Clinician's Commentary on Janaudis-Ferreira et al.¹

Upper-extremity (UE) training is recommended as part of a comprehensive exercise programme for people with COPD² and is known to have a positive impact on arm exercise capacity, arm muscle strength, and symptoms of dyspnea associated with overhead arm activity.^{2,3} Typical arm-training exercises for people with COPD reported in the literature include arm ergometry, upper-body resistance training with hand weights, and overhead tasks.³ These types of activities are simple to incorporate into pulmonary rehabilitation (PR) programmes, as they do not require specialized equipment, and may be very relevant to people who experience dyspnea during everyday activities (e.g., while brushing their hair or reaching overhead to place items on a shelf).

Several valid and reliable tests have been used to evaluate UE function in people with COPD.⁴ Janaudis-Ferreira and colleagues¹ describe three common tests used for UE function in people with COPD, the correlations among these tests, and their responsiveness in detecting changes after a PR programme that included arm resistance training.

The authors suggest that three different aspects of UE function are evaluated by this battery of tests: *strength* was measured using hand-held dynamometry; *arm exercise capacity* was measured using the unsupported upper limb exercise test (UULEX); and *arm function* was evaluated with the 6-minute Pegboard and Ring Test (PBRT). The three tests were shown to be correlated with each other (*r*-values ranging from 0.41 to 0.61), and all showed responsiveness to the arm-training programme in people with COPD.¹ So how can we use these results to determine which test might be most applicable to the clients we see in clinical practice?

When choosing a test for routine clinical practice, in addition to looking at its measurement properties (reliability, validity, and responsiveness to change) we also want to ensure that we are measuring the outcome or construct that is the target of the rehabilitation programme.⁵ In other words, which evaluation tool will capture the specific changes that we are trying to achieve in our PR programme? To answer this question, let's take a look at each test in a little more detail.

Hand-held dynamometry (HHD) has been widely used as a measure of muscle strength and is a well-accepted measure of maximal force-generating capacity.⁶ HHD gives us a way to evaluate the gains in muscle strength of specific muscle groups in response to a resistance training programme. However, HHD is also critiqued for its specificity to measuring the force generated by an isolated muscle group, an outcome that may not have meaning to a client interested in seeing improvements in function. Therefore, while HHD may be of value in evaluating the effectiveness of a resistance training programme, it may not tell us about changes in function or performance of daily tasks that use the arms.

The other two tests described by Janaudis-Ferreira and colleagues¹ use combined overhead movements of the arms and require a combination of arm muscle strength, endurance, and motor coordination. The UULEX is a symptom-limited incremental test used to measure arm endurance.⁷ Patients are asked to move a weighted bar of a given load (0.2 kg, increased in increments of 0.5 kg to a maximum of 2 kg) at a given cadence until exhaustion. The UULEX is primarily a test of arm muscle

endurance, since it involves repeated movements that are continued until fatigue, but also requires a certain degree of muscle strength. Although the bar is relatively light (2 kg maximum), people with greater muscle strength will use a smaller percentage of their maximum strength to lift the bar, and therefore will likely be able to continue the test longer. So it is not surprising that the UULEX was moderately correlated with both elbow flexion and shoulder flexion strength, as these muscles would be two of the prime movers during the test. However, the UULEX is likely to be most useful to measure changes in arm endurance rather than in strength. So an arm-training programme incorporating endurance-based exercises (i.e., lighter loads and more repetitions) could be evaluated using the UULEX.

The third test used in this study was the 6-minute PBRT.⁸ In addition to requiring arm muscle endurance, this test also requires a certain degree of motor coordination and finger dexterity to place rings over pegs both quickly and accurately. Since the loads are negligible, however, it likely does not reflect changes in muscle strength as closely as HHD. As might be expected, the 6-minute PBRT was more highly correlated with the UULEX, another test of arm endurance, than with measures of muscle strength from HHD in Janaudis-Ferreira and colleagues'¹ study. Like the UULEX, the 6-minute PBRT may be best suited to evaluating the effects of an arm-training programme with a focus on endurance of the arm muscles. However, since it has the added complexity of motor coordination, it may be most feasible for clients who do not have issues with fine motor control of their fingers. One study reported that 53% of people with COPD exhibit signs of peripheral neuropathy, which may be associated with smoking and/or hypoxemia;⁹ they may be particularly at risk for problems with motor control of distal finger muscle, as required by the 6-minute PBRT.

In the end, the clinician must choose a test that is feasible to conduct and whose outcome is relevant to the training programme in question. Although Janaudis-Ferreira and colleagues report that HHD, UULEX, and 6-minute PBRT correlated with each other and were responsive to PR, these tests cannot be used interchangeably: HHD is quite specific to measuring muscle strength of isolated muscle groups, whereas the UULEX and 6-minute PBRT measure arm muscle endurance. The 6-minute PBRT also incorporates an aspect of motor coordination. Furthermore, a test that measures a change that is meaningful to the patient would be ideal, and patient goals should be considered both when developing a rehabilitation programme and when choosing the appropriate outcome measure.

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