharged at a time before 14 weeks, were also noted.

RESULTS

We identified 24 patients treated conservatively for an OCF between 2010 and 2015. Some data (including neck pain and GCS) were impossible to collect on all patients' due to not available data or patients being intubated/sedated. Patient characteristics are summarized in Table 2. Of the 24 patients, 20 were male and 4 female. Their average age was 43.8 years (age range 23–66), with a median age of 43. In 75% of the cases, the mechanism of injury was high-energy trauma. Seven patients had concomitant cervical spine fracture. The mean GCS was 11.6 and the median 14 with most patients scoring between 9 and 15 (n = 15; 75%). However, of the severely injured scoring lower all had a GCS 3 (n = 5; 25%). 14 patients had initial neck pain, two had no neck pain, and information is not available for the remaining eight.

Fracture classification

For the fracture classification, trauma CT scans were reviewed by two investigators and fractures were classified according to the systems by Anderson and Montesano, Mueller *et al*., and Tuli *et al*.[16,22,24] None of the patients had a bilateral OCF. The classifications and subtypes are summarized in Table 3.

According to the Tuli *et al*. classification, 23 patients had Type I and IIa (implying stability) and only one patient had a Type 2b, implying potential instability. According to the Anderson and Montesano system, we found seven patients

Table 1: Dichotomization of outcome

Neurology	Radiological changes	Neck pain
Neurological intact	>3 mm change in alignment	Pain free
Any neurological deficit	Any other visible change	Neck pain

Table 2: Patient characteristics

Characteristic	Number of patients (%)
Sex	
Male	20 (83)
Female	4 (17)
GCS	
3-9	5 (25)
9-15	15 (75)
Concomitant cervical fracture	
Yes	7 (29)
No	17 (71)
Mechanism of action	
High energy	18 (75)
Low energy	6 (25)
Initial neck pain	
Yes	14 (58)
No	2 (8)
No information	8 (33)

GCS - Glasgow Coma Scale

with the subtype III, which is potentially unstable. In three cases, the investigators were unable to differentiate between Type I and III fractures, bringing the total number of potentially unstable fractures to ten. The two systems failed to provide similar results regarding potential instability. When classifying using the system by Mueller *et al*.,[22] none of the fractures were considered unstable.

Follow-up data

Of the 24 patients, 23 entered the control program. Due to multitrauma and the severity of other injuries, four patients were unable to complete first visits and instead entered in a later phase (week 6 or 12). Two patients ended treatment before the 14 weeks (at week 2 and 6) due to clinical decision made by the responsible surgeon. Since some patients chose not to attend the planned visits in the outpatient clinic, we were unable to register all patients at all time intervals [Figure 1]. No patients were surgically treated.

Outcome

Of the 23 patients that entered the control program, only two had neck pain after 14 weeks. None of the patients had neurological deficits or any visible changes on plain radiographs (fracture displacement or any other radiological change described) at any of the clinical follow-ups. The outcome after ended treatment is summarized in Table 4. In all cases, the dynamic flexion-extension X-rays after 14 weeks ruled out instability.

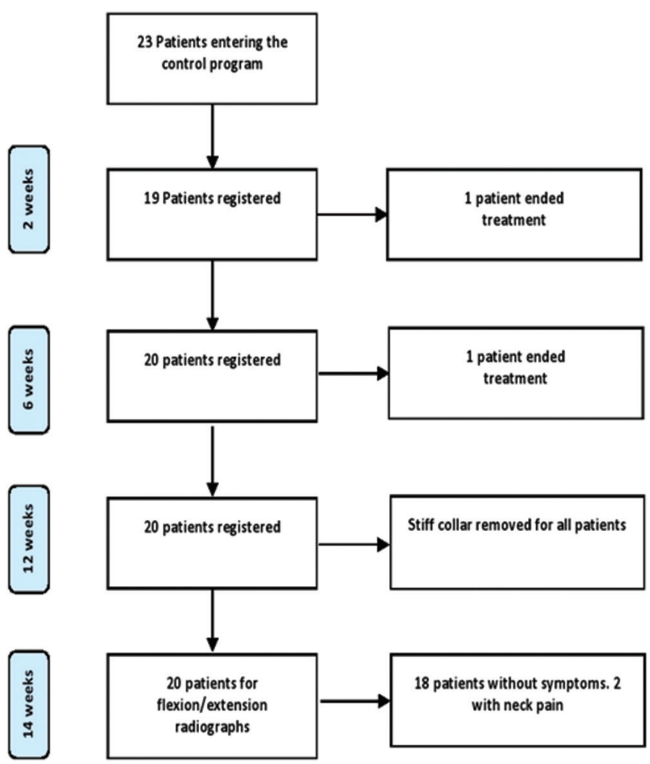

Figure 1: The number of patients attending the outpatient clinic at the given time interval. To the right, it specifies major events (patients ending treatment, stiff collar removed and outcome at last control)

Information of initial neck pain was incomplete, but Figure 2 shows the number of patients that were reported pain-free at the clinical follow-ups. After 2 weeks of stiff collar immobilization, 11 patients had no neck pain. This increased to 17 patients at weeks 6 and 12, and finally, 18 of 20 patients were pain free at 14 weeks, including the 2 patients ending the treatment early and 1 patient reported pain free but not present at the last clinical consultation, a total of 21 patients ended treatment without neck pain. Two patients reported neck pain after 14 weeks. These two had a fracture Type III according to Anderson and Montesano, Type 1 for Tuli *et al*., and type 1 according to Mueller *et al*.

Table 3: Fracture classification

Fracture classification	Type	Number of patients (%)
Anderson and Montesano	I	10 (42)
	II	4 (17)
	III	7 (29)
	I and III (unable to differentiate)	3 (13)
Tuli *et al.*	I	18 (75)
	IIa	5 (21)
	IIb	1 (4)
Mueller *et al.*	I	24 (100)
	II	
	III	

Table 4: Outcome after ended treatment

Outcome variable	Number of patients (%)
Neurology	
Neurological intact	23 (100)
Neck pain	
No	21 (91)
Yes	2 (9)
Radiology	
>3 mm change in alignment	0
Any other visible change	0

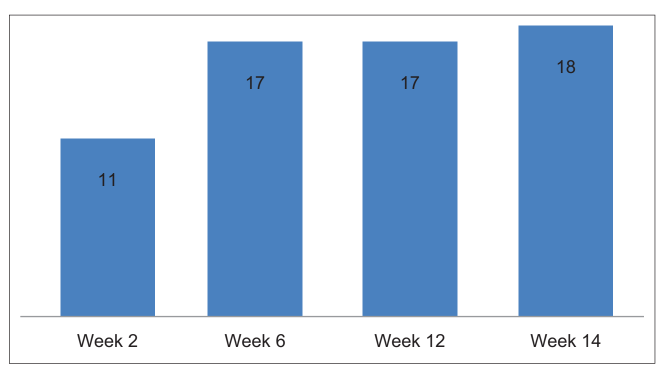

Figure 2: Number of patients with no neck pain at the clinical follow-ups

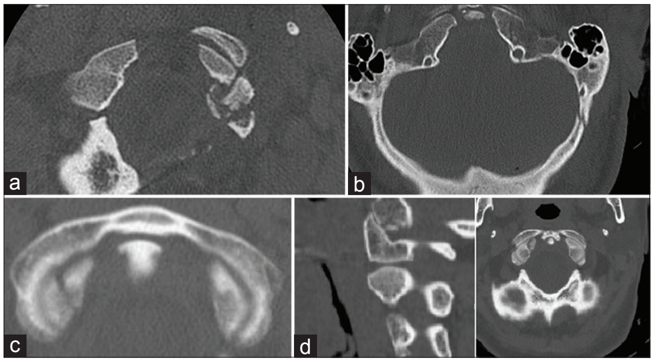

Figure 3: (a) Comminute fracture of the left occipital condyle, Type I Anderson and Montesano. (b) Skull base fracture with extension to the left occipital condyle, Anderson and Montesano type 2. (c) Avulsion fracture of the right occipital condyle, Anderson and Montesano type 3. (d) In three cases we were unable to differentiate between type I and III with the Anderson and Montesano classification system

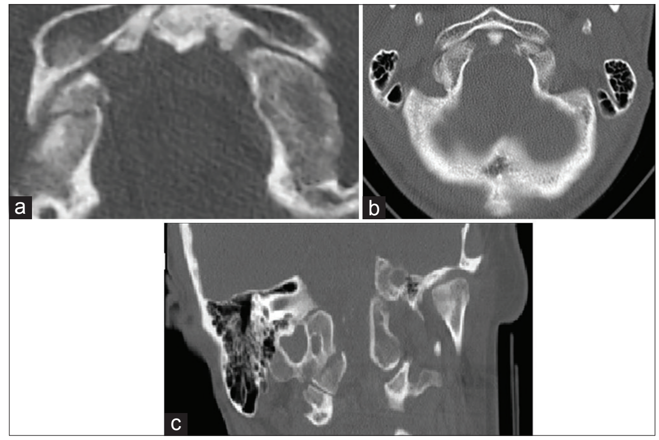

Figure 4: (a) Unilateral nondisplaced fracture of the right occipital condyle, Tuli type 1. (b) Unilateral nondisplaced fracture of the right occipital condyle, Tuli type IIa. (c) Unilateral fracture of the right occipital condyle with clear displacement, considered unstable. Tuli type IIb

DISCUSSION

Our study investigated the clinical outcome of 23 patients with an OCF treated conservatively with stiff collar. We investigated the frequency of neck pain, radiologic instability, and neurologic deficits and performed classification of the fractures using three established classification systems. The literature is sparse on the treatment of OCF, with the largest series including up to 100 patients,[1,4,15,22,27] and to the best of our knowledge, no meta-analysis. Our study has a total of 24 patients and aims to support these previous studies. OCF is a rare fracture,[2,3,20,22] and our study also shows this. Over a 5-year-period, we identified 24 patients treated conservatively in our catchment area of 1.2 million, corresponding to an incidence of 0, 4 fractures/year/100.000.

The major cause for OCF was high-energy trauma (18 patients, 75%), which also has been shown in other studies.[1,2,15,22] Low-energy trauma does, however, not rule out the finding of OCF. We found that six of our patients (25%) suffered from low-energy trauma. Although the severity of trauma the median GCS was 14, and the mean 11.6 ($n = 20$), however, those scoring lower ($n = 5$) all had a score of three. Other studies have shown lower scores although Malham *et al*.[2] reported a median GCS of 14. With our results from 20 males (83%) and an average age of 43.8 years, gender and age combined may be regarded as a potential risk factor. Kruger *et al.*[19] reported a lower average age of 24 with only eight male patients included. Hanson *et al*.[4] reported a median age of 33 with an abundance of male patients and Maddox *et al*.[27] showed a mean age of 38 years.

In total, seven patients suffered from an additional cervical spine injury (C1 = 3, C3–C7 = 4), all of which were treated conservatively alongside the OCF. Of the two patients ending treatment with reported neck pain, none had a concomitant cervical fracture.

Tuli *et al*.[24] and Anderson and Montesano[16] were the first major classification systems introduced for OCFs. Anderson and Montesano differentiate OCFs into three groups [Figure 3] based on fracture morphology, where only a Type 3 fracture (avulsion fracture) is potentially unstable. We reported that seven patients had a Type 3 fracture but were unable to differentiate between Type 1 and 3 in three cases. Tuli *et al*. classification system [Figure 4] provides an approach in which the stability is assessed. Type 1 is an OCF not displaced (<2 mm), Type 2a is an OCF displaced without atlanto-occipital dissociation (AOD), Type 2b is an OCF displaced with AOD. Only Type 2b is considered unstable. We found 23 patients with stable fractures (18 Type 1 and 5 Type 2a) and only one potentially unstable fracture (2b). Thus, a clear difference between the two systems in our data is found since only 1 is potentially unstable with Tuli *et al.* system whereas seven (and potentially additional three, where we were unable to categorize the fracture type unequivocally) with Anderson and Montesano system. It is our experience that these classifications fullfill a more academical role when assessing OCFs retrospectively and little importance in the everyday clinical assessment of OCFs.

In 2011, Mueller *et al*.[22] presented a new and more practical classification for OCFs. Type 1 is a unilateral OCF without AOD (Type 1, 2, and 3 due to Anderson and Montesano), Type 2 is a bilateral OCF without AOD. Type 3 is a unilateral or bilateral OCF with AOD. They suggest 6 weeks of treatment for a Type 1 fracture. All our patients suffered a unilateral OCF and majority were pain free at week 6. This classification system may actually be of more use in the everyday clinical decision and management of OCFs.

We reported that a majority of our patients were pain free at week 6 (n = 17; 71%), and further treatment provided a negligible change in patients ending treatment without neck pain. After ended treatment, a total of 21 patients (91%) had no neck pain. Hanson *et al*.[4] found that 65% had good outcome after 4 weeks. As expected all patients ended treatment completely neurologically intact, probably explained by the fact that such deficits genereally are seen in more severe cases.[7,11,12,14,28] As emphasized before OCFs are practically impossible to detect on plain radiographs.[15,19,20] We confirm that conventional X-ray is of limited value since no fracture displacement or any other radiologic change were found on the X-rays. Our data, therefore, suggest that plain radiographs have a limited role the clinical control of OCFs. A dynamic flexion-extension X-ray will reveal major instability in the cervical spine and should probably still be performed. Thus, we suggest 6 weeks of treatment with stiff collar as sufficient for the treatment of unilateral OCFs without AOD. It is likely that bilateral OCFs can be treated similarly,[22] however, we have no cases of bilateral OCFs included in our study.

The retrospective nature of our study left some limitations. Although patients were treated using a standardized treatment protocol, this did not guarantee uniform reporting of all variables. The data did not allow for grading of the neck pain beyond a simple yes/no. A natural loss to follow-up can be expected. We, however, only lost one patient completely to follow-up. Our study still provides a good opportunity to assess the clinical outcome of conservatively treated OCFs. However, future prospective studies are needed to further confirm our findings.

CONCLUSIONS

OCFs that are not dislocated can be treated with stiff collar with good results. Our study investigated the outcome after 12 weeks' conservative treatment. The two larger classification systems of Anderson and Montesano and Tuli *et al*. are of mostly academic interest and provided little aid in the everyday clinical practice. Instead, we found that the newer classification system by Mueller *et al*. potentially could be useful in the treatment algorithms of OCF.

Based on our study, we recommend reducing treatment time to 6 weeks of treatment with stiff collar for unilateral OCFs without AOD. A dynamic flexion-extension radiograph together with a clinical examination should be performed before ending treatment. Plain radiographs have a limited place in the clinical control of this type of fracture.

Declaration of patient consent

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

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Conflicts of interest

There are no conflicts of interest.

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