International Surgery Journal
Irshad M et al. Int Surg J. 2018 Feb;5(2):538-543
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20180347

Original Research Article

The frequency of infection in early versus late surgery of compound depressed skull fractures in adults

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Received: 20 November 2017
Accepted: 27 December 2017

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ABSTRACT

Background: The treatment of penetrating head injuries and depressed skull fracture has shown a gradual change over the past decades. A proper debridement and closure of scalp wounds and dural tears have been shown to decrease infection and mortality rate of compound skull fractures. This study has been designed to determine the frequency of infection in early versus late surgery of compound depressed skull fractures in adults.
Methods: A total of 226 (113 in each group) patients with compound depressed skull fracture were taken. Group A was managed by early surgery while group B underwent late surgery. Data were entered and analyzed using computer program SPSS version 18.
Results: Out of these 226 study cases, 143(63.3%) were male, while 83 (36.7%) were females. The mean age of study cases was 37.50±10.58. The mean duration of presentation at the hospital was 6.76±2.41 hours. Roadside accident was noted to be a major etiological factor, i.e. 132 (58.4%) presented with the history of roadside accident. Base of the skull was a major site of wound, i.e. 79 (35.0%). The mean size of the wound was 13.79±3.49cm. Wound infection was seen in 51 (22.56%) of present study cases. Wound infection in group A was seen in 11 (9.7%) out of 113 patients while in group B it was 40 (35.4%) out of 113 patients (p=0.000).
Conclusions: The findings of the current study have indicated that early surgery among the targeted population is associated with significantly less frequent wound infection.

Keywords: Early surgery, Late surgery, Wound infection

INTRODUCTION

Neurosurgical trauma is the most important segment and forms the basis of neurosurgery.[1] A skull fracture considered depressed when the outer table of the skull lies below the normal anatomical position of the inner table.[2] Skull fracture occur when the forces striking the head exceed the mechanical integrity of the calvarium.[3]

The term compound depressed fracture is used when the depression creates a potential passage between the subarachnoid space and the atmosphere. Fractures may be seen anywhere in the skull and are classified in three ways, by pattern (linear, comminuted, depressed), by anatomic location (vault, convexity, base) and by skin integrity (open, closed). Depressed skull fractures are common occurring in 10% of patients, with significant head injury, and are compound in the majority of individuals ranging from 75-91%.[2,3] Depressed skull fractures are often diagnosed on routine skull radiography but computed topographic scan brain non-contrast especially bone window is the diagnostic method of choice.[4]

Surgical intervention is required in 32% of head trauma patients, 50% of which have depressed skull fracures.[5]

Another study reported that 28.3% patients with head injury requiring surgery have compound depressed skull fracture.[6] Hesnry and Hunt believe that in selected situations nonsurgical approach may prove to be equally safe.[7] Elevation and repair of an open depressed fracture is often thought of as an emergency procedure.[8] Timeous intervention and good surgical principles are advocated to prevent secondary infection and further neurological deterioration.[9,10]

Jannett et al, reported 5% infection incidence in early and 37% infection incidence in late surgery.[11] Another retrospective cohort study about the ideal timing of surgery of frontal depressed skull reported that time to surgery does not seem to be crucial in the prognosis of the victims, allowing surgical correction to be scheduled after patient's stabilization without compromising neurological recovery.[12] Bone fragment removal is intended to reduce the potential for infection, however bone fragment removal often necessitate the second operation to repair the resultant culvarial defect.

It has been concluded in many other studies that immediate replacement of bone fragments in compound depressed fracture does not increase the risk of infectious complications even in grossly contaminated wounds or those with dural tear.[13] The patients with intact dura had relatively favourable outcome, when compared to patients with shattered dura.[14]

The operative procedures included elevation of depressed fractures in 54.1% patients, dural repair in 27.0% patients and intra-cranial debridement in 18.9% patients. Delay in surgery could lead to intracranial sepsis, including meningitis and brain abscess. Thus, these fractures should be aggressively treated. In a National study dural tear, free bone fragments and late presentations (more than 8 hours after trauma) are the important risk factors in postoperative infectious complications.

The study was conducted to determine the frequency of infection in early versus late surgery of compound skull depressed fractures in adults as there is no such study conducted in Pakistan previously, but the problem is more common in the country.

METHODS

After approval from the Institutional Review Board, this was carried out in the Department of Neurosurgery, Nishtar Hospital, Multan, Pakistan from a period of June 2015 to December 2015. After an informed consent, 226 patients were selected and were divided in two groups (113 in each) following inclusion and exclusion criteria.

Inclusion criteria

- Patients from 14 to 70 years of age.
- All mild and moderate head injured patients (GCS 9-15) having a compound depressed skull fracture.
- Patients who survived till the end of the study.

Exclusion criteria

- Patients having bleeding disorders, with a history of malignancy (on medical history) etc.
- Known diabetic and hypertensive patients (on medical history)
- Multiple trauma (on clinical and radiological examination)

Data collection

A specialized proforma had been developed to record findings of this study. Permission from the ethical committee of the institution was taken before the start of the study. Patients coming to the outpatient and Emergency Department of Neurosurgery, Nishtar Hospital, Multan, fulfilling the inclusion and exclusion criteria were enrolled in the study. Time since injury was specifically inquired. Patients were managed surgically by means of wound cleansing, debridement, dural repair and bone replacement.

Each patient was evaluated for local and systemic signs and symptoms of infections. Infections in any case was determined by clinical signs and symptoms, then appropriate lab parameters (TLC, DLC), pathological testing (CSF, local wound discharge or frank pus) and radiological investigations were done. Each patient was followed for one month, at discharge, after one week postoperatively and then after one month. Data was collected proforma.

Data analysis

The data were entered and analysed using SPSS software version 18. Mean±SD have been given for quantitative variables like age, size of wound, time period since injury to surgery.

Frequencies and percentage were given for qualitative variables like gender, age groups, mode of injury, clinical findings, CSF leak, wound infection, surgical intervention, site of wound. Effect modifiers like age, gender, site of wound, size of wound, mode of injury and surgical intervention were controlled by stratification. Post stratification Chi-square test was applied to see their effect on the outcome. A P-value ≤ 0.05 was considered as significant.

RESULTS

Out of these 226 study cases, 143 (63.3%) were male patients while 83 (36.7%) were females. The mean age of study cases was 37.50±10.58 (with minimum age was 22 years while the maximum age of present study cases was 57 years). The mean age of group A patients was noted to be 36.88±10.35 years while that of group B was 38.13±10.82 years (p=0.374) (Table 1).

Table 1: Demographic and clinical features among study groups (n=226).

		Group A	Group B
Gender	Male n=143 (63.3%)	75 (66.4%)	68 (60.2%)
	Female n=83 (36.7%)	38 (33.6%)	45 (39.8%)
Age groups (years)	20-40 n=138 (61.1%)	69 (61.1%)	69 (61.1%)
	41-60 n=88 (38.9%)	44 (38.9%)	44 (61.1%)
	Mean (SD) age	36.88±10.35	38.13±10.82
Mode of injury	Assault n = 55 (24.3%)	27 (23.9%)	28 (24.8%)
	Fall n=39 (17.3%)	17 (15.5%)	22 (19.5%)
	Road side accident n=132 (58.4%)	69 (61.1%)	63 (55.8%)
Site of wound	Skull vault n = 75 (33.2%)	40 (35.4%)	35 (31%)
	Skull convexity n=72 (31.9%)	33 (29.2%)	39 (34.5%)
	Base of skull n=79 (35.0%)	40 (35.4%)	39 (34.5%)
Size of wound	<15cm n = 181 (80.1%)	91 (80.5%)	90 (79.6%)
	>15cm n= 45 (19.9%)	22 (19.5%)	23 (20.4%)
	Mean (SD)	13.82±3.50	13.75±3.50
Diabetes	Yes n = 54 (23.9%)	25 (22.1%)	29 (25.7%)
	No n= 172 (76.1%)	88 (77.9%)	84 (74.3%)
Anemia	Yes n = 91 (40.3%)	45 (39.8%)	46 (40.7%)
	No n=135 (59.7%)	68 (60.2%)	67 (59.3%)
Wound infection	Yes n = 51 (22.6%)	11 (9.7%)	40 (35.4%)
	No n=175 (77.4%)	102 (90.3%)	73 (64.6%)

Mean duration of presentation at the hospital was 6.76±2.41 hours. Roadside accident was noted to be a major etiological factor, i.e. 132 (58.4 %) presented with the history of a roadside accident (Table 3). Base of the skull was a major site of wound, i.e. Base of skull 79 (35.0%).

The mean size of the wound was 13.79±3.49cm (Mean size of the wound in group A was 13.82±3.50cm and in group B was 13.75±3.50 cm) (Table 1).

Table 2: Stratification of wound infection with regards to surgical intervention.

Surgical intervention	Wound infection		P value
	Yes (n=51)	No (n=175)	
Early surgery	11	102	0.000
Late surgery	40	73	
Total	226		

Table 3: Stratification of gender with regards to wound infection in both groups.

Gender	Wound infection	Groups		P value
		Group A	Group B	
Male (n=143)	Yes (n=17)	6	11	0.195
	No (n=126)	69	57	
Female (n=83)	Yes (n=34)	5	29	0.000
	No (n=49)	33	16	

Table 4: Stratification of age with regards to wound infection in both groups.

Age groups (years)	Wound infection	Groups		P value
		Group A	Group B	
20-40 (n=138)	Yes (n=22)	5	17	0.009
	No(n=116)	64	52	
41-60 (n=88)	Yes(n=29)	6	23	0.000
	No(n=59)	38	21	

Table 5: Stratification of mode of injury with regards to wound infection in both groups.

Mode of injury	Wound infection	Groups		P value
		Group A	Group B	
Assault (n=55)	Yes (n=05)	5	00	0.023
	No (n=50)	22	28	
Roadside accident (n=132)	Yes (n=35)	06	29	0.000
	No (n=97)	63	34	
Fall (n=39)	Yes (n=11)	00	11	0.001
	No (n=28)	17	11	

Of these 226 study cases, 54 (23.9%) were diabetic patients and 91 (40.3%) were anaemic. Wound infection was seen in 51 (22.56%) of present study cases. Wound infection in group A was seen in 11 (9.7 %) out of 113 patients while in group B it was 40 (35.4%) out of 113 patients (p=0.000) (Table 2 to Table 10).

Table 6: Stratification of site of wound with regards to wound infection in both groups.

Site of wound	Wound infection	Groups		P value
		Group A	Group B	
Skull vault (n=75)	Yes (n=00)	00	00	NA
	No (n=75)	40	35	
Skull convexi (n=72)	Yes (n=34)	11	23	0.036
	No (n=38)	22	16	
Base of skull (n=79)	Yes (n=17)	00	17	0.000
	No (n=62)	40	22	

Table 7: Stratification of size of wound with regards to wound infection in both groups.

Size of wound	Wound infection	Groups		P value
		Group A	Group B	
<15cm (n=181)	Yes(n=46)	11	35	0.000
	No(n=135)	80	55	
>15cm (n=45)	Yes(n=05)	00	05	0.049
	No(n=40)	22	18	

Table 8: Stratification of diabetes with regards to wound infection in both groups.

Diabetes	Wound infection	Groups		P value
		Group A	Group B	
Yes (n=54)	Yes (n=25)	07	18	0.016
	No (n=29)	18	11	
No (n=172)	Yes (n=26)	04	22	0.000
	No (n=146)	84	62	

Table 9: Stratification of anemia with regards to wound infection in both groups.

Anemia	Wound infection	Groups		P value
		Group A	Group B	
Yes (n=91)	Yes(n=35)	11	24	0.009
	No(n=56)	34	22	
No (n=135)	Yes(n=16)	00	16	0.000
	No(n=119)	68	51	

Table 10: Stratification of gender with regards to age.

Age groups	Gender		P value
	Male (n=143)	Female (n=83)	
<50 (n=138)	83	55	0.258
<50 (n=88)	60	28	
Total	226		

DISCUSSION

Compound depressed skull fracture (CDSF) is a discontinuity in the skull in which one (or more) of the discontinuous edges is displaced below the inner table of the surrounding intact skull with a connection to the exterior, through the paranasal sinuses, the external auditory meatus or a scalp laceration.[15] It constitutes about 80% of depressed skull fractures and 2.5% of head injuries, and is the most frequent reason for operative treatment in childhood head injury. Like all traumatic injuries, especially to the head, more males than females are affected with about 70% of cases diagnosed clinically, requiring therefore the superior diagnostic sensitivity of computerized tomography, CT to reduce the incidence of false negatives. Infection, from contamination at the time of trauma, is a major determinant of long term morbidity and neglected cases are a principal cause of intracranial abscess.[16]

Dural laceration is reported to be a major predictive factor for intra-axial sepsis and focal neurological deficits. It had been established in an earlier study, that closure of the scalp alone without adequate haemostasis and debridement, does not alter the infective sequelae from CDSF. Elevation and debridement done within 48hours, historically, offers the best chance for an uneventful outcome, barring the severity of the parenchymal injury sustained from the trauma; recently however, a recent report advocated 72 hours. A CDSF on its own, therefore, becomes a mandatory indication for operative treatment in most cases once the diagnosis is established. On rare occasions, though, when the fracture directly involves a major dural venous sinus and elevation could precipitate life-threatening haemorrhage, conservative treatment has been exceptionally advocated.[15]

Depressed skull fractures (DSF), one of the types of compound cranial fractures, usually resulting from blunt injuries, occur when the extent of bone displacement is greater than the full thickness of the adjacent calvarium. Compound DSF are fractures with an overlying scalp laceration and galeal disruption. By convention, closed (nonmissile), linear cranial fractures are considered nonoperative lesions unless associated with concomitant focal lesions, such as contusions and hematomas. On the other hand, frontal DSF are treated surgically, with debridement, elevation of depressed fragments and dural repair. Operative indications may include anterior table displacement with cosmetic deformity; fractures with evidence of nasofrontal outflow obstruction; displacement or an extensive commination of the posterior sinus wall, because this predicts likely dural laceration; and presence of refractory CSF leakage. The theoretical benefits beyond cosmesis are the decrease in the incidence of infection and LPE. Opinions on the immediate handling of these patients diverge and there has been much debate on the ideal timing of surgery. Some authors advocate an immediate surgical procedure, whereas others have reported better results with delayed surgery.

The treatment of penetrating head injuries and depressed skull fracture has shown a gradual change over the past decades. A proper debridement and closure of scalp wounds and dural tears have been shown to decrease

infection and mortality rate from compound skull fractures.[10]

Different studies have reported male gender predominance over the female gender in patients with CDSF. Out of the 226 study cases, 143 (63.3%) were male patients while 83 (36.7%) were females. A study conducted by Neville et al, also reported a male gender predominance as 97.50% male patients, showing the same trend as that of present study findings.[10] Similar results have been reported by Rehman et al, from Islamabad.[14] A study conducted by Emejulu et al from Nigeria, reported 92% male patients, again showing the male gender predominance.[16]

In literature different studies conducted have reported these fractures being more common in young adults, similar findings were made in present study.[11,14] The mean age of present study cases was 37.50±10.58. Present study results have indicated that the majority of present study cases, i.e. 69 (61.1%) belonged to age group of 21-40 years of age. A study conducted by Neville et al.[10] reported mean age to be 27.9 years, which is close to present study results. A slightly lower mean age reported by Neville et al can be explained in terms of the fact that they had registered children as well, but present study only included adults more than 20 years of age.[10]

Mean duration of presentation at the hospital was 6.76±2.41 hours (with minimum duration of presentation was 2 hours while maximum duration was noted to be 12 hours). Roadside accident was noted to be a major etiological factor, i.e. 132 (58.4%) presented with the history of a roadside accident followed by assaults and falls from height.

A study conducted by Neville et al, reported 50% roadside accident as a major etiological factor, these findings are in compliance with that of present study results.[10] Emejulu et al, from Nigeria also reported 50% roadside accident as major etiological factor which was followed by assaults, these findings are also similar to that of present study results.[16] Base of the skull was a major site of wound, i.e. Base of skull 79 (35.0%). Similar results have been reported by Neville et al and Emejulu et al.[16]

Wound infection was seen in 51 (22.56%) of present study cases. Wound infection in group A was seen in 11 (9.7%) out of 113 patients while in group B it was 40 (35.4%) out of 113 patients (p=0.000). A study conducted by Emejulu et al, from Nigeria reported 31.5% wound infection of which 27.8% had delayed surgery, these findings are in compliance with that of present study results.[16] A study conducted by Jannett et al reported 5% infection with early surgery while that of 37% with that of late surgery, these findings are also close to that of present study results.[11] Similar results have been reported by Rahman et al.[14]

CONCLUSION

Current study results have indicated with early surgery among the targeted population is associated with significantly less frequency of wound infection. The present study results recommend early surgery to prevent post-operative wound infection, which will help to decrease morbidity and will also be helpful for hospital authorities in terms of decreased hospital stays and extra economic inputs. Roadside accidents still remain to be a major cause of these injuries, particularly among male youth. Road safety campaigns are suggested to improve awareness among targeted populations. Use of helmets while riding motorbikes can significantly decrease such injuries. Wound infection was significantly associated with anemia and a history of diabetes, so the impact of these confounders also plays an important role.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Irshad M, Manzoor CA, Aamir M. The frequency of infection in early versus late surgery of compound depressed skull fractures in adults. Int Surg J 2018;5:538-43.