Four Square Step Test for Adults with Lower-Limb Amputations

<u>Description</u>: The Four Square Step Test (FSST) is a clinical test of dynamic standing balance,^{1, 2} which may be used to assess fall risk, and predict prosthetic nonuse³ in patients with a lower-limb amputation who are using a prosthetic device. This test should not be performed on individuals who utilize a walker.

Equipment: 4 canes (or tape if performing modified test); 3mx3m floorspace; stopwatch

<u>Test Set-Up</u>¹: Rest the canes flat on the floor forming a square as shown in the diagram below. Patient stands in square 1 facing square 2. The sequence performed is: 1,2,3,4,1,4,3,2,1 (i.e., clockwise then counter-clockwise), which requires the patient to step forward, backward and sideways to the right and left.

Patient Instructions: "Try to complete the sequence as fast as possible without touching the canes (tape). Both feet must contact the floor in each square. If possible, face forward during the entire sequence."

<u>Clinician Instructions</u>: After giving the verbal instructions, demonstrate the sequence and allow for questions. Give the participant 1 practice trial prior to timing; allow body rotation to clear canes if needed. Invalid trials are those where the sequence is incorrect, there is a loss of balance, both feet do not touch each square, or the canes (or tape) are touched. Turning does not invalidate trial but may lead to longer times. Start the stopwatch when the first foot contacts box 2 and stop when both feet return to box 1.^{2,4} Do not call numbers out during the test. Record the faster time of 2 trials.^{2,6}

<u>Modification</u>: Canes can be replaced with lines on the floor to increase valid trials and reduce the floor effect and may help with differentiation of functional mobility levels.^{2, 4} Document if modification is made.

Predictive Ability when Stepping Over Canes:

Risk of multiple falls at 6 months post-discharge in patients with a unilateral transtibial amputation who are ≥18 years:
≥24 seconds⁵ Sensitivity: 92% Predictive Value: 86%
Specificity: 93% Negative Predictive Value: 96%

- Prosthetic nonusers in patients with a transtibial amputation (or more proximal amputation) or bilateral amputations 1 year follow-up post-discharge from rehabilitation: \geq 36.6 seconds³

<u>Psychometric Properties</u> Test-Retest Reliability ⁶ : ICC:0.97 (0.94-0.98) <u>Interrater Reliability</u> ⁶ : ICC: 0.99 (0.99-1.00) <u>MDC</u> ₉₀ ⁶ : 2.0 (0.8-3.5) seconds <u>SEM</u> ⁶ : 0.9 seconds <u>MCID</u> : Unknown Floor Effect ⁴	Reference Values: Prosthesis Users ^{6,7}	Time, sec (mean±SD)
	Bilateral transfemoral, aged 27.7 ± 8.4 yrs Full-length prostheses (n=17) Stubby-length prostheses (n=5)	22.0±10.2 21.4±5.3
	Unilateral transtibial or transfemoral, aged 55± 21 yrs, 16±15 yrs prosthesis use (n=60)	10.4±5.3

Reference Values: Able-	Time, sec
Bodied Adults ^{3, 8}	(mean±SD)
Adults, aged 74 ± 6 yrs	8.70
(n=27)	(7.36, 10.01)*
Adults, aged 84 ± 6 yrs (n=45)	15.8±8.3
*data presented as median (Q1, Q3)	

Reference Values Modified Test: Lower-Limb Loss ≥ 1yr prior ⁴	Time, sec mean [95%Cl]
Transtibial	
K3, aged 50 (95%CI: 46–55) yrs (n=28)	8.82 [8.30–9.34]
K4, aged 40 (95%CI: 35–46) yrs (n=22)	7.80 [7.21–8.38]
Transfemoral	
K3, aged 50 (95%CI: 40–61) yrs (n=10)	10.34 [9.47–11.21]
K4, aged 38 (95%CI: 26–49) yrs (n=7)	8.67 [7.63–9.72]

¹Sions, J. M., Beisheim, E. H., & Seth, M. Selecting, Administering, and Interpreting Outcome Measures Among Adults with Lower-Limb Loss: an Update for Clinicians. *Curr Phys Med Rehabil Rep.* 2020;8(3), 92–109. ²Dite W, Temple VA. A clinical test of stepping and change of direction to identify multiple falling older adults. *Arch Phys Med Rehabil.* 2002;83(11):1566–71. ³Roffman, C.E., Buchanan, J., et al. Locomotor performance during rehabilitation of people with lower limb amputation and prosthetic nonuse 12 months after discharge. *Phys Ther.* 2016;96:985-994. ⁴Beisheim EH, Horne JR, Pohlig RT, Sions JM. Differences in measures of strength and dynamic balance among individuals with lower-limb loss classified as functional level K3 versus K4. *Am J Phys Med Rehabil.* 2019;98(9):745–50. ⁵Dite, W., Connor, H.J., et al. Clinical identification of multiple fall risk early after unilateral transfibial amputation. *Arch Phys Med Rehabil.* 2007;88:109-114. ⁶Sawers, A., Kim, J., Balkman, G., & Hafner, B. J. Interrater and Test-Retest Reliability of Performance-Based Clinical Tests Administered to Established Users of Lower Limb Prostheses. *Phys Ther.* 2020;100(7), 1206–1216. ⁷Carroll MK, Carroll K, Rheinstein J, Highsmith MJ. Functional differences of bilateral transfemoral amputees using full-length and stubby-length prostheses. *Technol Innov.* 2018;20(1–2):75–83. ⁸Cleary K, Skornyakov E. Predicting falls in older adults using the four square step test. *Physiother Theor Pract.* 2017;33(10):766–71.

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