

## Neurocognitive Concussion Testing & The ImPACT™ Test

At the forefront of concussion management is the implementation of neurocognitive testing in athletic programs. Such evaluation can help to objectively evaluate the concussed athlete's post-injury condition and track recovery for safe return to play, thus preventing the cumulative effects of concussion or returning an athlete to play too soon who has not fully recovered.

Neurocognitive testing can be in the form of a pencil-and-paper test (SAC, SCAT3) or a computerized test (ImPACT, ANAM, CogSport). Pencil-and-paper tests remain an effective tool for coaches to use on the sideline to assess athletes with potential head injury. But pencil-and-paper tests lack sufficient sensitivity over an extended period of time for medical and healthcare professionals to base critical management and return to play decisions. After 2-3 days post-injury, pencil-and-paper tests are ineffective and may not reveal the presence of a concussion injury (false-negative). While concussion recovery often necessitates 2-4 weeks, some require more time where computerized neurocognitive testing is much more sensitive to brain function for many weeks and months post-injury.

Computerized applications have been available in recent years to individual schools and teams at an annual cost of \$400-\$800, making it cost-prohibitive for many schools. Recently, ImPACT Applications, Inc. fashioned a testing program model for healthcare networks having met specific medical criteria with access to specific resources. Such testing is now more cost-effective for schools, where many schools have their testing fully funded through local/area resources. As a result, the Nebraska Sports Concussion Network & Testing Program (**NSCN**) was developed and will assist schools to implement, and where possible, fund a concussion testing program using the ImPACT Test.

### **ImPACT Test™**

ImPACT (Immediate Post-Concussion Assessment and Cognitive Testing) is an on-line, user-friendly computer-based testing program specifically designed for the management of sports-related concussion. ImPACT is a research-based software tool developed at the University of Pittsburgh Medical Center that evaluates multiple aspects of neurocognitive function, including memory, attention, brain processing speed, reaction time, and post-concussion symptoms.

Current ImPACT clients include all NFL & NHL teams, MLB, including all umpires, NASCAR, and numerous NCAA Division I Football Programs, including the University of Nebraska-Lincoln. Other athletic programs in Nebraska currently implementing the program include: UNK, UNO, Doane College, Concordia Univ., Peru State College, all Lincoln Public & Private high schools, in addition to more than 250 high schools in Nebraska.

### **Baseline Testing**

*Baseline Testing* refers to neurocognitive testing under normal conditions before injury, often conducted in the pre-season. The baseline test gives us a snapshot of how one's brain functions in normal, everyday circumstances. Baseline testing is conducted on-site at schools by trained school staff with

assistance from healthcare providers trained in ImPACT testing. Using a school's computer lab and internet to log onto an on-line testing website, multiple users can be tested at the same time. It takes ~25 minutes to complete the baseline test. The testing application formulates "baseline data" which are stored on a secure, HIPAA compliant server at ImPACT Applications, Inc. which can be retrieved anytime at a later date by a credentialed ImPACT Provider if an athlete sustains a concussion.

### **Post-Injury Testing**

In the event an athlete sustains a concussion, the athlete is tested again post-injury. *Post-injury testing composite scores* are then compared to the baseline scores acquired earlier before a concussion injury affected brain function. Therefore, baseline testing only becomes of value when post-testing is utilized for comparison after a concussion injury. We estimate 10% of athletes on average in collision and contact sports (15%-20% of football players) will risk concussion injury necessitating post-injury testing.

*Post-Injury Testing* is conducted by medical or other appropriate healthcare professionals having specialized training and credentialing by ImPACT and NSCN to interpret and evaluate post-testing composite scores for deficiencies or abnormalities. These trained professionals will objectively base their management and return to play decisions on post-test comparisons, depending on when post-test scores return to baseline, among other clinical considerations such as balance tests and eye function tests. Hence, better, safer, and more consistent decisions can then be made about an injured athlete returning to play. Subjectivity is far less apparent, and an athlete can potentially be allowed back sooner, rather than their return to play being delayed by uncertainty or overly conservative measures.

*Post-Injury Testing* may be conducted as early as 24-72 hrs. post-injury, but is often conducted once a concussed athlete is symptom-free (asymptomatic), depending on the healthcare provider managing the athlete's condition. When post-concussion testing is opted for online, another form of the test is selected having a different word and design list, as well as other randomized stimuli. This feature is incorporated into ImPACT to help reduce the practice or learning effect often associated with neuropsychological measures. Given this issue, multiple forms are utilized for each post-injury testing session. On occasion, multiple post-injury tests (serial testing) may be conducted to monitor an athlete's recovery over time.

If post-injury testing scores have not recovered in sufficient time (usually within 3-4 weeks), the athlete may be referred to a neuro-specialist with advanced, formal training in treating head injuries, i.e. Neurosurgeon, Neuropsychologist, Rehabilitation Specialist.

### **Testing Cycle**

Baseline testing offered through the Nebraska Sports Concussion Network will be available to 7<sup>th</sup> through 12<sup>th</sup> grade athletes, participating in collision and contact sports having the highest incidence of concussions [football, volleyball, basketball, wrestling, diving, soccer, track-jumpers, baseball, and softball]. Schools wanting to baseline test non-contact sports [cross-country, golf, tennis, swimming, track-runners] or any other groups, will have the option to arrange for and purchase baseline tests at a cost of \$5/test.

During a school's 1<sup>st</sup> year of testing, baseline testing is conducted on everyone within the identified groups. Thereafter, an athlete's baseline testing is then conducted on a 2-year cycle, with testing of incoming 7<sup>th</sup> graders, 9<sup>th</sup> graders, and those entering 11<sup>th</sup> grade performed each year. Any newcomers to an athletic program, and those having sustained a concussion the previous year will be tested each year as well.