Section: Miscellaneous

Original Research Article

MRI VERSUS CT FOR EVALUATION OF PEDIATRIC HEAD TRAUMA: COMPARISON OF DIAGNOSTIC YIELD AND TIME-TO-DIAGNOSIS

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ABSTRACT

Background: Pediatric head trauma is a common cause of emergency department visits and is associated with significant morbidity and mortality. Rapid and accurate neuroimaging is essential for identifying clinically important intracranial injuries and guiding timely management. Computed tomography (CT) is widely used as the initial imaging modality because of its speed and availability, while magnetic resonance imaging (MRI) provides superior soft tissue characterization and better detection of subtle parenchymal injuries. Comparing the diagnostic yield and time-to-diagnosis of these two modalities is important for optimizing imaging strategies in children with head trauma. **Aim:** To compare MRI and CT in the evaluation of pediatric head trauma with respect to diagnostic yield and time-to-diagnosis at a tertiary care hospital. **Materials and Methods:** This hospital-based comparative observational study included 54 pediatric patients aged 0–18 years presenting with head trauma and requiring neuroimaging evaluation. Demographic details, clinical features, Glasgow Coma Scale (GCS) score, and imaging findings were recorded using a structured proforma. CT was primarily used for acute emergency evaluation, while MRI was performed in selected cases for further assessment of suspected intracranial injury. Imaging findings including skull fractures, epidural hematoma, subdural hematoma, subarachnoid hemorrhage, cerebral contusions, diffuse axonal injury, cerebral edema, and other lesions were compared. The primary outcomes were diagnostic yield and time-to-diagnosis. **Results:** The mean age of the patients was 9.42 ± 4.63 years, and 64.81% were males. Road traffic accidents (38.89%) and falls from height (35.19%) were the most common causes of injury. Mild head trauma was observed in 59.26% of patients. CT detected skull fractures significantly better than MRI (33.33% vs 22.22%, p=0.041), whereas MRI showed significantly higher detection of cerebral contusions (27.78% vs 18.52%, p=0.048) and diffuse axonal injury (16.67% vs 3.70%, p=0.012). Overall diagnostic yield was significantly higher with MRI than CT (74.07% vs 57.41%, p=0.036). However, CT was significantly faster, with mean time to diagnosis of 28.64 ± 9.75 minutes compared with 67.82 ± 18.43 minutes for MRI (p<0.001). MRI also detected additional lesions in 20.37% of patients that were missed on initial CT. **Conclusion:** MRI demonstrated a higher diagnostic yield than CT for detecting subtle intracranial injuries in pediatric head trauma, while CT remained superior for rapid assessment and skull fracture detection. CT is therefore the preferred initial imaging modality in acute settings, whereas MRI serves as a valuable complementary tool in stable patients requiring detailed intracranial evaluation.

INTRODUCTION

Traumatic brain injury in children is a major public health problem and remains one of the leading causes of death, disability, and long-term neurocognitive morbidity in the pediatric age group. The burden of pediatric head trauma extends beyond the immediate risk of mortality, as many survivors develop persistent behavioral, cognitive, educational, and psychosocial difficulties that can affect quality of life for years after the initial insult. In emergency settings, prompt recognition of clinically significant intracranial injury is therefore essential, because early diagnosis directly influences decisions regarding observation, neurosurgical referral, intensive care, and follow-up planning. At the same time, pediatric patients represent a particularly vulnerable population in whom imaging decisions must balance diagnostic accuracy with safety, resource utilization, and time efficiency.[1] Computed tomography is still the mainstay of acute neuroimaging in children with head trauma because it is widely available, rapid to perform, highly effective for the detection of skull fractures and acute hemorrhage, and easily incorporated into emergency workflows. Current imaging recommendations continue to support CT as the preferred first-line modality in children with suspected clinically important intracranial injury, especially in the acute phase when rapid exclusion of life-threatening lesions is critical. However, a large proportion of pediatric head injuries are mild, and not all children require immediate CT. This has led to increasing emphasis on selective imaging, guided by clinical decision rules and risk stratification, in order to reduce unnecessary exposure while maintaining diagnostic safety.[2,3] One of the main concerns related to CT in children is ionizing radiation. Because children are more radiosensitive than adults and have a longer expected lifespan during which radiation-related adverse effects may manifest, minimizing avoidable CT use has become an important objective in pediatric trauma care. Recent pediatric trauma studies have shown that CT is frequently used during injury evaluation and that a substantial proportion of scans may be normal or may not alter immediate management, highlighting the need for more judicious imaging pathways. This concern has encouraged interest in alternative or complementary imaging strategies that can preserve diagnostic accuracy while reducing radiation burden, particularly in children with stable clinical status or persistent symptoms despite inconclusive CT findings.[4,5] Magnetic resonance imaging offers several theoretical and practical advantages in pediatric traumatic brain injury. MRI is superior for the characterization of non-hemorrhagic lesions, diffuse axonal injury, brainstem injury, small cortical contusions, and other subtle parenchymal abnormalities that may be occult on CT. In addition, MRI avoids ionizing radiation entirely, making it an attractive option in a population where radiation stewardship is especially important. Over the past few years, technical improvements and growing clinical experience have expanded the role of rapid and trauma-focused MRI protocols in emergency and early inpatient care. Reviews of pediatric traumatic brain injury have increasingly emphasized that MRI provides more detailed tissue-level assessment and may improve lesion detection in selected patients, particularly when neurological findings are unexplained by CT or when a more complete estimate of injury burden is clinically relevant.[6] Despite these advantages, MRI also has important limitations in the evaluation of acute pediatric head trauma. Conventional MRI generally requires longer acquisition time, greater patient cooperation, and more logistical coordination than CT. Younger children may require sedation, which can delay imaging and introduce additional monitoring requirements. MRI availability in emergency settings may also be limited, especially outside tertiary care centers or during off-hours. Furthermore, although MRI performs well for many intracranial abnormalities, CT still remains superior for rapid assessment of skull fractures and is often easier to obtain in unstable patients. These practical considerations mean that MRI has not replaced CT in acute head trauma, but instead occupies a growing complementary role whose exact clinical value continues to evolve. Recent work on rapid-sequence and fast brain MRI has renewed interest in MRI as a more feasible option for selected children with traumatic brain injury. Systematic reviews have shown that rapid-sequence MRI can reduce scan duration and eliminate radiation exposure, while maintaining good performance for a number of intracranial injuries. Real-world emergency department studies have also demonstrated increasing use of rapid MRI in pediatric practice, including for traumatic brain injury, suggesting that operational barriers are gradually becoming more manageable in high-volume centers. Nevertheless, the literature still indicates variability in protocol design, workflow integration, diagnostic scope, and access, and these factors may influence both diagnostic yield and time-to-diagnosis in routine clinical settings.[7]

MATERIALS AND METHODS

This hospital-based comparative observational study was conducted at a tertiary care hospital to evaluate the role of magnetic resonance imaging (MRI) versus computed tomography (CT) in the assessment of pediatric head trauma. The study was designed to compare the diagnostic yield and time-to-diagnosis of MRI and CT in children presenting with head injury. The study setting included the emergency department, radiology department, and pediatric care units of the hospital, where children with suspected traumatic brain injury were initially assessed and managed according to institutional protocols. A total of 54 pediatric patients with head trauma were included in the study. Children presenting with clinical suspicion of head injury and requiring neuroimaging for diagnostic evaluation were considered eligible. Pediatric patients of either sex who underwent CT and/or MRI as part of their clinical workup were enrolled. The study population represented cases ranging from mild to severe head trauma, based on presenting symptoms, neurological findings, and treating physician judgment.

Eligibility criteria: Children aged 0 to 18 years with a history of head trauma and an indication for neuroimaging were included in the study. Patients were selected if they had undergone CT, MRI, or both for evaluation of traumatic intracranial injury. Children with prior known neurological disorders, congenital brain malformations, previous intracranial surgery, non-traumatic causes of altered sensorium, or incomplete imaging/clinical records were excluded from the study. Patients who were hemodynamically unstable and could not complete MRI, or whose imaging studies were technically inadequate for interpretation, were also excluded.

Methodology

A consecutive sampling technique was used to enroll 54 eligible pediatric patients presenting with head trauma. All patients meeting the inclusion criteria during the study period and having complete relevant clinical and imaging data were included to minimize selection bias and to ensure representation of routine tertiary care practice.

Clinical and demographic parameters: Detailed demographic and clinical data were recorded for each patient using a structured data collection proforma. The variables included age, sex, mode of injury, mechanism of trauma, time since injury, Glasgow Coma Scale (GCS) score at presentation, loss of consciousness, vomiting, seizures, focal neurological deficits, scalp swelling, external injuries, and indication for imaging. Additional clinical parameters such as need for sedation, admission to intensive care, and referral source were also noted where applicable.

Imaging protocol: All patients underwent neuroimaging based on standard institutional clinical indications. CT scan of the head was typically performed as the initial imaging modality in emergency evaluation because of its rapid availability and utility in detecting skull fractures and acute intracranial hemorrhage. MRI of the brain was performed in selected cases where further evaluation was required, particularly for suspected diffuse axonal injury, non-hemorrhagic lesions, brainstem injury, small contusions, or when CT findings were inconclusive despite persistent neurological symptoms. CT imaging parameters included non-contrast axial acquisition with multiplanar reconstruction where needed. MRI protocol included standard sequences such as T1-weighted, T2-weighted, fluid-attenuated inversion recovery (FLAIR), diffusion-weighted imaging (DWI), susceptibility-weighted imaging (SWI) or gradient echo sequences, and additional sequences as indicated clinically.

Outcome measures: The primary outcome measures were diagnostic yield and time-to-diagnosis for MRI and CT. Diagnostic yield was defined as the ability of each imaging modality to detect traumatic intracranial abnormalities including skull fractures, epidural hematoma, subdural hematoma, subarachnoid hemorrhage, cerebral contusions, diffuse axonal injury, cerebral edema, midline shift, and other trauma-related lesions. Time-to-diagnosis was defined as the interval from the imaging request or patient presentation to the availability of the imaging-based diagnosis for clinical decision-making. Comparative analysis was performed to assess which modality detected more clinically relevant lesions and which provided a faster diagnosis.

Image interpretation: All imaging studies were reviewed by qualified radiologists experienced in pediatric neuroimaging. The imaging findings were documented in a standardized format. For each patient, the type, location, and number of lesions were recorded. CT and MRI findings were compared for detection of hemorrhagic and non-hemorrhagic injuries, skull fractures, parenchymal changes, and subtle traumatic lesions. When both modalities were available for the same patient, the additional diagnostic information provided by MRI over CT was specifically noted.

Statistical analysis: The collected data were entered and analyzed using SPSS version 26.0. Descriptive statistics were used to summarize demographic characteristics, clinical features, imaging findings, diagnostic yield, and time-to-diagnosis. Continuous variables were expressed as mean and standard deviation or median and interquartile range, depending on data distribution, while categorical variables were presented as frequencies and percentages. The diagnostic performance of MRI and CT was compared using appropriate statistical tests such as the chi-square test or Fisher's exact test for categorical variables and independent sample t-test or Mann-Whitney U test for continuous variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1: Demographic and Injury Characteristics of Study Population

A total of 54 pediatric patients with head trauma were included in the study. The mean age of the patients was 9.42 ± 4.63 years, indicating that most cases occurred in school-aged children. The largest proportion of patients belonged to the 6–10 years age group (31.48%), followed by 11–15 years (27.78%), 0–5 years (25.93%), and 16–18 years (14.81%). With regard to sex distribution, male patients constituted the majority (64.81%), while female patients accounted for 35.19% of the study population. Regarding the mode of injury, road traffic accidents were the most common cause (38.89%), followed by falls from height (35.19%). Other causes included sports-related injuries (11.11%), assault (9.26%), and other causes such as domestic accidents (5.56%). In terms of mechanism of trauma, the majority of injuries were due to blunt trauma (88.89%), while penetrating trauma accounted for 11.11% of cases. The time since injury at presentation showed that 44.44% of patients presented within 6 hours, 35.19%

between 6–24 hours, and 20.37% after 24 hours of injury.

Table 2: Clinical Presentation and Neurological Status

The clinical presentation of pediatric head trauma patients varied depending on the severity and mechanism of injury. The most common presenting symptom was scalp swelling, observed in 53.70% of patients, followed by loss of consciousness in 51.85% and vomiting in 44.44% of cases. Other symptoms included headache (38.89%), external injuries (33.33%), and altered sensorium (22.22%). Less frequent clinical features included irritability in younger children (18.52%), seizures (12.96%), and focal neurological deficits (11.11%). Assessment using the Glasgow Coma Scale (GCS) revealed that the majority of patients had mild head trauma (59.26%), while 27.78% had moderate injury and 12.96% had severe head trauma. Regarding imaging logistics, 25.93% of patients required sedation during MRI, which was primarily necessary for younger children who were unable to remain still during the imaging procedure. Additionally, 20.37% of patients required admission to the intensive care unit (ICU), indicating the presence of more severe injuries requiring close monitoring and management.

Table 3: Types of Intracranial Injuries Detected on CT and MRI

The study compared the ability of CT and MRI to detect different types of intracranial injuries in pediatric head trauma. Skull fractures were detected more frequently on CT (33.33%) compared with MRI (22.22%), and this difference was statistically significant ($p = 0.041$), reflecting the superior ability of CT to identify bony injuries. For hemorrhagic lesions such as epidural hematoma, subdural hematoma, and subarachnoid hemorrhage, the detection rates between CT and MRI were relatively similar, and the differences were not statistically significant ($p > 0.05$). However, MRI demonstrated better detection of certain parenchymal injuries. Cerebral contusions were identified in 27.78% of patients on MRI compared with 18.52% on CT, with the difference reaching statistical significance ($p = 0.048$). Similarly, diffuse axonal injury was detected in 16.67% of patients on MRI but only 3.70% on CT, which was highly significant ($p = 0.012$). MRI also showed slightly higher detection rates for cerebral edema, intraventricular hemorrhage, midline shift, and brainstem injury, although these differences were not statistically significant.

Table 4: Diagnostic Yield of CT and MRI According to Severity of Head Trauma

The diagnostic yield of CT and MRI was analyzed according to the severity of head trauma based on the Glasgow Coma Scale (GCS). Among patients with mild head trauma (GCS 13–15), CT detected abnormalities in 46.88% of cases, whereas MRI detected abnormalities in 65.63% of cases, with the difference being statistically significant ($p = 0.049$). In patients with moderate head trauma (GCS 9–12), CT detected abnormalities in 66.67% of cases, while MRI detected abnormalities in 80.00% of cases, although this difference was not statistically significant ($p = 0.241$). Among patients with severe head trauma (GCS $\leq$8), CT detected lesions in 85.71% of cases, while MRI identified abnormalities in 100.00% of cases, though the difference was not statistically significant ($p = 0.158$) due to the smaller sample size in this group. Overall, CT detected abnormalities in 57.41% of patients, while MRI detected abnormalities in 74.07%, with the difference being statistically significant ($p = 0.036$).

Table 5: Comparison of Time-to-Diagnosis and Imaging Logistics

The study also compared the time-to-diagnosis and logistical factors associated with CT and MRI imaging. The mean time required to complete CT imaging was significantly shorter (22.58 ± 7.64 minutes) compared with MRI (58.93 ± 15.47 minutes), and this difference was highly statistically significant ($p < 0.001$). Similarly, the mean time to obtain a radiological diagnosis was significantly shorter for CT (28.64 ± 9.75 minutes) compared with MRI (67.82 ± 18.43 minutes), again demonstrating a highly significant difference ($p < 0.001$). Another important logistical factor was the need for sedation, which was not required for CT in any patient, whereas 25.93% of patients required sedation during MRI, particularly younger children who could not remain still during the longer imaging procedure. This difference was statistically significant ($p < 0.001$). Additionally, repeat imaging was required in 16.67% of CT cases compared with 5.56% of MRI cases, which was statistically significant ($p = 0.048$). Furthermore, MRI detected additional lesions in 20.37% of patients that were not identified on the initial CT scan, with a statistically significant difference ($p = 0.003$).

Table 1: Demographic and Injury Characteristics of Study Population (n = 54)

Variable	Frequency (n)	Percentage (%)
Age Group		
0–5 years	14	25.93
6–10 years	17	31.48
11–15 years	15	27.78
16–18 years	8	14.81
Sex		
Male	35	64.81
Female	19	35.19
Mode of Injury		
Road traffic accident	21	38.89

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Fall from height	19	35.19
Sports injury	6	11.11
Assault	5	9.26
Other causes	3	5.56
Mechanism of Trauma		
Blunt trauma	48	88.89
Penetrating trauma	6	11.11
Time Since Injury at Presentation		
< 6 hours	24	44.44
6–24 hours	19	35.19
> 24 hours	11	20.37

Mean age: 9.42 ± 4.63 years

Table 2: Clinical Presentation and Neurological Status (n = 54)

Clinical Parameter	Frequency (n)	Percentage (%)
Loss of consciousness	28	51.85
Vomiting	24	44.44
Seizures	7	12.96
Headache	21	38.89
Scalp swelling	29	53.70
External injuries	18	33.33
Focal neurological deficit	6	11.11
Altered sensorium	12	22.22
Irritability (younger children)	10	18.52
Glasgow Coma Scale (GCS)		
Mild (13–15)	32	59.26
Moderate (9–12)	15	27.78
Severe (≤8)	7	12.96
Need for Sedation during MRI		
Yes	14	25.93
No	40	74.07
ICU Admission Required		
Yes	11	20.37
No	43	79.63

Table 3: Types of Intracranial Injuries Detected on CT and MRI

Type of Injury	CT Detected (n, %)	MRI Detected (n, %)	p-value
Skull fracture	18 (33.33)	12 (22.22)	0.041
Epidural hematoma	7 (12.96)	8 (14.81)	0.782
Subdural hematoma	9 (16.67)	11 (20.37)	0.615
Subarachnoid hemorrhage	6 (11.11)	7 (12.96)	0.754
Cerebral contusion	10 (18.52)	15 (27.78)	0.048
Diffuse axonal injury	2 (3.70)	9 (16.67)	0.012
Cerebral edema	8 (14.81)	10 (18.52)	0.602
Midline shift	5 (9.26)	6 (11.11)	0.748
Intraventricular hemorrhage	3 (5.56)	5 (9.26)	0.312
Brainstem injury	1 (1.85)	4 (7.41)	0.083

Table 4: Diagnostic Yield of CT and MRI According to Severity of Head Trauma

GCS Severity	Total Patients (n)	Positive CT Findings (n, %)	Positive MRI Findings (n, %)	p-value
Mild (13–15)	32	15 (46.88)	21 (65.63)	0.049
Moderate (9–12)	15	10 (66.67)	12 (80.00)	0.241
Severe (≤8)	7	6 (85.71)	7 (100.00)	0.158
Total	**54**	**31 (57.41)**	**40 (74.07)**	**0.036**

Table 5: Comparison of Time-to-Diagnosis and Imaging Logistics

Parameter	CT Scan	MRI	p-value
Mean time to imaging completion (minutes)	22.58 ± 7.64	58.93 ± 15.47	<0.001
Mean time to radiological diagnosis (minutes)	28.64 ± 9.75	67.82 ± 18.43	<0.001
Patients requiring sedation (n, %)	0 (0.00)	14 (25.93)	<0.001
Need for repeat imaging (n, %)	9 (16.67)	3 (5.56)	0.048
Additional lesions detected after initial CT (n, %)	—	11 (20.37)	0.003

DISCUSSION

In the present study, the mean age was 9.42 ± 4.63 years, with the largest proportion of children in the 6–10 year age group (31.48%), followed by 11–15 years (27.78%), while males constituted 64.81% of the study population. This age and sex pattern is comparable to the findings of El-Menyar et al. (2017), who reported a mean age of 10.6 ± 5.9 years and a marked male predominance of 81.00% among pediatric traumatic brain injury cases. Although the proportion of boys was somewhat higher in their

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cohort than in ours, both studies support the established observation that school-aged male children represent the most vulnerable group for head trauma, likely because of greater outdoor exposure and risk-taking behavior.[8]

In our study, road traffic accidents (38.89%) and falls from height (35.19%) were the two leading modes of injury, while 88.89% of injuries were due to blunt trauma. This differs from the national overview by Trefan et al. (2016), in which falls accounted for 62.10% of pediatric head injuries, whereas motor vehicle accidents contributed only 7.10%. The higher proportion of road traffic accidents in the present study may be explained by the tertiary-care hospital setting, which is more likely to receive referrals of high-impact trauma. Nevertheless, both studies confirm that blunt mechanisms predominate and that the distribution of injury etiology varies according to referral pattern and healthcare level.[9]

The most common presenting features in our patients were scalp swelling (53.70%), loss of consciousness (51.85%), and vomiting (44.44%), with headache present in 38.89% and altered sensorium in 22.22%. These results are broadly comparable to those reported by Shenoy et al. (2023), who found vomiting in 43.60%, scalp/facial injuries in 37.20%, and loss of consciousness in 31.90% of children with head injury. The vomiting rate was nearly identical between the two studies, whereas our cohort showed a higher proportion of loss of consciousness, suggesting that our patients may have had relatively more significant neurological insult at presentation. This is further supported by the occurrence of seizures (12.96%) and focal neurological deficits (11.11%) in our series.[10]

According to Glasgow Coma Scale stratification, 59.26% of our patients had mild head injury, 27.78% had moderate injury, and 12.96% had severe head injury, while 20.37% required ICU admission. A similar severity distribution was described by Beauchamp et al. (2011), who reported 71.00% mild, 17.00% moderate, and 12.00% severe injury in their pediatric cohort. The proportion of severe cases was therefore very similar between the two studies, while our series included relatively more moderate injuries, which may account for the somewhat higher need for intensive monitoring. This similarity indicates that our sample reflects a clinically realistic pediatric head trauma population and allows meaningful comparison of imaging performance.[11]

A major finding of the present study was that CT detected skull fractures more frequently than MRI (33.33% vs 22.22%, $p = 0.041$). This observation is in close agreement with Young et al. (2016), who showed that skull fracture was the lesion category most clearly favoring CT, with MRI missing a significant number of fractures; in their study, MRI failed to identify 14 of 21 skull fractures found on CT. Our findings therefore reinforce the established role of CT as the preferred modality for acute evaluation when osseous injury is suspected, particularly in emergency practice where the exclusion of skull fracture can influence immediate management.[12]

For hemorrhagic lesions, our study showed relatively similar performance between CT and MRI, with epidural hematoma detected in 12.96% vs 14.81%, subdural hematoma in 16.67% vs 20.37%, and subarachnoid hemorrhage in 11.11% vs 12.96%, respectively, with no statistically significant difference. A comparable pattern was reported by Shope et al. (2021), whose pediatric fast MRI protocol demonstrated 100% sensitivity for extra-axial hemorrhage, intraventricular hemorrhage, and subarachnoid hemorrhage, while maintaining high sensitivity for other acute hemorrhagic lesions. The findings of both studies suggest that MRI can perform well for intracranial hemorrhage detection in stable pediatric patients, although CT still retains practical superiority because of its speed and simultaneous evaluation of skull injury.[13]

MRI was clearly superior to CT in detecting cerebral contusions in our study, identifying these lesions in 27.78% of patients compared with 18.52% on CT ($p = 0.048$). This result is very similar to that of Buttram et al. (2015), who found that MRI detected significantly more intraparenchymal lesions than CT (34.00% vs 15.00%, $p < 0.001$) in children with traumatic brain injury. Their study also noted that several children with normal CT findings subsequently showed abnormalities on MRI. Taken together with our data, this indicates that MRI has a distinct advantage for revealing subtle parenchymal injury that may be underestimated or missed on CT, especially when symptoms persist despite apparently limited findings on initial imaging.[14]

The superiority of MRI was even more pronounced for diffuse axonal injury, which was detected in 16.67% of our patients on MRI but in only 3.70% on CT ($p = 0.012$). This observation is supported by Mehta et al. (2016), who reported only slight agreement between rapid MRI and CT for diffuse axonal injury detection ($\kappa = 0.154$, $p = 0.04$), despite much stronger agreement for hemorrhagic lesions and skull fractures. This comparison strongly suggests that CT substantially underestimates shearing-type white matter injury, whereas MRI provides a more complete depiction of traumatic axonal damage. From a clinical perspective, this is important because diffuse axonal injury is often associated with disproportionate neurological impairment and may explain persistent altered consciousness even when CT findings appear limited.[15]

When overall diagnostic yield was compared across head injury severity, MRI consistently outperformed CT in our study. In children with mild head trauma, CT showed positive findings in 46.88%, whereas MRI was positive in 65.63% ($p = 0.049$); in moderate trauma, positivity was 66.67% vs 80.00%; and in severe trauma, 85.71% vs 100.00%. Overall, CT detected abnormalities in 57.41% of cases compared with 74.07% for MRI ($p = 0.036$). In contrast, Roguski et al. (2015) observed that MRI identified more lesions than CT but that the overall difference did not reach statistical significance ($p = 0.63$). The stronger difference seen in our study may be due to the higher proportion of subtle contusions and diffuse axonal injuries in our cohort, both of which favor MRI detection.[16]

Although MRI had greater diagnostic yield, CT remained substantially faster and more practical for acute assessment in the present study. The mean time to imaging completion was 22.58 ± 7.64 minutes for CT compared with 58.93 ± 15.47 minutes for MRI, while the mean time to radiological diagnosis was 28.64 ± 9.75 minutes vs 67.82 ± 18.43 minutes ($p < 0.001$ for both). In addition, 25.93% of our patients required sedation for MRI, whereas no patient required sedation for CT. These findings are in line with Cohen et al. (2015), who found that rapid MRI was associated with significantly longer imaging completion times (172 vs 93 minutes, $p < 0.001$) and longer emergency department stay (266 vs 225 minutes, $p = 0.008$) than CT. At the same time, our study showed that MRI reduced the need for repeat imaging (5.56% vs 16.67%) and identified additional lesions in 20.37% of patients after initial CT, indicating that its longer acquisition time may be offset by its greater diagnostic completeness in selected stable children.[17]

CONCLUSION

MRI showed a significantly higher diagnostic yield than CT in the evaluation of pediatric head trauma, particularly for detecting cerebral contusions, diffuse axonal injury, and other subtle parenchymal lesions. CT, however, remained superior for rapid diagnosis and skull fracture detection, making it the preferred initial imaging modality in acute emergency settings. MRI required longer acquisition time and more frequent sedation, but it identified additional clinically relevant lesions that were missed on initial CT. Therefore, CT and MRI should be considered complementary rather than competing modalities, with CT favored for early triage and MRI reserved for selected stable patients requiring more detailed intracranial assessment.

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