Original Article

Individual and combined efficacy of multi angel isometric exercises and electrical stimulation in treatment of haemophilic arthritis

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ABSTRACT

Background: Hemophilia is a congenital sex-linked disorder resulting from a deficiency of clotting factor. Recurrent joint bleeding in persons with hemophilia is known to lead to joint damage associated with pain, loss of range of motion and function. Objective: Comparing between individual and combined efficacy of electrical stimulation and multi angel isometric exercises in patients with hemophilic arthritis. Methods: Twenty patients had participated with age ranged from 15 to40 years, whose were randomly assigned into two experimental groups. First group (A) was consisted of ten males patients with mean age 27.3 (± 7.2) years, received multi angel isometric exercises program. Second group (B) was consisted of ten males patients with mean age of 28 (± 8.2) years, received a program of combined multi angel isometric exercises with electrical stimulation. Treatment was given 3 times/ week, every other day, for 6 consecutive weeks. Patients were evaluated pre and post treatment for their functional walking, pain levels and knee joint extension range of motion. Results: The results revealed that, there were significant differences in knee joint extension range of motion measured further, the pain levels were not significantly differ between both groups regarding to improvement in functional walking. Conclusion: Combination of both multi angle isometric exercises with electrical stimulation which is the most beneficial method for patients' addition to hemophilic arthritis to improve their joint health better than using one modality and which reflect on gait and activity daily level.

Keywords: Hemophilic arthritis, multi angel, isometric exercises, electrical stimulation.

Introduction

Haemophilia is a congenital sex-linked disorder resulting from a deficiency of clotting factor. Affected individuals lack factor VIII or IX procoagulant activity and consequently experience repeated, often spontaneous and haemorrhagic episodes in organs, including locomotor tract, muscles and might be gradually encounter serious problems of daily activities [1].

Hemarthrosis is the most common and disabling manifestation of hemophilia. Approximately, 80% of hemorrhages associated with hemophilia were hemarthrosis. Usually, hemarthrosis is beginning at around 12 to 24 months of age and persist throughout life [2].

Any joint that has three or more bleeding episodes over a period of 3 to 6 months is a target joint, much more susceptible to subsequent bleeding and arthritic changes [3, 4].

Hemophilic arthritis is manifested by pain, joint instability, malalignment, muscular atrophy, impaired range of motion (ROM) and impaired function [2]. Recurrent joint bleeding in persons with haemophilia is known to lead to joint damage associated with pain, loss of ROM and function and long term physical and psychosocial impairments [5, 6].

A serious consequence of progressive joint disease that could be surgically correct in all patients with hemophilia is chronic pain. Often, pain persists despite the patient's and medical

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team's best efforts to control joint bleeding and disease progression [7].

Hemophilic arthropathy is an ongoing cumulative process which eventually results in damaging joint effects. The long-term effects on joints include limited (ROM), deformity, crippling disability and chronic pain [8].

Regular exercise (30 min at least and three times per week) in patients with existing joint disease might be decrease or prevent the progression of haemophilicarthropathy [9].

Resistance training (RT) is effective method to improve the bone metabolism in severe haemophilia patients [10].

Electrical stimulation (ES) does not be acting directly on the joint and could be used as a therapeutic technique to recover pathologies such as haemarthroses, chronic synovitis, improves muscle strength and reduces muscular atrophy.

Querol et al.[11] reported that changes induced in physical strength, nervous activity and cross section of the rectus femoris after applying for 6-week unilateral ES treatment to haemophilic patients.

Purpose of this study is to compare between individual and combined efficacy of ES and multi angel isometric exercises in patients suffer from hemophilic arthritis.

Material and Methods:

The study was operated on twenty patients whose ages ranged from 15-40 years and randomly assigned into two experimental groups.

First group (A): Consisted of ten patients who received a program of multi angel isometric exercises of the knee for six weeks.

Each exercise was repeated 3 sets of 10 repetitions. The patients rested 1 minute after the conclusion of each [12].

Second group (B): Consisted of ten patients who received a program of both multi angel isometric exercises in combination with ES in both training groups.

Inclusion criteria:

1. Patient diagnosed as having moderate hemophilic arthritis.
2. Age of patients was ranged from 15-40 years.
3. Approvals by their hematologists to participate in the exercise program.

Exclusion criteria:

1. The inability to attend exercise sessions at least twice a week for six consecutive weeks.
2. Surgical procedures performed six weeks prior to or during the exercise program.
3. A major bleeding episode that poses a risk or prevented exercise.

Instrumentations used for treatment:

1. **Electrical stimulation device.**

Med serve device was made in England used in the study, its model is pro Stim ET-3000, class 1, type BF photo (1).

Photo 1: Electrical stimulation device

Treatment procedure:

I- Group A:

a) Isometric Squats:

Patients were placed his back against a wall and lower himself until his upper legs are parallel to the floor Shuffle his feet until your lower legs are parallel to the wall behind him. His knees should be bent to 90 degrees. Hold his arms out in front of him and hold the position for 10-30 seconds. Repeat 2-3 times at 30, 60, and 90 degrees [13].

b) Multi angel isometric from seated position at 30, 60 and 90 degrees:

The patient seated with flexion knee and hip 90 degree. Leg attached to a band with fixed resistance at 30, 60 and 90 degrees, then patient asked to extend his knee with maximum effort against the band and hold for 6 seconds then relax. This process was repeated for 2-3 time at 30, 60 and 90 degree (Photo 2 and 3).

Photo 2: Pushing against fixed resistance.

Photo 3: Electrical stimulation electrodes placement.

Results:

The mean, standard deviation, maximum and minimum values of age, weight, height and BMI of the two different groups were showed in table (1).

First group (A), was aged ranged from 19 to 40 years with means of 27.3+ 7.2 years, weight ranged from 50 to 70 kg, with means of 60.7 + 6.7 kg, the height ranged from 161 to 183 cm^2, with a mean of 173.7 + 7.3 cm^2 and BMI (body mass index) ranged from 18 to 23 with means of 20 + 1.6 kg/m^2. Second group (B), their age ranged from 18 to 40 years with means of 28 + 8.2 years, weight ranged from 46 kg, to 70 kg, with means of 57.2 + 7.9 kg, the height ranged from 155 to 183 cm^2, with a mean of 170.8 + 8.2 cm^2 and BMI (body mass index) ranged from 18 to 23 with means of 19.3 + 1.8 kg/m^2 (Table 1).

Table 1: Percentage of change of pain variable between group (A) and group (B).

Treatment	Group (A)	Group (B)	T-value	*P*-value
Percentage of change	71.6 ± 31.7	9.2 ± 7.1	6.2	0.00*
	Before program knee extension ROM variable			
	1.65 ± 0.33	1.45 ± 0.44	1.14	0.27**
	After program knee	extension ROM variable		
	1.8 ± 0.35	2.5 ± 0.53	-3.5	0.00*

Level of significance at $P < 0.05$

* = significant.

** = non-significant.

Comparison between the mean values of percentage of change of pain variable in the two experimental groups:

Unpaired t test was used to show difference between the two groups as regards the percentage of change in pain after treatment. This test revealed there was a non-statistical significant difference between the mean value of group A (71.6 ± 31.7) and the mean value of group B (9.2 ± 7.1) with t test = 6.2 and *p* value = 0.00*

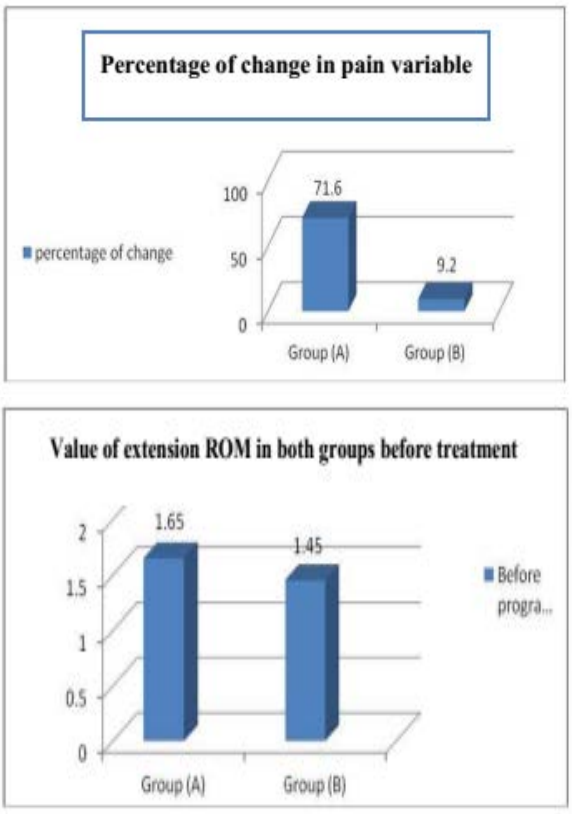

Figure 1: Statistical analysis for values of knee extension ROM variable between group (A) and group (B) before the exercise program.

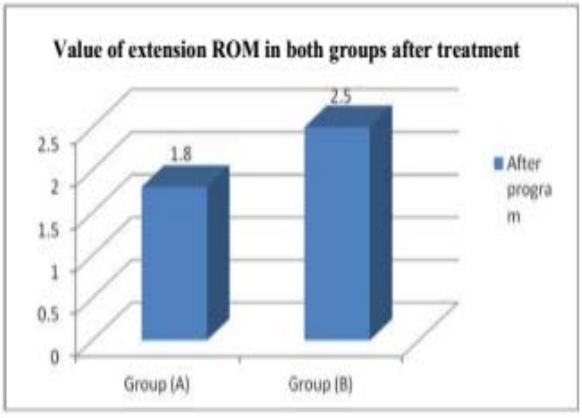

Figure 2: Statistical analysis for values of knee extension ROM variable between group (A) and group (B) after the exercise program

Comparison between the mean values of percentage of change of knee extension ROM variable in the two groups:

Unpaired t test was used to show difference between the two groups as regards the percentage of change of knee extension ROM variable after treatment. This test revealed a statistical significant difference between the mean value of group A (6 ± 12.9) and the mean value of group B (83.3 ± 54.4) with t test = -4.2 and *P* value = 0.00*

Table 2: Percentage of change of knee extension ROM variable between group (A) and group (B).

Treatment	Group (A)	Group (B)	T-value	P-value
Percentage of changes	6 ± 12.9	83.3 ± 54.4	-4.2	0.00*

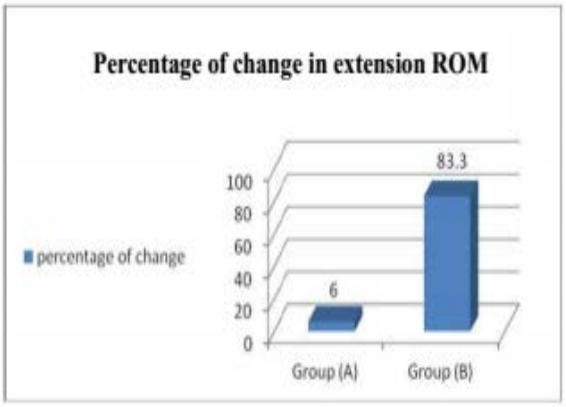

Figure 3: Statistical analysis for values of percentage of change for knee extension ROM variable between group (A) and group (B).

Discussion

Physical benefits of exercise:

The results generated by this research lead the authors to propose that properly managed exercise and participation in appropriate sports were highly beneficial for patients with hemophilia (PWH). Results from earlier studies (i.e. before 2001). Pierstorff et al. [14] demonstrated that dynamic isokinetic or isometric exercise improved the muscle strength of PWH. Recently, light weight training takes the same trend proprioceptive and isometric training and electrically stimulated strength exercises also have also been shown to be safe and effective [10]. Furthermore, Pierstorff et al. [14] found a significantly reduced bleeding tendency as well as slight improvements in flexibility and balance in children with haemophilia following an individualized home exercise program. Motion analysis parameters including gait and squat were not improved Pierstorff et al.[14]. The benefits for PWH as improved strength, proprioception, ROM of joints and lean body mass, together with a reduced frequency of bleeding [15].

Knee extension ROM measurements demonstrated significant improvement in favor of group B after treatment. These results are consistent with previous findings which showed improved knee ROM and function after a strength training protocol involving varieties of exercises [3].

Results confirmed by findings of who report a significant increase in knee ROM, quadriceps muscle strength, as well as hamstring muscle strength as a result of a 7-week rehabilitation program [16]. In addition, Hewett et al. [17], observed a higher increase in overall knee ROM, hamstring muscle strength rather than quadriceps muscle strength in uninjured female athletes after 6 weeks of functional jumping training.

Functional walking:

There was no significant improvement in functional walking between the two treatment groups that might be the duration of training was not enough to trigger such improvement.

In a comparative study reported using specialized training program included gentle strength training with low resistance performed for 20 to 25 repetitions [18]. Nine participants showed significant ($P< 0.05$) improvement in maximal isometric leg muscle strength and overall knee function, as measured by leg press. This low-intensity, high repetition program was performed to apply minimal stress to the lower extremity joints.

Likewise, tested the effect of a 3-week isometric exercise program on a single 12-year-old participant with severe factor VIII deficiency and chronic knee arthritis, Their intervention produced increased strength in the right hamstring and quadriceps muscle without adverse effect [19].

When comparing the results with those of Hilberg et al. [20] found similarities in improved knee function without any significant differences. Our participants were prescribed an exercise program based on their joint integrity, pain, bleeding history, strength, and available ROM. We allowed participants to progressively increase intensity of exercise as tolerated over the period of the study. The clinical relevance of this finding is that it indicates a more intensive strengthening program can be both safe and effective.

The results were revealed that both groups demonstrated a significant increase in overall functionality, as measured by the six-minute walk test (6MWT) although neither of the exercise superimposed the other on improving functionality. The functional improvement of our patients agrees with previous findings reported in the literature of good-to-excellent functional results after similar rehabilitation protocols [21].

Significant gains were observed in distance walked on the 6MWT pre and post treatment in both group A and B while there was no statistically significant difference between groups A and B. Although it should be interpreted with cautions due to the limitations such patient can't attend for two sessions peer week at least, measure bleeding during treatment period and patient had any surgery during treatment period; it does not show superiority of either treatment when measured by the 6MWT. This clinical gain, however, was important for our participants because it reflects an improvement in functional exercise level such as walking, activities of daily living, and self-care [22].

In the study of Mulvany et al. [18] several factors may have contributed to this functional improvement: increased stride length from improved ROM, improved muscular endurance, improved cardiopulmonary efficiency, improved circulation, and improved biomechanical loading on the joints from gains in ROM and muscle strength, resulting in a more comfortable and efficient [22]. The improvement in functional walking also could result from behavioral and psychological factors such as increased confidence, improved body image, and decreased fear of movement or injury [18].

Pain

It has been demonstrated that pain in PWH can be relieved by physiotherapy and rehabilitation. A study of 31 consecutive cases of young PWH enrolled on a 4-week intensive physiotherapy program, with concomitant factor replacement, reported all scores of pain and disability to be significantly decreased [23].

The association between the ROM increase, clinical improvement in functionality, and pain observed in this study may be of great importance. This relationship between locomotor function and quadriceps muscle strength was already emphasized by Powers et al. [24] who concluded that strengthening can be considered a very useful treatment option for patients with patella femoral pain.

Another study by Natri et al. [25] confirms this conclusion by identifying a strong correlation between restoration of quadriceps muscle strength and the long-term outcome in patients with patellofemoral pain. Apparently, in this study the improvement in function and pain was independent of the type of exercises used. We therefore do not advocate using a single exercise by itself, but rather we suggest a combined use of the exercises.

Conclusions:

Multi-angle isometric exercises and electrical stimulation could improve knee extension ROM and decrease pain, while it does not show significant difference in improve functional walking between two groups of treatment in patient with hemophilic arthritis

Conflict of interest

The author declares that there is no conflict of interest.

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