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THE EFFICACY OF AQUATIC EXERCISE PROGRAM ON KNEE JOINT DYSFUNCTION IN INTERNAL DERANGEMENT OF THE KNEE

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ABSTRACT

Background: The knee is the most vulnerable joint in the body. Quadriceps muscle group provides the stability to the knee joint along with the ligaments and the menisci. While performing recreational activities the inappropriate lower limb movements can lead to injury to the joint. Knee injuries are one of the most common and painful injuries. The torn ligaments and meniscus can cause internal derangement of the knee joint.

Methods and Materials: The objective of this study was to check the efficacy of Aquatic exercise program on knee joint dysfunction in internal derangement of the knee. 30 Subjects were randomly selected based on the inclusion and exclusion criteria. The outcome measures was Visual Analogue Scale (VAS), Berg Balance Scale (BBS) and Lyshlom Knee Scoring Scale (LKSC). Based on these three scales the pre assessment was taken and after Aquatic Exercise Program for three weeks was given with all the precautions and then the post assessment was taken. Based on the data collected from pre and post tests the statistical analysis was done.

Results: The results stated that VAS, BBS and LKSC improved over time in the treatment group significantly with post treatment p values for VAS on rest 0.0197 on activity > 0.10, BBS 0.0002 and for LKSC < 0.4302 respectively.

Conclusions: The exercise protocol structured by this study, using the principles of Aquatic therapy, has considerably reduced pain measured by visual analogue scale. Also, there is considerable improvement in balance according to the Berg Balance Scale. The knee function which was measured

using lyshlom knee scoring scale shows improved knee function in subjects having knee joint dysfunction in internal derangement of knee. This study highlights the importance of Aquatic exercise in management of complications followed by internal derangement of the knee joint.

Keywords: Aquatic exercises, Knee instability, Knee pain

INTRODUCTION

The knee is large and also most injury prone joint in the body. Knee joint is hinge like in character, depending for stability primarily on the active control of the powerful quadriceps group of muscles, and secondarily on the passive control of the ligaments and menisci. The latter structures determine the direction in which muscle action is transmitted to the moving surfaces and achieve through their sensory nerve fibers the co-operation essential to protection from injury. Traumatic knee injury is associated with Osteoarthritis later in life **[1]**.

Knee injuries are some of the most common and the most painful injuries cause due to poor muscle control while recreational activities, awkward landings, twisting of joint segments, poor warm up sessions. Internal derangement of the knee (IDK) is a chronic mechanical condition that interferes with normal knee joint motion/mobility **[2, 3]**.

A fragment of bone or soft tissue that suddenly gets trapped between the articulating surfaces is the classic cause of internal derangement. The misplaced fragment can be either radiopaque or radiolucent. The most frequent cause of locking is trapping of the radiolucent meniscus **[4]**.

ACL injury is the commonest Internal derangement of knee followed secondly by Medial meniscus injury. Isolated ACL tear occurs less often and is most commonly associated with medial meniscus injury. Most commonly affected age group is of 30-40 years male **[5, 6]**.

Physiotherapy is used along with NSAIDs medications or therapeutic injections (corticosteroid, hyaluronic acid, etc.). If the condition is because of an obvious structural defect, or conservative modalities have not provided adequate pain relief, a surgical intervention may be considered **[6]**.

Common symptoms of internal knee joint dysfunction are pain, joint effusion, joint stiffness, difficulty in weight bearing and catching or locking of the knee joint these symptoms can disturb the daily activities of the individual **[7]**. Patients with knee joint dysfunction experience chronic form of pain and show a declining ability to use their joints, which consequently weakens the muscles. Hence, these weakens the joints and reduce the physical functions of patients; further, the motions required for

the patients' daily activities become restricted **[8]**.

Hydrotherapy exercises are usually prescribed in treatment of painful conditions such as hip and knee osteoarthritis, rehabilitation of ligament reconstruction surgeries. Aquatic exercise has many advantages particularly those associated with buoyancy which potentially reduces joint loading **[9]** water pressure where each molecule of water applies pressure over the joint helps to reduce swelling and increases blood circulation, the temperature could also lead to an increased sensory output **[10, 11, 12]**. An underwater environment allows early active mobilization and dynamic strengthening. Exercise will be performed with less injury, less pain and easier to learn in water **[12, 13]**. Reduction of symptoms will improve Quality of life. QOL is described as general well-being of individuals. Some of important indicators of it including physical and mental health, recreation and leisure time **[14]**. It is hypothesized that hydrotherapy speeds patient's early dynamic muscular strengthening and active mobilization even in the presence of severe pain and discomfort **[15]**.

Therefore, the aim of this study was to evaluate whether an Aquatic exercise program reduces pain, Balance and overall knee function in knee joint dysfunction in internal derangement of the knee.

METHOD AND MATERIALS

After gaining consent from the Institutional Ethics Committee, this experimental investigation was carried out at Krishna Hospital in Karad. The study's main goal is to see the efficacy of Aquatic exercise program on knee joint dysfunction in internal derangement of the knee.

Participants:

30 Samples were selected within the age limit of 18-45 years by simple random sampling method as per the inclusion criteria, grade 1 and 2 ligamentous and meniscal injuries, arthroscopic repair of soft tissues were taken. Patients with fractures, osteoarthritis, gout, rheumatoid arthritis were excluded.

Procedure:

All patients were approached and explained about all the details related to the study also written informed consent was obtained. A brief demographic data was obtained from the participants before initiating the study. Assessment was obtained by using Berg Balance Scale (BBS), Visual Analogue Scale (VAS) and Lyshlom Knee Scoring Scale (LKSS). After the initial assessment, under the supervision of the researcher, the subjects were introduced to the Aquatic therapy pool after the application of HMP for pain reduction with all the precautions for the treatment program of 4 weeks for 4 times a week.

Data Collection Tools

Determination of Pain: The patient was explained about the visual analog scale (VAS) which contains a scale ranging from 0 to 10. '0' is the indication of no pain at all and '10' indicates severe pain. This examination was done under two circumstances, pain at rest and pain during the activity. The patient was asked to mark between 0 to 10 on basis of the pain he/she experiences first while in rest, and then while during an activity.

Determination of Balance: The subjects were explained about the Berg Balance Scale which has 56 points for 14 task-oriented question which has 4 options related to the ability to perform the tasks, scoring from 0-4 points. The patient was asked to mark according to his/her ability of knee function.

Determination of knee function: The patients were explained about the Lyshlom Knee Scoring Scale which has 8 sections regarding the functional ability and disability of the knee each section has further variable points which contains different scores. The patients were asked to mark according to their self-evaluation.

Exercise protocol: Aquatic exercise treatment protocol included stability and mobility exercises. Each session had about 40 minutes whose 5 minutes was allocated to warm up and 20 minutes to strength training and balance training followed by 5 minutes of cool down phase **[16]**. Type and time duration of exercise program in each session are shown in **Table 1**.

Table 1

Exercise	Duration (min)	Type of exercises
Warm up	5	Forward, Backward, Lateral walking
Strengthening	20	Double-leg Squats, Lunges, Hip flexion, extension, adduction and abduction, Straight and oblique kicks, marching in one place.
Balance	10	Double leg calf raises, single leg standing.
Stretching	5	Hamstring and gastrocnemius stretching.

None of the participants had a history of participating in aquatic exercise for treatment of their knee pain and did not take any oral medication in order to reduce the pain.

Statistical Analysis: The outcome measures were evaluated at the start of the study. In this study, descriptive statistics such as bar diagrams, and percentages were used to statistically assess the acquired data. Paired t-test was used to evaluate the collected data. The data was expressed as mean values and their standard deviation (SD). The statistical significance level was set at t-test at $p < 0.05$.

RESULTS

The t-test revealed significant difference between the mean of pre and post

assessment values. **Table 2** shows demographic variables and personal characteristics **(Table 2)**.

The results showed that pain symptoms got improved after the Aquatic exercise program. The mean and standard deviation of the VAS score pre and post treatment are shown in **Table 3**.

Table 2: Participant's demographic variables and personal characteristics.

	no. of individuals	% Of individuals
GENDER		
Male	**15**	**50%**
Female	**15**	**50%**
TYPE OF INJURY		
ACL + Meniscal	**08**	**26.6%**
ACL	**09**	**30%**
Meniscal	**06**	**20%**
PCL	**02**	**6.6%**
PCL + meniscal	**02**	**6.6%**
Arthroscopic Ligament repair	**03**	**10%**

Table 3: Comparison between pre and post pain assessment scores.

Pre intervention	Mean	SD	p-value
On Rest	1.94	1.250	>0.10
On Activity	5.0433	1.600	0.0127
Post Intervention			
On Rest	1.2033	1.046	0.0197
On Activity	3.2733	1.418	>0.10

Table 4: Comparison between pre and post scores of Berg balance scale.

BBS	Mean	SD	p-value
Pre Intervention	52.7	2.307	<0.0001
Post Intervention	54.66	1.373	0.0002

Table 5: Comparison between pre and post scores of Lyshlom knee scoring scale.

LKSC	Mean	SD	p-value
Pre Intervention	82.933	10.123	0.0012
Post Intervention	88.700	6.705	<0.4302

DISCUSSION

Numerous studies of Aquatic Therapy are done on knee condition such as OA but there is no such study focusing on Aquatic Therapy for knee soft tissue injuries. This study was carried out to check the efficacy of Aquatic Exercise program on knee joint dysfunction in internal derangement of the knee in Krishna College of Physiotherapy, Karad.

30 Subjects participated in the research study among 30, 50% are males and 50% are females the mean age of the participants is 23.86 years with SD 2.46 years. The major goal of this study was to check the efficacy of Aquatic Exercise Program on knee joint dysfunction in internal derangement of the knee and as per the research conducted study has shown the positive effect on the condition.

Based on this research hypothesis, results showed that pain reduced significantly after the aquatic therapy. Results proved that aquatic exercise program for knee joint dysfunction has a significant effect on improving painful conditions, the results of this study are in agreement with findings by **[16, 17, 18]**. On the other hand, Lund *et al*. (2008) immediately at the end of the study and Wang *et al*. (2007) **[17]** observed no significant differences in pain scores **[19, 20]**. The probable reason for this difference may be due to a variety of training period and the type of equipment so in this research we have designed a generalized treatment protocol where we will work on stability, mobility followed by endurance though main concern of this study is to focus on stability and mobility only. Where different exercises will work to reduce the symptoms caused by knee joint dysfunction.

Pain is the main and prominent symptom of knee joint dysfunction so the main goal of any treatment method is reducing the clinical signs. The pain intensity has reduced significantly in conducted research with the values on rest, pre treatment mean 1.94 and post treatment mean is 1.20 with the SD of 1.25 and 1.04 respectively on visual analogue scale and on activity pre treatment mean is 5.04 and post treatment mean is 3.27 with SD 1.6 and 1.4. Strengthening can reduce symptoms like imbalance and pain. We cannot confirm this because we did not directly measure the thigh strength. As the balance is the second most concerning issue of knee joint dysfunction in this research, we have worked on balance also and the balance assessment was taken using Berg Balance Scale scoring 56 points the mean of pre treatment score is 52.7 with SD 2.307 post treatment score 54.66 with SD 1.373 it showed significant improvement. There are studies showing that excess cytokine production in body is the root cause of articular cartilage erosion and joint problems such as osteoarthritis. Physical inactivity increases cytokine production, and then increases pain and affects overall joint function. In addition, the other factor that may lead to pain and loss of function is muscle wasting which can be due to lack of activity and vice a versa subjects avoid movements to reduce pain which can lead to muscular atrophy which in turn will cause the deterioration of the condition.

The effect of aquatic program on improvement of knee function is because of improved neuromuscular functions related to the movement of muscles around the knee (increases power, strength and endurance).The third outcome measure of the research was to assess the change in knee function using Lyshlom knee scoring scale of 100 point which includes various questions regarding the knee function, pre treatment mean of the score is 82.933 with SD 10.123 and post treatment mean of the

score is 88.700 with SD 6.705 we can observe the improvement in the score after the treatment program so according to the research we can suggest water based treatment plan for the condition.

CONCLUSION

The exercise protocol structured by this study, using the principles of Aquatic therapy, has considerably reduced pain measured by visual analogue scale. Also there is considerable improvement in balance according to the Berg Balance Scale. The knee function which was measured using lyshlom knee scoring scale shows improved knee function in subjects having knee joint dysfunction in internal derangement of knee. This study highlights the importance of Aquatic exercise in management of complications followed by internal derangement of the knee joint.

LIMITATION, SUGGESTIONS, RECOMMENDATIONS

The present study is a small part of a solution to a large problem: the detrimental effect of the internal derangement of the knee-on-knee joint function and quality of life gets affected in a large population group. Though the findings are statistically significant, the study noted observations for a small group and had less sample size of 30. Hence it is difficult to generalize the results. Future studies could explore the effects of the aquatic exercise program on a larger sample or explore the effects of other exercise forms on the knee joint dysfunction along with the assessment of the strength of the different muscle groups.

Ethics Committee:

The study was accredited by the institutional ethical committee of Krishna Institute of Medical Sciences Deemed to Be University, Karad, Maharashtra.

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Statement conflict of Interest:

The authors declare that there are no conflicts of interest concerning the content of the present research.

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