INTRODUCTION
The assessment of musculature strength may assist in the determinations of disability or impairment following injury. However, the validity of strength test results may be compromised by participant exertion of a non-maximal effort. A wide variety of physical and psychosocial factors have been implicated to underlie the production of non-maximal efforts during testing in patient populations. These may include the presence of pain and fear of re-injury, as well as an attempt to exaggerate or feign muscle strength weakness for secondary gain purposes [1]. As such, there is a need for development of decision rules by which clinicians may ascertain maximal effort production during muscular strength testing. Previous research has established probability-based decision rules for ascertaining the type and level of effort exerted by participants during knee isokinetic testing using measures that quantify within-set performance consistency [2]. One of the decision rules was found to be particularly good in differentiating between maximal and a combination of submaximal and feigned efforts. However, in this former investigation only young, healthy participants were tested, and thus the generalizability to a heterogeneous patient sample is unknown. The purpose of this investigation was to assess the performance of the aforementioned decision rule in the ability to differentiate between maximal and submaximal knee isokinetic efforts in participants who underwent surgical reconstruction of the Anterior Cruciate Ligament (ACL).

METHODS
Procedures were approved by the institutional review board and written informed consent was obtained from all participants. The concentric knee strength of 36 patients (18 men, 18 women, mean age 31 years, range 18-55 years) that have undergone surgical reconstruction of their ACL was measured using a Biodex System 4 isokinetic dynamometer (Biodex Medical Systems Inc., Shirley, NY, USA). Average time of testing following surgery was 13 months (range 2.5-30). The protocol entailed performance of 4 sets of 6 concentric knee extension-flexion repetitions at an angular velocity of 60°/sec performed through a 60° range of motion. The sets consisted of: 1) maximal effort; 2) self-perceived 75% of maximal effort; 3) self-perceived 50% of maximal effort, and; 4) a set attempting to feign or exaggerate knee muscle weakness. Average cross correlation (CC) and % root mean square difference values (%RMSD) were computed between moment curves 2 through 5 in each direction for quantifying set internal consistency. These scores were subsequently inputted into a logistic regression based-decision rule previously established [2] to be classified as being maximal or not (Table 1). Performance of the decision rules is reported in terms of number of misclassifications per effort condition and as sensitivity and specificity values expressed as percentages of the total number of tested participants.

RESULTS
Of the total 36 maximal effort attempts, 35 were classified correctly, whilst 1 effort was misclassified. Of the total 108 submaximal and feigned efforts, 5 were misclassified as being maximal (3 trials at the 50% effort condition and 2 trials at the 75% effort condition). No feigned effort attempt was misclassified. Of the 5 total submaximal misclassification cases, 2 belonged to the same individual. As such, when expressed on an individual participant basis, the decision rule’s corresponding specificity and sensitivity values are 97.2% and 88.8%, respectively.

DISCUSSION & CONCLUSIONS
The performance of the decision rule developed for ascertaining maximal effort production during isokinetic testing of the knee joint showed satisfactory performance when applied to a sample of patients who underwent ACL reconstructive surgery. Future work will assess whether this decision rule may also be used in patients recovering from other types of traumatic and non traumatic knee injuries.

REFERENCES

Table 1: Performance of decision rule for ascertaining maximal effort production during knee isokinetic testing of ACL reconstructed patients. *Denotes number of misclassifications of total number of efforts in each condition.