Low Back and Leg Endurance Tests

The following are five simple tests that can be performed in a treatment room to evaluate endurance of the low back extensors, abdominal muscles, gluteus maximus and quadriceps. These muscles play an important role in low back, lower extremity, and balance problems. They may also contribute to poor trunk stability leading to neck and upper quarter dysfunction.

One particular advantage of these tests is that they have published referent values (designated as "normative" data by some authors[1,2]) against which you can compare your patient's performance. If these referent values are used, *it is important to follow the technique instructions exactly.* They are considered to have satisfactory reliability.[1,3]

These tests are not intended for acute phase evaluation. They should be performed when the patient's low back pain is resolving or, in the case of chronic pain patients, when the pain is at least controlled.

Referent Values

Sample from Repetitive Arch Up Test

AGE	MALES (n=242)						FEMALES n=(233)					
	Blue Collar		White Collar		All		Blue Collar		White Collar		All	
	X	SD	X	SD	X	SD	X	SD	X	SD	X	SD
35-49	26	11	34	14	29	13	28	13	27	11	27	12

For the first four tests, referent data are broken down by age range (left column), gender (males-left half, females-right half), and occupation (blue collar, white collar). The average of both white collar and blue collar workers is reported in the far right hand column under "all."

The average number of repetitions (or seconds, in the case of a timed test) is found in the column labeled X and the standard deviation (SD) is adjacent. The last row (not shown here) is the *average* of all subjects tested (35 to 54 years old).

If the patient is under 35 years of age, use the referent values for 35. The standard deviation is given to create a "normative" range. (For example, "26 SD 11" repetitions indicates a range of 15 to 37.)

Referent data for the Side Bridge Test are based on a younger population and occupation is not reported.

Static Back Endurance Test

This test is commonly used to measure endurance of the low back extensors. Because it requires only 40-50% of a maximum voluntary contraction, it is suitable to test patients with back pain because weaknesses are less likely due to pain inhibition. The test includes the longissimus thoracis, iliocostalis lumborum, and particularly the multifidus muscles.[4] Poor extensor endurance has been correlated with both first-time low back pain and recurrence.[5,6] In addition, it has been suggested that this test may be appropriate to use in patients with the following activity or work intolerances (which correlate with job traits found in the Dictionary of Occupational Titles): standing, walking, sitting, lifting, and balancing.[7]

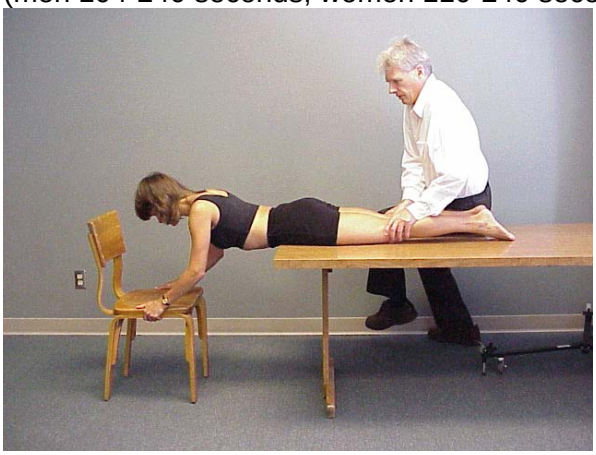
Technique: The patient is placed prone with the ASIS's just on the table, trunk extended off, arms at sides, and the ankles and thighs are fixed by strapping (alternatively, the practitioner can hold the patient's ankles on the table). A chair can be placed at the head of the table to support the patient's upper body until testing actually begins. The patient holds the horizontal position as long as possible or for 240 seconds, whichever occurs first.

Static back endurance test is measured in seconds.

AGE	MALES (n=242)						FEMALES n=(233)					
	Blue Collar		White Collar		All		Blue Collar		White Collar		All	
	X	SD	X	SD	X	SD	X	SD	X	SD	X	SD
35-39	87	38	113	47	97	43	91	61	95	48	93	55
40-44	83	51	129	57	101	57	89	57	67	51	80	55
45-49	81	45	131	64	99	58	90	55	122	73	102	64
50-54	73	47	121	56	89	55	62	55	99	78	69	60
35-54	82	45	123	55	97	53	82	58	94	62	87	59

This test is considered to be reliable.[5, 8] In a prospective study, diminished endurance of the back muscles predicted the occurrence of first-time low back pain over a one year period.[5] In a cross-sectional study, patients with current low back pain had significantly shorter endurance than healthy controls on average.[9] A 1999 reliability and case-control study performed on 63 subjects confirmed that the this test (aka the Biering-Sorenson test) is a reliable test of position-holding time (muscular endurance) and can discriminate between subjects with and without nonspecific low back pain.[10]

Note: Overall, asymptomatic individuals with very poor scores (less than 53 seconds) are three times more likely to suffer from low back pain in the next year than those scoring considerably higher (men 104-240 seconds, women 110-240 seconds).[6]



Repetitive Arch-up Test

The repetitive arch-up test is used to measure endurance of the low back extensors. It has correlated better with changes in patients' activities of daily living (as indicated by a perceived disability questionnaire) than did the more precise measurements of a high tech isokinetic machine.[11] It has also been suggested that this test may be appropriate to use in patients with the following activity or work intolerances (which correlate with job traits found in the Dictionary of Occupational Titles): standing, walking, sitting, lifting, and balancing.[7]

Technique: The patient is placed prone with the ASIS's just on the table, trunk extended off, arms at sides, and the ankles and thighs are fixed by strapping (alternatively, the practitioner can hold the patient's ankles on the table). A chair can be placed at the head of the table to support the patient's upper body until testing actually begins.

The patient raises upwards to the horizontal position and back down to a 45 degree angle. The patient should move slowly, taking 2-3 seconds to do one repetition. Do not allow the patient to hyperextend during test. The number of repetitions is recorded. A maximum of 50 repetitions is allowed. **Note:** This test is more conveniently done on a table higher than a conventional adjusting table.

Repetitive Arch-up Test (number of repetitions)

AGE	MALES (n=242)						FEMALES n=(233)					
	Blue Collar		White Collar		All		Blue Collar		White Collar		All	
	X	SD	X	SD	X	SD	X	SD	X	SD	X	SD
35-49	26	11	34	14	29	13	28	13	27	11	27	12
40-44	23	12	36	14	28	14	25	14	20	11	23	13
45-49	24	13	34	16	28	15	25	15	31	16	27	15
50-54	21	11	35	17	26	15	18	14	26	14	19	14
35-54	24	12	35	15	28	14	24	14	26	13	24	14

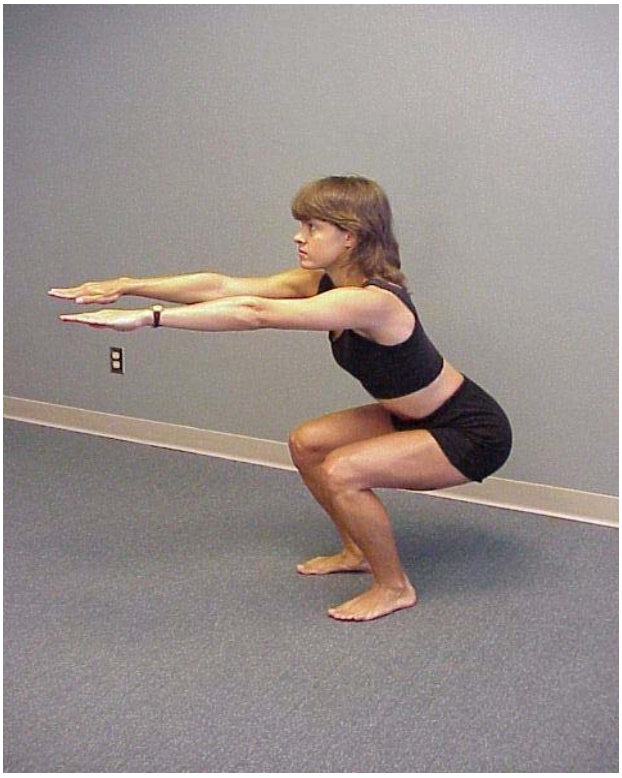
Repetitive Squat Test

The repetitive squat test may is used to evaluate endurance of the quadriceps and gluteus maximus muscles. This test has correlated better with changes in low back pain patients' activities of daily living (as indicated by a perceived disability questionnaire) than did the more precise measurements of a high tech isokinetic machine.[11] It has also been suggested that this test may be appropriate to use for patients with the following activity or work intolerances (which correlate with job traits found in the Dictionary of Occupational Titles): lifting, climbing, balancing, stooping, kneeling, and crouching.

Technique: The patient stands with feet 15 cm apart, squats until the thighs are parallel to the floor, and returns to an upright position. Record the number of repetitions to a maximum of 50. See alternative method (without normative values) in the Osteoporosis Care Pathway, Special Appendix X.

Repetitive Squat Test (number of repetitions)

AGE	MALES (n=242)						FEMALES n=(233)					
	Blue Collar		White Collar		All		Blue Collar		White Collar		All	
	X	SD	X	SD	X	SD	X	SD	X	SD	X	SD
35-39	39	13	46	8	42	12	24	11	27	12	26	12
40-44	34	14	45	9	38	13	22	13	18	8	20	12
45-49	30	12	40	11	33	13	19	12	26	13	22	13
50-54	28	14	41	11	33	14	13	10	18	14	14	11
35-54	33	14	43	10	37	13	20	23	23	12	21	12



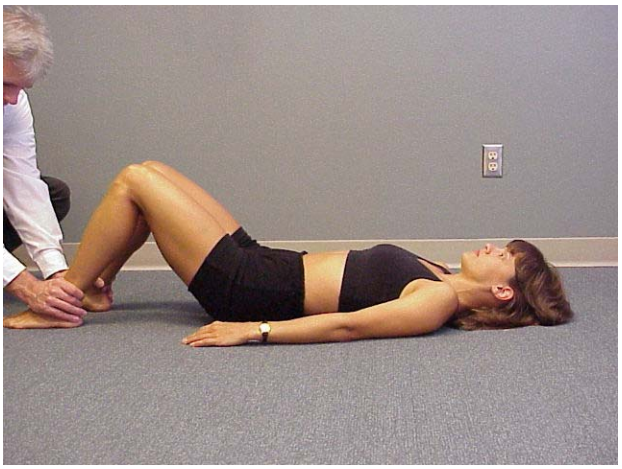
Repetitive Sit-up Test

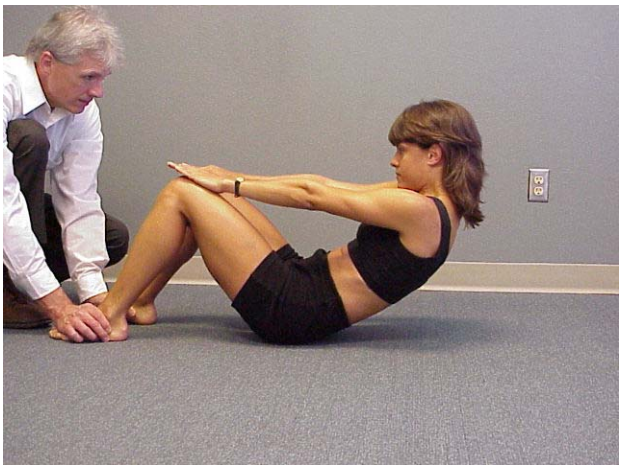
This test evaluates the endurance of the abdominal muscles. It has also been suggested that it may be appropriate to use for patients with the following activity or work intolerances (which correlate with job traits found in the Dictionary of Occupational Titles): sitting, balancing, and stooping.

Technique: The patient lies supine, knees flexed to 90 degrees with ankles fixed. S/he is instructed to sit up, attempting to touch the thenar pads to the knees, and then curl back down at a rate of one repetition every 2-3 seconds up to a maximum of 50 repetitions. **Note**: other sit up tests, such as Janda's curl up test which is done with the ankles unanchored, the knees less flexed, and done as a partial curl only, would not necessarily correspond to these normative values.

Repetitive Sit-up Test (number of repetitions)

AGE	MALES (n=242)						FEMALES n=(233)					
	Blue Collar		White Collar		All		Blue Collar		White Collar		All	
	X	SD	X	SD	X	SD	X	SD	X	SD	X	SD
35-39	29	13	35	13	32	13	24	12	30	16	27	14
40-44	22	11	34	12	27	13	18	12	19	13	19	12
45-49	19	11	33	15	24	14	17	14	22	15	19	14
50-54	17	13	36	16	23	16	9	10	20	13	11	11
35-54	23	13	35	13	27	14	17	13	24	15	19	14





Side Bridge Test[12]

The Side Bridge tests the endurance of the quadratus lumborum and the oblique abdominal muscles. Because the procedure minimizes the load on the lumbar spine, it is appropriate for most patients with low back pain. Because it requires no special equipment and is well tolerated by a wide range of subjects, it is a useful test based on the criteria of cost, safety, and reliability. Current reference values are based on a study of 75 subjects with a mean age of 23 years. A health status questionnaire was used to exclude individuals in poor health, particularly those with disabling back pain.

Technique: Patients lie on an exercise mat on their right side with legs extended. For support, the upper foot is placed in front of the lower foot on the mat. Supporting themselves with the feet and elbow, patients are then instructed to lift their hips off the mat (maintaining a straight line over full body length). The practitioner times how long the patient can hold this posture. The uninvolved arm is held across the chest with the hand placed on the opposite shoulder. The test ends when the hips return to the mat. It is repeated on the other side.

Reference values for extensor-side support ratios were established by comparing side-bridge times with those obtained during the static back endurance test. Men could maintain the side bridge for a period that was 65% of their extensor time, whereas women could maintain it for 39% of their extensor time.

A reliability study with five of the 75 subjects found that repeated tests on five consecutive days produced excellent reliability coefficients—99% for the side bridge on the left and right sides.

Mean Endurance Times (sec) With Standard Deviations

MALES		FEMALES		ALL	
X	SD	X	SD	X	SD
94	34	72	31	81	34
97	35	77	35	85	36

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