EFFECT OF THE EXTERNAL MUSCLE SYSTEM ON STRENGTH PERFORMANCE

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SUMMARY

Introduction: Stretch shortening cycle (SSC) involves storage of elastic strain energy in the muscle during contraction. The stored elastic strain energy during the eccentric contraction phase release in concentric contraction phase. External muscle system (EM) was designed according to the SSC theory. This study tried to investigate the effect of external muscle system on strength performance. **Method**: The rectus femoris EMG signal was collected to determine muscle activity using a self-designed external muscle system. The maximum joint torque of isokinetic movement and peak velocity of isotonic movement were measured in knee flexion movement. **Result**: The peak velocity of external muscle (EM) was higher than no external muscle (NEM). The RF muscle activity with EM was declined compared to NEM. **Conclusion**: The external muscle system has positive effect on muscle performance, but future studies need to focus on the optimum stiffness of external muscle system in different movements.

Key words: Electromyography, Muscle strength, Torque, Velocity

INTRODUCTION

Utilization of stretch shortening cycle (SSC) is characteristic for many human movements. SSC involves storage of elastic strain energy in the muscle during a contraction. The storage of elastic strain energy release during the concentric phase that immediately followed the eccentric phase. Activities such as running or jumping, the lower extremity muscles usually have this phenomenon [1, 2]. External muscle system was based on SSC theory to stored extra elastic strain energy in addition to muscle itself. The external force can increase the muscle strength via this extra elastic strain energy. The purpose of this study was to investigate the effect of the external muscle system on muscle strength.

METHODS

Three healthy male participants without any neuromuscular disorders in six months were recruited in the study. Electromyography of right rectus femoris (RF) muscle was recorded using Biopac system and acqknowledge 3.9.1 software. After the skin preparation, the bipolar electrode was placed on the midpoint of anterior superior iliac spine (ASIS) to superior aspect of patella. An isokinetic system (Biodex, USA) was used to measure the RF muscle strength and velocity. The participants were tested in seated position. The test range of motion of knee joint was set 0°-90° while 0° was defined as knee at neutral extension position. In isokinetic test, the angular velocity was set at 300°/s for five repetitions. Peak torque was normalized with body mass. In isotonic test, the resistance was set at 1N-M for five repetitions. The elastic band was fixed on lower extremity to simulate external muscle system. The original of the elastic band was fixed on the one-third posterior of RF muscle. Then the elastic band crossed the knee joint, the insertion of elastic band was fixed on the two-thirds posterior of tibia. The velcro and bandage were used to fix the elastic bands. All subjects did isotonic and isokinetics exercise with EM and NEM, the EMG signal was recorded at the same time. All data were compared with descriptive statistics.

RESULTS AND DISCUSSION

In isotonic test, the peak velocity of EM was higher than NEM (816.07 degree/s vs 814.00degree/s, Figure 1). The RF muscle activity with EM was decline compare to NEM (0.952 mv vs 1.344 mv, Figure 2). While the RF muscle activity of EM was lower, but the peak isotonic velocity of EM was higher. This result indicated that the external muscle system has the trend to enhance muscle performance by utilizing the extra stored elastic strain energy.

In isokinetic test, the peak torque with EM was lower than NEM (Figure 3). The RF muscle activity with EM was declined compared to NEM (Figure 4). Theoretically, the peak isokinetic torque should increase with EM, but it showed decreasing trend in current study. Future studies should have more participants with different stiffness of EM to clarify the effect of EM.

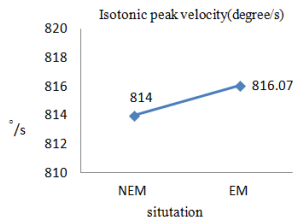

Figure 1: Isotonic peak velocity (degree/s)

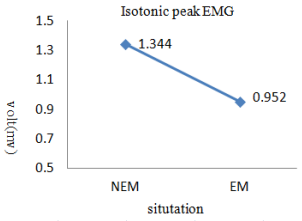

Figure 2: Isotonic peak EMG (Mv)

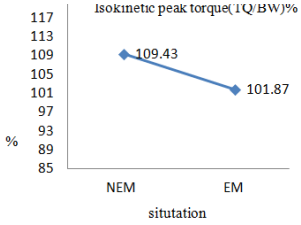

Figure3: Isokinetic peak torque of knee flexion (TQ/ BW %)

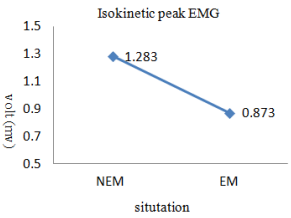

Figure 4: Isokinetic peak EMG (Mv)

CONCLUSIONS

The basic finding of current study indicated that a self-designed external muscle system may have positive effect of muscle performance, but future studies need to focus on the optimum stiffness of external muscle system in different movements.

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