

Incremental Shuttle Walking Test (ISWT)

Standard Operating Procedure (SOP)

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C E R S
Centre for Exercise and
Rehabilitation Science

Standard Operating Procedure – Incremental Shuttle Walking Test (ISWT)

Scope and Purpose

The original purpose of the ISWT was to develop a standardised, externally paced, incremental field walking test to assess the functional capacity in patients with chronic heart and lung disease (1-3). The ISWT is a valid symptom limited maximal test of functional capacity that relates strongly to VO₂max during cardio-pulmonary exercise testing on a treadmill (4).

Equipment

- Two small cones to mark the turnaround points 9 meters apart with a 0.5m inset for turning.
- One chairs, one at one end of the walking course
- BORG Scale (Appendix 1)
- RPE Scale (Appendix 2)
- Clipboard with an ISWT Proforma and a pen
- Automated blood pressure machine
- Pulse oximeter
- 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 ISWT include (3, 5-6):

- 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 ISWT include (3, 5-6):

- 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 before testing. Stable exertional angina is not an absolute contraindication for an ISWT,

but subjects with these symptoms should perform the test after using their anti-angina medication, and rescue nitrate medication should be readily available.

Safety Issues

1. Testing should be performed in a location where a rapid, appropriate 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 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 (6, 7)

- 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 SpO₂ ≤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 of the event and the technician's assessment of the severity of the event and the risk of syncope. Prior to conducting the test the following should be obtained based on the judgment of the technician: blood pressure, pulse rate, oxygen saturation, and a physician evaluation. Oxygen should be administered as appropriate.

Preparation

Establishment of a Walking Track

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

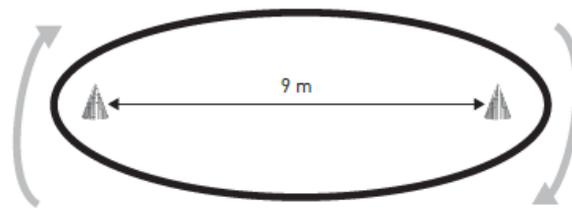


Figure 1 (4)

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 ISWT.

Encouragement: Only the standardised phrases for encouragement (as specified in the procedure below) must be used during the test. 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 SpO₂ 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. Significant improvement in the distance walked, or the dyspnoea scale, after administration of bronchodilators has been demonstrated in patients with COPD (8).

Procedure

- The ISWT must initially be performed on *two occasions* to account for a learning effect. The best distance walked in metres is recorded, to the nearest 10m as completed lengths.

- If the two tests are performed on the same day, at least 30 minutes rest should be allowed between tests.

- 1) Set the track/ CD to the start and play the standardised instructions to the individual. Patients are advised to:

"You should walk at a steady pace, aiming to turn around the cone at one end of the course when you hear the first bleep, and at the other end when you hear the next. At first, your walking speed will be very slow, but you will need to speed up at the end of each minute. Your aim should be to follow the set rhythm for as long as you can.... You should stop walking only when you become too breathless to maintain the required speed or can no longer keep up with the set pace."

- 2) After the subject has been at rest for 15 minutes (5), 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) The speed at which the patient should walk is directed by an audio signal played on a CD player/ MP3 file.
- 7) Once the first triple bleep plays the test has started.
- 8) The operator should walk alongside the patient for the first minute (level 1) and then step away.
- 9) Monitor the subject for any untoward signs and symptoms throughout the duration of the test. Heart rate and RPE can be recorded at the end of each level (this is often done for cardiac rehabilitation patients).
- 10) Watch the patient. Ensure you keep count of the number of lengths as the subject completes them, throughout the duration of the test.
- 11) At every increase in speed, at the end of every minute, indicated by a triple bleep advise the patient 'you now need to increase your speed of walking.'
- 12) During the test only one verbal cue can be used to encourage the patient to pick up their speed 'you need to increase your speed to keep up with the test' (see below).
- 13) The test is terminated when either 1) the subject indicates that they are unable to continue, 2) if the operator determines that the subject is not fit to continue, or, 3) the operator assess that the subject was unable to sustain the speed and cover the distance to the cone prior to the beep sounding (see below for more details).
- 14) 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.
- 15) Immediately record oxygen saturation, heart rate, Borg dyspnoea and RPE Score on the proforma. Measure and record the subject's blood pressure.
- 16) Total up the number of lengths walked in meters (to the last 10m completed), and record on the proforma.
- 17) 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 the second walk test on the same day.

Recording Test Performance

The assessor should calculate the distance walked to the nearest 10m completed. Time to completion can also be recorded. Results can be collected on the ERS/ATS shuttle walking test recording form (appendix 3) or within other suitable paperwork.

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 the test is terminated and the distance recorded.

The test should be discontinued by the operator if SpO₂ falls below 80% as per ATS/ACCP guidelines for cardiopulmonary exercise testing (7).

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).

Repeating the ISWT at subsequent research or clinical visits

Due to the learning effect, 2 ISWTs should be repeated at follow-up visits if the patient completed their last ISWT >3 months ago.

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 first 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. It is recommended therefore that anyone unfamiliar with test procedures completes 10 observed ISWTs, 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).

References

- (1) Singh SJ, Morgan MD, Scott S, Walters D, Hardman AE. Development of a shuttle walking test of disability in patients with chronic airways obstruction. *Thorax* 1992 Dec;47(12):1019-1024.
- (2) Dyer CA, Singh SJ, Stockley RA, Sinclair AJ, Hill SL. The incremental shuttle walking test in elderly people with chronic airflow limitation. *Thorax* 2002 Jan;57(1):34-38.
- (3) Core Competences for the Physical Activity and Exercise Component for Prevention and Cardiovascular Rehabilitation Services. BACPR 2017.
- (4) Singh SJ, Morgan MD, Hardman AE, Rowe C, Bardsley PA. Comparison of oxygen uptake during a conventional treadmill test and the shuttle walking test in chronic airflow limitation. *Eur Respir J* 1994 Nov;7(11):2016-2020.
- (5) Holland AE, Spruit MA, Troosters T, Puhan MA, Pepin V, Saey D, et al. An official European Respiratory Society/American Thoracic Society technical standard: field walking tests in chronic respiratory disease. *Eur Respir J* 2014 Dec;44(6):1428-1446.
- (6) ACPICR Standards for Physical Activity and Exercise in the Cardiovascular Population, 2015. 3rd Edition.
- (7) American Thoracic Society, American College of Chest Physicians. ATS/ACCP Statement on cardiopulmonary exercise testing. *Am J Respir Crit Care Med* 2003 Jan 15;167(2):211-277.
- (8) Pepin V, Saey D, Whittom F, LeBlanc P, Maltais F. Walking versus cycling: sensitivity to bronchodilation in chronic obstructive pulmonary disease. *Am J Respir Crit Care Med* 2005 Dec 15;172(12):1517-1522.

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.

ISWT – Competency Form

ISWT - 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: _____