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Wolters Kluwer

Minor head trauma in infants and children: Management

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INTRODUCTION

Head trauma occurs commonly in childhood. Most head trauma in children is minor and not associated with brain injury or long-term sequelae. However, a small number of children who appear to be at low risk may have a clinically important traumatic brain injury (ctTBI).

The clinical challenge for evaluating minor head trauma in pediatric patients is to identify those infants and children with ctTBI while limiting unnecessary radiographic imaging and radiation exposure. Neuroimaging, usually with computed tomography (CT), is highly sensitive for identifying brain injury requiring acute intervention. However, individual clinical predictors for ctTBI are often nonspecific, particularly in young children. Thus, evaluation for high-risk findings and the use of a clinical decision rule can provide a balanced approach that identifies almost all infants and children with ctTBI after minor head trauma without overuse of CT. Most infants and children with minor head trauma can be safely discharged home after careful evaluation without undergoing imaging. If neuroimaging is performed, those patients with normal clinical findings and imaging may also be discharged home.

The management of infants and children with mild head trauma is presented here.

The clinical features of head-injured children with and without brain injury and the evaluation of minor head trauma in children, concussion and mild head trauma in adolescents, severe traumatic brain injury (TBI) in children and adolescents, and abusive head trauma in children are reviewed separately:

- (See "[Minor blunt head trauma in infants and young children \(<2 years\): Clinical features and evaluation](#)".)
- (See "[Concussion in children and adolescents: Clinical manifestations and diagnosis](#)" and "[Concussion in children and adolescents: Management](#)".)
- (See "[Acute mild traumatic brain injury \(concussion\) in adults](#)".)
- (See "[Sideline evaluation of concussion](#)".)
- (See "[Severe traumatic brain injury \(TBI\) in children: Initial evaluation and management](#)".)
- (See "[Child abuse: Evaluation and diagnosis of abusive head trauma in infants and children](#)".)

DEFINITIONS

Minor head trauma — Because of the difference in mechanisms and presentations, it is best to define minor head trauma differently by age as follows (see "[Minor blunt head trauma in infants and young children \(<2 years\): Clinical features and evaluation](#)", section on 'Epidemiology' and "[Minor blunt head trauma in children \(≥2 years\): Clinical features and evaluation](#)", section on 'Epidemiology'):

- **Children younger than two years of age** – Minor head trauma is generally defined separately in children younger than two years of age for the following reasons [1,2]:
 - Clinical assessment is more difficult
 - Infants with intracranial injuries are frequently asymptomatic
 - Skull fractures or clinically important traumatic brain injury (ciTBI) may occur despite minor trauma

- Inflicted injury occurs more frequently

Experts define minor head trauma in these patients as a history or physical signs of blunt trauma to the scalp, skull, or brain in an infant or child who is alert or awakens to voice or light touch [2].

- **Children two years of age and older** – The definition of minor head trauma for children two years of age and older has often been based upon the Glasgow Coma Scale (GCS). Some have defined minor head trauma as a GCS score of 15, whereas others have included children with scores ≥ 13 ([table 1](#)) [3,4]. However, the rate of traumatic brain injury (TBI) in children with a GCS score of 13 is as high as 20 percent, which makes neuroimaging indicated for most children with this degree of altered mental status.

Thus, for the purposes of this discussion, we define minor head trauma in previously healthy children two years of age and older as follows:

- GCS score of 14 or 15 at the initial examination
- No abnormal or focal findings on neurologic examination
- No physical evidence of skull fracture

However, the clinician should regard these patients as having **apparently** minor head trauma because approximately 5 percent have TBI on neuroimaging, and 1 percent have ciTBI. (See "[Minor blunt head trauma in children \(\$\geq 2\$ years\): Clinical features and evaluation](#)", section on 'Epidemiology'.)

Concussion — From a clinical standpoint, concussion can be defined as trauma-induced brain dysfunction without demonstrable structural injury. As such, concussion is a type of minor head trauma. (See "[Concussion in children and adolescents: Clinical manifestations and diagnosis](#)", section on 'Definitions'.)

The clinical manifestations, diagnosis, and management of concussion in children and adolescents are discussed in greater detail separately. (See "[Concussion in children and adolescents: Clinical manifestations and diagnosis](#)" and "[Concussion in children and adolescents: Management](#)".)

Mild traumatic brain injury — Mild TBI is generally associated with symptoms such as a brief loss of consciousness, disorientation, or vomiting. Like minor head trauma,

patients with mild TBI usually have GCS scores of 13 to 15, measured approximately 30 minutes after the injury. In comparison, patients with moderate TBI generally have initial GCS scores between 9 and 12, whereas those with severe injury have GCS scores ≤ 8 ([table 1](#)) [5]. (See "[Minor blunt head trauma in infants and young children \(<2 years\): Clinical features and evaluation](#)", section on 'Clinical features' and "[Minor blunt head trauma in children \(\$\geq 2\$ years\): Clinical features and evaluation](#)", section on 'Clinical features'.)

Clinically important traumatic brain injury — Several observational studies have been performed to identify infants and children who are at higher risk of intracranial injury after minor head trauma [6]. For this topic, we will define ciTBI using criteria similar to that established for the largest cohorts studied as follows [7-10]:

- Presence of an intracranial injury on neuroimaging associated with one or more of the following:
 - Neurosurgical intervention (either surgery or invasive intracranial pressure [ICP] monitoring)
 - Endotracheal intubation for the management of head injury
 - Hospitalization directly related to the head injury for at least 48 hours
 - Death

or

- Depressed skull fracture warranting operative elevation (ie, depressed past the inner table of the skull)
- Clinical findings of a basilar skull fracture (periorbital ecchymosis, Battle sign ([picture 1](#)), hemotympanum ([picture 2](#)), cerebrospinal fluid [CSF] otorrhea, or CSF rhinorrhea)

MANAGEMENT

Most infants and children with minor head trauma will not require neuroimaging, and for many patients that do, the fast magnetic resonance imaging (MRI) or computed tomography (CT) will show no structural damage. In these cases, management is

based upon clinical findings. For the few patients who have significant traumatic brain injury (TBI), specific management is determined by the type of injury.

TBI on neuroimaging or clinical deterioration — Interventions to treat increased intracranial pressure (ICP) ([table 2](#)), as needed, and prompt neurosurgical consultation should be obtained in the patients with the following findings:

- Brain injury detected by neuroimaging (see "[Intracranial subdural hematoma in children: Clinical features, evaluation, and management](#)" and "[Intracranial epidural hematoma in children: Clinical features, diagnosis, and management](#)")
- Depressed, basilar, or widely diastatic skull fracture (see "[Skull fractures in children: Clinical manifestations, diagnosis, and management](#)", section on 'Basilar skull fractures' and "[Skull fractures in children: Clinical manifestations, diagnosis, and management](#)", section on 'Depressed skull fractures')
- Deteriorating clinical condition (eg, Glasgow Coma Scale [GCS] score ≤ 12 or rapidly decreasing) regardless of neuroimaging results (see "[Severe traumatic brain injury \(TBI\) in children: Initial evaluation and management](#)")

These patients typically warrant hospital admission (in consultation with a neurosurgeon). Intensive monitoring or neurosurgical intervention may also be indicated depending upon the specific brain injury and clinical condition.

Minor head trauma

Low risk — We recommend that infants and children with minor head trauma who have undergone a complete evaluation and are found to be at very low risk for clinically important traumatic brain injury (ciTBI) based upon clinical findings (eg, trivial mechanisms of injury, no symptoms, and a normal physical examination) or according to a clinical decision rule, such as the Pediatric Emergency Care Applied Research Network (PECARN) rule ([table 3](#)) be discharged home without neuroimaging rather than undergoing hospital admission. All such patients should meet discharge criteria and be given clear discharge instructions with reasons to return reviewed. (See '[Discharge criteria](#)' below.)

Evidence indicates that the likelihood of an undetected ciTBI that warrants intervention is extremely low in these patients. As an example, the risk of ciTBI in

infants and children who meet criteria for very low risk of ciTBI by the PECARN rule ([table 3](#)) is approximately 0.5 to 3 per 1000. Thus, neuroimaging with the risk of radiation exposure if CT of the head is performed is not indicated. (See "[Minor blunt head trauma in infants and young children \(<2 years\): Clinical features and evaluation](#)", section on 'Clinical decision rules' and "[Minor blunt head trauma in infants and young children \(<2 years\): Clinical features and evaluation](#)", section on 'Approach'.)

Not low risk — Infants and children who are **not** at low risk for ciTBI according to the PECARN rule ([table 3](#)) should undergo either observation or neuroimaging, based upon age and specific findings. (See "[Minor blunt head trauma in infants and young children \(<2 years\): Clinical features and evaluation](#)", section on 'Approach'.)

Decisions regarding hospital admission or discharge of infants and children who are not at low risk for ciTBI depend upon the approach and subsequent findings as follows:

- **Not low risk with observation (no neuroimaging performed)** – We suggest that infants or children who are at intermediate risk for ciTBI based upon clinical findings or according to the PECARN rule ([table 3](#)) and who are observed without neuroimaging be discharged home rather than undergo hospital admission if they show improvement in initial symptoms during an observation period lasting up to four to six hours post-injury in the emergency department and meet all criteria for safe discharge. (See '[Discharge criteria](#)' below.)

Factors influencing duration of observation should be based upon the clinical scenario (eg, age and symptoms of child, time since injury, time of day, home distance from hospital, and perceived quality of caregiver observation).

- **Rapid clinical improvement** – Limited evidence suggests that rapid clinical improvement over a few hours is associated with a risk that is <1 percent, making discharge a safe approach. (See "[Minor blunt head trauma in infants and young children \(<2 years\): Clinical features and evaluation](#)", section on 'Approach' and "[Minor blunt head trauma in children \(≥2 years\): Clinical features and evaluation](#)", section on 'Clinical judgment'.)
- **Worsening of symptoms or >1 risk factor** – Infants and children with more than one risk factor or worsening of symptoms over time warrant

neuroimaging and management according to radiographic findings. (See "[Minor blunt head trauma in infants and young children \(<2 years\): Clinical features and evaluation](#)", section on 'Intermediate risk' and "[Minor blunt head trauma in children \(≥2 years\): Clinical features and evaluation](#)", section on 'Intermediate risk'.)

- **Delayed presentation or diagnosis** – Delayed diagnosis may occur when a patient returns more symptomatic after initial emergency department evaluation and discharge, or when the initial presentation is delayed from the time of injury. Data are limited as many studies (including PECARN and the Canadian Assessment of Tomography for Childhood Head injury [CATCH]) specifically exclude children with head injury who present more than 24 hours after injury. However, observational studies suggest that the risk of traumatic brain injury may be significant and that neuroimaging is often warranted in well-appearing children with non-frontal hematomas or signs of skull fracture:
 - In a prospective, observational study of almost 20,000 children with minor head trauma, of the 1,000 children who presented >24 hours after minor head injury and had a GCS score of 14 to 15, nearly 4 percent had an abnormal head CT, 0.8 percent had ciTBI, and 0.2 percent required neurosurgery [11]. Nonfrontal scalp hematoma and clinical suspicion for a depressed skull fracture were strongly associated with ciTBI.
 - In a retrospective study of 76 children <24 months of age who presented with scalp swelling greater than 24 hours following head trauma, 42 percent had isolated linear/nondisplaced skull fracture, and 41 percent had linear/nondisplaced skull fracture with associated extra-axial hematoma (epidural or subdural hematoma) [12]. No patient had neurologic deficits, and none required surgical intervention nor experienced neurologic decline.
 - In a retrospective study of 344 children younger than 24 months with CT imaging for head trauma, 68 (19.8 percent) had late presentations (>24 hours from the injury). Of those with late presentations, 15 (22 percent) had significant TBI on CT (intracranial bleeding, pneumocephalus, cerebral edema, depressed or diastatic fracture), two (3 percent) had

ciTBI, and one (2 percent) required neurosurgical intervention. There was no significant difference in rates of ciTBI or neurosurgical intervention between those who presented early and late. Since only patients who had CT were included in the analysis, incidence of ciTBI could not be calculated for the total head injury population presenting early or late [13].

- **Not low risk with normal neuroimaging** – We recommend that infants and children with minor head trauma who are initially **not** at low risk for ciTBI but have normal neuroimaging, a normal level of consciousness, and meet all discharge criteria undergo discharge home rather than hospital admission. (See ['Discharge criteria'](#) below.)

Additional considerations may exist for children with selected skull fractures that may necessitate observation or hospital admission. However, most children with skull fractures and normal neuroimaging can be safely discharged home. (See ["Skull fractures in children: Clinical manifestations, diagnosis, and management"](#), section on ['Management'](#).)

Such patients are unlikely to have ciTBI upon repeated neuroimaging or to require neurosurgical intervention. As an example, in a multicenter observational study of 13,543 children who were evaluated in children's hospital emergency departments for isolated minor head trauma (GCS 14 or 15) and who had normal cranial CT scan results, repeat neuroimaging (CT or MRI) was performed in 2 percent of 11,058 discharged patients and 6 percent of admitted patients [14]. Of these, 0.05 and 0.6 percent of discharged patients and admitted patients, respectively, subsequently had positive findings upon repeat head CT. No patient in either group required neurosurgical intervention.

Early post-traumatic seizures — Children who have seizures after minor head injuries should undergo neuroimaging. (See ["Minor blunt head trauma in infants and young children \(<2 years\): Clinical features and evaluation"](#), section on ['Approach'](#).)

The approach to these patients is based on the patient's past medical and family history and the characteristics of the seizure.

Children with no prior seizures and no family history of epilepsy who have had a brief, generalized post-traumatic seizure following minor head trauma and have normal neuroimaging typically do not warrant hospital admission. In two small observational studies describing such patients, no further seizure activity or neurologic sequelae were noted within the first day to week after injury [15,16]. In a larger, multicenter, prospective study, 457 patients had a post-traumatic seizure, no TBI on CT (or no CT performed), and known recurrent seizure status. Of these, five individuals (1.1 percent) had seizure recurrence, only one of these presented with a GCS score of 15, and none required neurosurgical intervention [17]. Although there is limited evidence to support a particular approach, we typically observe these children for several hours until they are back to baseline mental status and then discharge them if they meet criteria and have close follow-up assured. (See ['Discharge instructions'](#) below.)

Evidence is limited to guide the management of children with more concerning features (eg, focal or prolonged seizure, strong family history, known seizure disorder). Such patients may benefit from hospital admission for observation, further evaluation (eg, electroencephalogram), and/or consultation with a neurologist, depending upon specific aspects of their clinical presentation.

Based upon low-quality evidence, prophylactic anticonvulsant therapy is unlikely to be helpful for patients with early post-traumatic seizures (ie, soon after the head trauma). Although observational studies indicate that these patients are at a modestly increased risk of epilepsy (standardized incidence ratio of 1.5 to 2.0 for children with mild head injury relative to the normal population) [18], studies of prophylactic anticonvulsant therapy in adult and pediatric patients with moderate or severe head trauma have shown no benefit beyond the first week after injury. (See ["Posttraumatic seizures and epilepsy"](#), section on ['Management'](#) and ["Posttraumatic seizures and epilepsy"](#), section on ['Prognosis'](#).)

Concussion — Some children with minor head trauma will also have signs and symptoms of concussion. The assessment and management of concussion in children and adolescents is discussed separately. (See ["Concussion in children and adolescents: Clinical manifestations and diagnosis"](#) and ["Concussion in children and adolescents: Management"](#) and ["Acute mild traumatic brain injury \(concussion\) in adults"](#) and ["Sideline evaluation of concussion"](#).)

Telephone assessment and management — Health care providers are frequently contacted by telephone after a child has sustained minor head trauma. Although there are no studies of the effectiveness and safety of telephone management of minor head trauma, observation at home without an in-person evaluation is reasonable under the following conditions:

- Age >3 months
- Normal mental status and at a baseline level of function
- Low-risk mechanism of injury
- No concern for inflicted injury
- No loss of consciousness or seizure
- No other apparent injuries
- No vomiting or only one episode of vomiting occurring shortly after injury
- No significant headache
- For the infants 3 to 12 months of age, trivial injury with either no hematoma or a small frontal scalp hematoma
- No underlying conditions predisposing to clinically important traumatic brain injury
- Reliable caretakers who are able to seek care, if indicated

Children who have sustained head trauma that meets these criteria may resume normal activity. It is not necessary to awaken them from sleep for monitoring.

Caretakers should be instructed to call right away or seek emergency treatment for the following indications (see ['Information for patients'](#) below):

- Persistent or worsening headaches
- Vomiting after the initial injury
- Change in mental status or behavior
- Unsteady gait or clumsiness/incoordination
- Seizure or loss of consciousness
- Bloody or clear rhinorrhea or otorrhea
- Development of focal weakness or numbness
- Irritability
- Difficulty staying awake or being aroused

Discharge criteria — All infants and children should meet the following conditions prior to discharge or undergo hospital observation or admission:

- No suspicion of inflicted injury
- Easily aroused with light touch with a normal neurologic examination (GCS or pediatric coma score 15 ([table 1](#)))
- At baseline level of function
- Tolerating oral intake of fluids
- No extracranial injuries warranting admission
- Capable caretakers who can reliably observe the child and who can return for care if indicated

Observation is still important after discharge because, although uncommon, signs and symptoms of traumatic brain injury may arise and should prompt return to the emergency department for re-evaluation. Therefore, prior to discharge, the clinician should provide specific instructions regarding the level of observation required, indications for seeking care, and follow-up. (See '[Discharge instructions](#)' below and '[Information for patients](#)' below.)

Discharge instructions — Caretakers of children who have been evaluated for minor head trauma should be given explicit and understandable instructions for monitoring, when to seek medical help, and when to return for follow-up. It is not necessary to awaken most children. Whether it is important to awaken some children to identify the very few who may be experiencing a change in neurologic condition is uncertain, since no evidence addresses this question. (See '[Information for patients](#)' below.)

Those patients who had a concerning mechanism or prolonged symptoms who do not undergo neuroimaging may be awakened from sleep every four or more hours, particularly if being discharged during evening or nighttime hours. Upon awakening, the child should be able to recognize his or her surroundings and appear alert to the caretaker. Follow-up within 24 hours, at least by telephone, should be arranged for all children who are discharged following a head injury.

Immediate medical attention is required when the following conditions are noted:

- Inability to awaken the child as instructed
- Persistent or worsening headache

- Continued vomiting or vomiting that begins/continues four to six hours after injury
- Change in mental status or behavior
- Unsteady gait or clumsiness/incoordination
- Seizure

Additional discharge considerations and instructions for infants and children with skull fractures are provided separately. (See ["Skull fractures in children: Clinical manifestations, diagnosis, and management"](#), section on 'Management' and ["Skull fractures in children: Clinical manifestations, diagnosis, and management"](#), section on 'Information for patients'.)

Return to play — Children and adolescents who have sustained a concussion are at risk for second impact syndrome if a second head injury occurs prior to full recovery. In addition, the cumulative effect of mild, repetitive brain injury on the developing brain is uncertain. Thus, any child who has symptoms of concussion as the result of minor head trauma should **not** participate in sports until cleared for play by a licensed professional (eg, athletic trainer, primary care provider, or specialist with expertise in concussion [eg, sports medicine specialist, neurologist, or neurosurgeon]).

Return to play guidelines for sports-related concussions are discussed in detail elsewhere. (See ["Concussion in children and adolescents: Management"](#), section on 'Management' and ["Concussion in children and adolescents: Management"](#), section on 'Return to play (RTP)' and ["Sequelae of mild traumatic brain injury"](#).)

COMPLICATIONS

Whether mild head trauma in infants and young children can cause long term deficits in brain function is debated. Negative effects on cognition and behavior as well as associations with psychiatric illness (eg, attention deficit disorder with hyperactivity and depression) have been proposed [19]. However, the quality of evidence supporting long term complications arising from minor head trauma in these patients is low and further study is needed [20,21].

Children and adolescents with concussions can have short and long-term sequelae, especially if they return to competition too soon and/or suffer a repeat injury. (See ["Concussion in children and adolescents: Management"](#), section on 'Complications'.)

Complications associated with skull fractures are discussed in greater detail separately. (See ["Skull fractures in children: Clinical manifestations, diagnosis, and management"](#), section on 'Clinical manifestations'.)

Children with early post-traumatic seizures are at a slightly increased risk of epilepsy. (See ["Early post-traumatic seizures"](#) above.)

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See ["Society guideline links: Increased intracranial pressure and moderate-to-severe traumatic brain injury"](#) and ["Society guideline links: Minor head trauma and concussion"](#).)

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

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Basics topics (see ["Patient education: Head injury in children and adolescents \(The Basics\)"](#) and ["Patient education: Skull fractures \(The Basics\)"](#))

- Beyond the Basics topic (see ["Patient education: Head injury in children and adolescents \(Beyond the Basics\)"](#))

SUMMARY AND RECOMMENDATIONS

- **Definitions**

- **Minor head trauma** – Infants with minor head trauma are alert or awakened to voice or light touch but have a history or physical signs of blunt trauma to the scalp, skull, or brain.

In children two years of age or older, this topic defines minor head trauma as children who have sustained head trauma but have a Glasgow Coma Scale (GCS) score of 14 to 15, normal physical examination, and no physical evidence of a skull fracture. (See ['Definitions'](#) above.)

- **Clinically important traumatic brain injury (ciTBI)** – ciTBI is defined as intracranial injury requiring neurosurgical intervention, intensive monitoring and supportive care, or prolonged hospitalization; or resulting in death, a depressed skull fracture requiring elevation, or a basilar skull fracture. (See ['Clinically important traumatic brain injury'](#) above.)
- **Management** – Management of infants and children with minor head trauma is based on clinical findings and, if obtained, neuroimaging (see ['Management'](#) above):
 - **Traumatic brain injury (TBI) on neuroimaging or clinical deterioration** – Interventions to treat increased intracranial pressure (ICP) ([table 2](#)), if suspected, and prompt neurosurgical consultation are needed for patients with any of the following findings (see ['TBI on neuroimaging or clinical deterioration'](#) above):
 - Brain injury detected by neuroimaging (see ["Intracranial subdural hematoma in children: Clinical features, evaluation, and management"](#))

and "Intracranial epidural hematoma in children: Clinical features, diagnosis, and management")

- Depressed, basilar, or widely diastatic skull fracture (see "Skull fractures in children: Clinical manifestations, diagnosis, and management")
- Deteriorating clinical condition (eg, GCS score ≤ 12 or rapidly decreasing) regardless of neuroimaging results (see "Severe traumatic brain injury (TBI) in children: Initial evaluation and management")
- **Low risk for ciTBI** – We recommend that infants and children with minor head trauma who have undergone a complete evaluation and are found to be at low risk for ciTBI based upon clinical findings (eg, trivial mechanisms of injury, no symptoms, no concerns for child abuse, and a normal physical examination) or according to the Pediatric Emergency Care Applied Research Network (PECARN) rule ([table 3](#)) be discharged home without neuroimaging and not undergo hospital admission (**Grade 1B**). (See 'Low risk' above.)
- **Not low risk for ciTBI** – Decisions regarding hospital admission or discharge of infants and children who are **not** at low risk for ciTBI based on clinical findings or the PECARN rule ([table 3](#)) depend upon the approach and subsequent findings as follows (see 'Not low risk' above):
 - No neuroimaging but improvement in symptoms during observation – We suggest that infants or children who are at intermediate risk for ciTBI and who are observed without neuroimaging be discharged home rather than undergo hospital admission if they show improvement in initial symptoms during an observation period lasting up to four to six hours post-injury and meet all criteria for safe discharge (**Grade 2B**).
 - Normal neuroimaging and improvement in symptoms – We recommend that infants and children with minor head trauma who are initially **not** at low risk for ciTBI but have normal neuroimaging, a normal level of consciousness, and meet all discharge criteria undergo discharge home rather than hospital admission (**Grade 1B**).
 -

- >1 risk factor or worsening symptoms – Infants and children with more than one intermediate risk factor or worsening of symptoms over time warrant neuroimaging (if not already obtained) and management according to radiographic findings. (See "[Minor blunt head trauma in infants and young children \(<2 years\): Clinical features and evaluation](#)", section on 'Approach'.)
- Early post-traumatic seizures – Children who have seizures after minor head injuries should undergo neuroimaging. The approach to these patients is based on past medical and family history and the characteristics of the seizure. Children who meet the following criteria are appropriate for discharge home: no prior seizures, no family history of epilepsy, seizures were brief and generalized, normal neuroimaging. (See '[Early post-traumatic seizures](#)' above and "[Posttraumatic seizures and epilepsy](#)".)
 - **Discharge criteria** – Prior to discharge, patients with minor head trauma should meet the following conditions or undergo hospital observation or admission (see '[Discharge criteria](#)' above):
 - No suspicion of inflicted injury
 - Easily aroused with light touch with a normal neurologic examination
 - At baseline level of function
 - Tolerating oral intake
 - No extracranial injuries warranting admission
 - Capable caretakers who can reliably observe the child and who can return for care if indicated
 - Any child who has symptoms of concussion as the result of minor head trauma should **not** participate in sports until cleared for play by a licensed professional (eg, athletic trainer, primary care provider, or specialist with expertise in concussion [eg, sports medicine specialist, neurologist, or neurosurgeon]). (See '[Return to play](#)' above and "[Concussion in children and adolescents: Management](#)".)

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GRAPHICS

Glasgow Coma Scale and Pediatric Glasgow Coma Scale

Sign	Glasgow Coma Scale ^[1]	Pediatric Glasgow Coma Scale ^[2]	Score
Eye opening	Spontaneous	Spontaneous	4
	To command	To sound	3
	To pain	To pain	2
	None	None	1
Verbal response	Oriented	Age-appropriate vocalization, smile, or orientation to sound; interacts (coos, babbles); follows objects	5
	Confused, disoriented	Cries, irritable	4
	Inappropriate words	Cries to pain	3
	Incomprehensible sounds	Moans to pain	2
	None	None	1
Motor response	Obeys commands	Spontaneous movements (obeys verbal command)	6
	Localizes pain	Withdraws to touch (localizes pain)	5
	Withdraws	Withdraws to pain	4
	Abnormal flexion to pain	Abnormal flexion to pain (decorticate posture)	3
	Abnormal extension to pain	Abnormal extension to pain (decerebrate posture)	2
	None	None	1
Best total score			15

The Glasgow Coma Scale (GCS) is scored between 3 and 15, with 3 being the worst and 15 the best. It is composed of 3 parameters: best eye response (E), best verbal response (V), and best motor response (M). The components of the GCS should be recorded individually; for example, E2V3M4 results in a GCS of 9. A score of 13 or higher correlates with mild

brain injury, a score of 9 to 12 correlates with moderate injury, and a score of 8 or less represents severe brain injury. The Pediatric Glasgow Coma Scale (PGCS) was validated in children 2 years of age or younger.

Data from:

1. Teasdale G, Jennett B. *Assessment of coma and impaired consciousness. A practical scale. Lancet* 1974; 2:81.
 2. Holmes JF, Palchak MJ, MacFarlane T, Kuppermann N. *Performance of the pediatric Glasgow coma scale in children with blunt head trauma. Acad Emerg Med* 2005; 12:814.
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Graphic 59662 Version 14.0

Battle sign

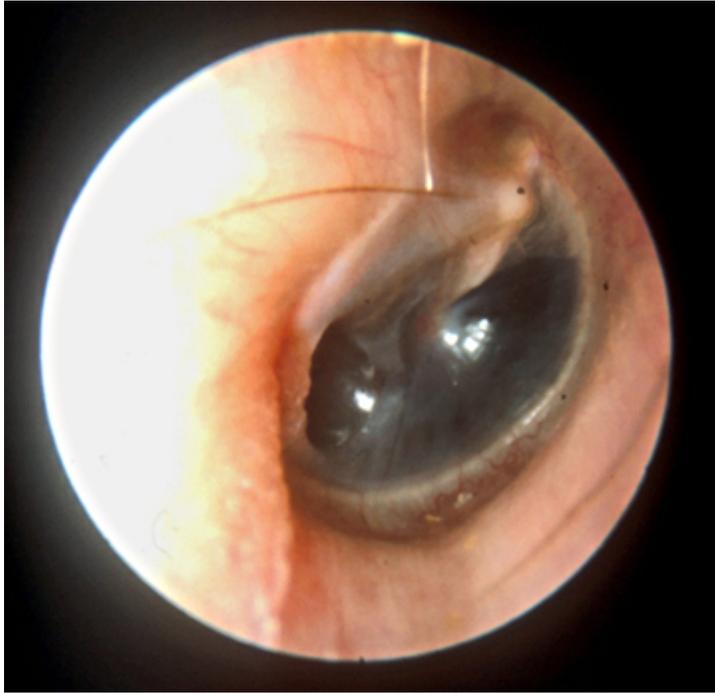


Retroauricular or mastoid ecchymosis (ie, Battle sign) typically appears one to three days after a basilar skull fracture is sustained.

Basilar Skull Fracture. In: Color Atlas of Emergency Trauma, Mandavia, DP, Newton, EJ, Demetriades, D, Cambridge University Press, Cambridge, UK 2003. Reprinted with the permission of Cambridge University Press. Copyright © 2003.

Graphic 69660 Version 4.0

Hemotympanum



Note the very dark fluid filling the middle ear space behind the tympanic membrane.

Courtesy of Adele Karen Evans, MD, FAAP and Steven D Handler MD, MBE.

Graphic 62387 Version 1.0

General measures for treatment of elevated ICP in children

<ul style="list-style-type: none"> ▪ Early consultation with a neurosurgeon to guide medical management and address surgical causes of elevated ICP*
<ul style="list-style-type: none"> ▪ Secure the airway using RSI (use cervical spine immobilization in trauma patients) for the following:
<ul style="list-style-type: none"> • Signs of herniation
<ul style="list-style-type: none"> • Refractory hypoxia
<ul style="list-style-type: none"> • Hypoventilation
<ul style="list-style-type: none"> • GCS ≤ 8 or < 12 and rapidly declining
<ul style="list-style-type: none"> • Loss of airway protective reflexes
<ul style="list-style-type: none"> ▪ Rapid treatment of hypoxia, hypercarbia, and hypotension
<ul style="list-style-type: none"> ▪ Elevation of the head 15 to 30 degrees while maintaining the head in a midline position
<ul style="list-style-type: none"> ▪ Aggressively treating fever with antipyretics and cooling blankets
<ul style="list-style-type: none"> ▪ Control of shivering in intubated patients with muscle relaxants (eg, vecuronium, rocuronium)
<ul style="list-style-type: none"> ▪ Administering prophylactic antiseizure medications (eg, levetiracetam, phenytoin, or phenobarbital) to patients who are at high risk of developing seizures
<ul style="list-style-type: none"> ▪ Maintaining adequate analgesia to blunt the response to noxious stimuli
<ul style="list-style-type: none"> ▪ In intubated patients:
<ul style="list-style-type: none"> • Maintaining the head in a midline position and taping, rather than tying endotracheal tubes to the face
<ul style="list-style-type: none"> • Avoiding high positive pressures and end expiratory pressures
<ul style="list-style-type: none"> • Maintaining adequate sedation and, in some patients, muscle relaxation to permit controlled ventilation
<ul style="list-style-type: none"> • Administration of lidocaine (1 mg/kg intravenously) before endotracheal tube suctioning to blunt the gag and cough responses

ICP: intracranial pressure; RSI: rapid sequence intubation; GCS: Glasgow coma scale.
* Refer to UpToDate topics on the management of elevated ICP in children.

Graphic 110252 Version 3.0

PECARN rules: Findings associated with very low risk of significant traumatic brain injury in children*^[1]

Age (years)	Clinical criteria
<2	Normal mental status
	Normal behavior per routine caregiver
	No LOC [¶]
	No severe mechanism of injury ^Δ
	No nonfrontal scalp hematoma
	No evidence of skull fracture
≥2 to 18	Normal mental status [◇]
	No LOC
	No severe mechanism of injury [§]
	No vomiting
	No severe headache
	No signs of basilar skull fracture [¥]

TBI: traumatic brain injury; GCS: Glasgow Coma Scale; LOC: loss of consciousness; CSF: cerebrospinal fluid.

* Significant TBI such as death or injury that requires neurosurgical intervention, endotracheal intubation for longer than 24 hours, or hospitalization for 2 or more nights is very unlikely if all of the clinical criteria are present. Thus, computed tomography of the head is usually not necessary in such patients. When individual criteria are not met, observation or neuroimaging may be indicated. Refer to topics on minor head trauma in infants and children for further discussion.

¶ For the purposes of this criterion, LOC does **not** include very brief (<5 seconds) LOC associated with low-risk mechanisms for head trauma.

Δ Severe mechanism of injury: fall >0.9 m (3 feet); head struck by high-impact object; motor vehicle collision with patient ejection, death of another passenger, or rollover; pedestrian or bicyclist without helmet struck by a motorized vehicle.

◇ Signs of altered mental status: agitation, somnolence, repetitive questioning, or slow response to verbal questioning.

§ As for children under 2 years of age except fall >1.5 m (5 feet) considered severe.

¥ Early signs of basilar skull fracture at presentation include hemotympanum, CSF rhinorrhea, and CSF otorrhea; late signs of basilar skull fracture, occurring up to 24 hours after injury, include raccoon eyes and post-auricular hematoma (Battle sign).

Reference:

1. Kuppermann N, Holmes JF, Dayan PS, et al. Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study. *Lancet* 2009; 374:1160.
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Graphic 58477 Version 9.0

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Sara Schutzman, MD No relevant financial relationship(s) with ineligible companies to disclose. **Richard G Bachur, MD** No relevant financial relationship(s) with ineligible companies to disclose. **James F Wiley, II, MD, MPH** No relevant financial relationship(s) with ineligible companies to disclose.

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