## Revision History

<table>
<thead>
<tr>
<th>Version</th>
<th>Date of Revision</th>
<th>Description of Revision</th>
<th>Revised By</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Important Information Before you Begin

The recommendations contained in this clinical knowledge topic have been provincially adjudicated and are based on best practice and available evidence. Clinicians applying these recommendations should, in consultation with the patient, use independent medical judgment in the context of individual clinical circumstances to direct care. This knowledge topic will be reviewed periodically and updated as evidence and best practice change.

The information in this topic strives to adhere to Institute for Safe Medication Practices (ISMP) safety standards and align with Quality and Safety initiatives and accreditation requirements such as the Required Organizational Practices. Some examples of these initiatives or groups are: Health Quality Council Alberta (HQCA), Choosing Wisely campaign, Safer Healthcare Now campaign etc.

This topic is based on the following guideline(s):

- Guidelines for Diagnosing and Managing Pediatric Concussion, Recommendations for Health Professionals (Ontario Neurotrauma Foundation, 2014)
- Position Statement: Sport-related concussion: evaluation and management (Canadian Pediatric Society, 2014)
- Joint Position statement - The Role of Family Physicians and physicians with Added Competencies in Sport and Exercise Medicine in a Public Health Approach to Concussions (August 2017)
- Consensus statement on concussion in sport—the 5th International Conference on Concussion in Sport held in Berlin (October 2016)

For questions or feedback related to this knowledge topic please contact Clinical Knowledge Topics by emailing clinicalknowledgetopics@ahs.ca
Rationale

Pediatric concussion is a prevalent and common presentation in Alberta primary care offices and emergency departments. The numbers of children and families seeking care for concussion is on the rise. Year over year concussion reporting in Alberta reveals an increase in diagnosis of concussion in primary care and emergency department settings.

Post-concussive symptoms are most severe acutely but can persist for days to several weeks (or even months) and result in functional disability and decline in quality of life. Clinics advertising concussion investigation often at high expense without a proven positive effect is increasing in popularity. **However, the majority of children with a concussion can be managed by their primary care provider and do not require treatment at a specialty clinic or expensive investigations.** Only a small proportion of children with a concussion will require a referral to specialized concussion resources for management of persistent and/or complicated presentations. Front line providers involved in concussion diagnosis and management should be empowered, educated and supported to gain the skills in recognizing concussion and comfort in making appropriate clinical decisions to optimize patient care and patient recovery.

This document will outline the diagnosis and management of **pediatric concussion**. Pediatric concussion is defined here as concussion injury in children and adolescents ages 5-17 years old. This document has been developed in consultation with various pediatric concussion experts in Alberta. This document outlines the first steps which will apply to the management of most children with concussions and will assist providers to identify the minority of patients who may require more specialized care.

While concussions may occur in the presence of other injuries, this guidance applies to the management of concussion only. Clinical judgement and discretion must be applied to triage the patient (in the case of complicated injury or polytrauma), evaluate and treat the patient according to injury severity.
Figure 1. Clinical algorithm for the initial acute evaluation of a suspected head injury, concussion, mild traumatic brain injury and/or neck injury for pediatric patients (Age 5-17 years old)

Decision Making

Presentation to ED with suspected head injury/ concussion within 3 days of injury

- GCS < 15
- Signs of skull fracture, cervical spine and other orthopedic injuries
- Altered Mental Status (agitation, somnolence, slow response, repetitive questions)

Concussion Symptom Checklist

Assess for risk / modifying factors for concussion

Concussion Assessment:
Complete initial physical/neurological examination.
Complete balance or postural stability testing.

Complete and document remainder of assessment tools if not already completed to establish injury baseline.

If additional considerations required, provide supportive interventions as indicated.

Initial symptom management
Establish a follow up plan with pediatrician, family medicine, sports medicine or physiotherapy

Manage persistent symptoms greater than 2 to 3 weeks
Establish follow up plan with pediatrician and plan a referral to neurology, headache clinic or concussion clinic

Concussion Management

Initial Assessment & Rule Out Severe Head Injury

Concussion Assessment/Evaluation

Consider diagnostic imaging (transfer to alternate site if imaging not available)
Determine if results are within normal limits; treat positive findings accordingly and consult neurosurgery.

Positive Findings?

Yes

Consider Admission

No

No

Re-assessment of symptoms or late presentation

Review mechanism and other injury characteristics

Yes to any

No

No

Concussion Symptom Checklist

Assess for risk / modifying factors for concussion

Yes to any

Yes to any

Yes to any

Yes to any

Yes to any

Yes to any

Yes to any

Yes to any

Positive Findings?

No

Initial symptom management
Refer to the following links for more information regarding:

☑ Aids for recognition and management of concussions (Appendix A)
☑ Detailed symptom management guidance (Appendix B)
☑ Patient Handout (Appendix H)
☑ Disposition planning - criteria for safe discharge, criteria for hospital admission, planned follow up (Disposition Planning and Follow Up)
☑ Clinical questions and recommendations (evidence summaries) (Appendix K)
Definitions
The following definitions are being described and used for the purpose of this document only. However there is no current evidence based consensus on terms related to post concussion symptomology.

- **Concussion**: Acquired traumatic injury to the brain that results in rapid onset of impairment of neurological function that is usually short-lived.
  - This can result from a blow to the part(s) or region(s) of the head, face, neck or elsewhere on the body with an ‘impulsive’ force transmitted to the head.
  - Although concussions are generally sports - and recreation-related injuries, they can occur in relation to other activities such as falls, motor vehicle collisions, and assault.

- **Concussive Event**: The event causing the injury

- **Acute Concussion Symptoms**: Symptoms that begin at the day of injury up to 0 to 27 days after a concussive event

- **Persistent Concussion Symptoms**: Symptoms continuing more than 28 days to 3 months after a concussive event in children / adolescents. (Please note this time-frame is 10-14 days for adults.) These symptoms are post-traumatic, non-specific and require a comprehensive assessment to identify relevant factors, pathologies or dysfunctions that may be present.

- **Chronic Concussion Symptoms**: Describes symptoms persisting longer than 3 months. These symptoms are post-traumatic, non-specific and require a comprehensive assessment to identify relevant factors, pathologies or dysfunctions that may be present.

- **Complicated/Modified Mild Traumatic Brain Injury (TBI)**: Glasgow Coma Scale (GCS) 13 to 15 with intracranial pathology

- **Moderate TBI**: GCS 9 to 12
Key Recommendations for Clinicians

History and Physical Examination

- Document the mechanism of injury.
  - A blow to the head, face, neck or elsewhere on the body with an ‘impulsive’ force transmitted to the head may cause a concussion. Although concussions are generally sports-related, they can occur in relation to other activities such as falls, motor vehicle collisions, and assault.

- Document the symptoms
  - A post-concussion checklist or inventory of symptoms such as may be used:
    - PCSI-C
    - PCSI-Y
    - PCSI-P
    - Health and Behaviour Inventory (HBI) (Appendix I)
  - The symptoms usually appear minutes to hours after the injury and usually resolve on their own within 27 days.

- A general physical examination and neurological examination should be performed with a focus on level of consciousness and behavior, the skull, the neck, focal neurological signs, and balance in addition to a thorough assessment for presence of other injuries.

- Tools helpful for documentation of concussion include:
  - ACE-ED for any concussion
  - SCAT5 / ChildSCAT5 for sport-related concussions.

These abbreviated tools highlight the key required points for assessing concussion. A detailed neurological examination to rule out other injury is required.

- A head CT is not useful in the diagnosis of concussion but may be warranted to rule-out other important intracranial injuries.

- Healthcare providers should use validated clinical decision rules (like PECARN, CATCH (Canadian Assessment of Tomography for Childhood Head Injury) rule, or Canadian CT Head Rule for children over 16 years of age) to identify children at risk for intracranial injury.

- Any persistent abnormality in level of consciousness / GCS, suspected open or depressed skull fracture, worsening headache, or irritability on examination warrants a CT to rule important intracranial injury like an intracranial bleed.

- Signs of a basal skull fracture, large boggy hematoma, or a dangerous mechanism (e.g. motor vehicle collision, fall from bicycle with no helmet, or fall from a height of 3 feet or 5 stairs) may warrant a CT.

Clinical Diagnosis

- History of an observed injury mechanism

- Minimum of 1 symptom from a post-concussion checklist or inventory of symptoms (PCSI-C, PCSI-Y and PCSI-P, ACE-ED or SCAT5 or Child SCAT5) (with increasing clinical suspicion if more symptoms are present), Health and Behavior Inventory (HBI) (Appendix I)
  - Without symptoms or signs of a more severe injury or alternative diagnosis

- Glasgow Coma Scale (GCS) rating of 13 to 15.

- A loss of consciousness and/or amnesia is not required for confirming a diagnosis of concussion. When there is a loss of consciousness, it is usually brief.
In our experience, if the loss of consciousness is longer than 5 minutes and / or the attained history details do not fit within these clinical parameters, a more severe traumatic brain injury or alternative diagnosis (Appendix F) should be considered.

- Concussion does not show any brain injury on routine imaging tests like x-rays, CT or MRI scans.
- A CT may be considered to rule out intracranial injury (i.e. intracranial bleed) in the presence of:
  - Persistent abnormality in level of consciousness or GCS,
  - Suspicion of an open or depressed skull fracture,
  - Worsening headache,
  - Irritability on examination,
  - Signs of a basal skull fracture,
  - Large boggy hematoma,
  - A dangerous mechanism (e.g. motor vehicle collision, fall from bicycle while not wearing a helmet, or fall from a height of 3 feet or 5 stairs)

There is no added value to grading the severity of a concussion itself as it will not change the treatment recommendations outlined in this document.

The following table outlines possible symptoms of concussion:

<table>
<thead>
<tr>
<th>Table 1. Possible Concussion Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance problems</td>
</tr>
<tr>
<td>Blurred/doubled vision</td>
</tr>
<tr>
<td>Confusion/disoriented</td>
</tr>
<tr>
<td>Difficulty concentrating</td>
</tr>
<tr>
<td>Difficulty remembering</td>
</tr>
<tr>
<td>Dizziness</td>
</tr>
<tr>
<td>Drowsiness</td>
</tr>
<tr>
<td>Fatigue</td>
</tr>
<tr>
<td>Headache/pressure in head</td>
</tr>
<tr>
<td>Irritability</td>
</tr>
<tr>
<td>Light sensitivity</td>
</tr>
<tr>
<td>Mentally foggy</td>
</tr>
<tr>
<td>Moving in a clumsy manner</td>
</tr>
<tr>
<td>Nausea</td>
</tr>
<tr>
<td>Neck pain</td>
</tr>
<tr>
<td>Nervousness</td>
</tr>
<tr>
<td>Noise sensitivity</td>
</tr>
<tr>
<td>Sadness</td>
</tr>
<tr>
<td>Slow to respond</td>
</tr>
<tr>
<td>Slowed down</td>
</tr>
<tr>
<td>Trouble falling asleep</td>
</tr>
<tr>
<td>Vomiting</td>
</tr>
</tbody>
</table>
Figure 2. Acute Concussion Evaluation in Emergency Department Setting – Sample

<table>
<thead>
<tr>
<th>A. Injury Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
</tr>
<tr>
<td>Time:</td>
</tr>
<tr>
<td>Reporter:</td>
</tr>
<tr>
<td>Patient ☐, Parent ☐, Other ☐</td>
</tr>
</tbody>
</table>

**Description:**

- Presence of red flags: ☐ Yes ☐ No
- Presence of danger signs: ☐ Yes ☐ No
- Loss of consciousness: ☐ Yes ☐ No
- *Answers questions slowly:* ☐ Yes ☐ No

<table>
<thead>
<tr>
<th>B. Symptom Checklist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Since the injury, has the patient experienced/told any of these symptoms more than usual today or in the past few days?</td>
</tr>
</tbody>
</table>

**PHYSICAL (10)**
- Headache: 0 1
- Nausea: 0 1
- Vomiting: 0 1
- Balance problems: 0 1
- Dizziness: 0 1
- Visual problems: 0 1
- Fatigue: 0 1
- Sensitivity to light: 0 1
- Sensitivity to noise: 0 1
- Numbness/tinnitus: 0 1

**COGNITIVE (4)**
- Feeling mentally foggy: 0 1
- Feeling slowed down: 0 1
- Difficulty concentrating: 0 1
- Difficulty remembering: 0 1

**EMOTIONAL (4)**
- Feeling emotionally upset: 0 1
- In pain: 0 1

**SLEEP (4)**
- Drowsiness: 0 1
- Sleep more than usual: 0 1
- Trouble falling asleep: 0 1

**Physical:**
- Cognitive: 4

**Patient participation:** ☐ Full ☐ Partial ☐ None
- Reason for partial/no: ☐ Young age ☐ Confused ☐ Inattentive ☐ Low arousal
- Other:

**Number of errors on mBEss:** ______/10

<table>
<thead>
<tr>
<th>C. Risk Factor Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous concussions: Y/N</td>
</tr>
<tr>
<td>History of Headaches: Y/N</td>
</tr>
<tr>
<td>History of migraines: Y/N</td>
</tr>
<tr>
<td>History of learning disabilities: Y/N</td>
</tr>
<tr>
<td>History of ADHD: Y/N</td>
</tr>
<tr>
<td>History of depression: Y/N</td>
</tr>
<tr>
<td>History of sleep disorders: Y/N</td>
</tr>
</tbody>
</table>

**Longest symptoms duration ≥ 1 week:** ☐

If multiple concussions did last force cause this injury: Y/N

List other comorbid medical disorders or medication usage (e.g. hypothyroid, seizures):

*For children above 5 years of age and within 48 hours of initial concussive event, use these indicated factors for the predictive pediatric clinical risk score for concussions to assess need for follow-up.

Score greater than or equal to 5 suggests the need for follow up with primary care provider or other specialist in concussion care.

**Total Score:** ____/12

<table>
<thead>
<tr>
<th>D. Follow-up Action Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge teaching completed by: MD ☐, Nurse ☐, Other ☐</td>
</tr>
<tr>
<td>“Kids-Concussion and Head Injuries” and “Concussion in Children - Returning to School and Sport” Handouts given: Yes ☐, No ☐</td>
</tr>
<tr>
<td>Recommended Concussion Web Portal: Yes ☐, No ☐</td>
</tr>
</tbody>
</table>

**Referral(s):**
- Primary care physician: ____________________________
- Concussion clinic: ________________________________
- Neurosurgery: _________________________________
- Neurology: ________________________________
- Sports Medicine: ________________________________
- Physiatrist: _______________________________
- Psychiatrist: _______________________________
- Other: _______________________________

**Within:** ____________________________

<table>
<thead>
<tr>
<th>Urgently</th>
<th>7-14 days</th>
<th>14-28 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ MD ☐</td>
<td>☐ Nurse ☐</td>
<td>☐ Other ☐</td>
</tr>
</tbody>
</table>
Disposition Planning/Follow Up

The following advice in this section pertains to information that should be highlighted with the patient and their family/immediate caregiver.

Clinicians should take the time to discuss anticipated symptoms, expected duration (even the possibility of a delayed recovery) and strategies for managing concussive symptoms at home are key components in normalizing symptoms and expected outcomes to aid recovery. The majority of children return to pre-injury functioning within 27 days post injury.

Laboratory Investigations and Diagnostic Imaging

Blood work, CT, MRIs, and neuropsychology assessment are not part of routine care in the recovery from concussion.

Considerations for admission to hospital

Indications for prolonged hospital observation including worsening symptoms, bleeding disorders, multisystem injuries, comorbid symptoms, or social factors influencing ability to monitor child at home

Considerations for discharge from Emergency Department

With clinical judgment, it is safe to have the child/adolescent observed at home when the following conditions are evident:

i. Normal level of consciousness with improving symptoms.
ii. No risk factors indicating need for CT scan or normal CT scan if already done.
iii. No indications for prolonged hospital observation including worsening symptoms, persistent clinical symptoms (nausea, headaches etc.), bleeding disorders, multisystem injuries or comorbid symptoms.

Follow Up

- Follow-up with primary care provider 7-10 days after the initial injury is recommended to monitor the progress of recovery after initial visit to the ED.
- Risk factors for protracted recovery (Appendix E) and the Pediatric Clinical Risk Score for Persistent Post Concussion Symptoms (Appendix G) may assist in early identification of those at risk for Persistent Symptoms.
  - A moderate or high score is rationale for an appropriate referral to a concussion clinic or pediatric neurologist for follow up care.
- For persistent symptoms (Table 1. Possible Concussion Symptoms) lasting more than 27 days post-injury, the primary care provider should strongly consider referral to a concussion clinic or pediatric neurologist for follow up care.
- Often symptoms of ADHD and/or learning difficulties will increase for a short period of time. We recommend continuing all treatments and medications when children return to school. We also recommend re-contacting your child’s school and physician/psychologist who was helping your child with these difficulties.
  - If the child/adolescent is currently seeing a specialist/HCP for mood and anxiety related symptoms pre-injury, encourage a follow-up visit with them to keep the lines of communication open.
- Clinical evaluation for endocrinopathies is recommended one-year post injury if the child/adolescent reports fatigue, cold intolerance, poor growth, altered puberty, mood disturbances or altered appetite control.
- Follow up is strongly recommended for sports-related injury even if symptoms improve.
  - For elite athletes, follow-up with a sports medicine physician can be recommended
- For worrisome symptoms, medical red flags, etc, child should return to ED/urgent care center.
Discharge Instructions:

- Provide patient and family handouts (Appendix H) to go home with and to take to primary care provider

Cognitive Rest and Return to School with Return to Activity and Sport

Different activities may make symptoms worse for different people. Discuss with patient and family the child/adolescent’s regular activities and determine an individualized approach to returning to those activities.

- Rest for 24 to 48 hours post injury at home. Physical and cognitive activity should be minimized in the initial 24-48 hours following a concussion. Gradual reintroduction of activities of daily living that do not provoke/increase symptoms (including walking) can be introduced following this initial period of relative rest. Currently there is no evidence to support keeping a child/adolescent in a dark room and restricting them from all activity until symptom-free. If this is done it may cause chronic fatigue, pain and other related psychiatric/neurological impairments.
  o A gradual return to physical activity is encouraged along side gradual return to cognitive activity. This is a step-wise process and may take one or more weeks as each step is separated by at least 24 hours.
  o Children/adolescents are strongly encouraged not to return to competitive (contact or collision) sport until medical clearance is obtained to avoid re-injury.
  o Cognitive rest is encouraged to avoid exacerbation of symptoms for the first 24 to 48 hours after injury. As symptoms begin to diminish, slowly increase activity to improve concentration, memory, and sensitization to light/noise. Include the use of electronics and reading as tolerated, that is in a way or amount that does not exacerbate symptoms. Social interactions are encouraged.
  o It is alright for a child to engage in watching television (at a reasonable distance from the screen), for a short period of time. There is no evidence prohibiting this activity. However, child/adolescent should be advised to the potential presence of phonophobia and/or photophobia. Therefore they should be advised NOT to watch television in a dark room and/or with surround sound.
  o It is common for a child/adolescent to feel restless or agitated by the lack of activity.

- Step 1 - By the 2nd/3rd day post injury, the child should, if not already engaged, begin with gentle activities like moderate reading (i.e. short periods of homework) and screen time with personal electronic devices (e.g. cellphones, tablets, and computers) for 15 to 20 minutes, followed by a break of equal length. A short and easy walk of about 15-20 minutes is also encouraged daily. If these activities are already taking place, increase time spent.
  o The intention of this is to start increasing cognitive load and the associated stressors. This may include homework completed at home with breaks for symptom management.

- Step 2 - If the child/adolescent is able to tolerate these activities well, try reintroducing the child/adolescent into the school environment. Well tolerated physical aerobic activity may be progressed to include individual sport specific activity such as skating, dribbling, throwing and catching.
  o Have the child/adolescent attend for half days (preferably the morning hours and stay over the lunch break) and also attend their less stressful classes. The main intention of this step is to have them socializing with their peers rather than completing the school work at this time.
  o They are encouraged to go to bed at regular times each night (including over weekends and holidays and are to limit naps instead taking breaks throughout their day, if needed.
  o Schooling accommodations can be used to reduce symptom burden for the first 2 weeks. (no exams,
sitting at the front of the class, decreasing activities that require more effort, having a quiet space to work/relax, and no homework)

- Physical activity in this phase is meant to add movement. School based physical education meeting the criteria may be engaged in (individual and skill based), however the child / adolescent is encouraged to sit out of more complex drills and situations.

- Step 3 - If they are able to tolerate the above mentioned activities well, they can attempt full days of school and begin homework/attending exams. If symptoms are fully resolved and school work is being completed in full, the child / adolescent may re-integrate into non-contact sport/team practices including physical education at school.
  - All missed work and exams should be caught up and academic performance at pre-injury levels of achievement.
  - The physical activity goal is to increase exercise, coordination and add cognitive load to physical activities.
  - Drills that are cooperative in nature are acceptable. These drills do not involve “challenge for possession” or include high risk skills such as blocking in volleyball, football and rugby or aerials in gymnastics, cheer and skateboarding.
  - Resistance training may be included at this stage.
  - Situations or drills involving scrimmages, games and opportunity for body and head contact are restricted until medical clearance is obtained.

- Step 4 – Full return to learning is complete and symptoms should be fully resolved at this stage. Medical clearance for return to sport may be obtained by the child / adolescent to initiate contact practices in the desired sport.
  - The goal for the child / adolescent is to regain confidence. Full practice speed, training and drills with appropriate learning progressions are expected.

- Step 5 – Full return to sport / activity and game play

Return to Learn and Return to Play can be performed simultaneously, however a full and complete return to school should occur prior to return to competitive (contact and collision) sport environments and include medical clearance for this activity.

Table 2. Return to School Strategy

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Aim</th>
<th>Start at home activities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Goal</td>
<td>Gradual return to typical activity</td>
</tr>
<tr>
<td></td>
<td>Activity</td>
<td>Usual activities such as reading, texting, screen time, home work. Begin with 5-15 minutes and increase gradually</td>
</tr>
<tr>
<td>Step 2</td>
<td>Aim</td>
<td>Start going back to school</td>
</tr>
<tr>
<td></td>
<td>Goal</td>
<td>Initial gradual return to school</td>
</tr>
<tr>
<td></td>
<td>Activity</td>
<td>Start going to school for half days, work up to full days Consider school supports to foster return</td>
</tr>
<tr>
<td>Step 3</td>
<td>Aim</td>
<td>Return to near-normal routine</td>
</tr>
<tr>
<td></td>
<td>Goal</td>
<td>Back to school full days all or most days of the week</td>
</tr>
<tr>
<td></td>
<td>Activity</td>
<td>Go to all classes, take transportation, limit naps</td>
</tr>
<tr>
<td>Step 4</td>
<td>Aim</td>
<td>Return to school full time</td>
</tr>
<tr>
<td></td>
<td>Goal</td>
<td>Return to full academic activity</td>
</tr>
</tbody>
</table>
Activity | Full-time attendance with a normal, full workload, including exams.

Table 3. Return to Sport Strategy

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Aim</th>
<th>Start at home activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal</td>
<td>Gradual return to typical activities</td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Usual activities, including light walking at an easy pace for 15-20 minutes and well-paced household chores</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 2</th>
<th>Aim</th>
<th>Light aerobic activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal</td>
<td>Increase heart rate, limit deconditioning</td>
<td></td>
</tr>
</tbody>
</table>
| Activity | DO - Walking, swimming, cycling at a light pace  
AVOID - Resistance training or weight lifting  
AVOID - Activity with a risk of re-injury  
DO - Up to 10-15 minutes, 2x/day |

<table>
<thead>
<tr>
<th>Step 3</th>
<th>Aim</th>
<th>Sport-related training and exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal</td>
<td>Add movement</td>
<td></td>
</tr>
</tbody>
</table>
| Activity | DO - Individual skills such as stickhandling, jumping/leaping, volleying, juggling, shooting, dribbling, throwing and catching  
DO - Up to 20-30 minutes 2x per day  
AVOID – Activities that would involve collisions or risk impact to the head |

<table>
<thead>
<tr>
<th>Step 4</th>
<th>Aim</th>
<th>Non-contact training drills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal</td>
<td>Increased exercise, coordination, and thinking</td>
<td></td>
</tr>
</tbody>
</table>
| Activity | DO - Cooperative training drills with team-mates  
DO - Full physical conditioning and exertion including resistance training  
AVOID - Body or head contact. This includes heading drills (soccer), diving/blocking (volleyball), aerials (gymnastics/cheer)  
AVOID - Drills that have an offense vs defense component (due to the risk of contact and/or re-injury) |

Full Return to Learn Complete  
Medical Clearance BEFORE a full return to sport

<table>
<thead>
<tr>
<th>Step 5</th>
<th>Aim</th>
<th>Full contact practice</th>
</tr>
</thead>
</table>
| Goal   | Restore confidence in the athlete and coach  
Assess functional skill |
| Activity | DO - Participate in full practice and normal training activity |

<table>
<thead>
<tr>
<th>Step 6</th>
<th>Aim</th>
<th>Return to Sport</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal</td>
<td>Normal Game Play, starting with scrimmages with teammates and working up to regular competitive games.</td>
<td></td>
</tr>
</tbody>
</table>

Referrals  
Level 1: Routine Follow Up with Primary Care Providers  
If they have not returned to pre-injury status (i.e. if they have concussion-related symptoms) after 7 to 10 days, we strongly suggest they follow-up with their primary care provider.  
- General Practitioner (GP), Family Medicine (FM), Pediatrician and/or Sport Medicine (SM) doctor (for competitive athletes)  
  - At least within the first 7 to 10 days’ post-injury  
  - Follow-up assessment before returning to contact sports
Medical clearance should be sought out before returning to contact play. Clearance should be provided by GP/FM/Pediatricians/SM experienced with concussion care.

- If not experienced/confident in providing clearance, primary care physicians should refer the patient to concussion clinic/multidisciplinary rehabilitation centre/SM.

- If patient doesn’t progress through return to play within 27 days after injury, the patient should be encouraged to return for follow up care.

**Level 2: Follow Up for Persistent Symptoms**

For persistent symptoms 28 days or more post injury, the child/adolescent needs to be sent to a SM specialized clinic, headache clinic or multidisciplinary rehabilitation centre with providers and/or specialists with expertise in managing concussion, SM, Pediatrician, Pediatric Neurologist, Physiotherapist.

- Referrals should be made to a health care provider experienced with concussion recovery management or to a health care provider who knows the patient’s previous medical history.
  - When the recovery pattern is atypical: i.e. headaches not diminishing in severity or frequency, or lasting longer than 2 weeks, see family physician/pediatrician to provide pharmacologic intervention and possible referral to a pediatrician or headache specialist (e.g. pediatric neurologist) for management.
  - If stuck within a recovery step for more than a week or persistent symptoms > 28 days, warrants referral to clinics with experience in treating concussions for further management.

**Level 3: Follow Up Referral to Sub-Specialties**

For specific symptoms, referral to other subspecialties (i.e. complex concussion clinic, sleep clinic, occupational therapy, physiotherapy, psychiatry, psychology, endocrinology, neuropsychology, educational psych. (via school services), etc.)

- Dizziness - Vestibular and cervical rehabilitation may be of benefit in decreasing persistent symptoms of dizziness and improving function. These therapies have been shown to benefit recovery when initiated within 10-14 days of injury. This form of rehabilitation should be performed by physiotherapists or other HCPs with expertise in this area as it relates to concussion.
- Neck pain - Cervical therapies may be of benefit in decreasing persistent symptoms of neck pain and headache of a cervical nature. These therapies have been shown to benefit recovery when initiated within 10-14 days of injury. This form of rehabilitation should be performed by physiotherapists or other HCPs with expertise in this area as it relates to concussion.
- Headaches - Headaches lasting longer than two weeks. Encourage the child / adolescent to see family physician/pediatrician to provide pharmacologic intervention and possible referral to a pediatrician or headache specialist (e.g. pediatric neurologist) for management.
- Sleep disturbance – Any sleep concerns/disturbances should be referred to the primary care physician/pediatrician. Referral to sleep clinic may be indicated.
- Cognitive complaints - Evaluation by neuropsychology/educational psych may assist in determining cause and management plan for persistent cognitive difficulties > 3 months’ post injury. Management may involve symptom control or more formal adjustments to school programming.
- Mood concerns - Children may have elevated anxiety after injury but not long term. Mood disorders persisting for 3 months should be evaluated as any other mood disorder. Those reporting 6 months after injury, may have a new onset of disorder (i.e. anxiety disorder).
Patient education/Discharge Instructions

Pamphlets

- “Kids – Concussions & Head Injuries” and “Concussion in Children – Returning to School and Sport” (Appendix H)

Web Links

https://myhealth.alberta.ca/Alberta/Pages/Concussions-in-Children-Care-Instructions.aspx
https://myhealth.alberta.ca/Alberta/Pages/Returning-to-School-and-Sport.aspx
HEAL Health Education and Learning: Head Injury
MyHealth.Alberta.Ca: Stress in Children and Teenagers
MyHealth.Alberta.Ca: Stress and Youth
**Name of Order Set: Minor Head Injury/Concussion ED/UCC Pediatric**

**Order Set Requirements:** Age, Weight  
**Order Set Keywords:** Head Injury, Concussion, Loss of Consciousness

*Blood work, CT, MRIs and neuropsychology assessments are not routinely ordered in the diagnosis of concussion.*

*The majority of patients with minor head injuries do not require ANY imaging. If considering imaging please refer to the clinical decision rules linked below and under the Computed Tomography header.*

Consider diagnostic imaging if:  
- Glasgow Coma Scale (GCS) less than 15  
- Signs of skull fracture, cervical spine and other orthopedic injuries  
- Altered mental status (agitation, somnolence, slow response, repetitive questions)  
- Vomiting (4 or more episodes)  
- Scalp hematoma (excluding frontal)  
- History of loss of consciousness  
- Severe headache (not acting normal per parent)  
- Severe mechanism of injury (fall more than 3 feet or 5 stairs, motor vehicle accident with ejection/rollover/fatality, bike/pediatric patient vs vehicle without a helmet, high impact injury to head)

Referrals to specialists are not required for most children with concussion.

**SCAT for Sports Related Injury:** [https://bjsm.bmj.com/content/bjsports/early/2017/04/26/bjsports-2017-097506SCAT5.full.pdf](https://bjsm.bmj.com/content/bjsports/early/2017/04/26/bjsports-2017-097506SCAT5.full.pdf)

**5P rule:** [www.5Pconcussion.com/en/scorecalculator](http://www.5Pconcussion.com/en/scorecalculator) to triage higher likelihood of requiring Specialist follow up.

**Diet and Nutrition**

- **NPO**  
  - Frequency: Effective Now  
  - NPO Except:  
    - Ice Chips  
    - Sips with meds  
    - Sips of clear fluids  
    - Other (specify)  
  - Diet Comments:

- **Pediatric Diet Options** *(configuration note: age range of patient defaults in each order item)*  
  - Pediatric Diet – Regular Diet  
  - Pediatric Diet – Clear Fluids  
  - Pediatric Diet – Full Fluids  
  - Pediatric Diet – Balanced Fluids  
  - Pediatric Diet – Diabetic Diet  
  - Pediatric Diet – Metabolic Diet  
  - Pediatric Diet – Ketogenic Diet
Patient Care

Precautions and Safety

☐ Spinal Motion Precautions
  ☐ Type (Full, Cervical, Lumbar, Thoracic):______________
  ☐ Log Roll
  ☐ Do Not Turn

Vital Signs

****************************************************************************************************
~Start of ED Vital Signs Order Panel

☐ Vital Signs: These orders need to be re-evaluated when the patient stabilizes or by two hours, whichever occurs first.
  ☐ frequency as per Assessment and Reassessment of Patient Practice Support Document
  ☐ every ______ hourly
  ☐ every ______ minute(s)
  ☐ Continuous cardiac monitoring

☐ Neurological Vital Signs: Notify physician if Glasgow Coma Scale drops 2 or more points below the baseline score
  ☐ frequency as per Assessment and Reassessment of Patient Practice Support Document
  ☐ every ______ hourly
  ☐ every ______ minute(s)

~End of ED Vital Signs Order Panel
****************************************************************************************************

Notify

☑ Notify physician if:
  • Glasgow Coma Scale (GCS) decreases by 2 points,
  • irritability
  • severe or worsening headache
  • vomiting
  • change in focal neurologic signs

Blood work, CT, MRIs and neuropsychology assessments are not routinely ordered in the diagnosis of concussion

Laboratory Investigations Stat

Coagulation
For any patient with known bleeding disorder
☐ PT INR
☐ PTT

Urine Tests
For patients greater than 12 years old, if considering imaging and patient is unable to give history of last normal menstrual period (LNMP).

- Pregnancy Test, Urine - POCT

Diagnostic Imaging

If a pediatric patient requires a CT head, skull radiographs are unnecessary. If you are considering a skull radiograph, consultation with a pediatric centre is recommended to avoid unnecessary radiation exposure.

General Radiology

- GR Cervical Spine, Reason for exam: Suspected cervical injury

Computed Tomography

The Canadian Assessment of Tomography for Childhood Head Injury 2 (CATCH2) Rule

CT of the head is required for children with minor head injury* and any 1 of the following findings:
- Glasgow Coma Scale (GCS) score less than 15 at 2 hours after injury
- Suspected open or depressed skull fracture
- History of worsening headache
- Irritability on examination
- Any sign of basal skull fracture*
- Large, boggy hematoma of the scalp
- Dangerous mechanism of injury*
- Greater than or equal to: 4 episodes of vomiting

* Minor head injury is defined as injury within the past 24 hours associated with witnessed loss of consciousness, definite amnesia, witnessed disorientation, persistent vomiting (greater than 1 episode) or persistent irritability (in a child aged less than 2 years) in a patient with a GCS score of 13–15.

* Signs of basal skull fracture include hemotympanum, raccoon eyes, otorrhea or rhinorrhea of the cerebrospinal fluid, and Battle sign.

* Dangerous mechanism is a motor vehicle crash, a fall from elevation greater than or equal to 3 ft (greater than or equal to 91 cm) or 5 stairs, or a fall from a bicycle with no helmet.

Our bootstrap analysis (1000 replications) for the CATCH2 rule using the derivation data had a sensitivity of 100% (95% CI 100%–100%) and a specificity of 35.6% (95% CI 34.0%–37.1%) for neurosurgical intervention, whereas the sensitivity for brain injury on CT was 99.4% (95% CI 97.9%–100%) and the specificity was 36.9% (95% CI 35.2%–38.4%).

The potential impact of the rule was assessed by comparing the CT rate according to the CATCH rule to the actual clinical practice of the physicians at the 9 sites. For the 4060 enrolled patients, the CT rate according to the CATCH rule was 43% and the CT ordering rate by the physicians was 35%. Using the CATCH2 rule, the CT ordering rate would be 55%.

One case of brain injury would have been missed using the CATCH2 rule. This was an adolescent whose occiput struck the ground after a tackle. The patient had loss of consciousness for 2 minutes.


Pediatric NEXUS is less widely validated than PECARN.

CATCH 2 study: [https://www.cmaj.ca/content/190/27/E816](https://www.cmaj.ca/content/190/27/E816)


- CT Head, Reason for exam: for suspected intracranial injury
- CT Cervical Spine, Reason for exam: for suspected spinal injury

**Magnetic Resonance**
- MR Brain, Reason for exam: for suspected intracranial lesion or spinal injury

**Other Tests**

**Cardiology**
- Electrocardiogram – 12 Lead

**Medications**

**Analgesics and Antipyretics**

~Start of Pediatric Fever/Mild Pain Smart Group

- acetaminophen
  - acetaminophen (infants)
    - acetaminophen liquid (15 mg/kg/dose) _____ mg PO q4 for mild pain. Max 75 mg/kg/day, 1000mg/dose and 4 grams/day Max 5 doses in 24 hours
  - OR (linked order)
    - acetaminophen suppository (20 mg/kg/dose) _____ mg PO q4 for mild pain. Max 75 mg/kg/day, 1000mg/dose and 4 grams/day Max 5 doses in 24 hours
  - acetaminophen (children)
    - acetaminophen liquid (15 mg/kg/dose) _____ mg PO q4 for mild pain. Max 75 mg/kg/day, 1000mg/dose and 4 grams/day Max 5 doses in 24 hours
    - OR (linked order)
acetaminophen chew tab (15 mg/kg/dose) _____ mg PO q4 for mild pain. Max 75 mg/kg/day, 1000mg/dose and 4 grams/day Max 5 doses in 24 hours

OR (linked order)
acetaminophen tab (15 mg/kg/dose) _____ mg PO q4 for mild pain. Max 75 mg/kg/day, 1000mg/dose and 4 grams/day Max 5 doses in 24 hours

OR (linked order)
acetaminophen suppository (20 mg/kg/dose) _____ mg PO q4 for mild pain. Max 75 mg/kg/day, 1000mg/dose and 4 grams/day Max 5 doses in 24 hours

☐ ibuprofen

Use caution in infants < 4 months. (Considered off-label use) and children with dehydration (as limited safety data are available for this group)

Usual max dose 400 mg per dose, with a daily maximum of 40 mg/kg/day or 2400 mg/day, whichever is less.

☐ ibuprofen (infants greater than 4 months)

ibuprofen liquid (10 mg/kg/dose)_____ mg every 6 hours as needed for mild pain, temperature greater than 37.5

☐ ibuprofen (children)

ibuprofen liquid (10 mg/kg/dose)_____ mg every 6 hours as needed for mild pain, temperature greater than 37.5

OR (linked order)
ibuprofen tablet (10 mg/kg/dose)_____ mg every 6 hours as needed for mild pain, temperature greater than 37.5

~End of Pediatric Fever/ Mild Pain Smart Group
******************************************************************************
Antiemetics

Ondansetron should be used as a single dose in most situations. Multiple doses, especially IV, can lead to QT prolongation.

**Ondansetron dose guidance:**
- 8-15 kg: 2 mg/dose
- Greater than 15-30 kg: 4 mg/dose
- Greater than 30 kg: 8 mg/dose

- □ ondansetron 0.8 mg/ml liquid oral (recommended dose 0.1 mg/kg/dose) _____ mg PO every 8 hours PRN for nausea/vomiting
- □ ondansetron tablet (recommended dose 0.1 mg/kg/dose) _____ mg PO every 8 hours PRN for nausea/vomiting
- □ ondansetron DISINTEGRATING tablet (recommended dose 2 mg)_____mg PO every 8 hours PRN for nausea/vomiting
- □ ondansetron oral disintegrating tablet (recommended dose 2 mg/dose) _____ mg PO every 8 hours PRN for nausea/vomiting

**Consults/Referrals**

Recommendation for return to play is to be seen by a physician or provider who can exam and provide clearance.

**Immediate Consults**
- □ Pediatric Inpatient Services/Hospitalist
- □ Neurosurgery
### Analytics – Outcome Measure #1

<table>
<thead>
<tr>
<th>Name of Measure</th>
<th>Provision of Concussion and Head Injuries Patient and Family Information Pamphlet at time of discharge.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
<td>Of the total number of patients presenting to the ED for concussion management, how many were provided the Concussion and Head Injuries Patient and Family Information Pamphlet at time of discharge.</td>
</tr>
<tr>
<td><strong>Rationale</strong></td>
<td>The Concussion and Head Injuries Patient and Family Information Pamphlet supports the teaching provided by the healthcare team and is a resource for patients diagnosed with concussion.</td>
</tr>
<tr>
<td><strong>Notes for Interpretation</strong></td>
<td>Patient Health Record to provide option for healthcare provider to document provision of information pamphlet.</td>
</tr>
</tbody>
</table>

### Analytics – Outcome Measure #2

<table>
<thead>
<tr>
<th>Name of Measure</th>
<th>Concussion repeated presentation to ED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
<td>Of the total number of patients presenting to the ED for concussion management, how many presented to the ED again for concussion management.</td>
</tr>
<tr>
<td><strong>Rationale</strong></td>
<td>Does availability of a provincial concussion clinical guidance tool kit decrease re-admissions and resource utilization?</td>
</tr>
<tr>
<td><strong>Notes for Interpretation</strong></td>
<td>Variation in complexity of patients, site capacity limitations. As well, access to primary care options (urgent care centers, family physicians, walk-in clinics) in a community vary and can contribute to significant variation in outpatient management and subsequent presentation to the ED, ultimately resulting in inpatient admissions.</td>
</tr>
<tr>
<td><strong>Cited References</strong></td>
<td>See knowledge topic reference list</td>
</tr>
</tbody>
</table>

### Analytics – Outcome Measure #3

<table>
<thead>
<tr>
<th>Name of Measure</th>
<th>Referrals for Concussion Management from the ED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
<td>Of the total number of patients presenting to the ED for concussion, how many patients were assessed using the Pediatric Concussion Risk Score and further followed by primary care or subspecialty provider.</td>
</tr>
<tr>
<td><strong>Rationale</strong></td>
<td>To ensure that every child meeting the moderate to high risk category from the Pediatric Concussion Risk Score Assessment is ensured a referral.</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Notes for Interpretation</strong></td>
<td>The usage of the AHS Concussion Assessment Evaluation tool for pediatrics will have documented Pediatric Concussion Risk Scores and recommendations for follow up.</td>
</tr>
<tr>
<td><strong>Cited References</strong></td>
<td><em>See knowledge topic reference list</em></td>
</tr>
</tbody>
</table>
Appendix A: Symptom Recognition

**Grading Concussion Severity**

There continues to be considerable debate about the stratification of concussion severity, and differentiating between the terms “concussion” and “mild traumatic brain injury” (mTBI / mild TBI). As a result, there are several grading systems that use loss of consciousness and amnesia as their primary determinants of the severity of the concussion or mild TBI. To aid in diagnosis and management for clinicians and other healthcare providers, this document considers all non-sports- and non-recreation- related concussions as a part of the mild traumatic brain injury (mTBI) spectrum, but on the milder end. Whereas, sports- and recreation- related concussions are placed slightly higher on this spectrum because of the risk of repeated concussion and sub-clinical concussive events, which are largely explored in scientific literature. However, there is no added value to grading the severity of a concussion / mild TBI itself (mild, moderate or severe; Level 1, 2 or 3; Grade I, II, III a or III b; AAN Grade 1, 2 or 3; ACRM & DSM-IV Type 1, 2 or 3), and grading will not change the treatment recommendations outlined in this document. As such, the broad term of ‘concussion’ to describe the assessment and management of this type of injury.

**Concussion Symptom Reporting**

The impaired neurological function observed is usually of rapid onset. However; in some cases signs and symptoms may evolve over a number of minutes to hours, creating considerable debate about the minimum number of symptoms required to satisfy criteria for neurological impairment, and also around delayed onset of symptoms (Table 1. Possible Concussion Symptoms). Self-reporting of symptoms is an appropriate assessment tool if such history is consistent with the injury event and / or subsequent alternations in neurological status. It is also reasonable in clinical practice to assume onset of symptoms within two or three days post injury, and that symptoms are likely expected to resolve on their own in the next week or two. Retrospective reports with symptom checklists / inventories (PSCI- C, PSCI-Y, PSCI-P or HBI) are useful in monitoring acute concussion symptom resolution in comparison to the pre-injury condition and functioning of the child / adolescent, and may also be useful in reducing parental concern. Discussing anticipated symptoms and the duration (even the possibility of a delayed recovery) is a key component in normalizing symptoms and expected outcomes as the majority of children return to pre-injury functioning within 27 days post injury.

**Goals of Post-Concussive Assessment**

The primary goals of acute post-concussive evaluations are to rule out complicated / modified mild or moderate traumatic brain injury, and to determine if there are changes in a child’s functioning compared with their pre-injury functioning. Assessment with children must be framed within the context of differences in neural development, physical, cognitive, behavioral and emotional maturation and influences of home, school and community supports and demands on the child. The collection of this information facilitates individualization of current recovery guidelines.

**Concussion Assessment and Evaluation**

Within the initial minutes to hours after an injury, the history and examination is focused on immediate resuscitation and thorough evaluation followed by performing focused neurological assessment emphasizing on neurological deficits, cervical spine status, and mental status. In some instances, a person with a concussion may look very unwell initially. Higher energy injuries, children with loss of consciousness, recurrent vomiting, high number and severity of acute symptoms, seizures, focal neurological and / or atypical features should be seen in the Emergency Department. Regardless of the apparent initial condition (even precautionary visits), once the injured patient has been stabilized, a history and physical examination focusing on neurologic abnormalities should be obtained. A description of the injury including cause and severity provides information about its nature and potential complications requiring prompt interventions. Clear documentation of the mechanism of injury, reporting of symptoms, and pre-injury functioning will guide clinicians in ruling out more severe injuries / mimickers of concussion, as well as directing ongoing and future recommendations for the child / adolescent.
Red Flags and Danger/Warning Signs
Red flags and concussion danger/warning signs include
• Complaints of neck pain,
• Increasing confusion or irritability,
• Repeated vomiting (>3 episodes),
• Seizure or convulsion,
• Weakness or tingling (paresthesia),
• Decreased coordination,
• Deteriorating conscious state (including fainting, drowsiness, significant decline in alertness, inability to wake from sleep, any prolonged loss of consciousness),
• Severe or increasing headache not subsiding with rest or medication,
• Unusual behavior change,
• Double vision,
• Incoherent speech (slurred),
• Discharge of clear, colorless, serous-like fluid from the nose or ears,
• Bloody discharge from the ears,
• Unequal pupil size

For Toddlers/Infants - any of the above signs or symptoms, plus
• persistent crying and cannot be consoled
• not nursing or eating

Risk / Modifying Factors
The presence of pre-existing medical conditions and / or particular post-injury signs and symptoms are associated with more complex concussion management and can influence the clinical interpretation, intended investigations and subsequent management. These risks and modifying factors (Appendix E) may predict the potential for prolonged or persistent symptoms and should be considered in detail during evaluation. Also, it is important to consider factors that might make the evaluation more difficult including:
• Alcohol and / or illicit drug use may mask the symptoms of concussion.
• Athletes and players may not report concussive symptoms as they often feel the injury itself is not serious enough to warrant reporting.
  • As well, athletes are motivated to return to play so they may downplay symptom reporting (despite actually experiencing symptoms).
• Children with intracranial injuries do not always display signs or symptoms, making physical and neurological examination alone inadequate predictors of injury.
• Pre-existing learning difficulties and attention disorders may make acute evaluation difficult and influence outcome.
• Presence of more overt physical injury (i.e. orthopedic or spinal cord injuries), may mask the initial symptoms of a concussion.
• Young, scared or children in pain may not be fully aware or able to articulate their symptoms clearly

General Examination
A general physical examination and neurological examination are recommended with a focus on level of consciousness and behavior, the skull, the neck, focal neurological signs, and balance. The presence of neurological signs and symptoms (i.e. persistent abnormality in level of consciousness or GCS, suspicion of an open or
Depressed/basal skull fracture, worsening headache, irritability, large boggy hematoma, or a dangerous mechanism of injury) are risk factors for a more serious injury and may warrant further investigations with CT or MRI. Healthcare providers should use validated clinical decision rules (like PECARN, CATCH (Canadian Assessment of Tomography for Childhood Head Injury) rule, or Canadian CT Head Rule for children over 16 years of age) to identify children at risk for intracranial injury.

Existing decision rules combine a variety of risk factors:

- Age less than 2 years old,
- Repeated vomiting,
- Length of LOC,
- Severe mechanism of injury,
- Severe/worsening headache,
- Amnesia,
- Non-frontal scalp hematoma,
- GCS <15,
- Clinical suspicion for skull fracture.

In instances where CT or MRI imaging modalities are not available, validated clinical decision rules are useful in determining to transfer to more equipped facilities / centers. Likewise, neck injury may be concurrent with a concussion, specific evaluation for a significant neck injury may also be performed, including C-spine evaluation and x-rays of the neck.

**Aids for Recognition and Management**

**Indications for Use**
The scoring attained from a single / various concussion recognition tools and / or symptom checklists should not be used as a stand-alone decision about a child / adolescents’ readiness to return to school or competitive play after a concussion. As signs and symptoms may evolve over time, it is important to consider repeat evaluation in the acute assessment of concussion and recommend follow-up visit with the primary healthcare provider within 7-10 days after the injury. Medical clearance to return to full physical activity and competitive play (with risk of head/body contact) is required from a healthcare provider experienced in concussion management and only after the child/adolescent has returned to full schooling activities.

**Tools**
Depending on the setting of the evaluation, the following tools are useful to aid in clinical gestalt and suspicion of concussion by medical professionals:

- Use validated clinical decision rules (like PECARN, CATCH (Canadian Assessment of Tomography for Childhood Head Injury) rule, or Canadian CT Head Rule for children over 16 years of age) to identify children at risk for intracranial injury
- Child Sports Concussion assessment tool for children aged 5-12 (ChildSCAT5), Sport Concussion Assessment Tool for Athletes aged 13+ (SCAT5), Pocket Concussion Recognition Tool and/or Acute Concussion Evaluation (ACE-ED) or ACE-Office (in primary care office) tools may be used for assessment on the day of injury or the following day
- Post-concussion symptoms inventory (PSCI-C, PSCI-Y, PSCI-P), or Health and Behaviour Inventory (HBI) (Appendix I) can be used to assess pre- and post- injury functioning with post-concussive symptoms and be used to monitor the recovery process
- Balance Error Scoring System may be used as an objective measure to assess the effects of concussion on static postural stability and can be performed in nearly any environment. The information obtained from this
clinical balance tool can be used to assist a clinician’s decisions about return to activities when compared to previous assessments (at baseline, time of injury, etc). Should be used with a standardized symptom checklist/inventory.

- **Concussion clinical prediction rule** can assist with assessing the risk of prolonged or persistent symptoms with concussion
- Screening questions) for cognitive and visual problems
  - Routine use of computerized cognitive testing is not recommended for baseline or diagnostic testing purposes. In select cases, referrals can be made for cognitive testing and further management if needed.

- Routine laboratory investigations have little role in confirmation of the clinical diagnosis. However, any patient who is receiving anticoagulation therapy should undergo the appropriate tests to determine the level of anticoagulant effect.
  - Patients with a supra-therapeutic INR may develop a delayed CNS bleed despite an initially normal cranial CT.

**Cervical Spine Assessment and Management**

Risk factors for cervical spine injury: Reason for immobilization and radiographic evaluation

- Unconscious patient,
- Mechanism of injury suggestive of possible cervical spine injury:
  - High-speed motor vehicle crash,
  - Fall greater than body height,
  - Bicycle or driving collision,
  - Forced hyperextension injury,
  - Acceleration-deceleration injury involving the head,
- Neck pain,
- Focal neck tenderness or inability to assess neck pain secondary to a distracting injury,
- Abnormal neurologic examination findings (motor, sensory, reflex examination),
- History of transient neurologic symptoms suggestive of spinal cord injury without radiographic abnormality (i.e. weakness, paresthesia, or lightening / burning sensation down the spine / extremity or related to neck movement),
- Physical signs of neck trauma (i.e. ecchymosis, abrasion, deformity, swelling, tenderness),
- Unreliable examination secondary to substance abuse,
- Significant trauma to head or face,
- Inconsolable child.
Appendix B: Symptom Management

Symptom Management

- Discussing anticipated symptoms, expected duration (even the possibility of a delayed recovery) and strategies for managing concussive symptoms at home are key components in normalizing symptoms and expected outcomes. A large number of children return to pre-injury functioning within 7-10 days and the majority within 27 days post injury.

Refer to Table 1. Possible Concussion Symptoms

Cervical Spine Involvement/ Neck Pain

- The cervical spine may be injured secondary to trauma and is widely cited as a source of neck pain and headache in the whiplash literature. The upper three cervical segments have been reported as a source of cervicogenic headache. Many of the muscles in the cervical region also refer to the head and may be a cause of headaches and neck pain. A combination of manual therapy and exercise (specific exercises focusing on neuromotor control) has been shown to be more effective than passive modalities for individuals with neck pain.

- In the area of concussion, limited evidence is available that evaluates isolated cervical spine treatments. However, in a study of adolescents and young adults with symptoms of dizziness, neck pain and/or headaches for more than 10 days following concussion, treatment involving a combination of individualized multimodal physiotherapy (including vestibular rehabilitation and cervical spine treatment) showed improvement and was superior to routine care. Treatment components include a combination of individually selected treatments focused on head/eye/neck movement control including sensorimotor and neuromotor control in conjunction with manual therapy and soft tissue techniques as indicated.
Figure 3. Headache Management Algorithm for Acute Concussion Symptoms and Persistent Concussion Symptoms for use within Acute Care or Community Settings

- **Treat headache**
- **Complaint of Headache**
  - **No history of trauma**
  - **History of trauma**
    - **Post-Traumatic Headache**
      - **Determine Headache type and possible triggers**
      - **Cervicogenic headache**
      - **Other post-traumatic headaches**
      - **Migraine**
      - **Are headaches persisting?**
        - **Yes**
          - **Discontinue Ibuprofen / Acetaminophen**
        - **No**
          - **Decrease Ibuprofen or Acetaminophen to 3 x per week or less**
          - **Self-management with graduated aerobic activities**
          - **Pharmacologic Treatment: Naproxen or Ketorolac +/- Metoclopramide up to 3 times per week or less after the first two weeks**
          - **Referral to family physician or pediatrician**
      - **Referral to neurology, headache specialist, or concussion clinic**
      - **Return to family physician for reassessment (ED if no family physician)**

- **Acute Post-Traumatic Headache** (Less than 2 weeks post-injury)
- **Persistent Post-Traumatic Headache** (More than 3 weeks post-injury)
Headaches
Headaches can occur within minutes of a concussive event and up to 7 days after the event, and/or be aggravated by activity. A pre-injury history of headache (such as migraine) may or may not be present.

Pre-existing headaches often become worse after a concussion. Further, headaches with different characteristics from the pre-injury headaches can also occur.

The overarching approach to headaches after a concussion is to endorse the practice of good headache hygiene behavior. This includes regular sleep habits, healthy meals, hydration, and the management of stress. [Appendix D]

Medical management of post-traumatic headaches is determined by:
- Pre-injury headache diagnosis,
- Characteristics of the new headaches,
- Severity of the headaches,
- Length of the headache disorder,
- Management of comorbidities, especially anxiety and mood changes

Acute post-traumatic headaches (up to 27 days post injury)
- Usually Over-the-Counter analgesics such as ibuprofen or acetaminophen can be used to manage these headaches. In children it is important to ensure that analgesics are used with sufficient and correct dosing, and attention to daily maximums
  - ibuprofen (10 mg/kg/dose; Maximum 400 mg/dose) or
  - acetaminophen (15 mg/kg; Maximum 75 mg/kg/day, 1000 mg/dose AND 4 g per day whichever is less)
- Consider trial of analgesics with attention to not overuse analgesia over time
  - After 2 to 4 weeks, analgesics should be limited to 3 times or less per week to avoid medication overuse associated headache
  - For acute severe post traumatic headaches, ED treatment may include initiation of intravenous therapy of ketorolac alone, ketorolac/naproxen and metoclopramide combination, or ondansetron only
  - Sometimes, a short course of steroids may be tried although there is no evidence to support this treatment. It is recommended that these cases be discussed with a neurologist or headache specialist
  - The safety of triptans in the first week after a concussion has not been determined and are not recommended at this time **There have been no studies exploring these agents for the treatment of acute headache related to concussion in the ED (studies have examined their use and efficacy in children presenting with an acute exacerbation of a primary headache only)**
  - Optimize medical management of any pre-injury headaches (especially migraine)

Persistent Post-traumatic headaches (28 days or more post injury)
Most acute post-traumatic headaches settle by 4 weeks. However a significant number of children with concussion can have persistent headaches. These are frequently accompanied by other post concussive symptoms [Appendix G] and the presence of comorbidities such as anxiety and mood problems.
As with all headache disorders, management includes self-management strategies, avoidance of medication overuse and use of medical treatment (pharmaceutical and non-pharmaceutical).

The following are useful suggestions to help management:

- Identification of headache type
  - Cervicogenic headaches should initially be treated with physiotherapy and/or occipital nerve blocks
  - Recognise medication overuse associated headache and decrease analgesic use
- Identification of headache triggers
  - Exercise and weight-lifting exercises are known to exacerbate headaches. A gradual increase in aerobic activity as tolerated is recommended. Avoid weight-lifting where possible until back to full aerobic exercise.
  - Stress is a common trigger. Self-management tips on managing stress in youth are available through MyHealth.Alberta.ca. Referral to a school or mental health counsellor for further support may be needed.

- Optimizing pre-injury headache management, especially migraine management
- Goals of treatment should include improving function, reducing headache frequency, reducing the progression to chronic daily headaches and lessening associated comorbidities
- Referral to a headache specialist or pediatrician is often required

Preventative treatments

- Useful for children/adolescents with a history of headaches and/or migraine. The main goal is to break the pain cycle with acute pain medications and provide a referral to a specialist (i.e. pediatric neurologist) for follow-up care.
- Possible medications that could be used include TCAs (amitriptyline and nortriptyline), beta-blockers (propranolol), melatonin and magnesium, antiepileptic (topiramate, valproic acid, gabapentin and zonisamide). Prescribing of these medications should be done in consultation with a pediatrician, pediatric neurologist and/or headache specialist
Dizziness/Balance

Figure 4. Dizziness/Balance Symptom Management for Acute Concussion Symptoms and Persistent Concussion Symptoms. For Use in Acute Care and Community Settings

Dizziness is a commonly reported symptom following concussion. What children mean by dizziness is variable. For some it may mean lightheadedness, nausea, spinning, disequilibrium or even blurred vision. Therefore, it is important to determine what is meant by dizziness and treat as appropriate. Balance alterations as measured by static balance tests may occur in a significant number of children, but often will get better without specific intervention over the first 10 days. Recently, longer lasting balance disturbance has been reported as measured through dynamic balance, gait and dual task methods.

- It is not recommended to avoid movement or mild aerobic activity because of dizziness or balance problems.
- Orthostatic symptoms of light-headedness or dizziness may respond to increased fluid and salt intake and light activity.
• Vertigo that is exacerbated by a change in head position is commonly seen in vestibular hypofunction and benign paroxysmal positional vertigo and often responds to appropriate vestibular rehabilitation and or specific maneuvers.
• Nausea and vertiginous dizziness often co-occur with migraine like headache.
• Dizziness or balance problems associated with neck pain may respond to treatment with specialized physiotherapy (see Cervical spine involvement/ neck pain).

If symptoms persist beyond 4 weeks, clinical investigation for vestibular dysfunction may be warranted.
Cognitive Symptoms

Figure 5. Concentration and Attention Symptoms for Acute Concussion Symptoms and Persistent Concussion Symptoms. For Use in Acute Care and Community Settings

- Complaints of difficulties with attention, memory, learning, reduced response speeds and/or executive function identified
  - Rest for 1-2 days
  - Begin light cognitive activities; follow steps outlined in the “Return to Learn” activity guidance
  - Are the symptoms persisting?
    - NO
      - Start introducing light aerobic exercises and follow the steps outlined in the “Return to Play” guidance
    - YES
      - See family physician or pediatrician; consider implementing a “temporary” individualized education plan to assist the child in returning to full days at school
      - +/- Psychological support
      - +/- Referral to concussion specialist (if stuck in a single recovery step of the “Return to Learn” guidance for greater than 1 week)

- (1 to 3 weeks post-injury)

- (Greater than 4 weeks post-injury)
  - See family physician or pediatrician; consider treating headaches, sleep and mood disturbances as these can contribute to the cognitive difficulties
  - +/- Referral to a concussion specialist (e.g. brain injury rehabilitation clinic, educational psychology, or neuropsychology)
  - Mood disturbances: Determine underlying cause (e.g. anxiety, depression, personality change disorders, PTSD, ADHD, substance abuse)
  - Persistent Post-Traumatic Headache: Follow the management algorithm
  - Sleep disturbances: Encourage good sleep hygiene practices
  - +/- Sleep aid (e.g. melatonin, amitriptyline, or short-term non-benzodiazepine sedative)
  - +/- Behavioural modification (e.g. cognitive behavioral therapy)
  - Selective serotonin reuptake inhibitor
  - +/- Behavioural modification (e.g. cognitive behavioral therapy)
  - +/- Referral to psychiatrist
Acute Treatment (< 27 days post injury)

- Supporting the child/adolescent as they return to schooling activities is key.
- Families and their children should be encouraged to talk to the school before the child returns.
- “Return to School” guidelines.
- Individualized Support Plan (ISP) is appropriate if the child is struggling to return to school as a full time student.
- The ISP provides temporary learning accommodations/modifications if child is struggling with complaints of attention, memory and learning difficulties, slower response speed and aspects of executive function.
- When possible, exemptions can be made so that the student doesn't have to “catch up” on all assignments or work missed, instead prioritize key areas or projects to work on (such as in-school work and assignments).
- Open communication between children/adolescent and their caregivers (parent, teachers and coaches) is encouraged, as many fear about failing at school and feeling left out.
- Sometime psychological support is necessary to aid in helping cope with these emotional difficulties.

Persistent Cognitive Difficulties (Symptoms greater than 3 months post injury)

- Persistence of neuropsychological impairment (difficulties with attention, memory and learning, response speed and aspects of executive function) after concussion is still debated.
- There is little evidence that the disruption in cognitive processes is related to the pathology of concussion injury.
- WHEN cognitive difficulties are suspected, sleep, headaches and mood disturbances should be addressed first, as these can all influence cognitive performance.
- If cognitive difficulties appear related to symptoms, like headache, fatigue, poor sleep – treatment should be directed towards specific complaints:
  - Headache reduction;
  - Sleep disturbance – may benefit from corrected sleep hygiene +/- use of temporary sleep aids (melatonin/ amitriptyline/ short term non-benzodiazepine sedatives;)
  - Psychological support may be necessary in helping the child/adolescent cope with these emotional difficulties.
- Recommend a gradual return to activities similar to the ones used during the acute and sub-acute recovery periods.
- Extra time in examinations is not recommended for concussion except in an examination that takes place within a month of injury. Cognitive studies show cognitive functioning returns to baseline levels within 1 to 2 weeks post injury.
- Sometimes accommodation in examinations are warranted if anxiety or mood disorders are present.
- Occasionally, neuropsychological/educational psychology evaluations can assist in determining causation and management plans but is not routinely available. Educational psychology evaluations are performed through the school systems but do not always appropriately assess or determine objective negative sequelae of concussion. Neuropsychology evaluations are available privately in the community. Limited resources for neuropsychological evaluations through the hospital services are performed on a case by case basis through brain injury rehabilitation clinics.

Visual Symptoms
Concussion related visual complaints include blurred/double vision, eye fatigue, the appearance of words moving on the page, loss of place when reading, and difficulty sustaining attention on a visual task. Identification of visual problems is important because approximately 50% of the brain’s circuits are dedicated to vision as well as the visual demands of children/adolescents engaged in full-time school (due to widespread use of electronic interfaces).

- Common problems may be present before the concussive injury such as accommodative disorders and convergence insufficiency. Less commonly retinal or optic nerve injury, saccadic dysfunction, and vestibulo-ocular dysfunction may be seen.
- Eye examination and optometric examination is warranted
- Treatments:
- Treat any visual acuity deficits with spectacles
  - Convergence insufficiency may respond to short term interventions guided by appropriate professionals (e.g., vestibular physiotherapists, optometrists, ophthalmologists) experienced and knowledgeable in concussion management.
  - The value of oculomotor retraining (including use of prisms) in concussion has not be proven and is not recommended for routine use except under guidance from ophthalmology or neurology.
  - Specific school-based accommodations are usually not required for typically recovering children. In some children, short term accommodation such as frequent visual breaks, and preprinted notes and material may be useful. Accommodations such as oral teaching, audio-books, large-font printed material (vs. small font electronically displayed material) are usually not required unless with guidance from an ophthalmologist, pediatrician or neurologist.
- Often a referral to a concussion specialist or eye-care professional is needed for a comprehensive visual and oculomotor evaluation beyond visual acuity testing, and for possible treatment of accommodation, binocular vision, and eye movements.
  - Accommodative complaints – spectacle correction for near-sighted, oculomotor training (short-term).
  - Convergence insufficiency – base in prism, near convergence exercises with in-office/home based programs, oculomotor training.

Mood Symptoms

- Mood changes and anxiety can be common during recovery from a concussion. Many children worry about failing at school, not being active, or feeling left out. These feelings may make symptoms worse (especially headaches and attention and concentration) and prolong recovery.
- Best practice recommendations emphasize the importance of providing social support to improve quality of life and reduce effects of stressors on a child / adolescent’s health. Such supports include:
  - Emotional guidance (empathy, love, trust, and caring) by caregivers (from parents/guardians, teachers, coaches, friends),
  - Informational guidance and appraisal (constructive feedback and positive affirmations), and provision of tangible aids/services directly assisting needs of the child/adolescent
    - School accommodation letters
    - Counselling services
- Social isolation has been identified as a risk of poor recovery and should be avoided during the recovery process. To avoid this situation, early return to scholastic pursuits is recommended. Post injury return to school guidelines can guide this process and should include return to half days of schooling (ideally the morning half and stay over the lunch hour). They can participate in school work during this time, and interaction with friends and peers should be encouraged.
• If the child/adolescent is currently seeing a specialist/healthcare provider for mood and anxiety related symptoms pre-injury, encourage a follow-up visit with them to keep the lines of communication open.

• Be aware of avoidant behaviors (feeling socially inept, reluctance to being involved with people, unwilling to try because the task may prove to be embarrassing), these are often associated with anxiety and should not be encouraged. Where there is avoidant behavior, it is helpful to have a psychologist or counsellor involved in the care.

Other Symptoms

The following symptoms may occur but are not commonly seen in children with concussions:

- Tinnitus ([Evidence Summary](#))
- Endocrinopathies ([Evidence Summary](#))
Appendix C: Role of Diagnostic Imaging

CT or MRI of the Head

Neuroimaging is not warranted unless indicated by “red flag” symptoms and clinically suggestive focal neurological findings. Routine CT or MRI scans contribute little to concussion evaluation and should be employed only when an intra-cerebral or structural lesion is suspected or in presence of red flags. A CT may be considered to rule out intracranial injury (i.e. intracranial bleed) in the presence of:

- Persistent abnormality in level of consciousness or GCS less than 15,
- Suspicion of an open or depressed skull fracture,
- Worsening headache,
- Irritability on examination,
- Signs of a basal skull fracture,
- Large boggy hematoma,
- A dangerous mechanism (e.g. motor vehicle collision, fall from bicycle while not wearing a helmet, or fall from a height of 3 feet or 5 stairs)

Health care providers should use validated clinical decision rules to identify children at low risk for intra-cranial injury, in whom head CT is not indicated, as well as children who may be at a higher risk for clinically important intra-cranial injury, and therefore may warrant head CT. Existing decision rules combine a variety of risk factors, including:

- Age less than 2 years old,
- Repeated vomiting,
- Loss of consciousness,
- Severe mechanism of injury,
- Severe or worsening headache,
- Amnesia,
- Non-frontal scalp hematoma,
- GCS less than 15,
- Clinical suspicion for skull fracture

In the instance where CT is not available, validated clinical decision rules are better than skull x-rays when screening patients with increased risk for intra-cranial injury and determining to transfer to other facilities.4

X-Ray of the Skull

Skull x-rays should not be used in the diagnosis of pediatric concussion or in the screening of intra-cranial injuries. Neuroimaging modalities, such a head CT, better detects intracranial injuries, thus making it the more appropriate diagnostic imaging choice when imaging is clinically indicated to assess for acute TBI. 5

Imaging Techniques in Development

Neuroimaging Studies for Acute and Persistent Concussive Symptoms

Recent neuroimaging studies have shown the use of special sequences like susceptibility weighted imaging, functional magnetic resonance imaging, and diffusion tensor imaging to detect abnormalities. However, current standard of care does not support the use in routine clinical practice of specialized MRI imaging sequences (i.e. fMRI, DTI) that have shown promise in research settings.4

Single-photon Emission Computed Tomography (SPECT)

Not used commonly in a clinical setting as it may require sedation and is costly.
## Appendix D: Headache Control

Table 2. Headache Control Tips for Patients and Families.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keep a headache diary</td>
<td>Identify headache triggers and the course of each headache</td>
</tr>
<tr>
<td>Get regular sleep</td>
<td>Go to bed and wake up at regular times each day</td>
</tr>
<tr>
<td></td>
<td>Do not sleep excessively on weekends and too little on weekdays</td>
</tr>
<tr>
<td>Eat nutritional, regularly spaced meals</td>
<td>Low blood sugar can trigger a headache</td>
</tr>
<tr>
<td></td>
<td>Eat regular meals three times a day including protein, fruits, vegetables and carbohydrates</td>
</tr>
<tr>
<td></td>
<td>Too much sugar may lead to a rapid increase in blood sugar followed by a rapid decline in blood sugar which can trigger a headache</td>
</tr>
<tr>
<td>Get moderate amounts of routine exercise</td>
<td>Moderate exercise will help reduce stress and keep you physically fit</td>
</tr>
<tr>
<td></td>
<td>Too much exercise or inconsistent patterns of exercise may trigger headache</td>
</tr>
<tr>
<td>Drink plenty of water</td>
<td>Dehydration may cause headaches</td>
</tr>
<tr>
<td>Limit caffeine, alcohol and other drugs</td>
<td>Caffeine is a stimulant.</td>
</tr>
<tr>
<td></td>
<td>Caffeine withdrawal may cause headaches when blood levels of caffeine taper</td>
</tr>
<tr>
<td></td>
<td>Alcohol may be a trigger for headaches</td>
</tr>
<tr>
<td>Reduce stress</td>
<td>Stress may lead to an increase in headache</td>
</tr>
<tr>
<td></td>
<td>Relaxation and stress management may help reduce headaches</td>
</tr>
<tr>
<td></td>
<td>Regularly set aside time for personal relaxation and stress reduction</td>
</tr>
<tr>
<td>Manage chronic headaches</td>
<td>Treat acute attacks of migraine early and aggressively</td>
</tr>
<tr>
<td></td>
<td>Avoid overuse of symptomatic medication</td>
</tr>
<tr>
<td></td>
<td>If you require prevention/suppression therapy, give the specific therapy time to be effective</td>
</tr>
<tr>
<td></td>
<td>If you suffer from a migraine “co-morbidity,” such as chronic insomnia, anxiety, depression, or other medical problems, seek treatment for that condition</td>
</tr>
</tbody>
</table>
Appendix E: Risk/Modifying Factors

The following “Risk/ modifying factors” can influence the clinical interpretation, intended investigations and management of a case of concussion/mild traumatic brain injury. In some instances, these factors may predict the potential for prolonged or persistent symptoms and should be considered in detail during evaluation.

<table>
<thead>
<tr>
<th>Category</th>
<th>Risk/ Modifying Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-existing conditions</td>
<td>Anxiety</td>
</tr>
<tr>
<td></td>
<td>Attention Deficit Hyperactivity Disorder (ADHD)</td>
</tr>
<tr>
<td></td>
<td>Depression</td>
</tr>
<tr>
<td></td>
<td>Learning difficulties (especially in early school years)</td>
</tr>
<tr>
<td>Past medical history</td>
<td>Migraine and exercise induced headache</td>
</tr>
<tr>
<td></td>
<td>Previous concussions especially with delayed recovery</td>
</tr>
<tr>
<td>Psychosocial history</td>
<td>Change of school</td>
</tr>
<tr>
<td></td>
<td>Loss of a family member/friend or pet</td>
</tr>
<tr>
<td></td>
<td>Previous stressful life events</td>
</tr>
<tr>
<td></td>
<td>Recent stressors and the child's reactions to these (i.e. conflicts)</td>
</tr>
<tr>
<td>Injury factors</td>
<td>Assault (associated with delayed recovery)</td>
</tr>
<tr>
<td></td>
<td>Litigation</td>
</tr>
<tr>
<td></td>
<td>Mechanism (i.e. high energy)</td>
</tr>
<tr>
<td></td>
<td>Severity of acute symptoms</td>
</tr>
<tr>
<td>Medication use</td>
<td>Alternative therapies</td>
</tr>
<tr>
<td></td>
<td>Analgesic use and/or overuse</td>
</tr>
<tr>
<td></td>
<td>Use of marijuana or illicit substances</td>
</tr>
<tr>
<td>Family history</td>
<td>Anxiety</td>
</tr>
<tr>
<td></td>
<td>Attention Deficit Hyperactivity Disorder (ADHD), learning disorder in 1st degree family</td>
</tr>
<tr>
<td></td>
<td>may support pre-existing diagnosis in child</td>
</tr>
<tr>
<td></td>
<td>Depression</td>
</tr>
<tr>
<td></td>
<td>Migraines, hemiplegic migraine</td>
</tr>
</tbody>
</table>
Appendix F: Differential Diagnosis of Concussion

Diagnosing concussions is based on clinical suspicion, acute injury characteristics and presenting signs and symptoms. However, to move towards an optimal, effective and individualized treatment plan, clinicians must use subjective reporting from the patient (and/or witnesses who saw the injury occur) and objective findings from their clinical examination. This is necessary to rule out other plausible underlying mechanisms which can have similar clinical presentations, such conditions include:

- Blunt neck trauma,
- Child abuse,
- Contusion of cerebrum,
- Delirium,
- Diffuse brain injury,
- Disturbance of consciousness,
- Encephalopathy,
- Epidural hematoma,
- Hypertensive encephalopathy,
- Hypoglycemia,
- Hypoxic-ischemic brain injury,
- Infectious disease of central nervous system,
- Intoxication,
- Intra-cerebellar and posterior fossa hemorrhage,
- Intra-parenchymal hematoma of brain,
- Neoplasm of brain,
- Poisoning by drug and/or medicinal substance,
- Post-concussion syndrome,
- Seizure,
- Skull fracture,
- Subarachnoid hemorrhage,
- Subdural hematoma,
- Syncope,
- Thromboembolic stroke
Appendix G: Pediatric Clinical Risk Score for Persistent Post Concussion Symptoms

- Use within 48 hours of concussion incident
- Complete an [ACE Assessment](#) or [SCAT5](#)
- Use the following chart to create a Pediatric Clinical Risk Score
- Before this score is adopted in clinical practice, further research is needed for external validation, assessment of accuracy in an office setting, and determination of clinical utility.

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Description</th>
<th>Points</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age group</strong> *</td>
<td>5 – 7</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8 – 12</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13 – 17</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td>Female</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Prior concussion and symptom duration</strong></td>
<td>Prior concussion AND</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Symptoms lasting ≥ 1 week</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Physician-diagnosed migraine history</strong></td>
<td>Yes</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Answering questions slowly</strong></td>
<td>Yes</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Balance Error Scoring System</strong></td>
<td>≥ 4 errors OR</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Tandem stance only</td>
<td>Physically unable to test</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Headache</strong></td>
<td>Yes</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Sensitivity to noise</strong></td>
<td>Yes</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Fatigue</strong></td>
<td>Yes</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Total Score</strong></td>
<td></td>
<td><strong>12</strong></td>
<td></td>
</tr>
</tbody>
</table>

* not applicable for children less than 5 years of age

- Anticipate recovery in 10 days < 3
- Follow up with primary health care provider or pediatrician 4 – 8
- Provide family with referral to neurology and/ or concussion specialist 9 – 12

[https://jamanetwork.com/journals/jama/fullarticle/2499274](https://jamanetwork.com/journals/jama/fullarticle/2499274)

Adapted from the original article by Codi Isaac PT
Appendix H: Patient Handouts – “Kids – Concussions and Head Injuries” and “Concussion in Children – Returning to School and Sport”

The patient handouts can be accessed through the following links:

https://myhealth.alberta.ca/Alberta/Pages/Concussions-in-Children-Care-Instructions.aspx

https://myhealth.alberta.ca/Alberta/Pages/Returning-to-School-and-Sport.aspx
Appendix I: Health and Behavior Inventory

Figure 6: Health and Behavior Inventory – Child Version

PARTICIPANT ID: ______________ DATE: __/__/_______ VISIT: ED B 3 12

HEALTH AND BEHAVIOR INVENTORY
(Child Version)

Directions: Below is a list of problems you may or may not have. For each problem, please rate yourself using the scale below based on the last week.

O = Never,  1 = Rarely,  2 = Sometimes,  3 = Often

1. I have trouble paying attention  0 1 2 3
2. I get distracted easily  0 1 2 3
3. I have a hard time concentrating  0 1 2 3
4. I have problems remembering what people tell me  0 1 2 3
5. I have problems following directions  0 1 2 3
6. I daydream too much  0 1 2 3
7. I get confused  0 1 2 3
8. I forget things  0 1 2 3
9. I have problems finishing things  0 1 2 3
10. I have trouble figuring things out  0 1 2 3
11. It’s hard for me to learn new things  0 1 2 3
12. I have headaches  0 1 2 3
13. I feel dizzy  0 1 2 3
14. I feel like the room is spinning  0 1 2 3
15. I feel like I’m going to faint  0 1 2 3
16. Things are blurry when I look at them  0 1 2 3
17. I see double  0 1 2 3
18. I feel sick to my stomach  0 1 2 3
19. I get tired a lot  0 1 2 3
20. I get tired easily  0 1 2 3
Figure 7: Health and Behavior Inventory – Parent Current Version

PARTICIPANT ID: _______________ DATE: ___/___/_______ VISIT: B 3 6

INFORMANT: MOM=1; DAD=2; GRANDMA =3; OTHER=4; SPECIFY: ________________

HEALTH AND BEHAVIOR INVENTORY
(Parent Current Version)

Directions: Below is a list of problems that your child may or may not have. For each problem, please rate your child based on the last week using the scale below.

<table>
<thead>
<tr>
<th></th>
<th>0 = Never, 1 = Rarely, 2 = Sometimes, 3 = Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>has trouble sustaining attention</td>
</tr>
<tr>
<td>2.</td>
<td>is easily distracted</td>
</tr>
<tr>
<td>3.</td>
<td>has difficulty concentrating</td>
</tr>
<tr>
<td>4.</td>
<td>has problems remembering what he/she is told</td>
</tr>
<tr>
<td>5.</td>
<td>has difficulty following directions</td>
</tr>
<tr>
<td>6.</td>
<td>tends to daydream</td>
</tr>
<tr>
<td>7.</td>
<td>gets confused</td>
</tr>
<tr>
<td>8.</td>
<td>is forgetful</td>
</tr>
<tr>
<td>9.</td>
<td>has difficulty completing tasks</td>
</tr>
<tr>
<td>10.</td>
<td>has poor problem-solving skills</td>
</tr>
<tr>
<td>11.</td>
<td>has problems learning</td>
</tr>
<tr>
<td>12.</td>
<td>has headaches</td>
</tr>
<tr>
<td>13.</td>
<td>feels dizzy</td>
</tr>
<tr>
<td>14.</td>
<td>has a feeling that the room is spinning</td>
</tr>
<tr>
<td>15.</td>
<td>feels faint</td>
</tr>
<tr>
<td>16.</td>
<td>has blurred vision</td>
</tr>
<tr>
<td>17.</td>
<td>has double vision</td>
</tr>
<tr>
<td>18.</td>
<td>experiences nausea</td>
</tr>
<tr>
<td>19.</td>
<td>gets tired a lot</td>
</tr>
<tr>
<td>20.</td>
<td>48. gets tired easily</td>
</tr>
</tbody>
</table>
Figure 7: Health and Behavior Inventory – Parent Retrospective Version

<table>
<thead>
<tr>
<th>PARTICIPANT ID: ______________</th>
<th>DATE: <em><strong>/</strong></em>/_______</th>
<th>VISIT: ED</th>
</tr>
</thead>
<tbody>
<tr>
<td>INFORMANT: MOM=1; DAD=2; GRANDMA =3; OTHER=4; SPECIFY: ______________</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**HEALTH AND BEHAVIOR INVENTORY**  
*(Parent Retrospective Version)*

**Directions:** Below is a list of problems that your child may or may not have had before the recent injury. For each problem, please rate your child based on the 4 weeks prior to the injury using the scale below.

O = Never, 1 = Rarely, 2 = Sometimes, 3 = Often

1. has trouble sustaining attention  
2. is easily distracted  
3. has difficulty concentrating  
4. has problems remembering what he/she is told  
5. has difficulty following directions  
6. tends to daydream  
7. gets confused  
8. is forgetful  
9. has difficulty completing tasks  
10. has poor problem-solving skills  
11. has problems learning  
12. has headaches  
13. feels dizzy  
14. has a feeling that the room is spinning  
15. feels faint  
16. has blurred vision  
17. has double vision  
18. experiences nausea  
19. gets tired a lot  
20. gets tired easily
Appendix J: References and Additional Reading


128. Ponsford 2001 - Impact_of_early_intervention_o.PDF.


160. Tsao JW. Rate of Persistent Postconcussive Symptoms Interventions for Anxiety and Depression in Conflict-Affected Areas. 2017;317(13).


Relevant Guidelines, Procedures, Protocols and Clinical Knowledge Topics

Clinical Knowledge Topic: Minor Head Injury, Adult – Emergency Department (Concussion)

Additional Guidelines

Physiotherapy Alberta College and Association: Concussion Management Toolkit
Parachute Canada: Concussion Information and Resources
BC Injury Research and Prevention Unit: Concussion Awareness Training Tool (CATT)
Centers for Disease Control and Prevention: Heads Up
Canadian Academy of Sport and Exercise Medicine
Appendix K: Clinical Questions & Recommendations

Clinical Questions help us to ask pertinent information about the knowledge topic in order to facilitate finding an evidence based answer that will guide decision making. Working groups have the option of identifying 2-3 key clinical questions. The questions chosen will then be prioritized using a Likert scale and evidence search strategy determined. Clinical questions may be formulated based on the PICO format as supported by Sackett and Guyatt in their User's Guide to the Medical Literature to define the clinical question. PICO-D format identifies the patient problem or population (P), intervention (I), comparison (C) and outcome(s) (O).


GRADE Methodology - Used to address quality of evidence and strength of recommendations of answers to the clinical questions. Whenever possible answers are identified from recent high quality guidelines or high quality systematic reviews and recommendations provided are based on GRADE definitions. Where guidelines or systematic reviews are not available to answer certain questions rapid reviews are undertaken and/or a consensus approach used to try to answer clinically relevant questions. Only where the evidence is supportive and the benefits clearly outweigh the harm is a “we recommend” strength of recommendation applied.

<table>
<thead>
<tr>
<th>Table 4. GRADE Quality of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>High GRADE A</td>
</tr>
<tr>
<td>Moderate GRADE B</td>
</tr>
<tr>
<td>Low GRADE C</td>
</tr>
<tr>
<td>Very low GRADE D</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 5. GRADE Strength of Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong GRADE 1</td>
</tr>
<tr>
<td>Weak GRADE 2</td>
</tr>
<tr>
<td>Insufficient evidence or no consensus</td>
</tr>
</tbody>
</table>

Clinical Question #1: In pediatric patients diagnosed with concussion, does a period of brain rest improve patient outcomes?

Clinical Recommendation #1: No evidence to support “absolute bed rest” to improve outcome after concussion.

Current guidelines, like the Ontario Neurotrauma Foundation guidelines (2014), advocate a conservative approach to return to activities (schooling and sport) once symptoms subside. However, recent evidence supports mild to moderate activities (active rehabilitation).

- Sustained rest may adversely affect the outcome following a concussion. Further, it can lead to physical deconditioning, loss of contact with peers, reactive depression, metabolic disturbances, etc.
- Patients can safely engage in controlled physical activity below the symptom threshold. This may be beneficial to the recovery process although more research is required.
- The 2017 Berlin consensus statement recommends that patients should rest for up to 24-48 hours after injury. This is considered reasonable and is followed by simultaneous re-integration into school physical activity. Full return to competitive and sport is meant to follow a step-wise process with a minimum of 24 to 48 hours per step. Both cognitive and physical loads are increased simultaneously, with contact activity occurring after full return to academics is complete.

Different activities may make symptoms worse for different people. Discuss with patient and family the child / adolescent's regular activities and determine an individualized approach to returning to those activities.

- Rest for 24 to 48 hours post injury at home. Physical and cognitive activity should be minimized in the initial 24-48 hours following a concussion. Gradual reintroduction of activities of daily living that do not provoke/increase symptoms (including walking) can be introduced following this initial period of relative rest. Currently there is no evidence to support keeping a child / adolescent in a dark room and restricting them from all activity until symptom-free. If this is done it may cause chronic fatigue, pain and other related psychiatric/neurological impairments.
  - A gradual return to physical activity is encouraged along side gradual return to cognitive activity. This is a step-wise process and may take one or more weeks as each step is separated by at least 24 hours. Children / adolescents are strongly encouraged not to return to competitive (contact or collision) sport until medical clearance is obtained to avoid re-injury.
  - Cognitive rest is encouraged to avoid exacerbation of symptoms for the first 24 to 48 hours after injury. As symptoms begin to diminish, slowly increase activity to improve concentration, memory, and sensitization to light/noise. Include the use of electronics and reading as tolerated, that is in a way or amount that does not exacerbate symptoms. Social interactions are encouraged.
  - It is alright for a child to engage in watching television (at a reasonable distance from the screen), for a short period of time. There is no evidence prohibiting this activity. However, child/adolescent should be advised to the potential presence of phonophobia and/or photophobia. Therefore they should be advised NOT to watch television in a dark room and/or with surround sound
  - It is common for a child/adolescent to feel restless or agitated by the lack of activity.

- Step 1 - By the 2nd/3rd day post injury, the child should, if not already engaged, begin with gentle activities like moderate reading (i.e. short periods of homework) and screen time with personal electronic devices (e.g. cellphones, tablets, and computers) for 15 to 20 minutes, followed by a break of equal length. A short and easy walk of about 15-20 minutes is also encouraged daily. If these activities are already taking place, increase time spent.
  - The intention of this is to start increasing cognitive load and the associated stressors. This may include homework completed at home with breaks for symptom management.
• Step 2 - If the child/adolescent is able to tolerate these activities well, try reintroducing the child/adolescent into the school environment. Well tolerated physical aerobic activity may be progressed to include individual sport specific activity such as skating, dribbling, throwing and catching.
  o Have the child/adolescent attend for half days (preferably the morning hours and stay over the lunch break) and also attend their less stressful classes. The main intention of this step is to have them socializing with their peers rather than completing the school work at this time.
  o They are encouraged to go to bed at regular times each night (including over weekends and holidays and are to limit naps instead taking breaks throughout their day, if needed.
  o Schooling accommodations can be used to reduce symptom burden for the first 2 weeks. (no exams, sitting at the front of the class, decreasing activities that require more effort, having a quiet space to work/relax, and no homework)
  o Physical activity in this phase is meant to add movement. School based physical education meeting the criteria may be engaged in (individual and skill based), however the child / adolescent is encouraged to sit out of more complex drills and situations.

• Step 3 - If they are able to tolerate the above mentioned activities well, they can attempt full days of school and begin homework/attending exams. If symptoms are fully resolved and school work is being completed in full, the child / adolescent may re-integrate into non-contact sport/team practices including physical education at school.
  o All missed work and exams should be caught up and academic performance at pre-injury levels of achievement.
  o The physical activity goal is to increase exercise, coordination and add cognitive load to physical activities.
  o Drills that are cooperative in nature are acceptable. These drills do not involve “challenge for possession” or include high risk skills such as blocking in volleyball, football and rugby or aerosials in gymnastics, cheer and skateboarding.
  o Resistance training may be included at this stage.
  o Situations or drills involving scrimmages, games and opportunity for body and head contact are restricted until medical clearance is obtained.

• Step 4 – Full return to learning is complete and symptoms should be fully resolved at this stage. Medical clearance for return to sport may be obtained by the child / adolescent to initiate contact practices in the desired sport.
  o The goal for the child / adolescent is to regain confidence. Full practice speed, training and drills with appropriate learning progressions are expected.

• Step 5 – Full return to sport / activity and game play

Return to Learn and Return to Play can be performed simultaneously, however a full and complete return to school should occur prior to return to competitive (contact and collision) sport environments and include medical clearance for this activity.

Table 2. Return to School Strategy

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Aim</th>
<th>Goal</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Start at home activities</td>
<td>Gradual return to typical activity</td>
<td>Usual activities such as reading, texting, screen time, home work. Begin with 5-15 minutes and increase gradually</td>
</tr>
</tbody>
</table>
### Return to School Strategy

**Step 2**
- **Aim**: Start going back to school
- **Goal**: Initial gradual return to school
- **Activity**: Start going to school for half days, work up to full days. Consider school supports to foster return

**Step 3**
- **Aim**: Return to near-normal routine
- **Goal**: Back to school full days all or most days of the week
- **Activity**: Go to all classes, take transportation, limit naps

**Step 4**
- **Aim**: Return to school full time
- **Goal**: Return to full academic activity
- **Activity**: Full-time attendance with a normal, full workload, including exams.

### Return to Sport Strategy

**Table 3. Return to Sport Strategy**

<table>
<thead>
<tr>
<th>Step 1</th>
<th><strong>Aim</strong></th>
<th>Start at home activities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Goal</strong></td>
<td>Gradual return to typical activities</td>
</tr>
<tr>
<td></td>
<td><strong>Activity</strong></td>
<td>Usual activities, including light walking at an easy pace for 15-20 minutes and well-paced household chores</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 2</th>
<th><strong>Aim</strong></th>
<th>Light aerobic activity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Goal</strong></td>
<td>Increase heart rate, limit deconditioning</td>
</tr>
</tbody>
</table>
|        | **Activity** | DO - Walking, swimming, cycling at a light pace  
AVOID - Resistance training or weight lifting  
AVOID - Activity with a risk of re-injury  
DO - Up to 10-15 minutes, 2x/day |

<table>
<thead>
<tr>
<th>Step 3</th>
<th><strong>Aim</strong></th>
<th>Sport-related training and exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Goal</strong></td>
<td>Add movement</td>
</tr>
</tbody>
</table>
|        | **Activity** | DO - Individual skills such as stickhandling, jumping/leaping, volleying, juggling, shooting, dribbling, throwing and catching  
DO - Up to 20-30 minutes 2x per day  
AVOID – Activities that would involve collisions or risk impact to the head |

<table>
<thead>
<tr>
<th>Step 4</th>
<th><strong>Aim</strong></th>
<th>Non-contact training drills</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Goal</strong></td>
<td>Increased exercise, coordination, and thinking</td>
</tr>
</tbody>
</table>
|        | **Activity** | DO - Cooperative training drills with team-mates  
DO - Full physical conditioning and exertion including resistance training  
AVOID - Body or head contact. This includes heading drills (soccer), diving/blocking (volleyball), aerials (gymnastics/cheer)  
AVOID - Drills that have an offense vs defense component (due to the risk of contact and/or re-injury) |

**Full Return to Learn Complete Medical Clearance BEFORE a full return to sport**

<table>
<thead>
<tr>
<th>Step 5</th>
<th><strong>Aim</strong></th>
<th>Full contact practice</th>
</tr>
</thead>
</table>
|        | **Goal** | Restore confidence in the athlete and coach  
Assess functional skill |
|        | **Activity** | DO - Participate in full practice and normal training activity |

<table>
<thead>
<tr>
<th>Step 6</th>
<th><strong>Aim</strong></th>
<th>Return to Sport</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Goal</strong></td>
<td>Normal Game Play, starting with scrimmages with teammates and working up to regular competitive games.</td>
</tr>
</tbody>
</table>
Quality of Evidence: Moderate, Grade B
Strength of Recommendation: Weak/Insufficient evidence

References:


Clinical Question #2: In pediatric patients diagnosed with concussion, what are the most effective treatments for headaches?

Clinical Recommendation #2: Recommendations are classified into 2 time points

- Acute post-traumatic headaches (initial 2-4 weeks post injury)
- Persistent post-traumatic headaches (> 4 weeks post injury)

Post-traumatic headaches have several different phenotypes including tension-type, migraine, medication overuse and cervicogenic headache.

There are no established guidelines for the treatment of post-traumatic headache, and practices vary widely.
Acute post-traumatic headaches (up to 27 days post injury)

- Onset is usually within 7 days of head and/or neck injury without history of a premorbid definable headache disorder
  - If a pre-existing headache (i.e. migraines) with the characteristics of a primary headache disorder worsen (often defined as a 2-fold or greater increase in frequency and/or severity), or
  - occurs in close temporal relation to an injury, both the initial headache diagnosis and diagnosis of headache attributed to trauma/injury to the head and/or neck are diagnosed.
  - Usually simple analgesics such as ibuprofen or acetaminophen can be used to manage these headaches.
    - Ibuprofen (7.5-10 mg/kg)/acetaminophen (15 mg/kg) initial treatment of choice as they are well tolerated.
    - After 2 weeks limit their use to 3 times or less per week to avoid medication overuse associated headache
  - ED treatment may include IV fluids, antiemetics and non-steroidal treatments including ketorolac, and steroids.

- If outpatient therapy fails, initiation of intravenous therapy of ketorolac alone, ketorolac and metoclopramide/prochlorperazine combination, or ondansetron only
  - There have been no studies exploring these agents for the treatment of acute headache related to TBIs in the ED (studies have examined their use and efficacy in children presenting with an acute exacerbation of a primary headache only)

**Persistent Post-traumatic headaches (> 28 days post injury)**

- Less frequent presentation. About 1 in 5 children will complain about persistent symptoms.
- Management should be targeted to the type of headache and also focused on the needs of the child
  - Identification of headache type
  - Identification of headache triggers
  - Goals of treatment should include reducing headache frequency, reducing the progression to chronic daily headaches and lessening associated disabilities
  - Referral to a headache specialist or pediatrician is often required

**Preventative treatments**

- Useful for children/adolescents with a history of headaches and/or migraine. The main goal is to break the pain cycle with acute pain medications and provide a referral to a specialist (i.e. pediatric neurologist) for follow-up care.
- Possible medications that could be used include TCAs (amitriptyline and nortriptyline), beta-blockers (propranolol), melatonin and magnesium, antiepileptic (topiramate, valproic acid, gabapentin and zonisamide).

Typical recommendations include practice of good headache hygiene behavior (which is defined as regular bedtimes and waking times with sufficient sleep time), healthy meals, hydration, and the management of stress

**Quality of Evidence:** Moderate, GRADE B

**Strength of Recommendation:** Weak, GRADE 2

**References:**

Clinical Question #3: In pediatric patients diagnosed with concussion, what are the most effective treatments for dizziness/balance disorders?

Clinical Recommendation #3: Dizziness is often the second most commonly reported symptom following concussion and has been reported to predict a longer recovery. What children mean by dizziness is variable. For some it may mean light-headedness, nausea, spinning, disequilibrium or even blurred vision. Therefore, it is important to determine what is meant by dizziness and treat as appropriate.

- Light-headedness may respond to increased fluid and salt intake.
- Nausea and dizziness may co-occur with migraine like headache.
- Balance alterations may occur in a significant number of children, but often will get better without specific intervention over the first 10 days.
- Not all individuals present with a specific type of vestibular disorder. Thus, treatment regimens are completed using an individualized approach based on persisting impairments. The more commonly reported types of vestibular disorders seen following concussion include labyrinthine concussion, central vestibular dysfunction, vestibulo-ocular reflex dysfunction and benign paroxysmal positional vertigo.
- Vestibular rehabilitation may be of benefit in decreasing symptoms of dizziness and improving function in children and adolescents following concussion.
- Adolescents and young adults treated with a combination of individualized multimodal physiotherapy (including vestibular rehabilitation and cervical spine treatment) in individuals with persistent symptoms of dizziness, neck pain and/or headaches following concussion were 4 times more likely to be medically cleared to return to sport compared to individuals continuing with a protocol of rest followed by graded exertion.
- Typical components of vestibular rehabilitation include habituation, adaptation, standing balance, walking and balancing, substitution exercises and canalith repositioning manoeuvres.
- There is no one recipe for vestibular rehabilitation following concussion and this form of rehabilitation should be performed by physiotherapists or other health care professionals with expertise in this area.

Vestibular rehabilitation has been shown to be safe and effective in multiple populations, including mild traumatic brain injury.
Quality of Evidence: Moderate/High GRADE A/B (one RCT, other case series)
Strength of Recommendation: Moderate/Strong, GRADE 1

References:


Clinical Question #4: In pediatric patients diagnosed with concussion, what are the most effective treatments for cervical spine involvement and neck pain following concussion?

Clinical Recommendation #4:

- Neck pain is a common symptom following concussion. The cervical spine may be injured secondary to trauma and is widely cited as a source of neck pain and headache in the whiplash literature. The upper three cervical segments have been reported as a source of cervicogenic headache. Many of the muscles in the cervical region also refer to the head and may be a cause of headaches and neck pain. 1

- A combination of manual therapy and exercise has been shown to be more effective than passive modalities for individuals with neck pain. A systematic review revealed a moderate benefit from neck strengthening exercise to reduce pain, improve function, and global perceived effect for individuals with mechanical neck disorders. A program incorporating eye/head coordination and proprioceptive training in addition to other exercises has shown moderate efficacy in both the short and long term for individuals with chronic neck pain with and without headache and whiplash associated disorders. A multimodal program, combining exercise with manual therapy, for sub-acute and chronic neck pain with or without headache was found to have strong positive evidence in reducing pain and improving function. 1

- In the area of concussion, limited evidence is available that evaluates isolated cervical spine treatments. However, adolescents and young adults treated with a combination of individualized multimodal physiotherapy (including vestibular rehabilitation and cervical spine treatment) in individuals with persistent symptoms of dizziness, neck pain and/or headaches following concussion were 4 times more likely to be medically cleared to return to sport compared to individuals continuing with a protocol of rest followed by graded exertion. 1

Quality of Evidence: Moderate- GRADE A/B (one RCT, minimal literature directly in this population)
Strength of Recommendation: Moderate

References:
Clinical Question #5: In pediatric patients diagnosed with concussion, what are the most effective treatments for mood symptoms following concussion?

Clinical Recommendation #5: Mood changes and anxiety can be common during recovery from a mTBI. Many children worry about failing at school, not being active, or feeling left out. These feelings may make symptoms worse or prolong recovery.

Best practice recommendations emphasize the importance of providing social support to improve quality of life and reduce effects of stressors on a child/adolescent's health. Such supports include:

- Emotional guidance (empathy, love, trust, and caring) by caregivers (from parents/guardians, teachers, coaches, friends),
- Informational guidance and appraisal (constructive feedback and positive affirmations), and
- Provision of tangible aids/services directly assisting needs of the child/adolescent
  - School accommodation letters
  - Counselling services

Social isolation has been identified as a risk of poor recovery and should be avoided during the recovery process. Hence, up to 3 days post injury the child/adolescent should return to half-days of schooling (ideally the morning half and stay over the lunch hour). They can participate in school work during this time, and interaction with friends and peers should be encouraged.

If the child/adolescent is currently seeing a specialist/healthcare provider for mood and anxiety related symptoms pre-injury, encourage a follow-up visit with them to keep the lines of communication open.

Quality of Evidence: Low, GRADE C to Moderate, GRADE B

Strength of Recommendation: Strong, GRADE 1

References:


Clinical Question #6: In pediatric patients diagnosed with concussion, what are the most effective treatments for attention and concentration symptoms following concussion?

Clinical Recommendation #6:
Acute/Sub acute Treatment (< 28 days post injury)

- Supporting the child/adolescent as they return to schooling activities is key.
  - Families and their children should be encouraged to talk to the school before the child returns.
  - Return to learn guidelines
  - Individualized educational plan (temporary learning accommodations/modifications) should be used, if child is struggling with complaints of attention, memory and learning difficulties, slower response speed and aspects of executive function
  - When possible, exemptions can be made so that the student doesn’t have to catch up on all assignments or work missed if necessary but prioritize key areas or projects to work on (such as in-school work and assignments).
- Open communication between children/adolescent and their caregivers (parent, teachers and coaches) is encouraged, as many fear about failure and social alienation.
  - Sometime psychological support is necessary aid to help the child make adjustments to the emotional stress that occurs following injury.
  - Cognitive reserve is dependent on factors such as: pre-injury academic functioning and intelligence, post-insult cognitive ability, level of education (in adults), socioeconomic status, family functioning, and premorbid learning problems
    - Pre-injury family psychosocial adversity is associated with increased risk of secondary Attention Deficit Hyperactivity Disorder (ADHD)
    - Those with history of ADHD/ existing learning disability (LD)/ etc.
    - Often symptoms of ADHD and/or LD will increase for a short period of time. We recommend continuing all treatments and medications when children return to school. We recommend re-contacting your child’s school and physician/psychologist who was helping your child with these difficulties.

Persistent Cognitive Difficulties (Symptoms > 3 months post injury)

- Persistence of neuropsychological impairment (difficulties with attention, memory and learning, response speed and aspects of executive function) after concussion is still debated, while evidence is emerging
- There is little evidence that the disruption in cognitive processes is related to the pathology of concussion injury.
  - WHEN cognitive difficulties are suspected, sleep, headaches and mood disturbances should be addressed first, as these can all influence cognitive performance.
  - If cognitive difficulties appears related to symptoms, like headache, fatigue, poor sleep – treatment should be directed towards specific complaints
    - headache reduction,
    - sleep disturbance – may benefit from corrected sleep hygiene +/- use of temporary sleep aids (melatonin/ amitriptyline/ short term non-BZD sedatives)
- Recommend a gradual return to activities similar to the ones used during the acute and sub-acute recovery periods
- Neuropsychological/educational psychology evaluations can assist in determining causation and management plans
Quality of Evidence: Moderate- Grade B  
Strength of Recommendation: Weak/Insufficient evidence  
References:


Clinical Question #7: In pediatric patients diagnosed with concussion, what are the most effective treatments for exertional symptoms following concussion?  
Clinical Recommendation #7: In some cases, individuals have ongoing difficulty with increasing activity levels/increased exertion. Adolescents performing a moderate level of exercise have been reported to perform better than individuals performing a high or low level of activity.

- Sub-symptom threshold exercise has been suggested as a treatment for individuals with ongoing symptoms and may provide benefit in individuals who are slow to recover (>4 weeks) following a concussion. This exercise has been shown to be safe and may assist with functional recovery in children and youth.
- In an uncontrolled study, children and adolescents performing sub-symptom threshold exercise 5-6 times per week at 55-65% of max heart rate (calculated as 220-age) for up to 15 minutes were reported to return to have functional improvements.
- Evaluation of exertional symptoms may be of benefit and identify individuals who may benefit from sub- symptom threshold training, although the evidence in this area is limited to uncontrolled studies.

Quality of Evidence: Low, GRADE C  
Strength of Recommendation: Weak, GRADE 2  
References:
Clinical Question #8: In pediatric patients diagnosed with concussion, what are the most effective treatments for visual symptoms following concussion?

Clinical Recommendation #8: Concussion/mTBI-related visual complaints include blurred/double vision, eye fatigue, the appearance of words moving on the page, loss of place when reading, and difficulty sustaining attention on a visual task.

- Common diagnoses include accommodative disorders, convergence insufficiency, saccadic dysfunction and associated vestibulo-ocular dysfunction (VOD).
- In one study, 69 of 100 adolescents, aged 11-17, had one or more of the above mentioned vision diagnoses. Vision diagnoses are associated with poorer verbal memory composite scores, which may reflect the role of the DLPC in both working memory and oculomotor function.
- Identification of visual problems is important because approximately 50% of the brain’s circuits are dedicated to vision. As well as the visual demands of children/adolescents engaged in full-time school (due to widespread use of electronic interfaces).

Screening tools and diagnostic tests:
- Convergence Insufficiency Symptom Survey (CISS), King-Devick Test, Eye movement tracking, Vestibular/Ocular Motor Screening (VOMS)

Treatments:
- Specific school-based accommodations – frequent visual breaks, oral teaching, audio-books, large-font printed material (vs. small font electronically displayed material), or preprinted notes
- Accommodative complaints – spectacle correction for near-sighted, oculomotor training (short-term)
- Convergence insufficiency – base in prism, near convergence exercises with in-office/home based programs, oculomotor training

Often a referral to a concussion specialist or eye-care professional is needed for a comprehensive visual and oculomotor evaluation beyond visual acuity testing, and for possible treatment of accommodation, binocular vision, and eye movements.

**Pediatric patients with acute sports-related concussion who met the clinical criteria for VOD at initial clinical consultation (approx. 7 days post injury) had 4 times the odds of developing PCS. However, further studies are need to confirm the prevalence of VOD among boarder pediatric sports-related concussion populations.**

Quality of Evidence: Low, GRADE C
Strength of Recommendation: Weak, GRADE 2

References:


**Clinical Question #9:** In pediatric patients diagnosed with concussion, what are the most effective treatments for associated endocrinopathies following concussion?

**Clinical Recommendation #9:** Significant injury to the hypothalamic-pituitary axis may complicate medical management, but evidence is limited for acute management of mTBI/concussions. Thus there is no need for blood work or neuroimaging to screen for endocrine-related disorders within the first 4 weeks after injury.

- Clinical evaluation with the primary healthcare provider is recommended one-year post injury if the child/adolescent reports fatigue, cold intolerance, poor growth, altered puberty, mood disturbances or altered appetite control.
  - Clinical investigations and screening for growth hormone deficiency, gonadotropin deficiency, precocious puberty, ACTH deficiency, central hypothyroidism, hyperprolactinemia, and diabetes insipidus are then warranted.

Current recommendations for screening in the ED, are intended for all patients after moderate or severe traumatic brain injury.

**Quality of Evidence:** Low, GRADE C  
**Strength of Recommendation:** Weak, GRADE 2

**References:**


**Clinical Question #10:** In pediatric patients diagnosed with concussion, what are the most effective treatments for tinnitus following concussion?

**Clinical Recommendation #10:**

- Tinnitus (ringing in the ears) is not commonly seen in an acute/urgent care setting for pediatrics. Rarely present in cases of blast, MVA, fall or assault related injuries.
- Persistent tinnitus may be due to injury (disruption or overrepresentation of signals) of the auditory-thalamic-limbic pathway, however this is not commonly seen in pediatric population.

Nonpharmacological treatments being examined are cognitive-behavioral therapy, tinnitus retraining therapy, phase-out sound cancellation treatment, and low-level laser therapy. Other possible treatment options include antiepileptic medication (i.e. diazepam – which affects GABA transmission within the pathway) or surgical cochlear implant. However, trials are needed to confirm their efficacy.
Quality of Evidence: Low, Grade C
Strength of Recommendation: Weak/Insufficient evidence
References:

Acknowledgements

We would like to acknowledge the contributions of the Provincial Clinical Knowledge Working Group members as follows. Your participation and time spent is appreciated.

### Pediatric Concussion Knowledge Topic Working Group Membership

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Knowledge Lead</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Katharine Smart</td>
<td>Emergency Pediatrics Knowledge Lead</td>
<td>Provincial</td>
</tr>
<tr>
<td>Troy Turner</td>
<td>Emergency Pediatrics Knowledge Lead</td>
<td>Provincial</td>
</tr>
<tr>
<td><strong>Topic Lead</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tina Samuel</td>
<td>Physician Research Associate, Pediatric Neurology</td>
<td>Provincial</td>
</tr>
</tbody>
</table>

### Working Group Members

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alf Conradi</td>
<td>Child and Youth Standing Committee Chair Physician, Pediatric Intensive Care Specialist</td>
<td>Provincial</td>
</tr>
<tr>
<td>Angelo Mikrogianakis</td>
<td>Physician, Pediatric Emergency Medicine</td>
<td>Calgary</td>
</tr>
<tr>
<td>Bruce Wright</td>
<td>Physician, Pediatric Emergency Medicine</td>
<td>Edmonton</td>
</tr>
<tr>
<td>Brenda Clark</td>
<td>Physician, Pediatrics</td>
<td>Edmonton</td>
</tr>
<tr>
<td>Codi Isaac</td>
<td>Physiotherapist, Cervical and Vestibular Rehabilitation</td>
<td>Edmonton</td>
</tr>
<tr>
<td>Karen Barlow</td>
<td>Physician, Pediatric Neurology</td>
<td>Calgary</td>
</tr>
<tr>
<td>Kate Randall</td>
<td>Neuropsychologist, Pediatrics</td>
<td>Edmonton</td>
</tr>
<tr>
<td>Kathryn Schneider</td>
<td>Physiotherapist, Cervical and Vestibular Rehabilitation</td>
<td>Calgary</td>
</tr>
<tr>
<td>Keith Yeates</td>
<td>Neuropsychologist, Pediatrics</td>
<td>Calgary</td>
</tr>
<tr>
<td>Lawrence Richer / Thilinie Rajapakse</td>
<td>Physician, Pediatric Neurology</td>
<td>Edmonton</td>
</tr>
</tbody>
</table>

### Clinical Support Services

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marcel Romanick</td>
<td>Pharmacy Information Management Governance Committee (PIM-GC) on behalf of Pharmacy Services</td>
<td>Provincial</td>
</tr>
<tr>
<td>James Wesenberg</td>
<td>on behalf of Laboratory Services - Provincial Networks</td>
<td>Provincial</td>
</tr>
<tr>
<td>Bernice Lau</td>
<td>on behalf of Diagnostic Imaging Services</td>
<td>Provincial</td>
</tr>
<tr>
<td>Carlota Basualdo-Hammond &amp; Kim Brunet Wood</td>
<td>on behalf of Nutrition &amp; Food Services</td>
<td>Provincial</td>
</tr>
</tbody>
</table>

### Strategic Clinical Networks

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal Newborn Child and Youth Strategic Clinical Network</td>
<td>Child and Youth Standing Committee and Core Committee</td>
<td>Provincial</td>
</tr>
<tr>
<td>Emergency Strategic Clinical Network Core Committee</td>
<td></td>
<td>Provincial</td>
</tr>
</tbody>
</table>

### Clinical Informatics Lead

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Megan Courtney</td>
<td>Registered Nurse</td>
<td>Provincial</td>
</tr>
<tr>
<td>Lorna Spitzke</td>
<td>Registered Nurse</td>
<td>Provincial</td>
</tr>
<tr>
<td>Karin Domier</td>
<td>Registered Nurse</td>
<td>Provincial</td>
</tr>
</tbody>
</table>
Additional Contributors

Thank you to all clinicians who participated in the colleague review process. Your time spent reviewing the knowledge topics and providing valuable feedback is appreciated.