Quadricep EMG Analysis: Ascending Stairs vs. Stair Stepper Machine With and Without a Load

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Background
A common activity of daily living (ADL) for community dwelling individuals is to negotiate stairs entering their home. Grocery shopping is also a common ADL. A purpose of physical therapy is to prepare individuals to return to their role as community dwellers as well as to complete necessary ADL. Stepper machines are frequently used in physical therapy practice for lower extremity conditioning and rehabilitation. Surface electrode electromyography (EMG) is a common method used to record the magnitude of muscle activity. Surface EMG has been found to be valid and reliable.

Methods
The participant was asked to walk a straight line; the leg used for step off was used as the testing leg. Surface EMG was used to record the activity of the vastus medialis (VM), rectus femoris (RF), and vastus lateralis (VL) muscles during negotiation of stairs as well as using a stepper machine with and without carrying a load. Subjects drew a colored marble to determine if they would begin on the stairs or stepper machine. The subjects were asked on either task to perform the first trail unloaded and to carry a load for the second trail. Subjects were not allowed to use the handrails for the stairs or stepper unless needed for safety. On the stairs, the subjects used the reciprocal gait pattern. Instructions were read before each activity, a demonstration performed, and then the participants completed the task. A metronome was set at 100 beats per minute to standardize the pace of the activities.

Results
The ANOVA for each muscle determined that there was no statistical difference found for the VM, RF, and VL muscle activity between the stepper loaded (SL) compared to the stepper unloaded (SUL) (P>0.05). The stepper machine has no descending component; therefore we could not compare descending stairs to the stepper machine. The activity of ascending stairs compared to the stepper machine loaded and unloaded showed no statistical difference (P>0.05). No statistical difference was found between ascending stairs unloaded (AUL) vs. ascending stairs loaded (AL) as well as between descending stairs unloaded (DUL) vs. descending stairs loaded (DL) (P>0.05).

Discussion/Conclusion
The results suggest that there is no significant difference in muscle activity when ascending stairs and when using the stepper machine; also, carrying a load while negotiating stairs or while using the stepper machine showed no difference in muscle activity. Since no difference was found, was the load great enough to challenge the muscles? Eccentric muscle activity during descending stairs may be the reason for the difference. Even though there was no significant difference between the muscle activities with each exercise, this suggests that stairs can be used as an efficient and effective tool for all therapeutic settings to improve muscle activity in the quadriceps.

Clinical Relevance
• Stairs are an efficient therapeutic tool to use in any physical therapy setting.
• The stairs involve both ascending and descending components that challenge the muscles both concentrically and eccentrically.
• The expense and lack of availability of a stepper machine in a home health or rural setting makes the stairs an ideal tool for physical therapy.

Subjects
Twenty volunteer subjects (10 males and 10 females) with no pathological conditions related to balance, human locomotion, or any cardiopulmonary dysfunctions participated in this study. The participants were between the ages of 23 and 30 (mean age=24.75, SD=1.8).

References