THE INFLUENCE OF POST-ACTIVATION POTENTIATION ON THE GLUTEUS MEDIIUS DURING A BOUT OF THERAPEUTIC EXERCISE
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INTRODUCTION
In the United States 10.9% of all doctor visits are primarily related to a musculoskeletal disorder. Of that, 80% are referred to physical therapy (PT) as the primary treatment. [2] Particularly, ailments that compromise the performance of activities of daily living are given special consideration with the restoration of mobility as a main focus, along with strength and motor control.

In previous studies the effectiveness of PT was examined. Rundell et al. analyzed the outcomes associated with PT and concluded that “greater use of active PT was most consistently related to the largest improvement in pain intensity.” [2] Components of physical therapy often times include modalities such as heat, cold, massage, electrical stimulation, manual therapy and exercise prescription. [3] Of these the exercise prescription has the greatest potential for change due to its inefficiencies.

The average treatment duration has been found to be 45-60 minute sessions over a period of six weeks. [3] Shortening this time frame will accelerate the recovery process while also reducing the cost of treatment. One way to decrease this time frame would be to increase the efficiency of the exercise prescription. The efficiency of the exercises can be viewed through surface electromyography (sEMG), which measures the activity of muscle. Muscular efficiency is manifested through a decrease in this variable, muscle activity. Being able to change this physiology to decrease muscle activity would result in an increase in muscular efficiency.

Post-Activation Potentiation (PAP) is a relatively new phenomenon that alters subsequent muscle activity [1]. In previous studies it has been shown to increase muscular efficiency producing muscle enhancements in many ballistic activities. If the PAP effect would be implemented in a clinical setting working with the general population, the goal of muscular efficient PT session could be achieved.

OBJECTIVE
The objective of the study was to quantify the difference between muscle activities during exercise over two days. One day with PAP effected muscle activity, the other being the control.

SUCCESS CRITERIA
To validate the objective we would like to see a decrease in muscle activity from the control to the PAP affected exercises.

METHOD
The study was designed to compare the maximum muscle activity and the total energy expenditure in a group of 10 healthy young adults. The subjects (age 21 ± 3.04 years) were consented and put through a physical examination prior to participation in the study. A surface electrode (sEMG) was placed on the gluteus medius and its location was verified using an oscilloscope. Data from the electrode was sampled at 2000 Hz. A cluster of markers was placed on the most lateral part of the lower leg and tracked by Vicon, a motion monitoring system, during the exercises. A data collection software, Motion Monitor, was used to capture the data from the sEMG and the cluster.

After the sEMG and the cluster were in place, the next step of the protocol was instructing the subject through a set of exercises. The same set of exercise was performed by the subject on two consecutive days. One day the exercises were preceded by a maximal voluntary isometric contraction (MVIC) which induced the PAP effect. The other day was a control. First, the set of exercises was started the same way both days, the subject would perform a set of 3 repetitions each of the three different exercise for normalization purposes. Next, was the MVIC (or not on the control day). The subject laid on their left side with a resistance band around their ankles, they then abducted their right leg against the band for ten seconds. Following the subject performed three sets of 10 repetitions of each exercise. The first exercise was clamshell, the second was leg lifts and the third was lateral side steps. The exercises have a two minute rest period between them.

During the exercise the surface electromyography was used to look at muscle activity and the cluster motion was recorded to capture the motion during activity. After two days of testing, the data was exported from Motion Monitor and analyzed using Matlab.

The data was filtered using high pass, low pass and band pass filters for noise. A linear envelope was then used to find the general trend of each set of exercises. From the trend line the peaks and the integral of each individual rep was found. P values for both variables of interest was calculated and was found to be statistically significant, p < 0.05.

RESULTS
When the data was compared between control and PAP sessions, there was a decrease in muscle activity. For the first exercise, clamshells, the decrease from control to PAP in peaks was 21.9% and the decrease in the integral was 13.0%, which can be seen in Figure 1.
Figure 1. This figure shows the average peak muscle activity from 10 subjects from the clamshell activity.

For leg lifts the percent difference was 15% for average peaks and 12% for the integral. For the band walks the decrease was 6% and the integral did not see a large change.

DISCUSSION
The results of this study supported our hypothesis and were within the constraints of our success criteria. The significance of the decrease in peak activity means that for the same exercise being performed the max muscle activity for each repetition was less after performing a PAP contraction. Because there was a decrease in the integral as well, that signifies an overall decrease in energy expenditure during the exercise after PAP contraction.

The decreases in activity means that the opportunity to implement PAP to clinical exercises is a possible method to increasing the efficiency of PT treatment.

The decrease in the percent difference through the exercise may be attributed to PAP effect being time dependent. As time goes on its effect can be seen to wear off. Because the exercises take 40 seconds each and there is a two minute rest between exercises, there is a significant amount of time between the MVIC and the last exercise.

The research was limited by the relatively new nature of PAP. There have not been many studies done on this effect in the clinical realm. Therefore it was difficult to state exactly the numerical value decrease we were searching for.

The future with PAP can be extensive. Additional studies can be done to investigate its effect on other muscles and then possible on more dynamic PT exercises.

CONCLUSION
Physical therapy is a very common prescription for people with musculoskeletal problems. Because of the length of time spent in PT the cost can be very expensive, therefore there needs to be a method to decrease time spent in clinic. PAP was studied as a method of decreasing this time by increasing the efficiency of the exercises done in the clinic. There was a significant decrease in muscle activity after subjects performed a PAP contraction. The effect of PAP is time dependent and decreases as time goes on.

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