

CDP Best Practices Update: New Bertec Norms

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With the new 2.4 Balance Advantage software release, clinicians can select either historical or the new Bertec norms to analyze CDP data: both are industry-standard norms and are valid measures of balance and postural control. The purpose of this update is to present the differences between the new Bertec norms and the historical norms to better inform the clinician when choosing the most appropriate norms.

Normative data are used to help clinicians compare an individual's performance to a reference population to aid in decision-making or to determine next steps for intervention. While normative data have been used in CDP systems for 30+ years, technological advances in balance plate precision and virtual reality integration have introduced differences in postural responses. Bertec's balance plate's higher sampling frequency of 1000 Hz and the immersive surround dome with no horizontal or vertical visual fixation reference points are the primary differences between the systems to consider when interpreting the results. Emerging research continues to establish normative data for Bertec's CDP.

One difference between the historical and the new Bertec norms is the age group distribution: the new Bertec norms—for the SOT and ADT are based on six decades (20-29, 30-39, 40-49, 50-59, 60-69, 70-79 years of age). The historical Sensory Organization Test (SOT) norms were divided into five groups (20-39, 40-59, 60-69, 70-79, and 80-89 years of age). The Adaptation Test (ADT) historical norms were collected across three age groups (20-59, 60-69, and 70-79 years of age).

SENSORY ORGANIZATION TEST

The SOT is sensitive to sensory integration changes across the lifespan: elders demonstrate significantly lower equilibrium scores for vision, visual preference, and composite scores, declining steadily with advancing age. The timeline of normal childhood development of postural control displays some variability; however, the visual system matures first, followed by the somatosensory system, and finally the vestibular system. While children can integrate sensory cues from different sources by 10 years of age, the vestibular system continues to mature in its ability to process, integrate, and organize sensory input through at least 14-16 years of age. Children often prefer visual to vestibular inputs and are unable to process misleading visual information as adults can. Using age-appropriate norms accounts for these developmental considerations.

Bertec norms for those older than 79 years and for the pediatric and adolescent (ages 3-19 years) populations have not yet been published so the historical norms should be selected. The new Bertec norms for vestibular sensory score ratios are not significantly different between the oldest and youngest age groups (20-79 years), potentially making it easier to detect even small vestibular impairments with the Bertec SOT. Regardless of the norms selected, the end of test report will note if the subject's age is outside the normative data age range and the closest age range will be used for normative comparison.

In general, the SOT scores are comparable between the historical and Bertec norms except for SOT4 (the visual score). The lack of a visual reference point in the immersive surround is responsible for differences between the new Bertec norms and the historical norms for the scores (SOT4) related to visual performance. The new Bertec norms may be more sensitive to detect the inappropriate use of visual cues to maintain balance (SOT3, SOT6). The clinician should recognize the potential differences between the historical and Bertec SOT norms for the following postural sway scores obtained on the Bertec system due

to the disruptive effect of the immersive surround on vision. Recall that higher scores reflect less postural sway.

- a. SOT1 and SOT4 scores may be lower.
- b. SOT2 scores may be higher than SOT1 as SOT1 is more disruptive to vision.
- c. Lower vision scores are likely due to a lower score on SOT4.
- d. Individuals with visual sensory impairments affecting balance will respond differently to SOT3 and SOT6 so Bertec norms should be used.

The minimal detectable change at the 95% confidence level (MDC_{95}) is useful in determining whether a true change has occurred. The clinician may use an overall composite score greater than 6.5 to indicate that a meaningful change has occurred. A composite MDC_{95} of 8 points and 4 points is the threshold for meaningful differences in those with vestibular impairments and healthy individuals across the lifespan, respectively.

In addition to the composite score MDC_{95} , the Bertec norms allow the clinician to further classify improvements by sensory condition. The MDC_{95} differs across the six Bertec SOT conditions and is the most sensitive when three trials per condition are completed. When the platform is stable (conditions 1-3), MDC_{95} values range from 3.01 to 4.26, meaning that small changes are clinically significant. In conditions 4-6 (sway-referenced platform movement), the MDC_{95} values range from 8.99 to 13.70. For vestibular conditions 5 and 6, the MDC_{95} values are 13.66 and 13.70 respectively in the young healthy population. Bertec norms are better able to correctly identify a treatment effect by sensory condition. Clinicians should keep these values in mind and realize that larger vestibular score differences are required to document change due to treatment, especially in those who do not use vestibular information correctly.

Sensory Organization Test Administration Considerations:

Users are cautioned that the results obtained by Bertec's SOT and the historical SOT are not universally interchangeable. Once the clinician decides which set of norms is most appropriate for the patient, those norms should be used for subsequent assessments to maintain consistency.

The first time a patient experiences the immersive surround in the dome to perform the SOT, the first trial for most conditions may not be an accurate reflection of their postural control, especially in those with vestibular deficits who have anxiety, fear of falling, or poor confidence while performing balance-related tasks. This can be remedied by adding a familiarization trial at the start of the more challenging conditions 4-6. While the clinician may be tempted to complete two trials per condition, research-based normative data are based on three trials per condition; therefore, to achieve the most reliable and consistent results, completing all three trials is highly recommended. Measurements made with the Bertec Balance Advantage SOT have been shown to be more reliable than the historical SOT.

When compared with clinical outcome measures, the Bertec SOT is correlated strongly with the Activities Balance Scale (ABC) and Dizziness Handicap Inventory (DHI) and shows a moderate correlation with the non-instrumented Dynamic Visual Acuity Test (DVA) and functional gait assessment (FGA). This indicates an interaction between postural control, gaze stability, and walking in those with vestibular impairment. Combining the Bertec SOT with Bertec's computerized vision assessment of gaze stability and dynamic visual acuity will yield more data upon which to base clinical decisions.

SOT Clinical Pearls:

- The immersive surround, without vertical and horizontal reference points, is more disruptive to vision. Select Bertec norms in those who are unable to suppress inappropriate visual cues.
- To compare against norms, performing three trials per condition is highly recommended.
- Select Bertec norms to better identify changes by decade for those between 20-79 years of age.
- Select historical norms at each end of the lifespan: 3-19 years and elders above 79 years of age.
- Bertec norms demonstrate significantly lower equilibrium scores for SOT4, SOT6, visual and preference scores, and composite scores in the older age groups compared to younger age groups.
- Minimal detectable change values for the composite and each of the sensory conditions may be applied when using Bertec norms.
- Bertec norm development utilized strict exclusion criteria resulting in similar SOT vestibular ratio scores between the eldest and youngest groups. Therefore, Bertec norms may be more sensitive in detecting vestibular impairments.

Adaptation Test

Historical and Bertec norms are not equivalent due to the destabilizing effect of the immersive surround. The historical norms are reported by trial, while the Bertec norms are reported as an average across five trials. Individual trials are presented in the report to assess whether central adaptation is occurring across the trials. The toes up (TU) condition in the 70–79-year age group demonstrates higher sway scores than all other age groups (20-69 years old) for the new Bertec norms. Increased TU sway scores have been associated with an increased risk of fall. Adaptation to sudden perturbations of the support surface becomes more difficult with increasing age. It is likely that Bertec and historical ADT sway energy scores differ significantly, therefore the ADT norms are not interchangeable.

ADT Clinical Pearls:

- Select Bertec norms with special attention to the TU condition and risk of fall, especially in elders aged 70-79 years of age and older.
- Recognize that the association between higher body mass and higher body mass index (BMI) allows for stronger compensatory strategies during the ADT.

FINAL THOUGHTS & RECOMMENDATIONS

Regardless of the normative data set selected, the clinician must follow the same test protocol for sequential testing, including patient set up, foot placement, harness use, standardized patient instructions, and the norms used for data interpretation. Objective data combined with expert clinician judgement will lead to the most accurate interpretation of the results, establish the foundation for a targeted training program, and document change over time to aid in clinical decision-making.

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