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Evaluation of isolated skull fractures in children

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ABSTRACT

Background: The Brain Injury Guidelines (BIG) was recently adapted to pediatric patients by developing a pediatric-specific risk stratification algorithm, BIG for Kids (kBIG).(1) Children differ from adults in injury patterns and have a higher prevalence of isolated skull fractures without intracranial hemorrhage (ICH). Given the frequency of this injury pattern, a distinct kBIG 0 category was created. This study aimed to better characterize isolated skull fractures in children. We hypothesized that these fractures carry a low risk of ICH development or neurosurgical intervention.
Methods: We conducted a retrospective cohort study of pediatric patients (<18 years) with isolated skull fractures treated at a Level 1 pediatric trauma center from January 2018 to April 2024. Data collected included demographics, injury characteristics, location of fracture, repeat head CT, and neurosurgical intervention. Fractures were classified as nondisplaced, minimally displaced (< one cranium width), or displaced (≥ one cranium width).
Results: Among 431 children, 63 % had nondisplaced, 27 % minimally displaced, and 10 % displaced fractures. Fracture locations most commonly involved the parietal, frontal, and occipital bones. ICH progression occurred in six patients (1.4 %), all with low Glasgow Coma Scale rating (GCS) or suspected hemorrhage. Nineteen patients (4.4 %) required neurosurgical intervention: six had GCS <15, and 13 had displaced fractures requiring fracture elevation. Fracture location was nonsignificant. No patient with a normal neurologic exam and a nondisplaced or minimally displaced fracture required surgery.
Conclusion: Children with isolated, nondisplaced or minimally displaced skull fractures and normal neurological exams had excellent outcomes. These patients do not require repeat imaging or neurosurgical consultation.

1. Introduction

Head trauma is a leading contributor to pediatric morbidity and mortality [3]. Skull fracture associated with TBI are frequently encountered in children due to increased relative head size and thinner, more pliable calvarium [4], and their fracture patterns differ from adults. Many of these skull fractures occur without associated ICH[2], and are thus classified as *isolated skull fractures.* Pediatric patients with isolated skull fractures account for a substantial proportion of pediatric head trauma presentations [5], and prior studies have shown that children with isolated, nondisplaced skull fractures rarely experience clinically significant traumatic brain injuries, neurological deterioration, or require neurosurgical intervention, documented as <1 % in multiple prior studies that looked at these outcomes [6–8]. Despite the frequency of these injuries and the minimal risk for clinical deterioration, current management of isolated skull fractures in children lacks standardization which has led to considerable variation in clinical practice, with many children requiring hospital admission, repeat neuroimaging, and neurosurgical consultation. The utility of these interventions has not been well established [5,9–11].

Our research group recently developed the Brain Injury Guidelines for Kids (kBIG) [1] to standardize management of pediatric TBI. As part of this effort, we introduced a management pathway for neurologically normal children with isolated skull fractures, referred to as kBIG 0. The therapeutic plan for kBIG 0 patients states that they can be safely discharged from the

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Emergency Department (ED) with no hospitalization, no repeat head CT, and no neurosurgical consultation [1]. Despite this advancement, a critical knowledge gap remains: how specific characteristics of isolated skull fracture patterns in children influences management decisions and outcomes is not yet defined.

The objective of our study was to further characterize skull fracture patterns in pediatric patients presenting without ICH. Specifically, we aimed to evaluate whether location of fracture and/or degree of fracture displacement correlate with subsequent hemorrhage development or need for operative intervention. We hypothesized that patients with nondisplaced or minimally displaced fractures who are otherwise clinically stable could be safely discharge home from the ED. We additionally wanted to investigate fracture location as a correlate for neurosurgical intervention.

2. Methods

2.1. Study design and data source

Following approval from the Institutional Review Board (#00176573), we conducted a retrospective study of pediatric trauma patients (<18 years) with isolated skull fractures treated at our Level 1 pediatric trauma center between January 2018 and April 2024. Initial data was extracted from the trauma registry, followed by an in-depth chart review. We included all patients with isolated skull fracture without intracranial hemorrhage identified on initial head CT (kBIG 0 and kBIG 3 due solely to fracture displacement >1 cranium width). kBIG 0 fractures were defined as isolated skull fractures without ICH on initial CT; patients who later developed hemorrhage on repeat CT were still categorized as kBIG 0 by initial definition. We excluded all patients that had evidence of ICH on initial head CT. Other exclusion criteria included patients with penetrating injuries and no radiographic evidence of TBI.

Data extraction was performed through electronic medical record review, and CT head images were reviewed for skull fracture data which included level of displacement, location of skull fracture, and presence of pneumocephalus. Dictated reports of initial CT head images were used in most cases; images were re-reviewed in cases of incongruent findings or documented progression. Neurosurgical operation details were extracted from operative notes. Fractures were categorized as frontal, parietal, temporal, occipital, skull base, sphenoid, and 2 or greater bones involved. Skull fractures were also categorized as non-displaced, minimally displaced (displacement ≤1 cranium width) or displaced (displacement >1 cranium width) [12]. Neurosurgical operations included craniotomy, fracture elevation, intracranial pressure monitoring, craniectomy, and cranioplasty. Progression on repeat head CT (RHCT) was defined as the development of any new ICH for the isolated skull fractures. kBIG classification was performed for each patient according to the published guideline [1].

2.2. Statistical analysis

Data analysis was performed using R software (version 4.5.1, R Foundation for Statistical Computing, Vienna, Austria). Descriptive statistics were used to summarize patient demographics, baseline characteristics, and clinical outcomes. Continuous variables were presented as median with interquartile range and analyzed using Mann–Whitney *U* test or Kruskal–Wallis test. Categorical variables were expressed as frequency and percentage and analyzed using the chi-square test or Fisher's exact test. To test our primary hypothesis, univariate analyses were conducted to compare clinical outcomes (intracranial hemorrhage progression and neurosurgical requirement) between levels of fracture displacement (non-/minimally displaced and displaced). Multivariable logistic regression was then used to identify independent predictors of these outcomes, adjusting for age, which was examined due to its potential influence on fracture biomechanics. Age, however, was not a statistically significant predictor of either hemorrhage progression or neurosurgical intervention in our models. Additionally, as an exploratory analysis, the cohort was stratified by fracture displacement to examine the isolated effect of fracture location on the study outcomes. Statistical significance was defined a two-sided p-value <0.05.

3. Results

A total of 431 patients met inclusion criteria: 389 with non-/minimally displaced fractures and 42 with displaced fractures (Table 1). Median age was 5 years (IQR 1–10), with displaced fractures occurring more often in older children ($p = 0.024$). The majority of fractures involved the parietal, frontal, or occipital bones (Table 1).

3.1. Fracture displacement and associated outcomes

Repeat head CT was obtained in 21 % of patients, more often in displaced fractures (45 %) than non-/minimally displaced (21 %) ($p < 0.001$). Pneumocephalus occurred in 23 % of patients with no significant difference across groups. ICU admission was more frequent in the displaced group (21 %) compared to the non-displaced and minimally displaced groups (11 %) ($p = 0.057$). Neurosurgical consultation was obtained in 64 % of patients, including 86 % with displaced fractures ($p = 0.003$). Operative neurosurgical intervention was required in 19 total patients (4.4 %), 14 with displaced fractures (33 %) and 5 with non/minimally displaced fractures (1 %) ($p < 0.001$). Among displaced fracture cases, 13 underwent fracture elevation and 1 underwent ICP monitoring alone. In contrast, non/minimally fractures had 2 craniotomies with ICP monitoring, 2 ICP monitoring placements alone, and 1 craniectomy. Each of these interventions in the non-displaced and minimally displaced groups were required in patients with GCS<15. All patients who underwent neurosurgical intervention had either a displaced fracture or an abnormal neurologic examination (GCS <15). No patient with a normal neurologic exam and a nondisplaced or minimally displaced fracture, patients defined as kBIG 0, required surgery.

3.2. Fraction location and associated outcomes

Analysis by fracture locations revealed that the majority of fractures occurred in the parietal, frontal, and occipital bones (Fig. 1), with 66 patients having fractures in two or more bones that were either contiguous or rarely, two separate locations. Fracture location was not independently associated with hemorrhage progression or neurosurgical intervention in adjusted analyses. Exploratory stratification showed that displaced fractures were most frequent in frontal (16 %) and parietal (11 %) locations. ICU admission rates were highest in multi-bone fractures (24 %) and frontal injuries (10 %) (Table 3). ICU admission rates were highest in frontal (10 %), parietal (5 %), occipital (9 %), and two-bone (24 %) fractures ($p < 0.001$). Operative intervention was most common in displaced frontal fractures (47 %) and parietal fractures (38 %) (Table 3). However, when limited to non-/minimally displaced fractures, operative rates were low and not significantly different by location (Table 2).

3.3. Progression cases and outcomes

Progression (development of new ICH) on repeat head CT was rare, occurring in 6 (1.3 %) patients: 4 with nondisplaced, 2 with minimally displaced, and no displaced fractures (Table 4). Fracture

Table 1
Demographics and clinical outcomes of pediatric patients with isolated skull fracture.

	All (N = 431)	Non-/Minimally Displaced (n = 389)	Displaced (n = 42)	P-value
Demographics				
Age, year[a]	5 (1, 10)	4 (1, 9)	7 (3, 12)	**0.024**
Sex[b]				0.747
Female	169 (39 %)	154 (40 %)	15 (36 %)	
Male	262 (61 %)	235 (60 %)	27 (64 %)	
Race[c]				0.273
American Indian/Alaska Native	4 (1 %)	4 (1 %)	0 (0 %)	
Asian	8 (2 %)	8 (2 %)	0 (0 %)	
Black	8 (2 %)	8 (2 %)	0 (0 %)	
Pacific Islander/Native Hawaiian	10 (2 %)	7 (2 %)	3 (7 %)	
White	345 (80 %)	308 (79 %)	37 (88 %)	
Ethnicity[b]				0.750
Hispanic	50 (12 %)	44 (11 %)	6 (14 %)	
Non-Hispanic	381 (88 %)	345 (89 %)	36 (86 %)	
Clinical Outcomes				
GCS[b]				0.951
14–15	386 (90 %)	349 (90 %)	37 (88 %)	
≤13	45 (10 %)	40 (10 %)	5 (12 %)	
Fracture location[c]				**0.044**
Frontal	107 (25 %)	90 (23 %)	17 (40 %)	
Occipital	89 (21 %)	86 (22 %)	3 (7 %)	
Parietal	118 (27 %)	105 (27 %)	13 (31 %)	
Temporal	49 (11 %)	46 (12 %)	3 (7 %)	
2+ bones	66 (15 %)	60 (15 %)	6 (14 %)	
Other (skull base, sphenoid)	2 (0 %)	2 (1 %)	0 (0 %)	
Pneumocephalus[b]				0.115
Yes	97 (23 %)	83 (21 %)	14 (33 %)	
No	334 (77 %)	306 (79 %)	28 (67 %)	
Repeat head CT[b]				**<0.001**
Yes	91 (21 %)	72 (19 %)	19 (45 %)	
No	340 (79 %)	317 (81 %)	23 (55 %)	
Progression on repeat CT[c]				0.337
Yes	6 (1 %)	6 (2 %)	0 (0 %)	
No	85 (20 %)	66 (17 %)	19 (45 %)	
Neurosurgical consultation[b]				**0.003**
Yes	274 (64 %)	238 (61 %)	36 (86 %)	
No	157 (36 %)	151 (39 %)	6 (14 %)	
Neurosurgery[b]				**<0.001**
Yes	19 (4 %)	5 (1 %)	14 (33 %)	
No	412 (96 %)	384 (99 %)	28 (67 %)	
Neurosurgical intervention[c]				**<0.001**
Craniectomy	1 (0 %)	1 (0 %)	0 (0 %)	
Craniotomy	14 (3 %)	2 (1 %)	12 (29 %)	
Cranioplasty	2 (0 %)	0 (0 %)	2 (5 %)	
Fracture elevation	13 (3 %)	0 (0 %)	13 (31 %)	
ICP Monitor (EVD, bolt)	5 (1 %)	4 (1 %)	1 (2 %)	
ICU admission[b]				0.057
Yes	49 (11 %)	40 (10 %)	9 (21 %)	
No	382 (89 %)	349 (90 %)	33 (79 %)	
Length of ICU stay, day[a]	1 (1, 4)	2 (1, 4)	1 (1, 1)	0.181
Discharge location[c]				0.215
Deceased	2 (0 %)	1 (0 %)	1 (2 %)	
Home Health	4 (1 %)	4 (1 %)	0 (0 %)	
Home	375 (87 %)	337 (87 %)	38 (90 %)	
Rehab	6 (1 %)	5 (1 %)	1 (2 %)	
Other	2 (0 %)	2 (1 %)	0 (0 %)	

Data were compared between Non/Minimally Displaced and Displaced using [a]Mann-Whitney *U* test, [b]chi-square test, and [c]Fisher's exact test. GCS: Glasgow coma scale; CT: computed tomography; ICP: intracranial pressure monitor; EVD: external ventricular drainage; ICU: intensive care unit.

locations varied but temporal bone involvement was noted in 3 cases. Of the nondisplaced and minimally displaced, 4 of these patients had a low presenting GCS (<15), and 1 other had initial CT findings concerning for ICH. Neurosurgical consultation was obtained in all but 1 case, where a discharged patient returned with new swelling and was found to have a small extra-axial bleed categorized as kBIG 1 and required no intervention.

Excluding the displaced fractures, 4 patients, all with GCS<15, underwent neurosurgical procedures: 1 craniotomy, 2 ICP monitor, and 1 craniotomy and ICP monitor. ICU stays ranged from 0 to 15 days, correlating with neurologic severity.

Five of the 6 total progression cases had suspected hemorrhage based on imaging or clinical signs. Only 1 patient (Case 1) had no hemorrhage concern and was diagnosed on ED return with a nondisplaced parietal fracture and GCS 15 (Table 4).

4. Discussion

In this retrospective study, children with isolated, nondisplaced or minimally displaced skull fractures and a normal neurological examination had universally favorable outcomes, with none of these patients requiring neurosurgical intervention. Across the full

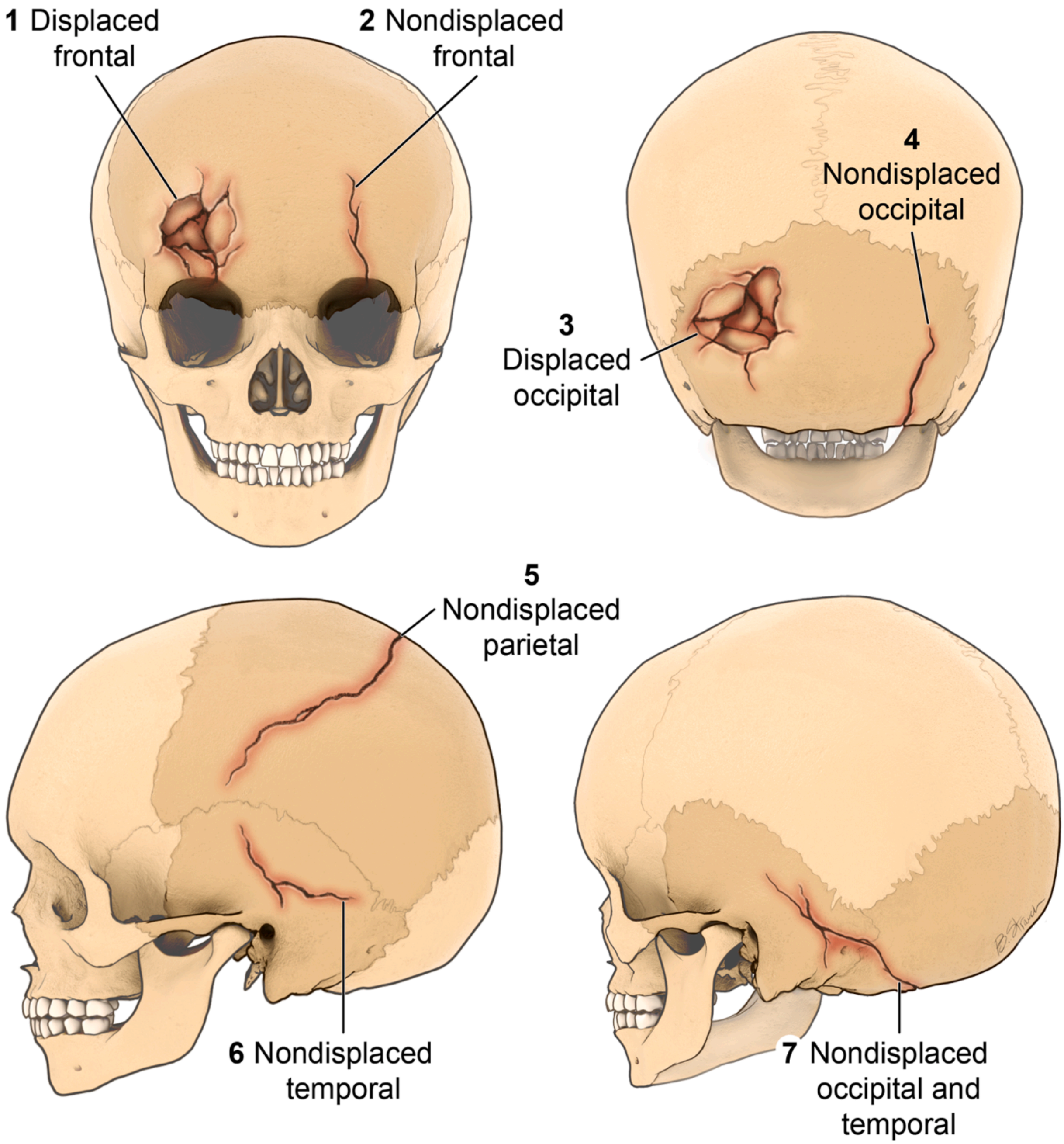

Fig. 1. Location and displacement of skull fractures
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cohort, only six children (1.4 %) experienced progression on repeat head CT, and just four of the nondisplaced/minimally displaced progression cases (0.9 %) ultimately required surgical intervention. All four children requiring surgery had either a displaced fracture or an abnormal neurologic exam (GCS <15), reinforcing that neurologically normal children with simple fracture morphology without displacement are extremely low-risk. Our findings support the conservative management of children who meet kBIG 0 criteria and emphasize the clinical safety of forgoing hospitalization, repeat CT, and neurosurgical consultation in this population. Our results build on prior studies showing that isolated skull fractures without ICH rarely result in deterioration or require surgical management [2,5,13]. They also validate the recommendations of the recently developed kBIG guidelines, which advocate for ED discharge of children with nondisplaced or minimally displaced skull fractures and normal neurologic exams [1].

For children with TBIs, the most critical clinical outcomes to evaluate are clinical deterioration and need for neurosurgical intervention. Notably in our study, cases with ICH progression were randomly distributed across fracture types and locations. Critically, all six children with progression had either an abnormal neurologic examination or initial radiologic findings suspicious for ICH and thus were not isolated fractures. This is consistent with prior studies that highlight the predictive value of GCS and bleeding in identifying higher-risk patients [2,5]. Our data identified a single case of ICH progression in a patient who initially presented with a normal neurological exam and a low-risk skull fracture. Notably, although a 3 mm extra-axial hemorrhage was detected on a repeat head CT

Table 2
Fracture location and associated clinical outcomes in non- or minimally displaced isolated skull fracture.

	Frontal (n = 90)	Occipital (n = 86)	Parietal (n = 105)	Temporal (n = 46)	2+ bones (n = 60)	P-value
GCS[a]						0.245
14–15	78 (87 %)	79 (92 %)	98 (93 %)	42 (91 %)	50 (83 %)	
≤13	12 (13 %)	7 (8 %)	7 (7 %)	4 (9 %)	10 (17 %)	
Pneumocephalus[a]						**<0.001**
Yes	26 (29 %)	13 (15 %)	4 (4 %)	17 (37 %)	23 (38 %)	
No	64 (71 %)	72 (84 %)	101 (96 %)	29 (63 %)	37 (62 %)	
Progression on repeat CT[a]						
Yes	1 (1 %)	1 (1 %)	1 (1 %)	1 (2 %)	2 (3 %)	0.795
No	23 (26 %)	7 (8 %)	13 (12 %)	9 (20 %)	13 (22 %)	
Neurosurgery[a]						0.508
Yes	2 (2 %)	1 (1 %)	0 (0 %)	1 (2 %)	1 (2 %)	
No	88 (98 %)	85 (99 %)	105 (100 %)	45 (98 %)	59 (98 %)	
ICU admission[b]						0.151
Yes	10 (11 %)	8 (9 %)	6 (6 %)	5 (11 %)	11 (18 %)	
No	80 (89 %)	78 (91 %)	99 (94 %)	41 (89 %)	49 (82 %)	
Length of ICU stay, day[c]	4 (2, 6)	2 (1, 2)	1 (1, 2)	5 (2, 6)	1 (1, 2)	0.054
Discharge location[a]						0.636
Deceased	0 (0 %)	0 (0 %)	1 (1 %)	0 (0 %)	0 (0 %)	
Home Health	1 (1 %)	1 (1 %)	1 (1 %)	0 (0 %)	1 (2 %)	
Home	79 (88 %)	76 (88 %)	85 (81 %)	39 (85 %)	58 (97 %)	
Rehab	2 (2 %)	1 (1 %)	0 (0 %)	2 (4 %)	0 (0 %)	
Other	0 (0 %)	1 (1 %)	1 (1 %)	0 (0 %)	0 (0 %)	

Data were analyzed using [a]Fisher's exact test, [b]chi-square test, and [c]Kruskal-Wallis test. GCS: Glasgow coma scale; CT: computed tomography; ICU: intensive care unit.

Table 3
Fracture location and associated clinical outcomes in displaced isolated skull fracture.

	Frontal (n = 17)	Occipital (n = 3)	Parietal (n = 13)	Temporal (n = 3)	2+ bones (n = 6)	P-value
GCS[a]						**0.003**
14–15	16 (94 %)	3 (100 %)	13 (100 %)	3 (100 %)	2 (33 %)	
≤13	1 (6 %)	0 (0 %)	0 (0 %)	0 (0 %)	4 (67 %)	
Pneumocephalus[a]						0.999
Yes	6 (35 %)	1 (33 %)	4 (31 %)	1 (33 %)	2 (33 %)	
No	11 (65 %)	2 (67 %)	9 (69 %)	2 (67 %)	4 (67 %)	
Progression on repeat CT[a]						0.999
Yes	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	
No	8 (47 %)	1 (33 %)	7 (54 %)	0 (0 %)	3 (50 %)	
Neurosurgery[a]						0.333
Yes	8 (47 %)	0 (0 %)	5 (38 %)	0 (0 %)	1 (17 %)	
No	9 (53 %)	3 (100 %)	8 (62 %)	3 (100 %)	5 (83 %)	
ICU admission[a]						**0.014**
Yes	4 (24 %)	0 (0 %)	0 (0 %)	1 (33 %)	4 (67 %)	
No	13 (76 %)	3 (100 %)	13 (100 %)	2 (67 %)	2 (33 %)	
Length of ICU stay, day[b]	1 (1, 1)	–	–	1 (1, 1)	1 (1, 4)	0.855
Discharge location[a]						0.085
Deceased	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	1 (17 %)	
Home Health	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	
Home	17 (100 %)	3 (100 %)	11 (85 %)	3 (100 %)	4 (67 %)	
Rehab	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	1 (17 %)	
Other	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	0 (0 %)	

Data were analyzed using [a]Fisher's exact test and [b]Kruskal-Wallis test. GCS: Glasgow coma scale; CT: computed tomography; ICU: intensive care unit.

Table 4
Cases with progression on repeat head CT.

Case	Fracture Displacement	Fracture Location	Mechanism	ED GCS	# of RHCT	NS Consultation	NS Intervention	Pneumo-cepahlus	ICU Days	Suspected Hemorrhage
1	Nondisplaced	Parietal	Fall	15	1	None	None	No	0	No – identified on ED bounce back
2	Nondisplaced	2 bones (occipital, temporal)	Bike	15	2	Yes	None	Yes	1	Yes – concern for open fracture
3	Nondisplaced	Temporal	Fall	14	3	Yes	Craniotomy	Yes	5	Yes – possible extra-axial seen on CT (motion artifact obscured image)
4	Nondisplaced	2 bones (occipital, temporal)	Fall	3	1	Yes	ICP monitor	No	6	Yes – low GCS
5	Minimally displaced	Frontal	MVC	7	1	Yes	ICP monitor	No	10	Yes – low GCS
6	Minimally displaced	Occipital	Struck	7	1	Yes	ICP monitor, craniotomy	No	15	Yes – low GCS

ICP monitor: intracranial pressure monitor; GSC: Glasgow Coma Scale; CT: computed tomography; ED: emergency department; NS: Neurosurgical.

during a return ED visit, the patient was safely discharged home without requiring intervention, suggesting that early discharge with strict return precautions is still appropriate. Similarly, Rollins et al., in a retrospective review of children presenting with an ED GCS of 15 and isolated skull fractures reported only one case of ICH progression on repeat imaging, in which the patient also required no intervention and was safely discharged [14]. Aside from the single case in our study, we observed no further instances of ICH progression in patients lacking initial clinical or imaging concerns, reinforcing the safety of a risk-stratified discharge strategy and aligning with prior data assessing the low likelihood of delayed hemorrhage [15,16]. These findings support that children with low-risk skull fractures, absent concerning neurological symptoms or radiographic features, can be considered for ED discharge with thorough return precautions and family education.

Additionally, the recently published kBIG TBI guidelines [1] do not consider fracture location in the risk stratification of the patient. In this study, we specifically evaluated clinical outcomes by fracture location. We found that the location of fracture does not predict likelihood of neurosurgical intervention or progression. Historically, occipital fractures have been associated with higher concern for clinical deterioration, given the risk of swelling in such a small space [17]. In our study, we found an extremely low operative intervention rate ($n = 1$ patient) among this subset of fractures, limited to one patient who had an ICP monitor placed due to an ED GCS of 3, categorizing this patient as a kBIG 3. Additionally, prior studies have found that isolated basilar skull fractures without concerning features including evidence of CSF leak, facial nerve injury, or hearing loss can be safely discharged from the ED with follow up [18]. Our findings suggest that fracture location is of little importance when taken into context of the entire clinical picture of the child, and fractures in specific locations are not predictive of worse outcomes so long as they fall within the displacement guidelines for low-risk fractures.

Our study demonstrates that pediatric patients with isolated skull fractures without initial ICH have a very low risk of clinical deterioration, need for neurosurgical intervention, or radiographic progression on repeat imaging. In our cohort, 33 % of patients with displaced fractures underwent operative intervention, nearly all involving fracture elevation procedures. These findings align with multiple prior studies that have identified displaced skull fractures as the most likely subset to warrant surgical management, typically for fracture elevation [4,5,16,19]. In our cohort, there were two nondisplaced and two minimally displaced fracture patients who required operative interventions. Importantly, all four of these patients presented with low GCS $\leq$14. Thus, our findings reinforce that neurologically normal patients with minimally or nondisplaced fractures, are highly unlikely to require surgical intervention. Additionally, surgical interventions were almost exclusively reserved for patients with displaced fractures, primarily for fracture elevation rather than evacuation of hemorrhage or decompression, a finding that had not been delineated by previous studies(20) Fracture displacement is the most reliable radiographic predictor of surgical need, and these findings are in line with the automatic upgrade of a displaced skull fracture to the highest TBI management category (kBIG 3) [1]. Our findings support a management strategy in which children with an initial ED GCS score of 15 and a nondisplaced or minimally displaced skull fracture can be safely observed without mandatory repeat head CT or neurosurgical consultation. These results support the recommendations of the recently published kBIG TBI guidelines for the management of pediatric isolated skull fractures.

Our study has several limitations. First, this was a retrospective review conducted at a single Level 1 pediatric trauma center, which may limit the generalizability of the findings to other institutions or patient populations. This study is also underpowered for the analyses regarding the effect of fracture location on the primary outcome. Additionally, some patients underwent repeat head CT or neurosurgical consultation based on provider preference rather than standardized criteria, which could introduce selection bias. Concurrently we are conducting both retrospective and prospective, multicenter studies to validate these findings and refine risk stratification protocols for children with isolated skull fractures.

5. Conclusion

Pediatric patients with a normal neurologic exam and non-displaced or minimally displaced fractures isolated skull fractures did not progress in our study and none required neurosurgical intervention. In contrast, those with an abnormal neurological exam or depressed fracture had a high risk of surgery. These findings support a risk-stratified approach, confirming that routine repeat imaging and neurosurgical consultation are unnecessary in low-risk cases regardless of fracture location.

Conflicts of interest

The authors declare no competing financial interests or personal relationships that could have influenced the work reported in this manuscript.

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