COMPARISON OF LUMBO PELVIC HIP STRENGTHENING VERSUS KNEE STRENGTHENING EXERCISE TRAINING IN THE MANAGEMENT OF PATELLOFEMORAL PAIN SYNDROME

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ABSTRACT

Background: Patellofemoral pain syndrome (PFPS) is one of the most common musculoskeletal disorders and reported to affect 21%-45% of adolescent.

Objective: The main objective of interventional study was in comparing the effectiveness Of Lumbopelvic Hip Strengthening verses knee strengthening with conventional therapy in reducing pain and improve functional outcome of knee in women with PFPS. 36 patients with PFPS are included in the study.

Method: The subjects were divided in to three groups with use of Simple Random sampling: Control Group, Lumbo Pelvic Hip Strengthening exercise and knee Strengthening exercise Group. All three groups were assessed for pain with 11- NPRS, lower limb muscle (hip flexor, hip extensor, hip abductor, hip external rotators, knee extensor ,trunk lateral flexors) strength with Hand Held Dynamometer and Functional assessment with KQFAS Questionnaire, before and after 8 weeks of intervention.

Result: There was a significant decrease in pain and improvement in the strength and functional ability of knee (p<0.001) in patients with PFPS who received Lumbo Pelvic Hip Strengthening exercise and knee strengthening.

Conclusion: When two interventions Lumbo Pelvic Hip Strengthening and Knee strengthening were compared Lumbo Pelvic Hip Strengthening Exs Group was found superior than Knee Strengthening Exs group in the management of patello femoral pain syndrome.

Key Words: patello femoral pain syndrome, Lumbo Pelvic Hip Strengthening ,Knee strengthening ex, Hand Held Dynamometer, KQFAS

INTRODUCTION

Patellofemoral pain syndrome (PFPS) is a descriptive diagnosis characterized by long-term Anterior knee pain. The pain is not constant, instead varying with the type and level of Activity. Naslund have been used to denote the syndrome, including chronic anterior Knee pain, idiopathic anterior knee pain, patellalgia, patellofemoral malalignment, patella Compression syndrome and chondromalacia patella[1]

Patellofemoral pain is a pattern of insidious onset diffused pain in knee usually aggravated by walking, stairs, deep squatting, kneeling, prolonged sitting (movie sign) and standing from sitting. PFPS is one of the most common musculoskeletal conditions in adolescents and young adultsand reported as occurring in 25% of general population[2]. The symptoms most frequently reported are diffuse peri-patellar (around knee cap) and retro `patellar (behind knee cap) localized pain, typically provoked by ascending or descending stairs, squatting and sitting with flexed knees for prolonged periods of time. Other common symptoms are crepitus and sensation of giving-way[3].

Anterior knee pain or patellofemoral pain syndrome (PFPS) is one of the most common disorders affecting the lower extremities. It frequently occurs among the physically active population, and its incidence is higher among women[4]

The proposed theories as cause of PFPS are multifactorial which includes malalignment of patella and lower extremity, excessive foot pronation, muscle imbalance, quadriceps insufficiency, patellar incongruence, excessive exercise, overtraining, training errors, poor equipment, and ignorance of the condition[5,6].

The AIMS OF THE STUDY was to compare effectiveness between Lumbo pelvic hip strengthening and knee strengthening exercise training program in Study Participants with Patello femoral pain syndrome.

MATERIAL AND METHODOLOGY

RESEARCH DESIGN   **:** Interventional study (comparative)

SAMPLE DESIGN   **:** Simple Random Sampling Method

STUDY POPULATION: Study participants with Unilateral PFPS in local population

SAMPLE SIZE : 36 Study Participants. (Group A=12, Group B=12,Groups C=12)**.**

STUDY SETTING   **:** Out Patient Department of CUSPC

STUDY DURATION   **:** 1 year (December 2011 to November 2012).

TREATMENT DURATION : 8 weeks

The included subjects were of Age:20-40years,Experience of anterior or Retro patellar knee pain, Presence of pain for more than one month,BMI: 18.5 -24.9 KG/M[2.]In addition, participants had to exhibit at least two of the following positive signs of anterior knee pain during the initial physical examination-Patellar crepitus,Clarke‟ssign,PatellarGlind Test ,Positive Zohlersign[7,8]. They were excluded if Any trauma, inflammatory or infectious pathology in the knee joint, extremity malalignment (such as foot pronation)Received NSAIDS, injections or physical therapy in preceding 3 months.Systemic disease such as diabetes and rheumatism,[8] Any trauma and operation on trunk region[9.]Faulty posture in lower extremity or trunk[7,]

OUTCOME MEASURES

The primary outcome measure of this study was NPRS[10], Kujala questionnaire of Functional ability scale[11], and Hand held dynamometer[12] for strength measurement were used as an outcome measures to assess baseline values and progression.

Common Treatment for Three Groups (A & B & C)

Warm up exercises:

Duration - 5 minutes (LLM stretching such as Hamstrings, Quadriceps, Iliotibial bands, Calf muscle,)[13] Stretching – 30 Second hold, 5 second rest, repeat 3 times[14].

Exercise phase:

Group A: conventional physiotherapy

Group B: Lumbo Pelvic Hip Strengthening Ex & Conventional Physiotherapy

Group C: Knee Strengthening Ex & Conventional Physiotherapy

Cool down phase:

Duration – 7-9 minutes (Stretching of Hamstring, PF, Quadriceps, Calf and ITB, Trunk lateral flexors.)[13]Stretching – 30 second hold, 5 second rest, repeat 3 times

Group A (control) was received Ultrasound therapy and ask them to continue routine regular Activities.(conventional physiotherapy), thrice a week for 8 weeks.

Ultrasound therapy[15]parameters: Frequency = 1 MHz Intensity=1.5 W/cm2 Duration = 5minutes,Site=Anterior knee

Group B (experimental I)

Lumbo Pelvic Hip Strengthening exercises and Conventional Physiotherapy FOR FIRST 2 WEEKS Non–weight-bearing exercises with the spine maintained in a neutral position**[16]**

Sr.No	Exercise Protocol (Repetition/Sets)	Position
1.	Alternate hip and knee flexion/extension motions.	Supine
2.	Gluteus medius exercises involving hip abduction/external rotation.	Sidelying (Short lever)
3.	Progression of gluteus medius exercise- Placing the uppermost knee in extension increases the lever arm. The hip should be held in less than 25° external rotation and slight extension.	Sidelying(Long lever)
4.	Gluteusmaximusstrengtheningwillfacilitated by extending the hip with the knee held in greater than 90° of knee flexion.	Prone
5.	Hip abductor and external rotator strengthening will be progressed by assuming quadruped starting position and performing an external rotation/abduction/extension motion of the lower extremity against gravity.	Quadruped

.No	Exercise Protocol(Repetition/sets) FOR 3rd TO 8th WEEKS[7]	Position
1.	All above exercises plus Hip abduction strengthening with sandbag , 3×10	side lying
2.	Hip abduction strengthening with Theraband band ,3×10	Standing
3.	Hip external rotation against Theraband , 3×10	Sitting
4.	Side-stepping against Therabandband , 3×10	Standing
5.	Hip extension against Therabandband , 3×10	Standing
6.	Trunk lateral flexors, 3×10.	standing

GROUP C: Knee Strengthening exercise training and Conventional Physiotherapy FOR FIRST 2 WEEKS

No	Exercise Protocol (Repetition/sets)	Position
1.	Short-arc quadriceps sets, Isometric quadriceps sets, 3×10	supine
2.	Straight-leg raises with the leg externally rotated.(30degree,45 degrees), 3×10	supine

No	Exercise Protocol (Repetition/sets)(3 to 8th weeks)[17]	Position
1.	Iliopsoas strengthening in non-weight bearing, 3× 10 repetitions	Sitting
2.	Seated knee extension 90°-45°, 3× 10 repetitions (70% load)	Sitting
3.	Leg press 0°-45°, 3× 10 repetitions (70% load)	Long sitting
4.	Squatting 0°-45°, 3× 10 repetitions	Standing

ISOMETRIC RULES OF 10's Protocol [18] Contraction = 2sec ,forcebuildMaximal hold = 6sec Force release =Relaxation = 10sec. Repetitions = 30 -40. Set 3-4 sets

At the end of each strengthening exercises session (Group B & C) Ice packs was applied to their knee joint for 10 minutes[19].After Clinical intervention at end of 8th week outcome measures were recorded and tabulated.

Result and interpretation:

All Statistical analyses Was done using Statistical Package for Social Science (SPSS16) for windows. Descriptive analysis was obtained by Mean and standard deviation for all parameter. Intergroup comparison of pretreatment score of NPRS, Kujala Questionnaire (KQFAS), Hand held Dynamometer of muscle strength was done using non-Parametric Kruskal Wallis and ANOVA Test.

Intra group comparison of pre & post treatment score of NPRS And KQFAS was done using non parametric wilcoxon Signed Rank Test , Hand held Dynamometer was used for muscle strength of hip flexors ,hip abductor , hip external rotators , knee extensor and trunk lateral flexors were done using Parametric Paired t-test of each muscle group. } Intergroup comparison of post treatment score of NPRS , KQFAS was done using non-Parametric Kruskal Wallis test, Hand held Dynamometer of muscle strength was done using parametric one way ANOVA. } One way ANOVA, Post hoc test was done to compare the effectiveness within the group.

Age distribution of Group A, Group B and Group C (TABLE:1)

Groups	N	Mean Age	Std. Deviation	Std. Error	Min	Max	P value
Control (A)	12	32.33	4.271	1.232	24	38	0.902
LPHS(B)	12	32.13	3.44	0.998	24	39	
KS(C)	12	32.50	3.529	1.01	22	39	

BMI distribution of group A , Group B and Group C (TABLE:2)

Groups	N	Mean BMI	Std. Deviation	Std. error	Min	Max	P Value
Control (A)	12	20.7	1.57	0.36	18.40	23.50	
LPHS(B)	12	21	1.26	0.42	18.80	23.20	
KS(C)	12	20.6	1.47	0.46	18.40	23.50	

TOTAL	36	20.7	1.50	0.41	18.5	23.4
						0.848

In thirty-six patients, mean age and standard deviation was 32.32 ± 3.74 with standard error 1.08

In thirty-six patients, Mean age and standard deviation was 20.7 ± 1.50 with standard error 0.41.

Inter group pretreatment comparison of NPRS, KQFAS & HHD (Strength) (Kruskal Wallis Test) (TABLE: 3)

Out Come Measure	GROUP A			GROUP B			GROUP C			P Value
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	
NPRS	3	6	5	3	6	5.33	3	6	5.25	o.846
KQFAS	36	65	47.25	36	71	50.75	32	56	46	0.987
HIP FLE	14	17	14.91	14	16	15.33	12	16	15.5	0.23
HIP.ET	10	14	12.08	10	14	12.5	10	14	12.1	0.881
HIP.ABD	9	13	11.08	10	12	11.33	8	12	11.08	0.843
HIP.EXT.ROT	8	12	10.33	8	12	10.33	12	16	14.08	0.848
KNEEXT	10	13	11.83	10	12	11.08	9	14	11.25	0.162
TRUNK.LAT.FL	8	10	8.91	8	12	9.58	8	12	10.08	0.316

The above table shows the inter group comparison of pretreatment scores of NPRS hhd& KQFAS. The p value is > 0.05. It shows that there is no Significant difference between the pretreatment scores of NPRS, HHD & KQFAS. Hence it proves that the groups are homogenous.

Intra Group Comparison of Pre & Post Treatment Scores (Group A) (TABLE:4)

Outcme measure	Pre			Post			P Value
	Min	max	Mean	Min	Max	Mean	
NPRS	3	6	5.25	2	4	3.66	0.006
KQFAS	43	65	50.66	52	71	60.33	0.002
HIP .FLE	14	17	14.91	15	17	15.83	0.002
HIP EXT	10	14	12.08	12	15	13.41	0.000
HIP.ABD	9	13	11.08	12	15	12.75	0.000
HIP.EXT.RO	8	12	10.33	10	13	12.08	0.001
KNEE.EXT	10	13	11.83	12	14	13.41	0.000
TRUNK. LAT.FLE	8	10	8.91	9	12	10.66	0.000

Intra Group Comparison Of Pre & Post Treatment Scores(Group B) (TABLE:5)

Outcome Measures	Pre			Post			P value
	Min	max	Mean	Min	Max	Mean	
NPRS	3	6	5.08	0	2	1.5	0.002
KQFAS	43	71	50.75	59	82	73.75	0.003
HIP.FLE	14	16	15.33	18	22	20.17	0.000
HIP.EXT	10	14	12.5	14	19	16.83	0.000
HIP.ABD	10	12	11.33	14	18	15.83	0.000
HIP.EXT.ROT	8	12	10.33	14	18	17.25	0.000
KNEE.EXT	10	12	11.08	14	22	17.5	0.000
TRUNK.LAT.FLE	8	12	9.58	12	15	14.58	0.000

Intra Group Comparison of Pre & Post Treatment Scores (Group C) (TABLE:6)

Outcome measures	Pre			Post			P value
	Min	Max	Mean	Min	Max	Mean	
NPRS	3	6	5.25	2	5	3.66	0.010
KQFAS	43	63	50.5	61	72	66.75	0.002
HIP .FLE	12	16	15.5	16	20	18.66	0.000
HIP.EXT	10	14	12.16	13	18	15.33	0.000
HIP.ABD	8	12	11.08	12	16	14	0.000
HIP.EXT.ROT	12	16	14.08	14	18	15.91	0.001
SKNEE.EXT	9	14	11.25	13	18	14.5	0.001
TRUNK.LAT.FLE	8	12	10.08	12	15	13.91	0.000

Inter Group Post Treatment Comparison Of NPRS ,HHD& KQFAS (Kruskal Wallis Test)

(TABLE:7)

Out Come Measure	Group A			Group B			Group C			P Value
	Min	Mx	Mean	Min	Max	Mean	Min	Max	Mean	
NPRS	2	5	3.66	0	2	1.5	2	4	2.75	0.000
KQFAS	52	71	60.33	59	82	73.75	61	72	66.75	0.001
HipFle	15	17	15.83	18	22	20.16	16	20	18.66	0.000
HipExt	12	15	13.41	14	19	16.83	13	18	15.33	0.000
Hip.Abd	12	15	12.83	14	18	15.83	12	16	14	0.000
Hip.Ext.Rot	10	13	12.08	14	18	16.16	14	18	15.91	0.000
Knee.Ext	12	14	13.41	14	22	17.5	13	18	14.5	0.000
Trunk.Lat.Fle	9	12	10.66	12	15	14.58	12	15	13.91	0.000

This table shows the inter group comparison of post treatment values. The value is <0.05 in NPRS, HHD and KQFAS scores indicating that there is significant difference in the improvement between the groups. The Post Comparison of NPRS & KQFAS has been done For 3groups with kruskal Wallis Test & Post comparison of muscle strength with HHD had been done with one-way ANOVA

Multiple Comparison for mean of difference of NPRS between Groups A, B And C(TABLE:8

Dependent variable	Groups		std. error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Post NPRS	Control	LPHS	0.33	0.000	1.3275	3.0058
		KS		0.028	.0775	1.7558
	LPHS	Control		0.000	-3.0058	-1.3275
		KS		0.002	-2.0891	-.04109
	Knee strengthening	Control		0.028	-1.7558	-.0775
		LPHS		0.002	.4109	2.0891

The above shows the comparison of mean of Post NPRS Score between Control group, LPHS group and KS group. It shows that there is significant difference between Control group and LPHS group with p value of 0.000 (i.e.<0.05), and also significant difference between Control Group and KS Group with p value of 0.028 (i.e. <0.05) as well as between LPHS Group and KS Group with p value of 0.002 (p-value <0.05). The mean plot shows the largest significant change in LPH Strengthening Group compared to Control and Knee Strengthening group.

Multiple Comparison for mean of difference of KQFAS between Groups A, B and C (TABLE:9)

Dependent variable	Groups	std. error	Sig.	95% Confidence Interval	
				Lower Bound	Upper Bound

Dependent Variable	Groups		std.error	Sig.	Lower	Upper
Post KQFAS	Control	LPHS		0.000	-19.9368	-6.8965
		KS		0.005	-12.9368	0.1035
	LPHS	Control	2.58	0.000	6.8965	19.9368
		KS		0.032	.4799	13.5201
	KS	Control		0.005	-.1035	12.9368
		LPHS		0.032	-13.5201	-.4799

The above table and graph shows the comparison of mean of Post KQFAS Score between Control, LPHS group and KS Group. It shows that there is significant difference between Control group and, LPHS group with p value of 0.000 (i.e.<0.05), and also significant difference between Control Group and KS group with p value of 0.005 as well as between , LPHS group and KS Group with p value of 0.032 (p-value <0.05). The mean plot shows the largest significant change in LPHS Group compared with Control and Knee strengthening group.ultiple Comparison for mean of diff. Hip Flexor Strength (HHD) of between Groups A, B and C(TABLE:10)

Dependent Variable	Groups		std. error	Sig.	95%Confidence Interval	
					Lower Bound	Upper Bound
Post Hip Flexor Strengh	Control	LPHS		0.000	-5.4670	-3.1997
		KS		0.000	-3.9670	-1.6997
	LPHS	Control	0.44	0.000	3.1997	5.4670
		KS		0.006	.3663	2.6337
	Knee strengtheni ng	Control		0.000	1.6997	3.9670
		LPHS		0.006	-2.6337	-.3663

Multiple Comparison for mean of difference Hip Extensor Strength (HHD) of between Groups A, B and C (TABLE:11)

Dependent variable	Groups		std. error	Sig.	95%Confidence Interval	
					Lower	Upper
Post Hip Extension	Control	LPHS		0.000	-4.8195	-2.0138
		KS		0.005	-3.3195	-.5138
	LPHS	Control	0.55	0.000	2.0138	4.8195
		KS		0.033	.0972	2.9028
	Knee strengthe ning	Control		0.005	.5138	3.3195
		LPHS		0.033	-2.9028	-.0972

Multiple Comparison for mean of difference Hip External Rotator Strength (HHD)of between Groups A, B and C(TABLE:12)

Dependent variable	Groups		std. error	Sig.	95%Confidence Interval	
					Lower	Upper
PostHip External Rotator	Control	LPHS		0.000	-6.5483	-3.7850
		KS		0.000	-5.0483	-2.2850
	LPHS	Control	0.53	0.000	3.7850	6.5483
		KS		0.030	0.1183	2.8817
	Knee Strengthe ning	Control		0.000	2.2850	5.0483
		LPHS		0.030	-2.8817	-.1183

Multiple Comparison for mean of difference Knee Extensors strength (HHD) of between Groups A, B and C(TABLE:13)

Dependent variable	Groups		std. error	Sig.	95%Confidence Interval	
					Lower Bound	Upper Bound
Post Knee Extensors	Control	LPHS		0.000	-5.5785	-2.5881
		KS		0.017	-3.2452	-0.2548
	LPHS	Control	0.59	0.000	2.5881	5.5785
		KS		0.001	0.8381	3.8285
	Knee strengthening	Control		0.017	0.2548	3.2452
		LPHS		0.001	-3.8285	-0.8381

Multiple Comparison For Mean Of Difference Trunk Lateral Flexors Strength (Hhd) Of Between Groups A, B And C(Table:14)

Dependent variable	Groups		std. error	Sig.	95%Confidence Interval	
					Lower Bound	Upper Bound
Post Trunk Lateral Flexors	Control	LPHS		0.000	-4.9708	-2.8626
		KS		0.000	-3.8874	-1.7792
	LPHS	Control	0.47	0.000	2.8626	4.9708
		KS		0.042	0.0292	2.1374
	Knee strengthening	Control		0.000	1.7792	3.8874
		LPHS		0.042	-2.1374	-0.0292

The above table shows the comparison of mean of HIP FLEXORS, HIP EXTENSORS,   HIP EXTENSOR ROTATORS ,HIP ABDUCTOR , KNEE EXTENSOR AND TRUNK LATERAL FLEXORS strengthScore between Control, LPHS group and Knee strengthening group . It shows that there is significant difference between Control group and, LPHS group with p value of 0.000 (i.e. <0.05), and significant difference between Control Group and Knee strengthening group with p value of 0.017 (i.e>0.05) as well as between , LPHS group and Knee strengthening Group with p value of 0.001 (p-value <0.05). That shows the significant change in LPHS Group compared to Control and Knee strengthening group.

DISCUSSION

Results indicate that there is significant improvement in pain, strength and functional status in patients with patello femoral pain syndrome at the end of 8 weeks in all the three groups after conventional physical therapy alone group A, Lumbo pelvic hip strengthening exercise program with conventional physiotherapy group B & knee strengthening Exs with Conventional physical therapy group C. All the three treatment groups obtained Successful outcomes as measured by significant reductions in NPRS score and significant increase in Strength and KQFAS Scores after 24 session of intervention. There is significant difference in intensity of pain as per NPRS, lower limb muscle Strength as per Hand held Dynamometer and functional ability as per KQFAS between three groups.

After that for finding the inter group comparison of pretreatment scores of Numeric Pain Rating Scale, Hand held dynamometer value &Kujala Questionnaire function ability scale were used. The p value is > 0.05. It shows that there is no Significant difference between the pre treatment scores of NPRS, Hand held dynamometer & KQFAS. Hence it proves that the groups are homogenous.

Intra group comparison of pre & post treatment score of NPRS And KQFAS was done using non parametric wilcoxon Signed Rank Test , Hand held Dynamometer was used for muscle strength of hip flexors ,hip abductor , hip external rotators , knee extensor and trunk lateral flexors were done using Parametric Paired t-test of each muscle group. Intergroup comparison of post treatment score of NPRS , KQFAS was done using non-Parametric Kruskal Wallis test, Hand held Dynamometer of muscle strength was done using parametric one way ANOVA.One way ANOVA, Post hoc test was done to compare the effectiveness within the group.

The objective of this study was to find the comparing the effectiveness Of Lumbopelvic Hip Strengthening verses knee strengthening with conventional therapy in reducing pain and improve functional outcome of knee in women with PFPS. all 3 groups shows overall effectiveness after 8 weeks on NPRS,FQFAS AND Hip Muscle,Knee Flexors And Trunk Lat.Flexors is p<0.005, All treatment protocol was effective significant improvement in pain, muscle strength and functional disability. So, null hypothesis-H01 hypothesis is rejected. And alternative hypothesis-H11 is accepted.

Multiple comparisons were done by Post hoc analysis test to justify the intergroup difference for each outcome measures. The results of post hoc analysis NPRS suggested that after 24 weeks of intervention, demonstrated lumbo pelvic hip strengthening group produced greater improvement in all the three outcome measures (NPRS,HHD, KQFAS) than knee strengthening group and Control group. Post hoc for **NPRS** Score, suggested that lumbo pelvic hip strengthening group (p= 0.000) and knee strengthening (p = 0.028) groups improved better than Control group and significant difference (p = 0.002) between that lumbo pelvic hip strengthening group and knee strengthening . Post hoc for **KQFAS** Score suggested that that lumbo pelvic hip strengthening group (p =0.000) and knee strengthening group=0.005)and improved better than Control group and a significant difference (p = 0.032) between that lumbo pelvic hip strengthening group (p = 0.000) and knee strengthening group.

When Post hocwasdone for**hipflexor,Hipextensors,anductors,hipext.rotators,knee extensors and trunk lateral rotator's s**trength Score It shows that there is significant difference between Control group and, LPHS group with p value of 0.000 (i.e. <0.05), and significant difference between Control Group and Knee strengthening group with p value of 0.000 (i.e<0.05) as well as between , LPHS group and Knee strengthening Group with p value of 0.042 (p-value<0.05).

We can easily get clear idea from the mean plot of individual post NPRS, Strength (HHD) and KQFAS with comparison of group A, B and C with the help of SPSS 16.0 through using post hoc analysis test.

There is a role of neuromuscular training of lumbo-pelvic region and its effect on the lower quarter function.it is currently theorized that the pathogenesis of PFPS starts with a decrease in hip and core neuromuscular control and strength; causing dynamic malalignment of the lower extremity. Ultimately significant weakness of the hip lateral rotators and abductors in women with PFPS. So improvement in hip and core musculature.

CONCLUSION

In our study, we found that that lumbo pelvic hip strengthening ex"s group and knee strengthening exs both were effective in reducing pain and disability and in improving Strength in patients with patellofemoral pain syndrome, Butlumbo pelvic hip strengthening exs was more effective than knee strengthening exs in reducing pain and disability and in improving Strength in patients with patellofemoral pain syndrome.

LIMITATION OF THE STUDY

- The study consists of a small quantity of subjects.
- No long term follow up was done.And No Blinding Was Done

SCOPE FOR FUTURE RESEARCH

- 1.Further study can be done with larger sample size
- 2.Study can be done with long term follow up.
- 3. The same study can be done with using EMG as a one of the outcome measures
- 4.Future study can be done on Male And Athletes population in PFPS.

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CONFLICT OF INTEREST:

We declare that there were no conflicts of interest in the entire journey of the study.

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