EFFECTIVENESS OF INSTRUMENT ASSISTED SOFT TISSUE MOBILIZATION ON PAIN AND FUNCTIONAL DISABILITY IN SUBJECTS WITH PATELLOFEMORAL PAIN SYNDROME

Mahida Payal Dharmendrasinh
Opp. Jyotindradave Udhyan, Honey park road, Adajan, Surat-395009 Gujarat

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ABSTRACT
The research study findings have indicated that Patellofemoral pain syndrome (PFPS) is a condition characterized by aching pain in the peripatellar area. The instrument assisted soft tissue mobilization shown significant effects on improvement of pain and functional disability. It was evaluated in 40 subjects classified into two groups(20 subjects per each group). The subjects in Study Group received IASTM techniques with conventional exercise for four week and Control group received only conventional exercise for four week and total duration of study was done for six months. Results show that the greater percentage of improvement was found in following instrument assisted soft tissue mobilization compared with conventional exercises.

INTRODUCTION
Patellofemoral pain syndrome (PFPS) is a condition characterized by aching pain in the peripatellar area that is exacerbated by physical activities such as climbing stairs, squatting, jumping, and running and/or by sitting with the knees flexed for prolonged periods of time (Earl JE et al, 2011).

The prevalence of patellofemoral pain syndrome has been reported as between 15-45% of the population (Waryasz GR et al, 2008). It has been reported across several age groups, with females (15.3%) having a higher prevalence than males (12.3%). The incidence rate for PFPS was 22/1000 person/years. The incidence rate in females was 33/1000 person/years and in males was 15/1000 person/years, with females being 2.23 times more likely to develop PFPS compared with males (Dixit S et al, 2007).

The mechanism for PFPS is not well understood; however, it has been suggested that the condition may arise from abnormal muscular and biomechanical factors that alter tracking of the patella within the femoral trochlear notch, contributing to increased patellofemoral contact pressures that result in pain and dysfunction (Lowe, W. 2011). Tracking of the patella affects the magnitude and distribution of forces acting at the patellofemoral joint and ultimately patellofemoral joint pressures. Proprioceptive information from the active (muscular) and passive (osseous/ligamentous) systems contributes to the overall neuromuscular control of patellar tracking. Specifically, vastus medialis oblique (VMO) is believed to assist in maintaining patella position by applying a medial force vector to counteract the lateral pull of the larger vastus lateralis (VL). The onset of VMO activation relative to the VL is commonly delayed in individuals with PFPS during stair ascent and descent, in contrast to healthy controls where concurrent onset of the contraction of VMO and VL is the norm (Ivković A et al, 2007) The pain and abnormal tissue stresses arising from maltracking of the patella may lead to abnormal proprioception in patients with PFPS. Some authors have detected proprioception deficits in PFPS. Mechanoreceptor damage has been described as the main factor affecting knee proprioception; however, functional movement depends not only on the acquisition of stimuli from peripheral mechanoreceptors in joints, muscles, and deep tissues but also on the regulation of this motion via agonist–
antagonist muscle activation by the central nervous system (Thomee R *et al*, 1999).

Due to lack of proprioception inputs in subjects with PFPS are prone for loss of balance and affect their overall function. Conservative treatment includes of physical therapy for alleviation of patellofemoral pain and restoration of patellar alignment through active or passive interventions. Intervention includes quadriceps muscle-strengthening exercises, stretching, patellar taping or bracing, biofeedback, and use of corrective foot orthoses (*Fredericson M et al*, 2006).

There is no treatment goals set to aim on treating mechanical in healing the tissue in PFPS. The IASTM method of intervention shown to improve pain and function in various conditions. Instrument-assisted soft tissue mobilization (IASTM) is an approach to soft tissue manipulation that uses concave and convex stainless steel instruments to release scar tissue, break soft tissue adhesions, and remove fascial restrictions. The variation in curvatures of the tools allows clinicians to individualize treatments to address specific tissues and anatomical regions. The goal of IASTM is to enhance the healing process by breaking down collagen cross-linkages, increasing blood flow, and increasing cellular regeneration. IASTM has been proposed as a treatment option for a wide variety of soft tissue injuries, ranging from medial and lateral epicondylalgia and rotator cuff tendinopathy to iliotibial band syndrome and plantar fasciitis. However, not all soft tissue pathologies can benefit from the use of IASTM (*Fredericson M et al*, 2006; *Powers CM et al*, 2003; *Piva SR et al*, 2005; *Boling M et al*, 2010).

Subjects with patellofemoral pain syndrome clinically complain of pain, a decreased range of motion, and joint instability, all of which lead to decrease function. With pain and decreased willingness to move, contractures eventually develop in portions of the musculotendon and overlying muscle, so as the disease progresses motion becomes more limited (*Dixit S et al*, 2007). The ageing process is accompanied by a decline in the function of the systems that are responsible for the control of balance (*Elias J3 et al*, 2004). Patellofemoral pain syndrome causes changes not only in the tissues within the articular cavity, but also the ligaments, tendons, and periarticular tissues including the muscles. It is already widely known that patients with PFPS have a disability.

Evidence regarding the use of IASTM is limited and often mixed with regard to benefits. Although the technique has been found to accelerate ligament healing using an animal model and increase shoulder range of motion in athletes, several studies have demonstrated no therapeutic benefits beyond those of more traditional treatments. This clinical roundtable discussion investigates the benefits and limitations of IASTM (*Elias J3 et al*, 2004).

But the effect of this IASTM is not known on patellofemoral pain syndrome. The individuals with PFPS expose to activities that challenge the knee to potentially load during therapy may help them learn to deal with these loads when encountered in regular daily activity. Therefore, there is a need to know the effect of IASTM on pain, and functional abilities in subjects with PFPS. Hence, the purpose of the study is to find the effect of Instrument-assisted soft tissue mobilization on improvement of pain, and functional abilities in subjects with patellofemoral pain syndrome.

**METHODOLOGY**

This is an experimental study included both male and female subjects age 35-45year willing to participate. Inclusion criteria were Pain since more than 6 months, presence of pain on step down from a 25 cm step or double leg squat, pain during sitting with knee bent more than 15 minutes, pain more than 3 cm on NPRS scale, clinical signs of patellofemoral pain syndrome such as retropatellar pain, crepitation, and pain with patellar grinding. Exclusion criteria were pregnancy, Subjects with Congenital, acquired abnormalities in lower extremities, Subjects with vascular disorder. History of Ligament and meniscal injury, lower limb fractures, post surgical condition of lower limb, Patellar subluxation, problem with vision, Osteoarthritis of knee and had a contraindication to IASTM technique including neoplastic disorders, kidney infection, anticoagulant medication, rheumatoid arthritis, uncontrolled hypertension, osteomyelitis or generalised infection. As the study involve human as subjects, the ethical clearance has been obtained from Ethical committee of Goutham College of Physiotherapy, Bangalore. The individuals who fulfilled the inclusion criteria and agreed to give consent and sign the consent form were included in this study. Total 40 subjects were included in my study. Subjects were randomly allocated and assigned to either Study Group or Control Group with 20 subjects in each group respectively. Forty small chits were used, with twenty pieces having the words “Study Group” and, twenty pieces having the words “Control Group”. All the pieces of paper were tightly folded and placed in a box. After shaking the box thoroughly, each subject was called forward to pick up a chit and go to the allotted group.

Pre-evaluation was measured. After intervention post-evaluation was again measured.

All the subjects assessed with numeric pain rating scale for pain, kujala functional score for function. Study Group received IASTM therapy along with the conventional exercise for 8 sessions over four week. Control Group received only conventional exercise for 8 treatment session for four weeks and total duration of study was done for six months.

**Statistical Analysis**

The Statistical software namely SPSS 16.0 (originally, Statistical Package for the Social Sciences, later modified to read Statistical Product and Service Solutions was released in its first version in 1968 after being developed by Norman H. Nie, Dale H. Bent and C. Hadlai Hull. It is now officially named “IBM SPSS Statistics” in its version 20.0), Stata 8.0, MedCalc 9.0.1 and Systat 11.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc. ( Other software are PASW Statistics IBM SPSS Statistics)
RESULT

Table 1 Show the basic characteristics of the subjects studied

<table>
<thead>
<tr>
<th>Basic Characteristics of the subjects studied</th>
<th>Study Group</th>
<th>Control Group</th>
<th>Between groups</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of subjects studied (n)</td>
<td>20</td>
<td>20</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Age in years (Mean: SD)</td>
<td>41±3.61</td>
<td>40.95±3.13</td>
<td>p= 0.930 (NS)</td>
<td></td>
</tr>
<tr>
<td>Duration in month</td>
<td>11.65±6.31</td>
<td>14±6.17</td>
<td>p= 0.064 (NS)</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>7</td>
<td>9</td>
<td>17.5%</td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>13</td>
<td>11</td>
<td>22.5%</td>
<td></td>
</tr>
<tr>
<td>Side</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>14</td>
<td>13</td>
<td>32.5%</td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>6</td>
<td>15</td>
<td>17.5%</td>
<td></td>
</tr>
</tbody>
</table>

The above table shows that in study Group there were 20 subjects with mean age 41 years and there were 7 males and 13 females were included in the study. In Control Group there were 20 subjects with mean age 40.95 years and there were 9 males and 11 females were included in the study. There is no significant difference in mean ages between the groups.

Table 2 Show Analysis of NPRS and Kujala score within Groups (Pre to post test analysis)

<table>
<thead>
<tr>
<th></th>
<th>Study Group</th>
<th>Control Group</th>
<th>Z value (Non parametric significance)</th>
<th>95% Confidence interval of the difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre intervention (Mean±SD)</td>
<td>6.30±1.41</td>
<td>5.15±1.26</td>
<td>-18.25%</td>
<td>-0.921 - 1.379</td>
</tr>
<tr>
<td>Post intervention (Mean±SD)</td>
<td>(4-8)</td>
<td>(3-7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentag e change</td>
<td>13.75%</td>
<td>26.03%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kujala score</td>
<td>51.10±6.88</td>
<td>65.20±6.29</td>
<td>-27.59%</td>
<td>-15.864 - 12.336</td>
</tr>
<tr>
<td></td>
<td>(40-62)</td>
<td>(52-76)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPRS</td>
<td>4.85±1.26</td>
<td>6.30±1.41</td>
<td>-19.83%</td>
<td>-1.008 - 1.392</td>
</tr>
<tr>
<td></td>
<td>(4-8)</td>
<td>(3-7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kujala score</td>
<td>49.75±5.36</td>
<td>62.70±6.14</td>
<td>-26.03%</td>
<td>-14.216 - 11.684</td>
</tr>
<tr>
<td></td>
<td>(39-60)</td>
<td>(52-75)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Statistically Significant difference p<0.05; NS- Not significant; a. Wilcoxon Signed Ranks Test

The above table shows that in both Groups there is a statistically significant change in means of NPRS and Kujala score when means were analyzed from pre intervention to post intervention within the groups with p<0.000 with positive percentage of change showing that there is increase in the post means following intervention and with negative percentage showing there is decreasing in post means.

The above graph shows that in both groups there is a statistically significant change in means of NPRS score when means were analyzed from pre intervention to post intervention within the groups with p<0.000.

Graph 2 Analysis of Kujala Score within Groups (Pre to post test analysis)

The above graph shows that in both Groups there is a statistically significant change in means of Kujala score when means were analyzed from pre intervention to post intervention within the groups with p<0.000.

Table 3 Comparison of means of NPRS and Kujala score between Groups (PRE AND POST TEST COMPARISION)

<table>
<thead>
<tr>
<th>Study Group</th>
<th>Control Group</th>
<th>Percentage of improvement</th>
<th>Z value (Non parametric significance)</th>
<th>95% Confidence interval of the difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPRS</td>
<td>6.30±1.41</td>
<td>5.15±1.26</td>
<td>-4.065</td>
<td>-0.921 - 1.379</td>
</tr>
<tr>
<td></td>
<td>(4-8)</td>
<td>(3-7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(40-62)</td>
<td>(52-76)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study Group</td>
<td>4.85±1.26</td>
<td>6.30±1.41</td>
<td>-4.179</td>
<td>-1.008 - 1.392</td>
</tr>
<tr>
<td></td>
<td>(4-8)</td>
<td>(3-7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kujala score</td>
<td>49.75±5.36</td>
<td>62.70±6.14</td>
<td>-3.391</td>
<td>-14.216 - 11.684</td>
</tr>
<tr>
<td></td>
<td>(39-60)</td>
<td>(52-75)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Statistically Significant difference p<0.005; NS- Not significant; a. Independent t test b. Mann-Whitney Test

The above table shows that when pre intervention means and post intervention means of NPRS and Kujala score were compared between study Group and control Group there is no statistically significant difference between the groups.

DISCUSSION

The objective of study was to find the effectiveness of instrument assisted soft tissue mobilization on pain and functional disability in subjects with patellofemoral pain syndrome and compare these findings with conventional exercises. In the present study it was found that there is a statistically significant improvement in pain based on NPRS and functional disability based on kujala score-questionnaire within study group who received IASTM with conventional exercises and control group who received only conventional exercises. Between the groups analysis found that there is no statistically significant difference in improvement of pain and functional disability. However the greater percentage of improvement was found in both the group who received instrument assisted soft tissue mobilization compared with conventional exercises.

In study group, the improvement in pain and functional disability could be because of “instrument assisted soft tissue mobilization (IASTM)” followed by initiating exercise ,active
warm up-cycling on stationary bicycle for 5-10minutes with minimal resistance and stretching should done before and after the exercise routine for hip flexor, quadriceps, hamstring, gastronemius and soleus tightness. Evidence regarding the use of IASTM is limited and often mixed with regard to benefits. Although the technique has been found to accelerate ligament healing using an animal model and increase shoulder range of motion in athletes, several studies have demonstrated no therapeutic benefits beyond those of more traditional treatments. This clinical roundtable discussion investigates the benefits and limitations of IASTM (Elias JJ et al, 2004).

The IASTM treatment is thought to stimulate connective tissue remodeling through resorption of excessive fibrosis, along with inducing repair and regeneration of collagen secondary to fibroblast recruitment. In turn, this will result in the release and breakdown of scar tissue, adhesions, and fascial restrictions (Strunk RG et al, 2014; Papa JA 2012; Davidson CJ et al, 1997). In laboratory studies using a rat model, the use of instruments resulted in increased fibroblast proliferation and collagen repair (e.g., synthesis, alignment, and maturation) in cases of enzyme-induced tendinitis (Geihlsen GM et al, 1999; Loghmani MT et al, 2009). Many of these benefits were also found in a laboratory study on ligament healing using the rat model which further provided supporting evidence that instrument massage produces a significant short-term increase in ligament strength and stiffness compared to the contralateral control limb (Fowler S et al, 2000).

Instrument assisted soft tissue mobilization that, as reported by the manufacturer, utilizes instruments to localize and treat soft tissue restrictions and enables the clinician to detect and effectively treat thickening, ridges, adhesions, fibrotic nodules, crystalline deposits, and scar tissue more precisely and at deeper levels of the body than the hands are capable of doing. The theory of IASTM is based upon the rationale for deep friction massage and cross fiber massage as proposed by Cyriax. Clinicians have hypothesized that IASTM produces a localized micro-trauma to soft tissue, producing microvascular and capillary hemorrhage, which reinitiates the body’s inflammation process and stimulates the body’s healing process and reparative system. This inflammatory process restarts the healing process by enhancing the delivery of blood, nutrients, and fibroblasts to the area, thus facilitating collagen synthesis, deposition, and maturation.

The result of this led to inference that instrument assisted soft tissue mobilization is effective in reducing pain and functional disability in subjects with patellofemoral pain syndrome, when given with proper dosage. Numerous studies have come up with effective instrument assisted soft tissue mobilization is effective in reducing pain and functional disability in subjects with patellofemoral pain syndrome. It would be useful to determine the long term effectiveness of such interventions in future studies. The result of this study may be applied to a population with chronic patellofemoral pain syndrome.

In control group the improvement in pain and functional disability could be because conventional exercises. Both the groups received conventional therapy consisting exercise that includes semi squat, quadriceps isometric, terminal knee extension with elastic band, terminal knee extension in supine position, and adductor squeeze in crook lying (squeeze the ball). Improvement in both the outcome parameters also could be due to conventional exercise. There are evidence based studies emphasizing on effect of different therapeutic exercise on reducing pain and disability in patient suffering from PFPS. Frye et al., (2012) in their systematic review summarized the research on the ability of an exercise or strengthening intervention to reduce pain measures or improve function measures in patients who already had PFPS and to compare these interventions with rest. They found that exercise is more effective treatment for immediate decrease in pain and increase in function (Heintjes et al, 2013) in their Cochrane review summarized the evidence on effectiveness of exercise therapy for reducing anterior knee pain and improving knee function in patients with PFPS. They found that there is conflicting evidence that exercise therapy is more effective in treating PFPS than no exercise in respect of functional improvement (Frye JL et al, 2012).

Patellofemoral pain syndrome is a degenerative progressive disorder. To answer the question of optimal type, frequency, and also dose of exercises, head to head comparisons in which participants are randomly assigned to receive different exercises are highly needed. There was numerous theories proposed effectiveness of various exercises in treatment of Patellofemoral pain syndrome. Physical therapy interventions might be useful for the people with Patellofemoral pain syndrome, but for some of interventions the effect is unclear. However subjects with Patellofemoral pain syndrome should not completely abstain from physical activities, although they should modify them. Improvements come slowly, especially at the beginning of treatment period, and the positive effects of training take time (Loghmani MT et al, 2009). Some studies proved the effectiveness of instrument assisted soft tissue mobilization. Results of their study showed small but significant reduction in knee pain (Loghmani MT et al, 2016; James R et al, 2017).

When the improvement in pain and functional disability of study group was compared with control group subjects there was no significant difference, however study group subjects showed improvement in pain and functional disability in PFPS, but effect is similar as convention exercise. The improvement can be variable as pre intervention comparison of means of study group and control group found that there is no statistically significant difference in NPRS and Kujala score.

The findings in this study are based on the subjects with both male and female age of 35-45 years having patellofemoral pain syndrome since more than 6 months. Moreover study was carried out for 4 weeks, there for long term effects of techniques were not evaluated.

The subjects in this group were treated for two sessions in a week of total 8 treatment sessions over a four-week period. There was an equal improvement found in reduction of pain and functional disability in both the groups after the session.

The result of this led to inference that instrument assisted soft tissue mobilization is effective in reducing pain and functional disability in subjects with patellofemoral pain syndrome, when given with proper dosage. Numerous studies have come up with effective instrument assisted soft tissue mobilization is effective in reducing pain and functional disability in subjects with patellofemoral pain syndrome. (Welty D, Loghmani MT et al, 2013; Gulick DT et al, 2014). It would be
useful to determine the long term effectiveness of such interventions in future studies. The result of this study may be applied to a population with chronic patellofemoral pain syndrome.

Analysis was done with the base line data and post treatment scores. There was significant improvement (p<0.001) in both the groups after two months of treatment session with instrument assisted soft tissue mobilization. There was no significant difference in post treatment comparison with instrument assisted soft tissue mobilization in both control and experimental group. The clinical findings and analysis showed that with instrument assisted soft tissue mobilization was effective in alleviation of pain and reduction in functional disability in subjects with patellofemoral pain syndrome.

The results of this study may be applied to a population with diagnosis of patellofemoral pain syndrome. This study did not include long-term follow up period, though it is effective for long term benefits of the interventions (Baker V et al, 2012; Yosmaoglu HB et al, 2013).

Hence based on the analysis and findings, the study found that with four weeks of IASTM there is a statistically significant difference in pain and functional disability, therefore considering the significant difference in outcome measure means the study rejects the null hypothesis.

CONCLUSION

The present study concluded that instrument assisted soft tissue mobilization shown significant effects on improvement of pain and functional disability in subjects with patellofemoral pain syndrome. However the greater percentage of improvement was found in following instrument assisted soft tissue mobilization compared with conventional exercises. It is recommended that implementation of instrument assisted soft tissue mobilization is useful technique along with conventional exercises for alleviation of pain and improvement in functional disability for subjects with patellofemoral pain syndrome.

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