



Original Research

Reliability of the Star Excursion Balance Test and Two New Similar Protocols to Measure Trunk Postural Control

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Abstract

Background: Although the Star Excursion Balance test (SEBT) has shown a good intrasession reliability, the intersession reliability of this test has not been deeply studied. Furthermore, there is an evident high influence of the lower limbs in the performance of the SEBT, so even if it has been used to measure core stability, it is possibly not the most suitable measurement.

Objective: (1) To assess the absolute and relative between-session reliability of the SEBT and 2 novel variations of this test to assess trunk postural control while sitting, ie, the Star Excursion Sitting Test (SEST) and the Star Excursion Timing Test (SETT); and (2) to analyze the relationships between these 3 test scores.

Design: Correlational and reliability test–retest study.

Setting: Controlled laboratory environment.

Participants: Twenty-seven physically active men (age: 24.54 ± 3.05 years).

Method: Relative and absolute reliability of the SEBT, SEST, and SETT were calculated through the intraclass correlation coefficient (ICC) and standard error of measurement (SEM), respectively. A Pearson correlation analysis was carried out between the variables of the 3 tests.

Main Outcome Measures: Maximum normalized reach distances were assessed for different SEBT and SEST directions. In addition, composite indexes were calculated for SEBT, SEST, and SETT.

Results: The SEBT (dominant leg: ICC = 0.87 [0.73-0.94], SEM = 2.12 [1.66-2.93]; nondominant leg: ICC = 0.74 [0.50-0.87], SEM = 3.23 [2.54-4.45]), SEST (ICC = 0.85 [0.68-0.92], SEM = 1.27 [1.03-1.80]), and SETT (ICC = 0.61 [0.30-0.80], SEM = 2.31 [1.82-3.17]) composite indexes showed moderate-to-high 1-month reliability. A learning effect was detected for some SEBT and SEST directions and for SEST and SETT composite indexes. No significant correlations were found between SEBT and its 2 variations ($r \leq .366$; $P > .05$). A significant correlation was found between the SEST and SETT composite indexes ($r = .520$; $P > .01$).

Conclusions: SEBT, SEST, and SETT are reliable field protocols to measure postural control. However, whereas the SEBT assesses postural control in single-leg stance, SEST and SETT provide trunk postural control measures with lower influence of the lower limbs.

Level of Evidence: III

Introduction

The Star Excursion Balance Test (SEBT) is a field test widely used to assess dynamic postural control [1-6], which is expressed as the maximum distance that participants can reach with their feet in several directions while maintaining a single-leg stance [7]. The SEBT has been performed normally either in 8 or 4 directions and even simplified to 3 directions (SEBT variation known as Y-Balance Test).

The popularity of the different SEBT protocols is mainly based on their relative low cost and ease of use

in comparison to posturographic tests, as well as on their within-session reliability [1,3,7-9] and their applications to injury prevention in clinical, sport, and research settings [10-17]. In this sense, low SEBT scores have been related with several injuries, such as recurrent ankle sprain and chronic instability [13-15,18], anterior cruciate ligament injury [11,16,17,19,20], and chronic low-back pain [12].

Regarding the reliability of the SEBT protocols, most studies have examined the within-session consistency, reporting moderate-to-good intrarater reliability (intra-class correlation coefficient [ICC]: $0.67 < ICC < 0.97$;

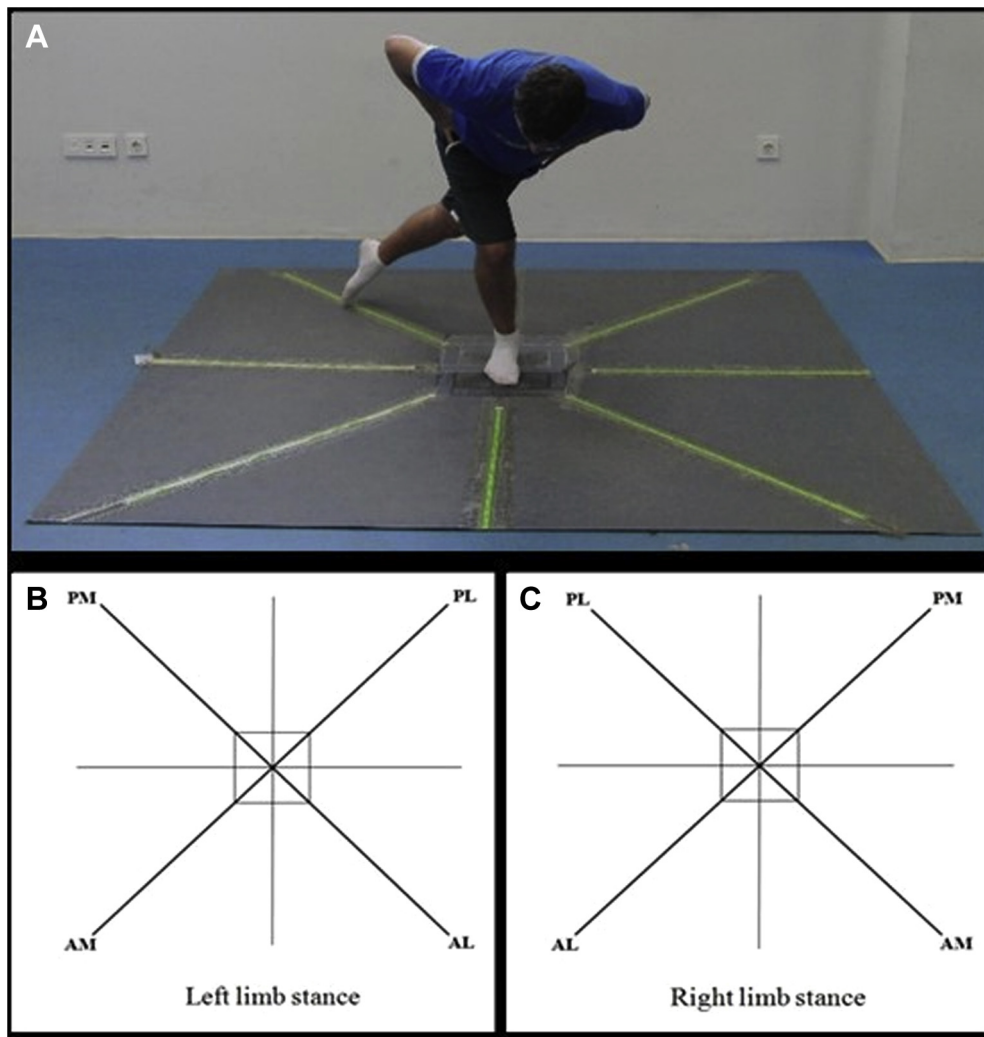


Figure 1. (A) Participant performing the SEBT along the posterolateral direction; (B) zenithal view of the 8-line grid used to perform the SEBT on the left limb; and (C) zenithal view of the 8-line grid used to perform the SEBT on the right limb. Test directions: AL, anterolateral; PL, posterolateral; PM, posteromedial; AM, anteromedial.

standard error of measurement [SEM]: $1.62\% < SEM < 7.61\%$) [1,3,8,9] and poor-to-good interrater reliability ($0.35 < ICC < 0.95$; $0.69 < SEM < 4.96$ cm) [3,7-9]. However, few studies [4-6,21,22] have studied the between-session reliability of the SEBT scores in depth, which is an important factor to know, for example, if the changes in SEBT scores in longitudinal studies are (or not) caused by within-subject variability. In this sense, although a minimum of 4 [20,23] or 6 [9,13,22] practice trials for each direction seem needed to obtain consistent SEBT scores in a single testing session, there is no agreement about the number of practice trials/sessions that are necessary to obtain consistent between-session SEBT scores, avoiding learning effect [5,21,22].

In addition, despite SEBT protocols having been widely used as dynamic postural control measures in single-leg stance [4,6,7], some researchers have used them to evaluate the effect of core/trunk stability programs (which are normally based on trunk exercises performed in lying positions) [24-27]; furthermore, in

one of these studies, a SEBT protocol was used as a core stability test [24]. However, although the upper body may have an influence in SEBT performance, SEBT scores reflect whole body balance in single-leg stance rather than stability of the trunk/core structures.

Therefore, although much information exists about the characteristics and applications of SEBT, there are important limitations in the scientific literature that must be addressed, especially the between-session reliability analysis of the protocol and the application of this or similar field tests to assess core stability. Based on these limitations, the aim of this study was to analyze the absolute and relative between-session reliability of the SEBT and 2 novel variations of this test, which were developed and tested for the first time to assess trunk postural control while sitting: The Star Excursion Sitting Test (SEST), expressed as the maximum distance that participants can reach with their hands while sitting, and the Star Excursion Timing Test (SETT), a similar protocol to the SEST with a time constraint. In

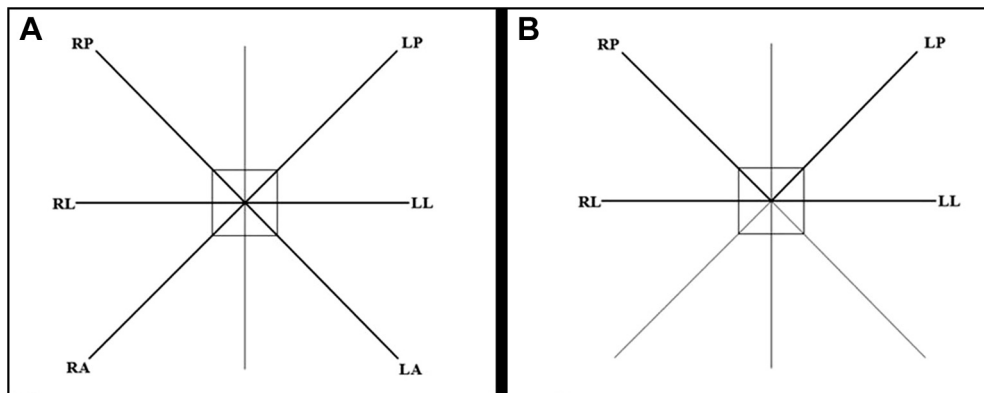


Figure 2. (A) Zenithal view of the 8-line grid used to perform the SEST; (B) zenithal view of the 8-line grid used to perform the SETT. Test directions: RA, right anterior; RL, right lateral, RP, right posterior; LA, left anterior; LL, left lateral; LP, left posterior. SEST, Star Excursion Sitting Test; SETT, Star Excursion Timing Test.

both SEBT variations the influence of the lower limbs was minimized to increase the role of the upper body in postural control and to obtain field measures related to core stability. The correlations between the 3 test scores also were analyzed to examine the relationships between protocols.

Methods

Subjects

Twenty-seven recreationally active male subjects volunteered to participate in this study (age: 24.54 ± 3.05 years; weight: 75.3 ± 9.96 kg; height: 176.81 ± 6.03 cm). Participants with known medical problems, histories of trunk, ankle, knee, or hip injury requiring treatment in the previous year, and participants with neurologic or musculoskeletal disorders that might adversely affect balance control were excluded. All participants signed an informed consent approved by the Ethics Committee of the University in accordance with the Declaration of Helsinki 2013.

Test Description

Star Excursion Balance Test

The test was performed following the protocol of Kinzey and Armstrong [4], with participants standing in

the middle of a grid with 8-mm lines extending at 45° angles from the center of the grid (Figure 1). The heel of the participant's stance foot was aligned with the center of the grid, and his big toe was aligned with the anterior line. The participant was asked to reach with his reaching leg as far as possible along the 4 diagonal directions: posteromedial (PM), posterolateral (PL), anteromedial (AM), and anterolateral (AL). He had to make a light touch on the line and return to the center while maintaining a single-leg stance with the opposite leg (stance leg) in the center of the grid and keeping his hands on his waist. Standard tape measures were placed on the grid lines to quantify the distance (centimeters) that each participant reached. Three consecutive repetitions were made in each direction in the following order: PM, PL, AM, and AL.

Star Excursion Sitting Test

The test was performed with participants sitting in the center of the aforementioned grid, but directions were renamed (Figure 2). Cones were placed in the grid over the standard tape measure lines in the 4 diagonal directions: right anterior (RA), right posterior (RP), left anterior (LA), left posterior (LP); and in the 2 lateral directions: right lateral (RL) and left lateral (LL).

Participants grabbed their legs with one arm, placing their hand under the popliteal area of the opposite leg,

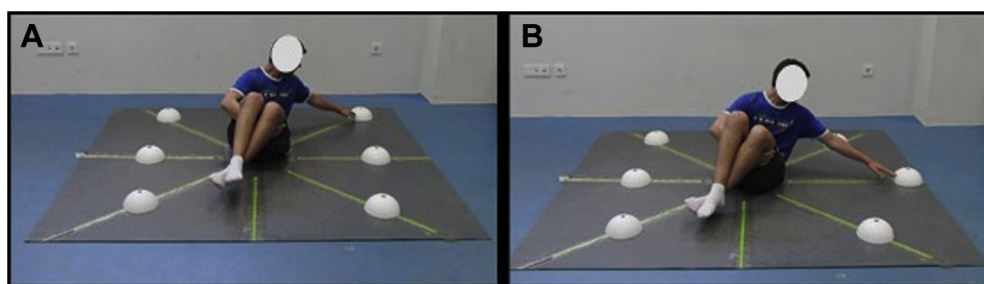


Figure 3. A participant performing the SEST along: (A) the left-posterior reach direction; and (B) the left-lateral reach direction.

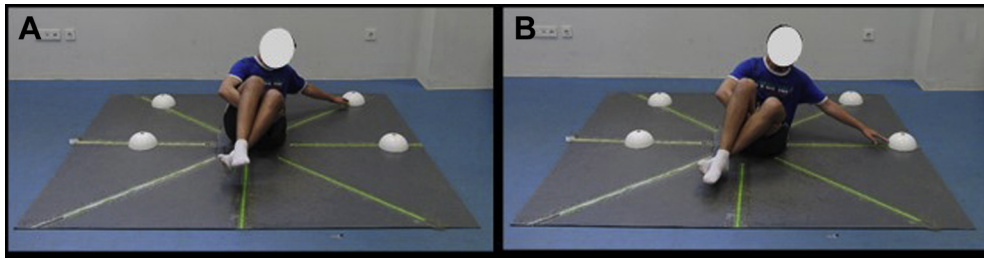


Figure 4. Participant performing the SETT along: (A) the left-posterior reach direction; and (B) the left-lateral reach direction.

while maintaining the balance sitting on their buttocks without touching the ground with their feet (Figure 3). In this position, they were asked to touch the cones with the middle finger of the other hand and displace them as far as possible along each line. For left directions, the right hand grabbed the legs and the left hand displaced the cones, and vice versa. Three consecutive repetitions were performed in each direction in the following order: RA, RL, RP, LA, LL, and LP. A repetition was considered as null if the participant knocked the cone over, let go of his legs, or leaned on his hand.

Star Excursion Timing Test

This test is a timed protocol performed in the same initial position described for the SEST (Figure 4). Cones were placed over 4 of the grid lines, ie, RL, LL, RP and LP. Participants performed 5 consecutive trials in which they had to move the cones as far as possible along the 4 lines (order: RL, RP, LL, and LP) in 8 seconds, without touching the ground with their feet. During each trial, after displacing the cones in the right directions (RL and RP), participants had to change the hand with which they grabbed their legs to move the cones in the left directions (LL and LP). The initial distance of the cones regarding the center of the grid was normalized for each participant calculating the adjacent side length of a hypothetical right triangle formed by this side, the hypotenuse (distance between C7 vertebra and their middle finger) and the opposite side (distance between trochanter and acromion). An acoustic recorded countdown was provided to the participants as verbal feedback about the time remaining to the end of the test. The criteria for null repetition were the same as for the SEST or to not displace the 4 cones in the 8-second time period.

Procedure

Participants performed the 3 tests in 2 testing sessions spaced 1 month apart. At the beginning of each testing session, several body anthropometric measurements were carried out (following the protocol previously described by Cabañas and Esparza [28] to analyze their influence on test scores: height, sitting height,

mass, trochanter-acromion length, wing span, arm length (C7 vertebra-middle finger distance), leg length (anterior superior iliac spine-external malleolus distance), biliocrestal diameter, and biacromial diameter. After the anthropometric assessment, participants carried out a warm-up consisting of 5 minutes of static cycling and performed a familiarization period to learn the proper technique and procedure of each test. In this period, the following strategies were explained to each participant to reach the maximum possible distance during the SEBT performance: (1) for posterior directions, to flex the ankle, knee, and hip of the stance leg as much as possible while bending the upper body forward to counteract lower limb elevation; (2) for anterior directions, to flex the ankle and knee of the stance leg as much as possible while extending the hip and leaning the upper body backward to counteract lower limb elevation. After this information, participants practiced each test direction during 30 seconds. Finally, they performed the tests in the following order: SEBT, SEST, and SETT.

Data Analysis

For each SEBT direction, the maximal reach distance (centimeters) of the 3 trials were normalized by dividing it by participant's length leg (centimeters) and multiplying it by 100 (score expressed in leg length percentage) [7]. In addition, the normalized results of the 4 directions (AL, PL, AM and PM) were averaged to create a composite normalized score for each dominant and non-dominant leg [2,8].

The maximal reach distance (centimeters) of the 3 SEST trials was selected for each testing direction (RA, RL, RP, LA, LL, and LP). In addition, a composite normalized score was calculated for the SEST averaging the 6 direction scores. Regarding the SETT, the reach distance obtained in the 4 directions (RL, RP, LL, and LP) were averaged in each of the 5 trials, and then the highest average was selected as SETT composite index.

Because arm length was highly correlated with SEST ($r \geq .609$, $P > 0.01$) and SETT ($r = .890$, $P > .01$) scores, these scores were quantified as the residual values of the regression analysis between raw SEST and SETT values and arm length, avoiding anthropometric

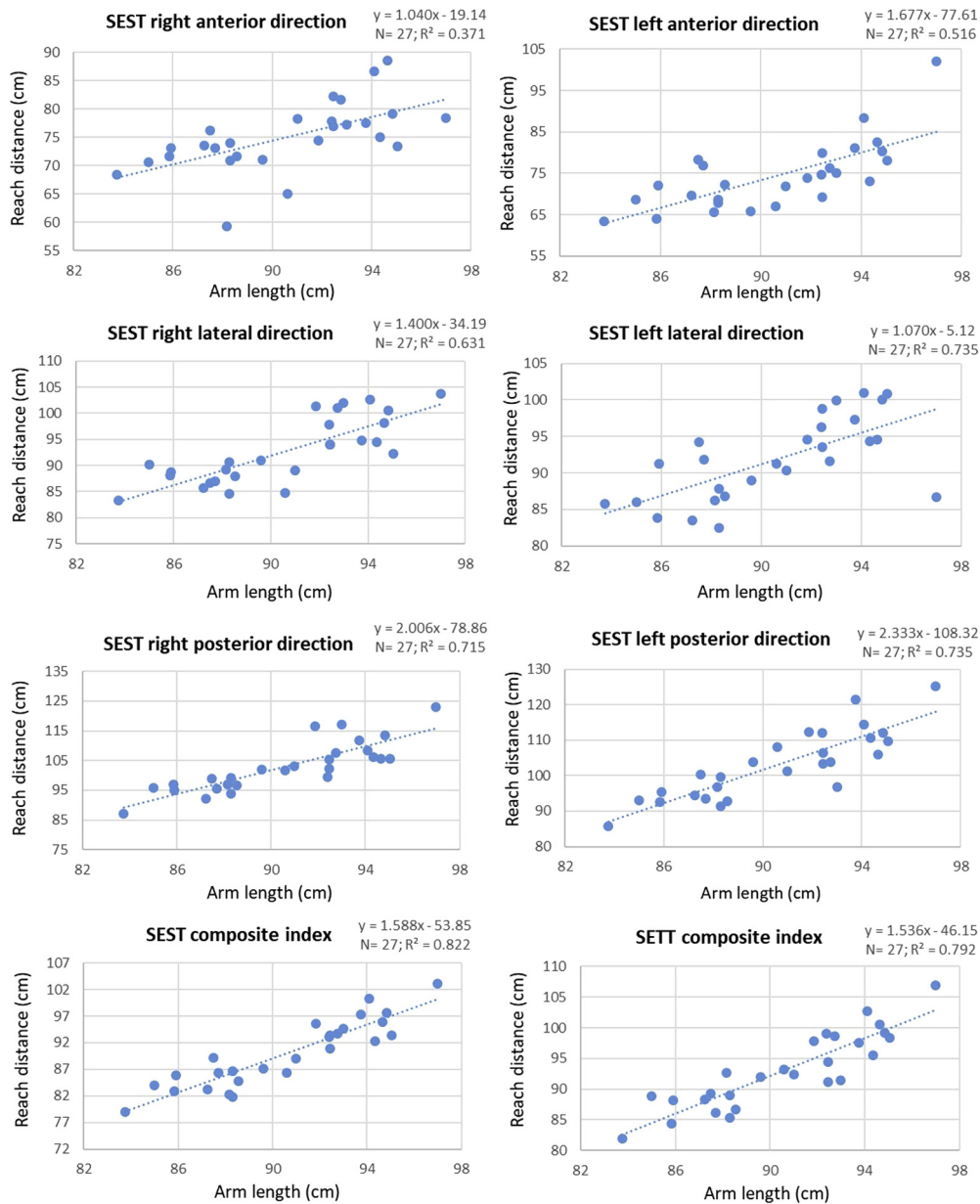


Figure 5. Regression analysis between arm length and raw scores of each SEBT direction, SEST composite index, and SETT composite index. SEBT, Star Excursion Balance Test; SEST, Star Excursion Sitting Test; SETT, Star Excursion Timing Test.

influence on trunk postural measures. To facilitate SEBT and SEST score interpretation, normalized values for each participant were expressed as the sum of the regression-predicted value of the averaged participants' arm length of this study and the individual's residual scores (Figure 5).

Statistical Analysis

The means and standard deviations of the normalized scores of each direction of the SEBT and SEST and the composite normalized scores of the SEBT, SEST, and SETT were calculated for each testing session. Normality

of the data distribution was verified via the Kolmogorov–Smirnov test.

To evaluate the between-session relative reliability, the ICC (model₂, ₁) was used for each direction and for the composite indexes, calculating their confident limits [29]. ICC values were interpreted according to the following criteria: <0.49, poor; 0.5–0.69, moderate; 0.7–0.89, high; 0.9–1, excellent [30].

Absolute reliability was assessed through the SEM, minimum detectable change (MDC) and change in the mean (CM). The SEM was calculated dividing the difference between consecutive pairs of trials by $\sqrt{2}$ (intrasubject variability); then, the MDC was calculated as 1.5 times the SEM [29]. A one-way analysis of variance

Table 1
Descriptive statistics and relative and absolute reliability of SEBT, SEST, and SETT

Variables	Session 1, mean \pm SD	Session 2, mean \pm SD	SEM, mean (95% CL) , %, mean (95% CL)	CM, mean (95% CL) , %, mean (95% CL)	Minimum Detectable Change, %, mean (95% CL)	ICC _(2, 1) , mean (95% CL), mean (95% CL)
Individual measures						
SEBT						
Dominant leg						
AL	72.83 \pm 7.06	72.62 \pm 6.85	5.94 (4.68-8.14)	-1.08 (-4.39 to 2.24)	8.91 (7.02-12.20)	0.63 (0.34-0.81)
PL	96.36 \pm 7.34	99.45 \pm 8.50	4.68 (3.64-6.57)	2.56 (-0.23 to 5.36)	7.02 (5.45-9.85)	0.68 (0.39-0.84)
AM	92.12 \pm 5.96	89.42 \pm 6.14	3.41 (2.68-4.71)	-2.94 (-4.89 to -0.99)	5.12 (4.01-7.07)	0.75 (0.52-0.88)
PM	101.56 \pm 6.58	103.96 \pm 8.00	2.74 (2.14-3.81)	2.21 (0.61-3.80)	4.11 (3.21-5.72)	0.86 (0.71-0.93)
Nondominant Leg						
AL	73.60 \pm 6.36	74.76 \pm 7.54	5.89 (4.64-8.07)	1.56 (-1.74 to 4.85)	8.83 (6.95-12.11)	0.62 (0.33-0.81)
PL	94.08 \pm 7.38	97.05 \pm 8.46	5.25 (4.13-7.20)	3.11 (0.18-6.05)	7.87 (6.20-10.79)	0.62 (0.31-0.80)
AM	90.77 \pm 5.25	89.16 \pm 6.93	3.50 (2.73-4.87)	-1.83 (-3.88 to -0.21)	5.25 (4.10-7.30)	0.75 (0.51-0.88)
PM	103.27 \pm 6.42	102.89 \pm 8.16	3.91 (3.06-5.39)	0.45 (-1.77 to 2.69)	5.86 (4.60-8.09)	0.71 (0.46-0.86)
SEST						
Right arm						
RA	73.93 \pm 6.31	75.23 \pm 4.80	4.88 (3.85-6.69)	1.75 (-0.97 to 4.49)	7.31 (5.77-10.03)	0.60 (0.28-0.79)
RL	91.81 \pm 3.10	92.93 \pm 3.81	2.41 (1.90-3.32)	1.20 (-0.14 to 2.56)	3.62 (2.86-4.98)	0.60 (0.29-0.80)
RP	102.24 \pm 4.07	103.16 \pm 4.49	3.39 (2.69-4.66)	0.90 (-0.99 to 2.81)	5.08 (4.03-7.00)	0.35 (-0.03 to 0.64)
Left arm						
LA	73.20 \pm 5.82	74.56 \pm 5.76	5.31 (4.18-7.28)	1.84 (-1.12 to 4.83)	7.97 (6.27-10.92)	0.56 (0.23-0.77)
LL	90.86 \pm 3.52	92.00 \pm 4.17	2.43 (1.88-3.32)	1.88 (0.53-3.27)	3.64 (2.82-4.97)	0.68 (0.43-0.85)
LP	101.32 \pm 4.60	103.40 \pm 4.97	3.29 (2.62-4.55)	2.03 (0.19-3.90)	4.94 (3.93-6.83)	0.52 (0.17-0.74)
Composite indexes						
SEBT						
Dominant leg	90.65 \pm 5.00	91.22 \pm 5.25	2.12 (1.66-2.93)	0.90 (-0.32 to 2.11)	3.18 (2.49-4.39)	0.87 (0.73-0.94)
Nondominant leg	90.43 \pm 4.98	90.97 \pm 6.17	3.23 (2.54-4.45)	0.50 (-1.35 to 2.35)	4.84 (3.80-6.68)	0.74 (0.50-0.87)
SEST	88.87 \pm 3.01	90.21 \pm 2.62	1.27 (1.03-1.80)	1.50 (0.78-2.25)	1.91 (1.54-2.70)	0.85 (0.68-0.92)
SETT	91.44 \pm 3.80	93.23 \pm 2.80	2.31 (1.82-3.17)	1.94 (0.65-3.24)	3.47 (2.73-4.76)	0.61 (0.30-0.80)

SEBT = Star Excursion Balance Test; SEST = Star Excursion Sitting Test; SETT = Star Excursion Timing Test; SD = standard deviation; SEM = standard error of the measurement; CL = confidence limit; CM = change in the mean; ICC_(2, 1) = intraclass correlation coefficient; AL = anterolateral direction; PL = posterolateral direction; AM = anteromedial direction; PM = posteromedial direction; RA = right-anterior direction; RL = right-lateral direction; RP = right-posterior direction; LA = left-anterior direction; LL = left-lateral direction; LP = left-posterior direction.

Table 2
Correlations between SEBT, SEST, and SETT scores

	SEBT								SEST		SETT	
	Dominant Leg				Nondominant Leg				Composite DL	Composite ND	Composite	Composite
	AL	PL	AM	PM	AL	PL	AM	PM	DL	NDL	Composite	Composite
SEBT												
Dominant leg												
AL	–	.12	.69	.45	.74	.43	.76	.43	.75	.73	.21	–.23
PL		–	–.10	.52	.20	.59	.21	.60	.63	.52	.11	–.05
AM			–	.35	.62	.07	.67	.25	.63	.48	.07	–.12
PM				–	.31	.60	.34	.51	.84	.57	.36	.04
Nondominant leg												
AL					–	.34	.73	.44	.62	.77	.04	–.35
PL						–	.39	.57	.63	.74	.37	–.17
AM							–	.61	.66	.84	.01	–.26
PM								–	.65	.83	–.02	–.34
Composite DL									–	.81	.27	–.11
Composite ND										–	.13	–.35
SEST composite											–	.52
SETT composite												–

Significant correlations are shown in bold ($N = 27$): $.3809 \leq r < .4869$ ($P < .05$); $r \geq .4869$ ($P < .01$).

SEBT = Star Excursion Balance Test; SEST = Star Excursion Sitting Test; SETT = Star Excursion Timing Test; DL = dominant leg; ND = nondominant leg; AL = anterolateral direction; PL = posterolateral direction; AM = anteromedial direction; PM = posteromedial direction.

was performed for each test score to explore the existence of statistically significant differences between sessions.

A Pearson correlation analysis was used to examine the relationships between the scores of the 3 tests. All data analyses were conducted with Statistical Package for Social Sciences (SPSS statistics 22.0 Inc., IBM Corp, Armonk, NY).

Results

Table 1 shows relative and absolute reliability values for the normalized SEBT, SEST, and SETT scores. For SEBT diagonal directions and the SEBT composite indexes, the relative reliability was moderate to large ($0.62 \leq ICC \leq 0.87$). Regarding absolute reliability, SEM values ranged from 2.12% to 5.94%, and MDC values ranged from 3.18% to 8.91%, being lower for the composite indexes than for most directions. Furthermore, the PL, AM, and PM SEBT scores of the dominant leg showed a significant CM (2.56%, –2.94%, and 2.21%, respectively).

The relative reliability of SEST directions (Table 1) was in general low to moderate, with ICC values ranging from 0.35 to 0.68. Nonetheless, SEST composite index showed a high relative reliability score ($ICC = 0.85$). Regarding absolute reliability, the composite index of this test also showed better values ($SEM = 1.27\%$; $MDC = 1.91\%$) than its diagonal and lateral directions ($2.41\% \leq SEM \leq 5.31\%$; $3.62\% \leq MDC \leq 7.97\%$). Furthermore, the LP direction and the composite index of the SEST showed significant CM (2.03% and 1.50%, respectively). Because the SEST direction reliability was not very large in comparison with the SEST composite reliability, only this global index was used in the correlational analysis.

Concerning the SETT composite index (Table 1), the relative reliability was moderate with an ICC value of 0.61, whereas the SEM was 2.31% and the MDC was 3.47%. A significant CM (1.94%) was observed for the SETT score.

Table 2 shows the Pearson correlation analyses between SEBT, SEST, and SETT variables. Each direction of the SEBT significantly correlated with the composite indexes ($r \geq .483$; $P > .05$) and with several of the other directions of this test. However, no relationships were found between any SEBT score and the composite indexes of SEST and SETT. In contrast, a significant correlation was found between SEST and SETT composite indexes ($r = .520$; $P > .01$).

Discussion

With the intention of improving the use and interpretation of the SEBT scores and providing reliable field measures of trunk postural control, this study analyzed the correlations and the absolute and relative between-session reliability of the SEBT and 2 variations of this test (SEST and SETT) performed in sitting position to reduce the influence of lower-limbs in postural control.

SEBT between-session relative reliability was moderate-to-high, with ICC values ranging from 0.62 to 0.87. Previous studies have shown ICC values slightly greater ($0.67 < ICC < 0.99$) in healthy male and female subjects [4–6], showing the robustness of SEBT protocols to categorize the dynamic postural control in homogeneous samples. In addition, the absolute reliability was good for SEBT diagonal directions and composite indexes (Table 1), supporting the results obtained in previous research [4–6,11,21,25].

Considering the MDC, SEBT composite index increases of at least 3.18% for the dominant leg and 4.84% for the nondominant leg would be necessary (eg, in an intervention study) to be confident with a 75% chance that a real change has happened in the dynamic postural control. Overall, these results show the SEBT consistency to assess this variable over time, for example during training and rehabilitation programs. However, 2 directions of the SEBT (PL and PM) showed a between-session significant score increase in the dominant leg, ie, a learning effect (Table 1). Therefore, although several strategies were explained to the participants to facilitate the learning of the SEBT, the familiarization period (30-second practice for each direction) was not long enough to avoid the learning effect in the aforementioned directions. Based on the study by Calatayud et al [21], 4 practice trials for each direction seem effective to avoid between-session differences in the SEBT scores. However, further research is needed to establish high efficiency familiarization protocols which improve SEBT learning with lower time cost.

In relation to SEST and SETT, the reliability analysis showed the consistency of these protocols to discriminate between participants with similar trunk postural control. In this sense, the relative reliability was high for the SEST composite index ($ICC = 0.85$) and moderate for most SEST directions ($0.35 \leq ICC \leq 0.68$; most of them >0.50) and for the SETT composite index ($ICC = 0.61$), although the lower limit of the 95% confidence interval of this index fell in the poor range ($ICC = 0.30$). Regarding absolute reliability, some authors have indicated that SEM values lower than 10% represent adequate levels of absolute reliability. Although this criterion seems arbitrary, SEST and SETT data showed SEM values clearly lower than this reference value, especially for the composite indexes (1.27% and 2.31%, respectively).

The SEM values of the SEST directions were slightly greater ($2.41\% \leq SEM \leq 5.31\%$) but similar to those obtained in the SEBT directions. The MDC showed similar results, with lower values for the composite indexes (SEST = 1.91%; SETT = 3.47%) than for the SEBT directions ($3.62\% \leq MDC \leq 7.97\%$). Regarding the between-session differences, a significant CM was detected for the LP direction of the SEST (2.03%) and for the composite indexes of SEST (1.50%) and SETT (1.94%). As commented before for SEBT, a longer familiarization period seems needed to learn these protocols properly.

Despite SEST and SETT were developed based on the SEBT protocol and carried out in the 45° spaced 8-line grid developed to perform this protocol, no significant correlations were found between the SEBT and its variations (Table 2). Therefore, although the 3 tests measure postural control, our results indicate that the ability to control body balance while standing on one leg is different from the ability to control balance while sitting with leg motion restriction. Considering that SEBT variations analyzed in this study increase the role

of the upper body in test performance, they seem more appropriate than SEBT to measure core stability in field settings. In this sense, although SEBT has been used to assess the effect of core stability programs [24-27], the lower limb may have more influence on test performance than trunk structures, especially in people with ankle chronic instability, leg extensor muscle weakness, or lower limb motion deficits. However, further research is needed to establish which tests are more suitable to measure core stability in clinical, sport, fitness, and research settings. In this sense, future studies must explore the advantages and disadvantages of using SEST and SETT to measure trunk postural control, for example, possible limitations of their use in some populations such as elderly people, overweight people, or individuals with hip and/or back mobility impairments (eg, patients who are sensitive to lumbar flexion).

Because of the similarity between the SEST and SETT, their composite indexes showed a significantly moderate correlation ($r = .520$; $P > .01$). However, although both tests are related, this relationship doesn't seem high enough to use them interchangeably. Possibly, the time restriction of the SETT involves greater postural control demands than the SEST, which (although it should be confirmed in future studies) is a remarkable characteristic in this type of protocols. In contrast, the SEST composite index showed better reliability data than the SETT score, which also must be taken into account when choosing a test to measure trunk postural control. Thus, the SEST and SETT could be used as an inexpensive tool to measure trunk postural control in some clinical scenarios for people without hip/back injuries or disabilities.

Conclusions

This study confirms the between-session consistency of the SEBT to measure dynamic postural control in single-leg stance and provides 2 reliable field tests (mainly the composite indexes) to measure trunk postural control in sitting position. Although the 3 tests are similar, SEBT scores did not correlate with SEST and SETT scores, maybe because the new protocols minimize the influence of the lower limbs on test performance (ie, obtaining measures of postural control more related to core stability). The 3 protocols are easy to use and inexpensive but they need a longer familiarization period than the one used in this study (30 seconds of practice for each direction) to avoid learning effect.

Acknowledgments

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