Endurance Shuttle Walking Test (ESWT)

Standard Operating Procedure (SOP)

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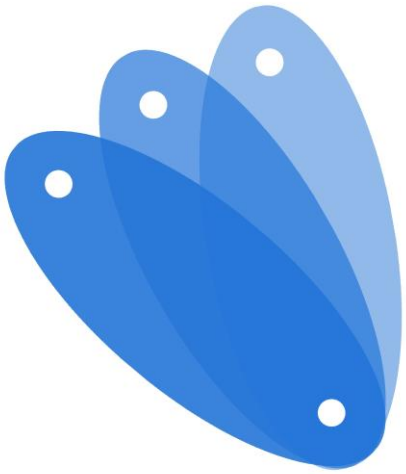

CERS

Centre for Exercise and Rehabilitation Science

Standard Operating Procedure – Endurance Shuttle Walking Test (ESWT)

Scope and Purpose

This is a standardised sub-maximal field test (1) for the assessment of endurance capacity in patients with chronic heart and lung disease (2, 3). The test was developed as an adjunct to the incremental shuttle walk test (ISWT) so that together they form a practical method of assessing both functional and endurance exercise capacity using the same 10 metre shuttle course. It is a validated field test that that has proven sensitive to changes in rehabilitation and bronchodilator therapy (2, 4-6).

The EWST is simple to perform, requiring only minimal equipment, and has good repeatability over the short and medium term. (2)

Equipment

- Two small cones to mark the turnaround points 9 meters apart with a 0.5m inset for turning.
- One chair, at one end of the walking course
- Clipboard with an ESWT Proforma and a pen
- BORG Scale (Appendix 1)
- RPE Scale (Appendix 2)
- Automated blood pressure machine
- Pulse oximeter
- Stopwatch
- Access to oxygen and telephone in case of an emergency
- Supplemental oxygen if required to perform exercise test by patient
- Optional/ if available: Polar heart rate monitor

The test should be conducted along a quiet corridor/physiotherapy gym/ or dedicated exercise testing room. If there is a dedicated exercise testing facility air conditioning would be optimal.

Precautions

Absolute contraindications for the ESWT include (2, 3, 7):

- unstable angina.
- myocardial infarction during the previous month (or within the last 10 days for cardiac rehabilitation).
- Uncontrolled arrhythmias or syncope.
- Severe aortic stenosis.
- SpO2 ≤85%.

Relative contraindications for the ESWT include (2, 3, 7):

- resting heart rate of more than 120.
- a systolic blood pressure of more than or equal to 180 mm Hg.
- diastolic blood pressure of more than or equal to 100 mm Hg.
- Stenotic coronary or valvular heart disease.
- Significant pulmonary hypertension with syncope.
- Symptomatic hypotension.
- Unstable diabetes.
- Unstable/acute heart failure.

Subjects with any of these findings should be referred to the physician ordering or supervising the test for individual clinical assessment and a decision about the conduct of the test. The results from a resting electrocardiogram done during the previous 6 months should also be reviewed, if available, before testing. Stable exertional angina is not an absolute contraindication for an ESWT, but subjects with these symptoms should perform the test after using their anti-anginal medication, and rescue nitrate medication should be readily available.

Safety Issues

1. Testing should be performed in a location where a rapid response to an emergency is possible. The location of a cardiac arrest trolley should be determined in advance.
2. Supplies that must be available include oxygen, sublingual nitroglycerine and Salbutamol (metered dose inhaler or nebuliser). A telephone or other means of communication should be in place to enable a call for help.
3. The technician conducting the test should be certified in cardiopulmonary resuscitation with a minimum of Basic Life Support by Resuscitation Council (UK)–approved cardiopulmonary resuscitation course. Advanced cardiac life support certification is desirable. Training, experience, and certification in related health care fields (e.g. registered nurse, registered therapist, exercise physiologist or certified pulmonary function technician) are also desirable. A certified individual should be readily available to respond if needed.
4. Physicians are not required to be present during all tests. The physician ordering the test or a supervising laboratory physician may decide whether physician attendance at a specific test is required.
5. If a patient is on long term or ambulatory oxygen therapy, oxygen should be given at their standard rate or as directed by a physician or protocol.

Stop the Test in the Event of Any of the Following (7, 8)

- Chest pain suspicious of angina.
- Evolving mental confusion or lack of coordination/ staggering.
- Evolving light-headedness.
- Intolerable dyspnoea.
- Leg cramps or extreme leg muscle fatigue.
- Excessive sweating.
- Persistent SpO_2 ≤80%.
- Pale or ashen appearance that occurs during the test.
- Any other clinically warranted reason.
- For cardiac rehabilitation the test may be terminated if the patient reaches 70% of their heart rate reserve (maximum heart rate- resting heart rate).

Technicians must be trained to recognise these problems and the appropriate responses. If a test is stopped for any of these reasons, the patient should sit or lie supine as appropriate depending on the severity or the event and the technician's assessment of the severity of the event and the risk of syncope. Prior to testing the following should be obtained based on the judgment of the technician: blood pressure, pulse rate, oxygen saturation, and a physician evaluation.

Preparation

Establishment of a Walking Track

- The course should be identified by 2 cones (9 meters apart) with an inset of 0.5m from either end, thus avoiding abrupt changes in direction (figure 1).

- The track should be flat, with minimal blind turns or obstacles.

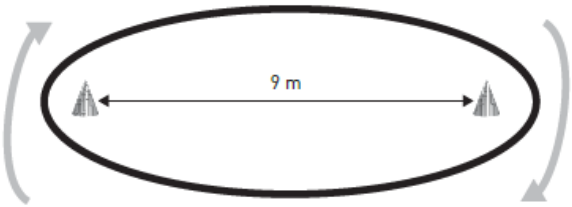

Figure 1 (2)

The walking track should be in an area with a maintained comfortable ambient temperature and humidity.

Patient Preparation

- Take into account any precautions or contraindications prior to performing the walk test.
- Instruct the subject to dress comfortably and wear appropriate footwear.
- Where possible/appropriate, the subject should be advised to avoid eating a heavy meal for two hours before the test as well as limiting caffeinated drinks which may affect test performance.
- Any prescribed inhaled bronchodilator medication should be taken as prescribed or according to the research/ clinical protocol.
- The subject should rest for at least 15 minutes before beginning the ESWT (or 30 minutes if following an ISWT).

Encouragement: Only the standardised phrases for encouragement (as specified in the procedure below) must be used during the test as encouragement significantly increases the distance walked.

Supplemental Oxygen: If oxygen supplementation is needed during the walks and serial tests are planned, then during all walks by that subject, oxygen should be delivered in the same way with the same flow. If the flow must be increased during subsequent visits due to worsening gas exchange, this should be noted on the worksheet and considered during interpretation of the change. Measurements of pulse and SpO_2 should be made after waiting at least 10 minutes after any change in oxygen delivery.

The type of oxygen delivery device should also be noted on the report: for instance, the subject carried liquid oxygen or pushed or pulled an oxygen tank, the delivery was pulsed or continuous. Technicians should avoid walking next to the subject with the oxygen source, however if the subject is not able to control/carry/manage their own oxygen cylinder, the technician should try to walk slightly behind the subject to avoid setting the walking pace. It should be clearly documented how the technician has assisted with the transport of the oxygen, so any subsequent walk tests with the same subject can be performed in the same manner.

Medications: The type of medication, dose, and number of hours taken before the test should be noted because significant improvement in the distance walked, or the dyspnoea scale, after administration of bronchodilators has been demonstrated in patients with COPD (4, 5).

Procedure

- If being performed on the same day as the ISWT, only one ESWT is required. The time walked in seconds is recorded.

- The test should be performed after at least 30 minutes of rest following the ISWT and measures of HR and SpO2 must have returned to baseline prior to the second test..

1) Set the level/CD [calculated from the ISWT; at a predefined percentage of peak performance of the ISWT (9)] and play the standardised instructions to the individual. Patients are advised to:

"The walking speed for the first 2 minutes is fairly slow, so don't go too fast".

Unlike the ISWT the test is not incremental and is at a constant speed, but there is a warm up period of approximately 2 minutes. At this point there are standardised instructions for the participant played from the CD advising the individual that at the next bleep the speed of walking will increase. This is the speed that the test is performed at.

2) After the subject has been at rest for 15 minutes [or 30 minutes if performed after an ISWT earlier during the visit (2)], obtain and record measurements of blood pressure, heart rate, oxygen saturation and Borg dyspnoea and RPE scores (Appendices 1 & 2).
3) Direct the subject to the 'starting cone' of the walking track.
4) Describe the walking track to the subject.
5) Give the patient the following instructions:

"Are you ready? Remember that the object is to walk AS LONG AS POSSIBLE, but don't run or jog.

6) Once the first triple bleep plays the test has started.
7) The initial stages of the test are at a slower speed and are a 'warm up' for the participant.
8) After the' warm up' period the speed of walking increases , this is advised on the audio instructions at the end of the 'warm up' period. Participants are then paced by the technician for the first 2 shuttles only. It is at this point in the test that timing with a stopwatch begins.
9) Monitor the subject for any untoward signs and symptoms throughout the duration of the test. Heart rate and RPE can be recorded throughout the test as required (this is often done at regular intervals for cardiac rehabilitation patients).
10) During the test only one verbal cue can be used to encourage the patient to pick up their speed 'you need to increase their speed to keep up with the test'.
11) As the test progresses, if the subject comfortably manages eight minutes and shows no sign of nearing completion, then the test should be stopped (unless stipulated otherwise in a research protocol). If stopped, the test should be repeated at the next level following a 30 minute rest for patients on levels 1-5. For patients on level 6 and above achieving eight minutes, the test should be repeated at 2 levels higher. Repeating the pre-training ESWT at a faster walking speed to achieve an exercise time between 5 and 10 min with moderate symptoms may be advantageous in terms of long-term improvements in a rehabilitation programme (10). If the patient is on level 16 (the last level) and manages more than 8 minutes, the patient should be allowed to carry on and do as much as they can i.e. even if they can walk for 20 minutes (the ceiling of the test) then that is their baseline score.
12) The test is terminated when either a) the subject indicates that they are unable to continue, b) if the operator determines that the subject is not fit to continue, *or,* c) the operator assess that the subject was unable to sustain the speed and cover the distance to the cone prior to the beep sounding.
13) Allow the subject to sit down or, if the subject prefers, allow to them to stand. If the subject elicits a significant cardiovascular response, marching on the spot or in sitting may be required, ensuring a safe cool down.

14) Immediately record oxygen saturation, heart rate, Borg dyspnoea and RPE Score on the proforma. Measure and record the subject's blood pressure.
15) Record HR and SpO_2 again following 5 minutes of rest.
16) Congratulate the patient on good effort and offer a drink of water.
17) Document the time walked and record on the proforma.
18) The subject should remain in a clinical area for at least 15 minutes following an uncomplicated test, or be allowed to rest for at least 30 minutes if performing a further test.

Operator termination of the test

The operator will be required to terminate the test if the participant fails to reach the cone/marker in the time allowed. This is defined as the individual being more than 0.5m away from the cone when the bleep sounds on a second successive 10m length. When the individual is just outside the 0.5m marker they are advised 'you need to increase their speed to keep up with the test', if they fail to do so on the next length, the test is terminated and the distance recorded.

The test should be discontinued by the operator if SpO_2 falls below 80% as per ATS/ACCP guidelines for cardiopulmonary exercise testing (8).

Participant termination of the test

The patient may indicate to terminate the test. Common reasons for termination include: excessive dyspnoea, fatigue (commonly leg fatigue) or pain (knee/hip/low back pain).

Recording Test Performance

Time of test termination should be recorded in seconds. Results can be collected on the ERS/ATS shuttle walking test recording form (appendix 3) or within other suitable paperwork.

Repeating the ESWT following an intervention

If measuring the ESWT again following an intervention such as rehabilitation, then they should repeat the test at the same level that they did at baseline and not recalibrate the level based on an improved/ decreased ISWT performance.

Quality assurance

It is important that all operators are familiar with the test procedures, as the test requires clear processes to be followed. It is important that the operator can walk exactly at the warm up speed of walking to pace the patient, this is particularly important for patients with a higher functional capacity who's natural speed of walking is faster than the warm up speed. Participants are then paced for the first 2 shuttles (10m length) of the ESWT speed that corresponds to the desired speed for that individual. It is recommended therefore that anyone unfamiliar with test procedures completes 10 observed ESWTs, which are performed to the standards identified above. A competent operator will be responsible for signing off satisfactory completion of the tests. Ideally quality assurance testing should require the operator to conduct the test on participants with a range of functional exercise capacity (appendix 4).

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Appendix 1: Borg Scale

The Borg scale should be provided as a laminated poster.
At the beginning of the walk test, show the scale to the subject and ask this "PLEASE GRADE YOUR LEVEL OF SHORTNESS OF BREATH USING THIS SCALE".
At the end of the exercise, remind the subject of the breathing number they chose before the exercise and ask them to grade their shortness of breath level again.

SCALE	SEVERITY
0	No Breathlessness At All
0.5	Very Very Slight (Just Noticeable)
1	Very Slight
2	Slight Breathlessness
3	Moderate
4	Somewhat Severe
5	Severe Breathlessness
6	
7	Very Severe Breathlessness
8	
9	Very Very Severe (Almost Maximum)
10	Maximum

Appendix 2: RPE Scale

The RPE Scale should be provided as a laminated poster.
At the end of the exercise test, show the scale to the subject and ask this “PLEASE GRADE YOUR LEVEL OF SHORTNESS OF BREATH USING THIS SCALE”.

rating	description
6	NO EXERTION AT ALL
7	
	EXTREMELY LIGHT
8	
9	VERY LIGHT
10	
11	LIGHT
12	
13	SOMEWHAT HARD
14	
15	HARD (HEAVY)
16	
17	VERY HARD
18	
19	EXTREMELY HARD
20	MAXIMAL EXERTION

Appendix 3.

Shuttle Walk Test Recording Form

Unit:

Designation:

Date:

ID:

First name:

Last name:

D.O.B. (dd/mm/yyyy)

Diagnosis:

Medication taken today	Dose	How many hours prior to testing?

Supplemental oxygen: yes/no
Flow rate:
Device:
Method carried:

Walking aid: yes/ no (specify)

Level:		1	2	3	4	5	6	7	8	9	10	11	12
ISWT	1												
	2												

		ISWT1	ISWT2			ESWT1	ESWT2
				Date/ Time:			
Date/ Time:				Speed/ level:			
Start	Dyspnoea			Start	Dyspnoea		
	HR				HR		
	SpO_2				SpO_2		
Distance (m):				Time (seconds):			
End	Dyspnoea			End	Dyspnoea		
	Exertion				Exertion		
	HR				HR		
	SpO_2				SpO_2		
Recovery	Dyspnoea			Recovery	Dyspnoea		
	Exertion				Exertion		
	HR				HR		
	SpO_2				SpO_2		
Reason for termination				Reason for termination:			

ESWT calculation:

Comments:

Print: Signature:

Appendix 4. ESWT Competency Form

ESWT - Observed Shuttles			
Name: _____			Trial:_____
No	Date	Comments	Signature: Print:
1			*Signature:* *Print:*
2			*Signature:* *Print:*
3			*Signature:* *Print:*
4			*Signature:* *Print:*
5			*Signature:* *Print:*
6			*Signature:* *Print:*
7			*Signature:* *Print:*
8			*Signature:* *Print:*
9			*Signature:* *Print:*
10			*Signature:* *Print:*
11			*Signature:* *Print:*
12			*Signature:* *Print:*
13			*Signature:* *Print:*

10 Observed shuttles should be observed prior to sign off by a qualified and competent assessor.

Sign Off Date:

_____

Assessor:

*Signature:*_____

Print: _____