



EFFECT OF ISOMETRIC EXERCISES ON KNEE JOINT FUNCTION IN PERSONS WITH HEMOPHILIA

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ABSTRACT

BACKGROUND AND OBJECTIVE: Chronic hemophilic arthropathy is the most disabling and common complication in severe haemophilia which occurs due to recurrent hemarthroses. The study designed to find the effect of isometric exercises on knee joint function in persons with hemophilia and to find the effect in reducing the frequency of bleeds in knee joint.

METHOD: This was a pre and post-experimental study (Longitudinal study) which was conducted over a period of one year among 35 hemophilia patients between 5 – 20 years who attended Hemophilia clinic of the Dept of Physical Medicine & Rehabilitation, Govt Medical College, Tvm, with knee joint as the target joint, but not on regular exercise program. Detailed history and clinical examination were performed using Gilbert score and patients were taught on isometric quadriceps exercise. Patients were reassessed on third, sixth and ninth month. Paired t test and Wilcoxon signed rank test were used to analyse the data

RESULTS: Among 35 patients, the mean joint score on the right side reduced from 2.94 ± 1.97 to 1.2 ± 1.02 at nine month and on the left side, reduced from 3.54 ± 2.02 to 1.74 ± 1.36 at nine month with p value < 0.001 . The mean frequency of bleeds in three months of period was 4 ± 1.9 at the initial visit, which has reduced to 2.5 ± 1.5 at ninth month. Significant reduction in the number of vials of factor utilized by the subjects was observed. There was significant improvement in the range of motion of knee joint and circumferential thigh measures at the end of ninth month.

CONCLUSION: Isometric quadriceps exercise is a simple and safe exercise therapy for hemophilic knee arthropathy. Regular exercise improves the knee joint function. It also helps to reduce the bleeding frequency in knee joint and thereby decreases the factor that is utilised by the patient for knee hemarthroses.

KEYWORDS : hemarthroses; hemophilic knee arthropathy; isometric exercise; Haemophilia

INTRODUCTION

Hemophilia is a rare X-linked recessive bleeding disorder. This disease occurs due to the mutations of clotting factor VIII and factor IX. These clotting factors are present in the intrinsic pathway of blood coagulation¹. Based on which clotting factor is affected there are two main types: Hemophilia A and Hemophilia B. Hemophilia A (Classic Hemophilia) occurs due to the deficiency of Factor VIII and Hemophilia B (Christmas disease) occurs due to the deficiency of Factor IX^{2,3}. Since it is an X-linked Recessive disorder, usually occur in males and females remains as carriers¹. Incidence of Hemophilia A is about 1 in 5,000 to 10,000 males, which accounts for 85% of global hemophilia cases. The remaining cases (15%) are type B hemophilia at the rate of 1 in 20,000 to 34,500 males worldwide³. Family history of the disease is absent in about 30% of cases⁴.

Based on the level of circulating coagulation factor, hemophilia is classified into mild, moderate and severe⁴. In moderate or severe hemophilia, minor trauma can result in bleeding in the joint and in muscle bleed. In severe hemophilia, 90% of bleeding is in musculoskeletal system, and of which, 80% is in the joints⁵. Bleeding in the joint (hemarthroses) is one of the most disabling conditions in hemophilia, as it will lead to chronic pain and limitation in function¹⁶. Among the joints, knee is the most frequently involved one⁵. Repeated bleeding in joints cause significant reduction in muscle function, muscle-tendon contracture and degeneration of the joints⁶.

Isometric exercise is a type of exercise in which, the muscle length remains constant during contraction and there will not be any visible joint movement⁹. Studies have observed that both submaximal and maximal isometric muscle actions can increase isometric strength of the muscle^{7,8,9} and can induce muscular hypertrophy^{10,11}. Studies have shown that strengthening of the periarticular muscles reduces the bleeding frequency in hemophilic joints¹² and also improve the functionality, pain perception and quality of life of persons with hemophilic arthropathy¹³ The

purpose of the study is to find the effect of isometric quadriceps exercise on knee joint function using Gilbert score in persons with haemophilia and to find its effect in reducing the frequency of bleed in knee joint. It also aims to find the effect in utilization of factor by the patients.

OBJECTIVES

PRIMARY OBJECTIVE

To find out the effect of isometric exercises on knee joint function in persons with Hemophilia attending the Department of Physical Medicine and Rehabilitation of Government Medical College, Thiruvananthapuram

SECONDARY OBJECTIVE

1. To find out the effect of isometric exercise in reducing the frequency of bleeds in knee joint.
2. To find the effect of isometric exercise in factor utilization

CLASSIFICATION OF THE SEVERITY OF HEMOPHILIA

Classification of the severity of hemophilia has been based on either clinical bleeding symptoms of bleeding or level of procoagulant in plasma. The most widely used classification is based on the level of plasma procoagulant¹⁴. (Table 1)

Table 1: Classification Of Severity Of Hemophilia

Factor level	Classification
< 0.01 IU/ml ($< 1\%$ of normal)	Severe
$0.01-0.05$ IU/ml ($1\%-5\%$ of normal)	Moderate
$> 0.05- < 0.40$ IU/ml ($> 5\%- < 40\%$ of normal)	Mild

In severe and moderate forms, the disease is characterized by frequent hemarthroses, soft tissues, and muscles after minor trauma or even spontaneously. Those with mild disease experience

infrequent bleeding that is usually secondary to trauma. And among those with residual F VIII or F IX activity >25% of normal, the disease is recognized only by bleeding after major trauma or during routine preoperative laboratory tests.

MATERIALS AND METHOD

STUDY DESIGN

Pre and post- Experimental study (Longitudinal study)

STUDY SETTING

Hemophilic Clinic of Outpatient Department of Physical Medicine and Rehabilitation, Government Medical College, Thiruvananthapuram.

DURATION OF STUDY

January 2016 to January 2017 spanning over a period of one year

STUDY POPULATION

Consecutive cases satisfying the sample size

INCLUSION CRITERIA

1. Moderate / severe Hemophilia A and B patients with knee joint as the target joint
2. Age between 5-20 years
3. Those who are willing to participate in the study
4. Those who give consent

EXCLUSION CRITERIA

1. Acute hemarthroses
2. Those with permanent deformities of the knee.
3. Those who were already on regular isometric quadriceps exercise.
4. Those who are not willing to participate in the study.

SAMPLE SIZE

35 patients

METHODOLOGY

Initially, all patients attending the Hemophilic clinic, who give consent were examined to assess the musculoskeletal system. Those patients who satisfied the inclusion criteria were taken for the study. Details of the patients were entered as per the proforma. Their annual family income was taken from the ration card issued by the state government. History regarding the frequency of bleed in the knee joint, number of factor VIII/IX taken for knee hemarthroses and absenteeism in school/ office in the previous three months due to knee bleeds was collected.

Clinical examination of the knee joint was initially carried out using Gilbert Score. This score is primarily designed for adults and children with established arthropathy to measure pain, bleeding and joint score. Pain and bleeding was scored according to the clinical features that described in the score. Joint score includes swelling, muscle atrophy, axial deformity, crepitus on motion, range of motion, flexion contracture and instability. It is based on an additive score of 0-12 with 0 being a normal joint and 12 being most affected. Measuring tape and goniometer were the instruments used in assessment of joint score. Swelling was assessed by inspection as well as palpation. Felt for "patellar tap" for effusion and "boggy" feel for thickened synovial membrane. Muscle atrophy was measured at 18cm above the upper border of patella circumferentially, using measuring tape, in all patients. To assess axial deformity, Q angle was measured. The Q (or quadriceps)-angle is the angle formed by the intersection of lines drawn from the bisection of a line from anterior superior iliac spine (ASIS) to the superior patella and a second line from the inferior patella to the tibial tubercle. Crepitus can be obtained when the joint is passively moved with one hand, while the other hand is placed on the joint to feel the crepitus. Range of motion and flexion contracture of the knee joint was measured using goniometer with axis on lateral knee joint, stationary arm remains at 0 degrees, and movement arm remains parallel to fibula laterally.

Instability was assessed using drawer sign, abduction and adduction test. After clinical examination, each patient was trained with isometric quadriceps exercise. Patient was asked to lie flat in

the bed. A towel was kept folded beneath the knee. Followed by that, patient was asked to tighten the muscle in the front of the thigh as much as possible, pushing back of the knee flat against the bed and has to hold the muscle tight for 10 seconds. This has to be done twenty repetitions twice daily. In case of acute hemarthroses, the exercise has been withheld till the patient becomes symptomatically better. The patient himself or the parents were asked to maintain a diary regarding the daily performance of the exercise as well as the details of bleeding episodes, factor intake and the number of days he took leave from the school/ office. The compliance of the performance of exercise was also ensured through telephone once in twice weekly. Patients were evaluated at the end of third, sixth and ninth month using the same score and mean while the diary was verified for their compliance for exercise. Statistical analysis was performed using the SPSS version 16.0 version. Paired t test and Wilcoxon signed rank test were used. The Wilcoxon signed-rank test was applied to determine statically significant changes at different follow ups. The results were considered significant at five per cent level of significance ($p < 0.05$).

DISCUSSION

The aim of this study was to find the effect of isometric quadriceps exercise on the knee joint function in persons with Hemophilia and to find its effect in reducing the frequency of bleeds in knee joints. This study included 35 Hemophilia A patients with severe Factor VIII deficiency. All the subjects were males between 5-20 years of years with knee joint as the target joint.

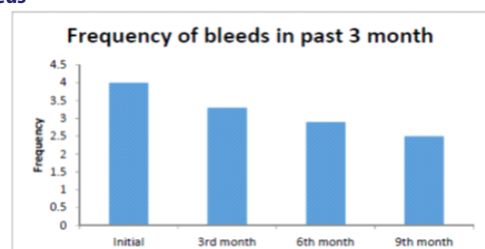
17.1% of them were with inhibitor positive status. According to World Health Organization and the World Federation of Hemophilia, prophylaxis is the first choice of treatment for Hemophilia patients. In this study, none of the patients were receiving prophylactic treatment. All the patients had episodic infusion of factor in almost all bleeding episodes. No subjects in the study group were on alternate management like blood transfusion.

The mean frequency of bleeds during a period of three months was found to be 4 ± 1.9 (range 2-10) at the initial visit. This has reduced to 3.3 ± 1.8 (range 1-6) at third month, 2.9 ± 1.9 (range 0-6) at sixth month and 2.5 ± 1.5 (range 0-5) at ninth month. This was proved to be significant when compared with the initial visit to all follow ups with p value of 0.006, 0.007 and < 0.001 at third, sixth and ninth month respectively.

Table 2: Pre And Post Exercise Comparison Of Frequency Of Bleeds

Paired comparison (t-test)	Mean Difference	SE	p
Initial Vs 3 rd month	1.086*	.374	.006
Initial Vs 6 th month	.714*	.248	.007
Initial Vs 9 th month	1.514*	.313	<0.001

Graph No. 1: Pre And Post Exercise Comparison Of Frequency Of Bleeds



This study was conducted among thirty three patients, of which 3 were female subjects. They concluded the study with significant improvement in ROM of all joints, including knee joint in pre and post exercise program. Also, there was significant improvement in the circumferential measures of the upper limb in pre and post exercise program. But, no significant effect in circumferential

measures was observed in the lower limb. In the present study, ROM of the knee joint has been significantly improved with the initialization regular isometric quadriceps exercises. In the study subjects, only 11.4% and 14.3% of the right and left knee joints respectively had normal ROM at the beginning of the study. This has been significantly improved to 68.6% and 48.6% on right and left side, at the end of ninth month. Also, 37.1% on right side and 40% on left side were with loss of >33.3% of full ROM at the initial visit. This was significantly reduced to 2.9% on right & 8.6% on left side at the ninth month.

Table 3: Pre And Post Exercise Comparison Of Rom On Right Side

Paired comparison (Wilcoxon signed rank test)	z	p
Initial Vs 3 rd month	4.243	<0.001
Initial Vs 6 th month	4.400	<0.001
Initial Vs 9 th month	5.013	<0.001

Table 4: Pre and post exercise comparison of ROM on left side

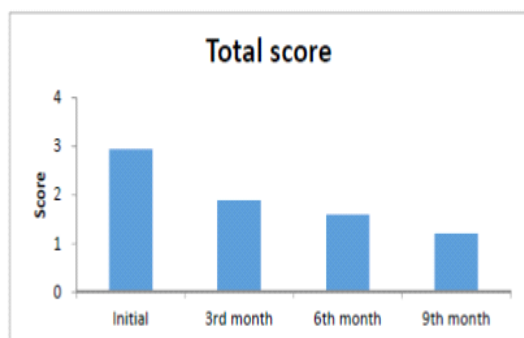
Paired comparison (Wilcoxon signed rank test)	z	p
Initial Vs 3 rd month	2.496	0.013
Initial Vs 6 th month	3.276	0.001
Initial Vs 9 th month	4.413	0.000

The present study showed significant improvement in the circumferential measurement at the mid-thigh region on regular exercise.

Although, there was not much improvement observed during the third and sixth month follow up, at the end of the study at ninth month, it was proved to be significant. During the commencement of the study, 40% and 51.4% were having atrophy of the thigh segment on the right side and left side respectively. This was significantly reduced to 5.7% and 22.9% on the right side and left side respectively. So, it suggests that consistent isometric exercise found to improve the circumferential measures on long term basis.

At the initial visit, the mean joint score on the rightside was 2.94 ± 1.97 and on the left side was 3.54 ± 2.02 . At the end of three months, the score reduced to 1.89 ± 1.35 and 2.57 ± 1.79 , which was proved to be significant ($p < 0.001$). In this study, further follow up at sixth and ninth month was considered. After nine months, the mean joint score reduced to 1.2 ± 1.02 on right side and 1.74 ± 1.36 on left side. The effect of exercise was analyzed using paired-t test and proved to have significant effect with p value < 0.001 in the joint score at third, sixth and ninth month of post exercise period.

Graph No.2: Pre And Post Exercise Comparison Of Joint Score On Right Side



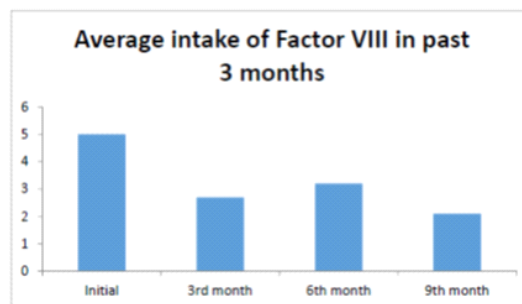
Graph no.3: Pre and post exercise comparison of joint score on left



Hemophilia is a chronic condition that requires lifelong treatment, with individual costs varying based on severity of the disease, complications, and treatment regimen. The majority of these are direct costs, which include anti hemophilic medication, visit to the clinician, hospital stay, medical or surgical procedures, and laboratory tests. Indirect costs are those associated with decreased productivity and increased absenteeism caused by hemophilia, its treatment, resulting disability, and death¹⁷. In this study, 48.6% of the subjects in the study population belonged to families with less than Rs.5000/- as their annual income. In the open market factor costs are high. So the State enhanced support for hemophilia patients and provides the factors free of charge through Karunya pharmacy.

Also studied about the average number of Factor VIII vials that a patient has to take in a period of 3 months and average number of days lost in school/ office due to bleeding. It was observed that during the pre-exercise it was 5 ± 3.3 vials per 3 months. This has been significantly reduced to 2.1 ± 2.7 vials of Factor VIII per 3 months at the end of the study. Since the bleeding frequency as well as the number of factor that has to be taken has been significantly reduced, this may indirectly result in reduction in frequency of clinician visit and hospital stay.

Graph no. 4: Pre and post exercise comparison of intake of Factor VIII



The exact expenses for these purposes were not studied in the current study. Increased absenteeism in school/ office due to bleeding episodes is another problem encountered by hemophilia patients. In the present study, mean absenteeism in school/ office due to bleeding was observed as 17.4 ± 8.3 days per 3 months on initial visit. During the post exercise period, this reduced to 11.8 ± 8.5 days at third month, 12.0 ± 8.3 days at sixth month and 7.6 ± 5.9 days at ninth month.

CONCLUSION

1. The study concluded that regular isometric quadriceps exercise improves the knee joint function of persons with hemophilic arthropathy.
2. Consistent isometric quadriceps exercise helps to decrease the frequency of bleeds in knee joint.
3. Regular isometric quadriceps exercise is beneficial to reduce the number of factor replacement that has to be taken for knee hemarthroses.
4. Long term isometric quadriceps exercise improves the circumferential measure of the thigh segment
5. Number of days a hemophilic person lost in school/ office due to knee hemarthroses can be reduced by regular isometric exercise.

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