A Preliminary Study

Effects of Imagery-Weight Exercise

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Objective: *To study the effects of imagery-weight exercise on muscle strength.*
Material and Method: *Preliminary study of a before and after designed experiment was conducted at the Department of Rehabilitation Medicine, King Chulalongkorn Memorial Hospital, Bangkok, from June to September 2004. Fifteen healthy sedentary volunteers: 5 males, 10 females, mean age 28.7 $\pm$ 3.5 years were enrolled. The participants were instructed to perform imagery-weight exercise training with their non-dominant arms. The program consisted of 3 sets of 10 repetitions of elbow flexion, 3 days/week, for 8 weeks. The arm muscles strength were assessed with computerized isotonic machine. One-Repetition Maximum (1-RM) at before and after the training program, was compared.*
Results: *The mean 1-RM of elbow flexors increased by 44.9% (from 6.78 $\pm$ 2.10 kg to 9.83 $\pm$ 2.32 kg, p = 0.000). The mean 1-RM of elbow extensors increased by 32.0% (from 4.03 $\pm$ 1.98 kg to 5.33 $\pm$ 2.32 kg, p = 0.000).*
Conclusion: *Imagery-weight exercise is another effective technique of low impact strength training.*

Keywords: *Exercise, Strength training, Muscle, Imagery*

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Strength training is essential in sports and rehabilitation programs. It contributes power and muscular strength needed in sports activities and activities of daily living. It is now recommended for most chronic medical conditions as a part of therapeutic exercise[1-5]. To develop strength, the muscles have to be overloaded enough to induce adaptation[4-6]. There are many types of exercises prescribed for strength train-ing that induces muscle contraction in different ways: isometric, isotonic, or isokinetic. The use of free weight or resistance machine is limited in some cardiovascular conditions, especially when exercise with upper ex-tremities that may induce hypertensive response[4]. In addition, inappropriate use of weight training equip-ments may result in musculoskeletal injuries[7,8]. Although isometric exercise is safe and easy to train, it has disadvantage in its angle specific property[2,4]. Furthermore, an isokinetic machine is expensive and inconvenient for most people.

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There are reports about motor imagery and mental practice used in sports training[9-11] and in neurological rehabilitation[12-14]. They reported the important role of cognitive motivation in enhancing physical performance. These lead us to question whether imagery weight training could be used instead of real weight, as it would be an alternative way of strengthening exercise with minimal risk of injury.

The present objective of this preliminary research was to study the effects of exercise training using imagery-weight on muscular strength.

Material and Method

The present study was conducted at the Department of Rehabilitation Medicine, Faculty of Medicine, Chulalongkorn University from June to September 2004. The research proposal was approved by the Ethics Committee of the Faculty of Medicine, Chulalongkorn University. The subjects were recruited from the white collar workers aged 25-40 of King Chulalongkorn Memorial Hospital. All were sedentary and had not been engaged in any exercise program for

at least six months. The subjects were fully informed about the protocol, contra-indications for exercise were excluded, and informed consents were signed before starting the program.

The non-dominant elbow flexors and elbow extensors strength were assessed with computerized isotonic machine before starting the training. Each muscle group was tested three times, and the mean 1-Repetition Maximum (1-RM) of the muscles in kilograms were recorded.

The subjects were instructed to exercise their non-dominant arm in a sitting position with their elbow resting on their lap. While slowly flexing the elbow, they had to imagine that they were lifting the heaviest weight they could until reaching full flexion within 5-6 seconds, then relaxing to the start position before repeating another round of exercise.

Surface electromyography electrodes were applied on elbow flexors and extensors to detect active muscle contraction during elbow flexion. The EMG tracing obtained during imagery-weight exercise were compared with the tracing obtained during real-weight lifting (isotonic exercise).

The supervised training program consisted of 3 sets of 10 repetitions of elbow flexion, with 1-minute rest between the sets, 3 times/week, for 8 weeks. The subjects had to perform the exercise correctly, and attend the sessions for not less than 80% of the program; otherwise he/she would be excluded from the present study. After having finished each exercise session, the researcher would interview the subjects about their feelings, symptoms, and satisfaction.

At the end of the training program, the arm muscles strength of each subject were re-assessed. The 1-RM of elbow flexors and elbow extensors at before and after exercise training were compared using paired t-test, with a level of significance at $p < 0.01$ and 95%CI. The data was analyzed by using SPSS program for windows version 11.0.

Results

Fifteen participants enrolled in the present study, 5 males and 10 females. Their average age was 28.7 ± 3.5 years, with mean height of 165 ± 8.8 cm, mean weight of 61.2 ± 14.0 kg, and mean BMI of 22.33 ± 4.1 kg/m^2.

Using surface EMG in studying arm muscles, it was found that both the elbow flexors and extensors had actively simultaneous contraction during imagery-weight exercises. In contrast with 4 kg weight lifting (approximated to 10-RM of the same subject) in the same position, the elbow flexors were mainly active while the elbow extensors remained silent (Fig. 1).

Comparing the muscle strength between before and after the training program, the mean 1-RM of elbow flexors showed significant change from 6.78 ± 2.1 kg. to 9.83 ± 2.32 kg ($p = 0.00$, 95%CI -3.6, -2.5), which was a 44.94% improvement. The mean 1-RM of elbow extensors had significantly changed from 4.03 ± 1.98 kg to 5.33 ± 2.32 kg ($p = 0.00$, 95%CI -1.8, -0.8), which was a 32.09% improvement. These results are shown in Table 1.

Each exercise session last about 5 minutes. All participants could follow and finish the program. The mean attending time was 87% of the full program duration. Most of them experienced mild muscle soreness during the last few minutes of the exercise session, which resolved within 1-2 minutes of rest. No

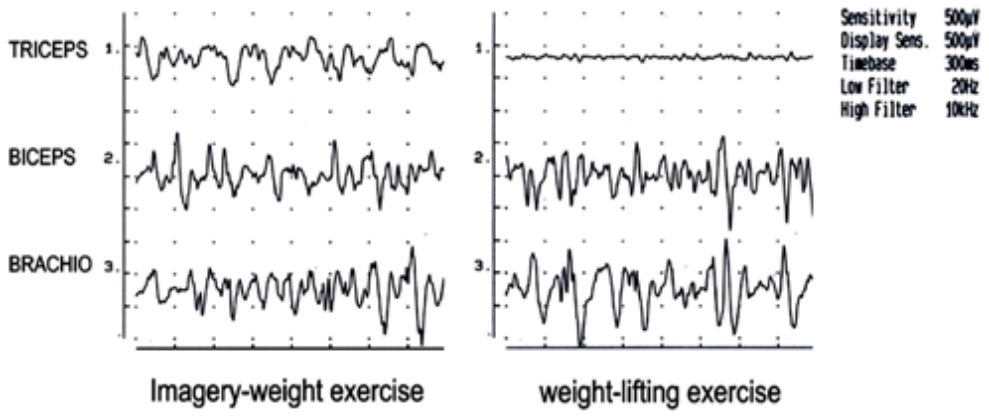

Fig. 1 EMG study of arm muscles: triceps brachii, biceps brachii, and brachioradialis during elbow flexion while performing imagery-weight exercise and weight lifting (isotonic) exercise in the same position

Table1. Elbow muscles strength at before and after training program (n = 15)

Muscles	Mean (SD) 1-RM (kg)		Mean difference		p-value	95%CI
	Before	After	Kg	%		
Elbow Flexors	6.78 (2.10)	9.83 (2.23)	3.05 (0.99)	44.94	0.000	-3.6, -2.5
Elbow Extensors	4.03 (1.98)	5.33 (2.23)	1.29 (0.83)	32.09	0.000	-1.8, -0.8

other side effects were reported. Every subject was satisfied with the program that it was easy to perform and required a short period of time.

Discussion

Imagery-weight exercise produces intense muscle contraction of the arm muscles similar to isometric type throughout the range of motion they perform. To imagine weight lifting helps the participants to develop high intensity muscle contraction and is easier than exercise with conventional methods. The intensity of muscle contraction depends on motivation and experience of each person to recruit his/her motor units.

As shown by surface EMG, the elbow flexors and elbow extensors were active in different percentages. The intensity of muscle contraction depends on motivation and experience of each person to recruit his/her own motor units. It is different from the conventional isotonic contraction that only the elbow flexors are active, and the intensity depends on the external resistance applied. Repeated contractions resulted in muscle soreness as usually found in an aerobic exercise, followed by muscle adaptation and strength gain.

About 30%-40% strength improvement resulted at the end of the 8 weeks training program. This is comparable to the study of Taaffe et al[15] that used isotonic exercise in older adults at 80% 1RM x 8 repetitions x 1-3 days/week x 24 weeks, and resulted in 37-40% strength gain. While McBride et al [16] reported 15% strength gain in sedentary subjects who underwent 10RM weight training x 6 sets/day x 2 days/week x 12 week program. Also the study of Harber et al [17] reported 15-42% strength improvement in untrained men who underwent circuit weight training three days/week x 10 weeks. Another study of Seynnes et al[18] reported results of two different intensities of progressive resistance training programs in the elderly. The programs consisted of 3 sets of 8 repetitions x 3 days/week x 10 weeks; the group used 40% 1RM (low-moderate intensity) gained 37%, while the group used 80% 1RM (high intensity) gained 61% strength improvement. These suggested that the presented imagery-weight training (3 sets of 10 repetitions x 3 days/week x 8 weeks) is equivalent to low-moderate intensity of strengthening exercise program.

The strength training is now well accepted and often prescribed as an essential part for health related physically fitness, for disease prevention and rehabilitation after orthopedic injuries[19-24]. The advantages of imagery-weight training are its brief and simple technique, the whole limb muscles could exercise simultaneously, and no external resistance or equipment is needed. The intensity used for exercise needs no adjustment, since the muscle could progressively increase its intensity by itself when the strength is gained day by day. It is, therefore, safe from musculoskeletal injury, but needs more intension to breathe regularly during exercise to avoid valsalva effect. Further study about physiologic responses and adaptations in other populations has been planned.

Conclusion

Eight weeks of imagery-weight training program resulted in 30-40% arm muscles strength gain in sedentary adults. It is easy to perform, with good adherence and no serious side effects. This could be another choice of low impact exercise for most people, including the elderly and post sports injured persons.

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ผลของการออกกำลังกายตามมโนภาพ: การศึกษาเบื้องต้น

ดุจใจ ชัยวานิชศิริ, สริสา แตงแก้วฟ้า, ศิริพร จันทร์ฉาย, เสก อักษรานุเคราะห์

วัตถุประสงค์: *เพื่อศึกษาผลของการออกกำลังกายตามมโนภาพต่อความแข็งแรงของกล้ามเนื้อ*

วัสดุและวิธีการ: *ทำการทดลองเบื้องต้น ศึกษาเปรียบเทียบชนิดก่อน-หลัง ที่ฝ่ายเวชศาสตร์ฟื้นฟู ร.พ.จุฬาลงกรณ์ ระหว่างเดือนมิถุนายนถึงกันยายน พ.ศ. 2547 โดยใช้อาสาสมัครสุขภาพดีจากบุคลากร ร.พ.จุฬาลงกรณ์ จำนวน 15 คน: ชาย 5 หญิง 10 อายุเฉลี่ย 28.7 $\pm$ 3.5 ปี สอนให้อาสาสมัครออกกำลังกายตามมโนภาพด้วยการงอศอกแขนข้างไม่ถนัด 10 ครั้ง x 3 รอบ, 3 วัน/สัปดาห์ เป็นเวลา 8 สัปดาห์ ตรวจวัดความแข็งแรงของกล้ามเนื้อด้วยเครื่อง Computerized Isotonic Machine เปรียบเทียบค่าเฉลี่ย one-repetition maximum (1-RM) ก่อนและหลังออกกำลังกาย*

ผลการศึกษา: *ค่าเฉลี่ย1-RM ของกล้ามเนื้องอศอกเพิ่มขึ้น 44.9% (จาก 6.78 $\pm$ 2.10 กก. เป็น 9.83 $\pm$ 2.32 กก. p = 0.000) ค่าเฉลี่ย1-RM ของกล้ามเนื้อเหยียดศอกเพิ่มขึ้น 32.0% (จาก 4.03 $\pm$ 1.98 กก. เป็น 5.33 $\pm$ 2.32 กก. p = 0.000)*

สรุป: *การออกกำลังกายตามมโนภาพเป็นอีกทางเลือกในการเพิ่มกำลังกล้ามเนื้อแบบไม่มีแรงกระแทก*