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INTRODUCTION

Skull fractures can either be classified on the basis of pattern (linear, diastatic, comminuted, depressed), by anatomic location (convexity, basal) or its type (simple, compound).¹ Compound fracture holds a major share in all skull fractures. It can be linear, depressed or sometimes elevated in nature. Such classification is seldom recognized in modern clinical practice as it was first described in the oldest scientific and surgical treatise known, the Edwin Smith Surgical Papyrus, over 5000 years ago.² It can be illustrated as "fracture in which fractured fragment is elevated above the level of the intact skull".³ Incidence of compound depressed fractures (CDF) accounts for 11-90% among all cases of depressed skull fractures and are associated with an infection rate of 1.9-10.6%. The average rate of associated morbidity is approximately 11% with

COMPOUND DEPRESSED FRACTURES; THE OUTCOME OF DELAYED REPAIR OF COMPOUND DEPRESSED FRACTURES; A TERTIARY CARE EXPERIENCE FROM KARACHI, PAKISTAN

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ABSTRACT... Background: It is defined as fracture in which fractured fragment is elevated above the level of the intact skull. **Objectives:** To assess the outcome of patients with delayed repair of compound depressed fractures. **Study Design:** Retrospective comparative cross sectional study. **Setting:** Civil Hospital, Karachi, Pakistan. **Period:** 01-01-2015 to 31-12-2016. **Methodology:** Sample size was calculated and sampling technique was non probability. Data was recorded from patients files to computer and analyzed on SPSS version 21. **Results:** The mean age of study participants was 21 years \pm 5. There were 14 (77.7%) male and 4 (22.2%) female patients in our study. The maximum time from injury to intervention was 84 hours. Most patients presented to the emergency department with compound depressed fractures due to fall or hit by blunt object (40%) followed by road traffic accidents (33.3%) and assault (26.7%). Most common location of the compound depressed fracture was frontal bone involving right side of the skull. All the patients were successfully managed with satisfactory outcome without any major complications. **Conclusion:** The authors conclude that repair of depressed compound fractures in adults, if managed properly shows good outcome with less complications even with delay of 6 hours to 84 hours from injury to intervention.

Key words: Depressed Fractures; Infection; CSF Leak.

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about 15% incidence of late seizure. The mortality rate of 1.4% to 19% is common with compound depressed fractures. Investigation like CT-scan is diagnostic and can guide a conservative intervention in selective patients. Cases of CDF with significant cerebral edema, dural lacerations or herniating brain matter presents with poor neurological status at time of admission.⁴ Depth of fracture defines the therapeutic approach in CDF. Surgery is necessary in cases of depressed skull fractures which are deeper than bone thickness. Early surgery is advisable in order to reduce the risk of infection. Repair of depressions with wound debridement is essential. If the wound is aseptic, primary bone grafting is possible.⁵ Dissociative bone flap cranioplasty is safer, more flexible, lesser complications and have better plasticity as compared to traditional cranioplasty. Usage of bone flap cranioplasty is encouraged for

depressed skull fractures intervention.⁶ Primary bone fragment replacement (after treatment with antiseptics) is the most reliable option in managing a non-missile CDF within 72 hours of injury in selective cases.⁷

The objective of our study was to determine the infection rate in patients with non-missile compound depressed fracture who were treated with primary replacement of bone fragment after debridement and elevation even with significant time delay of more than 6 hours after injury. These patients were referred from primary and secondary care units and there was excessive time delay between injury and intervention. According to the best of our knowledge much less data is available from Pakistan. Therefore it is necessary to fill this knowledge gap in our part of the world.

Skull compound depressed fractures are very important to be surgically managed with minimal complication rate. CSF leak and septicemia are major associated complications in surgical repair of depressed skull fractures.

Grossly septic compound depressed cranial fractures need immediate medical attention. It is suggestive to perform debridement with elevation of bone on urgent basis after such injury. If the presenting case is aseptic at the time of admission, immediate bone fragment replacement seems better option. Increment in the incidence of infection doesn't take place if surgery is performed promptly. Such replacement abate the need for subsequent cranioplasty and reduce its attendant risk of complications.⁸

When there is a linear skull fracture parallel to the sinus over the dural venous sinus or a depressed skull fracture penetrating the sinus, the surgeon should make arrangements for the possible fatal venous sinus injury, even if the hematoma isn't present in such cases.⁹

Simple suturing of bony flaps is another good option in patients with compound depressed fractures in which no significant mass is affected with no brain matter herniation.¹⁰

Early definitive diagnosis and management of skull fractures results in reduction of morbidity and fatality as well as assist in achieving maximal functional and aesthetic rehabilitation. Other injuries such as blunt chest injury, abdominal injury, injury to extremities, spinal injury or pelvis injuries can be associated with depressed skull fractures.¹¹

MATERIAL AND METHODS

Our study was a retrospective comparative cross sectional observational study which was conducted at neurosurgery department in Civil Hospital Karachi, Pakistan. The sample size was calculated and the sampling technique in our study was non probability.

The variables of our study were age of patients, gender of patients, presentation of patients, Glasgow coma score, size of wound in centimeters, site of injury, operative findings, and antibiotics given to patients and outcome of surgical repair.

The data was collected from patients file and recorded on computer by trained medical students. The data was analyzed on SPSS version 21. The descriptive statistics were observed.

The inclusion criterion of our study was patients who came to the emergency with depressed skull fractures due to non-missile injury and Glasgow coma score above 10/15. These patients were referred from primary and secondary health care units therefore there was a maximum time delay of even 84 hours.

The exclusion criterion was the exclusion of all patients with compound depressed fracture with associated severe diffuse brain injury, patients who suffered missile injury and poly trauma patients with multiple injuries.

All ethical considerations were taken during the study.

PROCEDURE

All the patients underwent surgery following standard protocols. In all patients skin laceration

above the depressed fracture was extended appropriately according to the shape and site of wound. Subperiosteal dissection was done to define the bony edges around the fracture. Bone fragments were gently elevated either after nibbling the bony edges or after making a burr hole in proximity to the fracture. Duroplasty was done in patients with torn dura. Bone pieces were replaced on the dura in a mosaic pattern appropriately. Bone fragments were anchored with long threads of absorbable sutures passing across the defect (Figure-1). Hemostasis was secured meticulously to negate the use of drain. Scalp was closed after freshening the edges.

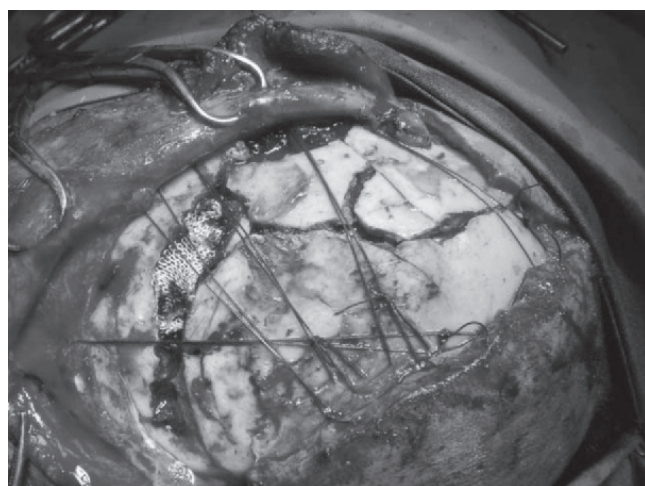


Figure-1. Figure showing long threads of absorbable sutures anchoring the fragments of bone.

RESULTS

In this study 18 consecutive patients with diagnosis of compound depressed skull fracture underwent debridement, elevation and primary replacement of bone fragments regardless of degree of wound contamination or dural laceration but with no clinical evidence of infection like purulent discharge from wound or running fever.

The maximum time delay from injury to intervention was 84 hours and minimum delay was 6 hours. The main reason for excessive delay was that these patients were referred to our centre from secondary or primary health care centers in the city or from remote areas outside the city.

Most patients presented to the emergency department with compound depressed fractures

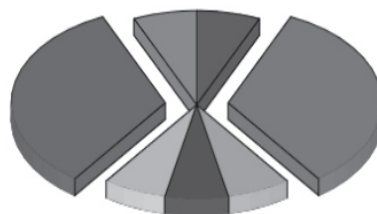
due to fall or hit by blunt object (40%) followed by road traffic accidents (33.3%) and assault (26.7%).

The mean age of study participants was 21 years ± 5. There were 14 (77.7%) male and 4 (22.2%) female patients in our study. The mean size of depressed fracture wound was 5.2 cm ± 3.9. The mean GCS of the patients upon presentation was 14±1.

The most common location of the compound depressed fracture was frontal bone involving right side of the skull. The locations of compound depressed fractures are showed in Figure-2.

The dura mater was torn among 13 (72.2%) patients while it was intact among 5 (27.7%). The operative findings are also shown in Figure-3. The pre and postoperative imaging is shown in Figure-4.

- Left frontal depressed fracture
- Right frontal depressed fracture
- right occipital depressed fracture
- right occipitoparietal depressed fracture
- right parieto-occipital depressed fracture
- Right parietal depressed fracture
- Right temporal depressed fracture



location of compound depressed fractures

Figure-2. Figure shows the location of depressed skull fractures

The outcome was satisfactory in all patients. None of the patient in our series developed wound infection. One patient had a CSF leak from the wound for few days which settled with acetazolamide and daily dressing while one patient had post-operative fever for few days.

The study showed good post-operative outcome with delayed repair of compound depressed fractures. The variables were also observed for any correlation or associations. There was no

significant relationship observed among study variables.

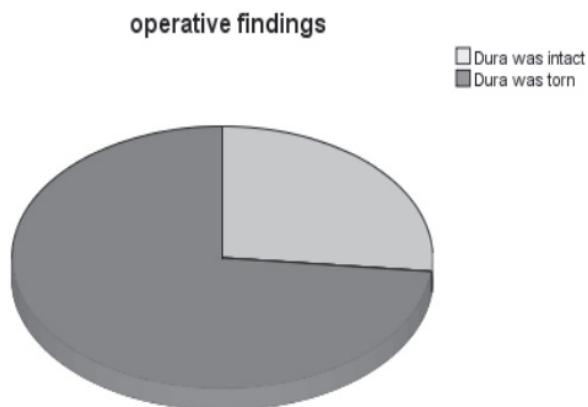


Figure-3. Figure shows the operative findings in patients with depressed skull fractures.

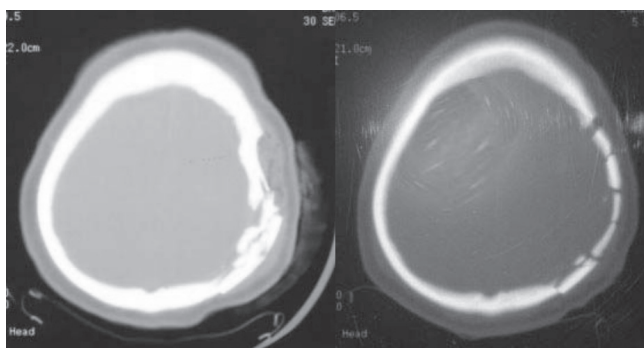


Figure-4. Pre-operative & Post-operative scans of compound depressed fracture.

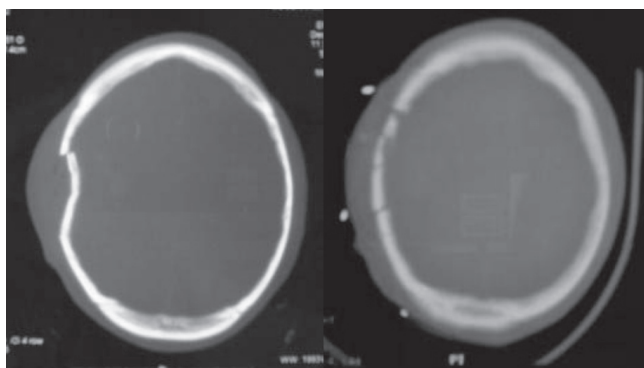


Figure-5. Pre-operative & Post-operative scans of compound depressed fracture.

Superior sagittal sinus injury (SSS) accompanying depressed skull fracture accounts for most common type of dural venous sinus injury. Associated morbidity and mortality is significantly high. Depressed skull fractures over SSS occasionally results in occlusion of SSS, which

concludes in secondary intracranial hypertension and other neurological deficits. Classical teaching is to treat these cases conservatively because of risk of fatal venous hemorrhage.¹²

Primary reconstruction of compound fractures should be attempted in any possible case, even in ones with delayed presentation. When done with native bone fragments and titanium mesh, it results in cosmeses, protection and prevention from skin flap syndrome with improved strength of construct.¹³

Repair of the frontal depressed skull fractures by refixation of bony fragments with titanium clamping is suitable and reliable. Such techniques promises to be a better substitute in the reconstruction of frontal comminuted depressed skull fractures. The simplicity, reliable fixation and prompt handling are its highlighting features.¹⁴

DISCUSSION

One international study reported that Frontal depressed fractures involving the anterior cranial base are complex and require a definitive plan of approach. Reconstruction of bony and dural imperfections reduces CSF leakage, brain matter herniation and sepsis formation. Cosmetic repair of the frontal disproportion is essential at later stage.¹⁵ In our study the frontal fractures were frequently reported and they were successfully operated with satisfactory outcome without any complications, and during follow up in clinic it was also revealed clinically that bone fragments were rigidly fixed and there was no evidence of free floating pulsatile bone even though we had used only anchoring vicryl sutures to hold the bone pieces in place.

An international study in 2014 by Neville IS et al discussed the fatality and morbidity with respect to timings of surgery. No significant difference was reported between the two groups of early and late surgical intervention with respect to death and unfavorable outcomes.¹⁶

An international study reported that Pneumocephalus is associated with compound depressed skull fractures. Definitive management

in the form of identification and repair of the bony and/or dural defect is imperative and is the objective. It can be carried out either endoscopically or via open craniotomy. An endoscopic or extra-cranial approach is preferred for the patient with multiple co-morbidities and those who cannot survive an open craniotomy.¹⁷ In contrast, in our study pneumocephalus was not observed in any of the patients who suffered compound depressed fractures.

Regarding complications of depressed skull fractures reconstruction, an international study reported that septic complications and CSF leaks occur as most consistent complications after surgery.¹⁸ In our study one of our patients suffered CSF leak and other patient suffered from fever for few days.

One study reported that Infection following traumatic brain injury with open skull fracture is the most common post-traumatic complication. On the other hand, post-traumatic cerebral infection is a well-recognized secondary complication.¹⁹ In contrast, in our study there was no secondary complications like cerebral abscess or osteomyelitis.

A study conducted by Vijaya S et al in 2015 reported that there was evidence of CSF leak and brain matter herniation from the wounds. In spite of the grossly contaminated wounds, thorough wound debridement and closure of the defects and duroplasty whenever applicable, resulted in significant improvement in all cases.²⁰ Similarly in our study patients showed very good outcome after closure of defect.

The limitations of our study were relatively smaller sample size. We recommend that in future similar studies should be conducted on larger sample size and the repair outcome of compound depressed fractures should be observed in pediatric age group.

CONCLUSION

The authors conclude that repair of compound depressed fractures in adults, if managed properly shows good outcome with less complications

and if they get delayed intervention ranging from 6 hours to 84 hours after injury.

The replacement of bone fragments primarily after debridement and dural repair could avoid second intervention for cranioplasty in case of sizeable defect with no significant risk of infection.

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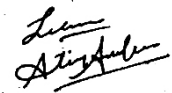


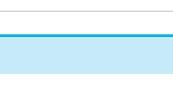

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4	Shiraz Ahmed Ghouri	Data collection	
5	Alizay Rashid Khan	Manuscript writing	
6	M. Osama Farooqui	Data collection	