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A study on efficacy of ultrasound effect of ultrasound with patellar taping and ultrasound with isometric exercises in the patients with patellofemoral pain syndrome-an experimental study

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Abstract
Patellofemoral pain syndrome (PFPS) is a syndrome characterized by pain or discomfort seemingly originating from the contact of the posterior surface of the patella (back of the knee cap) with the femur (thigh bone). Commonly occurs in the athletes. Several non- operative interventions with varying success rates, have been described. The aim of this study was to compare the effectiveness of 2 protocols for the management of patellofemoral pain syndrome: (1) ultrasound with patellar taping (2) ultrasound with isometric exercises. The purpose of the study is to determine which treatment is more effective in treating patients with patellofemoral pain syndrome.40 subjects with a case of PFPS were chosen for the study. Then the subjects are divided in two groups each group will have 20 subjects. Subjects were pre-tested using Visual analogue scale (VAS) for pain intensity and WOMAC scale for functional disability. The first group was given ultrasound with patellar taping second group received ultrasound with isometric exercises. Both the groups will be trained for 2 weeks and the assessment parameters will be taken at the end of the 2 weeks. In the present study, within group analysis showed pain relief and increased range of motion which was statistically significant in both the groups ($p<0.001$) whereas the between group analysis revealed that Group 2 (ultrasound with isometric exercises) was highly significant ($p<0.001$) as compared to Group 1. Both groups statistically showed significant responses to their interventions. Ultrasound with isometric exercises was found to be more effective than the ultrasound with patellar taping to reduce the pain and to decrease functional disability in patients with patellofemoral pain syndrome.

Keywords: Patellofemoral pain syndrome, ultrasound, isometric exercises, patellar taping, visual analogue scale (vas), womac scale

Introduction
Patellofemoral pain syndrome (PFPS) is described in the literature as anterior knee pain, caused by aberrant motion of the patella in the trochlear groove, which results from biochemical and/or physical changes within the patellofemoral joint (PFJ). PFPS exists without gross abnormality of the articular cartilage. It is a problem of chronic overload of the muscles of the lower extremity [1]. Patellofemoral pain syndrome (PFPS) is a common musculoskeletal complaint characterized by pain in front of the knee which is provoked by activities such as walking up and down stairs, sitting with flexed knees for long periods, running, kneeling and squatting [2] Patellofemoral pain syndrome (PFPS) is usually due to weakness of vastus medialis obliqus (VMO) resulting in abnormal patellar tracking [3]. Pain at the front of the knee or "behind the knee cap" is a common problem for many sports people and can be very debilitating. This condition has a number of names including "Patello-Femoral Pain Syndrome" & "Runners Knee". The problem occurs between the patella and the femur. Under normal circumstances, the patella presses against the lower portion of the femur when the knee is in a bent position [4, 5]. Patellofemoral syndrome (PFPS) is one of the most common joint complaints and affects athletes and non-athletes alike. PFPS patients report of symptoms of anterior knee pain, aggravated by functional activities. Patellar crepitation, swelling and locking are other symptoms [6]. During running or any step, squat or landing & jumping activity, the patella moves up and down or "tracks" against the femur and in so doing, acts as a

fulcrum, which provides a mechanical advantage for the quadriceps muscle. Decreased soft-tissue flexibility is also evident in adolescents due to the inability of soft tissues to accommodate the rapid growth of skeletal structures such as the long bones [7, 8]. There is a commonly accepted concept that conservative rehabilitation induces symptom relief for PFPS patients. Different treatments can be tried to reduce the pain and difficulties experienced during daily activities which includes drugs, electric modalities and massage. Exercise regimens to strengthen the muscles surrounding and supporting the knee are other options [9]. The patello femoral pain is one of the most common cause of retro patellar or peripatellar pain. It is caused by imbalances in the forces controlling patellar tracking during knee flexion and extension particularly in the knee joint. PFPS is a condition of both mal alignment and mal tracking, the most widely accepted cause of patellaofemoral pain is mal tracking of patella which occurs due to weakness of VMO [10]. Conservative treatment of patellofemoral pain syndromes is focused on restoring normal patella tracking and its strengthening of quadriceps muscle which places an important role in maintaining patella in its normal position. Patella taping was originally developed to create a mechanical medial shift to the patella, thus centralizing it and thereby improving patellar tracking. In the appropriate hands and with the right technique patellar taping has been successful [4]. Patellofemoral pain is associated with patellar mal alignment and quadriceps weakness, which are seen more commonly in women. In general population females have a higher incidence of patellofemoral pain than males 3:2. There are clear structural, biomechanical, sociological and hormonal differences between women and men that contribute to an increase in incidence of PFPS in women. This high incidence in women has been attributed to the gender difference in muscle strength, conditioning and anatomic structure especially increased Q – angle [7]. Studies have shown that strengthening the quadriceps specifically the VMO can have the impact on mechanics of patellofemoral joint and VMO is the only muscle that can move the patella medially and it works tonically throughout the entire range of motion [11].

It is proved that patellar taping is very effective at reducing the level of pain during activities that create large patellofemoral joint reaction forces. However it has been proven that taping can be helpful in reducing short term pain with activities [2]. Conservative treatment for PFPS often consists of a variety of components designed to improve patellar alignment including quadriceps retraining (especially VMO), patellar mobilization, stretching lower limb muscles, correcting foot biomechanics with orthosis, taping, icing, ultrasound for relief of pain and inflammation, squatting exercises [11, 12]. Treatment of PFPS in a running individual should focus on the usual methods of the quadriceps strengthening [13]. Anterior knee pain is a common presenting complaint and in many cases no identifiable cause can be found. In these circumstances it is commonly known as anterior knee pain syndrome or patellofemoral pain syndrome. The management for this condition is most commonly non-operative. Treatment strategies includes physiotherapy, pharmacotherapy, orthotics and combination of the above. Patellofemoral pain syndrome (PFPS) is a term commonly used to describe anterior knee pain and is usually aggravated by walking up/down stairs, deep-squatting, kneeling, prolonged sitting and standing up [11, 1]. PFPS especially affects young adults daily living activities and leads to functional deficiency. Rehabilitation includes specific exercises thought to encourage VMO activity, general quadriceps exercises and stretching tight lateral structures [3]. Additionally to this patient education, rest, activity modification, electromyographic biofeedback, neuromuscular electric stimulation, therapeutic ultrasound, thermotherapy, patellar taping, bracing, shoe orthotics, knee sleeves and nonsteroidal anti-inflammatory drugs are generally included in the nonoperative treatment of PFPS [4, 7]. Patellofemoral pain syndrome (PFPS) is a relatively common disorder encountered in the clinical setting affecting an estimated 7% to 40% of adolescents and active young adults [10, 3]. The diagnosis of PFPS is typically made based on the presence of anterior or retropatellar knee pain associated with prolonged sitting or with weight-bearing activities that load the patellofemoral joint such as squatting, kneeling, running and ascending and descending steps [14]. Current evidence-based treatment approaches include taping, strengthening of the hip musculature and quadriceps, manual therapy to the lower quarter and fitting of foot orthoses. Treatment interventions for PFPS have previously targeted presumed altered patellofemoral joint biomechanics [15, 16, 17, 18]. One intervention often incorporated into the management of patients with PFPS is patellar taping [15]. Therapeutic ultrasound has benefits on tissue such as speeding healing process, reduction of swelling and edema with decrease in pain intensity micromassage benefits to reduce the adhesion.Patellar taping is useful in person with PFPS to improve stability of patellofemoral joint during range of motion activities.Isometric contraction of quadriceps muscle helps in increasing the muscle strength and fasten soft tissue healing with improved ADL activies.This study focuses on functional recovery and improvement of ADL activities in patient with PFPS.

Materials and Methods: Source of data obtained from patients referred to the Government Wenlock hospital, Mangalore. Shree devi college of physiotherapy, Mangalore. SCS hospital, Mangalore with confirmed diagnosis of PFPS. Research design: Pre and post- test experimental study. Method of collection of data: Subjects were assigned in to two groups by random sampling method. 40 Patients diagnosed to have PFPS was been recruited for the study after obtaining informed consent. Group 1: The subjects received ultrasound with patellar taping. Group 2: The subjects received ultrasound with isometric exercises. Subjects fulfill the following inclusion and exclusion criteria randomly assigned in to two groups. INCLUSION CRITERIA: Sub acute symptomatic patients age ranges between 18-45 years of both genders, Sub acute stage, Pain present during activities such as descending and ascending stairs, squatting and running, Subjects with lateral tilt of patella. (positive J sign), On radiograph patellar malalignment (patellar tracking). EXCLUSION CRITERIA: Patella dislocation, History of fracture around knee, Knee flexion deformities like genu varum, flexion contracture, genu recurvatum, Ligament/ meniscal injuries, O.A Tibiofemoral, Other neurological abnormalities. MATERIALS: Plinth to position the subject, Ultrasound machine, Non allergic tape, Cotton, Pillow, Bolster, Mackintosh, Aqua sonic gel. METHODOLOGY: All the subjects randomly assigned into two groups (Group 1 and Group 2 of 20 each.) Both the groups receives conventional treatment. Conventional treatment (ultrasound therapy) which was given in supine lying position pillow placed under the knee. Parameter chosen was pulsed mode with mark: pulse ratio 1:1 with intensity 0.8-1.0 watts/cm^2. Group 1: The subjects were received ultrasound with patellar taping. Group

2: The subjects were treated with ultrasound and isometric exercises. GROUP 1:- Subjects were given ultrasound and patellar taping by using adhesive tape. The patient positioned in supine lying position. The purpose of taping was to correct the components of lateral tilt, medial glide and rotation. In supine lying position Glide Component- First of all lateral border of the patella will be palpated. Then medial glide of patella is achieved by fixing the tape to the lateral border and pulling the patella medially before attaching tape to the skin. Tilt component- Place the tape in the middle of the patella and pull the tape posterior and attach over the tape used for glide correction or over the skin. Rotation component- Internal rotation of patella was corrected by anchoring on the lateral aspect of the inferior pole of the patella and pulling towards medially. GROUP 2: The subjects given ultrasound and isometric exercises. Ask the patient to lie in supine position with knee extension by placing rolled towel or bolster under the knee, and subject is asked to tighten the quadriceps muscles as possible as hold the contraction by pressing the rolled towel or bolster with knee, the contractions held for 6 seconds and the subject should relax the quadriceps muscle. The same exercises repeated for 15 times. Treatment duration for both groups continuously 2 weeks. OUT COME MEASURES: The following outcome measures were measured at baseline and at the end of 2nd week of treatment. A follow-up measurement was done at 4 weeks from the end of treatment. Visual analog scale (VAS), WOMAC SCALE

Fig No: 1 Patellar Taping

Fig No: 2 Ultrasound Machine

Fig no: 3 Isometric Exercise of Quadriceps

Fig no: 4 Multiple Angle Isometric Exercise of Quadriceps

Fig no: 5 Conventional Therapy (ultrasound therapy)

Results

Paired and unpaired t tests and chi square test were done for statistical analysis. In present study intra group comparison results showed that pain relief and improved functional activities was statistically significant in both the groups. Whereas inter group comparison results showed that group 2 i.e. ultrasound with isometric exercises was statistically significant in reducing pain and improving functional activities than Group 2 subjects with PFPS. Hence based on results of present study it can be concluded that both group showed significant decrease in VAS, improvement in functional activities whereas group 2 showed better results as compared to group 1. This study was focused on pain relief, where pain assessment was done by visual analog scale (VAS) and improvement in the functional activities of daily living, assessment was done by WOMAC score. In this study the age group was between 18-45 years. Total of 40 subjects were included in the study after satisfying the inclusion criteria. Group 1 consists of 20 subjects and Group 2 consists of 20 subjects. The mean values of data from present study indicates that group 1 and group 2 treated with ultrasound with patellar taping and ultrasound with isometric exercises respectively showed when the intra group mean values of VAS were analyzed it was found statistically significant in both groups pre to post intervention, but when comparison was done inter group, statistically group 2 showed more significance as compared to group 1 in relieving pain. In the present study of reduction in pain level, as quantified by the VAS with the application of both ultrasound with patellar taping and ultrasound with isometric exercises is consistent on pain relief and improved functional disability on WOMAC scale. Also the result of the study shows an overall improvement in pain score on VAS and improvement in functional activity on WOMAC scale in group 2 in comparison to group.

Table no. 5.1: age wise distribution of subjects in both the group X2=.410, p=.815, NS

		Group		
		Group 1	Group 2	Total
AGE	18 - 25	5	4	9
		25.0%	20.0%	22.5%
	26 - 35	8	10	18
		40.0%	50.0%	45.0%
	36 - 45	7	6	13
		35.0%	30.0%	32.5%
Total		20	20	40
		100.0%	100.0%	100.0%

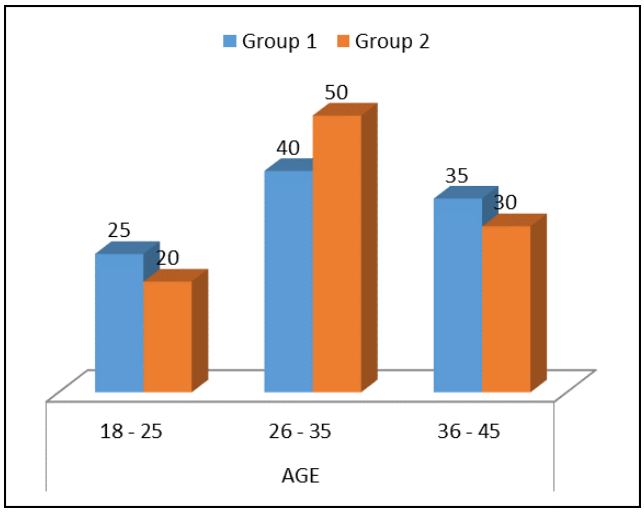

Figure no: 5.1 Age wise distribution of subjects in both the group Group 1 : In group 1 25% subjects were in the age group of 18-25 years, 40% subjects were in the age group of 26-35 years and 35% subjects were in the age group of 36-45 years.Group 2 : In group 2 20% subjects were in the age group of 18-25 years, 50% subjects were in the age group of 26-35 years and 30% subjects were in the age group of 36-45 years.There was no singnificant difference between age wise distribution in both the groups as p value 0.815 > 0.05.

Table no 5.2: Gender wise distribution of subjects in both the group X2=.102, p=.749, NS

		Group		
		Group 1	Group 2	Total
SEX	F	8	9	17
		40.0%	45.0%	42.5%
	M	12	11	23
		60.0%	55.0%	57.5%
Total		20	20	40
		100.0%	100.0%	100.0%

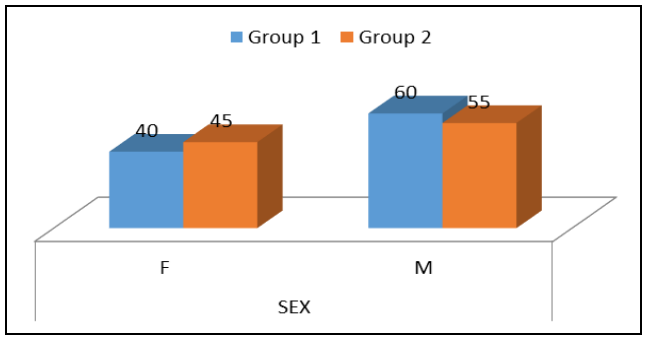

Figure no 5.2: Gender wise distribution of subjects in both the group.Group 1:In group 1 there were 40 females and 60 males.Group 2 : In group 2 there were 45 females and 55 males.There was no significant difference between two groups with respect to gender as p value 0.749 > 0.05.

Table no 5.3: Side involvmennt wise distribution of subjects in both the group.X2=.102, p=.749, NS

		Group		
		Group 1	Group 2	Total
SIDE	Right	12	11	23
		60.0%	55.0%	57.5%
	Left	8	9	17
		40.0%	45.0%	42.5%
Total		20	20	40
		100.0%	100.0%	100.0%

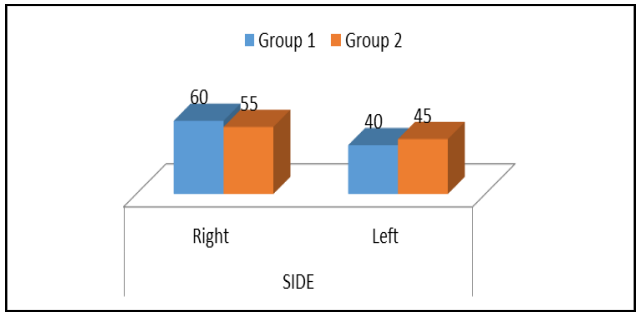

Figure no.5.3: Side involvmennt wise distribution of subjects in both the group.Group 1 : In group 1 right side involvment was 60% and left side involvment was 40%.Group 2 : In group 2 right side involvment was 55% and left side involvment was 45%.There was no significant difference between two groups with respect to side involvment as p value 0.749 > 0.05.

Table no 5.4: Comparison of two groups before the treatment .There is no significant difference between group 1 and 2 with respect to all the outcome parameters as p value > 0.05.

BEFORE

Parameter	Group	N	Minimum	Maximum	Mean	Std. Deviation	Median	t value	p value
VAS	Group 1	20	5	8	6.50	1.051	6.50	.81	.423
	Group 2	20	5	9	6.80	1.281	7.00		NS
	Total	40	5	9	6.65	1.167	7.00		
WOMAC SCORE	Group 1	20	65	93	80.50	8.069	79.50	.16	.874
	Group 2	20	65	95	80.90	7.806	80.00		NS
	Total	40	65	95	80.70	7.839	80.00		

Table no 5.5: Within group comparison- pre to post comparison in group 1 and group 2

Parameter: VAS

Group		N	Minimum	Maximum	Mean	Std. Deviation	Median	Mean difference	S.D of difference	Change (%)	t value	p value
Group 1	BEFORE	20	5	8	6.50	1.051	6.50	2.400	.681	36.92	15.77	.000
	AFTER	20	2	6	4.10	1.021	4.00					HS
Group 2	BEFORE	20	5	9	6.80	1.281	7.00	3.850	1.424	56.62	12.09	.000
	AFTER	20	1	4	2.95	.826	3.00					HS

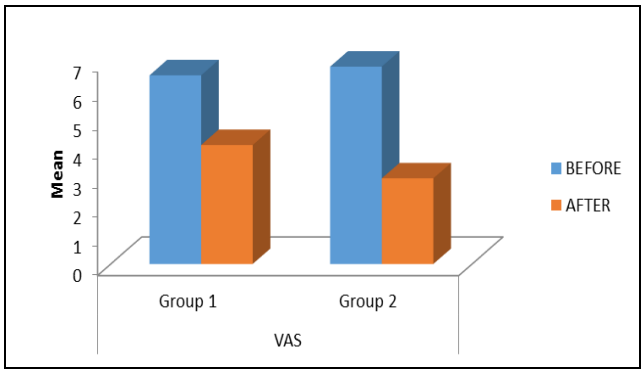

Figure no.5.5: Within group comparison- pre to post comparison in group 1 and group**.** In group1: Pain level before treatment was 6.5 ± 1.05 and after the treatment 4.10 ± 1.02 resulting in 36.92% improvement after the treatment. Test shows there is significant improvement after the treatment as p value 0.00 < 0.01.In group 2: Pain level brfore treatment was 6.80 ± 1.2 and after the treatment 2.95 ± 0.8 resulting in 54.6% improvement after the treatment. Test shows there is significant improvement after the treatment as p value 0.00 < 0.01. So both the treatments are effective in reducing pain.

Table no 5.6: Comparison of effects between the groups. Group 1: In group 1 there was 36.92% improvement.Group 2 : In group 2 there was 56.62% improvement.Test shows that there is significant difference in the effect of two treatment as p value < 0.01 so group 2 treatment is better than group 1 treatment.

Parameter Vas

Group	N	Mean difference	S.D of difference	Change (%)	t value	p value
Group 1	20	2.400	.681	36.92	4.11	.000
Group 2	20	3.850	1.424	56.62		HS

Table no 5.7: Within group comparison- pre to post comparison in group 1 and group 2

Parameter: WOMAC SCORE

Group		N	Minimum	Maximum	Mean	Std. Deviation	Median	Mean difference	S.D of difference	Change (%)	t value	p value
Group 1	BEFORE	20	65	93	80.50	8.069	79.50	21.500	6.992	26.71	13.75	.000
	AFTER	20	40	71	59.00	8.572	60.00					HS
Group 2	BEFORE	20	65	95	80.90	7.806	80.00	36.250	9.558	44.81	16.96	.000
	AFTER	20	27	60	44.65	9.631	45.00					HS

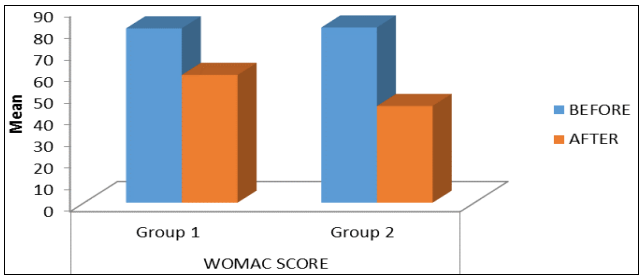

Fig no. 5.7: Within group comparison- pre to post comparison in group 1 and group 2

In group 1: Functional level before treatment was 80.50 ± 8.06 and after the treatment 59.00 ± 8.57 resulting in 26.71% improvement after the treatment. Test shows there is significant improvement after the treatment as p value 0.00 < 0.01.In group 2: Functional level brfore treatment was 80.90 ± 7.80 and after the treatment 44.65 ± 9.63 resulting in 44.81% improvement after the treatment. Test shows there is significant improvement after the treatment as p value 0.00 < 0.01. So both the treatments are effective in improving functional disabilities.

Table no 5.8: Comparison of effect between the groups. Group 1: In group 1 there was 26.71% improvement. Group 2: In group 2 there was 44.81% improvement. Test shows that there is significant difference in the effect of two treatment as p value < 0.01 so group 2 treatment is better than group 1 treatment.

Parameter: WOMAC SCORE

Group	N	Mean difference	S.D of difference	Change (%)	t value	p value
Group 1	20	21.500	6.992	26.71	5.57	.000
Group 2	20	36.250	9.558	44.81		HS

Table no.5.9: Effect of gender on the treatment .There is no significance difference with respect to gender in both the treatment groups.

	Parameter	Group	SEX	Mean	Std. Deviation	t value	p
Change	VAS	Group 1	F	2.25	.463	.797	.436
			M	2.50	.798		NS
		Group 2	F	4.00	1.225	.417	.682
			M	3.73	1.618		NS
	WOMAC SCORE	Group 1	F	24.25	8.049	1.480	.156
			M	19.67	5.836		NS
		Group 2	F	35.22	11.734	.426	.676
			M	37.09	7.854		NS

Table no 5.10: Effect of side involved on the treatment. There is no significance difference with respect to side involvement in both the treatment groups.

	Parameter	Group	SIDE	Mean	Std. Deviation	t value	p
Change	VAS	Group 1	Right	2.33	.778	.526	.605
			Left	2.50	.535		NS
		Group 2	Right	4.09	1.640	.829	.418
			Left	3.56	1.130		NS
	WOMAC SCORE	Group 1	Right	20.67	6.972	.643	.529
			Left	22.75	7.305		NS
		Group 2	Right	38.36	10.529	1.099	.286
			Left	33.67	8.047		NS

Table no 5.11: Effect of age on the treatment

Correlations

		Parameter	Group	Karl pearson correlation coefficient r	p	
AGE with	Change	VAS	Group 1	-.046	.848	NS
			Group 2	-.395	.085	NS
		WOMAC SCORE	Group 1	-.183	.440	NS
			Group 2	-.145	.541	NS

AGE

Group	Mean	Std. Deviation
Group 1	32.20	7.777
Group 2	32.20	7.991
Total	32.20	7.783

There is no significance difference with respect to age in both the treatment groups.

Discussion

The present study was conducted to compare the effectiveness of ultrasound with patellar taping versus ultrasound and isometric exercises in subjects with patellofemoral pain syndrome. The results of the study were focused on pain relief, pain assessment was done by visual analog scale (VAS) and improvement in the functional activities of daily living, assessment was done by WOMAC score. In this study the age group was between 18-45 years consecutively patient referred to physical therapy treatment with PFPS. The mean values of data from present study indicates that group 1 and group 2 treated with ultrasound with patellar taping and ultrasound with isometric exercises respectively showed when the intra group mean values of VAS were analyzed and was found statistically significant in both groups pre to post intervention, but when comparison was done inter group, statistically group 2 showed more significance as compared to group 1 in relieving pain. The present study showed reduction of pain level, as quantified by the VAS with the application of both ultrasound with patellar and ultrasound with isometric exercises is consistent with findings of previous studies including ultrasound with patellar and ultrasound with isometric exercises in reducing pain in patients with PFPS in pain score on VAS and improved functional disability on WOMAC scale. This study aimed to examine the effectiveness of each of these techniques in isolation for one week and in combination for one week. In isolation, quadriceps stretching and quadriceps strengthening resulted in more improvements than taping. Combining these treatments is recommended as the initial approach to treating patellofemoral pain but further individualized more functional, global treatment is essential and also the result of the study shows an overall improvement in pain score on VAS and improvement in functional activity on WOMAC scale in group 2 in comparison to group 1. From the present study it can be concluded both groups showed significant improvement in terms of pain and functional disability in patients with PFPS. But group 2 showed better result as compared to group 1. In the present study, within group analysis showed pain relief and increased range of motion which was statistically significant in both the groups ($p<0.001$) whereas the between group analysis revealed that Group 2(ultrasound with isometric exercises) was highly significant ($p<0.001$) as compared to Group 1.

Limitation of the study: Sample size was small, It is limited by the fact daily activities of the subjects were not monitored which could have influenced, Duration of the study is also short, Occupation relevance was not compared. Future scope of the study: Studies with longer duration are recommended with longer follow-up period to assess long term benefits, Conduct the study with larger sample size.

Conclusion

Both groups statistically showed significant responses to their interventions. Ultrasound with isometric exercises was found to be more effective than the ultrasound with patellar taping to reduce the pain and to decrease functional disability in patients with patellofemoral pain syndrome.

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