Integration of EMG to assist with load tolerance treatment for post surgical knee patient: CASE STUDY

Introduction

Increasing tolerance to load is essential in post surgical patients looking to return to strength training and functional fitness. The addition of external load to the rehabilitative process is often accompanied by having the patient find their 1 or 10 repetition maximum and then base percentages off of that to allow for the proper dosage of exercise. Lifting at higher percentages of one rep maximum has been proven to be effective at building strength. However, with the complexity of pain, atrophy, and different body types affecting how the load is distributed through the musculture we hypothesize that utilizing FlexrGO as a topical EMG will allow for more critical clinical decision making. Generally, increased external load can elicit greater increases in EMG activity. Generally, changing the mechanics of a lift can elicit changes in EMG activity. The purpose of this particular case study was to determine if it was necessary to continue to increase external load or if remaining at a certain percentage of her one rep maximum allowed for similar EMG activity. In addition, we wanted to determine what affect changing the technique of her treatment exercise would have on the EMG activity of the quadriceps musculature. Through these two inferences, we can better guide our patient through rehabilitative care with increasing tolerance to load, developing hypertrophy after post-surgical atrophy, and providing biofeedback of her muscle activity in reference to any pain she may have.

Description of Patient

Patient is a fifteen year old female status 20 weeks post-surgical tibial tubercle osteotomy with a medial patellofemoral ligament reconstruction revision. At the time of the study patient had been full weight bearing for two months. Patient has reported anterior knee pain focused on the quadriceps tendon after the first two months of recovery. Doing those two months patient has been seeing a physical therapist for traditional strengthening post-surgical care such as single leg raises, quadriceps isometric holds, and eccentric step downs. Our plan of care with her has been the first introduction of weight training and external load following surgery.

Assessment and Diagnosis

Patient is 4 months post operative tibial tubercle osteotomy with a medial patellofemoral ligament reconstruction revision. Immediate concerns are of quadriceps atrophy of the involved extremity of greater than one inch diameter in locations superior to the patella comparatively to the uninvolved side.

Although our predominant treatments applied have been focused on posterior chain strengthening, we have begun implementing treatment specific to quadriceps activation and strength development with external load.

The two primary treatments used in combination with the FlexrGO were:

Single leg tripod box squats to an 18 inch box. This treatment involves the uninvolved slightly in front of the involved leg and maintaining little to no weight bearing while the involved leg performs a squat to an 18 inch box.

Goblet Squats. These squats are bilateral and involve holding a dumbbell in a vertical position while squatting to a depth where the legs are parallel to the ground.

Treatment Outcome

Utilizing the FlexrGO in combination with these movements provided an insight to adjustments that may prove beneficial in addition to a progressive overload strengthening program. The foot position and rotation of the lower leg had little to no effect on the amount of EMG activity the patient was presenting with during the activity.

The EMG activity with the goblet squats allowed us to see that despite having a heavier external load with the forty pound dumbbell, the patient did not elicit greater EMG activity with it compared to the twenty pound dumbbell. Knowing this may allow us to achieve greater volume of repetitions and weight moved during the goblet squat treatment to promote further hypertrophy and strength increases. This was consistent as seen by maximum EMG activity and average rate of contraction. There was a noted difference between air squats (with no external load) and the twenty-five pound dumbbell in EMG response. The difference between the twenty-five and forty pound dumbbell was non-significant.

Both of these observations from the feedback of the FlexrGO drove our clinical decision in a slightly different direction than if we did not have that real time feedback. The ability to make technical and load changes with the feedback of EMG activity allowed our prescription of exercise to be altered in a beneficial way for the patient.

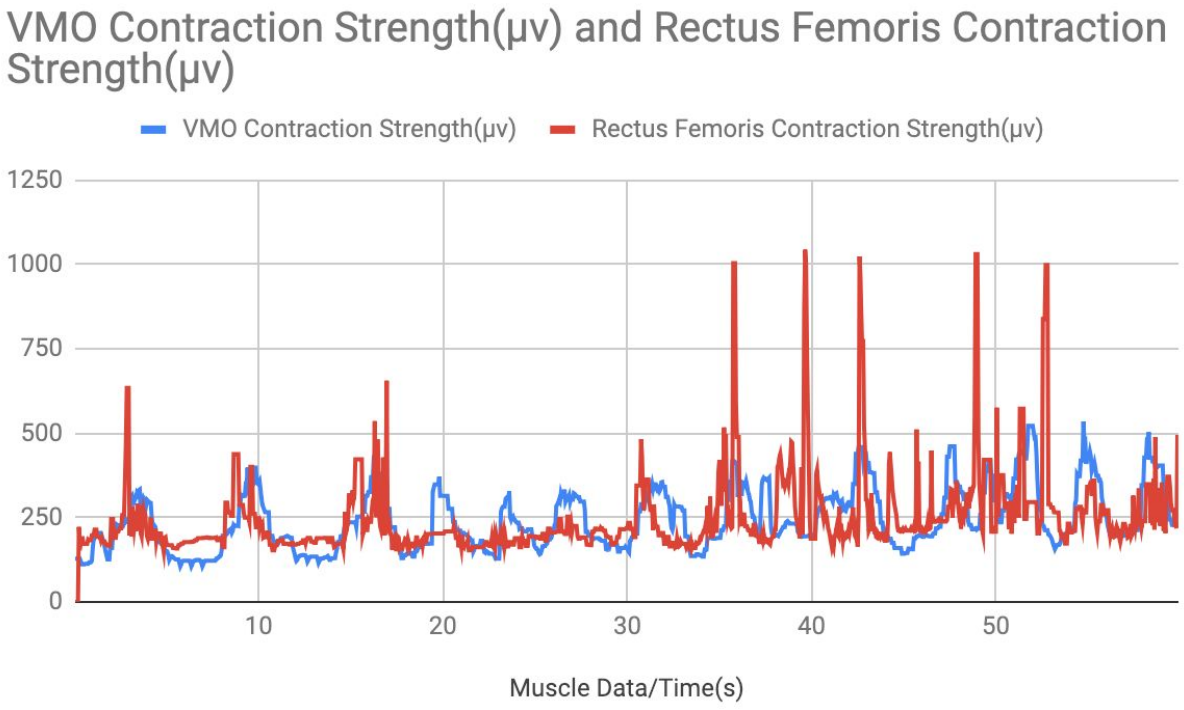

Fig 1.

In figure 1 above 3 peaks before the 20 second mark indicate three air squats performed. The 5 peaks after the thirty second mark indicate the 5 goblet squats performed with a 20 pound dumbbell. An increase in load sees an increase in EMG activity.

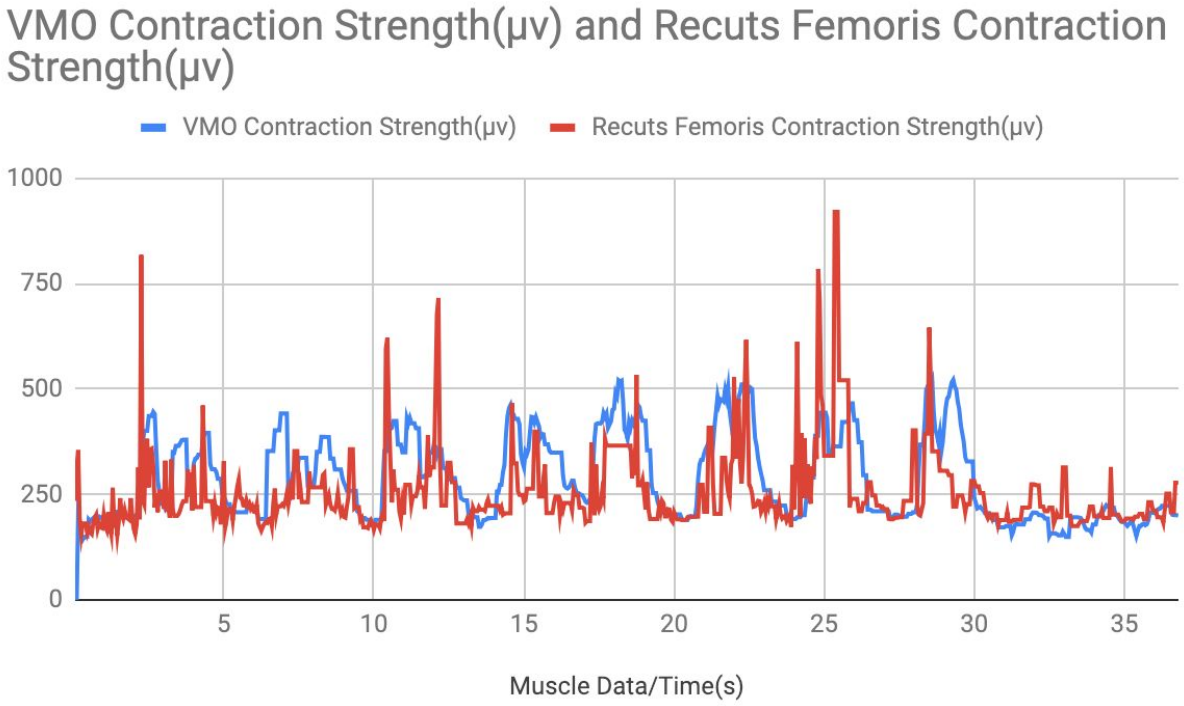

Fig 2.

In figure 2 above the patient performed 8 squats with the 40 pound dumbbell with varying degrees of consistency. An increase in load does not necessarily see a similar increase in EMG activity compared to the 20 pound dumbbell squats for the rectus femoris.

Discussion

The interaction between pain, movement, and external load is complex. This complexity within a treatment session can be daunting when attempting to determine what is the right prescription or dosage of exercise. Traditional physical therapy has likely underloaded patients, with bodyweight and theraband exercises not providing enough of a stimulus to do so, especially for those looking to return to sport or functional fitness. Utilizing external load and weight training can be dosed and prescribed to allow for that proper stimulus. However, without a sufficient history of training it may be difficult to determine what that proper dose is. Often times clinicians are left guessing or relying solely on the subjective (rate of perceived exertion) RPE of the patient. Although RPE can be a beneficial tool, a biofeedback tool for both the patient and the clinician in regards to EMG activity can allow for both technical and comfort changes when it comes to the prescription and dosage of exercise. Typically topical EMG has been utilized as a biofeedback tool for the patient, which in itself can be beneficial. This case study looked to utilize it both for the patient biofeedback and clinician biofeedback. The utilization of it for both parties gives a multitude of benefits in a team effort to help in the rehabilitative process.

The FlexrGO is intended for a quick set up and utilization within minutes. Multiple factors can affect this: From the pads placement on the patient, the battery life of the current units, or the bluetooth connection between those two. When those are in place, the system set up takes less than minutes but at times could be frustrating when having to troubleshoot one or more of those issues. We found that with more repetitions with the patient, the set up became easier, both from getting more consistent placement of the electrodes but also with following up on charging the units themselves. The iPad with FlexrGO app allowed for a great visualization for both us as clinicians and for the patient.

Conclusion

The treatment method of using the FlexrGO for both clinician and patient feedback was good and safe. In addition to being applicable to other patients it allows for a more precise clinical decision on load management and allows the patient and clinician to work as a team to determine the appropriate stimulus for recovery.

About Author:

Dr. Ryan Smith is the COO and Co-founder RECHARGE. He is a leading expert in postpartum health and return to fitness. He specializes in treating individuals who participate in CrossFit, olympic lifting, powerlifting, and other recreational sport activities. He also specializes in pelvic health therapy, utilizing an external approach that focuses on education and management of diastisis recti, pelvic organ prolapse, and postpartum issues. He is an avid supporter of the Senior Rehab Project and promoting individuals to strength train throughout their lifetime. Dr. Ryan is a former soccer player and wrestler. Dr. Ryan is originally from Wisconsin (yes he likes cheese) and currently resides in Ellicott City.

Dr. Ryan Smith
COO, RECHARGE LLC
Doctor of physical therapy
www.rechargexfit.com
Ryan@rechargexfit.com
443-583-7093