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What Factors Influence the Final Outcome in Occipital Condyle Fractures?

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Abstract

Introduction Diagnosis of occipital condyle fracture (OCF) following a trauma needs high awareness among the trauma surgeons.

Aim In our study, we attempt to discern if any factor or a combination of factors influences the final outcome following OCF.

Materials and Methods We prospectively analyzed the outcome in OCF patients admitted during 2017 to 2019 at our center. We had 14 patients with polytrauma with OCF. Among them two were lost for follow-up. So, 12 patients were followed up for 6 months after injury. The following 10 factors were analyzed—age, sex, injury, Glasgow Coma Scale, Injury Severity Score, spinal injury, associated injuries, blood pressure, medical conditions, and surgical intervention. Outcome was divided into good and poor outcomes. Chi-squared test was used. All these patients were treated conservatively for OCF for 3 months.

Results There was no significant factor, since *p*-value was greater than 0.05 for all variables. Only Injury Severity Score (0.091) was close to the significant *p*-value. Seven patients had severe head injuries and among them one died and four had the worst outcome. Among the five patients who had spinal injuries, only two had good outcomes.

Conclusion Our results indicate that the outcome following OCF is not determined by any single factor. Injury Severity Score comes close to determining the final outcome. This indicates that the overall patient management especially of associated injuries is the determining factor in the outcome in patients who had sustained OCF.

Keywords
- occipital condyle fracture
- Polytrauma
- head injuries

Introduction

Diagnosis of occipital condyle fracture (OCF) following a trauma needs high awareness among the trauma surgeons. It is a rare condition and can be life threatening if missed.[1–3] The injury is usually due to high-velocity injury.[4,5] Majority of OCF is associated with polytrauma.[1,3,6] A retrospective analysis of 30 head computed tomography (CT) scans in trauma cases revealed in only 16 were the occipital condyles adequately imaged. Hence, it is emphasized that it should be a standard practice to include this area when performing CT scan of the head in trauma victims. Early accurate diagnosis

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and institution of proper treatment are necessary to prevent untoward complications.[1,3,4,6]

Aim

In our study, we attempt to discern if any factor or a combination of factors influences the final outcome following OCF.

Materials and Methods

We prospectively analyzed the outcome in OCF patients admitted during 2017 to 2019 at our department. We had 14 patients with polytrauma with OCF. Among them two were shifted to other hospitals and lost to follow-up. So, 12 patients only were included in our study. In all these patient's periodic clinical assessment and X-rays of the cervical spine to detect craniocervical instability were taken till 6 months after injury. The following 10 factors were analyzed: age, sex, mode of injury, Glasgow Coma Scale (GCS), Injury Severity Score (ISS), spinal injury, associated injuries, blood pressure, medical conditions, and surgical intervention if performed (►**Table 1**). Outcome was divided into two categories in view of small sample size and rarity of the OCF. Good outcomes were defined as those who became normal or had mild-to-moderate disability. Poor outcomes were defined as those who either died or had severe disability.

Table 1 Patient characteristics, parameters analyzed with outcome, and *p*-values

Variable	Categories	Patient numbers	Good outcome $n=7$	Poor outcome $n=5$	*p*-Values
Age in years	< 60	12	7	5	–
	>= 60	0	0	0	
Sex	Male	9	6	3	0.310
	Female	3	1	2	
Injury	Fall	1	0	1	0.217
	RTA	11	7	4	
GCS	>8	5	4	1	0.198
	≤ 8	7	3	4	
ISS	≤ 25	3	3	0	0.091
	26–74	9	4	5	
Spinal injury	Absent	7	5	2	0.276
	Present	5	2	3	
Other injuries	Absent	1	1	0	0.377
	Present	11	6	5	
BP	Normal	11	7	4	0.217
	Hypotension	1	0	1	
Medical diseases	Absent	11	7	4	0.217
	Present	1	0	1	
Surgery	No	9	6	3	0.31
	Performed	3	1	2	

Abbreviations: BP, blood pressure; GCS, Glasgow Coma Scale; ISS, Injury Severity Score; RTA, road traffic accident.
p-Value < 0.05 only significant. None of the variables were significant since *p*-value was greater than 0.05.

In polytrauma prognostication, "Injury Severity Score [ISS] is considered as one of the most important indicators of severity of injury."[7] "In case of a polytrauma, three most severely injured body parts among the below mentioned 6 body parts are considered for assessment of the ISS. They are [1] Head/ Neck [2] Face [3] Chest [4] Abdomen or Pelvic contents [5] Extremities or Pelvic girdle and [6] External. Abbreviated Injury Scale [AIS] value is assigned to each of the injured parts of the body. It ranges from 1 [minor] to 6 [maximum severity]. ISS is the sum of the squares of the single highest AIS score given for each of the three most severely injured body parts. An ISS score of 75 suggests that the patient is unlikely to survive."[7] Literature states that 10% mortality is observed with an ISS of more than 15.[7] ISS above 15 is considered as major injuries and ISS above 25 to 74 is considered as critical.[7] Hence, we took the ISS score value of 25 which is critical as a cutoff point in our analysis.

OCF injuries were classified in consonance with Anderson and Montesano[5] and Tuli et al[8] classification of OCF (►**Figs. 1**, **2**), but we did not correlate it with the outcome. Chi-squared test was used to find out the significant factors. All these patients were treated conservatively with Philadelphia collar or Sternal Occipital Mandibular Immobilizer (SOMI) brace brace for 3 months.

Results

We had 12 patients among 14 with OCF treated between 2017 and 2019. These patients were periodically followed up for 6 months to 1 ½ years. Patient characteristics, parameters analyzed, and *p*-values are summarized in ►**Table 1**. In more than 90% of cases (11/12), the mechanism of injury is high-speed road traffic accidents. In seven patients, the GCS score was less than 8 (►**Table 1)** and as per hospital protocol all of them were intubated and ventilated. Among them three patients had good outcomes and four had poor outcomes (►**Table 1)** We had three cases with ISS less than or equal to 25 and nine cases between 26 and 74 which indicated we had more critically injured patients in our study. In nine cases whose ISS score was between 26 and 74, four had good outcomes and five had poor outcomes (►**Table 1).**

On further analysis to identify the associated neurosurgical findings in this group of 12 OCF patients, we found that 11 patients had head injuries that varied from mild-to-severe. We had five cases of Diffuse Axonal Injury (DAI) among that two had brainstem injury. There were two other patients with brainstem injuries. One patient who had posterior fossa extradural hematoma with cerebellar ischemic infarct was operated. We had five patients with associated spinal injury. Among them one patient had C7 body fracture dislocation causing paraplegia that was surgically stabilized. Four patients had stable spine injuries without neurological deficit. Only one patient had an associated C1 stable fracture. There was no case of Atlanto-occipital dislocation (AOD). Among the 12 cases, 11 had extracranial–extraspinal injuries (►**Table 1)**. These results

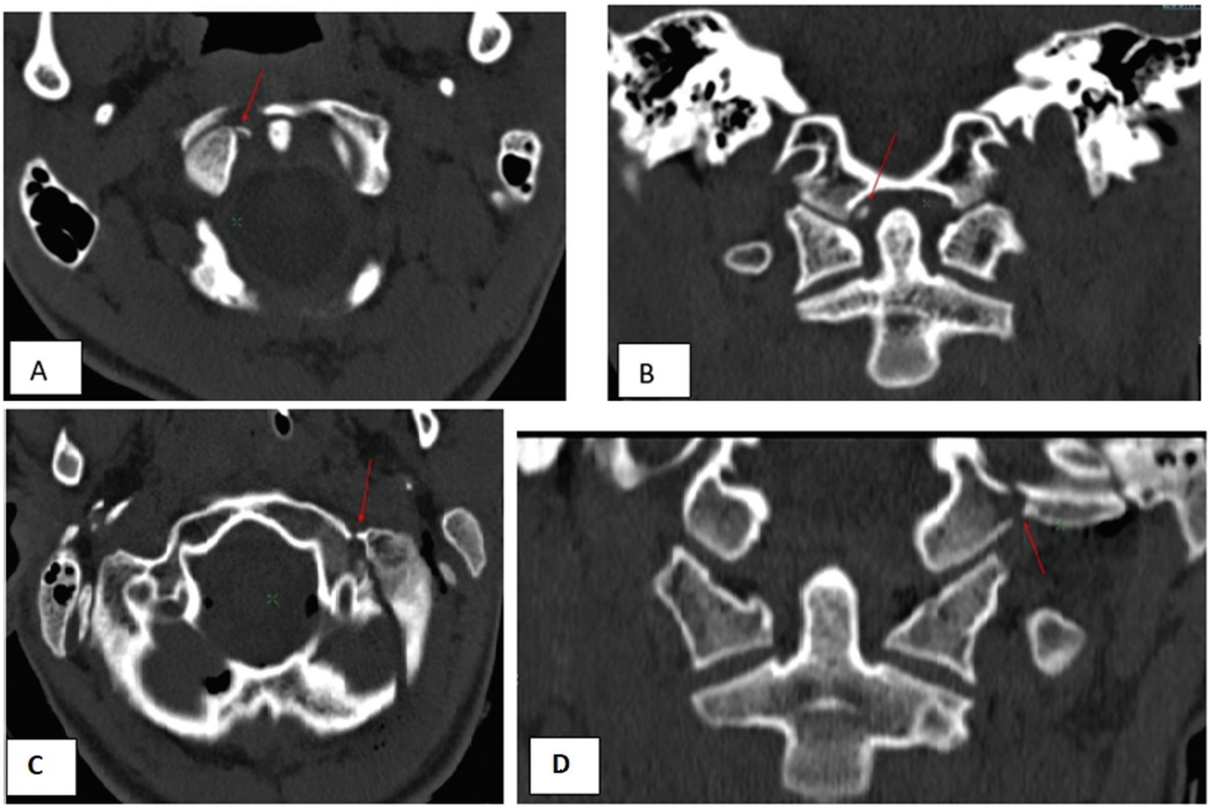

Fig. 1 Axial (**A**) and reconstructed coronal (**B**) computed tomographic (CT) images of an Anderson and Montesano type 1 (Tuli type 1; occipital condyle fracture [OCF]) on the right side. Note the fracture of the right occipital condyle without displacement of the fracture segments (arrow). Axial (**C**) and reconstructed coronal (**D**) CT images of an Anderson and Montesano type 2 (Tuli type 1) OCF on the left side. Note the extension of the basilar skull fracture into the left occipital condyle (arrow).

indicate in any case of severe polytrauma associated OCF to be excluded. Only one patient was admitted with hypotension who needed inotropic support. We had another patient who developed hyperpyrexia. Two other patients underwent surgical intervention. One patient was operated for delayed development of extradural hematoma and ischemic cerebellar infarct, while another patient was operated for fracture of radius. All our 12 patients were treated with Philadelphia collar or SOMI brace for 3 months. At the end of 6 months' follow-up, none of the 11 surviving patients developed craniocervical instability requiring surgical stabilization.

Our results indicate that among the 10 factors we analyzed that there was no factor which was significant to that outcome variable (►**Table 1).** If the *p*-value is less than 0.05, we can say there is association between that variable and the outcome variable (►**Table 1).** Results of our statistical analysis using Chi-squared test revealed that all the *p*-values were greater than 0.05. Among all the factors only ISS (0.091) was close to the above significant *p*-value. So, no variable is significant to the outcome variable. For the age category, it was in one category so it does not converge and hence we did not get *p*-value.

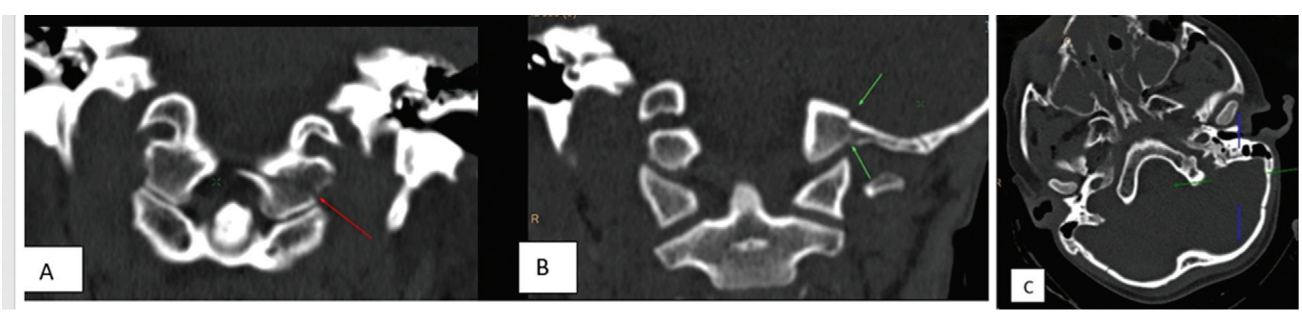

Fig. 2 Axial (left **A**) and reconstructed coronal (right **B**) computed tomographic images of an Anderson and Montesano type 3 (Tuli type 2a) occipital condyle fracture. Note the avulsion fracture of the occipital condyle on the left side (arrow). This patient was treated with immobilization in a hard cervical collar (**C**) showing the associated anterior cranial fossa fracture with orbital wall fracture.

Discussion

►**Table 2** showing the various classifications for OCFs with the corresponding CT scan pictures. Byström et al[6] opined that Anderson and Montesano[5] and Tuli et al[8] classification systems (►**Table 2)** are not of much use in clinical decision making in the management of these OCF cases. Mueller et al[9] presented a classification for OCFs (►**Table 2)**. World Federation of Neurosurgical Societies (WFNS) spine committee 2020[10] in its recommendations advocated Mueller et al classification[9] to be used in the management of cases with OCF.[9] Byström et al[6] in their series of 24 patients observed that 91% (21/24 patients) had no neck pain with 6 weeks of nonoperative treatment using a hard cervical collar. Hence, they recommend nonoperative treatment of OCF without AOD. Similar opinion was expressed by others.[3,11] WFNS spine committee 2020[10] also came to a consensus that conservative treatment should be preferred to surgical treatment in OCFs without AOD. Our results also support the above views since all our OCF cases were managed nonoperatively with a hard cervical collar.

In Maserati et al[1] series among 100 OCF patients, only two patients had craniocervical malalignment as detected using CT imaging and underwent occipitocervical fusion. They detected craniocervical malalignment based upon Pang et al's criteria.[1,12] It states that occipital condyle to C1 distance if more than 2.0 mm indicates craniocervical malalignment.[12,13] Rest of the patients were managed nonoperatively. They concluded that it is necessary only to diagnose craniocervical malalignment from the CT scans. Additional classification is unwarranted.[1]

Analysis revealed that there was no factor that was significant to the outcome variable. If the *p*-value is less than 0.05, we can say there is association between the variable and the outcome variable. But in our study, all the variables had a *p*-value greater than 0.05 (►**Table 1).** So, no variable is significant to the outcome variable. Hence, statistically there was no significant factor. If the variable is significant in univariate analysis, then it is advisable to do multivariate analysis and can get combined results. Since there were no significant variables in univariate analysis and sample size is small, multivariate analysis was not done. Among all the factors, only ISS (0.091) was close to the above significant *p*-value. Further analysis revealed 7 among the 12 patients had severe head injury with GCS less than 8 (►**Table 1).** Among these, one patient died and three other patients had poor outcomes. Five patients had spinal injuries and one of them had quadriplegia. Only two patients among these five had good recovery.

Conclusion

Our results indicate that the outcome following OCF is not determined by any single factor. ISS comes close to determining the final outcome. This indicates that the overall patient management is the determining factor. Limitation of our study is the relatively small size of the patients, even though if the data from only one center is considered, it is a larger number of OCF patients considering the rarity of the disease.

Table 2 The various classifications for OCF with the corresponding CT scan pictures

Types	Classification system	Stability	Management
	Anderson and Montesano[5] classification		
Type 1	Comminuted without fragment displacement—(►**Fig. 1**)	Stable	Conservative
Type 2	Linear fracture—(►**Fig. 1**)	Stable	Conservative
Type 3	Avulsion fracture with fragment displacement—(►**Fig. 2**)	Unstable	Surgery—occipitocervical posterior stabilization
	Tuli et al[8] classification		
Type 1	Not displaced (< 2mm)—(►**Fig. 1**)	Stable	Conservative
Type 2a	Displaced without AOD—(►**Fig. 2**)	Stable	Conservative
Type 2b	Displaced with AOD	Unstable	Surgery—Atlanto-occipital stabilization
	Mueller et al[9] classification		
Type 1	Undisplaced OCF without AOD—(►**Figs. 1, 2**)	Stable	Conservative treatment for 6 weeks with nonrigid orthosis (cervical collar)
Type 2	Bilateral OCF without AOD	Stable	Conservative treatment for 6 weeks with nonrigid orthosis (cervical collar) or more rigid external immobilization in a halo-vest device
Type 3	Unilateral or bilateral OCF with AOD	Unstable	Surgical treatment with occipitocervical fixation

Abbreviations: AOD, Atlanto-occipital dislocation; CT, computed tomography; OCF, occipital condyle fractures;
Pang et al's[12,13] criteria for AOD are occipital condyle—C1 interval should be greater than 2.0 mm. We did not have any case of bilateral OCF nor AOD and hence not included in the Table 2.

Conflict of Interest
None declared.

Acknowledgment
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