



Weill Cornell Brain and Spine Center

Weill Cornell Brain and Spine Center BASELINE & POST-INJURY NEUROPSYCHOLOGICAL TESTING

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Disclosures: Has no relevant financial relationships to disclose.

HISTORICAL PERSPECTIVE

- High incidence of Football Injuries
- 1905 White House Meeting
- President Theodore Roosevelt



- 1986 Jeffrey Barth, PhD at University of Virginia Research Concussive Effects — Football
- 1993 Mark Lovell, PhD et al Pittsburgh Steelers Traditional Neuropsychological Testing
- 1995 Kenneth Kutner, PhD et al New York Giants Computerized Neuropsychological Testing

Kutner, K., Warren, R. & Barnes, R., Computerized Neuropsychological Assessment. (1997) Paper Presented at the NFL Physician's Society Annual Symposium

Kutner, K., Relkin, N., Barth, J., Barnes, R., et al Sports Head Trauma, (1998) National Academy of Neuropsychology Bulletin

Sideline Concussion Checklist (SCC)-B	
Player Date / /	
LOC No Yes Length Time of Injury	
Respiration: Normal Apnea Irregular	
<u>Trial #1 #2 #3 #4</u>	
Time:::::::_	-
1. Unequal Pupils 2 2mm	
2 Orientation: *If on sidelines turn player pure from field *	1 Mai #1 #2 #3 #4
Opponent v n v n v n v n	Gait: intact intact intact
Current Date v n v n v n v n	impair impair impair
Current Quart y n y n y n	Right intact intact intact
Current Score yn yn yn	impair impair impair impair
Play Injured yn yn yn	Left intact intact intact intact
3. Fine Motor: Thumb to Fingertip Sequencing	impair impair impair impair
Right intact intact intact intact	9. Cognition:
impairimpairimpairimpair	ST Memory - Shirt, Car, Apple
Left intact intact intact intact	<u>y_n_y_n_y_n_y_n</u> _
4 Vomiting: v n v n v n v n	Dign Span: Forward 63716 63716 63716 63716
5. 0 - None 1 - Mild 2 - Moderate 3 - Severe	
Headache:	Backward 8517 8517 8517 8517
Dizziness:	y_ny_ny_ny_n
Nausea:	Oral Trails B: Alternate numbers & letters
6. Dysmetria: Examine player with eyes open. Have player touch	1-A-2-B-3-C-4-D-5-E-6-F-7-G-8-H-9-I-10-J
examiner's finger then his nose at right, left and midline. Player	y_n_y_n_y_n_y_n_
nead/eyes are unlixated.	Kemote Memory: *Player Explains Coach Provided Play*
Right IntactIntactIntact	<u>y_n_y_n_y_n_y_n_</u>
Left intact intact intact	
impair impair impair	10. Exertion Stress Test
7. Diplopia: Examine with eyes open with central fixation. Have	Asymptomatic Symptomatic
player count lines in left and right visual fields. Have players count lines	Other: y_n_ y_n_ y_nn
or fingers.	i.e. Lethargy
<u>yn yn yn</u>	Agitation
	Examiner:
	Kutner, K., Relkin, N., Barth, J., Barnes, R., Warren, R., & O'Brien, S. 8/1/97
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Head Injury Assessment



NEUROPSYCHOLOGICAL TESTING IS AN INTEGRAL PART OF CONCUSSION MANAGEMENT

- American Academy of Neurology Sports Concussion Guidelines 2013
- American Medical Society for Medicine Position Statement: Concussion in Sports 2013
- Consensus Statement on Concussions in Sports: 4th International Conference 2012
- National Athletic Trainers' Association Position Statement: Management of Sports Concussion 2014
- NFL Brain & Spine Committee/Center for Disease Control



NEUROPSYCHOLOGY

Neuropsychology is the study of brain-behavior relationships.

Clinical Neuropsychology is the clinical application of neuropsychology.

Includes evaluation and treatment of cognitive impairment.

Utilizes scientifically developed procedures to reliably and validly measure cognition.



NEUROPSYCHOLOGICAL EXAM

- Attention/Concentration
- Reasoning
 - Verbal/Nonverbal
- Intelligence
- Memory
 - Short Term/Long Term
 - Working Memory
 - Verbal & Visual

Tests of Effort/Malingering

Practice Parameters (1997) TCN/AACN

- Speed of Information Processing
- Language
 - > Expressive
 - Receptive
- Visuo-Spatial
- Academic
- Pre Accident Psychological Hx
 - Learning Disabilities
 - > ADHD
 - Depression/Anxiety/Pani c



NEUROPSYCHOLOGICAL TESTING

*** Two Critical Issues ***

RELIABILITY & VALIDITY

Reliability is consistency of measurement. Repeated administrations of a test reveal consistent findings. Tests must be reliable.

.60 - .69 Marginal .70 - .79 Adequate .80 - .89 High .90 + Very High



Validity reflects how well a test assesses what it is supposed to be measuring. Tests can be reliable but not valid. Does a test actually measures cognitive impairment.



Greater incidence of invalid test performances in group administration

- Determine athletes understand purpose and nature of baseline testing
- Ensure athletes understand the test directions
- Encourage good effort on part of the athlete
- Reduce and control for distractions
 Comfortable seating, separation between athletes, limit extraneous sounds, limit interruptions, limit athletes talking, functional computers and mouse
- Have administrator present at all times, baseline and post-injury administration

NY Giants 2014 Baseline Examinations



COMPUTERIZED TESTS







Axon Sports provides online cognitive assessment tools that aid the evaluation and management of sports-related concussions.





POST-INJURY TESTING INTERVALS

Research is not clear Initial 48-72 hours Subsequent Exams 7-10 days



Neuropsychological Testing may be most valuable when the athlete is at or is approaching being symptom free.

TYPE I & TYPE II ERRORS





COMPUTERIZED VS TRADITIONAL TESTING

TRADITIONAL 1:1

- Motivation better assessed
- Understand Task Directions better
- Neurobehavioral status assessed
- Better control of environment
- More global and detailed exam

<u>COMPUTERIZED</u>

- Reaction time better measured
- Automatic scoring
- Less Expensive
- Multiple athletes run at same time
- Test in Multiple Languages

WHY DO TEST SCORES IMPROVE POST INJURY?

- 1. Practice Effects: Test-Retest Effect
- 2. Motivation: More Motivated to Score Higher
- 3. Individuals who score at the bottom 10% on baseline can score higher due to regression to the mean.
- 4. Computerized tests need to repeat a subset of subtests within the same testing i.e. ANAM.

 ** Utilizing > 1.5 SD below mean for impairment. Impact Test results are not normally distributed.
 15% of non-injured score > 1 SD below mean for 1 Composite 40% of non-injured score > 1 SD below mean for 4 Composites Schatz, P & Iverson, G (2014)

** Reliable change indicator (RCI) for ImPACT. Single positive RCI score may but usually does not = impairment. Two positive RCI scores suspicious for but may not = impairment Three positive RCI scores = impairment

** Recommend use of Base Rate Analysis

** Neuropsychologists are in the best position to interpret ImPACT and other cognitive test scores, i.e. NFL

1-Year Test-Retest Reliability of ImPACT in NHL Players 2014, April 28/1Bruce, J., Echemendia, R., et al The Clinical Neuropsych

Baseline to post-injury evaluation is often years (4 in NFL)

305 Players, Mean age 25.61 \pm 4.87, Mean Education 12.63 \pm 2.21 years, mult language Mean time between testing 373.35 \pm 13.86 days

Composite	English Speaking <i>n</i> =119					
	Mean ₁	Mean ₂	.70 RCI	.80 RCI	.90 RCI	
Verbal Memory	87.92	88.71	10.19	12.60	16.15	
Visual Memory	77.81	77.92	11.52	14.23	18.23	
Reaction Time	0.57	0.57	0.07	0.09	0.11	
Visual Motor	41.42	41.76	4.31	5.33	6.82	

**Study found mixed support for use of Visual Motor and Reaction Time Composites

**Rest-retest reliabilities for the Verbal and Visual Memory Composites were low, suggesting low sensitivity to memory change

**Supplement ImPACT testing with 1:1 for memory assessment

ImPACT — Future Directions

- 1. Standard Scores for Individual Subtests
- 2. Percentiles for Individual Subtests
- 3. Implementation of Two-Factor Theory Increased Sensitivity (89%) & Specificity (70%) Resulted in Improved Reliability Memory (Verbal & Visual) 1 month .88 1 year .85 2 years .76 Speed (Visual Motor Speed & Reaction Time) 1 month .81 1 year .75 2 years .74

Schatz, P. & Maerlander, A., (2013) Arch Clin Neuropsychol, 28(8)



POST INJURY ImPACT WITHOUT BASELINE

- Increase chance of making Type I & II Error
- 90% of non-injured population score low on at least 1/10 tests
- Athletes with Learning Disability, ADHD, or history of substance use score lower on baseline in absence of injury
- Utilizing CogSport/Axon baseline method resulted in higher specificity and classification rates than normative method
- Louey, A., et al (2014) Arch Clin Neuropsych online: May 9, 2014

FUTURE DIRECTIONS

- 1. Head-to-head testing will determine which computerized test has best reliability & validity.
- 2. College and and possibly high school testing will incorporate hybrid testing format.
- 3. Normative data for specialized groups (LD & ADHD) will be developed and utilized.
- Improved Baseline Validity Measures (Reduce Sandbagging)
 i.e. ANAM PVI: Performance Validity Index



THANK YOU

