STUDY OF THE TRAINING EFFECT OF PASSIVE REPEATED PLYOMETRIC TRAINING MACHINE

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In order to train high level muscle power, the function of reflex stretch and phenomenon of stretch-shortening-cycle in neuromuscular system were used to design Passive Repeated Plyometric Training Machine (PRP Training Machine). This present study tried to compare the training effect of muscle strength and power between the PRP training method and the traditional isotonic weight training method. The results were analyzed by repeated measurement t-test revealed that both training methods could significantly increase muscle strength and power ($p<.05$). And the independent t-test showed that the effect of power training by PRP training was significantly better than the traditional isotonic weight training. The findings of this study suggested that the PRP Training Machine is an efficient training equipment for muscle strength and power.

KEY WORDS: power, strength, passive repeated plyometric, training effect

INTRODUCTION: Weight training is a major component to win the competition in all sports. In the pass years, there were various training methods for strength and power such as traditional concentric muscle contraction training, eccentric muscle contraction training, impact training, plyometric training and so on. The plyometirc training had been studied being able to improve muscle power or explosive muscle strength (Komi, 1984). Moreover, the previous studies had demonstrated that the plyomtric training was an efficient power training method for sports (Miller, 1982; Clutch et al, 1983; Brown, 1984; Stemm, 1993). In some sports, many movements required muscle contraction with high frequency to perform well, but most weight training methods couldn't reach that goal. For example, the 100M sprinters have to raise leg about five times per second. Most of the traditional training methods could not provide five actions per second in strength and power training. Therefore, in order to reach the best training effect, we have to use special technique to train muscle to match real movements in competition.

According to the descriptions above, the Passive Repeated Plyometric Training Machine (PRP Training Machine) were designed to reach the goal. The PRP training machine forced muscles concentric contracted and eccentric contracted passively. It would reduce the phenomenon of reflex stretch or stretch-shortening-cycle in neuromuscular system which could increase more strength and power (Asmussen & Bonde-Petersen, 1974). It was resulted from the storage of elastic energy before concentric contraction as well as muscle spindles were excited and gathered more motor units immediately. Therefore, this present study was designed to investigate and compare the training effect between Passive Repeated Plyometric training and traditional isotonic weight training methods.

METHODS: Fourteen college males voluntarily participated, and were appointed randomly into the experimental group and the control group. There were seven participants with mean age 23.28±3.40 years trained by the Passive Repeated Plyometric Training Machine (shown in Figure 1). The amplitude of the Passive Repeated Plyometric Training Machine was set 100 mm with 100 R.P.M. frequency. The training time was 20 seconds one set, four sets each time and two times a week during training period of six weeks. The loading of training was added 5% of the lower limbs maximum strength per week from 30% to 55%. The control group had seven participants with mean age 24.28±2.60 years and did traditional isotonic weight training by the Cybex of Hack Squat Station (shown in Figure 2). The training content was four sets each time and two times a week during six weeks. The train intensity of four sets were different that the first set was six repetitions with 70% of lower limbs maximum strength, the second set and the

third set were both five repetitions with 80% of lower limbs maximum strength, the fourth set was three repetitions with 90% of lower limbs maximum strength.

Figure 1 – PRP training machine.

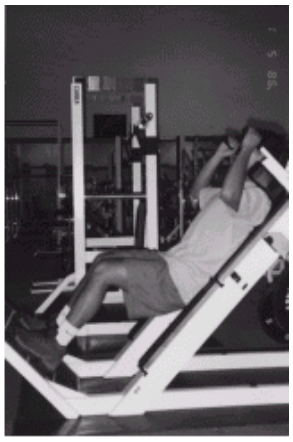

Figure 2–Traditional weight training.

Figure 3–The maximum strength test.

The lower limbs maximum strength and vertical jump were evaluated in pre-training and post-training period. The lower limbs maximum strength represented the muscle strength in present study. All subjects used their maximum strength to press the loading on the leg press of Cybex (shown in Figure 3). The best performance of vertical jump in three measurements represented the muscle power in present study. All subjects were tested without approach running and swing arms. SPSS for Windows was used to do the statistical analysis, and the repeat measurements t-test and independent samples t-test were employed to analyze the data. The significant levels was set at 0.05.

RESULTS AND DISCUSSION: The repeated measurements t-test were used to compare the training effect between passive repeated plyometric training and the traditional isotonic weight training after six weeks training period. In the passive repeated plyometric training group, the average pre-training lower limbs maximum strength was 165.89±19.02 kgw and the average vertical jump was 59.42±10.15 cm. The mean lower limbs maximum strength and vertical jump were 208.64±26.05 kgw and 65.28±8.47 cm in post-training. In the traditional isotonic weight

training, the average pre-training lower limbs maximum strength was 173.11±22.11 kgw and the average vertical jump was 59.25±6.21 cm. The mean lower limbs maximum strength and vertical jump were 205.22±29.82 kgw and 62.66±5.88 cm in post-training. The results revealed that both passive repeated plyometric training and the traditional isotonic weight training could significantly improve strength and power after six weeks training ($p<.05$)(shown in Figures 4 and 5). Previous studies already reported that the plyometric training could increase strength and performance of the vertical jump (Conroy, 1992; Villarrea, 1992; Stemm, 1993) which is similar to the results of this study. Besides, the passive repeated plyometric training could provide faster and better training effect on muscle strength and power. So, the passive repeated plyometic training is a new choice to increase muscle strength and power for athletes.

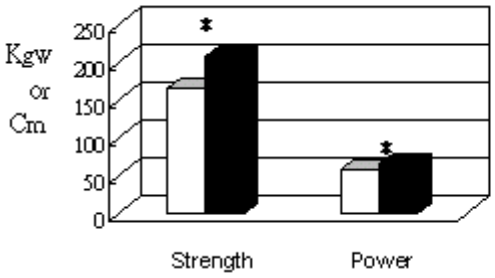

Figure 4 –The training effect of the Passive Repeated Plyometric Training method (□: pre-training ■: post-training) (*p<.05)

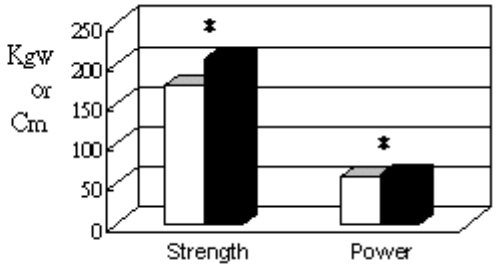

Figure 5 –The training effect of the traditional isomeric weight training method (□: pre-training ■: post-training) (*p<.05)

The independent t-test was used to compare training effect between passive repeated plyometric training and the traditional isotonic weight training. After the training period of six weeks, the strength and power were improved about 25.88% and 9.85% by the passive repeated plyometric training. And the strength and power were improved about 18.39% and 5.91% by the traditional isotonic weight training. The results of training effect of strength showed that there were no significant difference between the passive repeated plyometric training and the traditional isotonic weight training ($p>.05$). But training effect of power of the passive repeated plyometric training was significantly superior to the traditional isotonic weight training ($p<.05$). (shown in Table 1)

Table 1 Comparison to Training Effect between PRP Training and Traditional Training

	PRP training	traditional training	t
	M ± SD	M ± SD	
Strength (%)	25.88 ± 9.24	18.39 ± 3.95	1.838
Power (%)	9.85 ± 3.75	5.91 ± 1.69	2.516*

*p<.05, n=14

On the other hand, the training time of the passive repeated plyometric training was less than the traditional weight training. So the passive repeated plyometric training was an efficient weight training method which not only in training effect, but also in saving training time. The results of present study were agree with previous studies by Miller(1982), Clutch et al(1983), Brown(1984) and Stemm(1993) which reported that the plyometric training is superior to the traditional weight training or non-weight training in muscle power.

These findings showed that plyometric training with stretch-shortening-cycle could increase more power than just the training of muscle concentric contraction (O'Bryant, 1985). Many sports, such as track and field, taekwondo, and volleyball need high level muscle power, especially in lower limbs. The passive plyometric movements could reduce the phenomenon of

the stretch-shortening-cycle which could match the real movements in competitions. And the muscle of lower limbs would reduce adaptation of neuromuscular to excite more motor neuron during the passive repeated plyometric movement.

CONCLUSION: Passive repeated plyometric training and traditional isotonic weight training could significantly improve muscle strength and power after six weeks training ($p<.05$). Passive repeated plyometric training was significantly superior to the traditional isotonic weight training in the training effect of power, but no significant difference was found in the training effect of strength ($p<.05$). These findings suggested that the passive repeated plyometric training was an efficient weight training method which not only in training effect, but also in saving training time. So the passive repeated plyometric training could be applied to increase strength and power especially for those athletes whose muscle power is essential in their sports.

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