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EFFECTIVENESS OF SUPERVISED VS UNSUPERVISED HIP AND KNEE STRENGTHENING EXERCISES ON PAIN, RANGE OF MOTION AND FUNCTIONAL ACTIVITY IN PATELLO FEMORAL PAIN SYNDROME INDIVIDUALS

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ABSTRACT:

BACKGROUND

Patellofemoral pain syndrome is a common disorder of knee especially in females that causes functional impairments and reduces quality of life

OBJECTIVES

To study the effectiveness of hip and knee strengthening on PFPS individuals on pain variation measured by visual analog scale (VAS), range of motion (ROM) variation measured by goniometry and functional activates measured by lower extremity functional scale (LEFS).

METHODS

Forty four female subjects were randomly assigned into supervised and unsupervised groups with hip and knee strengthening for 4 weeks with 12 treatment sessions 3 times in a week. Patients were evaluated for pain by VAS, knee ROM by goniometer , and functional activity by LEFS were measured at before and after 4th week of treatment.

RESULTS

VAS, knee ROM and LEFS shows statistically significant ($p<0.05$) improvement in both groups.

CONCLUSION

The present RCT shows effectiveness of hip and knee strengthening on pain, knee ROM and functional activity in female subjects with patellofemoral pain syndrome. The study shows improvement in both groups but supervised group is more effective than unsupervised group.

Thus, this study concludes supervised hip and knee strengthening exercises is more effective in treating the subjects with patellofemoral pain syndrome.

KEYWORDS:

PATELLOFEMORAL PAIN SYNDROME, ANTERIOR KNEE PAIN, HIP AND KNEE EXERCISES, KNEE ROM, VAS, LEFS.

INTRODUCTION:

Patellofemoral pain syndrome (PFPS) is one of the most common knee pain syndromes encountered in the orthopedic physical therapy outpatient department[1,2]. PFPS is described as anterior or retro patellar knee pain in the absence of other pathology. The incidence rate for PFPS was 22/1000 person years. Females were approximately 2 times more likely to develop PFPS when compared with males[3,4].

The Possible causes of abnormal lateral tracking of the patella include, neuromuscular imbalance of the vastus medialis obliqus (VMO) and the vastus laterals (VL) muscles (2) tightness of the lateral knee retinaculum, hamstrings, iliotibial band, and bilateral gastrocnemius, and (3) over pronation of the sub-talar joint[5] .

Hip muscle weakness has been proposed to contribute to patella-femoral-alignment and the development of PFPS. hip musculature plays an important role in controlling transverse-plane and frontal-plane motions of the femur. Dynamic valgus, consisting of hip medial rotation, adduction, and flexion, is a potential contributor to PFPS[6].

The patellar alignment can be determined by observation in standing and walking. The lateral hyper-mobility, and J-sign are commonly used to determine patellar maltracking. The patellofemoral glide, tilt and grind tests (Clarke's sign), when performed, can provide strong evidence for PFPS.[13] Lastly, lateral instability can be assessed via the patellar apprehension test, which is deemed positive when there is pain or discomfort associated with lateral translation of the patella providing strong evidence of PFPS[12,13] .

The Conservative management is the first choice of treatment, which includes exercises, patella taping and bracing, foot orthosis, manual therapy, electrotherapy, biofeedback and pharmacology. There is strong evidence for the efficacy of a multimodal physiotherapy approach targeting distal and proximal muscular influences as compared with placebo in a shorter duration in treating PFPS . [14]

More recently, some researchers have recognized that the patellofemoral joint could be influenced by abnormal hip motion leading to excessive femoral movements in the transverse and frontal planes. Powers et al. Demonstrated that during weight-bearing activities, individuals with PFPS exhibited excessive femoral medial rotation, leading to a relative lateral displacement of the patella[6]. Based on this study and considering that complaints of pain with PFPS are typically during weight-bearing activities, a growing body of clinical and biomechanical literature has been published on the influence of the hip musculature to control knee motion [8,9,10,11]

As far, few studies demonstrated improvement in knee functional activity with significant reduction in pain by strengthening hip and knee musculature under supervision.

Hence, it is proposed to study effectiveness versus unsupervised hip and knee strengthening pain, range of motion and functional activity in patellofemoral pain syndrome individuals.

NEED OF STUDY:

In PFPS individuals, there will be excessive medial femoral rotation, adduction, flexion that leads to decrease patella femoral contact or increases patella femoral joint stress leads to PFPS.

Many studies have shown that knee muscle strengthening and stretching are effective for persons with patellofemoral pain syndrome benefits include reduced knee symptoms like pain, increased muscle strength and performance of functional tasks, and enhanced health quality of life.

So, need of this study is to find out the effectiveness of hip and knee strengthening exercises in pain, range of motion and functional activities in people with PFPS

AIM OF THE STUDY:

To find out the influence of hip and knee strengthening exercises on PFPS individuals.

OBJECTIVES:

1. To study the effectiveness of hip and knee strengthening exercises on PFPS individuals on pain variation measured by visual analog scale (VAS).
2. To study the effectiveness of hip and knee strengthening exercises on PFPS individuals on range of motion (ROM) variation measured by goniometry.
3. To study the effectiveness of hip and knee strengthening exercises on PFPS individuals on functional activates measured by lower extremity functional scale (LEFS).

HYPOTHESIS:

NULL HYPOTHESIS:

There is no significant difference between supervised and unsupervised hip and knee strengthening group subjects with patellofemoral pain syndrome.

ALTERNATE HYPOTHESIS:

There is significant difference between supervised and unsupervised hip and knee strengthening group subjects with patellofemoral pain syndrome.

MATERIALS USED:

1. Visual analog scale
2. Goniometer was used to measure the ROM of hip joint and knee joint
3. Thera- tube used for strengthening the muscles
4. Weight cuff used for strengthening the muscles
5. Leg press machine
6. Lower extremity functional scale

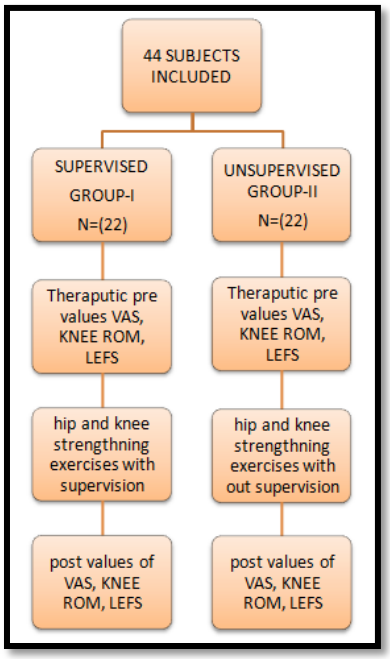
METHODOLOGY:

STUDY DESIGN: The design adopted for this study is randomized controlled trail.

STUDY PERIOD: Exercise protocol was given for 4 weeks with 12 treatment sessions 3 times in a week.

SAMPLE SIZE: Forty four subjects were taken and equally divided into two groups

STUDY ALGORITHM



STUDY SETUP:

College of Physiotherapy SVIMS and BIRRD hospital, Tirupati.

INCLUSION CRITERIA:

- Age:- 40-60 years
- Sex: females
- History of anterior knee pain for at least 3 months

EXCLUSION CRITERIA:

- Neurological disorder
- Any injury to lumbosacral hip or ankle
- Rheumatoid arthritis, surgery to lower extremity
- Inflammation to knee
- Osteoporotic changes
- Peripatellar tendinitis or bursitis
- Plica syndromes
- Osgood Schlatter's disease
- Males

OUTCOME MEASURES:

1. Pain scale
2. Knee range of motion (ROM)
3. Functional activates

PROCEDURE:

The complete orthopedic assessment was done for 42 subjects who were found suitable for participation in this study and informed consent form was taken from all the subjects.

Pre participation evaluation form consisting Visual Analog Scale (VAS) scale used to assess pain, goniometer was used to assess knee range of motion, Lower Extremity Functional Scale (LEFS) scale used to assess lower limb functional activity.

Then the subjects were allocated randomly by lottery method into two groups (group-I and group-II) with 21 subjects in each group. Pre therapeutic outcome measures were recorded before starting the treatment. Later, post therapeutic outcome measures were recorded after 4 weeks.

Pre and post therapeutic outcome measures of VAS, knee ROM, LEFS were recorded

- Supervised hip and knee exercises were given to group-I for four weeks.
- Unsupervised hip and knee exercises were given for group-II for four weeks.

EVALUATION OF VAS FOR GROUP-II AND GROUP-I:

VAS was performed at baseline and post intervention. The pain was noted using VAS with values ranging from 0-10 in units.

0= no pain

10= worst pain

EVALUATION OF ROM FOR GROUP-II AND GROUP-I:

ROM was measured by goniometer at base line and post intervention in degrees.

EVALUATION OF LEFS FOR GROUP-II AND GROUP-I:

LEFS was performed at baseline and post intervention. The maximum score is 80

Percentage of maximal function= LEFS score/80×100

The lower the score the greater is the disability.

INTERVENTION:

GROUP-I AND GROUP-II:

KNEE EXERCISES

- Stretching for hamstrings, plantar flexors, quadriceps, and iliotibial band
- Seated knee extension
- Leg press
- Squatting
- Single-leg calf raises
- Prone knee flexion

HIP EXERCISES

- Hip abduction with weights
- Hip abduction against elastic band
- Hip lateral rotation against elastic band
- Hip extension

SUPERVISED HIP AND KNEE PROTOCOL FOR GROUP-I

After initial base valuation, subjects were prescribed structured exercise protocol one session per day, done weekly three times. The structured protocol was prescribed for 4 week period with in the limit of tolerance of the subject. Subjects were reassessed for outcome measures after four weeks for pain, knee range of motion and functional activity.

UN-SUPERVISED HIP AND KNEE PROTOCOL FOR GROUP-II

The subject are advised to continue the exercises and medication as per the surgeon and researcher advise and also log book was given to record their activity and exercises during 4 week period and reassessed after 4weeks for pain, range of motion and functional activity.

KNEE EXERCISES PROTOCOL:

- **Stretching's**

- Hamstrings stretching with supine lying. Therapist kneeling near the leg region of the patient and the patient leg is kept over the shoulder with knee extension. Therapist flexes the hip of the patient 3 repetitions, each repetition is held for 30 seconds in each session.
- Quadriceps stretching is performed in side lying position. T therapist standing back to the patient and seeing the limb. one hand of the therapist stabilizes the pelvic and restrict the movement another hand of the therapist hold the knee in flexed position and forearm supporting the leg. After maximum flexion of the knee, hip extension made by leg pulling the backwards 3 repetitions, each repetition is held for 30 seconds.
- Iliotibial band stretching done in supine lying position. Therapist flex the hip along with knee adduction with internal rotation of the hip of the patient 3 repetitions, each repetition is held for 30 seconds.
- Plantar flexors stretching of patient. Therapist holds the lower thigh region with one hand and flexing the knee, and hold the heel in neutral position with another hand. slowly extending the knee and dorsiflexes the heel at the re 3 repetitions, each repetition is held for 30 seconds.

- High sitting knee extension from 90° to 45°, 3 sets of 10 repetitions
- Leg press from 0° to 45°, 3 sets of 10 repetitions
- Squatting from 0° to 45°, 3 sets of 10 repetitions
- Single-leg calf raises, 3 sets of 10 repetitions
- Prone lying knee flexion, 3 sets of 10 repetitions

HIP EXERCISES:

- **HIP ABDUCTION WITH WEIGHTS**

  Patient in sidelying Attach the cuff weight to ankle. Bend opposite knee. Lift leg upward, keep knee straight. Hold and slowly return. Be sure to keep leg aligned with trunk and shoulders. 3 sets of 10 repetitions.

- **HIP ABDUCTION AGAINST ELASTIC BAND (STANDING)**

  Loop one end of elastic band around a sturdy object and the other end around ankle. Stand tall with the looped ankle farthest from the opposite end of the band while holding the sturdy object with your inside arm. Lift outer leg up and straight out to side as far as possible. Pause, then return your leg to the starting position. 3 sets of 10 repetitions.

- **HIP LATERAL ROTATION AGAINST ELASTIC BAND (SITTING),**

  Sit at the edge of a table or chair with knees bent. Feet should not be able to touch the ground. Tie a elastic band to a fixed object. The band should be at the same height as your ankle or slightly higher. Slowly lift the foot up toward the other side of your body, turning your leg but keeping your thigh against the table. Come up as high as you can, pause and then go back down slowly. 3 sets of 10 repetitions.

- **HIP EXTENSION**

  Secure the ankle strap around the ankle of active leg, with the ring in the front. Stand 3 to 4 feet away from a fixed object, with both legs even (side by side). If necessary, place a chair beside you to use for balance. Keep your back straight, head straight and stomach tight. While keeping your active leg straight, push your leg back and return to normal. 3 sets of 10 repetitions.

  The load during training was standardized to 70% of the estimated 1-repetation maximum, defined as the maximum load with which 1 repetition of the exercises could be completed with out no pain. Ankle weights and knee extension machine based on the patient tolerance.

STATISTICAL ANALYSIS AND RESULTS:

TABLE 1:- DEMOGRAPHIC CHARACTERISTICS (AGE AND GENDER) OF SUBJECTS IN THE SUPERVISED AND SUPERVISED GROUP

DESCRIPTIVE STATISTICS

GROUP	N	AGE	GENDER
SUPERVISED	21	52.95 ± 4.42	FEMALE
UNSUPERVISED	21	50.45 ± 6.66	FEMALE

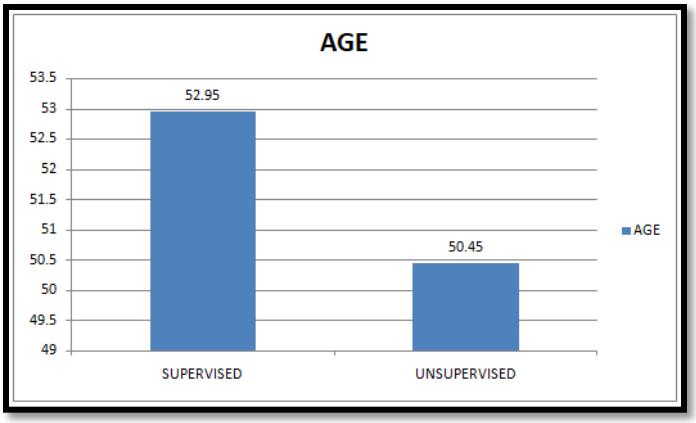


FIGURE 1: DEMOGRAPHIC CHARACTERISTICS (AGE AND GENDER) OF SUBJECTS IN THE SUPERVISED AND SUPERVISED GROUP

TABLE 2:- MEAN OF VAS IN THE SUPERVISED AND UNSUPERVISED GROUPS

DESCRIPTIVE STATISTICS

PARAMETER		SUPERVISED MEAN ± SD	UNSUPERVISED MEAN ± SD	P VALUE SUPERVISED & UNSUPERVISED
VAS	Pre	7.77 ± 0.97	7.63 ± 1.04	0.05
	post	2.40 ± 0.79	6.5 ± 0.91	0.05

Analysis of VAS (pain) has been observed at two points pre and post for each patient in the supervised and unsupervised groups.

Paired t- test Results shows between supervised and unsupervised groups pain score statistically significant difference at $p<0.05$ level.

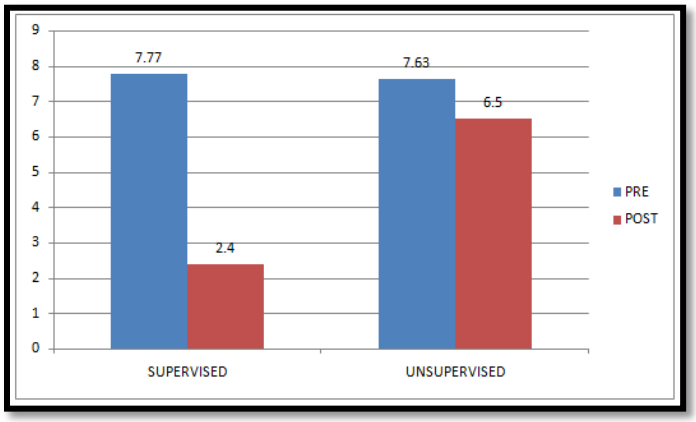


FIGURE 2: MEAN OF VAS IN THE SUPERVISED AND UNSUPERVISED GROUPS

TABLE 3:- MEAN OF KNEE ROM IN THE SUPERVISED AND UNSUPERVISED GROUPS

DESCRIPTIVE STATISTICS

PARAMETER		SUPERVISED MEAN ± SD	UNSUPERVISED MEAN ± SD	P VALUE SUPERVISED & UNSUPERVISED
KNEE ROM	Pre	69.09 ± 9.33	74.77 ± 10.63	0.05
	Post	89.77 ± 6.45	76.27 ± 10.66	0.05

Analysis of knee ROM has been observed at two points pre and post for each patient in the supervised and unsupervised groups.

Paired t- test Results shows between supervised and unsupervised knee ROM statistically significant difference at $p<0.05$ level.

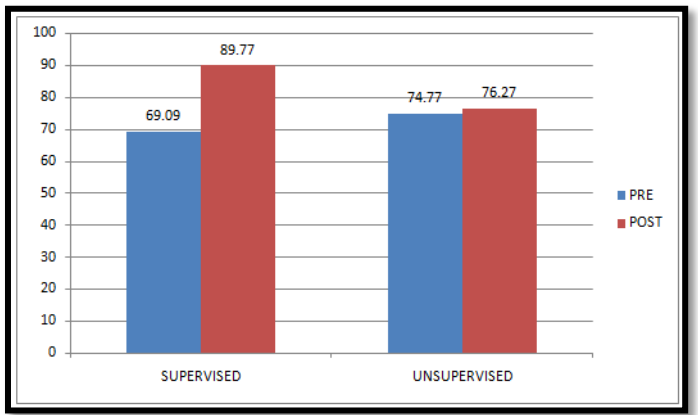


FIGURE 3:- MEAN OF KNEE ROM IN THE SUPERVISED AND UNSUPERVISED GROUPS

TABLE 4:- MEAN OF LEFS IN THE SUPERVISED AND UNSUPERVISED GROUPS

DESCRIPTIVE STATISTICS

PARAMETER		SUPERVISED MEAN ± SD	UNSUPERVISED MEAN ± SD	P VALUE SUPERVISED & UNSUPERVISED
LEFS	Pre	22.82 ± 8.39	25.29 ± 10.25	0.05
	post	75.60 ± 7.04	34.19 ± 11.91	0.05

Analysis of LEFS (functional activity) has been observed at two points pre and post for each patient in the supervised and unsupervised groups.

Paired t- test Results shows between supervised and unsupervised LEFS score statistically significant difference at $p<0.05$ level.

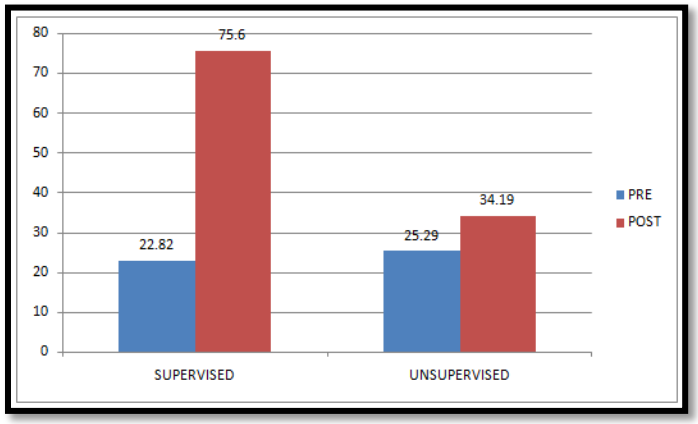


FIGURE 4:- MEAN OF LEFS IN THE SUPERVISED AND UNSUPERVISED GROUPS

TABLE 5:- POST ANALYSIS COMPARISION BETWEEN SUPERVISED AND UNSUPERVISED GROUPS

DESCRIPTIVE STATISTICS

POST ANALYSIS			
	UNSUPERVISED MEAN ± SD	SUPERVISED MEAN ± SD	P VALUE SUPERVISED & UNSUPERVISED

VAS	6.50 ±0.91	2.41 ± 0.79	0.05
LEFS	34.19 ±11.91	75.60 ± 6.22	0.05
KNEEROM	76.27 ± 10.66	89.77 ± 6.45	0.05

Analysis of VAS (pain), KNEE ROM, LEFS (functional activity) has been observed at two points pre and post for each patient in the supervised and unsupervised groups.

Paired t- test Results shows between supervised and unsupervised VAS (pain), KNEE ROM LEFS score statistically significant difference at $p<0.05$ level.

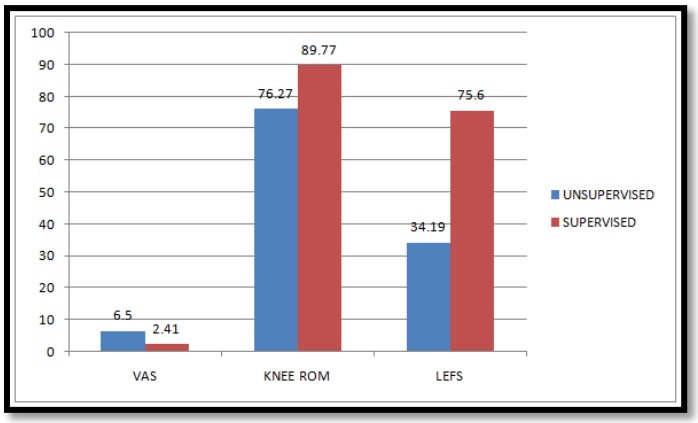


FIGURE 5: POST ANALYSIS COMPARISON BETWEEN SUPERVISED AND UNSUPERVISED GROUPS

DISCUSSION:

PRE AND POST INTERVENTION VALUES OF VAS BETWEEN SUPERVISED AND UNSUPERVISED GROUPS

The difference in the VAS between groups was statistically significant in the post training. Previous systemic reviews have supported the effectiveness of exercise in reducing pain levels for PFPS.[15,16,17]

Dolak et al.[18] also showed that patients who strengthened the hip muscles had less pain intensity after four weeks treatment, when compared to those who strengthened only knee muscles.

Exercise promotes pain relief and is characterized by reduced N-methyl D-asparate receptor phosphorylation, suggesting reduced central facilitation. Further regular exercise reduces serotonin transporter expression, increases serotonin levels, and increases uploads in central inhibitory pathways including the Periaqeductal gray, suggesting exercise utilizes our endogenous inhibitory systems to reduce pain[19]

Khayambashi et al,[20] shows improved hip abduction and external rotation strength. Excessive hip adduction and internal rotation have been postulated to influence patellofemoral joint kinematics. Therefore, alterations in muscular hip strength might have resulted in a decrease in patellofemoral joint loading which inturn relieves patellofemoral pain intensity.

Females are more likely to have stronger internal rotator muscles and weaker external rotator muscles compared with males, possibly due to improved lower extremity joint alignment leading to decreased patellofemoral joint pressure and pain intensity. [20]

PRE AND POST INTERVENTION VALUES OF KNEE ROM BETWEEN SUPERVISED AND UNSUPERVISED GROUPS

Knee ROM was improved in both groups, but the unsupervised group shows post intervention very less improvement when compared to pre intervention. In supervised group post intervention showed much more improvement when compared to other.

Boling et al. opined that the risk factors for the development of patellofemoral pain syndrome include decreased knee flexion angle[21] In our study knee ROM was increased during post intervention in both groups, but supervised group has shows more improvement.

The range of movement is increased and muscles must be strengthened progressively by resisted exercises, which are specific for the group to which the muscles belong.

Exercise in inner range is used to gain or maintain movement of a joint in the direction of the muscle pull, and to train some extensor muscle which are responsible for stabilizing joints. [22,23]

PRE AND POST INTERVENTION VALUES OF LEFS BETWEEN SUPERVISED AND UNSUPERVISED GROUPS

Functional capabilities were evaluated using LEFS that the participants from the supervised group achieved greater improvement of function compared to the unsupervised group, but observed that all participants showed improvement in the reported functional capabilities after intervention

Several authors have documented significant weakness of the hip lateral rotators and abductors in women with PFPS. Several researchers have also measured excessive internal rotation and adduction of the hip, leading to an excessive dynamic valgus alignment of the knee, in women with PFPS. Based on these reports, strengthening of the hip musculature could help to improve lower extremity alignment and tracking of the patella, reducing excessive retropatellar joint pressure and ultimately leading to decreased pain and improved function in individuals with PFPS. Thiago yukio fukuda, flavio marcondes rossetto et al(2010); studied Short-Term Effects of Hip Abductors and Lateral Rotators Strengthening in Females With Patellofemoral Pain Syndrome: A Randomized Controlled Clinical Trial had found that Rehabilitation programs focusing on knee strengthening exercises and knee strengthening exercises supplemented by hip strengthening exercises were both effective in improving function and reducing pain in sedentary women with PFPS.[24]

CONCLUSION:

The present randomized control trail carried out has proved that the effectiveness of hip and knee

strengthening exercises on pain, knee range of motion and functional activity in female subjects with patellofemoral pain syndrome individuals is significant.

The study shows improvement in both groups, but supervised group is more effective than unsupervised group.

Thus, the study concludes that the hip and knee strengthening exercises along with supervision is more effective in treating the subjects with patellofemoral pain syndrome.

LIMITATION AND RECOMMENDATIONS:

LIMITATIONS OF THE STUDY:

- Only knee ROM was taken in this study.
- Small sample were taken.
- Only female subjects included in this study.

RECOMMENDATIONS

- Hip external rotation and abduction should include in the study.
- Study should be conduct with large sample.
- Q angle should be included.

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