BTrackS™ Accuracy Report

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As an athletic trainer or healthcare provider, you want to provide your athletes with the best balance test possible. You know that force plates are used for balance testing in hospitals and balance clinics worldwide – but you can’t afford to spend thousands of dollars on a force plate.

Now, with BTrackS, you can afford a force plate! BTrackS is the first affordable force plate system that provides you with an objective, accurate and reliable system to measure balance. The BTrackS Balance Test (BBT) is the balance test you can provide for all your athletes.

This report will explain the BBT and how it’s objective, accurate and reliable. It should answer the questions you have. At the end of the document, there are results of several athletes who were baseline tested with the BBT before their season started - and then suffered concussions and took the BBT until they returned to baseline.
Is BTrackS objective, accurate and reliable?

**Objective**

Today, athletic trainers and healthcare providers face increasing pressure to make accurate decisions regarding an athlete’s health status following a suspected concussion. The most recent position statements on concussion management from The American Medical Society for Sports Medicine and the 4th International Conference on Concussion in Sport both recommend including balance testing as part of a well-rounded concussion protocol.

Force plates, like BTrackS, provide objective measurements of balance. BTrackS is an FDA Registered Class I medical device (#3010668481) that employs sensors and computers and software to measure balance. There is no subjectivity in a BTrackS Balance Test (BBT). The athlete being tested is measured by sophisticated computer technology. The person administering the test only instructs the athlete on when to get on the board and when to get off the board.

Unfortunately, today, the most common approach to assessing balance in the field of athletic training relies on the *subjective* visual judgment of athletic trainers to determine an athlete’s balance. Because force plates are too expensive - the Balance Error Scoring System (BESS) is the most common example of visual testing. The BESS is a visual assessment of an athlete’s balance as a series of standing positions are executed. The examiner counts the errors that occur during the test. The BESS does not measure balance by measuring the postural sway of the athlete – it counts errors. It does not measure postural sway like a force plate. If you were in your training room and had both a force plate and the BESS – you would use the force plate.

*Bottom Line - BTrackS provides an objective, sensor measured and computer-generated computations of an athlete’s postural sway, which is an industry-recognized objective method of measuring balance.*

**Accurate**

The BBT measures the center of pressure (COP) postural sway of the athlete being tested. The BBT senses the small movements (sway) of the athlete while they stand on the BTrackS Plate. The BBT measures postural sway in centimeters. Typically, a healthy athlete will sway somewhere between 10 and 40 centimeters in just 20 seconds.

In order to verify that the BBT is measuring the postural sway accurately, the BTrackS Plate and Software are calibrated by completing a 40-point calibration procedure. The procedure verifies that the distance measured by the BTrackS Plate and software is equal to the actual distance on the board. For example – a measuring device physically measures to a spot on the board 4 centimeters from the center of the board. Then, we exert pressure on that exact same spot and verify that the software also reports that it’s 4 centimeters. We do this to 40 different locations on the board – 10 to the upper left quadrant of the board, 10 to the to lower left quadrant and 10 to lower right quadrant. Results are shown below:
The accuracy of BTrackS in the side to side (COPx) direction is shown in the left graph, while the accuracy of BTrackS in the front to back (COPy) direction is shown in the right graph. Each point on the graph represents a single test point (40 in total) that represents the location on the board where the calibration tool was applied and plotted against the measured value by BTrackS. When a line of best fit is applied to this data, there is a strong linear relationship seen between the actual COP and the BTrackS measured COP. The fit of the line, established using a Pearson correlation coefficient (r), is greater than r=0.99. This value suggests that COP determined using BTrackS is equivalent to the actual location of pressure placed on the board.

**Bottom Line - BTrackS is an accurate device for measuring center of pressure (COP) postural sway.**

**Reliable**

A key feature of any balance test is test-retest reliability. This is how consistently the test provides statistically similar results from a person when nothing has changed in their health status. Reliability is important because the more reliable the test is, the easier it is to see a true change in balance due to injury such as concussion.

Test-retest reliability of a balance test can be determined using a statistic called the intra-class correlation coefficient (ICC). A group test is considered to be reliable if data has an ICC greater than 0.7 on a scale from 0-1. Group data from several research studies have shown that the BTrackS Balance Test (BBT) protocol of three, 20-second balance trials with eyes closed and both feet on the ground is reliable. These research studies have determined that the BBT has an ICC value that is 0.7 or greater\(^1\). Our own group studies at Balance Tracking Systems have also confirmed these reliability results. When we tested 100 people twice, separated by a week, the BBT had an ICC value of 0.8.

**Bottom Line – BTrackS and the BBT are a reliable means of performing balance testing.**
**What is the BTrackS Balance Test and where does it come from?**

The BTrackS Balance Test is designed to detect disrupted balance in a quiet, eyes-closed, feet shoulder length apart standing position. The BBT consists of four 20-second trials. The first trial is a familiarization trial. The following three trials are used to actually measure the number of centimeters of postural sway. The BBT then averages the outcomes from the three trials and provides a final BBT result. BTrackS uses four-sensor, center of pressure measurement technology as the basis for all four trials.

The BBT is a derivative of the Romberg balance test, an important element of neurologic examinations for over 150 years. The test, named after German neurologist Moritz Heinrich Romberg (1795-1873), determines the body sway of an individual while they are standing with their feet together and their eyes closed for up to 60 seconds. By eliminating vision, the Romberg test challenges the individual to maintain balance based on proprioception and vestibular senses that are known to be key contributors to balance ability. Romberg testing has been shown to be an effective clinical diagnosis tool for balance problems associated with many neurological clinical conditions such as Parkinson’s disease, stroke, and traumatic brain injury.

**Can balance be measured in just 3 trials of 20 seconds each?**

When using a force plate – like BTrackS – the answer is yes. A recent study by Golriz et al (2012) was performed to determine how many trials a balance test needs to be reliable. Using a test protocol similar to the BBT, but with eyes open, it was found that acceptable reliability (i.e. ICC>0.7) was achieved with only two balance trials for a measure of center of pressure called mean velocity. This measure is equivalent to the measure used by Balance Tracking Systems in the BBT (i.e. postural sway - total path length).

While two trials was acceptable, Golriz et al (2012) showed that adding a third trial improved the reliability of balance testing further, with an ICC of 0.95 reported. There was no statistically significant improvement by adding a fourth or fifth trial of balance data, suggesting a three trial test was both reliable and practical.

**Why not use the conditions of the BESS for the BBT?**

First off, the BESS measures balance by counting the errors committed by the athlete during the six conditions of the test. That is not measuring postural sway. The BESS needs to challenge the user to not make an error by implementing perturbed balance conditions. Force plates like BTrackS, when testing simple static postural sway, don’t need to create perturbed conditions because they are sensitive computerized medical devices.

Secondly, an important limitation of the BESS conditions is that they are only performed once each and have been shown to be unreliable – even when performed on a force plate. A recent study by Chang et al (2014) demonstrated this by quantifying the test-retest reliability of the BESS conditions in 30 healthy adults, tested twice, one week apart, while doing the BESS on a scientific grade force plate. The results showed that only 2 of the six conditions produced reliable results above an ICC of 0.7.
Can the BBT detect balance deficits in a concussed athlete?

Testing with BTrackS is ongoing with the assistance of San Diego State University’s athletic training program and other schools in the San Diego area. Since testing began in early 2014, BTrackS has been utilized to baseline over 200 athletes and assess multiple concussions.

Two examples of concussion data are shown below. In each case, the black dashed line represents the baseline BBT. Data from a women’s water polo athlete is shown on the left. This athlete had more postural sway (i.e. higher BBT) than baseline following her concussion, which improved for the first 48 hours. At 72 hours, the athlete had a relapse of concussion symptoms that was also reflected in her postural sway. The athlete returned to play on day 11 and balance was back to baseline at this point. Data from a men’s rugby player is shown on the right. This athlete’s postural sway increased following his injury and then returned to baseline within a week.

These are excellent examples of balance measurement following a concussion but it should be noted that not all concussed athletes show balance deficits due to the variable nature of the injury.

Is the BBT impacted by fatigue?

One concern of any sports-related balance test is the effect of fatigue on the test results. For balance tests with demanding and/or perturbed conditions, like the BESS, it has been found that balance decreases can occur for up to 20 minutes following game based exercise. This fatigue effect can cause an athlete to test false positive, where that athlete appears to have a balance deficit due to an injury, but is really just showing the effects of fatigue.

Given the more straightforward nature of the BBT protocol, the effects of fatigue are largely mitigated. Balance Tracking Systems conducted a test of 11 healthy adults who had exercised for 20 minutes at a workload equivalent to 75% of their maximum heart rate. The results of the test showed that “before exercise” balance was restored in just 5 minutes and remained consistent for at least 30 minutes. These results, illustrated below, suggest the BBT can provide an accurate assessment of balance following exercise - significantly quicker than the BESS.
References


