Academic International Journal of Medical Update
ISSN: 2984-7761
Aca. Intl. J. Med. U. 2024; 2(2) 15-22
Journal homepage: www.aipublishers.org/aijmu

Assessing the Role of Neurosurgical Consultation in The Treatment of Isolated Linear Pediatric Skull Fractures

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Article Info.
Article history:
Received 1 June 2024
Revised 10 June 2024
Published 29 August 2024
Keywords:
Assessment, neurosurgical, consultation, treatment, skull, fractures.
How to cite:
Samir F. Hassan, Assessing the Role of Neurosurgical Consultation in The Treatment of Isolated Linear Pediatric Skull Fractures, Aca. Intl. J. Med. U. 2024; 2(2) 15-22
DOI:
https://doi.org/10.59675/U223

Abstract

Objective: Head injuries represent a significant issue for emergency pediatric care. Most brain injuries are rather minor. The majority of individuals experience positive results even when computed tomography (CT) reveals abnormalities. Our goal was to assess the Glasgow Coma Scale (GCS) and clinical course of pediatric patients with head trauma. Score of 15, in which aberrant findings on cranial CT were observed, in order to ascertain the influence of radiographic characteristics on the necessity of hospitalization and the course of clinical care. **Methods:** Patients under the age of five to thirteen who had inaccessible mild head injuries, GCS scores of fifteen, aberrant CT results, and who were admitted to the emergency room between July 2021 and August 2023 were retrospectively examined.

Results: The study involved ninety patients. There were 55 patients (66%) who were male, and (5–13 years). Hospitalization was necessary for eighty-six (85%) of the patients, with a median stay of one day (one to five days). Repeat CT was performed on sixty-eight (70%) of the patients, and radiographic progression was seen in 15 (25%) of the patients. Two patients (3%), out of the ten patients, required surgery for their subdural or epidural hematomas. No radiological or clinical deterioration was observed in patients with a single skull fracture or subarachnoid hemorrhage.

Conclusion, even when CT scans reveal abnormalities, surgery may not always be necessary for individuals with head injuries aged 5 to 13 who take a GCS score of 10. Patients with isolated skull

fractures before subarachnoid hemorrhages, in example, may not always need to be hospitalized. To validate the results of this investigation, a validation study is required.

Introduction

Reports vary from 6.26 to 8.6%, however the precise number of skull fractures in individuals with head trauma is unknown. Nevertheless, because it might result in a cerebral hemorrhage and infection, a skull fracture brought on by a severe blow to the head may affect the patient's prognosis.

[1], the simplest and most direct diagnostic technique for identifying skull fractures is plain radiography. The standard plain radiography of the skull includes a left and right anterior-posterior (A-P) picture, a towne view, a right lateral view, and supplementary views of the basin, the Waters, the Caldwell, etc.[2].

Although brain computed tomography (CT) provides the most accurate diagnosis for skull fractures [3], it is not economical to do brain CT on every patient who has experienced mild head trauma. Even though brain CT is a more accurate way to assess head trauma than plain radiography, plain radiography can still be useful as a skull survey technique in cases when brain CT is difficult to conduct or for injuries that is not accidental[4,5].Hospital admission is necessary for 10% of pediatric patients who arrive at the emergency department (ED) with head injuries as their primary complaint [1]. 4%–16% of pediatric head traumas result in intracranial hemorrhage (ICH), despite the fact that 50%–80% of these cases are classified as minor with a Glasgow Coma Scale (GCS) score of 14–15.skull CT (Computerized Tomography) images of the patients [6, 7].Due to institution-specific variations in admission, observation, repeat CT, and discharge criteria, children with brain injuries require even more sophisticated care. Even in the case of a minor head injury, the European Federation of Neurological Societies advises hospital admission and follow-up for a minimum of 24 hours in patients with ICH [8]. Nonetheless, a large number of patients leave the hospital within 24 hours of being admitted. Outpatient therapy is frequently taken into consideration in place of hospitalization for individuals with isolated skull fractures (SFs). Neurosurgical intervention is rarely necessary for patients with minor head injuries [9–12].Skull fractures occur in children in 2–20% of head injuries, with infants under 1 year old having the highest risk [13, 14].

Isolated linear skull fractures (ILSF) are the most common kind of fracture, accounting for 85% of all adolescent skull fractures [15].Although multiple extensive research studies have demonstrated that individuals with ILSF who score less than 14 on the Glasgow Coma Scale (GCS) are unlikely to experience significant outcomes [16–17], hospitalization and routine pediatric neurosurgery consultations remain common approaches for managing these patients.

The medical industry is currently actively employing deep learning for image analysis. Specifically, research on the assessment of abnormalities in imaging exams through the use of DL algorithms has been released [18-21]. Our objective was to look into the traits, wounds, interventional needs, and results of the young patients in who needed surgery to repair their cerebral vault fractures to the skull.

Methods

A database containing every patient diagnosed with a cranial fracture at Karbala's Alkali Hospital between 2021 and 2023 was examined. Regardless of the kind of treatment, hospitalization requirement, or specialty of the treating physician, all patients with a analysis of a skull fracture were comprised. Records were maintained on the features of the patient, the mode of injury, associated trauma, involvement of the fractured bone, surgical repair, problems, and outcomes. A comparison was made between individuals in the Non-Op group who did not receive any surgical treatment, the Repair group who underwent surgery specifically to repair a fractured skull, and the TBI group, who either had a broken skull repaired or underwent surgery for traumatic brain injury (TBI). In the repair group, open fracture, frontal sinus fracture, displaced or depressed fracture, and cosmetic deformity were among the criteria for intervention.

The underlying trauma in the TBI group of patients was treated with procedures such external ventricular drain (EVD) insertion, decompressive hemicraniectomy and hematoma evacuation. Surgery was not performed primarily to treat the skull fractures of the TBI group, however that possibility did exist. For children under five, seams were typically used to affix the bone.

Titanium plates and screws were used for kids older than five years old. Utilizing SPSS version 20 (SPSS, Inc.), the data was examined. To compare categorical variables between groups, chi-square tests were employed. The continuous variables, age, length of hospital stay, and Glasgow Coma Scale (GCS) score, were compared using Kruskal-Wallis tests because they were not normally distributed. The mean values' standard deviation was shown.

Results

Patient characteristics: In total, 90 patients were diagnosed with a skull fracture between 2021 and 2023 at the Alkali Hospital in Karbala. Of these patients, 16 (17%) received non-operative treatment (referred to as the Non-Op group). Next, groups of the remaining patients were created according to the surgical intervention's indication: In order to treat a traumatic brain injury (TBI group), 16 patients (17%), 17 (18.8%) underwent fracture repair (also known as the Repair group) for fracture elevation, frontal sinus repair, open fracture debridement, or cosmetic surgery; 14 patients (15%) required intervention, including hematoma evacuation, 10 (11%) cardiac, abdominal 13 (14%), and 14 (15%) orthopedic procedures as listed in Tables 1 and 2.

Table 1: connotation injures

connotation injures	Non-operatively (non-op) group)	traumatic brain injury	repair of a skull fracture	All	P Value
Facial fracture	16(17%)	14(15%)	17(18.8%)	47(90)	<0.0001
Intracranial hematoma	25(27%)	23(25.55%)	34(37.7%)	82(90)	<0.0001
spine	12(13%)	2(2.22%)	2(2.22%)	16(90)	1.0
cardiac	10(11%)	5(5.55%)	7(7.77%)	22(90)	<0.0001
Abdominal	13(14%)	8(8.88%)	2(2.22%)	23(90)	<0.0001
Orthopedic	14(15%)	11(12.22%)	2(2.22%)	27(90)	<0.0001

Patients ranged in age from 5 to 13 on average. Of the children, 33.33% (n = 30) were younger than 8 years old, 22.22% (n = 20) were between 10 and 13 years old, and 44.44% (n = 40) were between 8 and 10 years old. Male preponderance was found in the majority of patients (n = 55; 61.11%). The majority

Aca. Intl. J. Med. U. 2024; 2(2) 15-22: https://doi.org/10.59675/U223

of injuries (n = 60; 66.66%) were from falls (Table 2). One-sided parietal fractures were the most frequent injuries.

Table 2: A feature of the research population

Sex, male	60(66%)
Sex, female	30(33%)
Age	5(5-13)
admission	80(88%)
Mechanism of injury	
Car accident	10(33.33%)
Bicycle accident	25(27%)
Fall down the stairs	40(22.22%)
Sports related	10(11.1%)
Fall (< 2 m)	15(16.6%)

Plain radiographic image data

The detection performance of the A-P view, towne view, left and right lateral views, and each view was examined were the four types of plain skull radiographs. Left/right lateral images with left and right reversal were mixed and examined in both lateral views since they shared the same image analysis properties. 387 photos in all, 106 in the A-C view, 94 in the view, and 187 in both lateral views, were analyzed using an IOU threshold of 0.1 and a confidence score threshold of 0.6. The percentages of true positives, true negatives, false positives, and false negatives for the complete image were 33.1%, 49.9%, 3.3%, and 13.7%, respectively, as shown in Table 3 and Figure 1.

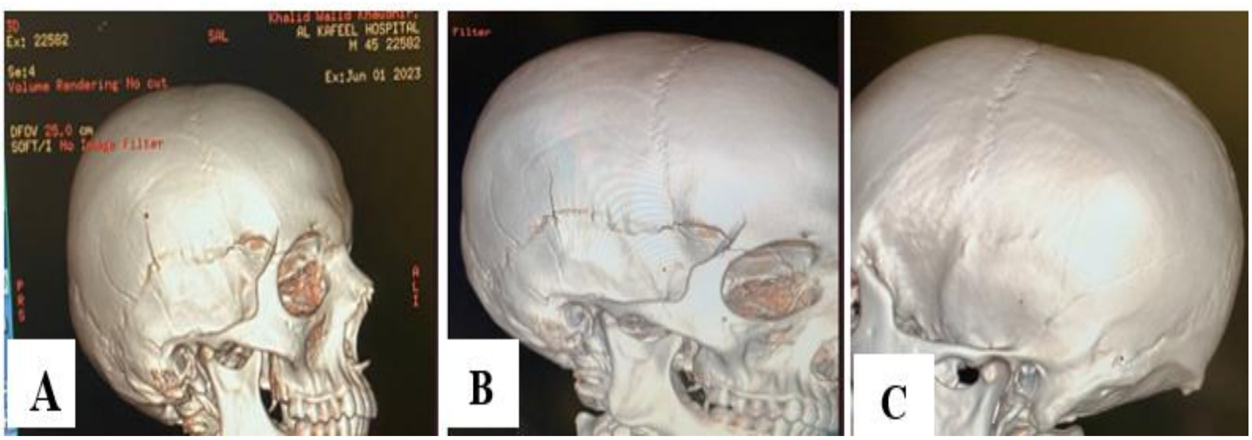

Figure 1: Sample photos were evaluated. A true-positive picture in lateral view that identifies a fractured parietal bone. B: False-positive picture identifying a lateral vascular groove view. C: False-negative picture failing to identify left diastatic fracture lambdoid suture seen in the anterior posterior view's left orbit region

Table 3: There are real positive/negative and false positive/negative findings

	Anterior –posterior view	Towne view	Both lateral view	total
True-positive	25	20	27	72
Trun –negative	28	22	30	80
False - positive	1	3	8	12
False- negative	16	20	14	50
Total	70(37.5)	65(24.4)	79(38.1)	214(100.0)

Discussion

In children, head trauma is quite prevalent, and between 8% and 25% of traumas, result in fractures to the skull.Our data provides an explicit answer to a particular question that has been mentioned in the results of other articles [22-25], but not stressed. In summary, [15] found that 326 patients with ILSF, whose median age was 19 months, did not require hospitalization unless a nonaccidental trauma workup was still pending.Blackwood et al. [26] identified 71 isolated linear skull fractures (ILSF) cases among 163 patients with a median age of 1.17 years; 78% of these required admission, although none of them required neurosurgical intervention.

Only 8 of the 131 individuals in the study who were younger than a year old needed neurosurgical intervention, according to the study by [27]; these patients had depressed skull fractures repaired or a developing skull fracture debrided. Their research also only says, "...none required neurosurgical intervention."

Previous studies have attempted to identify which radiographic traits or symptoms may necessitate neurosurgical intervention for children with Glasgow Coma Scale scores greater than 14[28].

Thankfully, neurosurgical treatments are uncommon in the overall pediatric trauma population, often occurring in the range of 0 to 8% [29].

Only 6.5% of 897 pediatric patients with skull fractures got surgical treatment for fracture elevation, frontal sinus repair, or open fracture debridement for esthetic purposes, according to investigations by [30].

7.5% more patients required surgery for additional severe injuries, such as decompressive craniectomy, external ventricular deflation, and hematoma evacuation placement of a drain[31].Furthermore, to track all trauma patients, a multidisciplinary pediatric trauma clinic is being developed. This will enable us to gather further data after our revised suggestions are made public. We concur with earlier research that indicates telemedicine may be a means to lessen transfers and provide community hospitals with access to specialty services, despite our awareness of the constraints, regulatory requirements, and overall comfort level of community emergency departments when it comes to managing pediatric head trauma [32–35].The authors acknowledge that drawing inferences on isolated linear skull fractures (ILSF) management may be difficult due to the small sample size of this retrospective analysis. Analogous results have been observed through data analysis from many single and multi-center investigations, however a formal meta-analysis is not yet available. Replicating these findings in a single, multi-center trial would be beneficial. Given that fewer than half of the patients visited the neurosurgical clinic after being discharged, we acknowledge that this low follow-up rate represents another study constraint. However, our study is not the only one with a low follow-up rate [16].

We anticipate that this problem will be resolved with the establishment of our comprehensive pediatric trauma clinic. Studies with follow-up rates ranging from 79 to 90% reassuringly reported no new clinical findings during clinic consultations or radiographic findings during outpatient surveillance CT as long as a year after injury [36].

Conclusion

We further reiterate that it might not be required to admit and transfer these patients to a tertiary center. We acknowledge that social factors may take precedence over other aspects, including the assessment of no accidental trauma. Ongoing quality improvement will be possible with prospective validation of our in-house recommendations for managing pediatric isolated linear skull fractures (ILSF).

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