

Assessment of Isokinetic Muscle Power in Chronic Poliomyelitis

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ABSTRACT

The aim of this study was to evaluate the effect of training program on muscle power in chronic poliomyelitic patients. Twenty poliomyelitic patients, ranging in age from 11 to 15 years were included in this study. These patients were involved in a training program comprising throwing events. They were evaluated before and after the training program that continued for 3 successive months. The Universal Gym equipment was used to assess the muscle power. The results collected after the termination of the suggested period of training revealed a significant improvement in the power of the muscles tested by the low pulley (trapezius and deltoid), and biceps/triceps machines. Significant increase was also found in the muscle tested by chest press machine (chest muscles, arm muscles and upper trunk muscles). No significant improvement was recorded in the muscle evaluated by back rotary (obloquies abdomenus) machine.

INTRODUCTION

Isokinetic instrument has been employed almost exclusively for assessing the performance of voluntary contracting muscles. It is also possible to use isokinetic instrument for measuring muscle performance¹⁰. At the most fundamental level, disablement reflects the consequences of advance health experiences that may be identified as diseases, disorders and losses e.g amputations¹⁷. The two most important intrinsic influences on disablement experience are the age and the nature of the underlying diseases or disorder. WHO¹⁸ defined disability as "any restriction or lack (resulting from an impairment) of the ability to perform an activity in a manner or within the range considered normal for human being". The disability may be congenital or may be as a result of accident or diseases including those

individuals with organic, muscular and neurological conditions that affect motor activity. Some persons are handicapped by only one disability while others are multi handicapped¹. Other types of disability may occur in young adulthood. Until recently, persistent muscle wasting was the most common sequely of paralytic poliomyelitis. According to Strohkendl, the functional approach which is based on the adjustment of certified classifiers supplemented where necessary by strength measurements and influenced by the quality and quantity of active muscle plus the ability of the disabled to perform various sport specific task.. For poliomyelitic patients, classification based simply upon muscle strength is considered indeed of substantial advantage¹⁴. Conditioning exercises are utilized in sport medicine to attain and maintain a high level of physical readiness which is required for top athletes in

order to achieve optimum or near optimum physical fitness². The role of exercise in adolescents has been discussed by McKeag⁹ including the consideration of conditioning and training guidelines for this age group. He reported that training should be sport specific with a specific conditioning program emphasizing the energy systems and particular sport. The basic requirements of an exercise program for the disabled are the same as those for non disabled. According to Cantu⁴, each exercise program should have three parts: a warm up period, endurance phase, and a cooling off period. The method by which muscular strength was assessed has been changed significantly in the last few years. Isokinetic muscle power assessment is the most objective method of assessment as reported by Wilk¹⁵. Isokinetic strength is defined as the maximal contraction of the muscle group at a constant speed throughout the full range of movement. The resistance device is controlled at a fixed speed which is a unique factor in the concept of isokinetic strength¹⁶.

SUBJECTS, MATERIALS AND METHODS

SUBJECTS

- ◆ The present work included 20 adolescent poliomyelitic athletes participating in throwing events (Javelin throwing and shot put) at the National and International levels.
- ◆ Their ages ranged from 11 to 15 years with a mean value of 13.1 years
- ◆ They were ambulant using crutches or braces, having normal functional in the throwing arm, but moderate trunk and lower limbs disability which reduce their functional motor ability, also with moderate sitting balance.

- ◆ All the subjects participated in the competitions (throwing) while sitting on wheel chairs well stabilized to the ground.
- ◆ The subjects were selected from the Olympic Sport Medicine Center Maddi, Cairo.

MATERIALS

- ◆ The Universal Gym equipment INC 930 27 TH A.V.S.W. was used for training.
- ◆ The FITNET machines was used to evaluate the muscle power in this study and included: low pulley (L.P.), Biceps / triceps (B.T), Chest press (C.P). finally Back Rotary (B.R.) machines.

METHODS

All the subjects received conditioning exercise program modified from Cantu⁴ including three phases:

- 1) Warm up phase (8-10 min), this phase included rhythmic, slow, stretching movements of the trunk and limb muscles preparing the body for the sustained activity of the main exercises (endurance phase).
- 2) Endurance phase (about two hours), This phase included specific training conditioning program which is for the different throwing events, in addition to isokinetic muscle training for the different upper trunk and upper limb muscle e.g. trapezius, rectus abdominous, erector muscles of the back, chest and upper back muscles and also biceps/triceps muscles of the upper limbs.
- 3) Cooling period (7-10 min), this phase included slow and gross body movements similar to those of warming up phase, that emphasize range of

motion of the joints including calisthenics.

The average training period was 2-3 hours conducted 3 times/week

METHODS OF EVALUATION

◆ Evaluation was conducted before the training period and three month later, after termination of training period.

◆ Isokinetic test was performed at pre-set speeds using different FITNET machines to evaluate the muscle power of the different muscles selected in this study. Each test was repeated three times and the average power was calculated and recorded.

Low Pulley (L.P.) machine was designed to test trapezius and deltoid muscles and adjusted at 64 degree/sec, Biceps/Triceps (B.T) machine was adjusted at 80 degrees/sec to assess the biceps and triceps muscles, Chest Press (C.P.) machine was used to evaluate the muscle of the chest and arms and upper back and it was adjusted at 64 degree/sec. finally Back Rotary (B.R.) was used to test oblique and lower back muscles at a speed of 90 degree/sec.

RESULTS

The results revealed significant improvement in power of the muscle tested by low pulley machine as shown in table (1) and Fig (1), when comparing the pre and post training results, where the mean value pre training was 172.7 ± 55.8 watts and 210.95 ± 72.7 watts post training.

Table (1): Muscle power in watts as tested by low pulley machine pre and post training.

Low Pulley	Mean	Standard Deviation	t	p
Pre	172.7	± 55.8	2.229	$p < 0.05$
Post	210.95	± 72.7		

t= student t-test

p= probability level

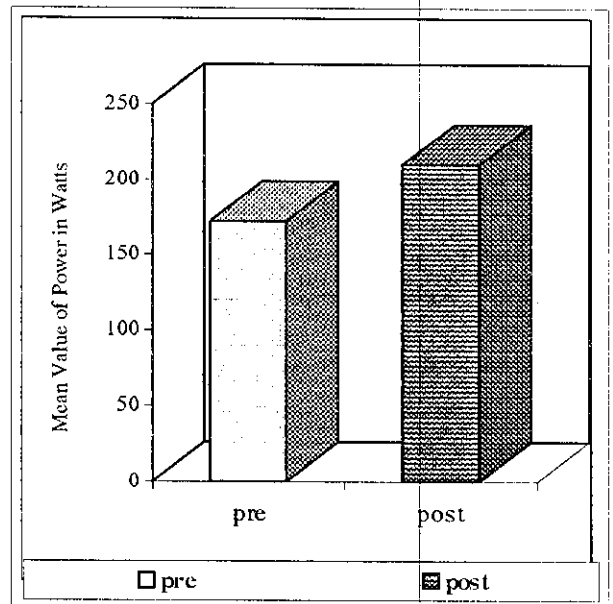


Fig (1): Mean values of muscle power for different muscles tested by low Pulley machine

Comparing the pre and post training mean values of the power of the muscles tested by the biceps / triceps machine as shown in table (2) and Fig (2), revealed significant improvement at ($P < 0.05$) where the mean value pre training was 111.65 ± 27.7 watts and 114.1 ± 23.7 watts post training.

Table (2): Muscle power in watts as tested by biceps / triceps machine pre and post training.

Biceps/ triceps	mean	Standard Deviation	t	p
Pre	111.65	± 27.7	3.8779	p < 0.05
Post	114.1	± 23.7		

t= student t-test

p= probability level

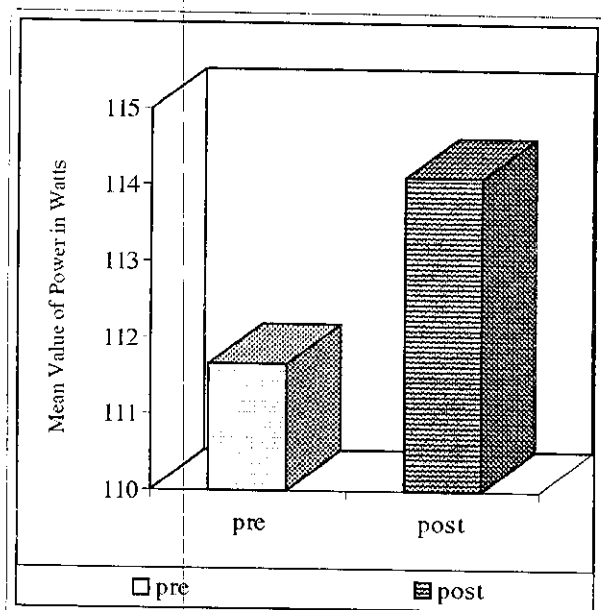


Fig (2): Mean values of muscle power for muscles tested by Biceps/ Triceps machine.

As shown in table (3) and Fig (3), comparison of the mean values of the power of the muscles tested by the chest press machine revealed significant improvement ($P < 0.05$) where the mean value pre training was 209.3 ± 53.6 watts and 241.8 ± 51.0 watts post training.

Table (3): Muscle power as tested by Chest press machine pre and post training.

Chest press	mean	Standard Deviation	t	p
Pre	209.3	± 53.6	1.9151	p < 0.05
Post	241.8	± 51.0		

t= student t-test

p= probability level

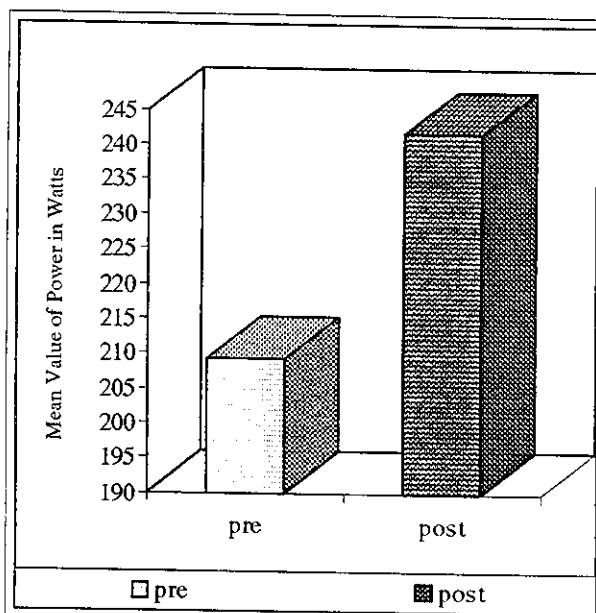


Fig (3): Mean values of muscle power for muscles tested by Chest Press machine.

Inspection of table (4) and Fig (4), revealed non significant improvement in power of the muscle tested by Back Rotary machine when comparing the pre and post training results.

Table (4): Muscle power tested by Back Rotary machine pre and post training.

Back Rotary	mean	Standard Deviation	t	p
Pre	52.6	±19.9	1.4943	p > 0.05
Post	63.15	± 42.0		

t= student t-test

p= probability level

where the mean value pre training was 52.6 ± 19.9 watts and 63.15 ± 42.0 watts post training.

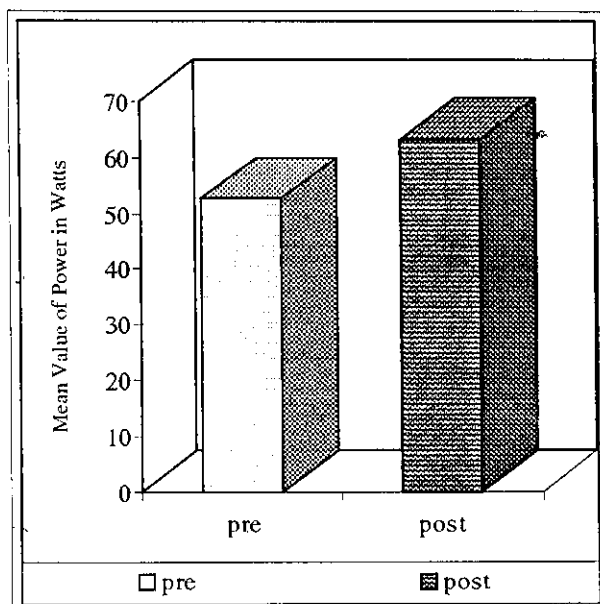


Fig (4): mean values of muscle power for different muscles tested by Back Rotary machine.

DISCUSSION

The idea of prescribing a deliberate increase of physical activity for the disabled is of quiet recent origin. In the past active recreation was

considered as the irresponsible waste of a limited energy store, so that the disabled was confined to institutions where physical activity was kept to minimum³. However, Stewart generally recognized that a carefully graded increase of physical activity can make an improvement contribution to the immediate health, life satisfaction and life expectancy of the disabled¹³. An isokinetic is an instrument which control the velocity of a moving limb, keeping it at a constant rate, while accommodating maximum resistance as the part moves through the range. The use of an isokinetic during a motor control assessment allows the therapist to monitor several important characteristics of muscles performance⁷. The Universal Gym Equipment which was used in this study to assess and train the muscle functions is one of the most advanced electronic resistive exercise systems, it is so flexible to meet all the requirements of the study, as it meets the needs of the variety of conditioning exercise programs. The reliability, validity and stability obtained from the isokinetic tests are of great importance in ensuring accuracy of measures. It should be also noted that through isokinetic exercises an individual will never meet more resistance than he can handle because the resistance is equal to the force applied¹⁶. So isokinetic contraction is superior to isometric and isotonic contractions because it offers maximal resistance to the muscle throughout the full range of motion⁸. Totally accommodating resistance is the phrase that defines isokinetic ability to provide a resistance at every degree in the range of motion that is equal to the muscle's ability to perform.

Comparing the mean values of the muscle power pre and post training (after 3 month), the results at the present study showed significant improvement in the power of the

trapezius and deltoid as tested by low Pulley (L.P) machine where the mean value pre treatment was 127.7 watts and post treatment was 210.95 watts, and the results of biceps and triceps muscles also showed significant improvement in their power when they are tested by Biceps/Triceps (B.T) machine where the mean value pre treatment was 111.65 watts and post treatment was 114.1 watts, while there was significant improvement in the power of chest, arm and upper back muscles as evaluated by Chest Press (C.P) machine where the mean value pre treatment was 209.3 watts and post training was 241.8 watts. But there was non-significant improvement in muscles tested by Back Rotary (B.R) machine, where the mean value pre treatment was 52.6 watts and post treatment was 63.15 watts. This may be due to the weakness of the muscles of the lower back (erector muscle) and oblique and rectus abdominous muscles resulting from paralytic poliomyelitis.

From the results of this study, it can be concluded that there are great benefits of introducing sports and improving the physical fitness for the disabled persons. Among the potential benefits of sports for disabled individuals as many authors reported is the improvement in psychomotor skills, stimulation of motivation of other tasks, reestablishment of contact with normal human environment, reduction of emotional tension and release of natural anger, aggression and increase of relaxation^{3,5,11}. Also regular physical activity and adapted sport activities delay possible deterioration of muscle power, restore the strength endurance and coordination¹¹.

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الملخص العربي

تقويم الأداء الفعلي لدى الموهقين من مرضى شلل الأطفال

تهدف هذه الدراسة الى تقويم الاداء الفعلي لبعض عضلات الكتف والصدر وثني وفرد الذراع بالإضافة إلى عضلات دوران الظهر بعد برنامج تدريبي (تمريبات الإحماء - تمرينات التدريب على قوة التحمل وإستخدام جهاز الإنقباض العضلي ضد المقاومة المتغيرة خلال المدى الحركي - تمرينات التبريد) وذلك على عشرين من مرضى شلل الأطفال الذين يمارسون رياضة الرمي ويتراوح أعمار المرضى من 11 إلى 15 سنة ، تم تقويم المرضى مرة قبل بداية التدريب وبعد ثلاث شهور قبل بداية المنافسة مباشرة ، وذلك لإستخدام أجهزة قياس لبعض العضلات.

وقد أظهرت الدراسة نتائج ذات دلالة احصائية بإستخدام كل من جهاز البكرة المنخفضة وجهاز ثني ومد مفصل الكوع وجهاز ضغط الصدر بينما لا توجد فروق ذات دلالة احصائية لجهاز دوران الظهر.