Management of Mild Traumatic Brain Injuries Has Evolved

by Angela Sinser, D.O., Mark Gormley, M.D., and Leslie Larson, P.N.P.

Most patients who sustain mild traumatic brain injuries (MTBI) recover fully, but as many as 12 percent experience persistent disabling problems.1 Until recently, many school-age athletes, their families and their coaches did not recognize the potential risks of an MTBI—particularly if the athlete did not lose consciousness—so the injuries often went undetected, and even if detected, were not always treated properly. Since passage of Minnesota’s MTBI law of 2002, the approach to management of mild traumatic brain injuries has changed significantly.

Management of MTBIs has evolved owing to advancements in medical and surgical treatments, a greater understanding of the pathophysiology of a brain injury, appropriate assessment techniques, neurocognitive screening tools, postinjury management strategies and return-to-play guidelines. The webinar training is eligible for CME credit. Please visit www.gillettechildrens.org/Publications/gillettechildrens.com.

Neurotrauma Webinar Available for Clinicians

Gillette offers an on-demand webinar for providers interested in learning more about treating traumatic brain injuries. The webinar provides participants with credits and explores the best practices in evaluating and managing concussions. This webinar offers a practical guide for identifying and diagnosing MTBIs. In addition, it includes guidelines for managing injuries and referring patients who have prolonged symptoms.

Identifying and Diagnosing MTBIs

MTBIs occur when an impact to the head or body causes the brain to quickly move forward and backward, striking the skull and injuring cells, nerves and blood vessels. When the brain hits the skull, the axons stretch or tear and the imbalance of an MTBI may take days, weeks, months or—even years. Children and adolescents may take longer than older patients to recover.

In the past, providers often used loss of consciousness as the hallmark of a concussion diagnosis. Today, however, providers recognize that mild traumatic brain injuries may not lose consciousness. In addition, the results of neuromaging studies usually are within normal limits for patients with MTBIs.

Key Insights

• Patients who have MBTIs may or may not lose consciousness.
• The results of neuromaging studies usually are within normal limits for patients with MTBIs.
• The neuromaging cascade and imbalance of an MBTI may take days to subside.
• Children and adolescents may take longer to recover from MBTIs than adults do.
• The duration of MTBI symptoms varies widely—from minutes to days, weeks, months or—even years. Children and adolescents may take longer than older patients to recover.

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Immediate Symptoms

MTBIs occur when an impact to the head or body causes the brain to quickly move forward and backward, striking the skull and injuring cells, nerves and blood vessels. When the brain hits the skull, the axons stretch or tear and the imbalance of an MTBI may take days, weeks, months or—even years. Children and adolescents may take longer than older patients to recover.
Acute Concussion Evaluation (ACE) Section A: Injury Characteristics

Date/Time of Injury: ___ No ___, ___ Yes ___

Section A: Injury Characteristics

1. Injury Description

1a. Is there evidence of a forceful blow to the head? ___ Direct or indirect injury? ___ No ___, ___ Yes ___

1b. Is there evidence of intracranial or skull fracture? ___ No ___, ___ Yes ___

1c. Location of intracranial or skull fracture? ___ Lt Temporal ___ Rt Temporal ___ Lt Parietal ___ Rt Parietal ___ Occipital ___ N/A ___, ___ Indirect injury ___

2. Causes

___ MVC ___ Pedestrian-MVC ___ Fall ___ Assault ___ Sports ___ Injury to another ___ Other ___

3. Amnesia Before (Bereitragen) Are there any events just before the injury that you/person has no memory of? ___ No ___ Duration ___

4. Amnesia After (Anterograghe) Are there any events just after the injury that you/person has no memory of? ___ No ___ Duration ___

5. Loss of Consciousness: Did you/person lose consciousness? ___ No ___ Duration ___

6. EARLY SIGNS

___ Appears dazed or stunned ___ Confused about events ___ Questions answered slowly ___ Repeats Questions ___ Forgetful (can’t recall) ___

7. Seizures: Were seizures observed? ___ No ___ Yes ___ Details ___

Subsequent Symptoms

Warning signs that can appear hours or days after an injury include:

- Chronic headaches
- Fatigue
- Sleep difficulties
- Personality or behavioral changes
- Sensitivity to light or noise
- Inability to think clearly, standing quickly
- A poor attention span
- Deficits in short-term memory, problem-solving and general academic functioning

Getting a comprehensive history is vital to determining the severity of a patient’s concussion. The Acute Concussion Evaluation (ACE) form, issued by the Centers for Disease Control and Prevention, will help you establish the scope of the injury, so you can manage patients appropriately. Key sections of the form are as follows:

To identify potential sleep difficulties, ask questions such as:

- “Do you wake up from a sound sleep and have trouble returning to sleep?”
- “Do you have problems falling asleep?”
- “Do you have difficulty remembering?”
- “Do you have concentration difficulties?”

Total Symptom Score (0-22) ________________

Emotional Total (0-4)  _____

- Sadness 0  1
- Nervousness 0  1

Visual problems 0  1

Dizziness 0  1

Fatigue 0  1

Nausea 0  1

Sensitivity to noise 0  1

Sensitivity to light 0  1

MVC ___ Pedestrian-MVC ___ Fall ___ Assault ___ Sports___ Injury to another ___ Other ___

Section B: Symptom Check List

Since the injury, has the patient experienced any of these symptoms more than usual today or in the past day? ___ (Indicate presence of any symptom [1] = Yes, [0] = No)

Physical (15) Cognitive (4)

Headache 0  1

Nausea 0  1

Vomiting 0  1

Balance problems 0  1

Dizziness 0  1

Visual problems 0  1

Fatigue 0  1

Memory 0  1

Speech 0  1

Emotional (4)

- Nervousness 0  1
- Sleep problems 0  1

Physical Activity ___ Yes ___ No ___ N/A ___

Exertion: Do these symptoms worsen with physical activity? ___ Yes ___ No ___ N/A ___

Cognitive Activity 0  1  N/A ___

Overall Rating: How does the patient compare to his/her usual self? [1] Normal 0  1  2  3  4  5  6

Very Different ___

The Giblett Children’s Specialty Healthcare Neurotrauma Clinic provides comprehensive care and support to patients who have moderate to severe head injuries. Depending on individual needs, the team may include pediatric rehabilitation professionals, occupational therapists, neuropsychologists, medical doctors, nurses, and physical therapists. The Giblett Children’s Specialty Healthcare Neurotrauma Clinic provides the following at-home care packages to help patients return to activities successfully:


Case Study – MBTI With Complications

History

A 12-year-old girl was injured when she slipped and hit her head while playing with friends on a frozen pond. Initially, she had concussive symptoms, including memory loss, confusion, headaches, and dizziness. She had sensitivity and light sensitivity and was slow. She also had neck pain. She was examined by an ER physician who ordered a CT scan and an MBTI. The tests showed no evidence of a hematoma.

Subsequently, the girl had difficulty returning to school, because of fatigue, headaches while reading and difficulty finding words. Physical activities also gave her a headache. She sought treatment from her primary care provider, but the headaches, visual issues and visual disturbances persisted, so she could not attend school full-time. Approximately six months post-injury, her primary care provider referred her to Giblett’s Neurotrauma Clinic.

Evaluation

Her Immediate Post-concussion Assessment and Cognitive Testing (IPOCT) score indicated lower than expected results for a student with her academic standing. She was also evaluated by a speech and language pathologist, an occupational therapist and a physical therapist. The assessments revealed that her language skills were significantly above average, except for verbal comprehension. Her visual-perceptual and visual spatial skills were compromised and she was deconditioned.

Treatment

Our occupational therapist set up a home program of organized visual activities to gradually improve visual-perceptual demands on visual perceptual skills. The patient attended physical therapy for three sessions and continued therapy at home between appointments. Our speech and language pathologist provided structured and supported language suggestions to help address the patient’s comprehension difficulties.

The patient’s endurance has gradually improved and her visual challenges have decreased. Her headaches persist, but she has decreased in intensity and time now referred to our staff psychologist for pain management and is planning to return to school full-time after the semester break.
Centers for Disease Control and Prevention. Excerpted from the Acute Concussion Evaluation (ACE) Physician/Clinician

1. Injury Description

_______________________________
Date/Time of Injury:

Section A: Injury Characteristics

___ Fall ___ Motor vehicle crash ___ Other ________________________________
___ Assault ___ Sports (specify) ____________
___ Other _______________________

Although describing the injury (Section A) is fairly straightforward, you must still be careful to ask probing questions and obtain the whole story. Events just AFTER the injury that you/person has difficulty remembering may be important in identifying changes in cognitive abilities, emotional function and/or sleep patterns (Section B, Page 3). Symptoms may appear days or weeks after the injury, and patients might not realize that cognitive and emotional symptoms are related to the brain injury, so they may not report them.

1. Injury Description

Get a comprehensive history is vital to determining the severity of a patient’s injury. The Acute Concussion Evaluation (ACE) form, issued by the Centers for Disease Control and Prevention, will help you establish the scope of the injury, so you can manage patients appropriately. Key sections of the form appear at left and on Page 3, and the form is available at www.cdc.gov/concussion/handout/pdf/ACE.pdf.

Warning signs that can appear hours or days after an injury include:
• Chronic headache
• Fatigue
• Sleep difficulties
• Personality or behavioral changes
• Sensitivity to light or noise
• Fatigue withstanding rest and sleep

A poor attention span

• Sensitivity to light or noise

• Personality or behavioral changes

• Fatigue

• Difficulty concentrating, and they heighten chances that the student will experience a serious and permanent brain injury.

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• Difficulty concentrating, and they heighten chances that the student will experience a serious and permanent brain injury.
Acute Concussion Evaluation (ACE)

Section A: Injury Characteristics

Date/Time of Injury:

Subsequent Symptoms

Warning signs that can appear hours or days after an injury include:

- Chronic headaches
- Fatigue
- Sleep difficulties
- Personality or behavioral changes
- Sensitivity to light or noise
- Nausea

**A poor attention span**

**Deficits in short-term memory, problem-solving and general academic functioning**

Getting a comprehensive history is vital to determining the severity of a patient’s concussion. The Acute Concussion Evaluation (ACE) form, issued by the Centers for Disease Control and Prevention, will help you establish the scope of the injury, so you can manage patients appropriately. Key sections include:

1. Location of injury:

   - Direct
   - Indirect
   - Occipital
   - Neck

2. Cause:

   - MVC
   - Pedestrian/MVC
   - Fall
   - Assault
   - Sports (specify)

3. Date/Time of Injury:

4. Is there evidence of a forcible blow to the head (direct or indirect)?

   - Yes
   - No

5. Loss of consciousness?

   - Yes
   - No

6. EARLY SIGNS:

   - Forgetful (recent info)
   - Answers questions slowly
   - Is confused about events
   - Yes
   - No
   - Duration ___________________

7. Amnesia Before (Retrograde)

   - Yes
   - No

   - Duration ___________________

   - Has no memory of (even brief)?

8. Amnesia After (Anterograde)

   - Yes
   - No

   - Duration ___________________

   - Has no memory of (even brief)?

9. Were seizures observed?

   - Yes
   - No

Although describing the injury (Section A) is fairly straightforward, you must also assess patients and their families carefully to identify changes in cognitive abilities, emotional function and/or sleep patterns (Section B, Page 3). Symptoms may appear days or weeks after the injury, and patients might not realize that cognitive and emotional symptoms are related to the brain injury, so they may not report them.

The more specific your questions about symptoms are, the better. For example, to learn more about cognitive function, ask questions such as:

**Do you have any more difficulty following directions?**

- Yes
- No
- Duration ___________________

When asking about headaches or vision problems, ask if the symptoms worsen during various activities:

**Do you notice any difficulty focusing on computer screens or testing?**

- Yes
- No
- Duration ___________________

**Do your headaches worsen while reading?**

- Yes
- No
- Duration ___________________

**Do you have problems falling asleep?**

- Yes
- No
- Duration ___________________

While patients are in the early postinjury phase, they may have more difficulty answering your questions, because their cognitive process is impaired by many factors. For example, patients may have trouble finding the proper words and may need extra time to understand and answer your questions. Speak slowly and allow patients ample time to process your questions.

**Additional Risk Factors Affect Management**

It is important to evaluate each episode of MBI in the context of a patient’s history of concussion, headaches and developmental or psychiatric issues (such as learning disabilities or depression). Patients with a history of those conditions may have a more complicated recovery, and that will affect their progress.

Although second-impact syndrome is rare, it can be serious. Second-impact syndrome refers to a condition that might occur if a second brain injury takes place while someone is still experiencing symptoms and recovering from a previous concussion. A second impact can occur days or weeks after the first. Second impacts are more likely than initial impacts to result in death or permanent disability. The likelihood of athletes experiencing second impacts increases if they have had a previous brain injury.

**Management by monitoring is appropriate in the following circumstances:**

1. If the patient has few MBI symptoms and they are mild
2. If the patient’s mild symptoms usually improve or are completely gone within three to five days

While symptoms are present, or if you think the injury is severe, it is important to contact a medical provider. However, you can use the ACE form to monitor and track your patient’s progress.

**How to Use the ACE Form**

The ACE form requires you to record your answers to the questions on the form. You and your patient can then use this form to track their progress and determine if they are ready to return to normal activities.

**Testing (ImPACT) scores indicated lower than expected results for a student with her academic standing. She was referred to Gillebert’s Neurometric Clinic for evaluation.**

The Gillette Children’s Specialty Healthcare Neurometric Clinic provides multidisciplinary approaches to care for children who have moderate to severe head injuries. The clinic is staffed with a large team of experts, including pediatricians, neurologists, physiatrists, physical therapists, occupational therapists, and speech and language pathologists. The clinic’s services include comprehensive evaluation of patients who have been involved in traumatic brain injuries (TBI). The clinic’s mission is to provide the best possible care to patients and their families.

**Case Study – MBI With Complications**

A 12-year-old girl was injured when she slipped and hit her head while playing with friends on a frozen pond. Initially, she had concussive symptoms, including memory loss, confusion, headaches, nausea, dizziness and sensitivity to light and noise. She also had neck pain. She was examined by an ER physician who ordered a CT scan and an MRI. The tests showed no evidence of a hematoma.

Subsequently, the girl had difficulty returning to school, because of fatigue, headaches while reading and difficulty finding words. Physical activities also gave her a headache. She sought treatment from her primary care provider, but the headaches, verbal issues and visual disturbances persisted, so she could not attend school full-time.

Approximately six months post-injury, her primary care provider referred her to Gillebert’s Neurometric Clinic.

**Evaluation**

Her Immediate Post-concussion Assessment and Cognitive Testing (ImPACT) scores indicated lower than expected results for a student with her academic standing. She was also evaluated by a speech and language pathologist, an occupational therapist and a physical therapist. Their assessments revealed that her language skills were significantly above average, except for verbal comprehension. Her visual perceptual and vestibular skills were compromised and she was deconditioned.

**Treatment**

Our occupational therapist set up a home program of organized visual and auditory tasks to assess the visual and auditory demand on visual perceptual skills. The patient attended physical therapy for three sessions and continued therapy at home between appointments. Our speech and language pathologist provided accommodations to help address the patient’s comprehension difficulties.

The patient’s endurance has gradually improved and her visual challenges have decreased. Her headaches persist, but have decreased in intensity. She has been referred to our occupational therapist for supportive language suggestions to help address the patient’s comprehension difficulties.

**Summary**

The patient’s condition has gradually improved and the patient is now able to return to normal activities. Her headaches have decreased, but she still experiences difficulty with concentration and memory loss. She continues to work with our occupational therapist to help her improve her cognitive and physical function.
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Most patients who sustain mild traumatic brain injuries (MTBI) recover fully, but as many as 15 percent experience persistent disabling problems.1 Within a decade, millions of school-age athletes, their families, and their coaches did not recognize the potential risks of MTBIs—particularly if the athlete did not lose consciousness—so the athletes often resumed play immediately, to their detriment. Newer Minnesota laws require medical evaluation post-concussion before student athletes return to play.

The law states that young athletes must be removed from play until they no longer exhibit concussion symptoms and behaviors. In addition, athletes must be evaluated by “a provider trained and experienced in evaluating and managing concussions” who must give the athlete “written permission to again participate in the activity.”2

Concussion Testing

Michael T. W. Hart, M.D.

Concussion is one of the most common problems seen in primary care.3 Approximately 4 million patients annually seek primary care treatment for a concussion, the majority of whom are school-age athletes.4

In the past, providers often used loss of consciousness as the hallmark of a concussion.5 Consequently, the baseline portion of the test will no longer be offered online at Gillette.

Instead, we recommend that primary care providers, coaches, athletic associations and teams work directly with ImpACT to develop testing programs in their schools or communities. Gillette will continue to provide interdisciplinary neurological assessments of people who have experienced a concussion, and postinjury ImpACT testing will remain one of our neurocognitive assessment tools.

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Gilibette Discontinues Online Baseline Concussion Testing

Immediate Post-concussion Assessment and Cognitive Testing (ImpACT) is an important tool for evaluating the scope of traumatic brain injury, but the baseline results are most reliable when the baseline test is procured in person. Consequently, the baseline portion of the test will no longer be offered online at Gillette.

The injury is not only structural but also metabolic. The cells release potassium and take in calcium. The calcium makes it difficult for cells to produce adenosine triphosphate (ATP), and because the neurons consume glucose to absorb the potassium, the injury ultimately draws on the energy needed for cognition, healing and resisting the effects of another injury. The duration of symptoms varies widely—from minutes to days, weeks, months—or in extreme cases—even years. Children and adolescents may take longer to recover than older patients to recover.

In the past, providers often used loss of consciousness as the hallmark of a concussion diagnosis. Today, however, providers recognize that mild traumatic brain injury may not lose consciousness. In addition, the results of neuromaging studies usually are within normal limits for patients with MTBIs.2

Key Insights

• Patients who have MTBIs may or may not lose consciousness.
• The results of neuromaging studies usually are within normal limits for patients with MTBIs.
• The neuromaging cascade and imbalance of MTBIs may take days to subside.
• Children and adolescents may take longer to recover from MTBIs than adults do.
• The duration of MTBI symptoms varies widely—from minutes to days, weeks, months or—in extreme cases—even years. Children and adolescents may take longer than older patients to recover.

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Immediate Symptoms

Within 24 hours of an injury, patients may experience some or all of these symptoms:

• Disorientation, temporary confusion or a “dazed” feeling
• Dizziness
• Headache
• Memory problems, including amnesia around the time of injury
• Uncoordinated hand-eye movements
• Nausea and vomiting, which are most often related to blows to the back of the head

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The law states that young athletes must be removed from play until they no longer exhibit concussion symptoms and behaviors. In addition, athletes must be evaluated by “a provider trained and experienced in evaluating and managing concussions” who must give the athlete “written permission to again participate in the activity.” (Section 121A.177 of Minnesota S.F. No. 612, as www.revisor.mn.gov/laws/id/90 (effective 2011)) As a result of the law, primary care providers may see more patients in their practice who have experienced MBTs. This article offers a practical guide for identifying and diagnosing MTBIs. In addition, it includes guidelines for managing injuries and referring patients who have prolonged symptoms.

Identifying and Diagnosing MTBIs

MTBIs occur when an impact to the head or body causes the brain to quickly move forward and backward, striking the skull and injuring cells, nerves and blood vessels. When the brain hits the skull, the atoms stretch or tear and the neurons fire simultaneously.

The injury is not only structural but also metabolic. The cells release potassium and calcium. The calcium makes it difficult for the cells to produce adenosine triphosphate (ATP), and because the neurons consume glucose to absorb the potassium, the injury ultimately draws on the energy needed for cognition, healing and resisting the effects of another injury. The duration of symptoms varies widely—from minutes to days, weeks, months or even extremes—non-athletes. Children and adolescents may take longer to recover from MBTs than adults do.

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• Headache
• Memory problems, including amnesia around the time of injury
• Nausea and vomiting, which are most often related to blows to the back of the head
• Vision problems

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Gilllette offers an on-demand webinar for providers interested in learning more about treating neurotrauma. The webinar provides participants with a science degree in nursing from the University of Minnesota. She is certified in primary care by the Pediatric Nursing Certification Board. Larson is a member of the American Academy of Nurse Practitioners and of the state and national chapters of the National Association of Pediatric Nurse Practitioners.

**Angela Sinner, D.O.**

Angela Sinner, D.O., is a pediatric rehabilitation medicine specialist at Gillette. She has a special interest in spina bifida, neuropsychiatry and a unique ability to make patients feel comfortable and safe. She is an assistant professor of pediatrics, orthopedics, neurology and rehabilitation medicine.

**Mark Gormley Jr., M.D.**

Mark Gormley Jr., M.D., is a pediatric rehabilitation medicine specialist at Gillette. He is board-certified in physical medicine and rehabilitation. He completed additional training at Gillette Children’s Specialty Healthcare. He has presented numerous presentations on topics including severe traumatic brain injuries. Larson has a master of science degree in nursing from the University of Minnesota. She is certified in primary care by the Pediatric Nursing Certification Board. Larson is a member of the American Academy of Nurse Practitioners and of the state and national chapters of the National Association of Pediatric Nurse Practitioners.

**Leslie Larson, R.N., C.N.P.**

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**Leslie Larson, R.N., C.N.P.**

Leslie Larson, R.N., C.N.P., is a certified nursing assistant and licensed Immediate Post-concussion Assessment and Cognitive Testing (ImPACT) is an important tool for evaluating the scope of traumatic brain injury, but the baseline results are most reliable when the baseline test is proctored. Consequently, the baseline portion of the test will no longer be offered online at Gillette.

Instead, we recommend that primary care providers, coaches, athletic associations and teams work directly with ImPACT personnel to develop baseline testing programs in their schools or communities. Gillette will continue to provide inter-disciplinary neurological assessments of people who have experienced a concussion, and postinjury ImPACT testing will remain one of our neurocognitive assessment tools.