Concussion Rehabilitation

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KAISER PERMANENTE ORTHOPAEDIC/SPORTS REHABILITATION FELLOWS

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Outline

- Pathophysiology
- Sideline Assessment
- Important Subjective Questions and Symptom Categories
- 4 main Assessment/Treatment categories
- Objective Tests including VOMS
- Early/Late Management
- Return to Sport

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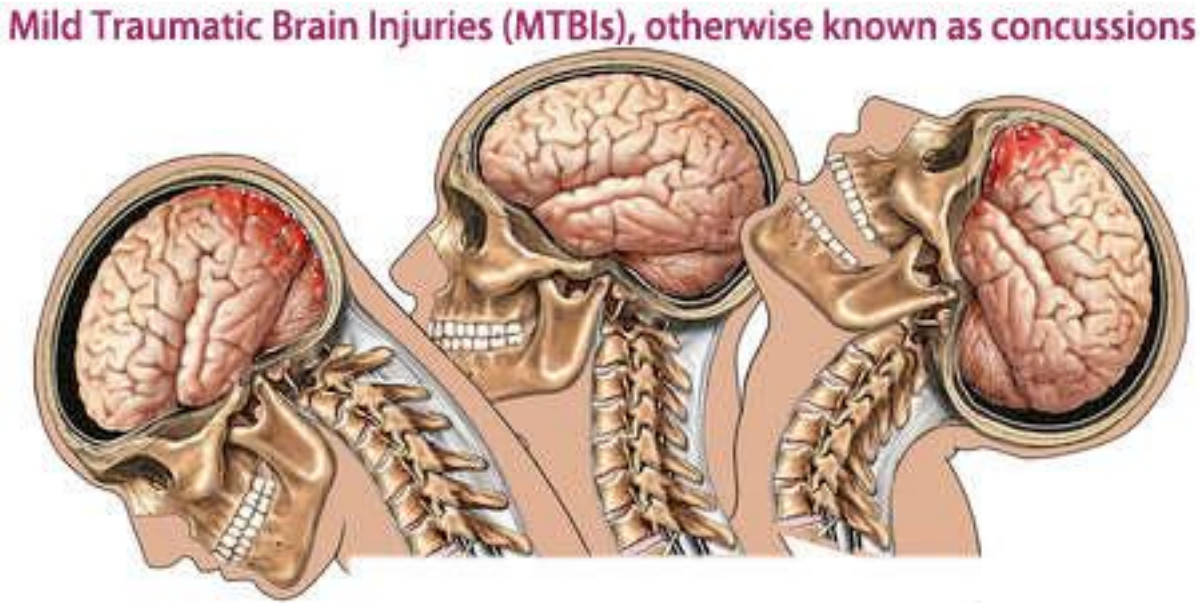
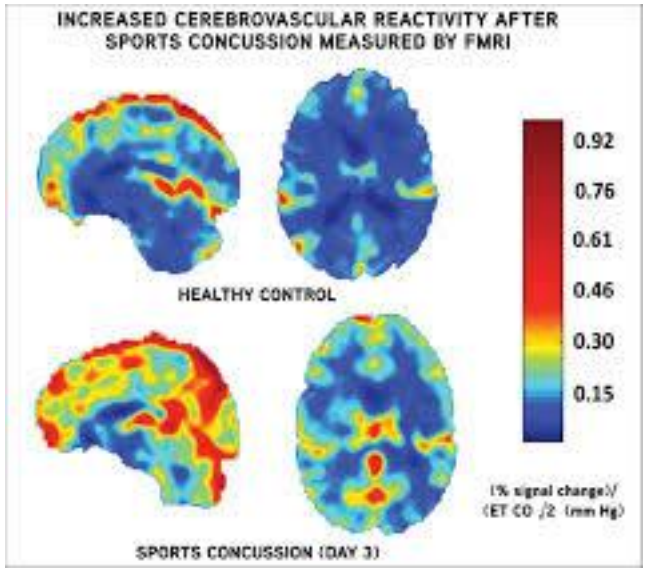
Pathophysiology





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Sideline Assessment for Athletics

- If Unconscious, assume unstable spine and immobilize
  - Needs to go to emergency room for imaging
- If Conscious, remove from emotion of the game before assessing
  - Cervical Spine ROM
  - Standardized Assessment of Concussion (SAC)
    - Short-term/ long-term memory
    - Orientation questions
    - Concentration assessment
  - If no symptom response, physically exert athlete and reassess for symptoms
  - If positive for possible concussion based off signs and symptoms, hold athlete from participation for remainder of day

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Detailed Subjective

- Obtain specific details on type of symptoms and provoking factors
- Most commonly noted symptoms is headache, assess history of HA or migraine prior to injury.
- Assess changes in hearing, ringing in ears, fullness in ears
- Assess difficulty swallowing, changes in speech, or double vision
- Symptoms may be rapid in onset or may be delayed
- Symptoms predicting prognosis…
- If loss of consciousness or vomiting were not present on the day of injury, more likely to recover in <7days.
- If Dizziness present on day of injury, increased likelihood of prolonged recovery >6 times more likely to take longer than 3 weeks to recover
- If resting symptoms present >3 days after injury, increased likelihood of protracted recovery
- Symptoms most likely to indicate prolonged recovery are Dizziness, amnesia and fogginess

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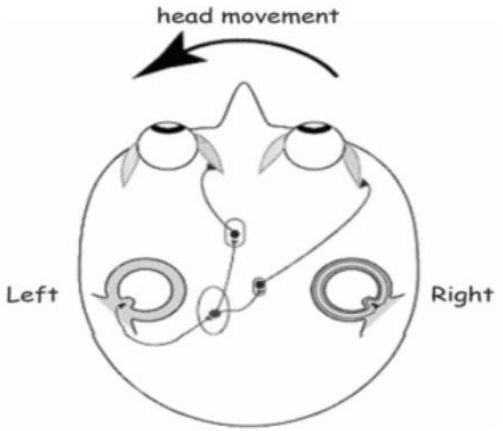
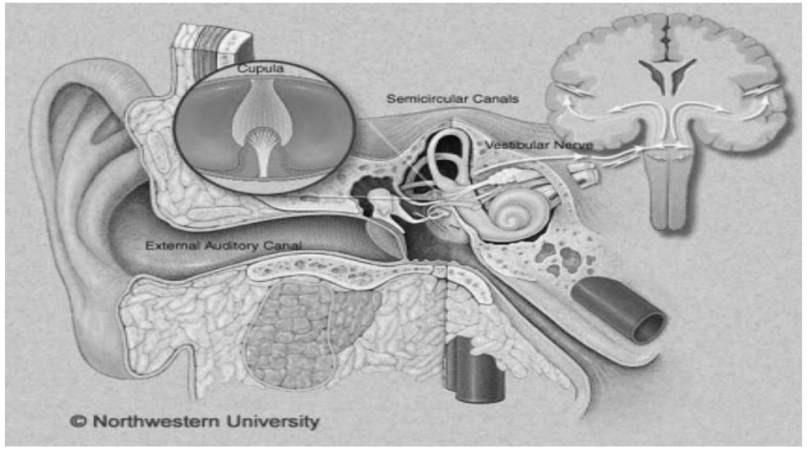
Four general symptom categories:



- Vestibular
  - PT vestibular evaluation and treatment
  - Help settle symptoms
- Ocular
  - Treated primarily by neuro-ophthalmologists or PTs
  - Treatment to focus on repeated stress (exposure to visual stimulus) and recoveries
  - For these patients, avoid dark rooms for rest as coming out of dark rooms can be harsh
- Cognitive
  - Managed primarily by psychology
  - Work on memory tasks or dual-tasking
  - Cognitive breaks
- Migrainous
  - Primarily managed medically
  - Treat any other symptoms overlayed from other categories



Hain, TC. http://www.dizziness-and-hearing.com. 27 Dec 2006 <http://www.dizziness-and-balance.com/images/master-ear.jpg>

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Be Objective

- Detailed Neurologic Exam
  - Cranial Nerve testing
  - UE/LE Dermatomes and Myotomes
- Neurocognitive testing:
  - SCAT3 used in clinic
  - Schools often use ImPACT computer based test
- Balance: Balance Error scoring system (BESS)
- Visual Occulomotor screen (VOMS)

SCAT3™

Sport Concussion Assessment Tool – 3rd Edition

For use by medical professionals only

Name | Date/Time of Injury: Date of Assessment: | Examiner:

What is the SCAT3?[1]

The SCAT3 is a standardized tool for evaluating injured athletes for concussion and can be used in athletes aged from 13 years and older. It supersedes the original SCAT and the SCAT2 published in 2005 and 2009, respectively[2]. For younger persons, ages 12 and under, please use the Child SCAT3. The SCAT3 is designed for use by medical professionals. If you are not qualified, please use the Sport Concussion Recognition Tool[3]. Preseason baseline testing with the SCAT3 can be helpful for interpreting post-injury test scores.

Specific instructions for use of the SCAT3 are provided on page 3. If you are not familiar with the SCAT3, please read through these instructions carefully. This tool may be freely copied in its current form for distribution to individuals, teams, groups and organizations. Any revision or any reproduction in a digital form requires approval by the Concussion in Sport Group.

NOTE: The diagnosis of a concussion is a clinical judgment, ideally made by a medical professional. The SCAT3 should not be used solely to make, or exclude, the diagnosis of concussion in the absence of clinical judgement. An athlete may have a concussion even if their SCAT3 is "normal".

What is a concussion?

A concussion is a disturbance in brain function caused by a direct or indirect force to the head. It results in a variety of non-specific signs and/or symptoms (some examples listed below) and most often does not involve loss of consciousness. Concussion should be suspected in the presence of **any one or more** of the following:

- Symptoms (e.g., headache), or
- Physical signs (e.g., unsteadiness), or
- Impaired brain function (e.g. confusion) or
- Abnormal behaviour (e.g., change in personality).

SIDELINE ASSESSMENT

Indications for Emergency Management

NOTE: A hit to the head can sometimes be associated with a more serious brain injury. Any of the following warrants consideration of activating emergency procedures and urgent transportation to the nearest hospital:

- Glasgow Coma score less than 15
- Deteriorating mental status
- Potential spinal injury
- Progressive, worsening symptoms or new neurologic signs

Potential signs of concussion?

If any of the following signs are observed after a direct or indirect blow to the head, the athlete should stop participation, be evaluated by a medical professional and **should not be permitted to return to sport the same day** if a concussion is suspected.

Any loss of consciousness?	☐ Y ☐ N
"If so, how long?"	
Balance or motor incoordination (stumbles, slow/laboured movements, etc.)?	☐ Y ☐ N
Disorientation or confusion (inability to respond appropriately to questions)?	☐ Y ☐ N
Loss of memory:	☐ Y ☐ N
"If so, how long?"	
"Before or after the injury?"	
Blank or vacant look:	☐ Y ☐ N
Visible facial injury in combination with any of the above:	☐ Y ☐ N

1 Glasgow coma scale (GCS)

Best eye response (E)	
No eye opening	1
Eye opening in response to pain	2
Eye opening to speech	3
Eyes opening spontaneously	4
Best verbal response (V)	
No verbal response	1
Incomprehensible sounds	2
Inappropriate words	3
Confused	4
Oriented	5
Best motor response (M)	
No motor response	1
Extension to pain	2
Abnormal flexion to pain	3
Flexion/Withdrawal to pain	4
Localizes to pain	5
Obeys commands	6
Glasgow Coma score (E + V + M)	of 15

GCS should be recorded for all athletes in case of subsequent deterioration.

2 Maddocks Score[3]

"I am going to ask you a few questions, please listen carefully and give your best effort."

Modified Maddocks questions (1 point for each correct answer)

What venue are we at today?	0	1
Which half is it now?	0	1
Who scored last in this match?	0	1
What team did you play last week/game?	0	1
Did your team win the last game?	0	1
Maddocks score		of 5

Maddocks score is validated for sideline diagnosis of concussion only and is not used for serial testing.

Notes: Mechanism of Injury ("tell me what happened"?):

Any athlete with a suspected concussion should be REMOVED FROM PLAY, medically assessed, monitored for deterioration (i.e., should not be left alone) and should not drive a motor vehicle until cleared to do so by a medical professional. No athlete diagnosed with concussion should be returned to sports participation on the day of injury.

BACKGROUND

Name: Date:

Examiner:

Sport/team/school: Date/time of injury:

Age: Gender: ☐ M ☐ F

Years of education completed:

Dominant hand: ☐ right ☐ left ☐ neither

How many concussions do you think you have had in the past?

When was the most recent concussion?

How long was your recovery from the most recent concussion?

Have you ever been hospitalized or had medical imaging done for a head injury?	☐ Y ☐ N
Have you ever been diagnosed with headaches or migraines?	☐ Y ☐ N
Do you have a learning disability, dyslexia, ADD/ADHD?	☐ Y ☐ N
Have you ever been diagnosed with depression, anxiety or other psychiatric disorder?	☐ Y ☐ N
Has anyone in your family ever been diagnosed with any of these problems?	☐ Y ☐ N
Are you on any medications? If yes, please list:	☐ Y ☐ N

SCAT3 to be done in resting state. Best done 10 or more minutes post excercise.

SYMPTOM EVALUATION

3 How do you feel?

"You should score yourself on the following symptoms, based on how you feel now".

	none	mild		moderate			severe
Headache	0	1	2	3	4	5	6
"Pressure in head"	0	1	2	3	4	5	6
Neck Pain	0	1	2	3	4	5	6
Nausea or vomiting	0	1	2	3	4	5	6
Dizziness	0	1	2	3	4	5	6
Blurred vision	0	1	2	3	4	5	6
Balance problems	0	1	2	3	4	5	6
Sensitivity to light	0	1	2	3	4	5	6
Sensitivity to noise	0	1	2	3	4	5	6
Feeling slowed down	0	1	2	3	4	5	6
Feeling like "in a fog"	0	1	2	3	4	5	6
"Don't feel right"	0	1	2	3	4	5	6
Difficulty concentrating	0	1	2	3	4	5	6
Difficulty remembering	0	1	2	3	4	5	6
Fatigue or low energy	0	1	2	3	4	5	6
Confusion	0	1	2	3	4	5	6
Drowsiness	0	1	2	3	4	5	6
Trouble falling asleep	0	1	2	3	4	5	6
More emotional	0	1	2	3	4	5	6
Irritability	0	1	2	3	4	5	6
Sadness	0	1	2	3	4	5	6
Nervous or Anxious	0	1	2	3	4	5	6

Total number of symptoms (Maximum possible 22)

Symptom severity score (Maximum possible 132)

Do the symptoms get worse with physical activity? ☐ Y ☐ N

Do the symptoms get worse with mental activity? ☐ Y ☐ N

☐ self rated ☐ self rated and clinician monitored

☐ clinician interview ☐ self rated with parent input

Overall rating: If you know the athlete well prior to the injury, how different is the athlete acting compared to his/her usual self?

Please circle one response:

no different	very different	unsure	N/A

Scoring on the SCAT3 should not be used as a stand-alone method to diagnose concussion, measure recovery or make decisions about an athlete's readiness to return to competition after concussion. Since signs and symptoms may evolve over time, it is important to consider repeat evaluation in the acute assessment of concussion.

COGNITIVE & PHYSICAL EVALUATION

4 Cognitive assessment

Standardized Assessment of Concussion (SAC)[4]

Orientation (1 point for each correct answer)

What month is it?	0	1
What is the date today?	0	1
What is the day of the week?	0	1
What year is it?	0	1
What time is it right now? (within 1 hour)	0	1
Orientation score		of 5

Immediate memory

List	Trial 1	Trial 2	Trial 3	Alternative word list		
elbow	0 1	0 1	0 1	candle	baby	finger
apple	0 1	0 1	0 1	paper	monkey	penny
carpet	0 1	0 1	0 1	sugar	perfume	blanket
saddle	0 1	0 1	0 1	sandwich	sunset	lemon
bubble	0 1	0 1	0 1	wagon	iron	insect
Total						

Immediate memory score total of 15

Concentration: Digits Backward

List	Trial 1	Alternative digit list		
4-9-3	0 1	6-2-9	5-2-6	4-1-5
3-8-1-4	0 1	3-2-7-9	1-7-9-5	4-9-6-8
6-2-9-7-1	0 1	1-5-2-8-6	3-8-5-2-7	6-1-8-4-3
7-1-8-4-6-2	0 1	5-3-9-1-4-8	8-3-1-9-6-4	7-2-4-8-5-6
Total of 4				

Concentration: Month in Reverse Order (1 pt. for entire sequence correct)

Dec-Nov-Oct-Sept-Aug-Jul-Jun-May-Apr-Mar-Feb-Jan	0	1
Concentration score		of 5

5 Neck Examination:

Range of motion Tenderness Upper and lower limb sensation & strength

Findings:

6 Balance examination

Do one or both of the following tests.

Footwear (shoes, barefoot, braces, tape, etc.)

Modified Balance Error Scoring System (BESS) testing[5]

Which foot was tested (i.e. which is the **non-dominant** foot) ☐ Left ☐ Right

Testing surface (hard floor, field, etc.)

Condition

Double leg stance:	Errors
Single leg stance (non-dominant foot):	Errors
Tandem stance (non-dominant foot at back):	Errors

And / Or

Tandem gait[6,7]

Time (best of 4 trials): _____ seconds

7 Coordination examination

Upper limb coordination

Which arm was tested: ☐ Left ☐ Right

Coordination score of 1

8 SAC Delayed Recall[4]

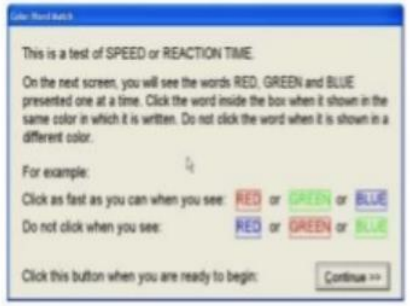
Delayed recall score of 5

Concussion Baseline Testing

ImPACT®

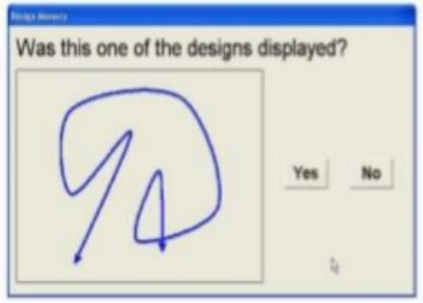
Immediate Post-Concussion Assessment and Cognitive Testing

Computer-Based Neurocognitive Testing



Reaction Time

Processing Speed



Visual Memory

Verbal Memory

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What ImPACT Is and Isn't:

- **IS** a useful and reliable/valid concussion management program.
- **IS** a tool to help determine recovery from injury.
- **IS** a tool to help manage concussion (e.g. return to exertion, return to academics, return to play).
- **IS** a tool to help communicate post-concussion status to coaches, parents, clinicians.
- **IS NOT** a substitute for medical evaluation / treatment

Score Card

Balance Error Scoring System (BESS)

(Guskiewicz)

Balance Error Scoring System – Types of Errors
1. Hands lifted off iliac crest 2. Opening eyes 3. Step, stumble, or fall 4. Moving hip into > 30 degrees abduction 5. Lifting forefoot or heel 6. Remaining out of test position >5 sec
The BESS is calculated by adding one error point for each error during the 6 20-second tests.

SCORE CARD: (# errors)	FIRM Surface	FOAM Surface
Double Leg Stance (feet together)		
Single Leg Stance (non-dominant foot)		
Tandem Stance (non-dom foot in back)		
Total Scores:		
BESS TOTAL:		

Which **foot** was tested: ☐ Left ☐ Right
(i.e. which is the **non-dominant** foot)

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Vestibular/Ocular Motor Screening (VOMS)

- Quick screen of 5 common clinical tests:
  - 1. Smooth Pursuit
  - 2. Horizontal and Vertical Saccades
  - 3. Convergence
  - 4. Horizontal and Vertical Vestibular Ocular Reflex (VOR)
  - 5. Visual Motion Sensitivity (VMS)
- Following each assessment in the VOMS, patient rate the following symptoms 0 (none) to 10 (severe):
  - Headache
  - Dizziness
  - Nausea
  - Fogginess
- Convergence is also assessed on near point of convergence (NPC) distance:
  - Normal ≤5cm

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Nystagmus

- Nystagmus can be a result of any disorder that results in the decreased or abnormal function of the VOR
- Abnormal VOR allows/makes the eyes drift to one side, followed by a central compensatory jerk of the eyes
  - Can be horizontal—with peripheral UVH
  - Can be vertical—with central disorders
  - Can have vertical or horizontal AND rotational component—with BPPV

VOMS

Horizontal and Vertical Smooth Pursuits

Horizontal and Vertical Saccades

Convergence

Horizontal and Vertical VOR

Visual Motion Sensitivity

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UPMC Vestibular/Ocular-Motor Screening (VOMS) for Concussion

Vestibular/Ocular Motor Test:	Not Tested	Headache 0-10	Dizziness 0-10	Nausea 0-10	Fogginess 0-10	Comments
BASELINE SYMPTOMS:	N/A					
Smooth Pursuits						
Saccades – Horizontal						
Saccades – Vertical						
Convergence (Near Point)						(Near Point in cm): Measure 1: _____ Measure 2:_____ Measure 3:_____
VOR – Horizontal						
VOR – Vertical						
Visual Motion Sensitivity Test						

Mucha et al, 2014

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Tests for VOR

- Static and Dynamic Visual Acuity
  - Allows us to see clearly when our head moves
  - Measure static acuity first
  - Dynamic: Tilt head forward 30 deg and move head at 2 Hz (2 side to side cycles per sec)
  - Note line pt. can accurately read all letters
  - >2 line change in score indicates vestibular impairment
- Head thrust test:
  - Maintain stable gaze with head movement
  - Specificity is 100%; Sensitivity 35% but if you tilt head 30 deg increases sensitivity
  - hold zygomatic arches, not mandible
  - high velocity but only about 15 deg rotation
  - Random!

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Early Management

- Education is KEY: "May feel worse before you feel better"
  - Patient
  - Family
  - Trainer/Coaches
- Prognosis: provide estimate of expected recovery times (adults heal faster)
  - 2-3 days for adults
  - 7-10 days for college athletes
  - 14-21 days for high school athletes
  - 28-35 days for middle school athletes
- Refer to MD or ED if symptoms worsen: HA, seizures, visual disturbances, N/T, extremity weakness, drowsiness

Early Management

- HA: Can take anti-inflammatory to help with pain
- Environment: screen time, bright lights, crowds
- Sleep: important for healing, consider routine bedtime, wake up time
  - if troubled: consider over-the-counter med's such as melatonin or Benadryl

Dizziness: Vestibular Interventions

- Adaptation: Improve gaze stability by increasing the gain of the VOR
- Habituation: Reduce sensitivity through repeated exposure
- Substitution: Use of other strategies to replace lost or compromised function
- Balance & Gait
- Optokinetic Stimulation: busy background videos/simulations
- Repositioning Maneuvers (For BPPV)

Vestibular adaptation exercises

- X1 viewing exercises:
  - Head moving while visually fixating on a stationary target
  - Hold or place letter/target, i.e. X, at ~ 2 . to 3 feet away at eye level
  - Turn head side to side or up and down 20 – 300 in either direction
  - Maintain target clear and stable
  - Provoke dizziness

- X2 viewing exercises:
  - Head moving while visually fixating on a moving target
  - Hold a business card with a letter, i.e. X, at arms length (or have someone else hold the card for you)
  - Turn head side to side or up and down 10-150 in either direction while moving the target in the opposite direction
  - Maintain clarity of target
  - Provoke dizziness
- Goal: 1- 2 minute of continuous gaze stability exercise, 3x in a row, 3 times/day

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Vestibular habituation exercises

- A long-term reduction in the pathologic response to a specific movement (noxious stimuli), brought about by repeated exposure to the provocative stimulus
- Have the patient complete a motion that creates dizziness
- Wait for the dizziness to end plus 40-60 seconds
- Repeat motion 5-10x
- Treatment considerations
  - 2-3 Motions/movements that are moderately stimulating
  - Number of repetitions (5-10 repetitions)
  - Frequency (3-5 times each day)

Vestibular substitution exercises

- **Visual Fixation on Stationary Object**
  - X1 viewing at slow speed to increase use of cervico-ocular reflex and central pre-programming
- **Active Eye Movements Between 2 Targets**
  - Facilitates use of saccadic or smooth pursuit strategies and central pre-programming
  - Hold 2 targets at eye level 10-12 inches apart, head in midline
  - Move eyes to one target
  - Maintain eyes on target and turn head to same target
  - Shift eyes to 2nd target
  - Move head to 2nd target
  - Repeat in opposite direction
- **Remembered/Imaginary Targets**
  - Improve voluntary control and central pre-programming
  - Place target directly in front of patient
  - While looking at the target, close eyes
  - Slowly turn head away while imagining the target
  - Have them open their eyes and verify still focused on the target adjust gaze if necessary
  - Repeat in multiple directions and at variable speeds

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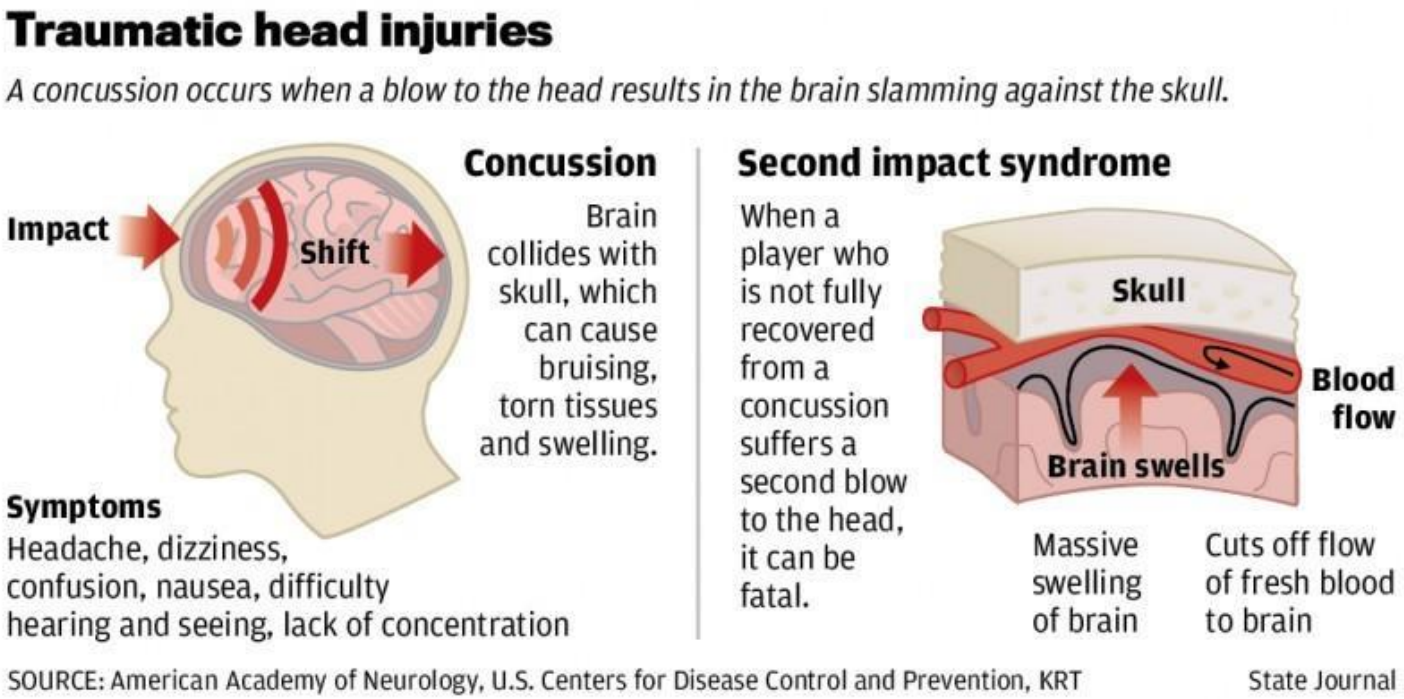
Late management

- Failed test becomes treatment
- Progress by incorporating other treatment categories:
  - Balance: SLS, unstable surface
  - Ocular: busy background, near vs far vision
  - Cognition: count backwards, dual tasking etc..
- DO NOT push patient past symptoms: best to stop at symptom onset
  - HA, dizziness, nausea, fogginess

Return to Sport



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Zurich Return to Play Guidelines (4 considerations)

- 1. Symptoms Resolution:
  - They must feel completely normal
  - Ask coach or Athletic Trainer if patient seems back to normal
  - Ask parents or siblings if they are back to normal
- 2. Normal Neurologic Exam:
  - Cranial Nerves, VOMS, and balance tests
- 3. Neurocognitive testing results returned to baseline
  - E.g. ImPACT results
- 4. Exertion
  - Graduated physical activity with no return of symptoms

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New Technology for concussion prevention: Q collar

Summary

- Symptoms are more than just a headache so make sure to ask about each one and dig into them
- Early management is focused on managing patient symptoms and screening for any other serious complications
- Late management can be categorized into one of 4 categories: Vestibular, Ocular, Cognitive, Migrainous
- VOMS is not only a great assessment tool but can also help direct your treatment
- Be objective especially when it comes to return to work/play where outside pressures may try to influence clinical judgment.

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Resources

- CDC Heads-up to Healthcare Providers
  - https://www.cdc.gov/headsup/providers/index.html
  - FREE – PDFs, online concussion courses, discharge criteria, progressive activity handouts
- Medbridge
  - Concussion courses for CEUs – Free as Kaiser PTs
  - Patient Education – Concussion video/handout
- SCAT 3
  - PDF of inventory or can be done online
  - http://www.sportphysio.ca/wp-content/uploads/SCAT-5.pdf

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Selected References

- Arnold T. Concussion in Sport: SCS Prep Course. lecture presented at the: Medbridge Education; June 1, 2019.
- Bell, D. R., Guskiewicz, K. M., Clark, M. A., & Padua, D. A. (2011). Systematic review of the balance error scoring system. *Sports health*, *3*(3), 287–295. doi:10.1177/1941738111403122
- Lau BC, Kontos AP, Collins MW, Mucha A, Lovell MR. Which on-field signs/symptoms predict protracted recovery from sport-related concussion among high school football players? The American journal of sports medicine. https://www.ncbi.nlm.nih.gov/pubmed/21712482. Published November 2011. Accessed April 10, 2019.
- Mucha A, Whitney S. Concussion Basics: Assessment, Screening, and Risk Factors. lecture presented at the: Medbridge Education; June 1, 2019.

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