LETTER TO THE EDITOR OF THE INTERNATIONAL JOURNAL OF SPORTS PHYSICAL THERAPY

Augustsson, J. A new clinical muscle function test for assessment of hip external rotation strength: Augustsson strength test. *Int J Sports Phys Ther.* 2016;11(4):520-526.

Dear Editor

We would like to congratulate Dr. Augustsson for his publication in IJSPT in August 2016, on his new clinical test for hip strength. After reading the article, we would like to make several comments pertinent to the interpretation of his results.

The 'clam' movement used in this assessment is a popular exercise for hip rehabilitation. The movement tested should not be considered pure hip external rotation; rather, the 'clam' exercise movement used in the study is a compound movement including hip external rotation, abduction, and extension to some degree. We're not aware of any specific measurement of femoral external rotation range of motion during this movement; however, we assume it's less than pure hip external rotation at 90 degrees of hip flexion, which is the traditional testing position of hip external rotation strength.

Most importantly, however, the amount range of motion of each individual, which didn't appear to be measured or controlled, limits the validity of this measurement. This study did not measure the strength of an individual; rather, it measured the linear distance of excursion in a compound movement that was then interpolated for 'strength.' The individual's flexibility likely had a significant impact on the outcome measure. This would be a major factor in patient populations.

The author neglected to provide detailed data or regression lines of the 'load-versus-displacement plot' that was used to 'interpolate' the strength values utilized in this study. Furthermore, the regression equation mentioned in the paper was not provided. It's critical that the author provides the regression equation, as it was the primary source of data used in the analysis. Doing so would also provide others in the field the ability to reproduce this study in other populations for reliability and validity of patient populations.

The internal and external validity of the findings are suspect due to a number of statistical choices the authors committed. The author did not provide any information to support the power of the statistical tests they employed in the analysis, including the effect size in order to address clinical relevance of the findings. The authors did not adequately justify employing an ICC rather than a Pearson's r when assessing consistency of the measure over two data collection points. Finally, the authors did not address the potential for an artificially inflated type I error rate in the study as the result of conducting multiple tests.

Dr. Augustsson did a good job in noting that the reliability of the measurement only applies to healthy individuals with assumed 'normal' hip strength. Reliability in a variety of patient populations should be assessed before recommending its use as an indicator of hip external rotation strength in a clinical population. We believe the author the author has prematurely recommended that this test may assess "hip strength in the etiology of ACL injuries" or before return to sport.

While the author accurately described the need to validate this test, his argument against doing so without the presence of a 'gold standard' isotonic test should not dismiss the ability to validate this test. Isokinetic and isometric tests of hip external rotation strength remain the gold standard in assessing hip strength and should, therefore, be appropriate to validate the strength of hip external rotation. Furthermore, the author referred to EMG studies of the clam exercise that "validates this test of hip strength in that it actually measures the strength of hip muscles." The author cannot draw this conclusion because no measurement of hip strength was made in these EMG studies. Without validation, the Augustsson Strength Test is simply a repeatable measurement of a subject's ability to perform the clam exercise against resistance.

We encourage further investigation of this novel clinically based strength test, particularly in patient populations.

Respectfully,

Phil Page, PT, PhD, ATC, CSCS, FASM
Robert Topp, PhD, RN

REPLY TO THE LETTER TO THE EDITOR REGARDING MY ARTICLE

Augustsson, J. A new clinical muscle function test for assessment of hip external rotation strength: Augustsson strength test. *Int J Sports Phys Ther.* 2016;11(4):520-526.

I would like to thank Doctor Page and Doctor Topp for their concern in this paper. I have read their comments with interest.

To begin with, the "Clam" movement (the position in which the subjects were tested) is dominantly an external rotation movement. As the feet stays together (as shown in Figure 3 in the paper) and as the hips and feet are aligned (as shown in Figure 2) the movement takes place in the transverse anatomical plane where the movement axis passes vertically from superior to inferior (hips and feet). Had the feet not stayed together such as when performing, for example, the seated abduction machine exercise then the movement had involved abduction of the hip. The movement of the test does not involve hip extension. Moreover, it would be possible to have the test device assess hip abduction strength, using the same side lying position, simply by letting the subjects extend their hips and knee fully and then have them abduct the upper leg.

It is correct that if the resistance provided from test device is not sufficient then at some point a subject's hip range of motion (ROM) rather than hip muscle strength will limit any further distance achieved by the subject. This is a valid point that could have been mentioned more clearly in the article. It is mentioned in the article, however, that the rubber band, doubled and of a heavy–duty type, was only moderately stretched during testing (see Figure 3, end position) which meant that full ROM was not reached for any of the subjects in the study. If a very powerful individual is to be tested, however, then an even heavier, larger sized elastic resistance band must be used in order to avoid that hip ROM rather than muscle strength is the limiting factor. The issue of hip ROM is also important, as noted by Doctor Page and Doctor Topp, when testing patient populations. Prior to testing, the ROM of each patient for the test movement should be investigated to make sure that hip flexibility is not the limiting factor during testing. Even a patient with very limited hip ROM (or even the strongest athlete), however, can be tested for muscle strength just as long as the resistance provided from test device is adjusted to avoid full ROM.

When it comes to the conversion of elastic resistance band displacement to force, the procedure was clearly stated in the article. The increase in length corresponded to a progressive increase in the elastic resistance which enabled a plot to be generated. The plot was then used to interpolate results for any given test value. No regression equation was necessary to use when generating the plot. As every elastic resistance band most probably has unique material properties the load-versus-displacement plot will likely differ. It is therefore important (especially in research) to generate a specific plot for a particular resistance band.

The main purpose of the article was to develop a dynamic clinical test of hip strength. A secondary aim was to investigate gender differences in hip strength using this test. No power calculations were performed when it came to the question of gender differences in hip strength. The subjects (34 women and 19 men) were however probably sufficiently many to answer the question on gender differences in hip strength. Effects size is normally calculated to determine the magnitude of treatment effects and was thus not used in the present study. Doctor Page and Doctor Topp mention "the potential for an artificially inflated type I error rate in the study as the result of conducting multiple t tests". Relatively few t tests (four), however, were performed in this study so the risk of mass significance and thus the incorrect rejection of a true null hypothesis (a "false positive") was therefore probably rather low. Lastly, the intra class correlation coefficient (ICC) is the gold standard test when it comes to measures of reliability in research and was therefore preferred over Pearson's r in the present study.

The Pearson r was often used in the past to quantify reliability, but the use of the Pearson r is typically discouraged for assessing test-retest reliability. The primary, although not exclusive, weakness of the Pearson r is that it cannot detect systematic error (Weir 2005).

It is clearly stated in the article that the generalizability of the study is limited to healthy, active young adults. For ACL injured or reconstructed people that has no history of hip disorder, however, the test probably can be used to assess hip muscle strength quite well since it does not involve any movement across the knee. In the Discussion section of the article the use of this test is not "recommended" but rather discussed as a test that could be used as a complement to the common strength tests performed before return to sport after ACL reconstruction.

When it comes to the question of validity: It is stated in the article that "when it comes to clinical tests of hip strength, no particular type of test could be considered as the gold standard measure." Isokinetic tests are not clinical tests. And isometric tests using isokinetic dynamometry are not clinical tests either. Of the existing clinical tests no one particular could be considered the gold standard measure. It is agreed, however, that a comparison with an isokinetic test of hip external rotation or an isometric test using isokinetic dynamometry would be interesting from a validation standpoint.

Lastly, in the study by Selkowitz et al (2013) a measurement of hip strength (maximum voluntary isometric contraction, MVIC) was indeed made as the subjects, lying in the "Clam" position exerted the MVIC against a strap positioned across the distal thigh, during which time the EMG signal was collected.

REFERENCES

1. Selkowitz DM, Beneck GJ, Powers CM. Which exercises target the gluteal muscles while minimizing activation of the tensor fascia lata? Electromyographic assessment using fine-wire electrodes. *J Orthop Sports Phys Ther*. 2013;43:54-64.
2. Weir P. Quantifying test-retest reliability using the intraclass correlation coefficient and the SEM. *J Strength Cond Res*. 2005 Feb;19(1):231-40.

Sincerely,

Jesper Augustsson, PhD, PT