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RESEARCH ARTICLE

TREATMENT OUTCOMES OF MAXILLOFACIAL FRACTURES ASSOCIATED WITH HEAD INJURIES: AN OBSERVATIONAL STUDY

[1,*]Adewale Francis Adejobi, [2]Olawunmi Adedoyin Fatusi, [3]Edward Oluwole komolafe, [4]Christianah Mopelola Asaleye and [5]Abimbola Samuel Phillips

[1,2]Department of Oral & Maxillofacial Surgery, Obafemi Awolowo University, Ile- Ife, Osun state, Nigeria
[3]Neurosurgical Unit, Department of Surgery, Obafemi Awolowo University, Ile- Ife, Osun state, Nigeria
[4]Department of Radiology, Obafemi Awolowo University, Ile- Ife, Osun state, Nigeria
[5]Department of Community Health, Obafemi Awolowo University Teaching Hospital complex, Ile-Ife, Osun State Nigeria

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ABSTRACT

Background: The anatomical closeness of the facial bone to the neurocranium increases the risk for concomitant head injuries. Patient's survival is largely dependent on the severity of the concomitant head injury; and prognosis improves with early intervention. However, detailed account of factors in patients with concomitant maxillofacial and head injuries that can determine the treatment outcomes is lacking. **Objective:** This observational study seek to assess treatment outcomes in patients with concomitant head and maxillofacial injuries. **Methods:** This is an observational study of sixty-one patients with concomitant maxillofacial fractures and head injuries in our hospital over a 26-month period. Information obtained included, age, anatomic sites of maxillofacial fractures and skull fracture, type and location of intracranial injuries, maxillofacial fracture treatment outcome and Glasgow outcome scale. **Results:** Fracture site infection and facial deformity were the only adverse outcome of maxillofacial injuries at 6 weeks. There was no significant association between age and treatment outcome. The GOS showed a steady improvement from good recovery in 37 (60.7%) patients at first week to 53 (86.9%) at sixth months. Patients with mild head injury had a significant better outcome than those with severe head injury. **Conclusion:** Fracture site infection and facial deformity are the facial adverse outcome seen. Patient's age have no significant effect on treatment outcome. Treatment outcome was good in most patients (86.9%).There was a statistically significant association between the severity and outcome of head injury in the study.

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INTRODUCTION

The anatomical closeness of the facial bone to the neurocranium increases the risk for concomitant head injuries (Haug et al., 1994; Haug et al., 1992) through fracture of the cribriform plate of ethmoid bone and temporal bone fracture. The trauma force is transmitted to the base of the skull with with varying types of head injuries (Haug et al., 1994; Adeolu et al., 2013; Pappachan, 2006; Hohlrieder, 2004) ranging from concussion to more dangerous cerebral laceration (Chang et al., 1994; Reilly, 1995). Treatment of these patients require the expertise of maxillofacial surgeons and neurosurgeons. Open reduction and internal fixation of fractures has good outcomes (Odai, 2013), satisfactory cosmetic outcomes have also been associated with close reduction and intermaxillary fixation (Ugboko, 1998; Fasola, 2001). Patient's survival is largely dependent on the severity of the concomitant head injury; and prognosis improves with early intervention (Mezue, 2013) as most deaths occur within 48 hours of injury (Jennett, 1975). Different studies had documented the associated risk of traumatic brain injury with facial fractures (Hohlrieder, 2004; Kraus, 2003; Kloss, 2008). This study explored the effect of age on treatment outcome, association between severity of head injury and treatment outcomes in patients with concomitant head and maxillofacial injuries.

***Corresponding author:* Adewale Francis Adejobi,**
Department of Oral & Maxillofacial Surgery, Obafemi Awolowo University, Ile- Ife, Osun state, Nigeria.

PATIENTS AND METHODS

Approval was granted by the Ethics Research Committee of the Obafemi Awolowo University Teaching Hospitals Complex, Ile-Ife, Nigeria where the study was carried out.

Patients who sustained concomitant maxillofacial fracture and head injury at the Accident and Emergency Unit were recruited for the study between April 2014 and June 2016. Patients were excluded if they were younger than 18 years, presented after 48 hours of sustaining trauma and sustained injuries in other parts of the body. All injuries were confirmed and assessed using craniofacial computed tomography. Maxillofacial fractures were classified by anatomical site into parasymphyseal fracture, mandibular body and ramus, condylar, zygomatic complex (ZMC) fracture, Le Fort I fractures and naso-ethmoidal fractures. Cranial bone fractures were also classified into skull vault fractures and base of the skull fractures (Thamburaj, 2012). Skull vault fractures were further classified by site: frontal, temporal, sphenoid, parietal, occipital or a combination of the fractures (Tandon, 2012). Neurological injuries - concussion and intracranial injuries (intracerebral and intracranial haemorrhage) – were also assessed. Impact of the head injury (combination of cranial bone fractures, neurological injuries and intracranial haemorrhage) was assessed using the Glasgow Coma Scale (Jennett, 1976).

Methods of treatment for maxillofacial fractures were defined as conservative, closed reduction with mandibulo-maxillary fixation and open reduction with internal fixation (ORIF) (Perry, 2014). All patients were offered ORIF as the standard treatment, however the option of treatment is determined by patient's financial capability. The neurosurgeon defined the treatment for head injuries either as non-operative (patients that required close monitoring of patients; no surgical treatment) or operative (patients that required surgery). Operative treatment included burr hole, craniotomy, craniectomy and elevation of skull fractures. Non-operative treatment comprised of medications (osmotherapy) and postural placement in 30^0 head up position. Treatment outcome of maxillofacial fractures was assessed at weeks 2, 4 and 6 post-treatment. Similarly, radiographic evidence of bone union was assessed at weeks 4 and 6 for mid-face and mandibular fractures respectively (Odai, 2013; Hurrell, 2014). Clinical maxillofacial treatment outcome parameters assessed were occlusion (intercuspation), presence or absence of facial deformity (facial asymmetry assessed by visual inspection of the entire face including facial subunit for symmetry in vertical and horizontal planes), presence or absence of infections (pus discharge) or nerve deficit (anesthesia in the region of distribution of inferior alveolar or infra-orbital nerve).

Treatment outcome for head injury were assessed at week 2, week 4 and 6-months post intervention using Glasgow Outcome Scale (Jennett, 1975). This scale is a descriptive score sheet that ranges from 1 – 5 [Score 1= Death, Score 2 = Persistent vegetative state -The characteristic feature of this condition of non-sentient survival, is that there is no evidence of psychologically meaningful activity, as judged behaviourally, Score 3 = Severe disability (conscious but disabled - Patient are unable to care for themselves with mental disorientation), Score 4 = Moderate disability (disabled but independent - Patients are able to care for themselves and some are capable of work) and Score 5 = Good recovery (Good recovery: Patient is able to participate in normal social life and could return to work)] (Jennett, 1972). Data was analysed using STATA 13 (Stata Corp, 4905 Lake way Drive, College Station Texas 77845 U.S.A). The dependent variables assessed were four treatment outcomes of maxillofacial fractures (infection, facial deformity, nerve dysfunction and occlusion) and one treatment outcome (Glasgow Outcome Scale –GOS) of head injuries while the severity of head injury, age and treatment options were the independent variables. Multivariate analysis was done using ordinal regression model to assess the effect of severity of head injury on treatment outcome (GOS). Binary logistic regression model was used to determine the severity of head injury on infection at fracture site and facial deformity.

RESULTS

Sixty-one patients were managed for concomitant maxillofacial fractures and head injuries under the review period. Thirty-six (59.0%) patients received conservative treatment for maxillofacial fractures and fifty-two (85.3%) for head injuries (Table 1). Closed reduction and mandibulomaxillary fixation was done for maxillofacial fractures in eighteen (29.5%) patients while seven patients (11.5%) had open reduction and internal fixation using plate osteosynthesis. Only nine patients (9%) had surgical intervention of their head injury out of which four (44.4%) had craniotomy for clot evacuation. The treatment outcome for head injuries in the patients at six months is presented in Figure 1. The Glasgow outcome scale (GOS) assessment showed steady improvement from good recovery in thirty-seven patients (60.7%) at first week to fifty-three patients (86.9%) at six months. Fifteen (24.6%) of these patients had mild disability at week one. By week 4, 52 (85.3%) of the patients had made good recovery. Mild and severe disabilities persisted in two (3.3%) and one (1.6%) patients respectively by 6 months.

Treatment outcome for maxillofacial fractures over six weeks is presented in Table 2. Six patients (10.7%) had infection at fracture site at week 1 and the infection persisted in three (5.4%) patients at six weeks. Facial deformity was seen in seven (12.5%) patients at first week which increased to 17.9% (10 participants) at six weeks. Post-traumatic nerve dysfunction seen at presentation in three (5.4%) patients persisted till the sixth week of review. Though malocclusion was recorded in one patient (1.8%) in the first week; all patients had good occlussion by the fourth week. Malunion of mandible was recorded in 2 (3.6%) patients with mandibular angle fracture. Table 3 shows injury combination, treatment modalities and treatment outcome in patients who had surgical intervention for their head injuries. Nine patients had surgical intervention for their head injuries, of which seven (77.8%) had either frontal bone or temporal bone fracture or a combination of fronto-temporal bone fracture. The zygomatic bone and mandible were the most commonly fractured bones with conservative treatment for mandibular fracture in the seven patients. Six of the patients (67%) had intracranial bleeds. The only patient with severe disability as an outcome had concomitant naso-ethmoidal and mandibular fractures associated with intracerebral injuries (contusion and intracerebral haemorrhage). Table 4 presents the results of the evaluation of the effect of age on outcome of maxillofacial fracture treatment in the study participants: one patient each in the 19-29 years, 30-39 years and 40-49 years age range had infection at fracture site in week 1, malunion in one case each in the 19-29 years and 40-49 years age groups and five (50%) cases of facial deformity in the 19-29 years age range. The prevalence of mortality (80%) was highest in the 30-39 years age group (Table 5). The 30-39 years age group also had the least proportion (78.95%) of patients with good outcome in.

Table 1. Treatment modalities for concomitant facial fractures and head injuries in the study

Variable	Frequency (N = 61)	Percentage (% = 100)
Type of facial fracture treatment		
Conservative	36	59.0
Closed reduction and mandibulomaxillary fixation	18	29.5
Open reduction and internal fixation	7	11.5
Type of head injury treatment		
Conservative	52	85.3
Burr hole	2	3.3
Craniotomy	4	6.6
Minimal craniectomy	2	3.3
Frontal bone elevation	1	1.6

Table 2. Treatment outcomes for fracture site infection, facial deformity, nerve injury and occlusion over six weeks in the patients

Treatment outcome	Week 1 (Freq.; %) N =56	Week 4 (Freq.; %) N = 56	Week 6 (Freq.; %) N = 56
Infection at fracture site			
Yes/No	6/50 (10.7/89.3)	4/52 (7.1/92.9)	3/53 (5.4/94.6)
Facial deformity			
Yes/No	7/49 (12.5/87.5)	10/46 (17.9/82.1)	10/46 (17.9/82.1)
Nerve dysfunction			
Yes/No	3/53 (5.4/94.6)	3/53 (5.4/94.6)	3/53 (5.4/94.6)
Malocclusion			
Yes/No	1/55 (1.8/98.2)	0/56 (0.0/100.00	0/56 (0.0/100.00
Radiographic bone union			
Malunion/ Union	-	-	2/54 (3.57/96.43)

Table 3. Injury combinations, treatment modalities and treatment outcome in participants

S/N	Maxillofacial fractures	Skull fracture	Intracranial injury	GCS	Treatment of maxillofacial fractures	Treatment of head injury	Outcome of maxillofacial fractures	Outcome of head injuy
1	Zygomatic complex fracture(ZMC)	Skull base	Epidural haematoma Cerebral oedema	Severe	Conservative	craniotomy	No adverse outcome	Good recovery
2	Zygomatic complex fracture	Frontal bone	Subdural haematoma Cerebral contusion	Moderate	Conservative	Elevation of frontal bone	No adverse outcome	Good recovery
3	Mandibular body and ramus , ZMC and Le Fort I fractures	Temporal bone	pneumocepahalus	Severe	Open reducton and internal fixation	Burr hole	No adverse outcome	Good recovery
4	Parasymphyseal fracture	No fracture	Subdural haematoma	Moderate	Close reduction and immobilisation	Craniotomy	No adverse outcome	Good recovery
5	ZMC fracture	Frontal bone	Cerebral contusion	Severe	Conservative	Craniectomy	Infection and facial deformity	Moderate disability
6	ZMC fracture	Frontotemporal bone	pneumocepahalus	Moderate	Conservative	Craniotomy	No adverse outcome	Good recovery
7	ZMC fracture	Frontotemporal bone	Pneumocepahalus Epidural haematoma	Mild	Open reducton and internal fixation	Burr hole	Facial deformity and nerve injury	Good recovery
8	Parasymphyseal and condylar fracture	Temporal bone	Subdural haematoma	Moderate	Close reduction and immobilisation	craniotomy	No adverse outcome	Good recovery
9	Mandibular body and naso-ethmoidal fractures	Frontotemporal bone	Intracerebral haematoma cerebral contusion	Severe	Open reducton and internal fixation	craniectomy	Facial deformity	Severe disability

Table 4. Association between age and outcome of maxillofacial fracture treatment

Age (Years)	Outcome at 6th week.					P-value
	Infection Yes/No (%)	Facial deformity Yes/No (%)	Nerve injury Yes/No (%)	Malocclusion Yes/No (%)	Malunion Yes/No (%)	0.119
19-29	1/22 (4.35/95.65)	5/18 (21.74/78.26)	1/22 (4.35/95.65)	0/23 (0.00/100.00)	1/22 (4.35/95.65)	
30-39	1/14 (5.26/73.68)	2/13 (10.53/68.42)	1/14 (5.26/73.68)	0/15 (0.00/100.00)	0/15 (0.00/100.00)	
40-49	1/9 (9.09/87.82)	2/8 (18.18/73.73)	0/10 (0.00/100.00)	0/10 (0.00/100.00)	1/9 (9.09/90.91)	
>50	0/8 (0.00/100.00	1/7 (12.50/87.50)	1/7 (12.50/87.50)	0/8 (0.00/100.00)	0/8 (0.00/100.00)	
Total	3/53	10/46	3/53	0/56	2/54	

Table 5. Association between age and outcome of head injury

	GOS					
Age (years)	death	Severe disability	Moderate disability	Good recovery	Total	P-value
19-29	0 (0.00)	1 (4.35)	1 (4.35)	21 (91.30)	23(100.00)	0.156
30-39	4 (21.05)	0 (0.00)	0 (0.00)	15 (78.95)	19(100.00)	
40-49	1 (9.09)	0 (0.00)	0 (0.00)	10 (90.09)	11(100.00)	
>50	0 (0.00)	0 (0.00)	1 (12.50)	7 (87.50)	8(100.00)	

Table 6. Binary logistic regression models of the predictors of facial deformity and infection at fracture sites

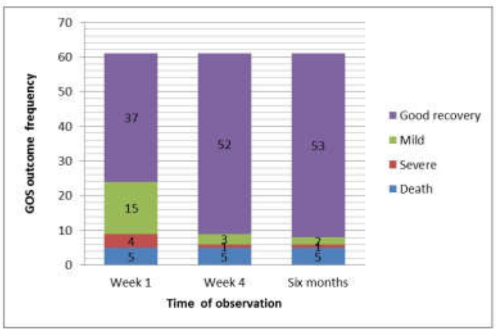
Independent variables	Facial deformity			Infection at fracture site		
	OR	95% CI	p-value	OR	95%CI	p-value
Severity of head injury						
+Severe						
Moderate	0.169	0.006-4.798	0.228	0.165	0.004-6.174	0.329
Mild	0.047	0.000-6.767	0.298	0.210	0.019-2.275	0.199
Treatment of head injury						
+Conservative (reference)	1			1		
Other procedures	9.883	0.159-612.697	0.277	0.141	0.011-1.848	0.136
Treatment of maxillofacial injury						
+Conservative	1			1		
Closed reduction and MMF	2.768	0.515-14.872	0.235	0.628	0.247-1.596	0.329
Open reduction and internal fixation	0.439	0.054-3.553	0.440	0.458	0.142-1.470	0.189
Age						
<40 years (ref)	1			1		
>= 40 years	0.329	0.019-5.832	0.448	0.571	0.147-2.221	0.419

+ Dummy variable

Table 7. Ordinal logistic regression of Glasgow Outcome Scale (GOS) on severity of head injury

	Dependent variable: GOS (Death=1; Severe=2; Mild=3; Good recovery=4)		
Independent variables			
	OR	95% CI	p-value
Severity of head injury			
+Mild	1		
Moderate	0.033	0.005-0.222	<0.001*
Severe	0.002	0.000-0.025	<0.001*
Treatment of head injury			
+Conservative	1		
Other procedures	2.965	0.687-12.789	0.145
Treatment of maxillofacial injury			
+Conservative	1		
Closed reduction and MMF	1.476	0.656-3.323	0.347
Open reduction and internal fixation	0.913	0.165-5.029	0.917
Age			
<40 years (ref)	1		
>= 40 years	2.033	0.480-8.615	0.335
Dummy variable			
*Significant p-value			

Patients'age was not statistically associated with outcome of head injury. There was no statistically significant effect of head injury on the occurrence of infection at maxillofacial fracture sites while adjusting for other variables such as type of treatment, time of presentation and week of observations (Table 6).



Key point

- Treatment outcome is good in most patients who sustained concomitant maxillofacial fractures and head injuries.
- Age has no significant effect on treatment outcome in these patients.
- The more severe the head injury sustained the more adverse the outcome.

Patients with mild and moderate head injuries were less likely to have infection at fracture site compared to those with severe head injury ($p = 0.199$ and 0.329 respectively). Patients with mild and moderate head injuries were less likely to have facial deformity compared to those with severe head injury however; none of these comparisons was statistically significant (Table 6). Post treatment occlusion and nerve deficit could not be modelled due to failure of model convergence as a result of lack of variation in the outcomes over the periods of observation. Patients with moderate head injury were significantly less likely to progress from a worse outcome to a better outcome (death to severe, severe to mild, or mild to good recovery) than those with mild head injury, adjusting for type of treatment, time of presentation and weeks of observations in the model (AOR=0.033; 95% CI=0.005-0.222; $p<0.001$). For moderate head injury, the odds of being in the recovery class versus combined mild, severe and death are 0.033 times lower than those with mild head injury adjusting for type of treatment, time of presentation and weeks of observations in the model. Likewise, those with severe head injury were less likely to progress to a better outcome compared to those with mild head injury (AOR=0. 002; 95% CI=0.000-0.025; $p<0.001$), adjusting for other variables in the model (Table 7).

DISCUSSION

Majority of patients with concomitant maxillofacial fractures and head injury we retreated conservatively.

The advantages of open reduction and rigid internal fixation of facial fractures include shortened period of mandibulo-maxillary fixation, bony union with minimal callus formation, early return to jaw function and maintenance of normal body weight. However, it is still not very popular in most developing countries mainly due to cost and time required to procure the plates as well as skills and expertise required (Udeabor et al., 2014; Adebayo et al., 2003). Some earlier Nigerian studies had attested to satisfactory results with closed reduction and mandibulo-maxillary fixation in facial fractures (Ugboko, 1998; Fasola, 2001). Six patients (10.7%) with comminuted facial fractures had infection at fracture site at week 1, though no significant relationship was observed, all were severely head injured. Their clinical state prevented them from doing the routine warm saline mouth bath. The infection persisted till six weeks post-treatment in three patients; two of whom had pre-injury undiagnosed diabetes mellitus while etiology in the third patient was gunshot injury. Infection at fracture sites was low in many studies (Odai et al., 2013; Ansari, 2004; Pham-Dang, 2014) and this was attributed to the use of prophylactic antibiotics which is premised on its ability to prevent infection (Andreasen et al., 2006). The treatment protocol at our institution which entails all facial fractured patients receive prophylactic antibiotic for a minimum of five days might have contributed to the low infection rate in this study. A Ugandan study reported a high infection rate (48.7%) which the authors attributed to the use of closed reduction with mandibulo-maxillary fixation and its accompanying oral hygiene and nutritional challenges (Kamulegeya et al., 2009). Our treatment protocol includes weekly hospital review to monitor oral hygiene and emphasize nutritional instructions. Nerve dysfunction involving infra-orbital nerve (2 patients) and inferior alveolar nerve (1 patient) persisted till sixth week of post intervention review.

This suggests that nerve dysfunction may or may not return to pre-injury state depending on the cause and nerve supply to the injured region should be assessed and documented at presentation to rule out the possibility of its being erroneously documented as a post-treatment complication.The six weeks period of evaluation of recovery of nerve injury after treatment in this study might have affected this outcome variable as a much longer period of review might have changed the outcome. Ultimately, recovery depends on the type of nerve damage. Malocclusion in one (1.8%) patient at week one contrasts a study in Uganda that found a high rate of malocclusion (17.5%).[27] The patient with post operative malocclusion in this study had open reduction and internal fixation under general anesthesia for mandibular fractures. Peri-operatively, achieving anesthesia via nasoendotracheal intubation was difficult hence the choice of orotracheal intubation which prevented temporary mandibulo-maxillary fixation prior to plating. The malocclusion was corrected at another theatre session using submental intubation with a reinforced endotracheal tube. No malocclusion was reported at 6 weeks' post intervention. Resource constraint and unavailability of plates were cited as reasons so most fractures were treated with closed reduction and mandibulo-maxillary fixation irrespective of degree of fracture displacement (Kamulegeya et al., 2009). Generally, malocclusion rate is low following treatment of facial fractures (Odai et al., 2013; Udeabor et al., 2014; Adeyemi et al., 2012). The characteristics of fracture locations and the degree of bone fragmentation contribute significantly to the development of facial deformity (Brasileiro et al., 2006).

Seven patients (12.5%) had observable facial deformity in the first week which increased to ten (17.9%) at six weeks. These patients sustained comminuted fractures of the central midface and would have benefited from open reduction and internal fixation but could not afford to pay for the treatment and were treated with closed reduction and mandibulo-maxillary fixation and internal wire suspension. Cosmetic and functional sequelae are common after maxillofacial injury and surgical repair involving the nasal-orbital-ethmoid complex is difficult (Brasileiro et al., 2006). Brasileiro and Passeri, (2006) in Brazil, reported a high complication rate (36.4%) of asymmetry and infection in naso-orbito-ethmoid complex fractures which was attributed to bony comminution and anatomical complexity of the injuries (Brasileiro et al., 2006). Most of the patients (52; 85.3%) had non operative treatment similar to 69.5% (137) reported by Emejulu and Malomo (Emejulu et al., 2008). Operative procedures in their study (Jennett, 1976) included craniectomy in 12 (6.09%), craniotomy in 10 (5.08%), exploratory burr hole in 9 (4.5%) and elevation and debridement of depressed skull fracture in 9 (4.5%). The same operative procedures were done in this study but in much smaller number. Operative management is recommended in head injured patients with symptomatic focal mass lesion and deteriorating conscious level or with frontal or temporal contusion greater than $20mm^3$ in volume and midline shift on computed tomograph (Bullock, 2006).

The recommended procedure is evacuation of haematoma through craniotomy in patients with focal lesions such as epidural and subdural haematoma and craniectomy in patients with diffuse parenchyma injury with refractive cerebral oedema, contusion and intracerebral haemorrhage. Non-operative procedures are preferable in patients without clinical evidence of neurological compromise and with no significant mass effect on computed tomograph. Frontal bone elevation remains the treatment of choice for symptomatic depressed skull fractures (Emejulu et al., 2008). Only one patient was indicated for this. The Glasgow Outcome Scale (GOS) assesses the overall social capability (or dependence) of the patient and considers the combined effect of specific mental and neurological deficits (Jennett, 1975). Most of the patients had progressed to a better outcome by week 4 (from 60.7% to 85.3%). Emejulu and Malomo (2008) in a retrospective study of isolated head injury in Ibadan, reported a lower value of 68.5% with good recovery. The difference could be due to nature of injury and mode of treatment since most (85.3%) of the cases in this study were managed non-operatively. However, there was no significant change in the GOS after week 4. By 6 months, only one additional patient progressed from mild to good recovery while there was no change in the patient with severe disability. This suggests that week 4 may be an ideal period for evaluation of recovery of head injuries and any residual head injury at week 4 may unlikely not resolve. Study recorded a mortality rate of 8.2% (5 patients) and all within the first week of presentation. While this suggests that patients with concomitant maxillofacial and head injuries are likely to survive if still alive, one week post-injury, the numbers are too small to make such categorical statements. Glasgow Coma Scale (GCS) at the time of admission is a reliable predictor of final outcome in head injured patients (Udekwu et al., 2004; Saini, 2012; Boto et al., 2006). The study observed that the severity of head injury had a significant effect on the outcome of head injury. Saini *et al.* (2012) in a study that investigated factors predicting outcome of severe head injury observed that unfavourable outcome was significantly increased with decreasing GCS. Unfavourable outcome in their study included; severe disability, vegetative state. Mild head injury was associated with better outcome in severe head injury (Udeabor et al., 2014). Others factors identified as predictors of outcome include; hypoxia, hypotension, alcohol and cause of injury[33] but these were not analysed in the current study. More adverse outcomes were noted in patients within age range 19 to 29 years. This age group engage in high risk activities and are prone to injuries. Most of the patients were involved in motorcycle accidents with no crash helmet on and werepredisposed to comminuted maxillofacial fractures (Oginni et al., 2006). There are varying reports on the effect of age on outcome of head injury (Vollmer, 1991; Mosenthal, 2004; Dhandapani, 2012). Anyanechi *et al*. (2016) reported worse outcome in the 15 to 35 years age group compared to 36 to 65 year age group. Similar to the present study, Mosenthal *et al.* (2004) study on the effect of age on functional outcome in traumatic brain injury over 6 months reported a good outcome in both elderly and young patients. The observation of four of the five deaths in this study occuring in the 30 to 39 years age range is in agreement with Dhandapani *et al*., (2012) whose study on prognostic significance of age on traumatic brain injury noted worse outcome in patients' aged 30 to 40 years. Some other studies reported unfavourable outcome in age groups 41 to 60 years and over 60years (Vollmer, 1991; Mosenthal et al., 2004; Dhandapani et al., 2012; Anyanechi, 2016; Narayan, 1981).

Conclusion

Infection at fracture site and facial deformity as complications of treatment were not significantly associated with severity of head injury. Treatment outcome of head injury was good in most patients (86.9%).There was a statistically significant association between the severity and outcome of head injury in the study. Patient's age have no significant effect on treatment outcome.

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Glossary of abbreviation

Glasgow coma scale-GCS
Glasgow outcome scale-GOS
Open reduction and internal fixation-ORIF
Zygomatic complexZMC

REFERENCES

Adebayo ET, Ajike O, Adekeye E. Analysis of the pattern of maxillofacial fractures in Kaduna, Nigeria. Br J Oral Maxillofac Surg 2003;41(6):396-400.

Adeolu AA, Abiona TC, Komolafe EO, Adeolu JO, Adegbehingbe OO. 2013. Epidemiology of neurotrauma in Ife-Ijesha zone of Nigeria. *World Neurosurg*., 80(3):251-254.

Adeyemi MF, Adeyemo WL, Ogunlewe MO, Ladeinde AL. 2012. Is healing outcome of 2 weeks intermaxillary fixation different from that of 4 to 6 weeks intermaxillary fixation in the treatment of mandibular fractures? *J Oral Maxillofac Surg.,*70(8):1896-1902.

Andreasen JO, Jensen SS, Schwartz O, Hillerup Y. 2006. A systematic review of prophylactic antibiotics in the surgical treatment of maxillofacial fractures. *J Oral Maxillofac Surg.,* 64(11): 1664-1668.

Ansari M. 2004. Maxillofacial fractures in Hamedan province, Iran: a retrospective study (1987-2001). *J Craniomaxillofac Surg.,* 32(1): 28-34.

Anyanechi CE, Osunde OD, Saheeb BD. 2016. Complications of the use of trans-osseous wire osteosynthesis in the management of compound, unfavorable and non-comminuted mandibular angle fractures. *Ghana Med J.,* 50(3):172-779.

Boto GR, Gómez PA, De La Cruz J, Lobato RD. 2006. Severe head injury and the risk of early death. *J Neurol Neurosurg Psychiatry.,* 77(9):1054-1059.

Brasileiro BF, Passeri LA. 2006. Epidemiological analysis of maxillofacial fractures in Brazil: a 5-year prospective study. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.,* 102(1): 28-34.

Bullock MR, Chesnut R, Ghajar J, et al., 2006. Surgical management of traumatic parenchymal lesions. *Neurosurgery*., 58(3): 25-46.

Chang C., Chen Y., Noordhoff S., Chang C. 1994. Maxillary involvement in central craniofacial fractures with associated head injuries. *J Trauma*., 37(5): 807-811.

Dhandapani S, Manju D, Sharma B, Mahapatra A. 2012. Prognostic significance of age in traumatic brain injury. *J of Neurosci Rural Prac.,* 3(2):131-135.

Emejulu J., Malomo O. 2008. Head Trauma in a Newly Established Neurosurgical Centre in Nigeria. *East and Central Afri J of Surg.,* 13(1):86-94.

Fasola A., Obiechina A., Arotiba J. 2001. An audit of midfacial fractures in Ibadan, Nigeria. *Afr J of Med Med Sci.,* 30(3):183-186.

Haug RH, Adams JM, Conforti PJ, Likavec MJ. 1994. Cranial fractures associated with facial fractures: a review of mechanism, type, and severity of injury. *J Oral and Maxillofac Surg.,* 52(7):729-733.

Haug RH, Savage JD, Likavec MJ, Conforti PJ. A review of 100 closed head injuries associated with facial fractures. J Oral Maxillofac Surg 1992;50(3): 218-222.

Hohlrieder M., Hinterhoelzl J, Ulmer H, Hackl W, Schmutzhard E, Gassner R. 2004. Maxillofacial fractures masking traumatic intracranial hemorrhages. *Int J Oral Maxillofac Surg.*, 33(4):389-395.

Hurrell M., Batstone M. 2014. The effect of treatment timing on the management of facial fractures: a systematic review. *Int J Oral Maxillofac Surg*., 43(8):944-950.

Jennett B, Bond M. 1975. Assessment of outcome after severe brain damage: a practical scale. *The Lancet*., 305(7905):480-484.

Jennett B. 1976. Assessment of the severity of head injury. *J Neurol Neurosurg Psychiatry.,* 39:647-655.

Jennett B., Plum F. 1972. Persistent vegetative state after brain damage: a syndrome in search of a name. The Lancet., 299(7753): 734-737.

Kamulegeya A, Lakor F, Kabenge K. 2009. Oral maxillofacial fractures seen at a Ugandan tertiary hospital: a six-month prospective study. *Clinics*., 64(9): 843-848.

Kloss F, Laimer K, Hohlrieder M. et al., 2008. Traumatic intracranial haemorrhage in conscious patients with facial fractures–A review of 1959 cases. *J Craniomaxillofac Surg.,* 36(7): 372-377.

Kraus JF, Rice TM, Peek-Asa C, McArthur DL. 2003. Facial trauma and the risk of intracranial injury in motorcycle riders. *Ann Emerg Med.,* 41(1):18-26

Mezue W, Ndubuisi C, Ohaegbulam S, Chikani M, Erechukwu U. 2013. Cranial bony decompressions in the management of head injuries: Decompressive craniotomy or craniectomy? *Niger J Clini Pract.,* 16(3): 343-347.

Mosenthal AC, Livingston DH, Lavery RF,et al. 2004. The effect of age on functional outcome in mild traumatic brain injury: 6-month report of a prospective multicenter trial. *J Trauma.,* 56(5):1042-1048.

Narayan RK, Greenberg RP, Miller JD. et al. 1981. Improved confidence of outcome prediction in severe head injury: a comparative analysis of the clinical examination, multimodality evoked potentials, CT scanning, and intracranial pressure. *J of Neurosurg*., 54(6):751-762.

Odai E, Obuekwe O. 2013. Is there any difference in the treatment outcome of maxillofacial fractures following use of rigid or semi-rigid osteosynthesis? *J Med Biomed Res.,* 12(1): 129-137.

Oginni FO, Ugboko VI, Ogundipe O, Adegbehingbe BO. 2006. Motorcycle-related maxillofacial injuries among Nigerian intracity road users. *J Oral Maxillofac Surg*., 64(1):56-62.

Pappachan B, Alexander M. 2006. Correlating facial fractures and cranial injuries. *J Oral Maxillofac Surg.,* 64(7):1023-1029.

Pappachan B, Alexander M. 2012. Biomechanics of cranio-maxillofacial trauma. *J Maxillofac Oral Surg.,* 11(2):224-230.

Perry M, Holmes S. Atlas of Operative Maxillofacial Trauma Surgery and Primary Repair of Facial Injuries:2nd ed. London:Springer; 2014; 673-684.

Pham-Dang N, Barthélémy I, Orliaguet T, Artola A, Mondie JM, Dallel R. 2014. Etiology, distribution, treatment modalities and complications of maxillofacial fractures. *Med Oral Patol Oral Cir Bucal*.,19(3): 261-269.

Reilly P, Simpson D. Craniocerebral injuries. Craniomaxillofac Trauma. 1995;7(5): 367-396

Saini NS, Rampal V, Dewan Y, Grewal SS. 2012. Factors predicting outcome in patients with severe head injury: multivariate analysis. *Indian J Neurotrauma*., 9(1):45-48.

Tandon PN, Ramamurthi R. Textbook of Neurosurgery, Vol 1 :3rd ed.New Delhi, JP Medical Ltd; 2012;469-493.

Thamburaj VA. 2012. Textbook of Contemporary Neurosurgery (Volumes 1). 1st ed. Chennai; *JP Medical* Ltd; 550-568.

Udeabor S., Akinbami B., Yarhere K., Obiechina A. 2014. Maxillofacial fractures: etiology, pattern of presentation, and treatment in university of port harcourt teaching hospital, port harcourt, Nigeria. *J Dent Surg.,* (2014):1-5.

Udekwu P., Kromhout-Schiro S., Vaslef S., Baker C., Oller D 2004. Glasgow Coma Scale score, mortality, and functional outcome in head-injured patients. *J Trauma*., 56(5):1084-1089.

Ugboko V., Odusanya S., Fagade O. 1998. Maxillofacial fractures in a semi-urban Nigerian teaching hospital: A review of 442 cases. *Int J Oral Maxillofac surgery*., 27(4):286-289.

Vollmer DG, Torner JC, Jane JA, James T, Lawrence FM. 1991. Age and outcome following traumatic coma: why do older patients fare worse? *Special Supplements*., 75(1S):S37-S49.

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