CHALLENGES DURING RECOVERY IN CONCUSSED YOUTHS:

THE MONTREAL CHILDREN'S HOSPITAL TRAUMA CENTRE’S MTBI PROGRAM/CONCUSSION CLINIC INTERPROFESSIONAL APPROACH
What is a concussion?
A concussion is “a complex pathophysiological process affecting the brain, induced by biomechanical forces…. Direct impact to the head, neck or face, or to somewhere else on the body that transmits an impulsive force to the head”

Concussion Facts

- A functional rather than a structural brain injury
- Can be symptomatic but have a normal CT scan
- Most common form of brain injury sustained by athletes
- May not have LOC or memory loss
- May be disoriented or confused
- Rapid onset of short-lived impairment of neurologic function
- Can result in a variety of symptoms that can appear immediately, hours later or even the following day
- Symptoms often increase upon school return
Second Impact Syndrome

- A second brain injury that occurs while the symptoms from the first concussion have not resolved
- A second brain injury can be separated by minutes, days, and even weeks
- Loss of auto regulation of the brain’s blood supply
- Vascular engorgement
- Cerebral edema
- Death
Post mTBI management

- Rest is the mainstays of initial management
- Most children and adolescents with a mTBI recover within 2-3 weeks
- Up to 15% will experience prolonged recovery
  - Role of MTBI team members to facilitate recovery
At MCH Emergency Department
Clinical Care Time Frame (Days)
Referral to Concussion Clinic

- Every child/adolescent who has had a mTBI should be assessed by a doctor
- Who is referred to clinic?
- When are they seen in clinic?
- What do we do in clinic?
Role of Trauma Coordinator

- Interview with patient and family
- Evaluate symptoms
- Review activity restrictions for home, sports and school
- Provide specific recommendations for sports and school
- Referrals as needed
- Follow up
Referrals

- Physiotherapist
- Psychologist
- Ophthalmologist
- Physician
- Others
Managing Concussions in the classroom
School Accommodations

- Attendance restrictions
- Testing
- Workload reduction
- Note taking
- Breaks
- Other accommodations/restrictions
Effects of a concussion on the student

- Concussion is an invisible injury that disrupts the way the brain normally functions by affecting mental stamina
- The brain must work longer and harder to complete simple tasks
- Affects reaction time, short-term memory, working memory and cognitive processing speed
- Affects the student in many different ways:
  - Physically, cognitively, emotionally and by disturbing sleep
Common Physical Symptoms

- Headache
- Dizziness
- Fatigue
- Nausea
- Sensitivity to light
- Sensitivity to noise

Symptoms interfere with the student’s ability to focus and concentrate
Emotional symptoms

- Irritability
- Sadness
- Nervousness or anxiousness
- More emotional

These symptoms result from struggling with self, peers, school and family pressures to keep up
Cognitive symptoms

- Feeling mentally foggy
- Feeling slowed down
- Difficulty concentration
- Difficulty remembering
- Difficulty focusing

These symptoms impact the ability of the student to learn, memorize and process information
Sleep

- Trouble falling asleep
- Sleeping more than usual
- Sleeping less than usual

These symptoms result from fatigue and anxiety
Case Study #1

- 17 yr old male
- Highly competitive slalom skier
- 1st year cegep, average student
- 3 previous concussions (ski related- 2011, 2012)
- Prior to concussion: headaches twice a week
- History of disruptive sleep pattern
Current MTBI (case study #1)

- 2013-11-17
- Grand slalom ski competition
- Fell at high speed
- No impact to head
- Continued to ski
- Headache started soon after
- Assessed by own MD few days later
- Referred to MTBI clinic
Coordinator Assessment (case study #1)

- Initial visit 2013-11-29
- 12 days post injury
- History taken
- Post-concussion Scale (PCS): Total score = 33
- Education provided in regards to activity and cognitive restrictions
Plan (case study #1)

- Referral to Psychology
- Follow-up appointment booked for 1st Physio evaluation 4 weeks post injury
Physio clinic visit #1 (case study #1)

- 2013-12-16
- PCS: Total score = 10
- School semester finished
- Exams postponed to next semester
- Physiotherapy evaluation
  - Mildly symptomatic
Active Rehab Plan (case study #1)

- Individualized program provided
- No skiing until completely recovered
- Psychology evaluation pending
- Phone follow-up: January 2, 2014
Physio phone f/u (case study #1)

- 2013-01-03
- PCS: Total score = 0
- Increase cognitive exertion
- Psychology evaluation: January 6, 2014
- Physiotherapy Clinic follow-up: January 27, 2014
Physio clinic visit #2 (case study #1)

- 2014-01-27
- Asymptomatic
- Neuropsychology testing complete
- No follow-up required
- Physical exertion test successfully completed
- Discharge from clinic 70 days post injury
Case study #2

- 12 yr old female
- Non sportive
- Grade 6
- Slightly below average, works hard
- Prior to concussion headaches 3-4 per month
- C/O increased headaches and dizziness prior to injury
- History of motion sickness
Case study #2

- 2014-01-13
- At home in bathroom felt dizzy
- Fell hitting left side of head on the bathroom floor
- C/O headache and dizziness
- Stayed home the next few days
- 2014-01-17
- During the night got up felt dizzy and fainted in bathroom
- Came to MCH Emergency Department
Emergency department visit #1 (case study #2)

- ED-management:
  - ECG – normal; Blood test – normal; urine analysis – normal
  - Physical and cognitive restrictions provided by ED upon discharge
  - Referred to mTBI clinic
Clinic coordinator Assessment (case study #2)

- Initial visit 2014-01-23
- 10 days post initial injury
- History taken
- PCS: Total score = 30
- Reported constant dizziness, difficulty falling asleep secondary to dizziness and feelings of sadness
- Education provided in regards to activity and cognitive restrictions
Plan (case study #2)

- Monitor mood and sleep problems
- Physiotherapy referral for evaluation at 3 weeks
- Proper hydration
- Follow academic recommendations and activity restrictions
Role of the Physiotherapist

- Role of physical activity restrictions in early phase of recovery
- Role of exercise in sub-acute phase of recovery
  - assist in resolving impairments due to MTBI
- Identify oculo-motor & vestibular-related deficits and develop an exercise program:
  - reduce complaints of dizziness, gaze instability, and imbalance
- Identify neck impairments and develop an exercise program
  - reduce neck pain, improve neck ROM and reduce tension-type HA
- Readiness for RTP once asymptomatic at rest for 1 week
  - complete physical exerting testing and teaching a graded-stepwise RTP guidelines
Consensus statement on concussion in sport: the 4th International Conference on Concussion in Sport held in Zurich, November 2012

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Concussion management

The consensus group recommends that the clinician should evaluate neurocognitive status using a validated psychometric and then a graded programme of exertion prior to medical clearance and RTP. The current published evidence evaluating the effect of rest following a sports-related concussion is sparse. An initial period of rest in the acute symptomatic period following injury (24–48 h) may be of benefit. Further research to evaluate the long-term outcome of rest, and the optimal amount and type of rest, is needed. In the absence of evidence-based recommendations, a sensible approach involves the gradual return to school and social activities (prior to contact sports) in a manner that does not result in a significant exacerbation of symptoms.

Low-level exercise for those who are slow to recover may be of benefit, although the optimal timing following injury for initiation of this treatment is currently unknown.

As described above, the majority of injuries will recover spontaneously over several days. In these situations, it is expected that an athlete will proceed progressively through a stepwise RTP strategy.58
Some patients experience persistent symptoms

Management options

1. Continue rest and avoid vigorous exercise
2. Limited activities under parental and school supervision
3. Treatment of symptoms:
   • Pharmacotherapy (eg. analgesics for HA; Melatonin for sleep disturbances; Psychostimulants for cognitive deficits)
   • Cognitive therapy (behavioral issues)
   • Physiotherapy musculo-skeletal treatment for neck pain
   • Physiotherapy vestibular rehabilitation for vestibular-impairments
4. Implement supervised physiotherapy active rehabilitation
Sub-acute phase of recovery

Is Rest After Concussion “The Best Medicine?”: Recommendations for Activity Resumption Following Concussion in Athletes, Civilians, and Military Service Members

Journal of Head Trauma Rehabilitation, 2012

TABLE 2 Recommendations for activity resumption following MTBI

1. Bed rest exceeding 3 days is not recommended. (Strength of recommendation = D)
2. Gradual resumption of preinjury activities should begin as soon as tolerated. (Strength of recommendation = B)
3. For contact sports and other activities with a high MTBI exposure risk, a delay of at least 1 week will help reduce the risk of overlapping injuries. (Strength of recommendation = B)
4. The medium- and long-term risks of exertion sufficient to exacerbate symptoms are unknown. In theory, during the acute recovery period (eg, first 2 weeks postinjury), heavy exertion that elicits significant symptoms could be harmful. We simply do not know. In response to symptom exacerbations, patients should therefore be advised to temporarily reduce their physical and cognitive demands and resume their graduated return to activity at a slower pace. (Strength of recommendation = I)
5. Return to school should be considered as per usual milestones. Individuals who remain symptomatic. (Strength of recommendation = C)
The MCH Trauma Programs has developed an approach, with patients who sustain mTBI in order to better monitor their return to competitive physical activities, which includes:

- individualized symptom management
- return to activity protocols (closely monitored step-wise method)
Physiotherapy active rehabilitation after mTBI

- Slow to recover patients are at risk for secondary problems if their activities are stopped for an extended period of time while they wait for complete symptom resolution:
  - Physical de-conditioning
  - Anxiety and stress
  - Mild depression
  - Irritability
Clinical program is based on the following principles:
- Aerobic activity has a cerebral effect and an effect on mental health
- Sport-specific skill practice increases endorphin release
- Improvement in mood, self-efficacy and performance
- Leads to empowerment and improved coping
Logic Model: Active Rehabilitation

Literature Review + Delphi consultation

Aerobic Activity
- Increased BDNF
- Increased cardiovascular activity
- Altered cerebral vascular function and brain perfusion
- Increased endorphin release

Coordination and Skill practice (enjoyed activity)
- Improved physical conditioning
- Improved brain autoregulation
- Improved mood

Visualization of positive and successful activities related to preferred physical activity
- Synaptogenesis
- Regeneration of damaged structures
- Decreased fatigue
- Decreased headache
- Increased attention and concentration

Improved cognitive abilities
- Improved health state
- Increased confidence in services provided
- Decreased length of episode of care
- Cost-effectiveness of intervention

Improved performance
- Increased self-efficacy
- Decreased risk of re-injury
- Social reintegration for athletes

Education and motivation
- Activated brain regions linked to motor activity
- Increased reassurance about ability to practice sport

Decreased overall level of symptoms
- Increased information education about condition and rehabilitation
- Increased reassurance about recovery
- Increased empowerment/ coping
Active rehabilitation for children who are slow to recover following sport-related concussion

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Abstract

Primary objective: To present an innovative approach to the management of children who are slow to recover after a sport-related concussion.

Research design: The article describes the underlying principles and the development of specific interventions for a new rehabilitation programme as well as preliminary data on pre- and post-rehabilitation changes in outcome measures.

Methods and procedures: Development of the intervention was done using multiple perspectives including that of the literature, of experts in the field of traumatic brain injury and of experienced clinicians involved with the paediatric and adolescent MTBI clientele. A logic model was developed providing sound theoretical background to the intervention. The intervention was implemented and evaluated with a sample of 16 children and adolescents.

Main outcomes and results: The presented cases suggest that involvement in controlled and closely monitored rehabilitation in the post-acute period may promote recovery in children and adolescents who present with atypical recovery following a concussion. All 15 of the children and adolescents recovered.

Conclusions: A gradual, closely-supervised active rehabilitation programme in the post-acute period (i.e. after 1 month post-injury) appears promising to improve the care provided to children who are slow to recover.
Other important considerations

Headaches and neck pain after mTBI
Headaches and neck pain after mTBI

- In some cases, the origin of post-concussive headaches may be related to a dysfunction in the neck.
- Blow to the head often involves abrupt movements of the neck which could be the source of acute muscular or joint problems.
- Nerves pass through muscle structures, so they may be compressed in several places and refer symptoms.
Headaches and neck pain after mTBI

- Mechanism of injury may involve other structures than the brain
  - Bony structures of the neck & skull base
  - Joint structures
    - vertebrae
    - TMJ
  - Neck muscles
  - Nerves of the neck and cranial nerves
When to refer for specific intervention?

- If complaints of neck pain persist beyond the acute period (5-7 days)
- If a suspected cause for headache (base of the neck, posterior surface of the head, sometimes around the eyes) is neck-related
  - PT may be indicated (exercises; joint mobilization)
  - Pharmacological intervention (e.g. GON block)
Other important considerations

Oculomotor and vestibular function after MTBI
Mechanism of injury may involve other structures than the brain
- Vestibular system

Why focus on this system?
- Controls gaze stability
- Involved in balance control
- Anatomical situation and the many central connections make it vulnerable to injury
Oculomotor & vestibular function after MTBI

• Exact nature of the problem difficult to assess, little research to date
  • Connectivity
  • Integration with other systems
  • Specific peripheral lesion (e.g. BPPV)
Oculomotor & vestibular function after MTBI

• Physiotherapy screening assessment if the individual complains:
  • Dizziness
  • Increase in symptoms with walking or movement (corridor at school, shopping centre)
  • Nausea
  • Blurred vision, difficulty reading
  • Balance disorders
Oculomotor & vestibular function after MTBI

Oculomotor screen

Very quick tests to determine whether the integration of eye movements may be affected. If oculomotor testing is abnormal, clinical vestibular testing is non valid.
When to refer for specific intervention?

- If complains of diplopia, peripheral vision difficulties or lack of convergence after the PT screen:

  Referral to ophthalmology and/or optometrist is indicated
Oculomotor & vestibular function after MTBI

Vestibular screen
A. Common clinical tests
B. Postural control
Oculomotor & vestibular function after MTBI

Gait and function
C. Special tests

Figure 2. In the modified Frenz maneuver, the patient's head is systematically rotated so that the loose
When to refer for specific intervention?

If you have any questions after the screening assessment.

Vestibular physiotherapy may be indicated for treatment:
- habituation
- adaptation
- substitution

More specific assessment ENT may be indicated.
Background and Purpose: Management of dizziness and balance dysfunction is a major challenge after concussion. The purpose of this study was to examine the effect of vestibular rehabilitation in reducing dizziness and to improve gait and balance function in people after concussion.

Methods: A retrospective chart review of 114 patients (67 children aged 18 years and younger [mean, 16 years; range, 8–18 years]; 47 adults older than 18 years [mean, 41 years; range, 19–73 years]) referred for vestibular rehabilitation after concussion was performed. At the time of initial evaluation and discharge, recordings were made of outcome measures of self-report (e.g., dizziness severity, Activities-specific Balance Confidence Scale, and Dizziness Handicap Inventory) and gait and balance performance (e.g., Dynamic Gait Index, gait speed, and the Sensory Organization Test). A mixed-factor repeated-measures analysis of variance was used to test whether there was an effect of vestibular rehabilitation therapy and age on the outcome measures.

Results: The median length of time between concussion and initial evaluation was 61 days. Of the 114 patients who were referred, 84 returned for at least 1 visit. In these patients, improvements were observed in all self-report, gait, and balance performance measures at the time of discharge ($P < .05$). Children improved by a greater amount in dizziness severity ($P = .005$) and conditions 1 (eyes open, fixed support) and 2 (eyes closed, fixed support) of the Sensory Organization Test ($P < .025$).

Discussion: Vestibular rehabilitation may reduce dizziness and improve gait and balance function after concussion. For most measures, the improvement did not depend on age, indicating that vestibular rehabilitation may equally benefit both children and adults.

Conclusions: Vestibular rehabilitation should be considered in the management of individuals post concussion who have dizziness and gait and balance dysfunction that do not resolve with rest.
Physical exertion testing
Physical exertion testing

- When symptom-free for one week
- Physiotherapy Evaluation:
  - post-concussion scale
  - neurological exam
  - coordination and balance testing

- Ready for Physical exertion testing
Physical exertion testing

- If pass:
  - Discharge with RTS guidelines (student, coach and parents)
  - Attestation from clinic for school and coach(es)
- If fail:
  - Provide an individualized activity program or continue with activity restrictions
  - Ongoing weekly follow-up to monitor progress
  - Will only re-do physical exertion testing when symptom-free for one week
Physical exertion testing

• RTS Guidelines
  • Consists of 6 steps
  • Sports specific or general
  • To be progressed by 24 hour intervals
  • If symptoms appear:
    Stop
    Rest
    Return to previous step
Case study #2
Physio clinic visit # 1 (case study #2)

- February 7, 2014
- 25 days Post-injury
  - PCS: Total score = 49
    - Fatigued, moderate headache, extremely dizzy
  - Oculomotor screen:
    - diplopia R > L eye
    - poor convergence
    - saccadic movements L eye
  - Vestibular screen:
    - Functional gait Assessment: Total = 16/30
    - Balance: BOT2 – SD from the mean = -2.0- 1.0 (below average)
  - Active rehabilitation:
    - Unable to initiate during session as too symptomatic
    - Vestibular rehab initiated : X1 viewing, balance
Physiotherapy Plan (case study #2)

- Referral to Psychology
- Referral to Ophthalmology
- Good sleep hygiene, suggested a trial of Melatonin
- Home exercise program (active and vestibular rehabilitation)
  - X1 viewing (BID) in sitting; static balance ex.; walking 10 minutes
  - Weekly physiotherapy follow-up
Ophthalmology visit (case study #2)

- 2014-02-13
- 30 days post-injury
  - Recommend reading glasses
  - Follow-up in 2 months
Physio phone follow-up (case study #2)

- 2014-02-14
- 31 days post injury
- PCS: Total score = 47
- Remains symptomatic
- Melatonin X 1 week with no improvement falling asleep
- Compliant with home exercise program with slight improvement
Physio Plan (case study #2)

- Continue with same HEP
- Recommend headache management in ED
Emergency Department visit #2
(case study #2)

- 2014-02-17
- 35 days post injury
- IV Maxeran administered to relieve constant headache
- Seen by neurologist
- Prescribed: Tylenol (3X/wk max)
  ↑ Melatonin to 6 mg/day
  Amitriptyline (Elavil - 10 mg/day)
- Follow-up 2 months
Psychology evaluation (case study #2)

- February 25, 2014
- 43 days post injury
- interview with patient and her dad
- sub-test from the Wechsler test of intelligence WNL except for visual processing (0.1 percentile)
Psychology Plan  (case study #2)

- Detailed individualized academic accommodations provided to school
- Follow-up via telephone
- Re-evaluation PRN
Physiotherapy clinic visit #2 (case study #2)

- 2014-03-04
- 50 days post injury
- PCS: Total score = 25.5
- Headaches and dizziness have decreased
- Compliant with exercises
- Has reading glasses
- Medication: Elavil – now at 20 mg/day; Melatonin
- Vestibular re-evaluation:
  - Functional gait Assessment: Total = 25/30 (IMPROVED)
  - Balance: BOT2 – SD from the mean = -2.0- 1.0 (below average)
Physio clinic visit #2  treatment and plan

- **Rx:**
  - Active and vestibular rehab progressed

- **Plan:**
  - New HEP: walking with active head turns side to side and up/down within symptom-tolerance; Modified Brandt-Daroff ex; Habituation strategies to reduce dizziness in crowds, mall; education and reassurance
  - Phone f/u in 2 weeks
Physiotherapy clinic visit #3 (case study #2)

- 2014-04-07
- 84 days post injury
- PCS: Total score = 4.5
- Continues Elavil and Melatonin
- Looks well, normal posture, asymptomatic
- BOT: Body coordination = 27th percentile rank
- Physical exertion testing successfully completed
Plan (case study #2)

- Step 1-3 RTS guidelines, still on Elavil so not recommended to do team sports. Once weaned off Elavil, can progress to Step 4-5.
- Letter to physical education teacher provided
- Discharged from mTBI Program/Concussion Clinic
Neurology f/u (case study #2)

- 2014-07-07
- 168 days post injury
- Headache free
- No Melatonin and Elavil for one month
- Follow-up PRN
- Thank-you

- Questions???