

Future of Pediatrics: Concussion Management

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Management of Concussion in Youth: Time to Get Active!

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Concussion as ADHD in 1980

ADHD

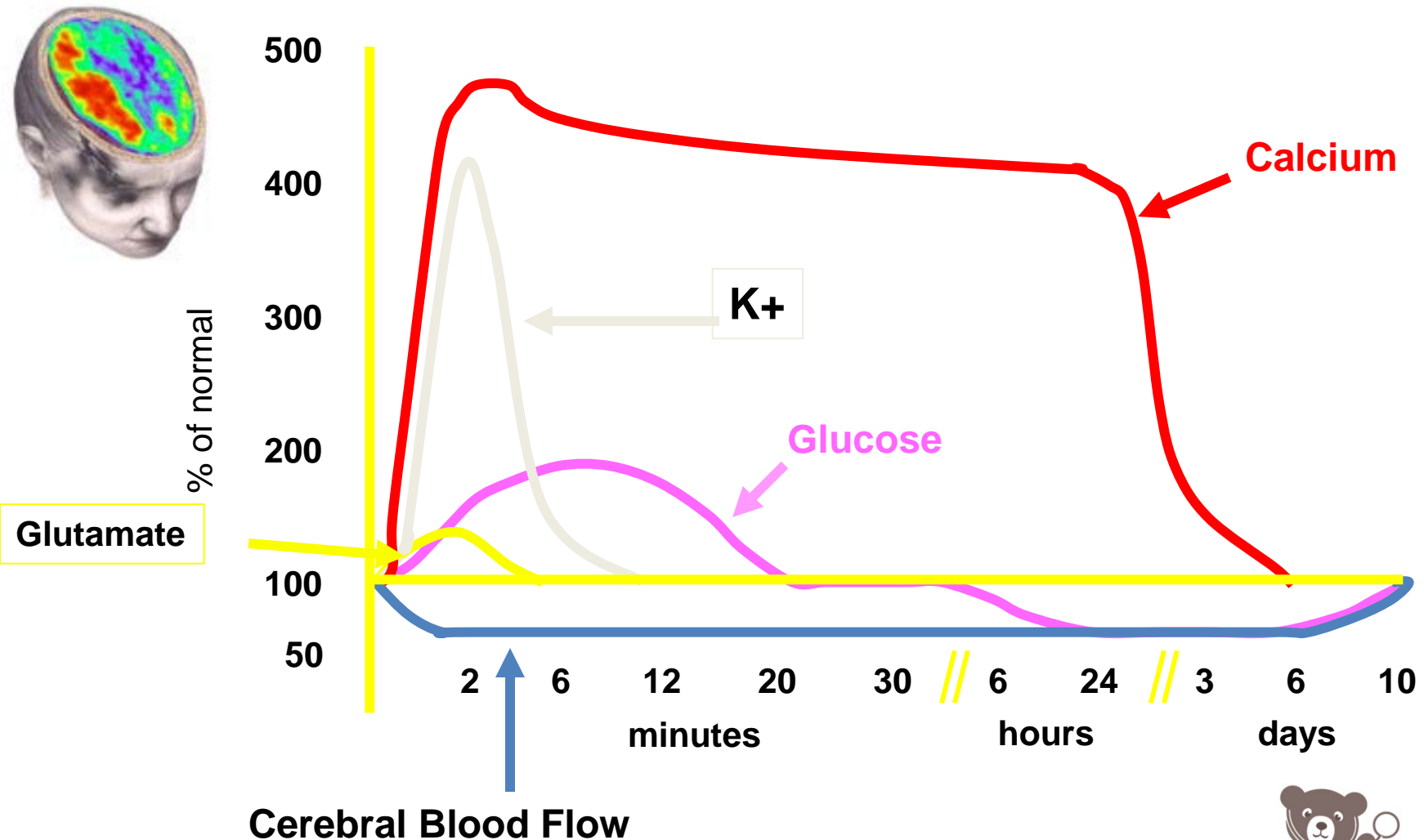
- 1980: Most kids were evaluated and treated by specialists
- 2013: Most kids are evaluated and treated by primary care physicians
 - Refer Complex Cases

Concussion

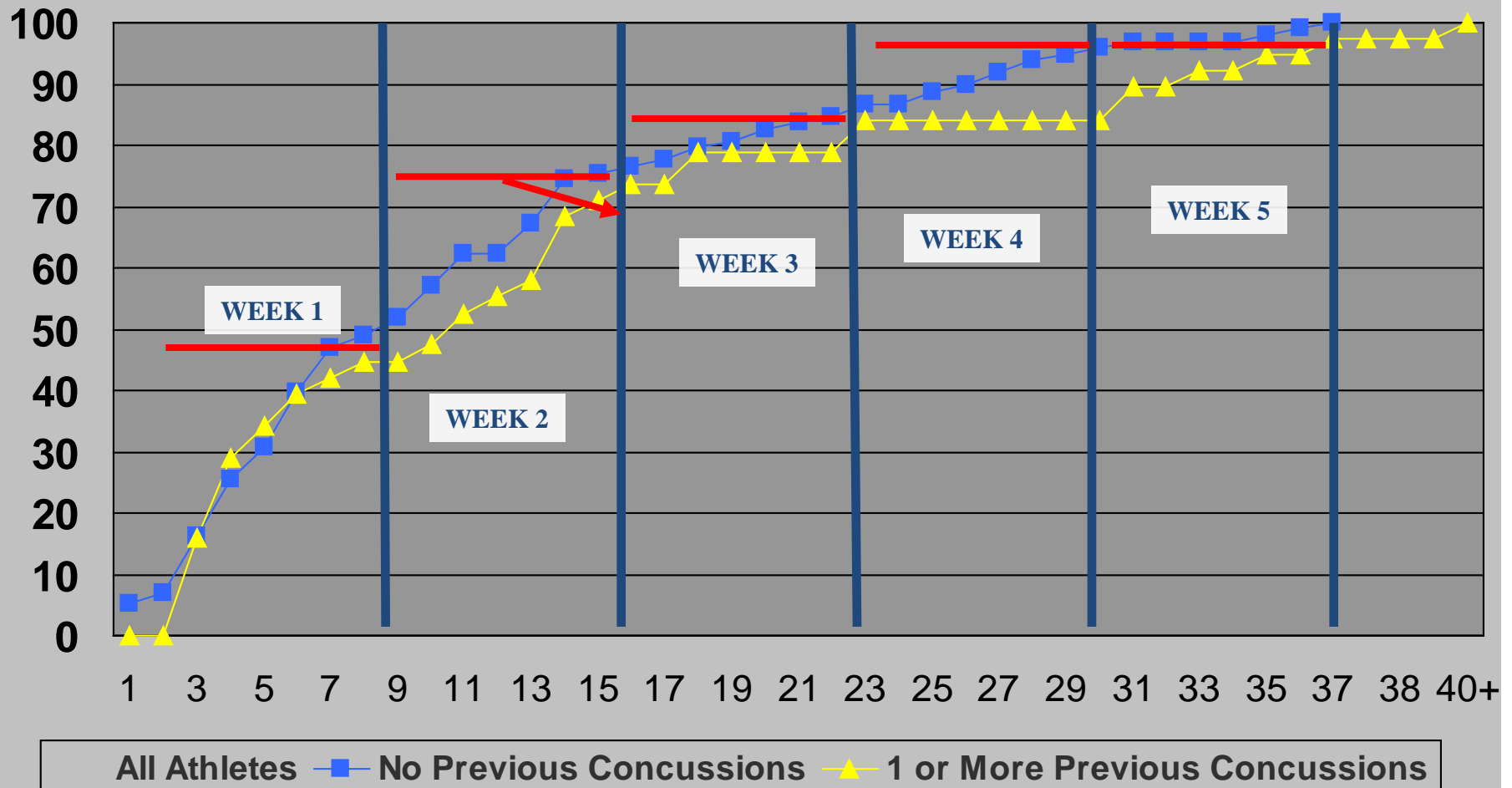
- 2013: Most kids are evaluated and treated by specialties
- 20??: Most kids are evaluated and treated by primary care physicians
 - Refer Complex Cases

Neurometabolic Cascade Following Traumatic Brain Injury

(Giza & Hovda, 2001)



Recovery From Concussion: How Long Can it Take?



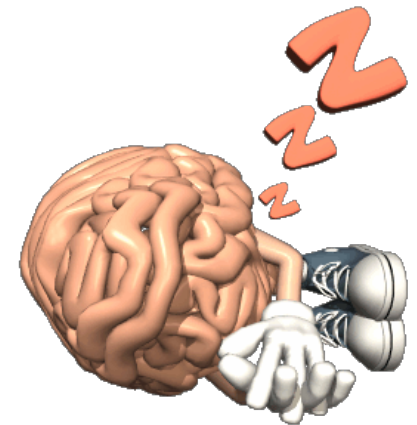
The Symptom Culprits

- Headaches
- Fatigue
- Vestibular (dizziness, balance)
- Cognitive problems (attention, memory, executive function, speed)
- Anxiety/ mood problems

Historic Approach(es) to Concussion Treatment

- REST
- REST
- REST

TIME



(CISG, AAP, etc.)

Is Rest After Concussion “The Best Medicine?”

- “Practice guidelines recommend an initial period of rest for concussion/ mild traumatic brain injury (MTBI)...
- BUT, compelling evidence that other health conditions can be worsened by inactivity, improved by early mobilization/ exercise...
- Best available evidence suggests that rest exceeding three days is probably more harmful than helpful...
- Gradual resumption of pre-injury activities should begin as soon as tolerated...
- Supervised exercise may benefit patients who are slow to recover...”

“New” Management Strategies

“Active” Rehabilitation

- No additional forces to head/ brain
- INITIALLY, resting the brain & getting good sleep (1st few days)
- Individualized moderated, monitored symptom management
 - Managing/ facilitating physiological recovery; teaching symptom monitoring, exertion concepts
 - Find the activity “sweet spot”
 - Optimized activity w/o over-exertion; Not too much BUT not too little
 - Plan of graduated physical and cognitive activation



Ways to over-exert

- Physical
- Cognitive (concentration)
- Emotional (stress)

Treatment Domain	Message
Patient/ Family Educational Interventions	<p>“Kids get better”</p> <p>“Every concussion is different (snowflakes)”</p>
General Symptom Management: Exertional Activity	<p>Balance activity with rest</p> <p>“Not too Little, Not too Much”</p>
Active Aerobic Rehabilitation	Dosing of physical activity
Management of Graduated Return to School	<p>“Get back to your routine, academically & socially”</p>
Targeted Symptom Intervention (persistent)	<p>“Treating symptoms that interfere with your recovery”</p>

Treatment Domain

Tools

Patient/ Family Educational Interventions

ACE Post-Concussion
Home/ School
Instructions
CDC Heads Up
materials

General Symptom
Management: Exertional
Activity

Progressive Activities
of Controlled Exertion
(PACE) Protocol

Active Aerobic Rehabilitation

PCERT
STR Progress Log

Management of Graduated
Return to School

Gradual Return to
School Chart

Targeted Symptom
Intervention (persistent)

Standard Therapeutic
Approaches



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Treatment Modalities

- Headache: behavioral medicine, lifestyle education, medication
- Cognitive problems: strategy use, environmental accommodations, medication
- Anxiety/ Mood: psychotherapy, medication
- Fatigue/ Sleep issues: behavioral sleep treatment, (medication)
- Vestibular dysfx: vestibular therapy

Standardized Acute mTBI Instructions for Home and School

Emergency
Department

Urgent Care

Pediatrician

ACE POST-CONCUSSION HOME/ SCHOOL INSTRUCTIONS



You have been evaluated for a suspected concussion.

Following these instructions can prevent further injury and help recovery.

WHEN TO SEEK CARE URGENTLY

Seek care quickly if symptoms worsen or if there are any behavioral changes.

Also, watch for any of the following Danger Signs:

Headaches that worsen	Very drowsy, can't be awakened	Can't recognize people or places
Seizures	Repeated vomiting	Increasing confusion
Neck pain	Slurred speech	Weakness/numbness in arms/legs
Unusual behavior change	Significant irritability	Less responsive than usual

If you observe any of the above Danger Signs, call your doctor or return to the Emergency Department *immediately*.

COMMON SIGNS & SYMPTOMS

It is common to have one or many concussion symptoms. There are four types of symptoms: physical, cognitive, emotional, and sleep. Keep track of them and record them.

Physical		Cognitive	Emotional	Sleep
Headache	Visual Problems	Feeling mentally foggy	Irritability	Drowsiness
Nausea/Vomiting	Fatigue/ Feeling tired	Feeling slowed down	Sadness	Sleeping less than usual
Dizziness	Sensitivity to light or noise	Difficulty remembering	More emotional	Sleeping more than usual
Balance Problems	Numbness	Difficulty concentrating	Nervousness	Trouble falling asleep

RETURNING TO DAILY ACTIVITIES

The key to recovery is sleeping, resting physically and mentally, and avoiding activities that *might* cause head injury.

- **Avoid:**
 - Physical activities that produce concussion symptoms, as this might increase the recovery time.
 - Lengthy mental activities requiring concentration (ie. Homework, schoolwork, job-related work, and extended video game playing) as these activities worsen symptoms and prolong recovery.
- **Sleep:** Get good sleep and take naps if tired. No late nights or sleepovers. It is NOT necessary to wake up periodically.
- The injured person should not participate in **ANY** high risk activities that might result in head injury until examined and cleared by a qualified health professional. High risk activities include sports, physical



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Activity-Rest Management

Concussion in Sports: Postconcussive Activity Levels, Symptoms, and Neurocognitive Performance

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Dianxu Ren, PhD*; Michael W. Collins, PhD*; Cara Camiolo Reddy, MD*;
Mark R. Lovell, PhD*; Amy K. Wagner, MD*

Objective: To examine the role postinjury activity level plays in postconcussive symptoms and performance on neurocognitive tests in a population of student-athletes.

Design: Retrospective cohort study with repeated measures

Not Too Little, Not Too Much

retrospectively assigned to 1 of 5 groups based on a postinjury activity intensity scale.

Results: Level of exertion was significantly related to all outcome variables ($P < .02$ for all comparisons). With multivariate analysis, activity intensity remained significant with respect to visual memory ($P = .003$) and reaction time ($P < .001$).

Conclusions: Activity level after concussion affected symptoms and neurocognitive recovery. Athletes engaging in high levels of activity after concussion demonstrated worse neurocognitive performance. For these tasks, those engaging in moderate levels of activity demonstrated the best performance.



"Active" Aerobic Rehabilitation

(Gagnon et al., 2009; Leddy et al, 2010)

- Structured and monitored subsymptom threshold exercise to facilitate healing.
- Progressive “controlled” exercise below level that produces symptom occurrence or worsening.

“Treatment with controlled exercise is a safe program that appears to improve PCS symptoms when compared with a no-treatment baseline.” (Leddy et al., 2010)

Active rehabilitation for children who are slow to recover following sport-related concussion

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(Received 25 February 2009; revised 29 August 2009; accepted 27 September 2009)

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 16 of the children and adolescents who participated in the programme experienced a relatively rapid recovery and returned to their normal lifestyles and sport participation.

A Preliminary Study of Subsymptom Threshold Exercise Training for Refractory Post-Concussion Syndrome

John J. Leddy, MD,*† Karl Kozlowski, PhD,‡ James P. Donnelly, PhD,§
David R. Pendergast, EdD,¶ Leonard H. Epstein, PhD,|| and Barry Willer, PhD**

Objective: To evaluate the safety and effectiveness of subsymptom threshold exercise training for the treatment of post-concussion syndrome (PCS).

Design: Prospective case series.

Setting: University Sports Medicine Concussion Clinic.

Participants: Twelve refractory patients with PCS (6 athletes and 6 nonathletes).

Intervention: Treadmill test to symptom exacerbation threshold (ST) before and after 2 to 3 weeks of baseline. Subjects then exercised 5 to 6 days per week at 80% ST heart rate (HR) until voluntary peak exertion without symptom exacerbation. Treadmill testing was repeated every 3 weeks.

Main Outcome Measures: Adverse reactions to exercise, PCS symptoms, HR, systolic blood pressure (SBP), achievement of maximal exertion, and return to work/sport.

Conclusions: Treatment with controlled exercise is a safe program that appears to improve PCS symptoms when compared with a no-treatment baseline. A randomized controlled study is warranted.

Key Words: traumatic brain injury, exertion, symptoms, physiology, blood pressure

(Clin J Sport Med 2010;20:21–27)

INTRODUCTION

The majority of patients with sport-related concussion recover within 7 to 10 days³ and nonathletes within the first months.² There is, however, a significant minority of athlete³ and nonathlete⁴ patients who continue to experience symptoms beyond this, called post-concussion syndrome (PCS). The World Health Organization defines PCS as persistence of 3 or more of the following after head injury: headache, dizziness, fatigue, irritability, insomnia, concentration difficulty, or memory difficulty.⁵ The primary forms of PCS treatment have traditionally included behavioral, educational, and pharmacologic

Benefits of Aerobic Activity

I. *Aerobic Activity*

Increase brain-derived neurotrophic factor (BDNF)

Synaptogenesis

Increased cardiovascular activity

Altered cerebral vascular function and brain perfusion

Increased endorphin release

Improved brain autoregulation

Improve overall fitness level

Reduce fatigue/improve energy levels

Reduce stress, worry and anxiety

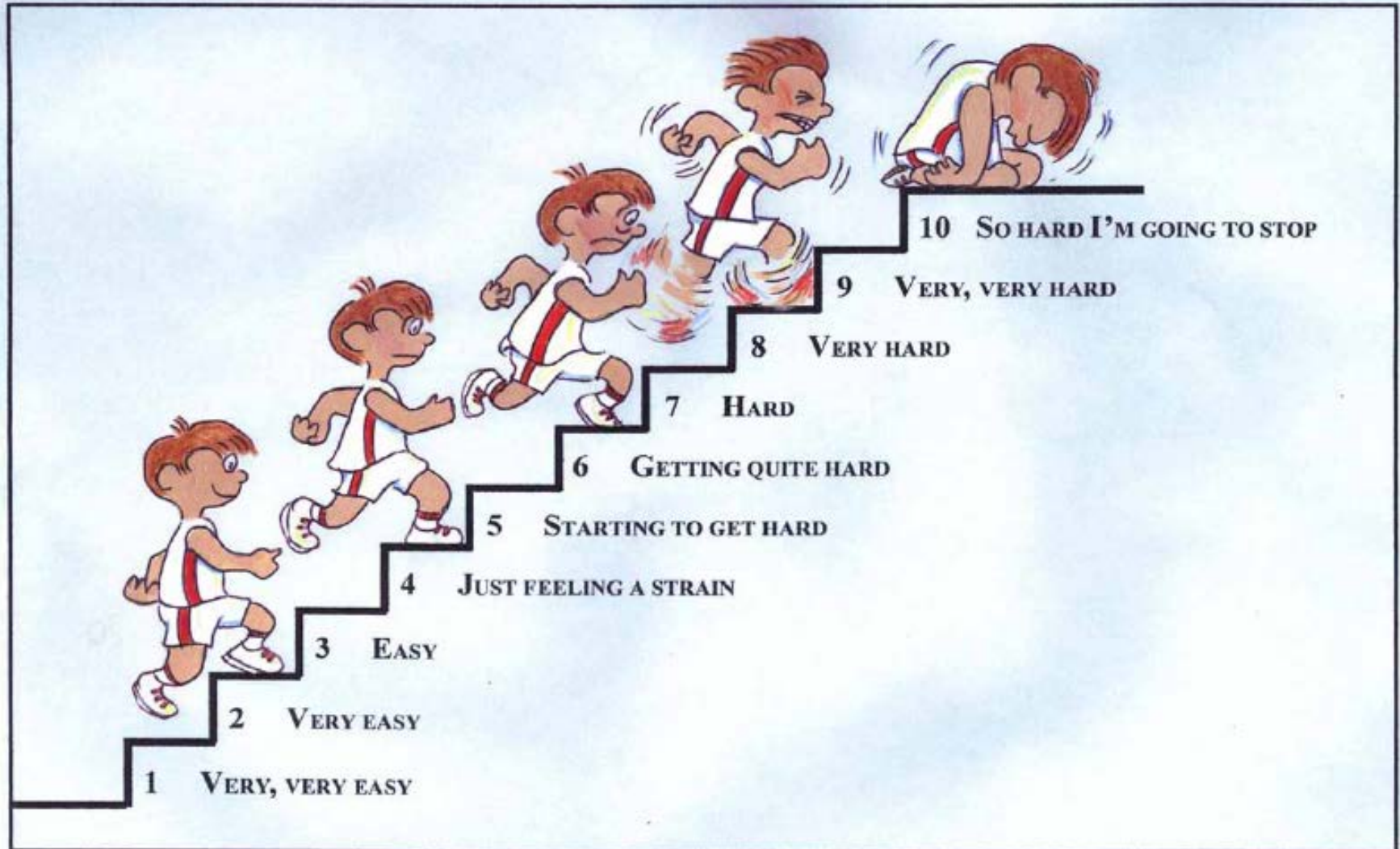
Improve mood

Improve cognition

Improve self-efficacy and performance



Pictorial Children's Effort Rating Table (PCERT)





STR PROGRESS LOG

Name _____

Therapist:

[illegible]

Gradual Return to School

Six Stages w Recommended Activity Level & Criteria for Movement

Stage	Description	Activity Level	Criteria to Move to Next Stage
0	No return, at home	Day 1 - Maintain low level cognitive and physical activity. No prolonged concentration. Cognitive Readiness Challenge: As symptoms improve, try reading or math challenge task for 10-30 minutes; assess for symptom increase.	To Move To Stage 1: (1) Student can sustain concentration for 30 minutes before significant symptom exacerbation, AND (2) Symptoms reduce or disappear with cognitive rest breaks* allowing return to activity.
1	Return to School, Partial Day (1-3 hours)	Attend 1-3 classes, intersperse rest breaks. No tests or homework. Minimal expectations for productivity.	To Move To Stage 2: Symptom status improving, tolerates 4-5 hours of activity-rest cycles; 2-3 cognitive rest breaks built into school day.
2	Full Day, Maximal Supports (required throughout day)	Attend most classes, with 2-3 rest breaks (20-30'), no tests. Minimal HW ($\leq 60'$). Minimal-moderate expectations for productivity.	To Move To Stage 3: Symptom number & severity improving, needs 1-2 cognitive rest breaks built into school day.
3	Return to Full Day, Moderate Supports (provided in response to symptoms during day)	Attend all classes with 1-2 rest breaks (20-30'); begin quizzes. Moderate HW (60-90') Moderate expectations for productivity. Design schedule for make-up work.	To Move To Stage 4: Continued symptom improvement, needs no more than 1 cognitive rest break per day
4	Return to Full Day, Minimal Supports (Monitor final recovery)	Attend all classes with 0-1 rest breaks (20-30'); begin modified tests (breaks, extra time). HW (90+')	To Move To Stage 5: No active symptoms, no exertional effects across the full school day.
5	Full Return, No Supports Needed	Full class schedule, no rest breaks. Max. expectations for productivity.	N/A

Summary

Active Treatment

- Multiple factors appear to relate to recovery duration in mTBI
- Most children and adolescents recover within 1-3 weeks
- INITIAL rest (& getting good sleep) appears to have support
- Active Education & reassurance from Day 1 has support
- Activity-Exertion Management
 - Teaching positive symptom monitoring, promoting self-efficacy
 - Addressing emotional response to injury
 - Find the activity “sweet spot”
 - Optimized activity w/o over-exertion: Not too much BUT not too little
- Physical activation protocols have promise
- Return to School as soon as tolerable, gradually

Rest and Concussion Management

- *Marc P. DiFazio, MD*
- *Medical Director*
- Children's National Outpatient Center
- of Montgomery County, MD (ROC)

Rest and Concussion Management: Current State

- Post-concussion
 - Often told to avoid school, physical activities, technology
 - If during activities return of symptoms, instructed to stop
 - Implication: *continued symptoms represent ongoing concussion related injury/exacerbation*


21st Century Rest


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activi
video
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loud n

Rancho Santiago Community College District

ATHLETICS

Concussion Home Instructions

☐ SANTA ANA COLLEGE

☐ SANTIAGO CANYON COLLEGE

I believe that _____ sustained a concussion on _____.

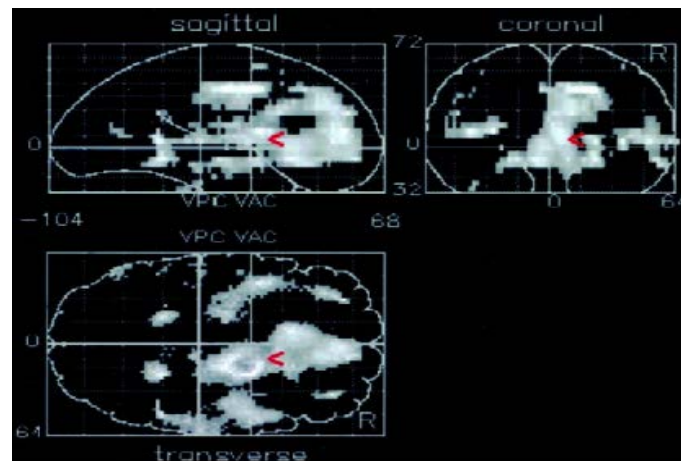
To make sure he/she recovers, please follow the following important recommendations:

1. Please **remind** to report to the athletic training room tomorrow at _____ for a follow-up evaluation.
2. Please **review** the items outlined on the **Physician Referral Checklist** (back of the sheet). If any of these problems develop prior to his/her visit, please call _____ or contact the local emergency medical system or your family physician. Otherwise, you can follow the instructions outline below.

It is OK to:	There is NO need to:	Do NOT:
<ul style="list-style-type: none">• Use acetaminophen (Tylenol) for headaches• Use ice pack on head and neck as needed for comfort• Eat a light diet and stay hydrated	<ul style="list-style-type: none">• Check eyes with flashlight• Test reflexes• Stay in bed• Wake up every hour	<ul style="list-style-type: none">• Drink alcohol• Eat spicy food• Hot Tub• Take aspirin/ibuprofen (Advil)

Is it possible to put the brain to rest?

- Volitionally? no.
- Impossible to “stop thinking” or consuming substrate
- No evidence technology (“Screen time”) more prone to consuming substrate
- No evidence that exercise “steals” healing capabilities or substrate from the brain
- Sleep states often more active versus wakefulness



Nofzinger 1997

What's wrong with rest?

Bed rest: a potentially harmful treatment needing more careful evaluation

- *“Published results give little support for bed rest as a form of management in a wide range of settings, and suggest that it may actually delay recovery and even harm the patient.”*

Self-Perpetuating Cycle

- Anxiety/fear regarding exacerbating symptoms



- Heightened sense of vulnerability



- Avoidance of exacerbating situations



- Increased sedentary behaviors



- Worsened symptoms, diminished conditioning

- Experimental Bed Rest

- 3-6 days: Headache, dizziness, mood changes, restlessness, poor sleep

Are we worsening symptoms?

DEC. 13, 1947	DANGERS OF
THE DANGERS OF GOING TO BED	
BY	
R. A. J. ASHER, M.D., M.R.C.P.	

- ▣ *"Lastly, consider the mental changes, the demoralizing effects of staying in bed. At the start it may produce fussiness, pettiness, and irritability. The patient may acquire an exaggerated idea of the seriousness of his illness and think, " Surely I must be very ill if I am kept in bed ? " At a later stage a dismal lethargy overcomes the victim."*

THE EVIL SEQUELAE OF COMPLETE
BED REST
WILLIAM DOCK, M.D. .
LOS ANGELES 1944

**Reassurance and Short Period of Bed Rest
in the Treatment of Concussion.**
**Follow-up and Comparison with Results in Other Series
Treated by Prolonged Bed Rest.**

1957



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Are we in part responsible for prolonged post-concussive symptoms?

The Activity Restriction Model of Depressed Affect

**Antecedents and Consequences
of Restricted Normal Activities**

GAIL M. WILLIAMSON and DAVID R. SHAFFER

“Stated explicitly, health-related stressors appear to affect depressive symptoms largely (and sometimes, only) to the extent that they restrict ability to conduct routine activities.”



EFFECTS OF A SYMPTOM-FREE WAITING PERIOD ON CLINICAL OUTCOME AND RISK OF REINJURY AFTER SPORT-RELATED CONCUSSION

CONCLUSION: Our findings suggest that an SFWP did not intrinsically influence clinical recovery or reduce risk of a repeat concussion. The overall risk of same-season repeat concussion seems to be relatively low, but there may be a period of vulnerability that increases risk of repeat concussion during the first 7 to 10 days postinjury. Further study is required to investigate this preliminary finding and help determine whether this risk can be reduced further with specific injury-management strategies.

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

- *Bernhardt 2008*
 - *Example: Stroke*
 - *Early mobilization/activity /engagement*
 - *Maximizing independence, decreased depression*
 - *"Being sedentary after an injury or illness is one of the most consistent risk factors for chronic disability"*

Minimize your recommendations for Rest

“...Authors caution against assuming that rest is helpful and suggest that it be subject to the same methodologically rigorous evaluation as any other intervention”

Complicated/Atypical/Slow to Recover Cases: What's not in the guidelines (yet)?

- Elizabeth Wells, MD, MHSc
- Pediatric Neurologist
- Assistant Professor, Pediatrics,
Neurology & Integrative Systems
Biology

Talk Objectives

- Management of patients with pre-existing neurologic conditions
- When to refer to subspecialists
- What to expect from consultation
- Approach to slow to recover cases

Children's National Concussion Team

- SCORE Neuropsychology
- Neurology
- Behavioral Medicine/Pain Psychology
- Physical Medicine
- Sleep Medicine
- Neuro-Ophthalmology
- Neuro-Radiology
- Emergency Department

Beyond Standard Management

- Who needs neurology referral?
 - Pre-existing neurologic conditions with question of post-injury involvement and management
 - ?worse injury or other acute problem (red flags)
 - Atypical symptom pattern
 - Slow to recover
 - Any patients you want us to see
- Referral sources
 - Concussion clinic (SCORE), PMD, other specialists, families
- Research is lacking

Pre-Existing Neurologic Conditions

- Chronic headaches, ADHD, mood disorders, sleep disorders, movement disorders, epilepsy, other conditions may worsen post concussion
- Concussion may be “tipping point”- need for intensified management
- **Patients benefit from having provider who best knows their medical and social history involved in their concussion care (PMD or subspecialist)**

Pre-Existing Neurologic Conditions

- Start with reassurance (most kids do fine) and standard management
- Clearance = return to pre-injury baseline
- Continue chronic therapies/medication
- See primary neurologist (or psychiatrist/psychologist/sleep specialist/pain doc) if not improved shortly after injury

Pre-Existing ADHD

- May hold stimulants for 1-2 days but not necessary
- Discontinuing stimulants may worsen mental fogginess, executive dysfunction, moodiness
- Complicates assessments
- Previously untreated may worsen post-concussion – consider 504/IEP or medication if prolonged

Pre-Existing Chronic Headaches

- Reinforce preventative care
 - Hydration
 - Sleep
 - Not skipping meals
- Address triggers
 - Noise/sound/crowds
 - Stress management (including new stressors: change in routine, missed school, sitting out sports)
 - Overexertion
- Continue preventative medications
- Abortive therapy often ineffective with concussion; watch for medication-overuse headaches

Slow to Recover Assessments

- Is this “concussion”?
 - Pattern of symptoms
 - Serial neuropsychological assessments
 - Personal/family history
 - Psychosocial factors
- Identify any driving symptoms (pain, cognition, mood, sleep)
- Comprehensive evaluation
 - Consider concussion context/timecourse
 - Broaden differential/assess as if the concussion didn’t happen

Slow to Recover Management

- Symptomatic care
 - Non-medicinal therapies/lifestyle modification/exercise
 - Medications
 - Headache prevention (3 month minimum)
 - Temporary stimulants for cognitive exertion (discuss timecourse)
 - None proven
- Other subspecialists: behavioral medicine, physical medicine, psychiatry, sleep medicine, etc
- Clearance for contact – complicated
 - Balance concern for worse symptoms from additional impact versus benefit of returning to “normal”
 - Requires coordination between PMD, concussion team and other specialists

Approach to Challenging Concussion Cases: Summary

- PMD plays key role
- Refer early to comprehensive concussion clinic
- Serial assessments help
- Notify/refer to patients' own subspecialists
- Need individualized assessment, plan, support
- Keep moving forward
- Clearance point = pre-injury baseline
- Goal: restore normal function (academic, athletic)