ROMBERG (R) & SHARPENED ROMBERG (SR)

[Note: SR is sometimes called AUGMENTED (MODIFIED) ROMBERG or TANDEM ROMBERG]

Type of test: The test is a measure of balance maintenance or equilibrium with a narrowed base of support

- ***Time to administer:*** A maximum of 3 trials per each test position (60 seconds per trial)
- ***Clinical Comments:*** The client should be closely supervised while doing the test to avoid falls. This test is nice to use because neurologists are familiar with it. If a client reaches the ceiling on the Berg, the Romberg may help to distinguish balance problems.

Purpose/population for which tool was developed: The original Romberg test was developed around 1851-3 and had subjects stand with feet close together. The examiner observed body sway with eyes open and closed. The SR came to be used clinically around 1944. [1] It is considered a more progressive posture requiring a higher skill level than the Romberg. [2] This test was introduced in 1853 by Romberg to demonstrate the effect of luetic posterior column disease upon human upright posture control. The test has been used with some minor modification for the clinical assessment of patients with dysequilibrium or ataxia from both sensory and motor disorders.

When appropriate to use: when individual has loss of vestibular function, cerebral ataxia, sensory ataxia and sensory neuropathy as in the case of unilateral or bilateral motor weakness, diseases of peripheral nerves, cerebellar disease and vertebrobasilar disease. The test has been used in aircrew, patients with disequilibrium and in divers with dysbaric illness and injuries.[1]

Scaling: When timed, these four tests use ratio scaling.

Equipment needed:

- Level surface
- Digital stop watch or watch with a second-hand

Directions*:*
Four maneuvers comprise these tests

- **Romberg**
  - 1) Feet together, eyes open, 60 sec **(R-EO)**
  - 2) Feet together, eyes closed, 60 sec. **(R-EC)**
- **Sharpened Romberg**
  - 1) Feet heel-to-toe (dominant foot behind non-dominant foot), eyes open, 60 sec. **(SR-EO)**
  - 2) Feet heel-to-toe (dominant foot behind non-dominant foot), eyes closed, 60 sec. **(SR-EC)**

Some studies have shortened the time to 30 seconds for testing, but this increases the ceiling effects. Three large studies used a limit of 10 seconds, rather than 60 seconds, on the test.[3-5] Other studies allow participants to continue as long as they are able.[6] It is best to use 60 seconds.[7]

The SR is performed in a heel-to-toe standing position with the dominant foot behind the non-dominant foot. The dominant foot is determined by asking the person to kick an object. Timing is started after the person assumes the proper position. Timing is stopped if subjects move their feet from the proper position, if they open their eyes on eyes closed trials, or if they reach their maximum balance times of 60 seconds. Three trials are performed if the maximum balance time is not reached in either of the first two trials. The longest balance time should be recorded (NOT THE AVERAGE OF THE TRIALS)! Sometimes subjects are told to cross their arms so that the open palm falls across the opposite shoulder.[1] Other times subjects are able to move their arms.[2, 8, 9] It is unclear whether subjects who need help to assume the position should be given it. In our study we did not give assist. A study of 71 non-institutionalized women (60-86 years) found no difference with shoes-on and shoes-off performance.[2]

Learning Effect: Diamantopoulos, (2003) [10] found no short-term learning effects in 24 subjects who practiced the tandem Romberg for a period of 10 days, 1 minute per day. There appears to be no learning effect past the second trial.[11] In people who were tested on 15 consecutive walking days (29 healthy subjects, mean age=33), there was a decrease in postural sway when holding the SR position.[12]

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Reliability:

Reference	*N =*	*Sample description*		*Reliability statistic*
Intrarater reliability: same rater within one session (or one day)				
Black, 1982[13]	132	Normal subjects; There was no significant difference between two trials for standard Romberg test with eyes open but with eyes closed and both Sharpened Romberg tests (eyes open and closed) there was significant second-trial improvement.		Mean squared displacement data given.
Franchignoni, 1998[14]	45	Females, SR		$ICC_{(2,1)}$ = .99 (EO & EC)
Kammerlind, 2005[15]	30	Unilateral Vestibular loss, SR		$ICC_{(2, 2)}$ Eyes open = .63 Eyes closed = .76
	20	Central neurological dysfunction, SR		Eyes open = .75 Eyes closed = .97
Interrater Reliability				
Franchignoni, 1998[14]	45	Females, 2 raters, SR		Eyes open = .90 Eyes closed = .76
Test-retest reliability: same rater over time (e.g., 1 week)				
Black, 1982[13]	12	Normal subjects; The coefficient of variation (CV) of 12 subjects over 5 consecutive days, suggests a high degree of variability for all 4 tests.		CV = 39 – 45%
Hamilton, 1989[16]	19	Volunteers aged 24-39; SR reliability for eyes open for Day 9 and Day 10 practice sessions comparisons		r=.72
Kammerlind, 2005[15]	30	Unilateral vestibular loss	SR Eyes Closed	ICC = .63
			SR Eyes Open	ICC = .76
	20	Central neurological dysfunction	SR Eyes Closed	ICC = .75
			SR Eyes Opened	ICC = .97

***Construct / Concurrent Validity*:** It is difficult to always differentiate between these 2 types of validity. Evaluating this property requires a "gold standard" measure with which to compare the tests results. Such a "gold standard" is often not available.

Population	*N =*	*Support for Validity*
Volunteers with Simulator Sickness	19	The SR eyes open was related to subjective reports of balance disturbances.[16]
Healthy Women	45	SR eyes open is correlated to SR eyes closed (.55), one-legged stance eyes open (.56), eyes closed (.45), functional reach (.45) and sit to stand time (-.40). Correlations of SR eyes closed: one-legged stance eyes open (.45), one leg stance eyes closed (.65), functional reach (.45) and sit to stand time (-.45).[14]
	110	SR eyes closed is significantly correlated to step width (rho=-.16)[8]
Men	54	Men, age 60-90 years, who considered themselves active had significantly higher SR eyes-closed scores compared to those who rated themselves less active. SR scores are positively correlated with normalized torques of hip extensors and right hip abductors (.28 to .31)[9]

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People with vestibular & Nonvestibular dizziness & unsteadiness	214	Age 23-87 yrs (mean 54), 110 males, DHI correlated with SR EO (-0.46), SR EC (-0.45) & Rom w/Jendrassik Manuever(UEs clasped & abducted)(-0.25) [Vereeck 2006]. Reference data by DHI groups (groups are significantly different):				
			Mild DHI (0-30) N = 100	Mod DHI (31-60) N = 76	DHI (61-100) N =38	p
		SR- EC (s)	10.5(10.6)	5.5 (8.3)	2.9(6.0)	<0.001
		SR- EO (s)	(28.0(6.5)	21.7(11.4)	14.9(12.8)	<0.001
		Romberg w/Jendrassik	29.8 (1.7)	27.2(7.8)	24.5(10.0)	<0.001
Predictive Validity:						
Fallers vs. non-fallers	110	Fallers (N=26) had significantly lower values 38 (25)s than non-fallers (n=84) 48 (20)s on the best trial of theSR-EO (t=1.98, p<.05).[8] This was not true for eyes closed.				
	71	No significant difference was found in mean SR (eyes open and closed) between subjects who had fallen versus those who had not fallen for females (60-86 years).[2]				
	177	Odds ratio=.50, p<.03 in predicting frequent falling (adjusted for age and sex).[17] It is unclear in article if Romberg is with eyes open or closed.				
Fractures	1018	Multiple fractures are associated with decreased R-EO in 75 year old women Women with a hip fracture (n=50) have a poorer R-EO test result: mean 77 s, vs all women in the sample: mean 90 s.[6]	**Number of fractures**	**n**	**Mean (s)**	
			No fractures	505	94	
			One fracture	305	88	
			Two fractures	121	85	
			Three or more	87	81	

Validity:

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Sensitivity/specificity:

Population	***N =***	***Cutoff Score and Description***	***Results***
Identifying Decompression Illness	151	Cutoff score of less than 40 sec (4 attempts) in SR-EC.[11]	Sensitivity 46% Specificity 95%
Identifying fallers (Persons with Parkinson's Disease)	59	Recurrent falls best predicted by prior falls, disease severity and R-EO test.[18]	*SR-EO* Sensitivity 53% Specificity 17% *SR-EC* Sensitivity 88% Specificity 54%
NOTE: Clinicians need to choose a cut-off score based on the specific purpose for which the test is used			

Responsiveness/sensitivity to change:

Population descriptor	***N =***	***Reference and intervention***	***Responsive: Yes/No***	***Data supporting responsiveness***
Crewmembers of Space lab-1	4	***Kenyon, 1986*** [19] Several days post 10 day flight	Yes	SR-EC showed decrements
Histology technicians	305	***Kilburn, 1987*** [20] Females, mean age=40 Multiple linear regression with SR-EC	Yes	Associated with age and doses of formaldehyde, not with cigarette smoke. The SR changed with exposure amount; no numbers given.
Divers with Decompression Illness (DCI)	35	***Fitzgerald, 1996*** [1] Measured 12 months after DCI	Yes	SR-EO shows change over time 32(27) to 55(14) seconds No change noted in 60 controls
Dizzy patients	42	***Hansson, 2004*** [21] 45 minutes, 2x/week, 6 weeks *Experimental group (N=23)* Balance training and vestibular rehab in group sessions *Control group (N=19)* No intervention	No difference between groups R-EO & R-EC	Diff from baseline at 6 mo: Experimental = .4s Control = -1.9s Diff from baseline at 3 mo: Experimental = .4 s Control = 0s
Stroke survivors	18	***Hart, 2004*** [22] 1 hour, 2x/week for 12 weeks *Experimental group (N=9)* Group Tai Chi *Control group (N=9)* Group PT focusing on improving balance	No	Experimental: no change in balance as measured by R-EO Control: improvement in balance

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Non-exercising community dwellers, age 58-68	40	***Federici, 2005*** [23] 60 min, 2x/week, 3 months *Experimental group (N=20, 7 males)* Caribbean dance exercise program *Control group (N=20, 7 males)* No physical activity	Yes	EG was significantly better than controls for both R-EC: t=42.7, p<0.001 SR-EC: t=34.8, p<0.001
Ambulatory people w/chronic CVA & LE spasticity or dec LE ROM	18	***Rydwik 2006*** [24] Ankle AA & PROM 3x/week, 6 weeks *Experimental group (N=9)* 30 minute sessions *Control group (N=9)* No intervention	No	R-EO,R-EC, & SR-EO & SR-EC were measured; no difference between groups at baseline or after intervention.
Sedentary women with Osteoporosis	50	***Alp 2007*** [25] 6 month follow-up; weekly phone calls Experimental group (N=25) Weekly group education sessions x5 Control group (N=25) Instructed to maintain sedentary lifestyle	Yes	Experimental: Difference from baseline at 5 weeks and 6 months (p<0.001); longer SR-EO & SR-EC

Ceiling & floor effect:

Ceiling effects
There is a ceiling effect with both the R and SR. Briggs (1989) found 69% of 71 non-institutionalized women (shoes on) age 60-86 reach maximum score of 60 with SR-EO and 20% reached maximum score of 60 with SR-EC [2]
Iverson (1990) found 87% of 54 community dwelling men reach the ceiling on SR-EO and 18.5% balanced the full 60s with SR-EC. [9]
In a study of 101 volunteers from a Naval base in Auckland, 93% of the sample obtained 60 seconds in 3 tries. [11]
In a study of 52 patients with reported dizziness of central or age related origin, 97% could stand 60 seconds R-EO and 80% R-EC [21]
In a group of 24 subjects average age of 30, 65% reached the ceiling on SR-EC with 2 trials [10]
In a group of 184 subjects age 20-79 all were able to balance 30 seconds with R-EO and R-EC [26]
Floor Effect
36% of 177 older adults with mild balance impairment (mean age = 78) could not perform the SR-EO test [17]

Reference data:

Gender and age did not have a statistically significant effect upon 7 of 8 SR-EC test trials for normal subjects (age 20-49).[13] Higher age was associated with poorer performance on SR-EC (r = .31to .46) N=54.[28]

Subjects		**Sharpened Romberg**	
		Eyes open	*Eyes closed*
Iverson (1990) found age and SR-EC inversely related (-.27). [9]	Community dwelling males ages 60-90, (N=54)	55 (15)s	25 (24)s
Bulbulian (1984) suggests that current activity plays a key role in balance and former activity history does not. [27]	Currently active former athletes, (N=15)	60 (0)s	21(5)
	Currently active non athletes (mean age=69) (N=14)	59 (.5)s	15(4)
	Inactive elderly former athletes, (N=12)	42 (7)	8(3)
	Inactive elderly (mean age of 68)	42 (6)	10(4)

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Table 1 & 2 report SR, eyes open and closed by gender and age cohorts. Results reported are with shoes on.

Table 1

Means (X) Standard Deviations (SD) and 95% Confidence Intervals (CI) of test results for the **Sharpened Romberg-Eyes Open (SR-EO), Sharpened Romberg-Eyes Closed (SR-EC)**, by Age and Gender Cohorts

			Total SR-EO (sec)			**Total SR-EC (sec)**		
Age	**Gender**	**N**	**X**	**SD**	**CI**	**X**	**SD**	**CI**
50-59	Male	9	60	0	60-60	51	18	37-60
	Female	15	56	15	48-64	37	22	24-49
60-69	Male	9	60	0	60-60	32	26	12-52
	Female	10	60	0	60-60	42	23	26-59
70-79	Male	10	54	17	42-60	26	20	12-40
	Female	14	44	24	30-58	23	21	11-35
80+	Male	4	48	24	9-60	20	25	0-60
	Female	12	19	20	7-32	5	6	1-9
Total Sample		**83**	**49**	**21**	**45-54**	**29**	**24**	**24-35**

Steffen, TM, Mollinger, LA (2005). Age-and gender-related test performance in community-dwelling adults: multi-directional reach test, berg balance scale, sharpened Romberg tests, activities-specific balance confidence scale, and physical performance test. Journal of Neurological Physical Therapy 29(4): 181-188.

Table 2

Means and Standard Deviation of the Sharpened Romberg-Eyes Open, Sharpened Romberg-Eyes Closed, by Age in females with shoes on. [2]

		SR-EO		**SR-EC**	
Age (y)	**N**	**X (sec)**	**SD (sec)**	**X (sec)**	**SD (sec)**
60-64	14	56.37	13.59	24.58	20.97
65-69	13	55.93	14.69	31.58	24.82
70-74	16	48.61	19.81	24.19	23.52
75-79	16	39.65	21.8	14.13	14.19
80-86	12	45.49	21.08	21.71	22.12

Briggs, RC, Gossman, MR, Berch, R, et al (1989) Balance Performance Among Non-institutionalized Elderly Women. *Physical Therapy*, 69 (9) 748-7

Other:

Eyes-closed tandem (SR-EC) shows increased mean-squared displacement of center-of-force which the authors attribute to the reduction of support surface in left-right axis and the relative sensitivity of the sensory input systems, particularly the vestibular system to detect L/R versus A/P sway.[13] An early study of 10 healthy people over 5 days found no significant differences in sway measures when people did R-EC.[29] In 300 people with neurological

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disorders the authors report the amplitude of sway increases considerably when the afferent proprioceptive system is defective. One of the most differentiating variables seems to be the frequency pattern. [30] Temporal sway, independent of muscle relaxation effects, in both R and SR may be significantly altered by use of hypnotic medications. [31]
The test incorporates several components of balance, including the vestibular system, strength, flexibility, proprioception and vision.[8] Fitzgerald (1996) reports a score at or above 48 seconds on a single trial of SR-EO is normal despite earlier work that reports 30 and 15 seconds for cutoffs.[1] There is a long lasting effect of sustained weightlessness on higher level descending postural control pathways. [19] Sensory organization test SOT & SBDT (standard balance deficit test)more sensitive than R-EO for measuring postural control in otolith disorders.[32]

The one-legged stance test (OLST) sometimes called the Solec test has been reported in several studies.[2, 8, 9, 14, 26, 33-35] There are many studies by Graybiel and Fregley (1966) on this test but their scoring is done differently and thus statistics cannot be compared. [36] A newer study compares strategies of experts (judo and dance) versus controls on a hard and foam rubber support. Training appears to result in shift from a visual to proprioceptive dominance in regulating postural control.[37]

Some studies have measured Romberg as a progression of positions and the maintenance of the position for 10 seconds only.[38-40] Three large studies used a limit of 10 seconds, rather than 60 seconds, on the test. [3-5] Other studies allow participants to continue as long as they are able .[6]

A modified version on the Romberg has been incorporated into the Gait and Balance Scale (GABS).[41]

A study by Moran (2005) reports a large study of 5 year old children with sleep disorders and controls in Brazil on the 10 second Sharpened Romberg with Eyes Open (SR-EO).[42]

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