Effect of Isokinetic Training on Strength and Spasticity in Spastic Hemiparetic Children

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ABSTRACT

Purpose: *This study was designed to test the premise that the performance of isokinetic strength exercises may increase spasticity in children with cerebral palsy (CP).* ***Methods:*** *Thirty spastic hemiparetic children (17 females, 13 males, and mean age 10.5 ± 1.11 years) participated in an isokinetic strength training program for the knee flexor group for 12 weeks successively. Knee extensor spasticity was assessed using the Biodex system 3Pro; Shirley, NY, USA at the three selected velocities (30, 60 and 120°/sec). Knee flexor strength was evaluated by the same device at the same velocities.* ***Results:*** *There were no changes in spasticity following the time of the study. The post treatment results revealed non significant difference in the measuring variables (peak torque and work) at P>0.05 as compared with its pre treatment results. On the other hand, the post treatment results of the strength measured variable (concentric peak torque) showed significant increase compared with its pre treatment results (P<0.05).* ***Conclusion:*** *The results of this study don't support the premise that exercises with maximum efforts (isokinetic exercises) increases spasticity in children with cerebral palsy.*

INTRODUCTION

Cerebral palsy (CP) is a collection of disorders characterized by an insult to the developing brain that produces a physical disability as the primary or distinguishing feature[13]. The spastic form of CP is most common and in those patients, additional clinical signs may include muscle shortening, diminished selective control and weakness. Cerebral palsy means weakness originating from brain and the use of the suffixes (plegia) or (paresis) also indicate that weakness is a prominent feature[13].

Even children with CP who have mild disabilities demonstrate substantial weakness compared with age-related peers[8,16]. The lower level of physical activity observed in this population is one potential contributor to weakness, but is hardly the sole explanation. Other possible factors include decreased central input to the muscle due to pyramidal tract insult, changes in the elastic properties of the muscle themselves, aberrations in the reciprocal inhibition pathways in agonist-antagonist muscle pairs, and heightened stretch responses or spasticiy[11]. Weakness in CP may be exacerbated by procedures that address other impairments in these patients. In fact, none of the major neurosurgical or orthopedic interventions that are prescribed in CP has a direct positive effect on muscle strength[13]. Selective dorsal rhizotomy unmasks weakness by reducing antigravity support that may have been provided by spasticity. Orthopedic surgery that lengthens or transfers tendons may have a negative effect on the force production of the muscle addressed, at least in short term[10]. Botulinum toxin directly and temporarily weakens the injected muscle to reduce its spasticity or overactivity. Intrathecal baclofen acts on contracted muscles to reduce spasticity and muscle spasms, and may have a direct negative effect on strength that warrants further exploration[12]. Each of these interventions may have an indirect positive effect on strength in the muscles opposite those that were spastic or short which could be enhanced even further by strength training[11]. Other common treatments such as the use of orthoses or serial casting can also exacerbate weakness due to immobilization[21]. Direct loading the muscle through specific exercises, activities, or sufficiently intense electrical stimulation is the only direct way to increase muscle strength in CP, and may be particularly useful in augmenting or maximizing the functional outcomes of other interventions that address different components of the motor disorder[13].

A widely used physical therapy intervention for children with CP has been based on the Bobath neurodevelopmental treatment (NDT) approach which focused on consideration of abnormal tone and postures during treatment. The use of strengthening exercises was strongly discouraged by proponents of the approach because they believed that excessive effort would increase co-contraction, spasticity, and associated reactions[4]. Emphasis was placed on interventions to prevent abnormal postures and excessive muscle co-contraction. Clinicians following this treatment approach avoided exercises with maximum effort in people with spastic form of CP[19].

Despite the variability in subject characteristics and program parameters, the literature provides evidence, although it is limited, that strength training programs may provide positive strength benefits for children and young adults with cerebral palsy[15]. There is no empirical evidence that strength training increases spasticity and contractures in people with CP. Some clinicians have argued that people with spastic CP are not weak and that the impaired performance of functional activities commonly observed is primarily a result of spasticity[26]. On the basis of clinical observation, it has been hypothesized that the increased effort associated with strength training would increase spasticity in people with neurological disorders and this would, in turn, lead to increased muscle and joint contractures and decreased motor function[5]. This view is not supported by the available empirical literature. Studies of the effect of strength training on spasticity showed that strengthening has either no effect on, or that training may possibly even reduce, spasticity. Similarly, there is no evidence to support the view that strengthening programs reduce the range of motion of people with CP. Rather; the evidence suggests that strength training might lead to increased range of motion, particularly in the lower limb[15]. Although the benefits of strengthening exercises have been demonstrated, the potential negative effects of an associated increase in spasticity have not been critically examined[19].

Spasticity was not related to strength in individuals with CP, this spasticity does not appear to be the cause for muscle weakness found in these individuals. In addition, spasticity was not present in the knee and ankle in all individuals with CP, however, muscle weakness was a consistent finding. Thus, muscle weakness, and not spasticity, may be a prevailing impairment in individuals with CP. Strengthening muscles in individuals with CP should become a treatment priority. The effect that muscle strengthening has on spasticity however, remains unclear[31]. While spasticity was once thought to be the primary contributor to the motor dysfunction noted in CP, many have challenged this perspective and now consider 'negative' signs such as muscle weakness to be more harmful to function[9].

Spasticity and a lack of muscle strength (weakness) are two major impairments associated with individuals with CP. The relation between these impairments is a question that has remained unanswered and is controversial among clinicians and researchers[31]. One of the unanswered questions is if a correlation exists between opposing muscle groups at the same joint. Some researchers suggested that muscles of those with CP are weak and these individuals are probably using as much muscle activity as they have available. This muscle weakness may have nothing to do with the coexisting spasticity and therefore, perhaps no correlation exists between spasticity in one muscle group is related to amount of strength in the opposing muscle group[13,31]. Objective measures of spasticity are needed to determine the effect of strength training on spasticity and function[31]. For the quantification of spasticity, biomechanical measurements have been used for the last decade and isokinetic dynamometer and electromyographic assessment have been used frequently. Isokinetic dynamometers are increasing in availability and have a passive mode for imposing controlled rotations of a joint while measuring the resistance to motion. The passive mode of an isokinetic dynamometer is already being used to measure spasticity in children with spastic CP[17].

Many issues still remain unknown about strengthening in CP. More controlled studies need to be conducted to establish the efficacy of different types of strength training programs[3,13]. This study was designed to determine whether isokinetic training can improve muscle strength of the affected hamstrings muscle in hemiparetic cerebral palsy children and whether gains are associated with alterations in muscle spasticity.

METHODOLOGY

Subjects

Thirty spastic hemiparetic cerebral palsy children (16 females and 14 males) participated in the study, after their parents gave written consent. Their ages ranged from 9 to 12 years old. All subjects met the following criteria: (1) were in good health, (2) were able to follow simple verbal directions, (3) had no surgical procedures to the lower extremities in the preceding 12 months, (4) the ability to actively extend the knee without simultaneous hip extension, (5) the ability to fit anatomically on the isokinetic device, (6) not taking any pharmacological agents at the time of the study and had no surgical procedures for the purpose of reducing spasticity. We excluded the patients that had a history of musculoskeletal or neurological disorders of the knee joint, limited range of motion of knee joint, severe spasticity (such as modified Ashworth scale grade 4)[6]. Because the severity of spasticity was a potential confounding variable, all subjects were assessed for their degree of quadriceps femoris muscle spasticity using modified Ashworth scale. The degree of spasticity for the selected subjects ranged between grade1 and grade 2 (mild degree). At the time of the study the participants were enrolled in a specific all designed physical activity program at the out-clinic of Faculty of Physical Therapy, Cairo University. Each child attended a 2-hours exercise session 3 times a week for 12 weeks. The program included training for righting, equilibrium and protective reactions and gait training in addition to strength training for knee flexors on isokinetic dynamometry.

Instrumentations

For evaluation:

A- Modified Ashworth scale[6]:

- It was used for grading spasticity at the time of child's selection. The examiner placed one hand around ankle joint, while the other hand stabilized the limb above the knee joint. The child's knee was then moved passively and quickly into extension. The resistance was then scored into the modified Ashworth scale. The child was asked to relax during the procedure.

B- Isokinetic device:

The isokinetic device Biodex Medical Systems (System 3Pro; Shirley, NY, USA), was used to assess spasticity by determining the peak torque and work values from each speed (30, 60 and 120º/sec.) for each child pre and post treatment period. These values represented the amount of work required by the Biodex system to move the passive knee throughout its entire range of motion at each speed.

The clinical computer interface of the system was bypassed in favor of custom data acquisition software, which was used to acquire the torque, position and velocity data and to initiate and terminate movements using command triggers. This hybrid system allowed complete flexibility in the experimental protocol while maintaining all of the safety features of the clinical measurement system. The angular velocity, position, and torque were measured at the knee axis of rotation using the transducers of the Biodex.

For treatment:

A- Isokinetic device (Biodex system) was used to train knee flexor muscle strength.

B- Mat, ball, rolls, wedges and balance board.

Procedures

For evaluation:

1- Spasticity evaluation:

The subject was seated upright on the testing chair with a firm spacer board placed behind the back as required to position the hips sufficiently forward so the rotational axis of the knee joint could be aligned with the input shaft of the dynamometer. This position is comfortable and reliable for testing maximum knee flexor and extensor torques in the hemiparetic population[33]. A velcro strap was secured around each child's waist and a second strap placed just proximal to the knee to provide stabilization to the body and to reduce unwanted contribution by muscles other than those of interest. A padded strap at the distal end of the dynamometer's lever arm was secured around the child's lower leg approximately 3 cm. above the malleoli. The child was instructed to remain as relaxed as possible as the knee is rotated passively from maximum flexion to the child's maximum extension position thereby stretching the flexor muscles.

Spasticity tests were conducted at speeds of 30, 60,120 degrees/second (º/sec.)[11,19]. Only one trial at each speed was actually used in the analysis. The therapist saved the trial when variation between trials was minimal or non-existent for a given speed. The machine torque required to stretch the knee flexors at each speed was recorded. The parameters measured were peak torque (Newton meter Nm) and work (joule J).The peak torque was defined as the peak resistance force during the passive movement. Work was defined as the sum of torques at each angular velocity, and was calculated from the areas of the torque angle curve; the boundaries for the area were the torque-angle curve and the zero torque line[24].

2- Strength evaluation:

This test protocol was done on the same isokinetic device with the child position as described before and in addition he/she was informed to fold arms across their torso throughout testing to minimize upper extremity involvement. Immediately following the passive spasticity test at the knee joint, the participant was asked to perform a maximum concentric contraction of the knee flexors. Isokinetic testing of the knee was performed at 30, 60 and 120º/sec. Each child performed a practice trial consisting of three submaximal knee extension-flexion combinations and three maximal efforts before recording the data. After a 30 seconds to 1-minute rest subjects were asked to "push and pull as hard as possible". Three to five trials were conducted to permit the child to achieve best performance. Only the trial indicating the greatest amount of torque, assessed by the physical therapist conducting the test, was used in the analysis. The maximum torques exerted by the participant over the range of motion was recorded. A peak torque was determined at the given velocities for the hamstring muscle group for the affected limbs[22,33].

Participants did not report any pain or discomfort during or following testing session. In some cases participants had difficulty retaining a smooth, repetitive movement across the range of motion during the initial trials of the first training session but overcame this difficulty before the recorded tests took place.

For treatment:

1- Isokinetic training intervention:

The training program required participants to attend three sessions per week for 12 consecutive weeks (36 sessions). Training sessions began with 15 minutes stretching exercises for the tightened muscles of the affected limb (hip flexors, knee flexors and ankle plantar flexors). Strength training involved knee flexion movement on Biodex isokinetic machine that controls the velocity of concentric muscle action. Children were seated as described earlier (in strength evaluation) and performed three sets of 6 to 8 repetitions of maximal effort at each of the three speeds approximately those used in testing. Progression was in all cases from the slowest to the fastest speed[33]. Starting from a full extended position of the knee, the subjects were instructed to flex their knee as rapidly and as far as possible. The end positions set on the machine were the child's maximum joint range of motion for knee flexion and extension. Isokinetic exercises were done with verbal encouragement and visual feedback from the monitor to obtain maximum efforts. Only the affected knee flexor musculature was trained in order to specifically address the effects of selective training on strength and spasticity. Upon completion of the strengthening exercises, stretches were repeated as a cool-down.

2- Designed physical therapy program:

It included righting and equilibrium reactions training which was used to improve the postural mechanism via a variety of exercises applied on medical ball and roll from sitting, standing and walking. Training of protective reactions was used to prevent the child from falling over when balance was disturbed severely. These exercises were done on medical ball and balance board. In addition, gait training was applied as forward, backward and sideways walking between parallel bars and in front of large mirror. Training of walking in open and closed environment by placing different obstacles across the track of walking (rolls of different diameters and wedges of different heights).

Statistical Analysis

Mean and standard deviation were calculated for each variable pre and post treatment. Paired t-test was used to compare the mean values for each variable before and after application of treatment (P<0.05).

RESULTS

Thirty spastic hemiparetic cerebral palsy children were recruited into the study with mean age (10.5 ± 1.11 years), mean weight (31.66 ±7.01 kilograms) and mean height (135.76 ± 5.65 centimeters), table 1. Twenty children were right-side affection and ten children were left-side affection, while degree of spasticity ranged from grade 1to grade 2 measured by modified Ashworth scale[6] (table 2). All children tolerated the testing and training procedures well.

Table (1): Biodata for the study group.

Sex		Side of affection		Modified Ashworth Scale		
F	M	Right	Left	Grade 1	Grade 1+	Grade 2
17	13	20	10	9	10	11

F: female M: male

There are two measured variables in this study including:

1- Spasticity:

- Peak torque and work values were determined from each speed (30, 60 and 120º/sec.) for each child pre and post treatment period.
- Peak torque (Newton meter Nm): statistical analysis of torque value for the study group revealed no significant difference on comparing the pre and post treatment mean values. The mean torque value before treatment at 30º/sec. was 13.08 ± 3.49 Nm, while the mean torque value after treatment was 13.07 ± 3.48 Nm (P>0.05). The mean torque value before treatment at 60º/sec. was 10.94 ± 2.70 Nm, while the mean torque value after treatment was 10.94 ± 2.70 Nm (P>0.05). The mean torque value before treatment at 120º/sec. was 9.15 ± 2.10 Nm, while the mean torque value after treatment was 9.13 ± 2.11 Nm (P>0.05) (table 2).

Table (2): peak torque value for spasticity measure pre and post treatment in the study group.

Speed	Mean	SD	t-test	P-value	L.O.S
30º/sec.	Pre: 13.08 Post:13.07	± 3.49 ± 3.48	1.88	0.07	NS
60º/sec.	Pre: 10.94 Post:10.94	± 2.70 ± 2.70	1.79	0.08	NS
120º/sec.	Pre: 9.15 Post:9.13	± 2.10 ± 2.11	1.95	0.06	NS

SD: standard deviation L.O.S: level of significance NS: non-significant

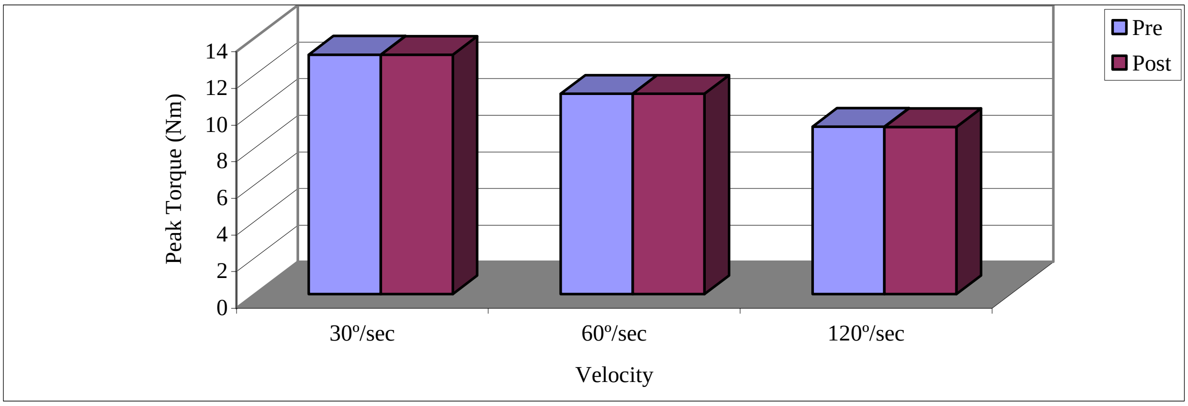

Fig. (1): Peak torque (Nm) value for spasticity measure pre and post treatment in the study group.

- Work (joule J): statistical analysis of work value for the study group revealed no significant difference on comparing the pre and post treatment mean values. The mean torque value before treatment at 30º/sec. was 100.92 ± 32.37 J, while the mean torque value after treatment was 100.91 ± 32.37J (P>0.05). The mean torque value before treatment at 60º/sec. was 109.86 ± 29.90 Nm, while the mean torque value after treatment was 109.80 ± 29.84 J (P>0.05). The mean torque value before treatment at 120º/sec. was 124.55 ± 27.23 J, while the mean torque value after treatment was 124.46 ± 27.13 J (P>0.05) (table 3).

Table (3): Work value for spasticity measure pre and post treatment in the study group.

Speed	Mean	SD	t-test	P-value	L.O.S
30º/sec.	Pre: 100.92 Post:100.91	± 32.37 ± 32.37	1.98	0.06	NS
60º/sec.	Pre: 109.86 Post:109.80	± 29.90 ± 29.84	1.40	0.17	NS
120º/sec.	Pre: 124.55 Post:124.46	± 27.23 ± 27.13	1.24	0.22	NS

SD: standard deviation L.O.S: level of significance NS: non-significant

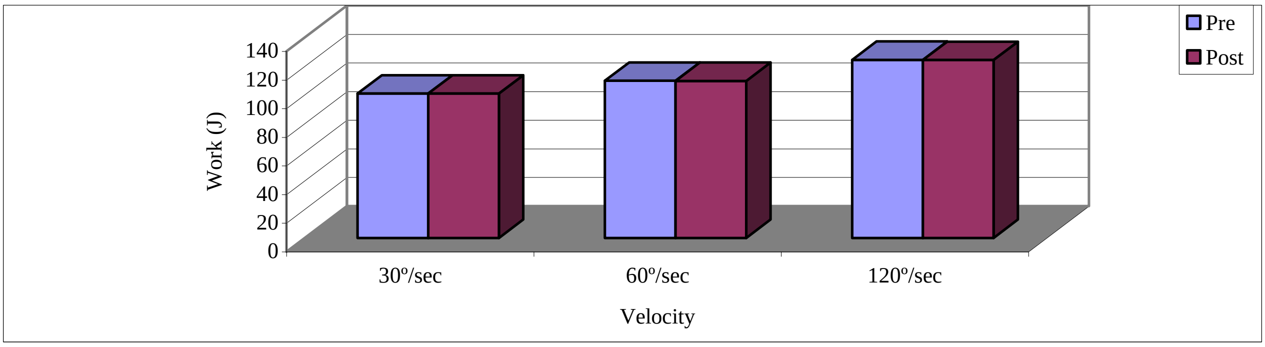

Fig. (2): Work value for spasticity measure pre and post treatment in the study group.

2- Strength:

- Concentric peak torque (Newton meter Nm) of hamstrings muscle at 30, 60 and 120º/sec. was tested statistically revealed significant improvement when comparing pre and post treatment mean values. At 30º/sec.: the mean value before treatment was 21.84 ± 1.48 Nm, while the mean value after treatment was 29.76 ± 1.47 Nm (P<0.05). At 60º/sec.: the mean value before treatment was 19.49 ± 1.40 Nm, while the mean value after treatment was 27.06 ± 1.51 Nm (P<0.05). At 120º/sec.: the mean value before treatment was 13.63 ± 0.79 Nm, while the mean value after treatment was 20.75 ± 0.97 Nm (P<0.05).

Table (4): concentric peak torque value for strength measure pre and post treatment in the study group.

Speed	Mean	SD	t-test	P-value	L.O.S
30º/sec.	Pre: 21.84 Post:29.76	± 1.48 ± 1.47	43.67	0.000	S
60º/sec.	Pre: 19.49 Post:27.06	± 1.40 ± 1.51	50.64	0.000	S
120º/sec.	Pre: 13.63 Post:20.75	± 0.79 ± 0.97	69.15	0.000	S

SD: standard deviation L.O.S: level of significance S: significant

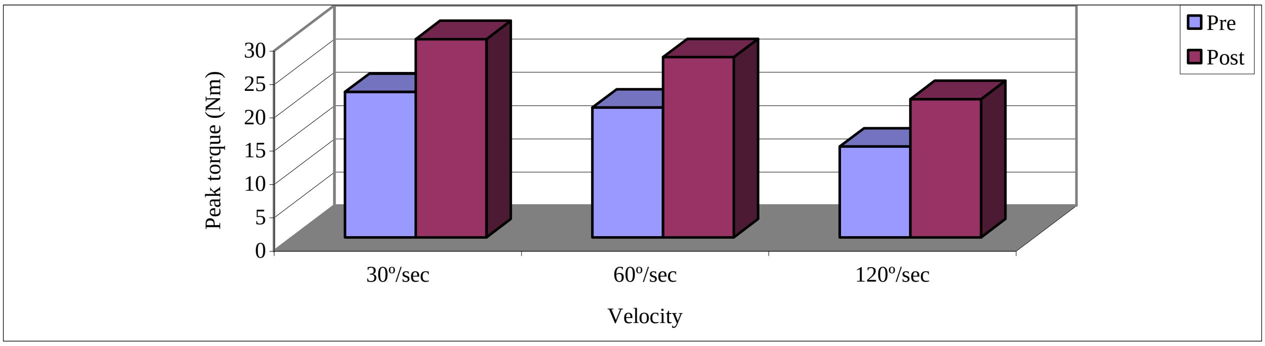

Fig. (3): Concentric peak torque value pre and post treatment in the study group.

DISCUSSION

The purpose of this study was to investigate the effect of strengthening exercises on spasticity and strength in children with spastic hemiparetic cerebral palsy. Such measures reported in this investigation are objective as they are not influenced by day-to-day or person-to-person evaluation fluctuations. A major thrust underlying this work is the belief that better treatment decisions are made when they are based upon information that minimizes assessment error.

Spasticity, a common problem in upper motor lesions, is classically defined as a motor disorder characterized by a velocity-dependent increase in tonic stretch reflexes (muscle tone) with exaggerated tendon jerks, which result from the hyperexcitability of the stretch reflex[25]. In order to develop a more valid and quantitative measure of spasticity, or to identify components of spasticity or resistance more precisely, multiple biomechanical and electrophysiological methods have been developed[14]. These methods include, but are not limited to, H-reflex testing, quantification of deep tendon reflexes[35] and clonus, resonant frequency tests, ramp and hold tests, pendulum tests[18], and instrumented torque measurements during passive motion at preset velocities[11]. Each of these methods varies in the degree of expertise and special equipment required the neural or peripheral component measured, the joints that can be tested, the reliability of the measurements, and the correlation of the parameters obtained with clinical and functional measures. Multiple reports have been published describing, validating and comparing these measures in a variety of patient populations[32]. The modified Ashworth is a subjective test that requires the examiner to interpret a catch or the point of resistance in a range during stretch to the spastic muscle group. Although the modified Ashworth scale was commonly used to assess the severity of spasticity in the clinical setting, it is highly dependent on the examiner judgment, its reliability is extremely low and it is not valid at lower grades[29]. Modified version of the Ashworth scale[6] was used to measure the effect of spasticity on resistance to passive knee motion before and after an eight-weeks exercise program for subjects with mild spastic CP. It was reported that the number of subjects exhibiting an Ashworth scale of at least 1 (slight increase in muscle tone) in the quadriceps femoris and hamstrings muscle decreased after the completion of the exercise program. However, the authors stated that these results should be interpreted with caution. Many of the subjects had Ashworth scale grades of either 0 (normal) or 1. The investigators had difficulty making the differentiation between these two grades due to lack of sensitivity of the scale and inability to ascertain whether the subjects were truly relaxed[27]. To overcome the limitations of the previous test, and to quantify spasticity more objectively, testing by an isokinetic dynamometer has been tried in this study. An isokinetic dynamometer tests spasticity by measuring the resistance of a joint incurred by sinusoidal oscillation of the joint at different constant angular velocities according to the definition by Lance et al., 1980[25]. This isokinetic dynamometer system enables the investigator to standardize both velocity and angle of motion, and to objectively record the amount of force generated by the subject's muscles. The operation and interpretation is simple, and the procedure can be applied to a variety of joints and muscles[24]. Spasticity has been characterized in many ways including: muscle hypertonia, hyperactive deep tendon reflex, clonus, stiffness during volitional movement[23], and velocity-dependent resistance to passive stretch[25]. We chose to quantify spasticity as a velocity-dependent resistance to passive stretch since it was clinically relevant and this method contained three elements that were fundamental to mechanical engineering principals (stretch, resistance, and velocity). Spasticity in this study was measured as torque and work values indicated by the Biodex isokinetic dynamometer. Muscle weakness is often a concern for health care professionals as they try to determine the most appropriate treatment for children with cerebral palsy[17]. Generally, all muscles in individuals with CP are very weak compared with individuals without disabilities and the amount of weakness may have no relation to the amount of spasticity present[30]. The children in this study demonstrated significant weakness of the knee flexors on the affected side according to the assessment of strength by the isokinetic dynamometer. A critical aspect in selecting a measuring procedure is its reliability. The reliability of isokinetic strength testing of knee extensors and flexors is widely documented in the literature for normal and children with minor learning disability[1,22,28].

Testing procedures for concentric contractions of knee extensors and flexors were reported to be highly reliable across a wide range of angular velocities[22,28]. Isometric and isokinetic dynamometry testing, particularly at slower speeds, have been shown to be reliable in this population (even in children as young as 4 to 5 years of age) as well as in other spastic disorders for selected muscle groups[1]. The decision of selecting isokinetic mode of testing and exercise come in agreement with another study which confirmed that isometric mode can be used to assess strength in a muscle group around a joint with a limited range of motion, and it does not provide detailed information on the dynamic characteristics of the muscular strength throughout the full range of motion[9]. On the contrary isokinetic muscular training has a distinct advantage over other modes of strength training as maximal torque can be generated throughout the whole range of motion[1].

Choosing concentric direction come in agreement with the opinion which documented that eccentric weakness was shown to be less marked than concentric weakness, a difference that may be explained by heightened stretch responses in the muscle being lengthened which is the antagonist during concentric activation, but the agonist during eccentric activation[11]. Also, concentric torque is relatively more impaired with increasing movement speed which could also be explained by heightened stretch responses with increasing velocity[11].

The finding of this study was that a 12-weeks training program of the hemiparetic knee musculature resulted in significant increases in muscle strength without and detectable change in extensor spasticity. Investigators have demonstrated the benefits of strengthening exercises in individuals with CP[7,8,27].

While therapists have been resistant to strength testing and training for several decades, others in the physical education and medical communities have not concurred with this viewpoint and have continued to support and even promote strength and endurance testing and training in cerebral palsy and other neuromuscular diseases[2,20]. Much of what has been learned in CP in this area has been mirrored by research on adults with spasticity and other disorders. As an example, in chronic stroke direct muscle strengthening improved functional performance in persons whose recovery had plateaued before this intervention and was not shown to increase spasticity[34]. In this study children with CP did not demonstrate a difference in knee extensors muscle spasticity immediately following strengthening exercises by the isokinetic device. We believe that our finding refutes the premise that the performance of exercises with maximum efforts will result in a large, or detrimental, increase in spasticity. This come in agreement with Damiano and coworkers (1995)[7] who showed that adolescents with CP underwent intensive strengthening exercises of the quadriceps, without surgical lengthening to the hamstrings had significant gains (50%) in strength. Thus supporting the notion that muscles, in individuals with CP, can gain strength following exercises with and without surgical intervention to the spastic group. It was reported that range of motion increased, rather than decreased, after an eight-weeks strengthening exercise program, which they believed indicated no increase in spasticity[20]. Also our study confirmed the results of the study by MacPhail and Kramer (1995)[27] who found that adolescents with CP had significant gains in strength even in spastic muscles and that the gains in strength resulted in improved function in nine of the 17 individuals. They also reported no increase in spasticity following strengthening, based in the Modified Ashworth scale of spasticity. Similarly, Fowler et al., 2001[19] showed no increase in quadriceps femoris spasticity after subjects with CP completed quadriceps femoris muscle strengthening exercises with maximum efforts. These results, considered along with the results of other studies that have demonstrated improvements in force production in individuals with CP, suggest that there are no detrimental effects associated with muscle strengthening programs. Those authors believed that their results should promote the use of strengthening exercises in individuals with CP where muscle weakness may contribute to functional problems. There are few reports of studies that examined the effects of strength training on the knee flexors in isolation or in conjunction with the knee extensors in the presence of extensor spasticity. From the results of this study we can conclude that strengthening training is an important part of treating children with cerebral palsy without any fear of increasing spasticity.

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الملخص العربي

تأثير التدريب الحركي على التقوية والتقلص في الأطفال المصابين بالشلل المخي النصفي

أجريت هذه الدراسة لاختبار الفكرة المسلم بها أن تمارين التدريب الحركي تزيد من درجة تقلص العضلات ف ي الأطفال المصابين بالشلل المخي . ثلاثون طفلا مصابين بالشلل المخي النصفي (١٧انثى و ١٣ ذكرا) متوسط أعمارهم ١,١١±١٠,٥ سنه شاركوا في برنامج تدريب حركي لعضلات ثنى الركبة لمدة ١٢ أسبوع متتالي وقد قيمت درجة تقلص عضلات فرد الركبة باستخدام جهاز (بيودكس) عند ثلاث سرعات مختارة (٣٠،٦٠،١٢٠°/الثانية) . وكذلك قيمت درجة قوة عضلات ثنى الركبة بنفس الجهاز عند الثلاث السرعات السالف ذكرها. تؤكد النتائج عدم وجود أي تغيير في درجة تقلص العضلات في نهاية وقت الدراسة بينما يوجد دلاله إحصائية على زيادة قوة العضلات متمثله في زيادة معدل العزم المركزي لعضلات ثنى الركبة . توضح نتائج هذه الدراسة أن الفكرة المسلم بها أن التدريب الحركي للأطفال المصابين بالشلل المخي تزيد من معدل التقلص غير صحيحة .