International Journal of Physiotherapy and Research,
Int J Physiother Res 2019, Vol 7(6):3287-94. ISSN 2321-1822
DOI: https://dx.doi.org/10.16965/ijpr.2019.182

Original Research Article

IMMEDIATE EFFECT OF DRY NEEDLING VS ULTRASOUND ON RELEASING TRIGGER POINTS IN QUADRICEPS IN PATIENTS WITH PATELLO-FEMORAL PAIN SYNDROME ON PAIN

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ABSTRACT

Background: Patello-femoral pain syndrome is a very common complaint seen in adolescence and young adults characterized by pain around and behind the patella. There has been prevalence of trigger points in the quadriceps leading to disruption of the VMO/VL firing pattern due to muscle inhibition by pain. Current studies suggest the use of strengthening exercises for hip and knee not focusing on releasing the trigger points. Releasing these trigger points could give additional benefit to the patient and can also be employed along with other conventional therapies.

Purpose of the study: To find out which treatment method gives faster results and works directly on the pain and function of the patient.

Objectives: To assess the immediate effect of Dry Needling Vs Ultrasound on releasing Trigger points in Quadriceps in patients with Patello-femoral Pain Syndrome on pain and knee/lower extremity function.

Study Design: Randomized Control trail

Setting: OPD setting.

Participants: 70 patients with chronic anterior knee pain, without any ligament, bony or sensory involvement around the knee.

Main outcome measures: Numerical Pain rating scale and Pressure Algometer.

Results: In the ultrasound group there was a change of 38.60% seen in NRPS post values with a mean difference of 2.21±1.21 and for pressure algometer a change of 36.23% was seen with a mean difference of 3.08±4.40. In the dry needling group there was a change of 64.53% seen in NRPS post values with a mean difference of 3.07±1.48 and for pressure algometer a change of 56.86% was seen with a mean difference of 8.36±6.90. When compared within group dry needling had a better effect than ultrasound on both NRPS and Pressure algomter.

Conclusion: The current study indicates that Dry needling is more effective than ultrasound for reducing pain and increasing functional outcome in patients with patellofemoral pain syndrome.

Key words: Anterior knee Pain, Patello-femoral Pain syndrome (PFPS), Trigger points, Dry Needling, Ultrasound.

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Access this Article online	Journal Information
Quick Response code	**International Journal of Physiotherapy and Research** ICV for 2016 86.93 ISSN (E) 2321-1822 | ISSN (P) 2321-8975 **https://www.ijmhr.org/ijpr.html** **DOI-Prefix:** https://dx.doi.org/10.16965/ijpr
DOI: 10.16965/ijpr.2019.182	**Article Information** Received: 22 Jul 2019 Accepted: 06 Sep 2019 Peer Review: 23 Jul 2019 Published (O): 11 Dec 2019 Revised: None Published (P): 11 Dec 2019

INTRODUCTION

Patello-femoral pain syndrome (PFPS) is the most common complaint in physically active individuals, adolescence and young adults. The term "PFPS" is often used interchangeably with "anterior knee pain" or "runners knee". The

incidence of PFPS is high and is located at 22/1000 persons per year. It has been assumed that this condition is more frequently seen in females than males, although there is not much epidemiological data to prove the same as of yet [1]. It is a condition of both muscular dysfunction and malalignment involving the patella, articular cartilage and the retinaculum that excludes other intra-articluar and peri- patellar pathologies [2,3]. The most frequently reported symptoms were pain around the patella (peripatellar) and behind the patella (retropatellar), provoked while ascending or descending steps and sitting with knees flexed for a long duration. Other common symptoms observed were crepitus, hypermobility or limited mobility of the patella and functional deficits with giving way [3,4].

The Patello-femoral joint, made by the patella and the femoral trochlea, is not involved in weight bearing but acts as an efficient pulley for the quadriceps muscle action. The patella is not completely engaged in the patella groove during weight bearing and in the first 0-30 degrees of knee flexion, thus chances of knee injury and patellar subluxations are increased if the patellar stabilizers are weak [5,6]. Contact of the patella with the patella groove is initiated at 20 degrees of knee flexion and increases further, reaching its maximum at 90 degrees of knee flexion [3].

The Patella is stabilized by static and dynamic stabilizers, which control the movement of the patella in the trochlear groove, referred to as patellar tracking. Any imbalance in these forces can alter patellar tracking leading to uneven distribution of forces on the patella-femoral joint surfaces, articular cartilage and adjacent soft tissues. Static stability to the patella is provided via the particular capsule, femoral trochlea, the medial and lateral retinaculum, and the patellofemoral ligaments. Dynamic stability to the patella is provided by the quadriceps tendon and patellar tendon, medially by the vastus medialis obliquis and laterally by the vastus lateralis and iliotibial band [3].

Patello-femoral pain syndrome as of current literature suggests that it is an extensor mechanism dysfunction, due to inhibition of the Quadriceps Femoris muscle activity. Several studies have reported delayed and altered activity of the Vastus Medialis (VMO) in comparison with Vastus Lateralis (VL) which is believed to cause patellar maltracking in these patients [7,8].

Myofascial trigger point is defined as a hyperirritable spot within a taut band of skeletal muscle or muscle fascia, which produces pain on compression at a target and around the surrounding structures (referred pain) [7,9]. The formation of trigger points is due to overuse, fatigue or injury to the muscle [9].

Trigger points cause pain and stress in the muscle or muscle fibre, which leads to reflex inhibition of the muscle and development of fatigue which makes the muscle more susceptible to activation of additional trigger points [7,9,10].

It is proved that due to the vicious cycle of pain, dysfunction and instability, leading to insufficiency and weakness of the Quadriceps. Thus the muscle has to now work harder to achieve the same contraction, eventually leading to overuse and fatigue. This explains the cause of myofascial trigger points in the quadriceps [9].

Dippenar proved in his study that 95% of the patients exhibited latent or active trigger points in quadriceps. This proves that there is a high degree of overlap between the presence of myofascial pain syndrome and patella-femoral pain syndrome in patients. Dippenar proved that myofascial pain syndrome is a predictive factor in the development of patella-femoral pain [10]. Simons et al in his study suggested that active trigger points in the knee muscles, particularly the vastus medialis and lateralis, may contribute to pain experienced by patients with patello-femoral pain syndrome [11].

Physical therapists approach the management of this pathology with a plethora of interventions, such as manual therapy, therapeutic exercises, taping, eccentric control of muscles, ischemic compression and foam rolling. However there are no gold standards set for treating such conditions, just a few guidelines to follow [9].

Dry needling is a new and upcoming method of releasing trigger points all over the body. It uses a thin filiform needle during the procedure to penetrate the skin. It penetrates the skin

causing an increase in blood flow and migration of cells to that part which repair and replace the damaged myofibrils. Due to stimulation of the mechanical receptors it also causes pain relief [12,13].

Ultrasound is commonly used for inflammation, bursitis, pain relief, tendonitis, myositis, myofascial tightness and trigger points. It is said that Ultrasound transmits vibration energy into the muscle which generates heats and breaks the trigger points. The effects of ultrasound are seen due to the thermal and non thermal effects such as cavitation, micromassage and acoustic streaming [9,14-16]. Ultrasound has an effect in all three stages healing, namely inflammatory, proliferative and remodelling [17,18].

Trigger point release is claimed to improve the local blood flow to that part thus aiding or facilitating in tissue healing and recovery and also normalizes the impaired firing pattern of VMO related to the VL, thus helping in correcting the lateral tracking of the patella. This is claimed to be helpful in reducing pain at the knee [7,14].

By this research I aim to prove the need to work on the muscle inhibition along with strengthening the muscle. Releasing the myofascial trigger points could then be employed along with other conventional therapies to give additional benefits to the patients.

A lot of modalities are used to treat extensibility, but we need a faster modality to give faster pain relief. Out of recent advances most used modalities were ultrasound, dry needling, myofascial release and foam rolling. Recent advances in the management of trigger points show that Dry needling and ultrasound are both newer techniques used to release trigger points and the pain caused by them. No one has compared which one is better or faster than the other.

In this study I will be comparing two different techniques, to find out which treatment methods gives faster and better results and focuses directly on the patients pain and function.

MATERIALS AND METHODS

Study Design – Randomized Control trial.

Subjects – All subjects were recruited from a hospital set up, on OPD bases. All participants were patients of patella-femoral pain syndrome coming for physical therapy. Patello-femoral Pain syndrome was identified as anterior knee pain, retro or peri patellar which is provoked during stair climbing and sitting with knees flexed for long durations. Inclusion criteria for this study were all patients having chronic anterior knee pain for more than 3 months. They were in the age group of 20-40 years (Mean age - 30±5) and tested positive for Clarkes and McConell test. Both male and female subjects were included. All subjects who had any ligament injuries or had undergone any bony or ligamentous surgeries around the knee were not included. Also subjects with degenerative changes or sensory involvement were excluded. Patients apprehensive to dry needling were not included in the study.

Procedure - This study design was a randomized control trial. This study was approved by the research and ethics committee of the institution before recruitment of its first participant. 93 patients with chronic anterior knee pain were screened for eligibility, out of which only 70 met the inclusion and exclusion criteria. Informed written consent was taken from all the participants of the study. All 70 participants were explained their role in the study and standardized instructions were given to all before the commencement of the research. Numerical pain rating scale (NPRS) and Pressure Algometer was explained to all the patients of both the groups before starting the study and the scores of their pre and post-intervention were used as the outcome measures. A baseline assessment consisting of NRPS values and Pressure algometer readings was carried out prior to the intervention. Immediate post assessment was carried out to see the difference on pain and on pressure algometer readings.

Intervention – After the evaluation the subjects were then assigned into 2 groups using the random table (N=35, in each group). For the ultrasound group the mean age was 33±3 and for dry needling it was 26±5. One session of 30 minutes was given to each participant(either dry needling or ultrasound along with the exercises). Group 1 was given ultrasound for 6 minutes at 1.2watts/cm^2 at a frequency of 1MHz on all the

trigger points present on quadriceps muscle of the affected leg [16]. Group 2 was given Dry needling on all the trigger points present on quadriceps muscle of the affected leg by the standard protocol method for 10 minutes [19]. Immediate post assessment was carried out after the intervention to see the difference on pain values and on pressure algometer readings. After this every participant was given a home exercise program consisting of stretching for Iliotibial band, Rectus Femoris and Hamstring along with strengthening for knee flexors and extensors and hip abductors and extensors. They were asked to perform all the exercises 3 times a week, with 15 reps of each [6].

Outcome measures – Numerical Pain Rating scale – It is a 11 point pain rating scale ranging from 0 (no pain at all) to 10 (most intense imaginable pain). It patient verbally assess a value that is most in line with the current pain intensity as well as the best and worst level of pain during the last 24 hours. According to Williamson and Hoggart, in their article published in 2005 have stated that NRPS has good sensitivity while producing data that can be statistically analyzed [20].

Pressure Algometer – It's a device used to check the pain threshold of a point by manually applying pressure to that point with the help of a probe. It is used for diagnosis of myofascial pain dysfunction syndrome characterized by tender myofascial trigger points. The reading where the pain starts to occur is noted down and is used as prognostic value [21].

Statistical Analysis – Statistical analysis was done using SPSS 16 software. The significance of P value was set at 0.05 and a confidence interval of 95% was followed. Man whitney U test was used to compare the values of numerical pain rating scale between the groups and wilcoxon sign rank test was used to compare the values of numerical pain rating scale within the groups. Unpaired T test was used to compare the values of Pressure Algometer between the groups and Paired T test was used to compare the values of Pressure Algometer within the group.

RESULTS

93 consecutive patients were screened for eligibility, 70 patients satisfied the eligibility criteria, agreed to participate and were randomized to dry needling (N=35) and Ultrasound (N=35). None of the patients reported any adverse effects after the treatment. The P value for all the tests was set at a significance of 0.05.

Ultrasound – Group 1: The Wilxocon sign rank test was used to compare the NRPS of the participants in the ultrasound group pre and post intervention indicated a significant P value of 0.00. The paired T test was used to compare the readings of the pressure algometer in the ultrasound group pre and post intervention, indicated a significant P value of 0.00 (as shown in Table1)

Dry Needling – Group 2: The Wilxocon sign rank test was used to compare the NRPS of the participants in the dry needling group pre and post intervention indicated a significant P value of 0.00. The paired T test was used to compare the readings of the pressure algometer in the dry needling group pre and post intervention, indicated a significant P value of 0.00. (as shown in table 2)

Between Groups – Man Whitney test was used to compare the NRPS pre and post intervention in both the experimental groups, indicated a significant P value of 0.009.(as shown in table 3)

The unpaired T test was used to compare the Pressure Algometer readings pre and post intervention in both the experimental groups, indicated a significant P value of 0.00.(as shown in table 3)

Table 1: Within group comparison of group 1 (ultrasound).

Within Group (Ultrasound)						
Intervention	**Test component**	**Pre mean±SD**	**Post mean±SD**	**Mean diff±SD**	**Pvalue**	**%change**
US	**NRPS**	5.54±2.21	3.44±1.9	2.21±1.21	0	38.60%
US	**PA**	8.50±12.58	11.58±14.23	3.08±4.40	0	36.23%

Table 2: Within group comparison of group 2 (dry needling).

Within Group (DryNeedling)						
Intervention	**Test component**	**Pre mean±SD**	**Post mean±SD**	**Mean diff±SD**	**Pvalue**	**%change**
DN	**NRPS**	4.85±1.68	1.72±1.64	3.07±1.48	0	64.53%
DN	**PA**	14.72±12.70	23.09±18.39	8.36±6.90	0	56.86%

Table 3: Between group comparison of Dry needling vs Ultrasound.

Between group results				
	NRPS		PA	
	US	DN	US	DN
Mean Difference	2.1±1.21	3.07±1.48	3.08±4.40	8.36±6.90
P value	0.009		0	

DISCUSSION

The present study aimed at improving the pain and functional outcome of patients with patello-femoral pain syndrome by releasing trigger points in the quadriceps by comparing two effective techniques, dry needling verses ultrasound for releasing the trigger points to see the benefit.

As seen in the flow chart, 93 patients with anterior knee pain were evaluated. Out of which 70 patients with mean age group of 30±5, met the inclusion and exclusion criteria. 35 patients were allocated to group 1 (Ultrasound) and 35 were allocated to group 2 (dry needling) by the random table method.

From the results we can see that there was a significant improvement on the numerical pain rating scale as well as on the pressure algometer readings, in both the groups. Table 1 shows that in the ultrasound group there was a difference of 38.60% seen on the numerical pain rating scale with a mean difference of 2.21±1.21 in the pre and post values and a difference of 36.23% on pressure algometer readings with a mean difference of 3.08±4.40 in the pre and post values.. Table 2 shows that in the Dry needling group there was a difference of 64.53% seen on the numerical pain rating scale with a mean difference of 3.07±1.48 in the pre and post vaues and a difference of 56.86% on pressure algometer readings with a mean difference of 8.36±6.90 in the pre and post values. Thus both groups showed significant difference post intervention.

On comparing between groups, for numerical pain rating scale there was a higher difference seen in the dry needling group as compared with ultrasound. For pressure algometer readings there was again a higher difference seen in the dry needling group as compared with ultrasound as shown in table 3.

Our findings are consistent with the findings in the other studies, but direct comparison is difficult because the treatment methods used are different and there are lack of studies performed examining these two interventions.

According to Dippenar, highest number of trigger points were present in the Vastus Lateralis, which coincides with the results of our study [7]. Out of the total 196 trigger points assessed, 101 (51.53%) were found in Vastus Lateralis, 67 (34.18%) were found in Vastus Medialis and only 28 (14.28%) were found in Rectus Femoris. Thus proving that Vastus Lateralis has the highest number of trigger points present in patients with patella-femoral pain.

In the present study, the significant improvement in the pain intensity can be attributed to its effect on the trigger points, timing of VMO firing, lengthening of the quadriceps, increases the effectiveness of the strengthening exercise program and correct tracking of patella in the femoral groove. Normalizing the firing pattern of VMO and correcting the patellar maltracking is the key to resolving patella-femoral Pain Syndrome [7].

Current evidence and clinical guidelines recommend the use of different multimodal intervention programs consisting of strengthening exercises, patellar tapping, patient education and activity modification for the management of PFPS [22-26]. There is only one study done by Gemma V, et.al in 2017 to check the effectiveness of including dry needling in the multimodal therapy program for PFPS. The results of this study were in contrary to the results of our study. In this study there was a follow up period of 3 months, with 3 sessions of dry needling. The condition

of all the patients improved but there was no additional benefit seen in the group which received a combination of dry needling as well as exercises. A track of the activities done by the patient in those 3 months was not kept and also the exercises given to the patient did not progress in load or repetitions which could have also resulted in the null hypotheses being true [27]. In this study the immediate effect of dry needling was seen, as the long term effects of dry needling are not studied yet while the immediate effects have been proven.

Dry needling produces an analgesic effect on the body. It stimulates release of inhibitory neurotransmitters (GABA) and also reduces the concentration of nociceptive substances at the site of synapse in the trigger points. It also works on the principle that "Inflammation can occur without healing but healing cannot occur without inflammation." Because of the injury caused to the muscle during needling, it stimulates an inflammatory response and triggers the migration of cells to that area which aid in healing and repairing of the damaged myofibrils [12,13,19].

It stimulates the release of exogenous opiods (endorphins, encephalin), which block the pain and give the body an analgesic effect. Overall it helps in reorganization of the muscle fibres and restores it to its normal length [12,13,19]. It releases the quadriceps and normalizes the activity of the VMO and VL. Once the timing and pattern of firing is changed, the patellar maltracking is also taken care of on its own.

Ultrasound is an old technique used for treating inflammation, bursitis, tendonitis, myositis, myofascial pain and trigger points. It transmits vibration energy into the muscle which dissipates heat and breaks the trigger points [9,14-16]. The thermal effects due to the ultrasonic waves being absorbed by the tissues and producing heat also accelerate the process of healing. It also increases the extensibility of collagen fibres and thus aids in faster break down of trigger points. Cavitation is the oscillatory activity of highly compressible bodies within the tissues such as gas or vapour filled voids. There is an additional micro-streaming effect also seen on the cells due to stable cavitation caused by the ultrasonic beams, where in it influences the permeability of cell membranes and the direction of movement of molecules into the cell. Unstable cavitation can be dangerous and should be avoided by continuously moving the treatment head during application [28]. Mechanical effects of ultrasound, which are the longitudinal movement produced by the beam to cause compression and rarefaction of cells affecting the movement of tissue fluid in the interstitial space and thereby also reducing swelling. This is also called as Micro-massage [17,18].

The biological effect of ultrasound has an effect in all the 3 stages of healing. During the inflammatory phase it increases the fragility of the lysosome membranes and thus enhances the release of their contained enzymes. These enzymes help to clear the area of debris and allow the next stage to occur [17,29]. During the proliferative phase calcium ions are driven into fibroblasts and myofibroblasts by ultrasound. This enhances their mobility and encourages their movement towards the area of repair. More collagen is produced by fibroblasts when exposed to ultrasound. The collagen formed also has more tensile strength after ultrasound treatment [30-32]. During remodelling ultrasound increases the tensile strength of the muscle by affecting the direction, strength and elasticity of the fibres [17].

Dry Needling showed better results as it's an invasive technique and also it has multiple effects. Other than just breaking the adhesions, it also gives an analgesic effect to the body and stimulates release of exogenous opiods [12,13,19]. It has a faster and deeper effect than ultrasound.

Thus with this study it can be said that releasing the trigger points can also be a very effective way in treating patello-femoal pain. Till now evidences only stated the importance of eccentric exercises, alternating forms of quadriceps exercises and patellar taping for maltracking to treat such situations [10,32]. According to this study and a few other literatures, dry needling and ultrasound can be very effective and quick in releasing trigger points and reducing pain in such patients, although dry needling was more faster than ultrasound but both will give positive results.

The results of this study come along with some potential limitations.A follow up of the pain and triggers was not kept. Thus to conclude the long term results is difficult. Also, there could be a possibility of triggers present in the other muscle surrounding the knee joint and also the hip musculature producing referred pain to the knee which was not taken into consideration. The effect we saw was only the effect of the intervention and no exercises. To improve this study as future scope, the intervention and exercise could be combined and compared with a control group to see the combined effect of the two with a longer intervention period.

CONCLUSION

The current study indicates that Dry needling is more effective than ultrasound for reducing pain and increasing functional outcome in patients with patellofemoral pain syndrome. Both groups achieved improvement in the symptoms but dry needling group had better improvement than the ultrasound group. It requires further investigation to now see the combined effect of dry needling and ultrasound with exercise on pain and functional outcome in patients with patello-femoral pain syndrome.

ABBREVIATIONS

PFPS - Patello-femoral pain syndrome
VMP - Vastus Medialis
VL - Vastus Lateralis
US - Ultrasound
DN - Dry Needling

ACKNOWLEDGEMENTS

We thank support to Dr. Rachna Dabadghav (P.T) and Dr. Dhara Kapoor (P.T) research coordinators of Sancheti Institute College of Physiotherapy , Dr. Ashok Shyam (MS Ortho) and Dr. Parag Sancheti (Chairman of Sancheti Hospital) for their expert guidance. We wish to acknowledge all the participants of this study for their co-operation, giving us their valuable time and allowing us to conduct this study. Authors acknowledge the immense help received from the scholars whose articles are cited and included in references of this manuscripts. The authors are also grateful to authors/editors/ publishers of those articles, journals and books from where the literature for this articles has been reviewed and discussed.

Conflicts of interest: None

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How to cite this article:

Zishta Patel, Ankit Srivastava, Ashok Shyam, Parag Sancheti. IMMEDIATE EFFECT OF DRY NEEDLING VS ULTRASOUND ON RELEASING TRIGGER POINTS IN QUADRICEPS IN PATIENTS WITH PATELLO-FEMORAL PAIN SYNDROME ON PAIN. Int J Physiother Res 2019;7(6):3287-3294. **DOI:** 10.16965/ijpr.2019.182