Isokinetic Training in Children with Hemophilia: Effects on Muscle Strength, Pain and Mobility

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Abstract

**Aim:** To investigate the effect of isokinetic training on muscle strength, pain and mobility in children with hemophilia.

**Subjects:** Forty boys, aged from 10 to 16 years, with moderate hemophilia A and B were enrolled in this study. They were randomly assigned to Group I and Group II, 20 boys each.

**Methods:** Group I received isokinetic training for knee flexors and extensors in addition to designed rehabilitation program, while Group II received designed rehabilitation program only. Treatment program was conducted for 90 minutes, three times/week for a successive 6 weeks for both groups.

**Main Measures:** Eccentric and concentric peak torque and power of the knee flexors and extensors, pain and mobility were evaluated before and after treatment period by using Biodex isokinetic dynamometer, Visual Analogue Scale and Functional independence score in Hemophilia respectively.

**Results:** Both groups showed a statistically significant improvement of the measured variables, but in favor of the Group I.

**Conclusion:** Isokinetic training in conjunction with a designed rehabilitation program significantly increase peak torque and power of the knee flexors and extensors, reduce pain and improve mobility in children with hemophilia.

**Key Words:** Isokinetic training – Children – Hemophilia – Functional independence.

Introduction

HEMOPHILIA is a sex linked inherited disorder caused by coagulation factors deficiency. Although it is a rare type of blood coagulation disorders, hemophilia is considered to be the most serious among them [1]. The overall prevalence of hemophilia is 1-10,000 [2]. There are two common types of hemophilia. Hemophilia A (80%) is due to deficiency in F VIII, while hemophilia B (20%) is due to deficiency in F IX are the commonest types. Antibody-mediated autoimmune response against F VIII typically in elderly represents the rarest form of hemophilia known as acquired hemophilia [3,4].

The blood level of coagulation factors determines the severity of hemophilia (1 international unite=1%). Hemophilia is classified in to severe (<1%), moderate (1-5%) or mild (>5-<40%) [5]. Hemophiliacs suffer from bleeding episodes varying from mild (low bleeding tendency) to severe (spontaneous), or even life threatening bleeds (intra-abdominal or cerebral) [6].

Generally most of the bleeds affect the joints (70%-80%). Common affected joints are knees, elbows, ankles, and shoulders. Being a large weight bearing joint, the knee joint is most commonly affected (45%) [7,8]. Repeated joint bleeds cause irreversible joint destruction, vicious cycle of pain, further intra-articular bleeds, subchondral bone destruction, abnormality in bone growth and lengthening and in short time flexion contracture of the target joint [8-10].

Factor replacement therapy is a method to overcome the deficiency in coagulation factors and it should be started as early as possible. It acts to prevent the patient's deficient factor from falling below 1% of normal. However, prophylactic treatment is expensive and the government of developing countries find difficulties in supplying hemophilic patients with it regularly, on-demand treatment is their only choice [5,10,11].

Sedentary lifestyle in hemophiliacs causes problems associated with inactivity including, muscle weakness, poor balance, increased the risk of
overweight, joint instability, recurrent bleeds and joint damage, decreased aerobic capacity and decreased motor fitness. Therefore, complementary rehabilitation with physical exercise and sports programs is highly recommended, to improve their performance [12-15].

Isometric, isotonic, or isokinetic exercises are different methods to gain muscle strength depend on the patient’s abilities [16]. The isokinetic mode is safe to use with children. It allows minimal risk of the muscle and joint injuries that can result from efforts to control the load if using free weights in one repetition-maximum testing [17]. Isotonic and isokinetic training are used in both sports medicine and clinical rehabilitation. The biomechanical characteristics differ in isotonic compared to isokinetic training with specific loads on the neuromuscular system. Isotonic movement involves a variable angular velocity and induces the greatest load on the neuromuscular system only at the weakest mechanical points of the range of motion, whereas the other angles are worked at less than maximal capacity. On the other hand, in isokinetic movement the resistance developed is in proportion to the amount of force exerted, and a maximal effort can be experienced, as if a maximal load was being applied at all points throughout the arc of motion [18]. Isometric, isokinetic exercise promotes joint mobility, described as chondroprotective by stimulating remodeling and repair. In isokinetic exercise, the speed of movement is controlled, allowing a maximum contraction at constant speed across the range of motion [19-21].

Isokinetic training is believed to have great advantage over other rehabilitation methods. The larger effect of isokinetic training could be attributed to that; maximal torque that can be achieved through the whole range of motion during isokinetic training is not achieved during weight training [22,23]. Therefore, the goal of the present study was to investigate the effect of isokinetic training on muscle strength, pain and mobility in children with hemophilia.

Material and Methods

Participants:

Forty children, who were moderate hemophilia A or B with unilateral knee hemarthrosis, were included in this study. Their ages ranged from 10 to 16 years. They were recruited from the outpatient clinic of Faculty of Physical Therapy and Abo El-Rish Pediatric Hospital, Cairo University, Egypt. All participants had knee joint problems (pain and bleeding) ranged from mild to moderate according to the classification of hemophilia recommended by the Orthopedic Advisory Committee of the World Federation of Hemophilia [24]. The work was carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans and after the approval of the children and their families and the attainment of informed consent. Exclusion criteria for all participants were surgical procedures performed 6 weeks prior to or during the treatment, participation in any other form of rehabilitation exercises during the study, acute joint or muscle bleeds or advanced radiographic changes such as bone destruction, bony ankylosis, knee joint subluxation or epiphyseal fracture.

Children were randomly assigned to one of two groups; Group I received isokinetic training in addition to designed rehabilitation program. Those in Group II, received the same designed rehabilitation program only.

All participants accepted to exercise three days/week for successive 6 weeks and to complete the pre and post-program evaluations. They also agreed to receive a prophylactic intravenous dose of factor replacement. The dose and frequency of factor replacement was described by the hematologist for each participant.

Instrumentation:

For evaluations:

All children in both groups were assessed for physical functioning by Biodex isokinetic dynamometer, Visual Analogue Scale (VAS) and Functional Independence Score in Hemophilia (FISH) (8 weeks).

- A universal weight and height scale was used to determine the children's weight and height.

- Biodex isokinetic dynamometer: All tests were completed on the the Biodex System 3 multi-joint system testing and rehabilitation (Biodex Medical System, Shirley, NY, USA) which was calibrated before every test session. Previous studies have demonstrated the reliability and validity of isokinetic devices for measuring muscle strength in adults as well as in children [25]. Eccentric and concentric peak torque and power of flexors and extensors muscles of the affected knee joint were measured during concentric and eccentric modes at angular velocity 60deg/sec.

- Visual Analogue Scale (VAS) is a horizontal line scale graded from 0-10. It was selected to
measure the pain scores. Zero position means no pain, while ten position means unbearable pain, from 1 to 10 means graduation intensities of pain [26].

- Functional Independence Score in Hemophilia (FISH) is a simple tool that can be safely used to assess functional abilities in hemophiliacs. Administration time is about 15 minutes. It is a score of three main categories: Self care (eating, dressing, grooming, bathing), transfer (chair, squatting) and mobility (walking, up stairs, running). Each activity is scored from 1 to 4 depending on the level of independency and amount of assistance needed. Interpretation of the results depends on the total summation of each activity which may by weak (8-18), moderate (17-24) or good (25-32) [27,28]. In this study, mobility was assessed for all participants in both groups.

For treatment:

- Ultra combi 707 unit: It is a microprocessor controlled unit for continuous and pulsed Ultra Sound (US) waves. It permits adjustment of intensity between 0 and 2W/Cm² with a frequency of 1MHz and 3MHz. The US device consists of mode selector (continuous or pulsed), automatic timer control, and having an ultrasound head with a diameter of 5cm and an indicator lamp which is off when there is contact of more than 50%, between the head and treated area, when this contact is less than 50%, the indicator lamp is on.

- Bicycle ergometer (Monark Rehab Trainer model 88 IE): It is an electronically braked ergometer. It is equipped with an electronic meter showing pedal revolutions per minute, the total pedal revolution and time function. The bicycle is supplied by pedal strap to provide complete fixation of the child's foot and back support in order to support and prevent over exhaustion of back muscles. It has a monitor that shows the heart rate of the child in order to control the exercise intensity and well stabilized by wide base of support, so that the child was trained with maximum safety.

- Biodex isokinetic dynamometer: It has been widely used in evaluation as well as training in different musculoskeletal and neuromuscular disorders. Faster velocities are not required, as research findings indicated that muscle eccentric force production reaches a functional plateau at the speed of 120°/s under isokinetic conditions. For appropriate programming of the exercise format, angular velocities are classified in to low speeds (30-60°/sec), moderate speeds (60-90°/sec) and fast speeds (90-120°/sec) on an isokinetic dynamometer [29]. The peak torque value at different angular velocities varies, as the peak torque during a low angular velocity of 30°/sec is higher than the peak torque at an angular velocity of 90°/sec [30].

For evaluation:

- Sociodemographic variables, including age, weight and height were collected for each participant.

- Isokinetic testing: Subjects were positioned in sitting with the backrest inclined 5° from vertical and were instructed to grip the sides of the seat during the testing. Straps were fastened at the thigh, pelvis, and trunk for stabilization. An adjustable lever arm was attached to the leg by a padded cuff just proximal to the lateral malleolus. The axis of rotation of the dynamometer arm was positioned just lateral to the lateral femoral epicondyle. Calibration before every test session was done. The subjects who did not have prior experience with the isokinetic dynamometer and were not familiarized with testing procedures were allowed to perform 3 consecutive submaximal warm-up trials for each muscle group, one of which was a maximal contraction. After a rest period conventional concentric and eccentric isokinetic tests were used to assess power and peak torque of flexors and extensors muscles of the affected knee at angular velocity 60deg/sec. During the test, the subjects performed 4 maximal reciprocal flexion extension repetitions. Four maximal contractions were recorded, with a 2-min rest period between each set. A mean was calculated of the best 3 of the 4 contractions. Eccentric tests were performed after concentric tests. A 20-minute rest was allowed between the concentric and eccentric tests. Participant was asked to move the knee joint through the whole range of motion between 90° flexion to full extension during the test. The subjects were verbally encouraged to produce maximal voluntary contractions during the tests [22].

- Pain was assessed obtained by VAS. The patients were asked to determine the level of pain by placing a mark at the appropriate level on the 10cm horizontal line. The pain is represented from Zero position means no pain, to ten position means unbearable pain [26].

- Mobility was assessed by FISH. Walking, up stairs and running items were selected. Each activity was tested according to scale prescription and scored from 1 to 4 depending on the level of independency and amount of assistance needed [27,28].

For treatment:

The treatment program for all children in both groups was conducted for 90 minutes 3 times/week.
Isokinetic Training in Children with Hemophilia

over a period of 6 successive weeks. Children in GI received isokinetic training in addition to a designed rehabilitation program, while those in GII received a designed rehabilitation program only.

**Isokinetic training program:**
Participants in GI received isokinetic training in addition to a designed rehabilitation program. Isokinetic training consisted of a 3 series of 10 consecutive maximal concentric and eccentric isokinetic contractions at angular velocity 60º/sec, 3 days/week for 6 weeks. Each series was preceded by 3 minutes rest, and there were no pauses between the 10 contractions [31]. Verbal instructions to direct the participants and for motivation such as “Push as hard and as fast as possible against the lever arm (concentric contraction) and at the end of extension; continue to push against the lever arm as it returns to the start position (eccentric contraction)” for knee extensors and vice versa for knee flexors [22].

**Designed rehabilitation program:**
All children in both groups received the same designed rehabilitation program as follows:

- Warm-up and cooling down exercises: Ten minutes per session involved warm-up and cooling-down exercises [12]. Children were asked to sit on the seat of the bicycle ergometer with straight and supported back. Pedal straps were used to guarantee foot fixation. The child was asked to grasp handles of the bicycle by both hands firmly to provide stability during training. The child was asked to perform pedaling at lower intensity for 5 minutes as a warming up. The participants were allowed for another 5 minutes for cooling down at the end of each session.

- Therapeutic ultrasonic: US with frequency of 1 MHz was adjusted to be used with a pulsed mode and intensity of 1.5W/Cm² for 10 minutes. It was applied on the knee joint while the participant was in relaxed comfortable supine lying position. The skin of the treated area (knee joint) was cleaned with alcohol. Adequate amount of aqua sonic-gel was applied around the knee joint [32].

- Flexibility exercises: Flexibility and joint ROM for hamstring and calf muscle was conducted after warming the tissue with active exercise. Gentle, low load, prolonged stretch guidelines within the pain-free range were used [33]. Each stretch was held for a minimum of 2 minutes. For efficiency with prolonged stretching longer than 2 minutes, a body part would be positioned and externally stabilized with weights or straps in a stretched position while other body parts were exercised [34].

**Strengthening exercises for 30 minutes in the form of:**

- Progressive functional strength-training exercises. The program consisted of three functional exercises (sit-to-stand, lateral step-up, and half knee-rise). Eight-repetition maximum was done before starting the treatment program to identify individual abilities and determine the starting level for the exercises. The repetition of the exercises was gradually increased according to patient's abilities [35].

- Resistance exercise training: Repetition maximum was determined before starting the treatment (the number of times the child lifted the weight through full ROM before getting fatigue) [36]. The exercises were conducted according to the abilities of each individual. Sand bags (from 2 to 6kg) were used, starting with small weight. Each individual was instructed to perform sets of repetitions starting at 3 sets of 10 repetitions and progressed to 3 sets of 15 repetitions with 2 minutes rest period between sets until the amount of weight lifted was no longer challenging. The exercises were conducted within their limits of pain and muscle fatigue. Resistance exercise training was applied for knee extensors and flexors [37,38].

**Data analysis:**

Descriptive statistics of mean and standard deviation presented the children’s age, weight and height. The paired and unpaired t-test was used to compare the pre-and post-treatment values of concentric and eccentric power and peak torque of knee flexors and extensors at angular velocity 60º/sec, within and between the groups. Non-parametric tests (The Wilcoxon signed rank test and the Mann-Whitney test) were used to analyze the pre-and post-treatment values of pain and mobility within and between the groups. A p-value of less than 0.05 was taken as significant.

**Results**

Table (1) presented the means ± SD of age, weight, and height for both groups. Characteristics of both groups were matched at the baseline. No significant differences were recorded (p>0.05).

**Isokinetic parameters:**

**Peak torque:**

As presented in (Table 2), there were no significant differences in the pre-treatment mean values of eccentric and concentric peak torque of knee
flexors and extensors at angular velocity 60º/sec between both groups (p>0.05). Significant differences between pre and post treatment mean values were recorded within each group (p<0.05). Significant differences of the post treatment mean values between both groups in favor of Group I were recorded (p<0.05).

Table (1): Demographic characteristics of children in both groups.

<table>
<thead>
<tr>
<th>Items</th>
<th>GI (X±SD)</th>
<th>GII (X±SD)</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>12.36±1.44</td>
<td>11.46±1.066</td>
<td>-1.58</td>
<td>0.13*</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>40.35±5.72</td>
<td>42.65±5.34</td>
<td>0.929</td>
<td>0.36*</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>141.40±7.027</td>
<td>135.4±8.04</td>
<td>-1.77</td>
<td>0.93*</td>
</tr>
</tbody>
</table>

X : Mean.  SD : Standard deviation.  * : Non-significant.

Table (2): Statistical analysis of concentric and eccentric peak torque at 60º/sec of the knee flexors and extensors within each group and between groups.

<table>
<thead>
<tr>
<th>Item</th>
<th>Pre (X±SD)</th>
<th>Post (X±SD)</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eccentric flexor torque:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group I</td>
<td>28.29±5.33</td>
<td>41.80±3.65</td>
<td>-11.44</td>
<td>0.000**</td>
</tr>
<tr>
<td>t-value</td>
<td>-0.89</td>
<td>-4.21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>0.38</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concentric flexor torque:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group I</td>
<td>23.81±5.81</td>
<td>38.15±3.9</td>
<td>-12.02</td>
<td>0.000**</td>
</tr>
<tr>
<td>t-value</td>
<td>-0.79</td>
<td>0.436</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>-5.309</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eccentric extensor torque:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group I</td>
<td>35.44±7.77</td>
<td>45.21±7.74</td>
<td>-7.7</td>
<td>0.000**</td>
</tr>
<tr>
<td>t-value</td>
<td>-1.20</td>
<td>0.245</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>-2.86</td>
<td>0.011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concentric extensor torque:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group I</td>
<td>30.80±7.13</td>
<td>43.61±7.09</td>
<td>-11.47</td>
<td>0.000**</td>
</tr>
<tr>
<td>t-value</td>
<td>-0.907</td>
<td>0.376</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>-3.98</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

X : Mean.  SD : Standard deviation.  ** : Significant.  t : Student t-test.

Power:

As presented in (Table 3), there were no significant differences of the post treatment mean values between both groups in favor of Group I and between groups (p>0.05). Significant differences of the post treatment mean values between both groups in favor of Group I were recorded (p<0.05).

Table (3): Statistical analysis of eccentric and concentric power at 60º/sec of the knee flexors and extensors scores within each group and between groups.

<table>
<thead>
<tr>
<th>Item</th>
<th>Pre (X±SD)</th>
<th>Post (X±SD)</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eccentric flexor power:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group I</td>
<td>5.83±0.61</td>
<td>12.24±1.179</td>
<td>-16.37</td>
<td>0.000**</td>
</tr>
<tr>
<td>t-value</td>
<td>-0.198</td>
<td>-8.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>0.062</td>
<td>0.000**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concentric flexor power:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group I</td>
<td>7.48±0.69</td>
<td>15.15±1.67</td>
<td>-14.64</td>
<td>0.000**</td>
</tr>
<tr>
<td>t-value</td>
<td>-2.322</td>
<td>-3.49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>0.032</td>
<td>0.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eccentric extensor power:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group I</td>
<td>16.59±1.271</td>
<td>23.63±2.18</td>
<td>-13.07</td>
<td>0.000**</td>
</tr>
<tr>
<td>t-value</td>
<td>-2.322</td>
<td>-3.49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>0.032</td>
<td>0.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concentric extensor power:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group I</td>
<td>20.77±1.34</td>
<td>30.84±1.31</td>
<td>-18.29</td>
<td>0.000**</td>
</tr>
<tr>
<td>t-value</td>
<td>-0.138</td>
<td>-8.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>0.184</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

X : Mean.  SD : Standard deviation.  ** : Significant.  t : Student t-test.

Pain:

As presented in (Table 4), there were no significant differences in the pre-treatment mean values of pain scores between both groups (p>0.05). Significant differences between pre and post treatment mean values were recorded within each group (p<0.05). Significant differences of the post treatment mean values between both groups in favor of Group I were recorded (p<0.05).

Table (4): Statistical analysis of pain scores within group and between groups.

<table>
<thead>
<tr>
<th>Item</th>
<th>Pre (X±SD)</th>
<th>Post (X±SD)</th>
<th>z-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>7.0±0.82</td>
<td>3.4±0.84</td>
<td>-2.86</td>
<td>0.004**</td>
</tr>
<tr>
<td>z-value</td>
<td>-0.564</td>
<td>0.573</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>-3.340</td>
<td>0.001**</td>
<td></td>
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</tr>
</tbody>
</table>


Mobility:

As presented in (Table 5), there were no significant differences in the pre-treatment mean values of mobility between both groups (p>0.05). Significant differences between pre and post treatment mean values were recorded within each group.
Significant decrease in the pain scores and improved mobility in both groups could be attributed to the use of Ultrasound (US). This was supported by the findings of Shakoor et al., [40] who reported that appropriate intervention and rehabilitation exercises enhance improvements in muscle strength and overall pain and function in subjects with knee disorders. In agreement with many reports [41,42], US is believed to be an effective therapeutic tool that allows cartilage regeneration. The anti-inflammatory effect of US is beneficial in reducing pain and improving functions in subjects with knee disorders. The US has been proved to enhance cell metabolism and enhance the capacity of tissue regeneration.

Improvement of mobility in both groups may be the consequence of increasing muscles strength and reducing pain in those children. This explanation is confirmed by the opinions of Willén et al., [43] who stated that, there is strong correlation between maximum walking speed and quadriceps muscle strength. The results comes in accordance with Khoganaamat et al., [44] who reported that, strength exercises increases muscle mass (hype- trophy), improve muscle strength and power, increase bone mineral density and postural balance, reduce risk of falling, increase walking speed, increase stair climbing strength and improve the symptoms in subjects with knee disorders. Similarly, Mulvany et al., [34] reported that to improve- ment of ROM; endurance; cardiopulmonary efficiency; circulation; and muscle strength allow comfortable and efficient gait. As well as increased confidence, social wellbeing, improved body image, and decreased fear of movement or injury all are believed to improve functional walking.

The results of the current study showed higher improvement in the measured variables in favor to the Group I. This difference may be attributed to the effect of isokinetic training. This explanation is supported by the findings of Kraemer et al., [45] who reported that, subjects who are frequently trained in different angular velocities show im-

(p<0.05). Significant differences of the post treatment mean values between both groups in favor of Group I were recorded (p<0).

Table (5): Statistical analysis of mobility within group and between groups.

<table>
<thead>
<tr>
<th>Item</th>
<th>Pre (X±SD)</th>
<th>Post (X±SD)</th>
<th>z-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking:</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Group I</td>
<td>1.4±0.52</td>
<td>3.5±0.53</td>
<td>−3.162</td>
<td>0.002**</td>
</tr>
<tr>
<td>Group II</td>
<td>1.3±0.48</td>
<td>2.3±0.48</td>
<td>−3.051</td>
<td>0.002**</td>
</tr>
<tr>
<td>Z-value</td>
<td>−2.821</td>
<td>−3.425</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>0.648</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up stairs:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group I</td>
<td>1.5±0.71</td>
<td>3.6±0.56</td>
<td>−2.914</td>
<td>0.004**</td>
</tr>
<tr>
<td>Group II</td>
<td>1.8±0.79</td>
<td>2.8±0.79</td>
<td>−2.316</td>
<td>0.002**</td>
</tr>
<tr>
<td>Z-value</td>
<td>−0.912</td>
<td>−2.274</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>0.362</td>
<td>0.023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Running:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group I</td>
<td>1.4±0.52</td>
<td>3.00±0.0000</td>
<td>−3.00</td>
<td>0.003 **</td>
</tr>
<tr>
<td>Group II</td>
<td>1.3±0.48</td>
<td>2.8±0.42</td>
<td>−2.889</td>
<td>0.004**</td>
</tr>
<tr>
<td>Z-value</td>
<td>0.457</td>
<td>−2.615</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>0.648</td>
<td>0.009**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

X : Mean.
SD : Standard deviation.
Z : Wilcoxon Signed Ranks Test and Mann-Whitney.
p : Level of significance.
** : Significant.

Discussion

This work was conducted to study the effect of additional isokinetic training on muscle strength, pain and mobility in children with hemophilia. The main findings in the present study were that children who received additional isokinetic training (Group I) showed a significant increase in isokinetic parameters (power, peak torque), marked decrease in pain scores and improvement of mobility (up stairs, walking and running) compared with those who received a designed rehabilitation program only (Group II).

The results of the current study showed significant improvement in concentric and eccentric peak torque and power of the knee flexors and extensors scores in the both groups might be attributed to the designed physical therapy exercise program aimed to increase the motor performance of the affected lower limb. This in turn improved muscle strength on the lower limb during both concentric and eccentric activity (flexion and extension) required during activity of daily living. This explanation mirrors the opinion of Hilberg et al., [39] who stated that, people with hemophilia can exercise safely. He also added that, the exercise prescription to hemophilic patients helps to improve muscle strength, increase ROM and joint stability, decrease body fatness, enhance fitness, improve functional abilities as well as improves self-image and prevent psychological problems. This agrees with the conclusion drawn by Scholtes et al., [38] who reported that, functional strength-training is a safe program widely used in rehabilitation for pediatrics as well as adults. The results are also in supported by the findings of Gur et al., [22] who reported that, functional exercises such as stair activities, changing position from sit to stand and sit into a chair allow the knee flexors and extensors contract eccentrically and concentrically.
Improvement in strength gain. The improvement in strength can be attributed to neurally mediated or due to changes in muscle architecture and/or in muscle contractile properties. Similarly, Blazevich et al., [46] reported that, in order to induce levels of neuromuscular activation sufficient to stimulate muscle growth and strength, heavy isotonic exercises should be included in rehabilitation programs. This opinion supports the higher results gained in Group I. This also comes in agreement with Hazneci et al., [47] who reported that, isokinetic training is beneficial in improving muscle strength and improve joint position sense. Finally, this was supported by the findings of Kettunen et al., [48] who suggested that, both eccentric and concentric contraction exercises are beneficial in improving muscles strength. Moreover, Jegu et al., [49] stated that, isokinetic exercises enhance faster rate of strength gain and reduced muscle tenderness than isotonic training as well as improve ambulation.

This study has several limitations. The small number of participants might limit the generalization of the study results. The children who participated in this study were all aged between 10 and 16 years old. Further studies are recommended to target different ages to enable comparisons of the results across different age groups. During the study, the children attended three sessions each week. Such a schedule was determined based on the assumption that outpatients would be less inclined to attend more frequent sessions. This limits the generalization of our results to intervention programs that have a different schedule, such as four times a week or even once a day. Future investigations will be needed to compare the effectiveness of different treatment schedules as well as the mechanisms underlying the effect. The lack of follow-up for the children in both groups might be considered another limitation of the study. We suggest that future studies control these potential sources of bias.

Conclusion:
The results of this study provide evidence that, isokinetic training can be used safely in children with hemophilia and they are beneficial in increasing muscle strength, reducing pain and improve mobility.

Clinical messages:
Isokinetic training in combination with proper physical therapy exercise programme increases muscle strength, decreases pain, and improve mobility children with hemophilia.

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References


