

Understanding the Effects of Contingencies on Muscle Flexion: Comparing No-Feedback to Non-Contingent Feedback.

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BACKGROUND

Surface Electromyography (sEMG)

Surface electromyography (sEMG) is the study of electrical activity in superficial muscles. An sEMG device – the flexdot – was created by the lab and operates by relaying the electrical signal produced by a muscle as EMG values to a corresponding android application. In this particular study, the muscle used is the vastus medialis oblique (VMO) – a teardrop-shaped muscle near the knee.



Figure 1: The flexdot and the associated mobile application



Figure 2: The vastus medialis oblique (VMO)

Previous Studies

The flexdot android application produces “flex” and “relax” prompts as well as auditory feedback in the form of a tone. Previous studies used the flexdot to analyze the effects of contingent feedback on VMO amplitude where the tone would only be provided when the participant flexed to reach a certain EMG value (amplitude) set by the researcher.

Non - Contingent Feedback

Contrasting the experiments mentioned above, the current study utilizes non-contingent auditory feedback where tone delivery occurs at random intervals during each flexion and is independent of VMO amplitude.

The contingent feedback and non-contingent feedback studies serve a broader purpose as the results from both can assist researchers in crafting the optimal conditions for knee rehabilitation following total knee arthroplasty aka TKA (a surgical procedure to replace the knee)

Literature

- TKA is known to relieve knee pain associated with medical conditions such as knee osteoarthritis. However, failure to actively engage the quadricep muscles – which include the VMO – after surgery can result in long-term “muscle atrophy” and disability due to “preoperative weakness” and “postoperative strength loss” (2).
- It is crucial that physical therapy and rehabilitation exercises begin early in the healing process - ideally, “within 1-10 days” after hospital discharge (3)
- Past behavior analysis experiments have studied the influence of contingent, non-contingent, and no feedback on muscle activity. Specifically, an EMG biofeedback study considering “frontalis muscle tension” showed no contrast between the results for non-contingent and no-feedback participants (4).

RESEARCH OBJECTIVE

The purpose of this project is to analyze the difference in VMO amplitude between a no-feedback condition and a non-contingent feedback condition.

METHODS

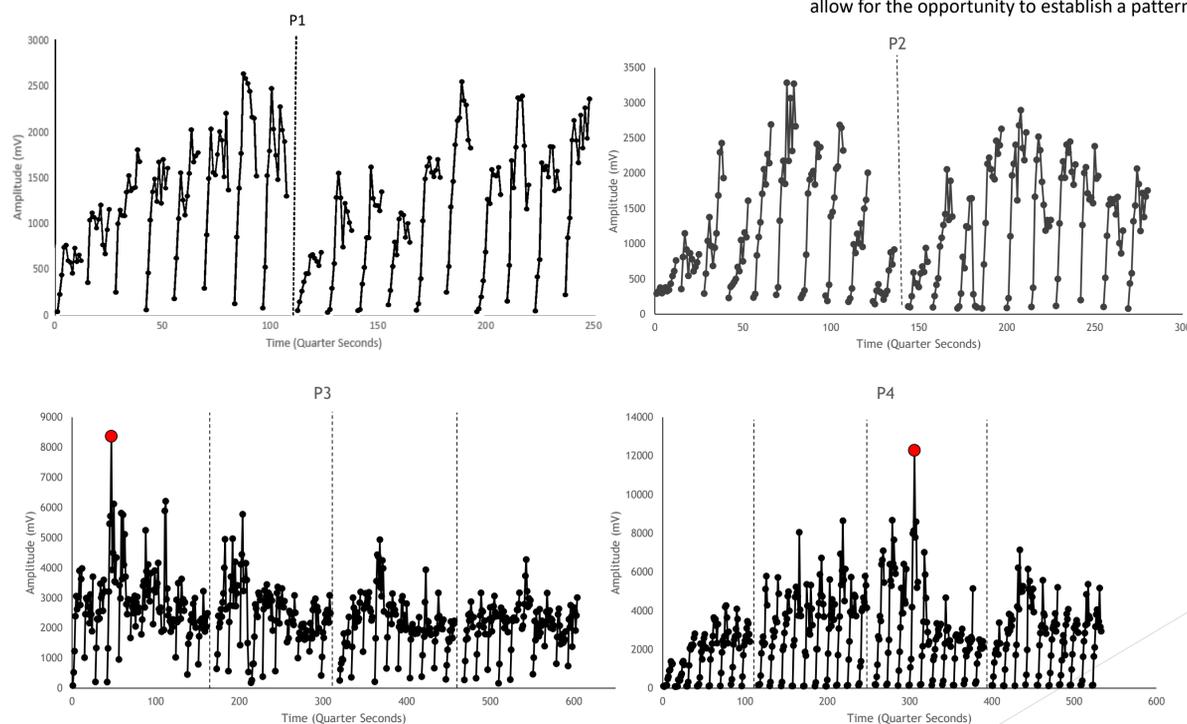
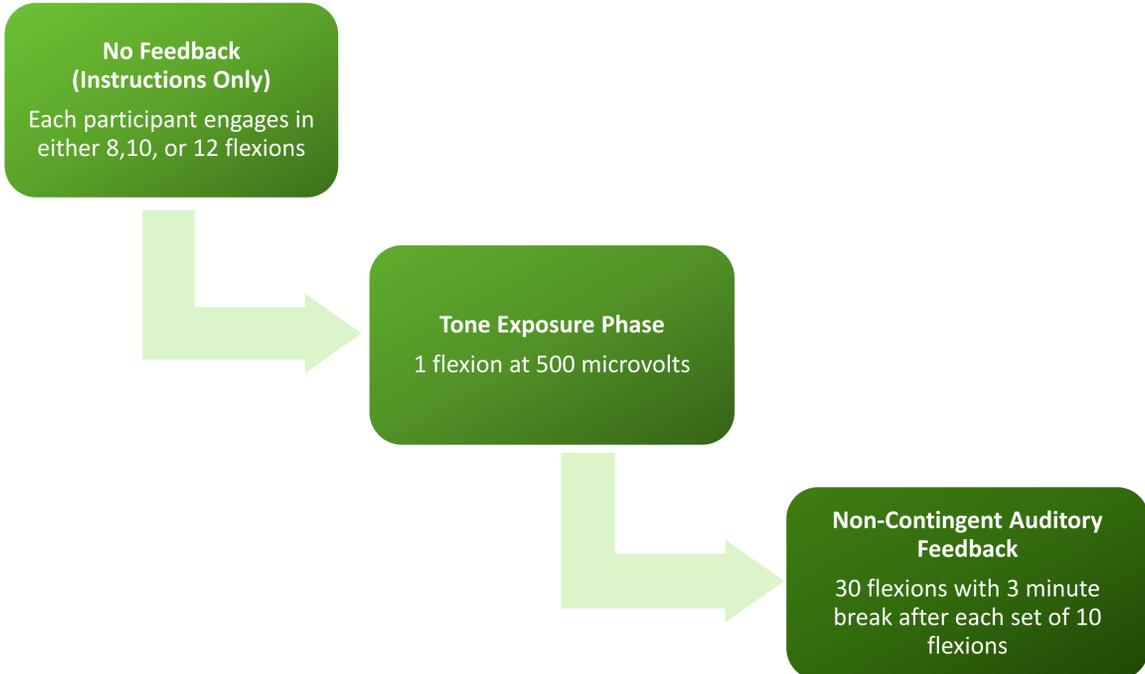


Figure 3: No-Feedback and Non-Contingent Feedback Data

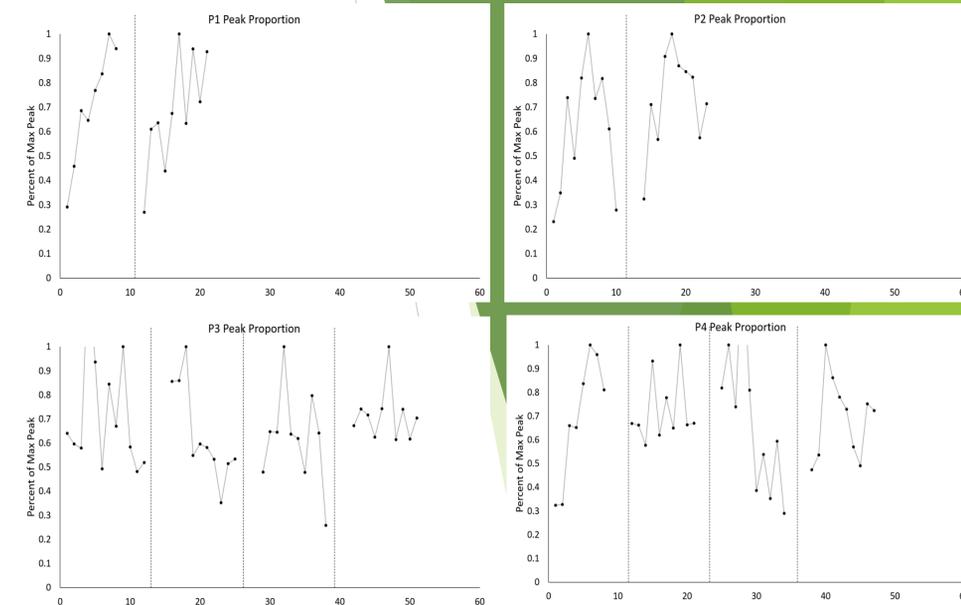


Figure 4: Peaks Proportion to Max Peak Data

RESULTS AND DISCUSSION

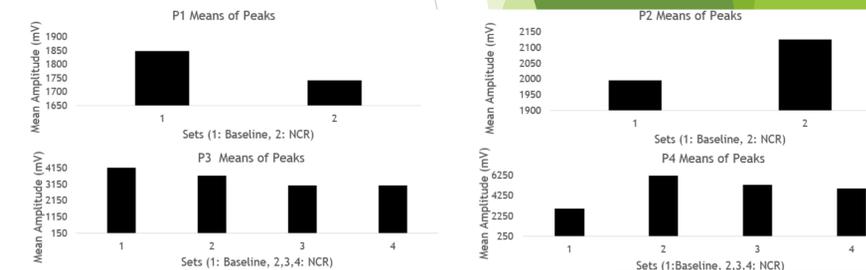


Figure 5: Means of Peaks Data

- The P1 through P3 waveform and peak proportion data display a pattern between the no-feedback and non-contingent feedback conditions for each respective participant. This pattern across a majority of the participants signifies little to no variation between the two conditions.
- However, the P4 EMG values do not show a pattern but, rather, signs of improvement in amplitude followed by fatigue, represented by the P4 waveform and mean peak data.
- The P1 and P3 mean peak data reflect a steady decrease in average amplitude over time (may be due to fatigue), and the P2 mean peak data reflects a slight increase in average amplitude.
- The study is ongoing with four to eight more participants to run, so the role of non-contingent feedback in VMO amplitude is yet to be established
- The implications of this study include understanding how the operant control of the VMO plays into creating the most effective contingencies for overall increase in amplitude and VMO strength.

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