COMPARISON OF THE EMG ACTIVITY BETWEEN PASSIVE REPEATED PLYOMETRIC HALF SQUAT AND TRADITIONAL ISOTONIC HAFT SQUAT

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The purpose of this study was to investigate neuromuscular characteristics of different method of strength training in lower extremity. Three healthy college males were the subjects in this experiment, the subjects' mean (±SD) age, height, and weight were 25±4.5 years, 172.33±15 cm, and 67.66±11.5 kg, respectively. All subjects attempt to perform Passive Repeated Plyometric half squat movement and traditional isotonic half squat movement. The results revealed that the IEMG of half squat performance by Passive Repeated Plyometric Training Machine in 60R.P.M. was significantly higher than traditional isotonic half squat performance in same speed. The findings of this study suggested that the Passive Repeated Plyometirc Training of lower extremity can significantly increase muscle strength and power than traditional training method.

KEY WORDS: passive repeated plyometric, electromyography

INTRODUCTION: Human muscle strength can be effectively increased by traditional resistance training with slow contraction velocities, but these methods often produce only small improvements in power production (Atha, 1981; Berger, 1962; Hakkinen, et.al 1985; Schmidtbleicher, et.al 1983). However, sporting activities involved striking, throwing, jumping, or high frequency rapid acceleration movements require a high power output of the involved muscles rather than high force production (Newton, et.al 1996). Coaches and athletes have modified training method in an attempt to develop explosive power rather than primarily maximal muscle strength. Besides, velocity of movement is an important factor to reach perfect performance. Therefore, The Passive Repeated Plyometric Training Machine (PRP Training Machine) was designed in order to reach the best power training effect. Passive Repeated Plyometric movement have been shown consisted of many characteristics that set them distinctly apart from other types of movement such as high velocity, high frequency movement under passive contraction. The mechanisms underlying the Passive Repeated Plyometric training effect may reside in both neural and muscular components. But the detail of the muscle activity Passive Repeated Plyometric movement still need investigation. The purposes of this study were to compare muscle activity between Passive Repeated Plyometric half squat movement and traditional half squat movement.

METHODS: Subjects: The subjects were three healthy college males who volunteered to take part in this study. The subjects' mean (±SD) age, height, and weight were 25±4.5 years, 172.33±15 cm, and 67.66±11.5 kg, respectively. And none of the subjects have any joint injury. All subjects attempted to perform Passive Repeated Plyometric squat movement by Passive Repeated Plyometric Training Machine, and traditional isotonic squat movement by the Cybex of Hack Squat Station.

Equipment: Passive Repeated Plyometric Training Machine allows Plyometric movement such as squat and bench press which can control the frequency of pedal and load in passive and repeated form (Figure 1). During entire test, each subject had four surface electrode modules attached on rectus femoris, caput longum of biceps femoris, tibialis anterior, and caput laterale of gastrocnemius. The electrode aligned parallel with the muscle fiber. Before electrode application, the skin surface of each muscle was shaved, cleaned with alcohol, and gently abraded, and a small amount of conductive gel was applied to each electrode. Preamplifiers were incorporated into the electrode modules with the signal being further amplified. The myoelectric signal was collected using Biopace system, MP100 and Acqknowledge (sampling rate was at 500Hz and recorded 6 seconds). All myoelectric signal were transformed to integrated electromyogram(IEMG), then the signal of 2-5 seconds of entire movement were stored in computer disk for later analysis.

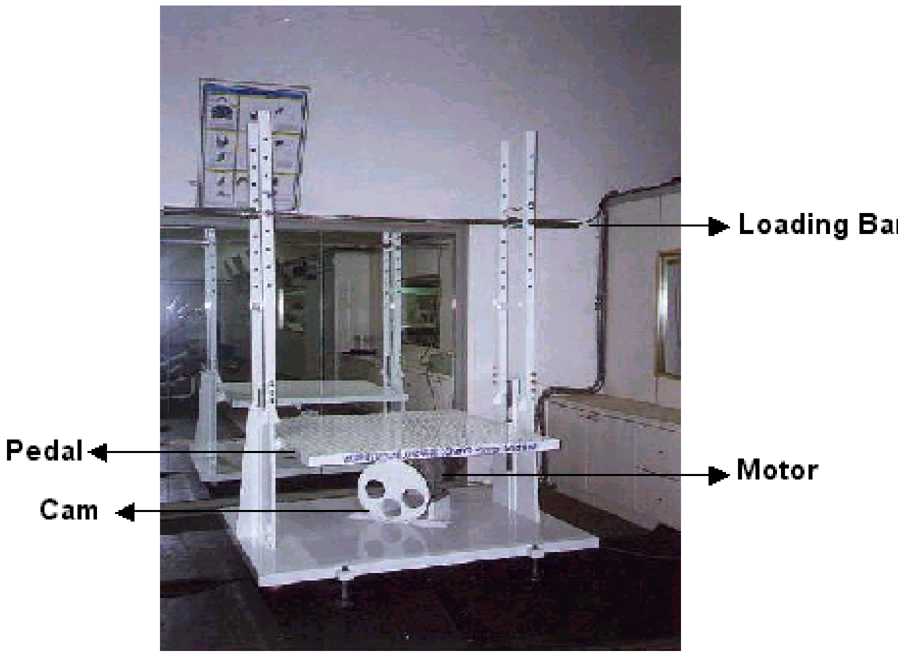

Figure 1 – The passive repeated plyometric training machine.

Figure 2 –Traditional weight training.

Figure 3 –PRP training.

Testing Procedures: Testing was conducted over two sessions. During first sessions, each subject was measured one repetition maximum (1RM) of load for the half squat by the Cybex of Hack Squat Station. The second session began with general warm-up involving three sets of 5 half squat at 10% of 1RM followed by 10 min of lower extremity static stretch. When completed warm-up, subjects attached the surface electrode at premier muscle. Two methods of half squat were then tested using 40% of 1RM as the load. The first was traditional half squat for which the subject was instructed to flex knee approximate to 90 degrees (Figure 2) then push the bar with 60 R.P.M. frequency for 10 seconds. The second was Passive Repeated Plyometric half squat which the subject followed Passive Repeated Plyometric Training Machine pedal movement(setting 60 R.P.M.) to perform half squat movement (Figure 3). Each test had 3 min rest to prevent neuromuscular system fatigue. The EMG data were collected in Biopac system, then transformed to integrated electromyogram by Acqknowledge software.

RESULTS: The integrated electromyogram signal of comparison illustration of major muscles were expressed at Figure 4. Left axis are integrated electromyogram signal of PRP half squat, and right axis are integrated electromyogram signal of traditional half squat.

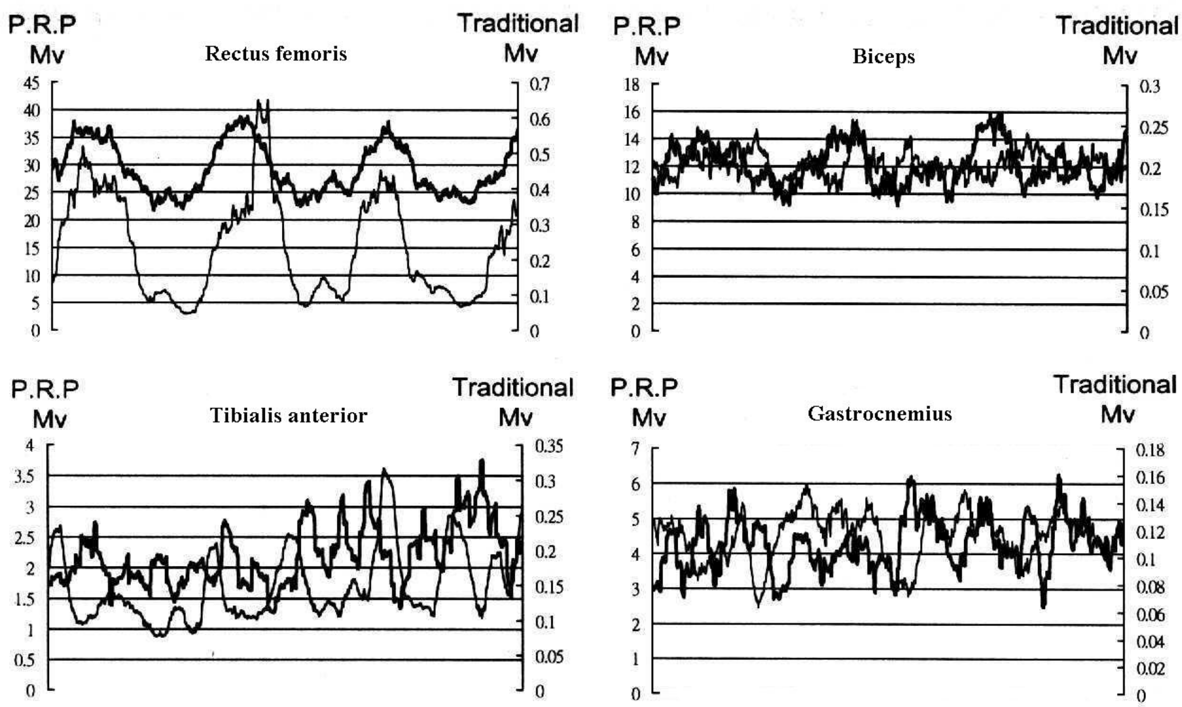

Figure 4- IEMG signal of rectus femoris , biceps femoris , tibialis anterior , and gastrocnemius during the PRP half squat and traditional half squat using 40% of 1RM load of 60 R.P.M. frequency. (— P.R.P. Traditional).

Table 1 Average IEMG During the PRP Half Squat and Traditional Half Squat Using 40% of 1RM Load with 60 R.P.M. Frequency (Unit: mv)

	Rectus femoris	Biceps femoris	Tibialis anterior	Gastrocnemius.
	M ± SD	M ± SD	M ± SD	M ± SD
PRP	22.04 ± 8.16	11.80 ± 3.19	5.30 ± 2.32	4.36 ± 0.95
Traditional	0.32 ± 0.17	0.24 ± 0.05	0.21 ± 0.12	0.22 ± 0.09

Significant differences between the Passive Repeated Plyometric half squat and traditional half squat were observed for integrated electromyogram in four muscles (Table 1). Integrated electromyogram of all muscles were significantly higher for the Passive Repeated Plyometyric half squat. Especially, rectus femoris had 22.04 mV of IEMG which is much higher than traditional half squat. The results show that PRP consisted of high velocity and high frequency movement which could efficiently increase muscle strength and power.

CONCLUSION: Plyometric and Ballistic types of training or activity simulating these contractions might be expected to induce very specific neuromuscular adaptations such as extremely high maximal motor-unit firing rates, brief EMG burst duration, and potential irregularities concerning the size principle of motor unit recruitment (Zehr, et.al 1994). Subjects performed Passive Repeated Plyometrc movement caused significantly higher EMG activity than traditional movement in this study which indicated that passive repeated plyometric training can efficiently cause neuromuscular adaptation. In conclusion, athletes could improve high velocity strength performance by Passive Repeated Plyometric training.

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