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Session 108: Improving Balance & Ocular Motor Function with Concussed Athletes
Robert Donatelli, PhD, PT

Balance and Ocular Motor Training in the Athlete

- Las Vegas Physical Therapy & Sports
- 7229 West Sahara Ave Suite 105
- 702 586 2177
The Hidden Victim – Ocular Motor with Head Trauma in Sports

I should have played Golf today

Traumatic Brain Injury - TBI

A complex pathophysiologic process affecting the brain, induced by traumatic biomechanical forces secondary to direct or indirect forces to the head.

A concussion — a mild form of brain injury — is the most common form of TBI in sports, the signs and symptoms can be the hardest to recognize among the types of TBI.
Epidemic

300,000 sports-related (TBI) concussions occur annually in the U.S.

- 60% of college soccer players reported symptoms of a concussion at least once.
- 20% of college football players have had multiple concussions - 3-6x more.

TBI-Related

- Estimated 1.6-3.8 million concussions a year.
- Approx. 136,000/yr. in high school athletes alone.
- Between 1997-2007, the number of ER visits for 14-19 y.o. for concussion TRIPLED!

TBI-Signs & Symptoms

- Results in physical, cognitive, emotional or sleep-related symptoms, may or may not involve a loss of consciousness (LOC).
- Duration of symptoms is variable, may last several minutes to days, weeks, months, or longer.
Early symptoms following TBI-concussion (Sports-Related)

- Headache (71%)
- Feeling slowed down (58%)
- Difficulty concentrating (57%)
- Dizziness (55%)
- Fogginess - Confusion (53%)
- Fatigue (50%)
- Vision blurry/double vision (49%)
- Light sensitivity (47%)
- Memory dysfunction (43%)
- Balance problems (43%)

(Lovell 2004)

Symptoms of Concussion
That may Not appear for hrs or days later

- Inability to maintain a coherent stream of thought
- A disturbance of awareness with heightened distractibility
- Inability to carry out a sequence of goal-directed movements (AANS.ORG)
- Emotional and behavioral changes post concussion (Miranda)
- Nausea or vomiting
- Memory loss
- Emotional (anxious, nervous, irritable)
- Personality changes
- Ringing ears
- Loss of smell or taste (AANS)

Clinical Assessment of Concussion

- SCAT 3
  - Best done 10 or more minutes post exercise
  - Scoring on the SCAT should not be used as a stand-alone method to diagnose concussion
  - Designed for rapid concussion screening on the sidelines and are not meant to replace comprehensive neuropsychological testing
The interpretation of in-game (sideline) SCAT3 - consider the effects of post-exercise fatigue on an athlete's performance, if preseason baseline data was collected when the athlete was well rested.

Exercise appears to affect symptom burden and physical abilities, such as balance and tandem gait, more so than the cognitive components of the SCAT3.

30% to 65% of patients with traumatic brain injury suffer symptoms of traumatic vestibular pathology.
- Rupture of the membranous labyrinth
- Temporal bone fracture, bony labyrinth or vestibular nerve
- Concussions – hemorrhage can damage the brainstem, cerebellum, or cerebral hemispheres

Vestibular symptoms after minor head trauma 13% of the subjects having purely vestibular symptoms.

(Vowell 06) 78% of concussions in high school and college athletes reported dizziness and 55.8% reported balance impairment.
Traumatic Vestibular Dysfunction

- Inflammatory and metabolic processes may disrupt permanently normal vestibular and auditory function at the level of the end-organ causing destructive effects on the cochlea and vestibular organs in young and adult individuals.

Post Concussion & Ocular Motor

- Ocular Motor Screen should be part of the post-concussion evaluation
- Damage to Cranial nerves
- Dislodged Otoconia

Head Trauma

- Increase in Injuries post concussion – damage to the balance systems
- Damage to DVA
- Damage to inner ear

A Brief Vestibular/Ocular Motor Screening (VOMS) Assessment to Evaluate Concussions
A Mucha et al AJSM 2014

- Vestibular spinal – Postural control balance
- Vestibular ocular motor – visual stability with head movement
- 30% of concussed athletes report visual problems during the first week after injury
- Blurred vision, diplopia, impaired eye movements, difficulty in reading, dizziness, headaches, ocular pain, poor visual-base concentration.
Post Concussion & Ocular Motor

- Ocular Motor Screen should be part of the post-concussion evaluation
- Damage to Cranial nerves
- Dislodged Otoconia Head Trauma
- Increase in Injuries post concussion – damage to the balance systems
- Damage to DVA
- Damage to inner ear

Concussion Increases Odds of Sustaining a Lower Extremity Musculoskeletal Injury After Return to Play Among Collegiate Athletes
Alison Brooks, MD AJSM 2016

- The incidence of acute lower extremity musculoskeletal injury was higher in concussed athletes (15/87) 17% compared with matched controls (17/182; 9%).
- The odds of sustaining an acute lower extremity musculoskeletal injury during 90-day period after return to play were 2.48 times greater in concussed athletes than controls during the same 90-day
- Conclusion: Concussed athletes have increased odds of sustaining an acute lower extremity musculoskeletal injury after return to play than their non-concussed teammates
Head Concussions in Combat Sports

Landers, Donatelli, Nash. Concussion Journal 2017

- Most common symptoms: headaches, disorientation and dizziness as reported by collegiate athletes
- Cerebral components are most often tested and recognized in recovery
- Twenty-two male participants with mean age of 29.2 (± 5.1) years and range of 22 to 41 years were studied. The corresponding Snellen fraction (20 ft) for the mean SVA was 20/13 with a loss of 5 lines when testing DVA
- Head shaking in the yaw (shaking no) and pitch (shaking yes) directions were tested at velocities of 150-200 deg/sec

Ocular motor assessment in concussion: Current Status and Future Direction: Rachel E. Ventura

Journal of Neurological Science 2016

- With concussions, the clinical neuro-ophthalmic exam is important for detecting abnormalities in vergence, saccades, pursuit, and visual fixation
- Light sensitivity  Trouble keeping attention when reading
- Words run together when reading* decreased reading comprehension*
- Unable to read continuous text comfortably  Words blurring or coming in and out of focus*  Eye strain*Visual fatigue  Difficulty scanning/navigating
- Visual motion sensitivity  Depth perception problem  Poor eye-hand coordination

Post Concussion & Ocular Motor

- Ocular Motor Screen should be part of the post-concussion evaluation
- Damage to Cranial nerves
- Dislodged Otoconia
- Head Trauma
- Increase in Injuries post concussion—damage to the balance systems
- Damage to DVA
- Damage to inner ear
Concussion - Cranial Nerve Damage
Lack of control of eye movements

Cranial Nerve III, IV & VI

- 6 Cardinal Fields of Gaze, Extraocular movement

- Ocular misalignment
- Diplopia Palsy
- Unable to move
- Convergence spasm movement down and away
Ocular Misalignment
Vertical misalignment - Diplopia
right cranial nerve III palsy secondary to TBI.
(Courtesy Suzanne Wickum, O.D.)

Suggestive of a vestibular disorder
Cranial nerve III damage

- Convergence spasm (Chan and Trobe, 2002)
- Convergence insufficiency (Kowal, 1992) inability to maintain binocular alignment close up
- Blurred vision, eye strain, double vision

Head Tilt – Ocular Misalignment
Cranial nerve IV palsy due to TBI

- Diplopia a vertical misalignment of the eyes due to a right Cranial nerve IV
- Compensatory head posture alleviate diplopia a vertical misalignment of the eyes due to a right.
Inner Ear Concussion Injury

- VIIIth cranial nerve or labyrinthine injury can include:
  - Hemorrhage into the membranous labyrinth can injure the endolymphatic system producing post traumatic symptoms of tinnitus, hearing loss, vertigo and imbalance

Post Concussion & Ocular Motor

- Ocular Motor Screen should be part of the post-concussion evaluation
- Damage to Cranial nerves
- Dislodged Otoconia
  - Head Trauma
- Increase in injuries post concussion – damage to the balance systems
- Damage to DVA
- Damage to inner ear

Vestibular Trauma in the Athlete?

- Dislodged Otoconia
  - Head Trauma
  - Small calcium crystals embedded in the inner ear can dislodged from the otolithic organs – move to the semi-circular canals
Otoconia Dislodged

- Free floating of crystal is more likely
- Utricle connects to the SSC not the saccule

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Frequency of Complaints in 100 patients with Benign Paroxysmal Positional Vertigo BPPV

<table>
<thead>
<tr>
<th>Complaint</th>
<th>Frequency %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor Balance</td>
<td>57</td>
</tr>
<tr>
<td>Sense of Rotation</td>
<td>53</td>
</tr>
<tr>
<td>Trouble Walking</td>
<td>48</td>
</tr>
<tr>
<td>Lightheaded</td>
<td>42</td>
</tr>
<tr>
<td>Nausea</td>
<td>36</td>
</tr>
<tr>
<td>Queasy</td>
<td>29</td>
</tr>
<tr>
<td>Spinning inside head</td>
<td>24</td>
</tr>
<tr>
<td>Sense of tilt</td>
<td>22</td>
</tr>
<tr>
<td>Sweating</td>
<td>12</td>
</tr>
<tr>
<td>Sense of Floating</td>
<td>15</td>
</tr>
<tr>
<td>Blurred vision</td>
<td>13</td>
</tr>
<tr>
<td>Jumping vision</td>
<td>10</td>
</tr>
</tbody>
</table>

Dizziness Questionaire

I have earring Difficult right/left/both
I have fullness in my ear right/left/both
I have ringing in my ears right/left/both
Did you have flu, ear infection, cold, virus right/left/both
Did you have trauma, fly in a plane, cough, sneeze, or swim underwater prior to feeling dizzy right/both
Did you get new glasses recently right/both
Do you consider yourself an anxious person right/both

Positional Tests

- Dix-Hallpike
- Right Side lying Test
- Log Roll
Dix Hallpike

Move Oticonia out of SSC

“Right Sidelying Test” to identify right posterior canal BPPV – Jeff Walters

Roll Test – Horizontal Canal
Roll Test to the left
If postural tests are positive
Treatment is Move Debris Out of SCC
Epley Maneuver
Prevent debris back into SCC use of a soft cervical collar

Cervicogenic Dizziness

Some patients suffer from vestibular-type symptoms associated with neck pain, neck tension, or torticollis.

CD results from abnormal input into the vestibular nuclei from the proprioceptors of the upper cervical region.

Head eye co-ordination and gaze stability in subjects with persistent whiplash associated disorders
Treleaven J, Jull G, Grip H Physical Therapy In Sports 2010

- The whiplash group demonstrated deficits in gaze stability and head eye co-ordination that may be related to decreased reflex activity associated with decreased head range of motion and/or neck pain.

- A Normal Healthy Neck
- A Neck after Whiplash Injury
Consider Cervicogenic Signs and Symptoms
- Nausea and vomiting
- Nystagmus
- Neck pain – disorientation when I move my head
- Frequent headaches
- Hypomobility of the upper cervical spine especially suboccipital area – Head feels tilted
- Cervical treatment – reduces symptoms

Vestibular/ Cervical Tests
- Cervicogenic Dizziness is a diagnosis of exclusion traditional Vestibular evaluation usually normal
- Neck Torsion test – Head fixed, body rotation to avoid stimulation of the labyrinth
- Nystagmus may be exhibited

Smooth Pursuit Neck Torsion Test
(SPNT Test)
The subjects’ ability to follow the target was measured in 3 test positions; torso and neck neutral, torso to the left with neck neutral (right neck torsion) and torso turned to the right neck neutral (left neck torsion).

Sensitivity 90%, specificity 91% for those with Whiplash Associated Disorder and dizziness (Julia Treleaven et al, J Rehab Med 2005)
Treatment of Post Concussion
Grabowski PT in Sports 2017

- Multimodal impairment-based physical therapy for the treatment of patients with post-concussion syndrome: A retrospective analysis on safety and feasibility
- Results: Controlled exercise program, perturbation/balance training and manual therapy (cervical spine/upper thoracic treatment approaches were beneficial in treatment of post concussion patients)

Poor Balance and Injury

- Proposal the Ocular motor system is the missing link in sports performance and injury prevention

Three Systems
- Vision
- Peripheral
  - Ocular Motor
- Somatosensory
- Hip and Trunk Muscle strength and endurance
What Does the Athlete See?
Can we Improve Hand – Eye – Head Coordination?
What is Dynamic Visual Acuity?
Can we see details on High Velocity Targets?

Highly Skilled Athletes What Do They See?

- Longer period of fixation
  more precise and consistent contact with the ball
- Less elite athletes use different targets with shorter Gaze Stability
- Retina slip difference between Eye & Head velocity
- Dynamic Visual Acuity see objects in detail with head movement

Quiet Eye
Dr. Vickers

- Since the Quiet Eye has been shown in elite athletes to be earlier and longer than that of athletes with lower skill levels
- It is trainable demonstrating large increases in performance.
The Quiet Eye Dr. Vickers = Gaze Stability
prof golfers longer 500-600 msec
amateur 200-250 msec Location of Gaze -Top or Behind the ball

Visual Workspace and Motor Performance
Objects and locations command performer’s gaze & attention
Gaze (fixation) is the ability to bring the critical information required to perform well onto the part of the eye, the fovea 1.5mm.

Visual Angle
Small area on the fovea where we are able to see clearly is 2°-3° of visual angle
The Thumb Rule: Estimate the size of this area by holding your thumb in front of you at arms length. The width of your thumb is about 2° of visual angle projected into space.
Watch the ball hit the bat/racket?
Ball/bat collision last 1-2 millisec
Use your eyes to lock onto the ball as it releases.

Vestibular Ocular Reflex - Final Gaze – Quiet Eye - DVA Convergence
Are we helping are athletes see better?
- Seeing the Target
- What is wrong with Andy's eyes?
- Where is the ball?

Roger Federer Vision System
- Watch the ball from the back of the racquet
  Keeps the head and eyes still longer before contact
- Makes it easier for you to prevent the head from jerking forward during the swing.
Anatomy and Physiology of the Vestibular System

- Vestibular System made of three components
  - Neural – ocular motor
  - Vestibular – Spinal Central processor
  - Eyes are portals into the vestibular system

- Jeff Walters PT DPT NCS online course Medbridge
- Neurology of Eye Movements Leigh & Zee
- Vestibular Function Clinical and Practice Management - Alan Desmond
- Vestibular Rehabilitation 3rd Edition - Susan J Herdman

The vestibular apparatus in humans serves three major functions:

- It is the **primary organ of equilibrium**, in the subjective sensation of motion & spatial orientation.
- 2. Vestibular input to nervous system inputs elicits reflex adjustments of muscle activity and body position to allow for upright posture.
- 3. Vestibular input into nervous system controlling eye movements helps stabilize the eyes in space during head movements. This reduces the movement of the image of a fixed object on the retina (fovea).
Midline cerebellar lesions cause unsteady gait (ataxia), eye movement abnormalities (nystagmus), vertigo, nausea & vomiting.

**Balance Training**

**Vestibular System in the Athlete**

Sensory information about head motion
- Angular motion sensors
  - SSC velocity movements
  - End of each SSC are 6 angular accelerometers
- Membranous Labyrinth is suspended within the bony labyrinth by the fluid and supportive connective tissue
Semi Circular Canals
Vestibular Ocular Reflex

- Convert Mechanical Energy generated by head movement into neural discharges
- Eye movement matching head velocity
- Eye stays fixed on an object during head movement – clear vision (DVA)

Semi Circular Canal ends are Ampulla
Cupula suspended in the endolymph are Dilated sense organs with Hair like cells

Hair Like Cells

- Fluid inside the semicircular canals moves depending on the axes of head movement. Fluid movement causes the cupulae in the canal to bend
- Senses angular acceleration (change in velocity) through displacement of the cupula
Reflex Eye Movements: head turn left, the hair cells of one horizontal semicircular canal are thrown into an excitatory state, while those of the other are inhibited.

Head movement to the right there is a corresponding decrease on the left.

Contraction of the lateral rectus on the left and the medial rectus on the right – reciprocal innervation – / VOR

Role of VOR is to allow stable gaze while the head is moving

- Clinical Example to demonstrate VOR:
  - Hold a page 18 inches from your field of vision.
  - Start moving your head back and forth at a maximum speed that still allows you to see clearly.
  - Next with your head stationary, move the page back and forth in front of you at the same speed you were moving your head.
  - Can not see the clearly.

Otoliths

Upright posture
- Saccule – vertical
- Utricle horizontal plane

- Acceleration of the Head
  - Anterior
  - Lateral
  - Head Tilt
    - Upright
    - Lateral Tilt
    - Forward/backward

- Angular Acceleration
Head Linear Movement t VOR

- The utricle and saccule are perpendicular to one another.
- Saccule hair cells aligned vertically, with their cilia pointing horizontally.
- This orientation in two planes gives us a more three-dimensional view.

Calcium Carbonate Otoconia

- The crystals like tiny grains of sand that roll around on the tops of the hair cells. As they roll, they deflect the cilia on the hair cells, causing a receptor potential.

Age Related Changes in Otoconia

- Increased variability in size
- Hypertrophy
- Fragmentation
- Fissured
- Pitted
Otolithic Organs Dysfunction Altered sense of Vertical

Sitting upright looking into a plastic bucket so that the bucket rims prevent gravitational orientation clues

- There is a dark, straight line
- The examiner rotates the bucket clockwise or counterclockwise to an end position and then slowly rotates it back towards the zero degree position
- Patients indicate 'stop' when they estimate the inside bottom line to be truly vertical
- The examiner reads off the degrees on the outside scale

- Ten repetitions have to be performed
- Healthy subjects align the bar within 1 – 2.5 deg of vertical; abnormal if bar greater than 2.5 deg from true vertical

Vestibular System Summary

- Semi-circular canals – angular acceleration
- Otolithic organs – Linear accelerations
- Head Tilt – gravity – Pitch, Roll, Yaw
- Linear accelerations ant-post, lateral

12 bedside Oculomotor Test

- Head Thrust or Head Impulse Test – VOR slow – fast
- Dynamic Visual Acuity
- Head Shaking
- Convergence
- Horizontal Saccades
- Vertical Saccades
- Smooth Pursuits
- Optokinetic Tracking
- VOR cancellation – Visual motion sensitivity
- Eye Movements
- Rapid saccades/saccadic jerks

Head Thrust – Head Impulse Test

- Clinical test of VOR
  - Head down plane 30°
  - Cervical rotation
  - Unpredictable timing and direction
- Specificity 82%
- Sensitivity
  - Unilateral Vestibular Hypofunction (UVH) 71%
  - Bilateral Vestibular Hypofunction (BVH) 84%

The head-thrust test
Testing VOR

Halmagyi and Curthoys 1988, uses high-acceleration impulsive head rotations delivered in the plane of each pair of semicircular canals while the subject attempts to maintain visual fixation.

Positive Head Thrust R

- Reliable, valid, cost effective clinical test for vestibular function
- Tester rotates head rapidly R
- Abnormal VOR allows eyes to move with head
- Tester observes corrective saccade back on target
- Positive Test
Video Head Thrust Test

- Head moves
- Eyes on target
- 1 Hz combo VOR & COR
- 3 Hz purely VOR
- Can quantify with eye chart
- Up to 2 line changes (i.e., 20/20 → 20/50) is WNL
- Herdman et al 1998
- Train at higher speeds – blurry or dizzy during the exercise

Ossolopsia

Dynamic Visual Acuity

- Head moves
- Eyes on target
- 1 Hz combo VOR & COR
- 3 Hz purely VOR
- Can quantify with eye chart
- Up to 2 line changes (i.e., 20/20 → 20/50) is WNL
- Herdman et al 1998
- Train at higher speeds – blurry or dizzy during the exercise
VOR Tests

- Dynamic visual acuity testing uses the Snellen eye chart to assess VOR stabilization of gaze.
- Comparing visual acuity with head still versus head moving.
- Performed at a FIXED velocity head movements.
- Drop of 3 or more lines was considered abnormal.

Head Shaking Nystagmus Vestibular

- Head tilt down 30° shake NO direction fast as possible of 30 sec (manually)
- Immediately eyes open look for nystagmus at least 5 beats within 20 sec. after head shaking.
- If nystagmus is produced – it will be horizontal for the peripheral lesion and vertical for central.
Hyperventilation-Nystagmus

Vergence produces one image

Simultaneous movement of both eyes to obtain or maintain single binocular vision. During fusion, the eyes must rotate around a vertical axis so that the projection of the image is in the center of the retina in both eyes. To look at an object closer, the eyes rotate towards each other (convergence), while for an object farther away they rotate away from each other (divergence). If one eye off target then not true binocular vision and inaccurate depth perception—poor

Brock String Test - Vergence

Symptoms of Vergence system deficits: (adapted from Scheiman, 2002)
- Trouble reading, focusing
- Trouble focusing from far to near (e.g., taking notes in class)
- Blurred vision
- Sensitivity to light
- Sensitivity to light (w/ excessive vergence response)
- Pulling sensation around eyes
- Avoidance of reading
12 bedside Oculomotor Test

- Head Thrust or Head Impulse Test – VOR slow – fast
- Dynamic Visual Acuity
- Head Shaking
- Convergence

- Horizontal Saccades
- Vertical Saccades
- Horizontal Protrusion
- Vertical Protrusion
- VOR cancellation – Visual motion sensitivity
- Ocular motor inaccuracy
- Ocular motor inaccuracy

Oculomotor - CNS

- Oculomotor testing should include:
  - Saccades - re-fixate gaze with minimal retinal slip
  - Smooth pursuit - maintain stable gaze while objects are moving within a visual field (alone or with VOR)
  - Refixation - smooth pursuit and saccades
  - VOR Cancellation

The common bond of each one of these tests is that each one evaluates eye movements that are modulated by the cerebellum and abnormal movements are considered signs of neurologic disease.

Saccades CNS

- Head Still eyes moving
- Ballistic eye movements reach speeds excess of 900-1000°/sec = 90 mph (145 kph)
  Important for high velocity objects such as in baseball, hockey puck, tennis ball, handball, frisbee

- Abnormal Saccades
  Rather than go directly to the object eyes:
  - Overshoot
  - > 2 eye movements
  - Jerky Nystagmus
Smooth Pursuit

- Head still
- Eyes follow target through 20-40 deg/sec through narrow arc
- Unable to maintain image on retina over 150° sec = 15mph
- Deteriorates with age
- Detects spins of an object, acceleration or decreases in speed
- Abnormal – nystagmus

Optokinetic Tracking CNS

- Optokinetic Reflex (OKR) is a combination of saccade and smooth pursuit eye movements
- Vestibular system will break down, system will look up during sustained horizontal head rotation, smooth pursuit is less than eye and maintain stable vision
- Nystagmus response is normal
Final Gaze

Eye Tracking Systems
VOR Cancellation

- The VOR cancellation - Cerebellum has to inhibit the VOR Gain during VOR Cancellation
- Head is moving synchronously with the target, the VOR must be suppressed, otherwise the image of the target could not be maintained on the fovea.
- Five times visual motion sensitive AJSM 2014 - A Brief vestibular-ocular motor screening assessment to eval concussions

What Does the Athlete See?

- Fred Funk looks from the tee to the flag - Depth Percepcion
- He uses his visual feedback to adjust his spatial awareness via Gaze control to abstract targets: putting on a sloped green
- Like a predatory mammal, he is judging distance to his prey (in this case a small hole) using binocular vision.
See Fred Take Away

- Fred Addresses with a quiet eye – gaze stability
- Slowly moves to Take Away & maintains Gaze fixation as head rotation occurs behind the ball on this
- Head rotation requires an effective VOR helps to maintain Gaze stability during backswing & maintained until after ball contact

Theoretical VOR in Swing

Take Away    Address    Follow Through

See Fred After Impact

- Uses Saccade to locate rapidly moving ball
See Fred Follow Through

- Smooth Visual Pursuit tracks ball to ground
- Provides visual feedback on shot
- Helps preview next lie
- Prevents anxiety in amateurs

Vision and Putting for the Elite Golfer

1. Fixation of the hole longer and uses slow Saccades of about 500 ms between the hole & ball
2. Directed 2-3 fixations to the hole & ball or club, with Saccades linking the fixations
3. During the stroke maintained quiet eye on the top or back of the ball thru the backswing and forward swing
4. At contact the quiet eye remained on the putting surface for 250ms.

Vestibular Rehab in the Athlete

- Comprehensive approach to assessing and treating symptoms of vestibular system pathology
- Vestibular Control in running – cutting – explosive movements
  - Biomechanical, neuromuscular, sensory/perceptual constraints
- Eye-Hand-Head Coordination
  - Oculomotor control – saccades – smooth pursuit
  - Gaze stabilization during head movements
  - Disk improvements
- Other Conditions
  - Pain – abnormal movement patterns and compensations
Dan Uggla Case
Oculomotor Testing and Rehabilitation
ROBERT DONATELLI PT PhD

Dan Uggla

- Professional MLB 2nd baseman
- Florida Marlins
- Atlanta Braves
- San Francisco Giants
- Washington Nationals
- 2010 Silver Slugger Award
- Atlanta acquired Uggla on Nov. 16, 2010, when Wren traded infielder Omar Infante and reliever Mike Dunn to the Marlins. Wren soon signed Uggla to a five-year contract worth approximately $62 million.

Tragedy Strikes

- July 24th, 2012
  Uggla was hit in the head by an errant pitch
- Uggla hit AGAIN during spring training 2013
No Concussion Symptoms

- Inability to maintain a coherent stream of thought
- A disturbance of awareness with heightened distractibility
- Inability to carry out a sequence of goal-directed movements (AANS.org)
- Effects can last 30 days post concussion (Miranda)
- Prolonged headache
- Nausea or vomiting
- Memory loss
- Emotional (anxious, nervous, irritable)
- Personality changes
- Ringing ears
- Difficulty concentrating
- Loss of smell or taste (AANS)

Braves Send Him For Lasik Surgery??

- Uggla’s performance quickly declined
- Attempted Lasik Surgery to correct vision to 20/10 - August of 2013
- Uggla, a three-time NL All-Star, hit .179 with 22 homers and 55 RBIs 2013. He struggled so much that he was left off the postseason roster

Poor Dynamic Vision

- Surgery was unsuccessful and Uggla continued to struggle to track the ball while moving dynamically
Released by the Braves

- Uggla’s frustrating, four-year tenure with the Braves ended Friday when the team requested unconditional release waivers on a former starter still guaranteed over $18 million for the remainder of this year and next. 7/18/2014 – Uggla signs with San Fran Giants 7/23/2014
- In his fourth season with the Braves, the 34-year-old Uggla was batting .162 with two home runs and 10 RBIs in 48 games and 130 at-bats.

Uggla Takes a Walk

- Dan Uggla had fallen so far, so deep into a two-season slump that he looked finished, released by two teams and discounted by others. “Washingtonpost.com”

Making a call to Marquis Grissom

- 7/30/14 San Fran 0 for 11 with 6 strike outs and 3 errors in four games
- "Making a call to Marquis Grissom dejected about how fast his career declined, and left with no explanation/answers, [Uggla] received a call from former major leaguer Marquis Grissom, who related his own story of struggling after being hit in the head and, ‘hooked up Uggla with Las Vegas Physical Therapist Robert Donatelli.’" Federalbaseball.com
Talking to Dan

- After asking Dan questions on the phone
- I was certain he had an ocular motor dysfunction and asked him to come to Vegas
- I told him I had to do an evaluation to verify what I thought was wrong
- He came to Vegas in September of 2014 after the San Fran Giant released him

Getting Healthy

- "Uggla came to Las Vegas to work with Dr. Donatelli for 2 weeks, twice per day for 10 days and then he was given a home program of exercises to improve the condition. He also worked with Tripp Smith in Atlanta, Ga. for the next two months
- November, Donatelli declared him healthy, his motion vision back to normal." 20/10
- Federalbaseball.com

Negative - Position Testing for BPPV
Position Tests Negative

Log Roll test
Cerviogenic?

Dan Uggla
Evaluation Ocular Motor Tests

Head Thrust test - positive
Head Shaking -
Saccades - over shoot
Smooth Pursuit - Jerk
Saccades
VOR Cancellation - positive
SVA vs DVA
20/10 - 20/100 lost of 11 levels of vision....

Abnormal Tests

- Smooth pursuit test
  - Abnormal eye tracking or saccade jerks is +
- VOR cancellation test
  - Inability to cancel VOR is + nystagmus
- Saccadic eye movement test
  - More than 2 saccades to shift gaze between targets and overshoots the target is +
Head Thrust

- Patient instructed to keep eyes fixed on a target (your nose)
- Move the patient’s head slowly side to side, then head is passively and quickly moved in one direction and stop
- Eyes should stay on target
- Corrective saccade to re-fix gaze on target is +

His DVA is Dysfunctional

Dynamic Visual Acuity Test (VOR)

- Patient reads to the lowest line of eye chart with head still
- Hold the patient’s head and passively move the patient’s head side to side in a small range of motion
- Patient reads eye chart while head moving; should degrade ≤ 3 lines
- Repeat with vertical movement
- Dan tested at 20/100

Dynamic Visual Acuity Exercise
Baseball specific Ocular Motor Training

Otolith Linear movements - Exercises

Trampoline Blind Fold

Balance Training
Baseball Specific Exercises

A Balanced Swing

Blind fold swings On shuttle balance

Soccer Specific

Adaptations

- Long term changes that are made in response to vestibular input: the intact side compensates for the affected side
- VOR exercise
  - Focus on target while moving head in and out or up and down for 1-2 mins
  - Move head and target in opposite directions keeping the letter in focus for 1-2 mins
  - Increase speed, duration, frequency, direction, background, posture

Exercises Adaptation

- Adapt to impaired vestibular system by compensating with other systems (vision, somatosensory, central processing).
  1. Eyes then head practice for 5 mins 2-5x/day
  2. Imaginary targets
     - Vary speed, amount of head rotation, direction of movement, location and size of target.
Dan's Come Back

VIERA, Fla. — Dan Uggla, who is competing for a spot on the Nationals' roster, continued his hot-hitting spring with a two-run homer in the third inning to propel the Nats to a 4-2 victory over the Marlins at Space Coast Stadium on Saturday.

Ugglal stuns former team as Nats charge past Braves

ATLANTA — Dan Uggla silenced those who had booed him the past two nights when he drilled a three-run home run off Jason Grilli in the ninth inning of the stirring 13-12 come from behind win the Nationals claimed against the Braves on Tuesday night at Turner Field.

Uggla's line-drive shot into the left-field seats proved decisive for the Nationals, who erased two eight-run deficits on the way to snapping their six-game losing streak.

Ocular Motor Dysfunction
The Hidden Victim in Head Concussions
Eye-(head)-Hand Coordination

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Ocular – Motor Balance Training Olympic Boxer

Many randomized controlled studies demonstrating the value of vestibular exercises. Herdman Vestibular Rehab 3rd edition

- Decrease dizziness
- Improve gaze stabilization
- Repair sensory and motor aspects of vestibular control
- Most cases the exercises facilitate CNS compensations rather than alter vestibular dysfunction. Exception BPPV

Mechanisms of Recovery Unilateral Vestibular Loss – Golfer/Skier

- Cellular recovery – receptors or neurons
- Exercises that incorporate head shaking with & without blind fold
- Adaptation of the Vestibular Ocular system is content specific – use of different velocities or head movements. Stress the system in Different ways

All Systems OCM, Vision, Somatosenory

- Balance Training
Summary
Eye-Vestibular - Coordination

Exercises
- Eye movements both visual and vestibular systems are used to improve gaze stability during voluntary and involuntary movements of the head
- Exercises include the use of unstable surface while performing eye movements
- Specificity of movements that are specific to the sport such as incorporating head shaking during the golf swing.
- Home exercise program are important
- Spontaneous reestablishment of the tonic firing rate centrally, vestibular adaptation and substitute of other strategies
- Recovery of tonic vestibular –ocular and vestibulospinal responses

Vestibular Dysfunction = Physical Limitations in the Athlete
- Unable to focus with quick head movements
- Poor hand-eye coordination
- Poor balance compensations hip and step strategies
  - Make compensations that reduce the athlete's agility, speed, and performance
  - May cause injury
- Maintenance of GAZE and Posture interaction of inputs from;
  - Vestibular
  - Visual
  - Somatosensory