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Patellofemoral pain syndrome and quadriceps muscle strength: A result of three manipulative treatment protocols

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Abstract
Background: Knee joint disorders are frequently associated with a loss of knee-extensor muscle strength. This weakness results from arthrogenic muscular inhibition (AMI). In the event of any joint damage, the free-nerve endings, a kind of pain receptor, located throughout the joint tissue, will undoubtedly be activated. If they have a significant effect on AMI is unknown.
Objective: The objective of this study is to compare the effectiveness of three manipulative therapy methods on quadriceps muscle strength in individuals with patellofemoral pain syndrome.
Material and Method: To ensure a consistent sample group, this study only included individuals with Patellofemoral Pain Syndrome (PFPS). This study used a convenience, purposive sampling strategy. In order to include individuals whose quadriceps muscle strength was impacted by AMI as a result of PFPS and not OA of the knee, 30 subjects were between the ages of 18 and 45, subjects were selected on the basis of inclusion & exclusion criteria. The individuals' quadriceps muscular strength and subject's subjective perception of their level of pain (associated to the PFPS) were measured both before and after manipulation.
Results: After manipulating the SI joint, the quadriceps strength dramatically increased (P = 0.05). AMI in the quadriceps muscle group has been connected to both the SI and knee joints.
Conclusion: Based on findings of the study, following treatment of the SI joint in PFPS patients, a notable improvement in the quadriceps and hamstrings strength was seen.

Keywords: Arthrogenic muscular inhibition, Knee joint, Muscle, Patellofemoral pain syndrome, quadriceps

Introduction
A lack of strength in the knee-extensor muscles is generally linked to diseases of the knee joint. Arthrogenic muscular inhibition (AMI) has been blamed for this weakness. AMI is a normal reaction intended to protect the joint from additional trauma and is defined as the failure of a muscle to activate all motor units of a muscle group to their full extent during a maximum effort voluntary muscular contraction [1]. Free-nerve endings, a kind of pain receptor, are present throughout the joint tissue and are certain to be activated in the event of any joint injury.
It's unclear whether they have a big impact on AMI. These mechano sensors act on inhibitory interneurons synapsing on the motor neuron (MN) pool of the joint musculature, reducing the force of any contraction originating from that MN pool [2]. These mechanoreceptors are found in tendons, ligaments, and joint capsules [3]. The idea that spinal manipulation could somehow affect, or even enhance, the nervous system's performance is still considered to be purely philosophical [4], but the neurophysiological effects of spinal manipulation have been seen in body parts that are not directly affected by the manipulations [5]. Collateral branches produced by articular mechano receptor afferent nerve fibers are dispersed both intra- and inter-segmentally. As a result, manipulating a single joint impacts the motor unit activity not only in the muscles that operate over that joint but also in muscles that are further away [4].
In the quadriceps muscle group, MI has been connected to the sacroiliac (SI) joint [1]. The lateral and medial collateral ligaments, the anterior and posterior cruciate ligaments, the joint capsule, the perimeniscal tissue, and the outer third of the menisci are knee joint structures that have been shown to cause quadriceps MI [6]. It has also been suggested that the lateral retinaculum may be a source of AMI, however it is unclear whether this is the case [2].

Additionally, linked to quadriceps MI are knee effusions and immobilisation. Two trials demonstrated that SI joint manipulation increased quadriceps muscular strength [1]. To the best of the researcher's knowledge, no studies have been done on how altering the knee joint affects quadriceps muscle strength.

Methodology

Study Design: A prospective clinical trial.

Sample Size: The sample size consisted of 30 patients that were allocated into three treatment groups.

Inclusion Criteria

According to studies, people with radiographic knee osteoarthritis (OA), whether or not they are symptomatic, have weaker quadriceps muscles than people without OA. Arthrogenic muscular weakness has been identified as the cause of this condition. Persons under 45 have little radiological evidence of OA. In order to enrol patients whose quadriceps muscle strength was impacted by AMI as a result of PFPS and not OA of the knee, subjects had to be between the ages of 18 and 45 [7]. Subjects had to have localised peri- or retro-patellar discomfort coming from the patellofemoral joint or the peri-patella tissue.

Exclusion Criteria

- Traumatic or spontaneous patellar dislocation;
- Any neurological involvement that influenced their gait; or
- Had undergone knee surgery.
- Subjects presenting with any of the following were also be excluded:
- Bursitis (suprapatellar, prepatellar, subcutaneous infrapatellar, deep infrapatellar bursitis over the tibial tuberosity).
- Fat pad syndrome.
- Any systemic arthritis that affect the knee.
- Ligamentous instability.
- Abnormalities indicative of osteochondritis dessicans, osteoarthritis or loose bodies.
- Pregnant and breast-feeding subjects.
- Suspected disc herniation with increasing signs and symptoms of neurological deficit.
- Suspected abdominal aortic aneurysm.
- Suspected lumbar spine tumors.
- Patients presenting with acute, severe PFPS

Procedure

Three manipulative treatment protocols were tested during this study. Subjects in group A received a long axis distraction manipulation of the tibio-femoral joint; subjects in group B received a sacroiliac (SI) joint manipulation on the ipsilateral side of the knee pain; and subjects in group C received both a long axis distraction manipulation of the tibio-femoral joint and a joint manipulation on the ipsilateral side of the knee pain.

A measurement of the subject's quadriceps muscle strength was obtained pre and post manipulation, using a Cybex Orthotron II Isokinetic Rehabilitation System. The subjective awareness of the subject's level of pain (related to the PFPS) was also measured pre and post manipulation, using the Numerical Pain Rating Scale (NPRS) [8].

The Cybex Orthotron II Isokinetic Rehabilitation System was used to perform the concentric-concentric isokinetic testing of the thigh. This machine is designed to measure the voluntary force output (isometric contractibility) of a muscle group. The muscles tested were the quadriceps and hamstrings. Several authors have agreed on the reliability and validity of this instrument [9].

Before the isokinetic testing was performed, subjects completed a 5-minute warm-up cycle, followed by 3 sets of a 20 second hamstring and quadriceps stretch. Subjects were placed in a comfortable upright-seated position, back restart 850, and secured using thigh, pelvic and torso straps in order to minimize extraneous body movements. The knee rested at an angle of 90 0 from full extension. The lateral femoral condyle was used as the bony landmark for matching the axis of rotation of the knee joint with the axis of rotation of the dyno-meter resistance adaptor. Subjects were given verbal encouragement while performing the test. The concentric-concentric testing procedure was as follows:

- 6 sub-maximal warm-up repetitions at 900/sec
- 1 minute rest3-5 repetitions of maximal effort at 600/sec
- 5 minute warm-down cycle
- Manipulative intervention/s applied
- 3-5 repetitions of maximal effort at 600 /sec

An average of three readings -before and after manipulation- were taken in order to make an accurate measurement of the isometric contractibility of the thigh.

Study Variables

Conceptual The Wilcoxon Signed Ranks test for matched pairs was used to compare both the objective and subjective results from related samples. In each test, the null hypothesis states that there is no significant improvement between the two related samples being compared at the α level of significance. The alternative hypothesis states that there is a significant improvement. The Wilcoxon Signed Ranks test has its most significant application in paired sample testing [10].

Statistical Methods

The statistical package SPSS was used for capture and analysis. The following tests were used:

The Wilcoxon Signed Ranks Test for matched pairs within Groups A, B and C. The level of significance will be set at α = 0,05 and p-values will be used for decision- making regarding the null hypothesis. The data was analyzed using a 95% confidence level.

Results

Table 1: Age distribution of the sample

	Years
Number of subjects	30
Mean age	26.77
Minimum age	20
Maximum age	39

Table 2: Sample activity comparisons (%)

	Primary	Secondary	Tertiary
Aerobic gym work	13	17	0
Canoeing	0	3	0
Cricket	0	0	3
Cycling	7	0	0
Golf		7	3
Gym	17	3	0
Hockey	3	3	0
Horse riding	0	0	3
None	17	57	80
Running	27	3	0
Soccer	3	3	3
Squash	7	0	3
Swimming	3	0	0
Touch rugby	0	3	3
Yoga	3	0	0

Table 3: Descriptive statistics of Average quadriceps force (NM)

Group		Mean	Std. Deviation	Min	Max
Group A	Pre -Manipulation	186.2	60.76	77	302
	Post- Manipulation	187.5	50.68	91	266
Group B	Pre -Manipulation	129.8	36.15	87	186
	Post- Manipulation	143.7	54.76	75	232
Group C	Pre -Manipulation	159.3	59.31	102	274
	Post- Manipulation	167.8	63.13	108	302

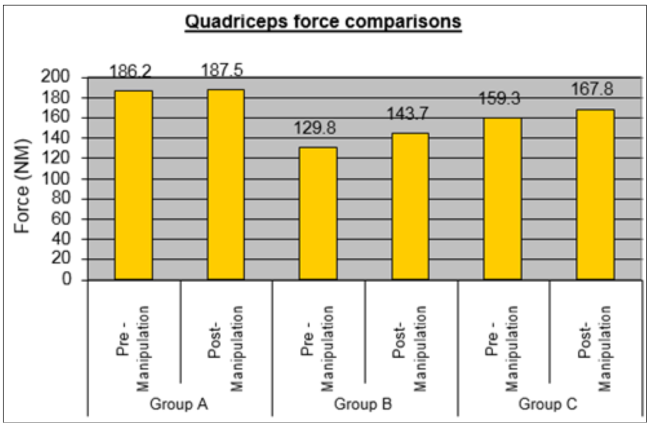

Fig 1: Quadriceps force comparisons

Table 4: Average quadriceps force: Wilcoxon Signed Ranks Test

Group		N	Mean Rank	Sum of Ranks	P-Value
Group A	Negative Ranks	3	6.50	19.50	0.415
	Positive Ranks	7	5.07	35.50	0.415
	Ties	0			0.415
	Total	10			0.415
Group B	Negative Ranks	1	6.00	6.00	0.050
	Positive Ranks	8	4.88	39.00	0.050
	Ties	1			0.050
	Total	10			0.050
Group C	Negative Ranks	3	5.50	16.50	0.262
	Positive Ranks	7	5.50	38.50	0.262
	Ties	0			0.262
	Total	10			0.262

For Group B, the null hypothesis was rejected because $p \leq 0.05$. this indicates a significant improvement in the quadriceps force after the sacroiliac manipulation on the ipsilateral side of the knee pain. For Groups A and C, the null hypothesis was accepted because $p > 0.05$. Therefore, there was no significant improvement in the quadriceps force after manipulation of the knee joint and a combination of manipulations of the knee and sacroiliac joints.

Table 5: Average hamstring force (NM): Descriptive statistics

Group		Mean	Std. Deviation	Min	Max
Group A	Pre- Manipulation	107	26.85	71	156
	Post- Manipulation	114	31.59	64	163
Group B	Pre- Manipulation	81.4	26.07	58	133
	Post- Manipulation	89.4	33.49	62	146
Group C	Pre- Manipulation	97.6	31.94	62	163
	Post- Manipulation	105	35.22	68	172

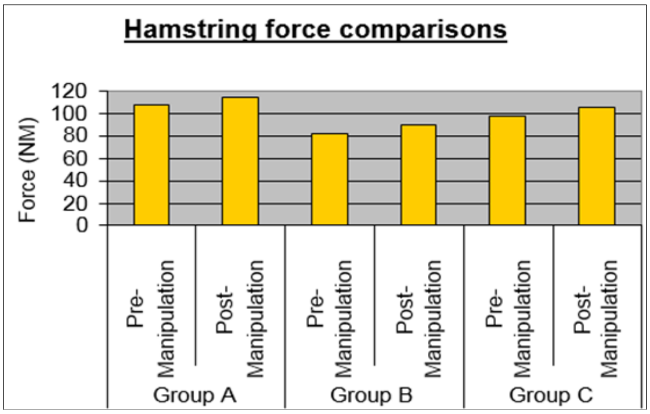

Fig 2: Hamstring force comparisons

Table 6: Average hamtrings force: Wilcoxon Signed Ranks Test

Group	Rank	N	Mean Rank	Sum of Ranks	P-Value
Group A	Negative	2	3.50	7	0.123
	Positive	6	4.83	29	
	Ties	2			
	Total	10			
Group B	Negative	2	3.50	7	0.036
	Positive	8	6.00	48	
	Ties	0			
	Total	10			
Group C	Negative	2	1.50	3	0.021
	Positive	7	6.00	42	
	Ties	1			
	Total	10			

For Groups B and C, the null hypothesis was rejected because $p \leq 0.05$. This indicates a significant improvement in the hamstring force after the sacroiliac manipulation on the ipsilateral side of the knee pain and a combination of manipulations of the knee and sacroiliac joints.

Discussion and Conclusion

Discussing the findings from the statistical analysis of the primary data, which included the maximal voluntary quadriceps and hamstring force production, the quadriceps and hamstring ratios, and the degree of pain perception.

Maximum voluntary quadriceps force output

The Wilcoxon Signed Ranks test for matched pairs was used to statistically analyze the mean quadriceps force values. After the modification, group B's quadriceps force increased significantly (P = 0.05). Both group A (P=0.415) and group C (P=0.262) had an increase in quadriceps force following manipulation, but the improvement fell short of statistical significance. The p-values for groups A and C may be compared to see that group C improved more.

The null hypothesis for Group B was disproved because p 0.05. Data shows a marked improvement in the quadriceps force following the sacroiliac manipulation on the ipsilateral side of the knee discomfort. Because *p*>0.05, the null hypothesis was approved for Groups A and C. Therefore, despite manipulations of the knee joint and a combination of the knee and sacroiliac joints, there was no appreciable change in the quadriceps force.

The maximum voluntary hamstring force output

Using the Wilcoxon Signed Ranks test for matched pairs, the mean hamstring force values were statistically examined. The hamstring force post-manipulation improved in Group A (P = 0.13) but did not reach a statistically significant level. Post-manipulation, the hamstring strength of Groups B (P = 0.036) and C (P= 0.021) significantly increased.

The null hypothesis was disproved for Groups B and C because p 0.05. This suggests a considerable improvement in the hamstring force following a combination of knee and sacroiliac joint manipulations on the ipsilateral side of the knee discomfort.

Because *p*>0.05, the null hypothesis was accepted for Group A. As a result, despite manipulating the knee joint, the quadriceps force did not significantly improve. The null hypothesis was accepted as p 0.05 for all groups. This shows that none of the three distinct manipulative therapy regimens resulted in a noticeable improvement in the quadriceps ratio. The null hypothesis was accepted as p 0.05 for all groups. This suggests that none of the three distinct manipulation therapy regimens resulted in a noticeably altered hamstring ratio. The null hypothesis was accepted as p 0.05 for all groups. This suggests that none of the three distinct manipulative therapy procedures resulted in a noticeable change in the NPRS.

This study sought to determine the impact of three manipulative therapy methods on individuals with patellofemoral pain syndrome's quadriceps muscle strength (PFPS). The initial goal was to assess how the tibio-femoral joint's long axis distraction manipulation affected the quadriceps' muscular strength. The second goal was to examine how the sacroiliac (SI) joint manipulation affected the quadriceps muscle strength. The third goal was to examine the impact of SI and tibio-femoral joint manipulation on quadriceps muscle strength. The evaluation of the three manipulative therapy methods' impact on patients' subjective experiences of anterior knee pain served as the fourth aim.

After manipulating the tibio-femoral and SI joints, a significant increase in hamstring force was noticed. This study was unable to demonstrate a substantial increase in quadriceps muscle strength after manipulating the SI and tibio-femoral joints. The three therapy groups did not differ from one another in terms of the treatment results, according to the inter-group study. The subjective experience of anterior knee pain was not significantly correlated with any of the manipulative therapy procedures (in any of the groups).

Conflict of Interest: There is no conflict of interest.

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References

1. Suter E, Mc Morland G, Herzog W, Bray R. Conservative lower back treatment reduces inhibition in knee-extensor muscles: A randomized controlled trial. Journal of Manipulative and Physiological Therapeutics. 2000;23(2):76-80.
2. Jon Ty Hopkins, Christopher D. Ingersoll, Arthrogenic Muscle inhibition: A Limiting Factor in Joint Rehabilitation, Journal of Sport Rehabilitation. 2000;9:135-159.
3. Levangie PK, Norkin CC. Joint structure and function. Third edition. Philadelphia: F.A. Davies Company; c2001. p 71.
4. Wyke BD. Articular neurology and manipulative therapy. In Glasgow, E. F., Tworney, L.T., Scull, E.R., Kleynhans, A.M. Aspects of Manipulative Therapy. New York: Churchill Livingstone; c1985. p. 72-77.
5. Suter E, Mc Morland G, Herzog W, Bray R. Decrease in quadriceps inhibition after sacroiliac manipulation in patients with anterior knee pain. Journal of Manipulative and Physiological Therapeutics. 1999;22(3):149-153.
6. Kim AW, Rosen AM, Brander VA, Buchanan TS. Selective muscle activation following electrical stimulation of the collateral ligaments of the human knee joint. Archives of Physical and Medical Rehabilitation. 1995 Aug;76(8):750-7.
7. Brandt KB. Osteoarthritis. [CD-Rom]. Harrison's principles of internal medicine; c2002.
8. Jensen MP, Karoly P, Braver S. The measurement of clinical pain intensity: a comparison of six methods. Pain. 1986;27:117-126.
9. Davies GJ. A compendium of iso-kinetics in clinical usage and rehabilitation techniques. Wisconsin: S&S publishers; c1992. p. 35-44.24.
10. Fairbank JC, Pyn Sent PB, Van Poortvleit JA, Phillips H. Mechanical factors in the incidence of knee pain in adolescents and young adults. Journal of Bone and Joint Surgery. 1984;66:685-693.
11. Beebe DW. Cognitive, behavioural, and functional consequences of inadequate sleep-in children and adolescents. Paediatric Clinics. 2011 Jun 1;58(3):649-65.