

Title: Single Leg Eccentric Exercise: Assessing Risk Factors for Dynamic Knee Valgus

Introduction

In physical therapy, quadriceps weakness is a very common ailment. Most physical therapists include an exercise called the forward eccentric step down as a principal activity in therapy to help strengthen the quadriceps muscle. When doing this exercise, because of the challenging position the exercise calls for, patients may be at risk for straining or hurting their knee by having it in a position called knee valgus. Our research asks two questions related to this. First, do the exercises reverse step downs or decline step downs put patients at less of an injury risk than typical forward step downs? Second, does Q angle (related to the natural position of the pelvis and leg) and quadriceps muscular balance (knowing if the medial and lateral side have equal strength) affect the of valgus positioning the knee is in? There is already a large body of work in research that involves the effectiveness of forward step down exercises for quadriceps weakness and that the valgus positioning puts the knee at risk for injury. Our research adds to the body of research because we are specifically diving into various step downs, not just the forward step down seen in research, and aligning these exercise with which puts the patient at the least amount of risk.

Methods

Two subjects were enrolled in the study with no current or previous history of knee injury. In order to address both research questions, researchers measured the subjects' Q angles, calculated the subjects' torque, and measured dynamic knee valgus during the three eccentric exercises (forward step downs, reverse step downs, and decline step downs). Measurement were taken of each subjects' Q angle of each knee in two conditions: passive standing without quadriceps contraction and standing with active contraction of the quadriceps muscles. Markers were placed on the subjects' bilateral ASIS and tibial tuberosities to increase the accuracy and consistency of measurements. The difference in Q angle between the two conditions for each subject represents the subject's patella tracking. The greater the difference between the two conditions, the greater the imbalance between the vastus lateralis and vastus medialis muscle strength causing the patella to be pulled laterally, representing increased patellar tracking. Increased patellar tracking is correlated with increased dynamic valgus according to previous studies. In each subject, the knee with the greatest Q angle difference performed the eccentric exercises in order to better represent patients and to see more exaggerated dynamic valgus between the different exercises. The peak quadriceps torque of each subject was calculated using the biodex machine. Subjects then performed three knee eccentric exercises including steps downs, reverse step downs, and step downs on a decline. The exercises were analyzed using 2D analysis using the HUDL app measuring knee valgus and hip adduction.

Results

In the results table below, the dynamic knee valgus and hip adduction angle averages measured over 9 trials of each exercise are shown. The bolded numbers are the the least valgus/adduction, which insinuates that those might be the exercises with the least injury risk. The "best" step down exercise is in inconclusive because the decline step down was the best for 3 of the criteria, and in the fourth criteria showed that forward step down may be the best exercise to minimize dynamic knee valgus.

	J Valgus	J Adduction	M Valgus	M Adduction
Forward Step Down	16.56°	22.89°	6.00°	17.11°
Reverse Step Down	20.22°	25.33°	9.78°	20.78°
Decline Step Down	6.40°	12.11°	7.67°	16.67°

Discussion

The results of the research study were inconsistent with previous literature on the topic, highlighting the important effects of other variables (beside patellar tracking and torque) on dynamic knee valgus during eccentric exercises. Compensations at both proximal and distal joints such as the trunk and feet, hip abductor strength, and neuromuscular control gained from previous training all heavily influence dynamic knee valgus and need to be considered when evaluating a patient with knee valgus. Due to these factors, the subjects differed in which exercise was “best” for them, or which exercise they had the least amount dynamic knee valgus. These results pinpoint the idea that when working in physical therapy, as well as many other medical professions, patients need to be treated as individuals, not just by the condition they have. Research results that are a product of human variability are important to see in research because biomechanics are not all that influence human performance.

5. Bibliography/Works Cited:

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