Optometric Evaluation of Concussion Patients

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Illinois College of Optometry
Associate Professor
Lecture Goals

- Geared toward the primary care optometrist
- Minimal focus on neurology

- Will review:
  - presentation of concussion
  - Important facts to know for well rounded care

- Determine optometric testing sequence and intervention options
Definitions

- **Traumatic Brain Injury (TBI)** - results from acute impact to the head causing brain dysfunction

- **Concussion** - a form of mild traumatic brain injury (TBI) owing to structural, metabolic and functional changes involving white mater tracts of the central nervous system in the absence of macroscopic findings
Concussions and Our Kids

America’s Leading Expert on How to Protect Young Athletes and Keep Sports Safe

Robert Cantu, M.D.
And Mark Hyman

The Danger of Concussions

Concussions Force Steve Young Into Retirement

San Francisco 49ers quarterback Steve Young lays motionless after suffering a concussion in the second quarter of the 49ers’ game against the Arizona Cardinals.

The Impact of Concussions

Former Football Players Sue NFL

All players who reported any symptoms of MTBI to the team athletic trainers or physicians were included in this study.
Concussion

- Significant short and long term issues
- Early diagnosis and treatment are key to recovery
- Visual symptoms and signs are common post recovery

- **Affects**
  - Balance
  - Cognition
  - Vision
    - Vision involves \( \frac{1}{2} \) of the brain’s systems
    - Many of the areas of the brain housing visual systems are susceptible to impact
What does the primary care practitioner need to know?
Concussion

- Neuro-ophthalmologic Findings
  - Accommodation
  - Convergence
  - Extraocular motility
  - Stereo acuity
  - Pursuits
  - Saccades
  - Vestibulo-ocular reflex
  - Balance
  - Cognition
  - Vision
Concussion Facts

- Functional rather than structural injury
- Axonal predilection – Diffuse axonal injury
- Loss of consciousness in less than 10%

Concussion Epidemiology

- 300,000 to 4 million per year

- Nearly 85% of concussions may go undiagnosed
  - Multiple studies suggest rate on rise

- Sports most affected
  - Boys’ High school football
  - Followed by girls' soccer

- Girls have a higher rate of concussion

CDC Report 2007 JAMA 2010
High School Concussions
(per 100,000)

Football: Between 60 and 76
Girl's soccer: Between 33 and 35
Boys' lacrosse: Between 30 and 46
Girls' lacrosse: Between 20 and 31
Boys' soccer: Between 17 and 19
Boys' wrestling: Between 17 and 23
Girls' basketball: Between 16 and 18
Softball: Between 11 and 16
Boys' basketball: Between 11 and 21
Girls' field hockey: Between 10 and 24
Cheerleading: 11
Girls' volleyball: Between 5 and 8
Boys' baseball: Between 4 and 6

Concussion in Youth Sports

Children are more susceptible to head injury than adults and require a longer period of recovery than adults.

Age of First Exposure to Football and Later-Life Cognitive Impairment in Former NFL Players (DETECT study)

Analysis of cognitive function among 42 former NFL players based-on age of first exposure (AFE) to tackle football

- **AFE <12 years**
  - associated with *greater later-life cognitive impairment* vs.
- **AFE >12 years**
  - Repetitive head trauma during critical period of brain development may lead to later-life cognitive impairment

Common Signs & Symptoms

**COGNITIVE**
- Feeling Mentally Fogy
- Difficulty Concentrating
- Difficulty Remembering
- Repeats Questions
- Feeling Mentally Slowed Down
- Forgetful of Recent Information
- Confused About Recent Events
- Answers Questions Slowly

**EMOTIONAL**
- Irritability
- Sadness
- More Emotional
- Nervousness

**PHYSICAL**
- Headache
- Nausea/Vomiting
- Balance Problems
- Numbness/Tingling
- Sensitivity to Light/Noise
- Visual Problems
- Dizziness
- Dazed or Stunned

**SLEEP**
- Drowsiness
- Sleeping Less Than Usual
- Sleeping More Than Usual
- Trouble Falling Asleep
Vision Problems Associated with Concussion

- Photophobia
- Accommodative dysfunction
- Binocular Vision dysfunction
  (Convergence insufficiency)
- Saccadic dysfunction
Vision Problems Associated with Concussion

Photophobia

Accommodative dysfunction

Binocular Vision dysfunction
  (Convergence insufficiency)

Saccadic dysfunction
Photophobia

- Photophobia/Photosensitivity an elevated sensitivity to light in the absence of ocular inflammation or infection
  - Reported in between 20-40% in those with TBI who are NOT visually-symptomatic
  - Reported in nearly 50% of those with TBI who ARE visually-symptomatic

- Types of photosensitivity may be:
  1) generalized to all types of lighting
  2) selective to fluorescent lighting

Photophobia Etiology


**Conclusions**

The results of these four papers led Ciuffreda’s research team to hypothesize that anomalous cortical or subcortical regulation of response to changes in illumination and visual-spatial patterns, possibly mediated by the dorsal visual pathway, may be contributing to the perception of photosensitivity on those with TBI.
Chronic / persistent photophobia seen with post concussion syndrome

- Post-concussion syndrome is a complex disorder in which various symptoms — such as headaches and dizziness — last for weeks and sometimes months after the injury that caused the concussion.
- In most people, post-concussion syndrome symptoms occur within the first seven to 10 days and go away within three months, though they can persist for a year or more.
Photophobia
Optometric Evaluation

- Contrast Sensitivity
- Scotopic Sensitivity
- Critical flicker frequency
- Coherent motion
- Pattern glare
Photophobia Treatment in TBI Patients

- Tinted lenses
- Colored overlays
- Brimmed caps

Often a subjective determination
Research looking for a more systematic determination

Colorimetry

means of determining the precise hue resulting in reduced visual stress for the patient
Vision Problems Associated with Concussion

Photophobia

*Accommodative dysfunction*

*Binocular Vision dysfunction*
  *(Convergence insufficiency)*

*Saccadic dysfunction*
Cross-sectional study of 100 subjects post concussion (mean age = 14.5 yrs)

69% with one or more binocular vision problems
- Accommodative disorders (51%)
- Convergence insufficiency (49%)
- Saccadic dysfunction (29%)

Highest prevalence if within 1 month of concussion
Optometric Exam Sequence
in the primary care practice

Not a lot of new information here
Four General Areas of Visual Function

- Accommodative System
- Vergence System
- Oculomotor System
- Ocular Alignment
- Vestibular-Ocular Reflex System
Optometric Exam Sequence

☐ Refraction

☐ Assessment of Accommodative Skills
  ■ Minus lens amplitudes
  ■ Flipper Facility as needed

☐ Assessment of Binocular Vision Status
  ■ Cover test – distance and near
  ■ Vergences – typically near, distance as needed
  ■ NPC – Near Point of Convergence

☐ Ocular Motility evaluation
  ■ King Devick Test
  ■ DEM – Developmental Eye Movement Test
Accommodative Disorders
Accommodative Dysfunction with TBI

Alvarez et al. 2012: 24%
Ciuffreda et al. 2007: 41%
Stelmack et al. 2009: 47%

General population: 6-9%

Stelmack JA, et al. Optometry 2009
The Accommodative Neural Circuit

The afferent limb of the circuit includes the

- **retina** (with the retinal ganglion axons in the optic nerve, chiasm and tract)
- **lateral geniculate body** (with axons in the optic radiations)
- **visual cortex**
  - visual association in the cortex determines if the image is "out-of-focus"
Recommended clinical evaluation for accommodative testing:
- Accommodative amplitude
- Accommodative lens flipper facility fatigue
- Stimulus AC/A ratio
- Horizontal near heterophoria
- NRA / PRA

We can simplify this...
# Symptoms of Accommodative Problems

## Accommodative Insufficiency

<table>
<thead>
<tr>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blurred vision at near</strong></td>
</tr>
<tr>
<td><strong>Discomfort and strain associated with near tasks</strong></td>
</tr>
<tr>
<td><strong>Fatigue associated with nearpoint tasks</strong></td>
</tr>
<tr>
<td><strong>Symptoms worse at end of day</strong></td>
</tr>
<tr>
<td><strong>Difficulty with attention and concentration with reading</strong></td>
</tr>
</tbody>
</table>

*Example text with letters: manons, chocolate filled with fresh cream (Belg.), maquereau, mackerel, marc, grape spirit, marcassin, young wild boar, marchand de vin, wine merchant, mariné, marinated, marinieré, white wine, mussel broth, thickened with egg yolks, marjolaine, marjoram, layered nut.*
Clinical Signs of Accommodative Problems

- Hyperopic Rx
  - May improve near symptoms
  - May not tolerate Rx at distance

- Retinoscopy reflex fluctuates
  - Often see A/R astigmatism
  - Myopia
    - Subjective > retinoscopy

- Variable acuity / may not achieve level expected as per findings
Optometric Findings in Accommodative Insufficiency

<table>
<thead>
<tr>
<th>Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low accommodative amplitudes</td>
</tr>
<tr>
<td>Low PRA</td>
</tr>
<tr>
<td>High MEM</td>
</tr>
<tr>
<td>Fails monocular accommodative facility with minus lenses</td>
</tr>
<tr>
<td>BAR - Fails (-)</td>
</tr>
</tbody>
</table>

Visual Acuity “mushy”
Reduced distance VA
Reduced near VA
Areas of Accommodation to Measure

- Accommodative Amplitudes
  - Push-up / Pull-away amplitudes (Donder’s)
  - Minus Lens Amplitudes

- Accommodative Response
  - NRA/PRA
  - Monocular Estimation Method (MEM)

- Accommodative Facility
  - Flipper Facility with +/- 2 D lenses

Let’s keep it Simple
Minus Lens Amplitudes
measures “power” of the accommodative system

Must determine age norm
**Accommodative Testing**

<table>
<thead>
<tr>
<th>Test</th>
<th>Normative Value</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Push up/Pull away amplitudes</em></td>
<td>15- ¼ age</td>
<td>+/- 2.00D</td>
</tr>
<tr>
<td><em>NRA</em></td>
<td>+2.00 D</td>
<td>+/- 0.50 D</td>
</tr>
<tr>
<td><em>PRA</em></td>
<td>-2.37D</td>
<td>+/- 1.00 D</td>
</tr>
<tr>
<td><em>Minus lens amplitudes</em></td>
<td>15- ¼ age – 2D</td>
<td></td>
</tr>
<tr>
<td><em>MEM (monocular estimation method)</em></td>
<td>+0.50 D</td>
<td>+/- 0.25 D</td>
</tr>
</tbody>
</table>

**Note:** for amplitudes always be aware of even a small difference between the 2 eyes that is repeatable. If this is backed up by symptoms there may be an accommodative problem.
Control Rx = +2.50 sphere
Minus Lens Amplitudes

- Control lenses
- Near PD / Phoropter converged / stand lamp
- Using nearpoint rod/ target at 16”
  - One line larger than patients near VA
  - Normed for 20/40
- Test monocularly
- Add minus lenses in 0.25 D increments to \textit{first sustained blur}
  - Alternative end points
    - Target goes “in and out” of clarity
    - Target is too small to read

- To obtain the amplitude in diopters add 2.50 D for the 40 cm WD
Target for Minus lens Amplitudes
PRA Findings
Occlude OS to begin Minus Lens Amps......
Minus Lens Amps ..... add 0.25 click of minus until first sustained blur
Occlude OD to begin Minus Lens Amps OS ....
Minus Lens Amps ......
add 0.25 click of minus until first sustained blur
Minus Lens Amplitudes

To obtain the amplitude in diopters
add 2.50 D for the 40 cm WD
Baseline +2.50 D

**OD** → -2.00
4.50 + 2.50 = 7D

**OS** → -2.50
5.00 + 2.50 = 7.50D
## Accommodative Facility Testing

<table>
<thead>
<tr>
<th>Test type</th>
<th>Population</th>
<th>Normative Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binocular</td>
<td>Children (7-12)</td>
<td>5.0 cpm</td>
</tr>
<tr>
<td></td>
<td>Adults</td>
<td>8.0 cpm</td>
</tr>
<tr>
<td>Monocular</td>
<td>Children 7-12</td>
<td>7.0 cpm</td>
</tr>
<tr>
<td></td>
<td>Adults</td>
<td>11-12 cpm</td>
</tr>
<tr>
<td></td>
<td>today</td>
<td>shall</td>
</tr>
<tr>
<td>---</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>6</td>
<td>under</td>
<td>found</td>
</tr>
<tr>
<td>11</td>
<td>white</td>
<td>which</td>
</tr>
<tr>
<td>16</td>
<td>every</td>
<td>force</td>
</tr>
<tr>
<td>21</td>
<td>should</td>
<td>finally</td>
</tr>
<tr>
<td>26</td>
<td>carry</td>
<td></td>
</tr>
</tbody>
</table>
Accommodative Facility

Modified facility testing

20/40 letter / line of letters

+2.00 D OU compared to -2.00 D OU

Is there blur?
Is one side more difficult than the other?

Which side is more difficult in Accommodative Insufficiency?
Accommodative Testing

1) Minus Lens Amplitudes

2) Flipper Facility
   +2.00 D OU compared to -2.00 D OU

3) Trial Frame Plus at near
   Start with +1.00 - +1.25
   Subjective response

4) Take Distance VA OU
   Can patient tolerate the plus at distance
   Single vision vs bifocal Rx
Binocular Vision Disorders
Convergence Insufficiency with TBI

- Alvarez et al. 2012: 23%
- Ciuffreda et al. 2007: 42%
- Brahnm et al. 2009: 46%
- General population: 4-6%

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermittent blur</td>
<td>Moderate to high exophoria or intermittent exotropia at near</td>
</tr>
<tr>
<td>Intermittent diplopia</td>
<td>Reduced positive fusional vergence at near</td>
</tr>
<tr>
<td>Symptoms worse at end of day</td>
<td>Low AC/A ratio</td>
</tr>
<tr>
<td>Burning and tearing</td>
<td>Low NRA</td>
</tr>
<tr>
<td>Inability to sustain and concentrate</td>
<td>Low MEM</td>
</tr>
<tr>
<td>Words move on the page</td>
<td>Fails binocular accommodative facility testing with +2.00</td>
</tr>
<tr>
<td>Sleepiness when reading</td>
<td>Intermittent suppression at near</td>
</tr>
<tr>
<td>Decreased reading comprehension over time</td>
<td>Receded near point of convergence</td>
</tr>
<tr>
<td>Slow reading</td>
<td>Normal accommodative amplitudes</td>
</tr>
</tbody>
</table>
## Clinical Vergence Disorders

**Soft Binocular Vision Problems**

Scheiman/Wick

<table>
<thead>
<tr>
<th>Vergences</th>
<th>Near</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smooth / Phoropter</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Base In</strong></td>
<td>11/19/10</td>
<td><strong>Base In</strong></td>
</tr>
<tr>
<td><strong>Base Out</strong></td>
<td>14/18/7</td>
<td><strong>Base Out</strong></td>
</tr>
<tr>
<td>Vergences</td>
<td>ADULTS</td>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>Prism Bar Vergences/Step</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vergence</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Near</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base In</td>
<td>x/13/10</td>
<td></td>
</tr>
<tr>
<td>Base Out</td>
<td>x/19/14</td>
<td></td>
</tr>
<tr>
<td><strong>Distance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base In</td>
<td>x/7/4</td>
<td></td>
</tr>
<tr>
<td>Base Out</td>
<td>x/11/7</td>
<td></td>
</tr>
</tbody>
</table>
Prism Bar Vergences Base IN
How to record Step Vergence Measurements

Base IN

Blur / break / recovery

x/20/12

Norm: NBI x/13/10
Prism Bar Vergences Base OUT
How to record Step Vergence Measurements

Base OUT

Blur / break / recovery

x/20/12

Norm: NBO x/19/14
# Clinical Vergence Disorders

**Soft Binocular Vision Problems**

Scheiman/Wick

<table>
<thead>
<tr>
<th>Vergences</th>
<th></th>
<th>CHILDREN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prism Bar Vergences/Step Vergence</td>
<td>Near</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Base In</td>
<td>x/12/7</td>
</tr>
<tr>
<td></td>
<td>Base Out</td>
<td>x/23/16</td>
</tr>
<tr>
<td></td>
<td>Distance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Base In</td>
<td>None established</td>
</tr>
<tr>
<td></td>
<td>Base Out</td>
<td>None established</td>
</tr>
</tbody>
</table>
Near Point of Convergence Testing

<table>
<thead>
<tr>
<th></th>
<th>NPC</th>
<th>Near Point of Convergence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Children</strong></td>
<td>Break</td>
<td><strong>6 cm</strong></td>
</tr>
<tr>
<td><strong>Adults</strong></td>
<td>Accommodative target</td>
<td><strong>5cm/8cm</strong> (break/recovery)</td>
</tr>
<tr>
<td></td>
<td>Red lens / transilluminator</td>
<td><strong>7cm/10cm</strong> (break/recovery)</td>
</tr>
</tbody>
</table>
NPC
NPC → TN
NPC for Stamina / Sustainability
Concussion Recovery as a Function of NPC

- Prospective analysis of concussion symptoms and NPC among 28 collegiate athletes with sports-related concussion

- Shortened (improved) NPC with resolution of symptoms

Analysis of 78 athletes s/p sports-related concussion (ave. 6 days)
Assessment of NPC, neurocognitive function (ImPACT) & post concussion symptoms score (PCSS)
42% of concussed athletes had CI
Athletes with CI had worse neurocognitive impairment and higher symptom scores than did those with normal NPC
Binocular Vision Testing

1) Cover test – Distance and Near

2) Stereopsis

3) Vergence Evaluation – Base IN and base OUT

4) NPC
Oculomotor Disorders
Saccade and Pursuit Dysfunction
Impaired eye movements in post-concussion syndrome indicate suboptimal brain function beyond the influence of depression, malingering or intellectual ability

Marcus H. Heitger,1,2 Richard D. Jones,1,2,3 A. D. MacLeod,4 Deborah L. Snell,4 Chris M. Frampton1 and Tim J. Anderson1,2,5

Prospective analysis of 36 PCS subjects vs. healthy controls
PCS associated with worsening of anti-saccades, self-paced saccades, memory-guided sequences & smooth pursuits
Eye movement dysfunction showed higher correlation with symptom load as compared to neuro-psych testing
Biological substrate for concussion-related symptoms
Oculomotor Disorders
Saccade and Pursuit Dysfunction

Optometric Evaluation Tool
King Devick Test
Rapid Number Naming

Test of saccades, verbalization & recall
High levels of test-retest reliability
High levels of validity for concussion identification

K-D Test Pro Monitoring is a post-injury evaluation tool used to monitor the patient’s oculomotor function during the concussion recovery process following identification of concussive injury. K-D Test Pro Monitoring may be used when a pre-injury K-D Test baseline is not available. The program uses charts and graphs to display K-D Test scores over the course of recovery.

- For clinical use only
- Standard-sized iPad App
- Quick, objective patient progress monitoring
- For serial post-injury testing
- Unlimited testing per patient for one year
- Purchase patient activations as needed
  - $20/patient
  - Minimal initial set-up required
ABOUT THE KING-DEVICK TEST

“King-Devick Test: a tool for evaluation of saccade, consisting of a series of charts of numbers. The charts become progressively more difficult to read in a flowing manner because of increasingly more difficult spacing between the numbers. Both errors in reading and speed of reading are included in deriving a score.”

- The eyes are part of the brain
- Eye movements involve a wide network of structures in the brain
- Eye movements relate closely to the functional integrity of an injured brain
- Impaired eye movements are an indicator of suboptimal brain function
EXTENSIVE PRESS COVERAGE

Los Angeles Times
“Sideline concussion test gets a new thumbs-up”

“New Test May Make it Easier to Diagnose Concussions -- This could save lives.”

Los Angeles Times
“Sideline concussion test gets a new thumbs-up”

“King-Devick Test – has emerged as one of the most promising tools for rapid sideline concussion diagnosis”

Los Angeles Times
“Sideline concussion test gets a new thumbs-up”

“Concussed athletes have great difficulty processing the numbers and can take minutes to finish, if they don’t give up entirely”

Los Angeles Times
“Sideline concussion test gets a new thumbs-up”

“Why the NFL Sucks at Testing for Concussions”

Los Angeles Times
“Sideline concussion test gets a new thumbs-up”

“Why the NFL Sucks at Testing for Concussions”

Edison, New Jersey: "Rinkside Test Accurately Helps Detect Professional Ice Hockey Team's Concussions in Minutes"

“Rinkside Test Accurately Helps Detect Professional Ice Hockey Team's Concussions in Minutes”

Edison, New Jersey: "Rinkside Test Accurately Helps Detect Professional Ice Hockey Team's Concussions in Minutes"

“While other sideline exams test cognitive or memory skills and rely on the administrator to make subjective decisions, the King-Devick Test is objective.”

Edison, New Jersey: "Rinkside Test Accurately Helps Detect Professional Ice Hockey Team's Concussions in Minutes"

“Vision Test Improves Concussion Detection”

Edison, New Jersey: "Rinkside Test Accurately Helps Detect Professional Ice Hockey Team's Concussions in Minutes"

“Vision Test Improves Concussion Detection”

Edison, New Jersey: "Rinkside Test Accurately Helps Detect Professional Ice Hockey Team's Concussions in Minutes"

“The King-Devick test is able to diagnose concussions even in athletes without traditional symptoms”

Edison, New Jersey: "Rinkside Test Accurately Helps Detect Professional Ice Hockey Team's Concussions in Minutes"

“the test can pick up deficiencies occurring across a wide range of neurological geography”

Edison, New Jersey: "Rinkside Test Accurately Helps Detect Professional Ice Hockey Team's Concussions in Minutes"

“Quick, Simple Test Can Detect Concussion in Athletes: Screening Superior to Other Sideline Tests in Spotting Early Signs of Brain Trauma”

Edison, New Jersey: "Rinkside Test Accurately Helps Detect Professional Ice Hockey Team's Concussions in Minutes"

“Quick, Simple Test Can Detect Concussion in Athletes: Screening Superior to Other Sideline Tests in Spotting Early Signs of Brain Trauma”

Edison, New Jersey: "Rinkside Test Accurately Helps Detect Professional Ice Hockey Team's Concussions in Minutes"

“many concussed athletes have passed SCAT but failed the King-Devick test.”

Edison, New Jersey: "Rinkside Test Accurately Helps Detect Professional Ice Hockey Team's Concussions in Minutes"

“Why the NFL Sucks at Testing for Concussions”

Edison, New Jersey: "Rinkside Test Accurately Helps Detect Professional Ice Hockey Team's Concussions in Minutes"

“Why the NFL Sucks at Testing for Concussions”

Edison, New Jersey: "Rinkside Test Accurately Helps Detect Professional Ice Hockey Team's Concussions in Minutes"
King Devick Test
Rapid Number Naming

- Has been examined in a range of athletes at various ages, may be useful in ID of concussion

- Worsening of baseline K-D test at the time of the injury indicates a 5x greater risk of concussion

- Reliable when administered by trained personnel and lay person

- Sensitive (86%) and specific (90%) for the detection of concussion
Subjective analysis of patient symptom provocation following various eye movements

Headache, nausea fogginess, dizziness

Some expertise required (not possible for most teams and level of play)

Symptoms provoked in 33 to 61% (VOR best)

Misses motility problems that could be detected by objective exam

Not validated on sidelines

Mucha A, et al. AJSM 2014
University of Florida study of K-D test, SAC & BESS in the sideline assessment of concussion
- SAC - Standardized Assessment of Concussion
- BESS - Balance Error Scoring System

N=217 athletes (men’s football, women’s soccer, and women’s lacrosse with 30 concussions

Standardized Assessment of Concussion (SAC)

- The SAC takes approximately 5 minutes to administer and includes measures of:
  - Orientation (month, date, day of week, year, time)
  - Immediate Memory
  - Neurologic Screening
  - Loss of consciousness
  - Amnesia
  - Strength
  - Sensation
  - Coordination
  - Concentration
  - Exertional Maneuvers
  - Delayed Recall
BESS - Balance Error Scoring System (BESS)

- The BESS is a portable, cost-effective and objective method of assessing static postural stability. Takes approximately 10 minutes to conduct.
  - The balance-testing regime consists three stances on two different surfaces
  - **Three Stances**
    - double leg stance
    - single leg stance
    - tandem stance
  - **Two Surfaces**
    - firm (ground)
    - foam surface.
Results

- 52% of concussions detected with SAC
- 79% of concussion detected with K-D test
- 80% of concussion detected with BESS
- 95% of concussions detected with combination of K-D & BESS
- 100% of concussions detected with combination of K-D, SAC & BESS
Treatment of Oculomotor Disorders

In office Vision Therapy

King-Devick Recovery Acceleration Program
King-Devick Recovery Acceleration Program is a computer and tablet based oculomotor concussion rehabilitation program for patients suffering from persistent symptoms.

- For clinical or home use
- Standard-sized iPad or laptop computer
- Requires Wi-Fi/internet

- Corrects deficits in eye movements and alleviates symptoms for many who have suffered a concussion
- Set goals and tailor programs for individual patients
- Real-time outcome measures to determine patient compliance and progress
- Patient has access to program for one year
- Patient activation costs - $65/patient; 10 code minimum
  - Resell code to patient – SRP $80
SOME OF OUR KEY RELATIONSHIPS

- New York University
- University of Florida
- Emerson Hospital
- University of Miami
- Major League Baseball
- Boston University
- Notre Dame
- GMAC
- University of Pennsylvania
- FIFA
- Mayo Clinic
- NHL
- ARIZONA
- University Hospital Zurich
- The Children’s Hospital of Philadelphia
- Concussion Legacy Foundation
- National Intrepid Center of Excellence
- U.S. Army
- NICoE
- Michigan High School Athletic Association
- Luftwaffe
King-Devick Video Resources

King-Devick Concussion Screening Test iPad App Demonstration Video Video Link

King-Devick Test Research and Publications Web Link

Mayo Clinic: King-Devick Test Detects Concussions in Youth Athletes Web Link
Amaal Starling, MD, Mayo Clinic Neurologist explains how and why the King-Devick Test can detect concussions in youth athletes

King-Devick Test On The Today Show Rahul Jandial, MD, Demonstrates the K-D Test Pro iPad App; Credit: The Today Show; Video Link

Email Questions To: support@kingdevicktest.com or visit: www.kingdevicktest.com
Return to Play
80 to 90% odds

- 40% of concussions are resolved in 1 week
- 70% of concussions are resolved in 2 weeks
- 80% of concussions are resolved in 3 weeks
- 95% of concussions are resolved in 5 weeks

90% within 21 days
(Guskiewicz et al, 2003)

80 to 90% odds in 1 to 4 weeks!
Risks of Premature Return to Play

- Risk of second impact syndrome
- Repeat impact before normalization of brain function
  - “window of vulnerability”
- Chronic headaches
- Depression
- Long-term cognitive deficits
- Post-traumatic encephalopathy (CTE)
2013 NCAA survey of 789 athletic trainers and 111 team physicians (530 institutions)

64.4% pressure from athletes
53.7% pressure from coaches

Greater pressure if female clinicians or if under supervisory purview of athletic department
Graduated Return to Play Protocol

<table>
<thead>
<tr>
<th>Rehabilitation Stage</th>
<th>Functional Exercise at Each Stage of Rehabilitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) No activity</td>
<td>Complete physical, cognitive rest</td>
</tr>
<tr>
<td>(2) Light aerobic exercise</td>
<td>Walking, swimming, stationary bike</td>
</tr>
<tr>
<td>(3) Sport-specific exercise</td>
<td>Running drills in soccer, skating drills in hockey, etc.</td>
</tr>
<tr>
<td>(4) Noncontact drills</td>
<td>More complex training drills, may start resistance training</td>
</tr>
<tr>
<td>(5) Full-contact practice</td>
<td>With medical clearance, participate in normal training activities</td>
</tr>
<tr>
<td>(6) Return to play</td>
<td>Normal game play</td>
</tr>
</tbody>
</table>

AAN Clinical Practice Reference Sheet for Clinicians, 2011.
Returning to Learning Following a Concussion
Mark E. Halstead, Karen McAvoy, Cynthia D. Devore, Rebecca Carl, Michael Lee, Kelsey Logan and Council on Sports Medicine and Fitness, and Council on School Health
Pediatrics; originally published online October 27, 2013;
DOI: 10.1542/peds.2013-2867
Return to Learn

- Return to learn must precede return to play

- Return to school when symptoms are tolerable for 30-45 min
  - usually within 2-4 days of concussion

- Schools/teacher should make adjustments to incorporate 5-10 min. of rest/hour

88 individuals (age 11-22 years) with ED presentation for acute concussion

Initial neurocognitive and balance assessments with daily record of post-concussive symptoms

Randomized to:
- strict rest (5 days) vs.
- 1-2 days rest followed by step-wise return to activity

No difference between groups regarding NC/balance outcomes

Increased symptoms among strict rest group

Role of Vision Therapy in Concussion Management

☐ Scientific basis for therapeutic value
☐ Addition to traditional vestibular and cognitive rehab
☐ For who and when and how to intervene (?)
Binocular Vision Testing

1) Cover test – Distance and Near

2) Stereopsis

3) Vergence Evaluation – Base IN and base OUT

4) NPC
There’s No Such Thing As A Tough Brain!®
Questions ??...... Thank You

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