Massage Therapists' Association of British Columbia

Clinical Case Report Competition

Vancouver College of Massage Therapy

April 2014

Second Place Winner

Olivia Rey

The effect of manual therapy on patellofemoral pain tracking syndrome

P: 604.873.4467
F: 604.873.6211
research@massagetherapy.bc.ca
massagetherapy.bc.ca

Case Advisor: Alison Esser RMT
VCMT of Utopia Academy

Acknowledgements:

I would like to express my appreciation to Alison Esser, my case study advisor, who has helped me greatly with her guidance and knowledge during this project. Also, thank you to Crystal Legere, Rob Dos Santos, Terri Green and Jody Tennant for their wonderful insight with the different modalities to use for the management to knee pathologies. Rebecca Buckman and Hayley Ostridge with the editing of this paper. Finally a great thank you to my case subject for her patience and time, this project would not have been feasible without you.

Abstract:

Patellofemoral pain syndrome (PFPS) was managed with manual therapy to restore the balance between the medial and lateral stabilizing forces of the patellofemoral joint. This study was administered on a single subject previously diagnosed with PFPS and Osgood-Schlatters.

Ten treatment, 1.5 hours in duration were carried out, where the lumbar, gluteals, hamstrings, the quadriceps muscles and soft tissue surrounding the patella were treated. Technique such as myofascial release, neuromuscular therapy and trigger point therapy were used in those soft tissues to decrease hypertonicity.

The results showed an increase range of motion of the knee and hip as well as improvement with Ober's special test and passive patellar glide measurements.

It was concluded that using manual therapy does improve passive stabilization medial and lateral forces of the patellofemoral joint.

Keywords: Patellar pain syndrome, Patellar tracking syndrom, Runner's knee, osgood-schlatter, Knee disorders, Knee pain

Introduction:

Patellofemoral pain syndrome (PFPS), also called "patellar tracking syndrome" or "runner's knee", is one of the most common disorders pertaining to the knee.[1,2,3] About 25% of the active population will present with this condition at some point in their life [7]. It is defined as anterior knee pain aggravated by repetitive activities that produce high patellofemoral compressive forces.[3,1] PFPS etiology is not fully understood, there are several predisposing factors that could be contributing factors to faulty patellar tracking. These factors could include faulty biomechanics, soft tissue dysfunction or previous trauma to the area.[9] Due to PFPS being associated with overuse of the knee joint, recent changes in activity duration, frequency and intensity of training should also be noted as contributing factors.

Patients with PFPS typically present with a dull achy pain or throbbing feeling around or underneath the patella in the peripatellar or subpatellar.[2,9] Patient may complain of pain and stiffness with long periods of sitting with knees flexed, called "movie theatre sign", and pain with activities that load the patellofemoral joint such as walking downstairs, squatting and running downhill.[2,9] Some of these activities are so painful that the knee may give away to protect the area.[2] Crepitus is usually present, a "catching" or "popping" sensation with knee flexion may also be described.[9] Swelling may be present due to arthritic changes. PFPS is linked with disuse atrophy and weakness of the vastus medialis obliquus and hypertoned lateral structures, which may lead to knee valgus orientation.[2,9] In an anterior view, with the patient's feet parallel, a medial orientation of the patella (squinting patella) may be caused by an internal femoral or tibial rotation. Thus, Q-angle should be measured and noted for any angle falling greater than 18 degrees. When a patient with PFPS is allowed to stand in their neutral position, still in a frontal view, the feet will appear externally rotated, while the patella is observed to have a medial position. With a lateral view, the knees may appear hyperextend, and the individual may also present with patella alta.[9]

The patellofemoral joint consists of the patella, a sesamoid bone sitting on the anterior surface of the distal femur, and the trochlea, which is the articular surface of the femur that the patella tracks along.[2,9] Appropriate patellofemoral joint stability involves dynamic and static stabilizers working simultaneously to control the movement of the patella within the trochlea during knee flexion and extension.[2,6,9] This movement of the patella within the trochlea is known as "patellar tracking." Dynamic stabilizers involves the quadriceps tendon, patellar tendon, vastus medialis obliquus (VMO), vastus lateralis (VL), and iliotibial band (ITB). The VMO is the only muscle that provides medial force and is therefore a key player in stabilizing the patella.[2,6,9] Static stabilization is maintained by the articular capsule, the femoral trochlea, the medial and lateral retinaculum and the patellar ligaments.[9]

Altered patellar tracking results when an imbalance develops in the patellofemoral stabilizing forces, affecting the distribution of forces along the patellofemoral articular surfaces.[2,7] The proper functioning of these forces is critical in the first 20 degrees of knee flexion. It is this position that the patella relative to the femur is determined by the interaction of lateral and medial soft tissue stabilizers.[7] Past the initial 20 degrees of flexion, the patella engages in the trochlea, where the bony architecture becomes increasingly responsible for the articular surface's stability.[7] Any imbalances in the soft tissue stabilizers in the first 20 degrees of flexion results in the patella lacking to enter the trochlea optimally. This will cause disproportionate stress on various tissue surrounding the joint.[7] By improving the flexibility of static stabilizing structures as well as function of dynamic stabilizing structures, physiotherapists and manual therapists can influence the way the patella enters the trochlea, thus restoring proper biomechanics at the patellofemoral joint. [7]

A tight iliotibial band is thought to play a major role in patellar tracking disfunction. It acts as both a passive and dynamic stabilizers of the patellofemoral joint. Proximally it attaches to the tensor fascia lata (TFL); moving distally it interdigitates with the VL.[4] Also, most of the lateral retinaculum arises from the ITB, and therefore, both the dynamic and passive structures on the lateral side of the knee are more extensive and stronger than on the medial side. This means that if the ITB is tight, excessive lateral tracking and/or tilt can present.[7] With these factors taken into consideration, it is essential to evaluate the length of the ITB, with patients presenting with patellar tracking issues.

The aim of this study was to investigate whether restoring balance between the lateral and medial passive and dynamic structure pertaining to the patellofemoral joint would help manage patellar tracking dysfunctions.

Case Study Subject:

This study was conducted on a twenty-nine year old female, who was diagnosed with PFPS by her physician 2 years ago. She was also diagnosed at a young age with bilateral Osgood-Schlatter. The subject has been working as a server for 8 years and has currently started a part-time school program. As a teenager and in her early twenties she played field hockey competitively. The patient has also been playing golf since she was a young adult and is still playing up to three days per week in the summer.

The subject has been experiencing knee pain since she was a child, she was diagnosed at a young age with bilateral Osgood-Schlatter. The onset of pain started before she could remember. Lately, it has been aggravated by a sudden increase in intensity, frequency and duration with exercise,usually running in her case. It goes away after 48 hours of rest, but she has had it last a week or two when she was actively training. The most pain she has ever felt was ranked as a 7-8 out of 10 on the pain scale.

With normal acute episodes after intense exercise, the pain is usually more achy and a 4/10 on the pain scale. The pain increases with going down the stairs or walking down a steep hill. With an increased strain on the anterior knee when the pain is still acute the subject sometimes feels her knee giving away during those activities. Using a foam roller to decrease tone in the ITB and quadriceps muscle has helped with the prevention of an acute flare up. She has also been seeking treatment from different health practitioners to decrease pain when she experiences an acute flare-up. In the past, the patient has seen physiotherapists, who performed some inter-muscular stimulation (IMS) on the affected area. The patient felt that IMS had helped temporarily. She has also seeked treatment from a Registered Massage Therapist that successfully alleviated her pain.

Methods:

Physical examination:

Baseline measurements to determine any biomechanics asymmetry included a postural assessment, where the subject was observed in standing position from the ground up.[2] Lower extremities were noted for any scars or trauma in the area that could be contributing to PFPS. Particular attention was noted for foot pronation or supination, patella baja or alta, patella medial or lateral displacement, quadriceps muscle hypertonicity or atrophy, genu valgum or varum, femoral anteversion, pelvis elevation, depression or rotation and lumbar lordodic curve.

Special tests to confirm patellar tracking syndrome and rule out other pathologies were also performed as part of the baseline measurements. These included patellar mobility and pain provocation tests, such as clark sign,[6] patellar tilt test,[6] patellar apprehension test.[6] Special tests included the varus and valgus stress test,[6] apley's distraction test, anterior and posterior drawer's test,[6] apley's compression,[6] Noble test,[6] piriformis length,[6] Tendelenburg test[6] were also performed to insure the subject was not presenting with any other conditions. Any test that yielded a positive result during the baseline measurement assessment were reassessed in the final reassessment for any changes.

Bilateral dynamic patellar tracking was assessed by recording the subject standing with feet aligned parallel and should width apart and then performing a squat and stand.[2] During this procedure imbalances between medial and lateral patella and soft tissue of the upper lower extremities (VMO in particular) were assessed individually bilaterally. Visual dynamic movement of patella and VMO engagement were closely observed during the early phase of flexion and terminal phase of extension.[2.3]

With the use of a goniometer, the Q-angle, Ober's test, Thomas test and passive and active range of motion at the knee and hip were measured.[8]

The lateral patellar flexor retinaculum was assessed and recoded on a star chart observing for any fascial restriction. A ruler was used to measure the medial or lateral patellar glide, with the knee in neutral position.[6].

Reassessment for hip and knee range of motion, Q-angle, Ober's test, Thomas test, patellar mobility test, and lateral patellar flexor retinaculum fascial restriction was done post treatments number three, five, seven and ten. The dynamic patellar tracking video was performed and was reassessed post treatment number five and in the final reassessment. A final postural reassessment was also performed, noting any changes at the end of the final treatment.

<u>Treatment procedure:</u>

The treatment procedure consisted of ten, ninety minute treatments. During each treatment, the lumbar region, gluteals, posterior and anterior thighs, posterior leg, fascia around the knee and the patella femoral joint were addressed. More emphasizes was taken in releasing the lateral region of the thigh, specifically the vastus lateralis, iliotibial band (ITB), and lateral flexor retinaculum, and strengthening the vastus medialis.

Each treatment began with assessing the pelvis for any rotation and reseting the pelvis to neutral with muscle energy techniques. Next, with the subject prone, myofascial release techniques were applied to the thoracolumbar fascia and lumbar erector spinea group (ESG). Kneading and static compressions were used to release the quadratus lumborum (QL) and the ESG along their inferior muscle attachments.

Knuckle kneading and compression were used on the gluteal region to warm up and re-establish circulation to the tissue. Neuromuscular friction (NMT) was applied at the inferior lip of iliac crest to release gluteus maximus, minimus and medius. Muscle stripping as well as a pin and stretch was applied to gluteus minimus, gluteus medius and piriformis muscles. The hamstrings were treated with intramuscular MFR with the intention to separate biceps femoris from semimembranosis and semitendinosis, also separating the long head of biceps femoris from ITB and gluteus maximus. NMT frictions were used on hamstrings attachments at the ischial tuberosity and GTO release was used with the biceps femoris tendon at the posterior knee. Knuckle and forearm kneading as well as muscle stripping was applied to the muscle belly of the hamstrings. Bowing of ITB anteriorly was used with a pin and stretch technique to decrease adhesion of the ITB on biceps femoris and vastus laterals. General swedish techniques were used to re-establish circulation to the posterior leg. Gluteal muscles fibers and hamstrings muscle fibers were reset with resisted RROM in knee flexion, hip extension, lateral and medial rotation.

The subject was then asked to turn over and was treated supine with pillow adjusted under the knee; wedging pillows on lateral side or medial side of the knee depending on patient presentation to bring the lower extremities into neutral rotation. General compressions were applied in quadriceps muscles as well as superficial MFR to warm up tissue. Intermuscular MFR, muscle stripping and trigger point therapy was applied to the vastus lateralis in order to decrease tone and release trigger points. ITB bowing and MFR while preventing the medial side of the patella to tilt was applied. A short duration of tapotement was applied to VMO to stimulate the muscle. MFR was applied to the lateral patellar retinaculum and medial glide joint mobilization were applied to the patella. PNF strengthening exercise were performed, where subject was ask to resist knee flexion for five seconds, while the VMO was stimulated by examiner with finger tip tapping. This procedure was done 5x on each leg. To re-establish circulation to the anterior leg, general swedish techniques were applied. Each treatment was terminated with passive stretches held for 30 seconds for the hamstrings and the quadriceps followed by a gentle traction of the lower extremity.

Results:

The postural assessment started with analyzing the subject's feet, knees and hips in her natural standing position. A minor genu valgum and knee hyperextension was observed as well as external rotation at the feet marginally greater on the right side than the left. Femoral anteversion with medial patellar torsion was noticed bilaterally, slightly greater on the left than the right side. No tibial torsion was identified but slight to moderate feet pronation with collapsed arches was noticed bilaterally equally.

Evaluating the patellar region more closely with the subject's feet shoulder width apart and parallel, bilateral patella alta was noted as well as a "squinting" patella again, on both sides, more prominent on the left than the right. Patella medial torsion was also noticed in both standing and supine position, greater on the right than the left side. Bony growth at the tibial tuberosity from Osgood-Schlatters was present bilaterally, more on the left than the right side.

Palpation evaluated in conjunction to the postural assessment and findings were that the hamstrings and quadriceps were both more hypertoned in the lateral thigh than medial thigh, with initial measurements indicating more hypertonicity on the right compared to the left quadratus lumborum (QL), gluteus maximus and even more so gluteus medius and minimus all displayed an increase in tone. During our final reassessment of the lumbar spine, the gluteals hamstrings and quadriceps group the toned decreased bilaterally, with the left slightly hypertoned than the right.

The subject was found to present initially with a left pelvis posterior rotation of 2.5cm. The hip rotation was reset back to neutral at the start of every treatment and was found to only be present prior to treatment 1, 2, 3, and 4, therefore hip rotation was found to be restored post treatment 4.

The dynamic patellar tracking yielded a positive “J” sign bilaterally for the baseline and the final reassessment (Table 2). Pain and crepitus was bilaterally positive with the patellar grind test. Using the initial measurement, pain was more prominent on the right than the left and in the final reassessment, the pain was more prominent on the left than the right (Table 2). Using Noble’s test, the pain initially started earlier with knee passive knee extension on the right than the left, but with the final reassessment the pain started earlier on the left then the right. However, for both sides the pain in the final reassessment as provoked later than in the initial assessment (Table 2). At the baseline, the patellar mobility test displayed a normal length of travel, ~1.5 quadrant with the patella medial glide, however the test was positive with the medial border of the patella tilting up and also the inferior pole of the patella rotating medially (Table 2). During the final reassessment the test yielded the same result except that the patellar medial tilt was only positive on the left side, rather than bilaterally. The patellar tilt test exhibited similar results where the baseline was initially positive bilaterally, but with the final measure the test was only positive on the left (Table 2).

Table 2. Baseline and Final reassessment special test’s yield and description.

Special test	**Initial Yield**	**Description**	**Final Yield**	**Desciption**
Deep tendon reflex (L4 & L5)	_	Grade 2	N/A	

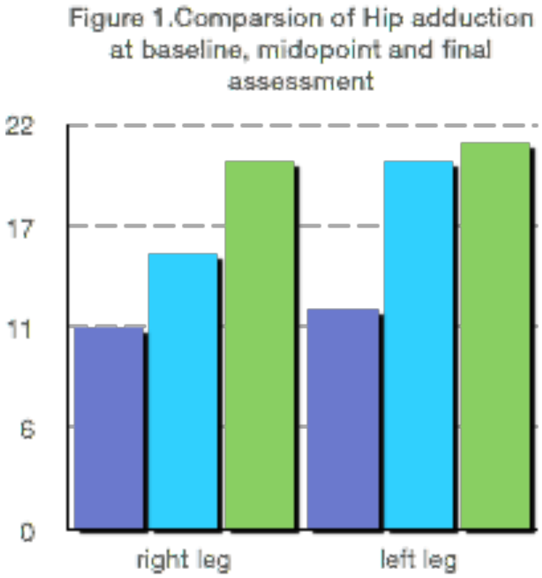
Table 2. Baseline and Final reassessment special test's yield and description.

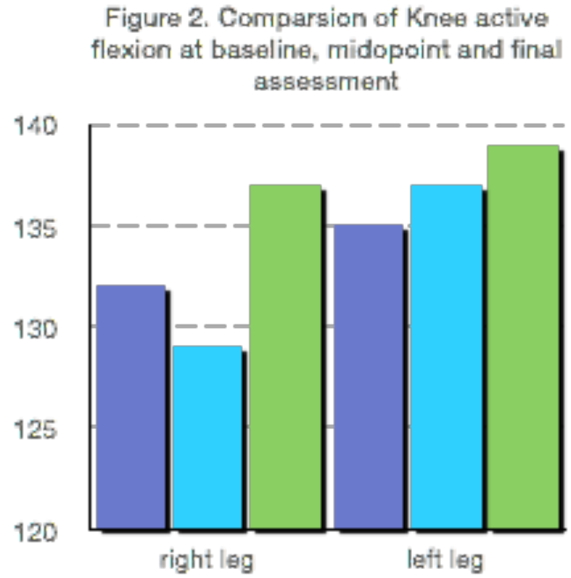
Special test	Initial Yield	Description	Final Yield	Desciption
Myotomes	_		N/A	
Valgus Stress test	_		N/A	
Varus stress test	_		N/A	
Apley's distraction	_		N/A	
Apley's compression	_		N/A	
Anterior Drawer (knee)	_		N/A	
Posterior Drawer (knee)	_		N/A	
"J" Sign	+	Bilateral lateral deviation with dynamic patellar tracking	+	Bilateral lateral deviation with dynamic patellar tracking
Patellar Grind test	+	Bilateral for pain (Right > Left), Crepitus bilaterally	+	Bilateral for pain (Left >Right) Crepitus bilaterally
Patellsr tilt test	+	Bilateral, No movement of lateral angle of patella	+	Only on Left
Patella mobility test	+	Bilaterally for medial border tilt and rotated medially, the length of travel was normal ~1.5 quadrant	+	Only on the left the medial border of the patella tilted up, bilateral + for medial rotation. rotation medially of inferior pole. The length of travel was normal at ~1.5 quadrant
Noble compression test	+	Bilateral pain (Right >Left)	+	Bilateral pain (left >right

Hip and knee passive and active range of motion for all action increased (Table 3 &4). The most important measurement pertaining to this condition would the increase in adduction of the hip (Table 3, Figure 1) and the increase in flexion of the knee (Table 4, Figure 2).Hip active range of motion with flexion and extension fell into normal range. Hip abduction with initial measurement fell slightly lower than normal AROM, however past the fifth treatment, AROM increased to within a normal range. Medial rotation of the hip (Table 3) is the only AROM that decreased with the final treatments and also fell under the normal range of motion (Table 3). Although, adduction increased progressively from the baseline to the final reassessment it was the only value that fell below the normal range throughout the 10 treatments (Table 3, Figure 1). All action in passive range of motion yielded a normal end field.

Table 3. Progresstion of Active Range of Motion of the Hip

HIP										
AROM										
Leg measured	**Right legs**					**Left Leg**				
Treatment #	1	3	5	7	Final	1	3	5	7	Final
Flexion	100	102	109	107	113	105	96	109	109	111
Abduction	22	31	34	36	39	22	25	32	35	37
Adduction	11	11	15	20	21	12	19	20	21	21
Medial rotation	40	42	24*	31	36	30	35	27*	35	37
Lateral rotation	30*	21*	52	50	53	51	29*	50	53	53
Extension	9	10	9	10	9	16*	10	9	10	10





Both flexion and extension of the knee AROM fell in to the normal range (Table 4). Flexion progressively increased throughout the ten treatments with the exception of the right leg prior to treatment five (Figure 2). Leg extension fell within normal AROM range, the measures were more scattered with lack of increased ROM (Table 4). All passive range of motion had normal end field.

Table 3. Progresstion of Knee Active Range of Motion measurements

Knee AROM										
Leg measured	**Right legs**					**Left Leg**				
Treatment #	1	3	5	7	Final	1	3	5	7	Final
Flexion	132	139	129	135	137	135	138	137	137	139
Extension	10	12	2	2	2	5	7	2	3	2

Ober’s test was positive from the baseline to the final reassessment yielded a positive bilaterally (Table 5). However the degree of movement progressively improved throughout the 10 treatments (Figure 4). Thomas test measuring quadriceps length was positive from the initial assessment to the final assessment and the values were slightly less consistent throughout the reassessment. Considering the initial and the final measurements, the degree on knee flexion improved. From the baseline measurements and the final reassessment, the Q-angle increased slightly in the right lower extremity and increased greatly in the left. The final reassessment measures displayed a greater than normal Q-angle.

Table 5. Measurement for ober’s test, thomas test, Q-angle

Leg measured	**Right leg**					**Left Leg**				
Treatment #	1	3	5	7	Final	1	3	5	7	Final
Ober’s (degree)	15	16	17	32*	21	18	18	23	23	29
Thomas Test (Quadriceps)	45	49	50	57	55	41	50	43	43	52
Q-angle	19	20	20	18	20	10	10	10	21	20

Figure 3. Comparison of Q-anglet at baseline, midpoint, and final assessment.

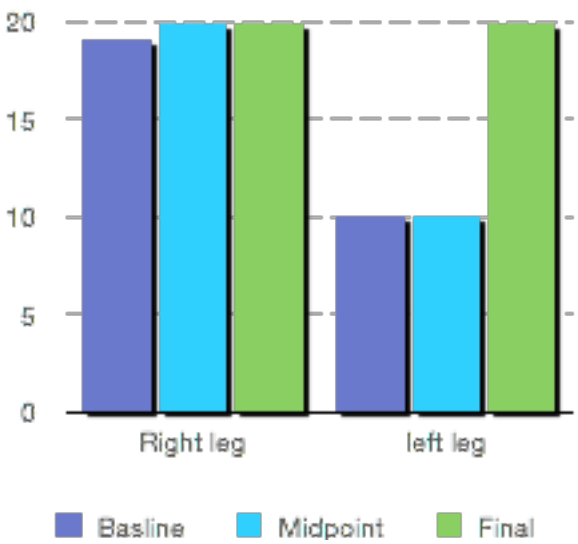
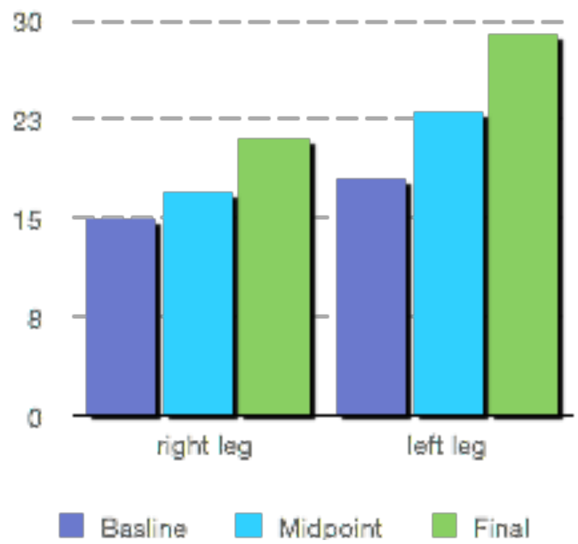
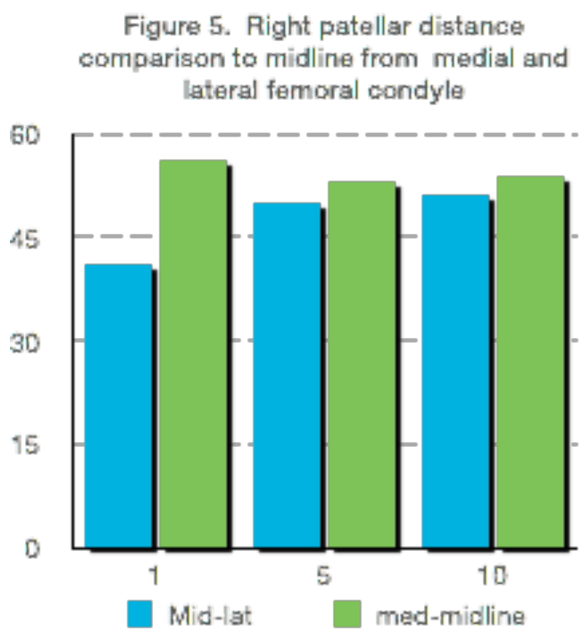
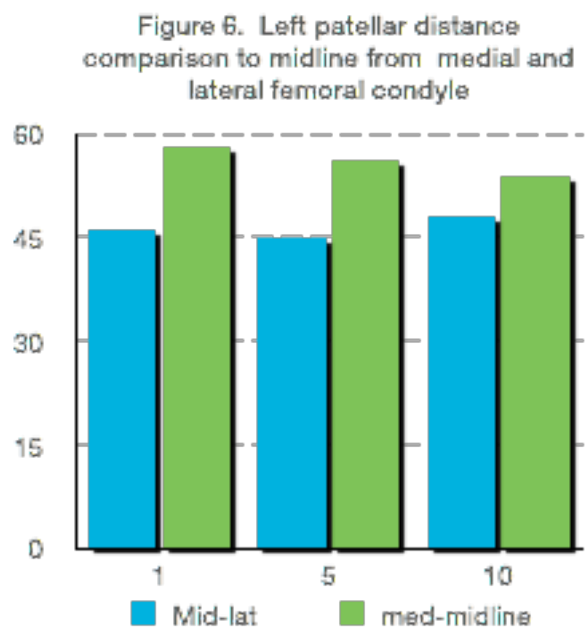


Figure 4. Comparison of Ober's test at baseline, midpoint, and final assessment.



The patella initially was located more lateral on the knee with this presentation more on the right than the left side. Throughout treatment the patella centralization improved bilaterally. From baseline to final reassessment the right patella changed from being more laterally positioned than the left to be more centralized than the left patella. Therefore, the proper patellar position yielded better results on the right versus the left





side.

Discussion:

The most significant finding in this study was the combination of the increasing hip adduction (Figure 1) in conjunction with an Ober's test that yielded a less positive result (Figure 4). This signifies that the lateral passive and active stabilizers of the knee especially the iliotibial band, TFL and VL, have decreased in tone and increased in length allowing the hip to engage into greater adduction. By looking at the final patellar glide measurements (Figure 5 & 6), the position of the patella was more centred on the patellofemoral joint, which further supports the findings that a decrease in tone of at the lateral passive and active stabilizers was achieved. Thus, these finding support that medial and lateral passive forces improved with the progression of treatments.

The improvement of dynamic stabilization forces versus the medial and lateral thigh was not as successful at creating a change in the assessment measures. This was demonstrated with the final yield of the special tests specific to the patella (Table 2); especially the dynamic patellar tracking assessment where the "J" sign remained positive on both sides. By incorporating strengthening and stretching home care exercises for the VMO, as well as strengthening of the medial thigh muscles in conjunction with the treatment could potentially show a greater improvement in the dynamic force imbalance of the patellofemoral joint.

Although the patellar mobility slightly improved bilaterally, greater improvement resulted with the right patella versus the left one. This was noted with the final reassessment of the patellar tilt test, the patellar mobility test, the patellar grind test , as well as Noble's compression test and the patellar glide measurements. This could have been due to human error with the therapist focusing on the right side, as it was initially more affected than the left. The same results may be achieved on the left, if more time was spent on it like the right.

An interesting finding was the realignment of the left posterior pelvic rotation, which was restored after the fourth treatment. This was not as significant for this particular study, however it was an important modality to note for the efficiency of using muscle energy techniques in realigning the pelvis from a rotation.

The Q-angle measurements did improve slightly on the right side and more so on the left. However the data for this test were more scattered. This was most likely due to human error in administrating reliable and accurate measurement. These results could of have been minimized with the use of more accurate assessing tools.

There were a few variables that may have impacted this study's findings validity and reliability. This included the inconsistency of the administered treatment, due to scheduling conflicts between the subject and therapist. For future research it is essential to maintain a scheduling agreement between the subject and examiner. Thus eliminating variables that may have skewed the results and allowing for more research on the best frequency to perform the treatment to optimize results. The usage of improper measuring equipment such as a goniometer that was too small in size, yielded less accurate results and could have been the cause of the data's outliers. A larger goniometer or electronic assessing tools may have improved the accuracy of the results.

Massage practitioners and other health care providers working with soft tissue should take under consideration further research with restoring medial and lateral patellofemoral forces. Supplementary studies in that matter could aid health practitioners in better understanding the PFPS in order to manage this condition more efficiently. Thus, improving life style, activity of daily living and well-being of individuals suffering from this condition in prevention of further pathologies developing secondary to PFPS such as chondromalacia, or osteoarthritis.[9] More importantly in prevention of major knee surgery, such as arthroplasty, which results in life long restrictions with the suffer's daily activities.

This case study supported the hypothesis that manual therapy can improve proper biomechanics at the patellofemoral joint by improving soft tissue balance between the medial and lateral passive stabilizing forces of the patellofemoral joint.

References:

1. Coppack RJ, Etherington J, Wills AK. The effect of exercise for the prevention of overuse anterior knee pain. The American Journal of Sport Medicine. 2011;39(5):940-948.

2. Dixit S, Difiori JP, Burton M, Mines B. Management of Patellofemoral Pain Syndrome. 2007 Jan 15;75(2):194-202.

3. Doucette SA, Globe EM. The effect of exercise on patellar tracking in lateral patellar compression syndrome. The American Journal of Sports Medicine. 1992; 20(4):434-439.

4. Hudson Z, Darthuy E. Iliotibial band tightness and patellofemoral pain syndrome: A case-control study. Manual Therapy. 2009;13:147-151.

5. Kaya DO, Toprak U, Baltaci G, Yosmaoglu B, Ozer H. Long-term Functional and Sonographic Outcome in Osbood-Schlatters Disease. Knee Springs Arthrosc. 2013; 21:1131-1139.

6. Magee D. Orthopedic Physical Assessment. 6th ed. Missouri USA: Elsevier Inc; 2014.

7. McConnell J. Management of Patellofemoral Problems. Manual Therapy. 1996;1:60-66.

8. Norkin CC, White JD. Measurement of Joint Motion. 3rd ed. USA: F.A. Davis Co; 2003.

9. Rattray F, Ludwig L. Clinical Massage Therapy: Understanding, Assessing and Treating Over 70 Conditions. Canada: Talus Inc; 2000.