



EFFECT OF RESISTED MULTI ANGLE ISOMETRIC EXERCISES VS RESISTANCE BAND EXERCISES ON PAIN, MUSCLE STRENGTH AND FUNCTIONAL ACTIVITIES AMONG SUBJECTS WITH PATELLOFEMORAL OSTEOARTHRITIS OF THE KNEE

Physiotherapy

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ABSTRACT

Background: Patellofemoral osteoarthritis (PFOA) is a degenerative knee condition that affects the articulation between the femur and patella, leading to anterior knee pain, stiffness, and functional limitation. **OBJECTIVE:** To compare the effects of resisted multi-angle isometric exercises versus resistance band exercises on pain, functional activities, and quadriceps muscle strength in individuals with patellofemoral osteoarthritis, using the KOOS questionnaire and Biodex assessment. **Methods:** A total of 30 participants aged 40–60 years with clinically diagnosed PFOA were recruited and randomly divided into two groups. Group A received resisted multi-angle isometric exercises with pulsed shortwave diathermy (PSWD), while Group B received resistance band exercises with PSWD. Both groups underwent treatment for three weeks. Baseline and post-intervention outcomes were measured for pain, function (as assessed by the KOOS), and quadriceps strength (using the Biodex). **Results:** Both groups showed statistically significant improvements in pain, functional outcomes, and quadriceps strength ($p < 0.05$). Group A demonstrated significantly greater improvements than Group B in pain reduction (KOOS: 75.80 vs. 60.38, $p = 0.011$), functional activity (KOOS: 76.38 vs. 56.68, $p = 0.002$), and quadriceps strength at 0° flexion (34.15 vs. 26.84, $p = 0.001$). However, no significant differences were observed between the groups at 30° flexion (57.76 vs. 54.08, $p = 0.253$) and 60° flexion (128.49 vs. 122.61, $p = 0.445$). **CONCLUSION:** Resisted multi-angle isometric exercises are more effective than resistance band exercises training in reducing pain, enhancing functional activities, and improving quadriceps strength among individuals with patellofemoral osteoarthritis.

KEYWORDS

Resisted Multi-angle Isometric Exercises, Resistance Band Exercises, PSWD, KOOS, Quadriceps Strengthening, Biodex

INTRODUCTION

Knee osteoarthritis (OA) is a progressive degenerative joint disorder that affects the articular cartilage, subchondral bone, and periarticular tissues. It is the most common joint disease worldwide and a major cause of disability, with prevalence increasing due to ageing, obesity, and sedentary lifestyles.⁽¹⁾⁽²⁾ Patellofemoral OA, often presenting with anterior knee pain, may occur alone or with tibiofemoral involvement. Clinical features include pain, stiffness, crepitus, swelling, reduced motion, and progressive functional decline.

Knee osteoarthritis arises from multiple factors. Age, sex, and genetics are non-modifiable, while obesity, malalignment, weakness, and repetitive stress are modifiable⁽³⁾. Prior ligament or meniscal injury increases risk. Patellofemoral OA is linked to patella alta, dysplasia, and maltracking. Diagnosis is clinical, supported by X-ray (narrowing, osteophytes and subchondral changes) and MRI (cartilage and soft tissue changes). Synovial fluid is non-inflammatory, helping exclude inflammatory arthritis.⁽⁴⁾

Knee OA is best managed conservatively with education, weight control, and activity modification. Exercise therapy—especially quadriceps, hamstring, and hip strengthening with proprioceptive and aerobic training—is the most effective approach. Taping, bracing, footwear modification, and modalities like shortwave diathermy provide relief. Medications (acetaminophen, NSAIDs) and intra-articular injections may be added⁽⁵⁾. Early physiotherapy and lifestyle changes slow progression and improve function. Among manual therapies, resisted multiangle isometrics and resistance band exercises are considered in this study, where the former has the potential to enhance clinical outcomes, but limited evidence exists. Along with that, PSWD combined to enhance the feasibility for the reduction of pain⁽⁶⁾. This study was designed to evaluate the effectiveness of this combined protocol on pain, ROM, and functional disability in patients with adhesive capsulitis.^(7,8,9)

METHODOLOGY

Study Design

A two-group pre–post comparative experimental study was conducted

at the BIRRD hospital, College of Physiotherapy, SVIMS University, Tirupati. Ethical clearance was obtained with IEC. NO. 1819 from the institutional ethics committee, and informed consent was collected from all participants.

PARTICIPANTS

Forty subjects with a mean age of 40-60 years diagnosed with patellofemoral OA of the knee were recruited. Inclusion criteria were: pain, crepitus and Kellgren Lawrence scale of grades 1&2 of the knee OA. Exclusion criteria included a history of major shoulder trauma, other inflammatory arthritis, gout, malignancies, severe DM, fractures, infections, and ligament tears.

Intervention

The subjects were divided into two groups, Group A and Group B, by using the simple randomisation method. Group = A (Experimental group), 20 subjects. Group = B (Experimental group), 20 subjects.

Group A: Received multiangle isometric exercises (quad set 0°, isometric 30° & 60° flexion, wall sit, step down hold, isometric lunge) with PSWD {Mode: pulsed, Pulse duration: 65–400 us (commonly 100–200us), Pulse repetition rate: 100–800hz, Average power: 5–20watts, Peak power: machine dependent, Placement: around the knee (drum or sleeve electrode), duration: 15–20min}.

Group B: Received resistance band exercises (knee extension, terminal knee extension, straight leg raise, side lying abduction, resisted long arc, mini squat, step up with band) with PSWD (same as mentioned above).

The treatment program included 3 sessions/week for 3 successive weeks. Each exercise included 10 10-second holding period in each exercise position for three sets per workout. (10–15 repetitions/session)

Outcome Measures

Pain & Functional ability: KOOS questionnaire⁽¹⁰⁾
Muscle strength: Biodex⁽¹¹⁾

RESULTS

The data were analysed using SPSS version 21 and MS-Excel 2007. The unpaired sample t-test was applied to compare pre- and post-test values. A p-value of $p < 0.05$ was considered statistically significant.

Demographic Distribution: Age: The mean age of Group A was 54.05 years & SD of 6.932, while Group B had a mean age of 53.65 years & SD OF 6.360. Gender: Group A had 60% females and 40% males, while Group B had 65% females and 35% males.



Figure 1: Biodex Analysing the Quadriceps Muscle Strength (Flexion at 0°, 30°, And 60°)

Table: Represents a Comparative Statistical Analysis of Groups A and B

Outcome measure	Group	N	Mean $\pm$ SD	t-value	p-value
Pain (KOOS)	Group A	20	75.80 $\pm$ 18.65	2.689	0.011
	Group B	20	60.38 $\pm$ 17.60		
Functional Activity (KOOS)	Group A	20	76.38 $\pm$ 16.61	3.268	0.002
	Group B	20	56.68 $\pm$ 21.23		
Muscle Strength (Biodex) 0° Flexion	Group A	20	34.15 $\pm$ 6.89	3.628	0.001
	Group B	20	26.84 $\pm$ 5.80		
Muscle Strength (Biodex) 30° Flexion	Group A	20	57.76 $\pm$ 10.47	1.162	0.253
	Group B	20	54.08 $\pm$ 9.54		
uMuscle Strength (Biodex) 60° Flexion	Group A	20	128.49 $\pm$ 26.40	0.773	0.445
	Group B	20	122.61 $\pm$ 21.42		



Graph 1: Depicting the Statistical Analysis in a Graphical Representation

- **Pain (KOOS):** Group A (75.80 $\pm$ 18.65) showed significantly greater pain reduction than Group B (60.38 $\pm$ 17.60), $p = 0.011$.
- **Functional Activity (KOOS):** Group A (76.38 $\pm$ 16.61) showed significantly better functional improvement compared to Group B (56.68 $\pm$ 21.23), $p = 0.002$.
- **Muscle Strength 0° Flexion:** Group A (34.15 $\pm$ 6.89) demonstrated significantly higher quadriceps strength than Group B (26.84 $\pm$ 5.80), $p = 0.001$.
- **Muscle Strength 30° Flexion:** No significant difference was observed between Group A (57.76 $\pm$ 10.47) and Group B (54.08 $\pm$ 9.54), $p = 0.253$.
- **Muscle Strength 60° Flexion:** No significant difference was found between Group A (128.49 $\pm$ 26.40) and Group B (122.61 $\pm$ 21.42), $p = 0.445$.

Overall: Resistance-based multi-angle isometric exercises (Group A) were more effective than resistance band exercises (Group B) in reducing pain, improving function, and increasing quadriceps strength at 0° knee flexion, while gains at higher flexion angles (30° and 60°) were comparable between groups.

DISCUSSION

Knee osteoarthritis affects millions globally, leading to pain, stiffness, and functional limitations. Exercise-based therapies are key to managing symptoms by improving muscle strength, joint stability, and proprioception. This study compared multi-angle isometric exercises and resistance band exercises in patients with patellofemoral osteoarthritis.

Forty participants aged 40–60 years were randomly assigned to two groups: Group A performed multi-angle isometric exercises with pulsed shortwave diathermy (PSWD), while Group B performed resistance band exercises with PSWD, three times per week for four weeks. Multi-angle isometrics activate the quadriceps at various joint angles, enhancing neuromuscular recruitment and stabilising the patellofemoral joint, while resistance band exercises provide isotonic loading that improves muscle endurance and joint control.

Outcomes measured by KOOS and Biodex showed significant improvements in both groups, but Group A demonstrated greater reductions in pain, superior functional gains, and higher quadriceps strength. PSWD further contributed by increasing local circulation, reducing joint stiffness, and promoting tissue healing. Overall, multi-angle isometric exercises are highly effective for early rehabilitation, while resistance band exercises complement long-term functional and strength improvements.

The observed improvements align with previous studies that support the above study by various authors. Comparable results have been reported by More et al. (2022), Suriani and Lesmana, Dr. Shreya More et.al, Dhivyadharshini V, et.al (2023), Emine Handan Tüzün et. al, who demonstrated that the above-mentioned protocol for patellofemoral OA knee helps in reducing the ongoing symptoms and improving strength.^(12,13)

CONCLUSION

The present study not only concluded that resisted multiangle isometric exercises were more effective than resistance band exercises in reducing pain, improving muscle strength and functional activity in individuals with patellofemoral osteoarthritis of the knee, but also emphasised that this was a multimodal strategy in treating such a condition. This was also a combined evidence-based approach which provides holistic benefits, where clinicians can be encouraged to adopt such practices in enhancing the treatment approaches towards the patients in daily practice, which was safe and effective.

Limitations

The study involved a small sample size, was conducted over a short duration and was expensive. Longer follow-up periods are required to fully assess the long-term effectiveness of these exercises in managing patellofemoral osteoarthritis of the knee.

Recommendations

Future research should include larger sample sizes and extend the intervention period beyond four weeks. The procedure should be feasible. Studies can also explore the effects of these exercises in different age groups to better generalise the findings.

REFERENCES

1. Cross M, Smith E, Hoy D, Nolte S, Ackerman I, Fransen M, Bridgett L, Williams S, Guillemin F, Hill CL, Laslett LL, Jones, Cicuttini F, Osborne R, Vos, Buchbinder R, Woolf A, March L. The global burden of hip and knee osteoarthritis: estimates from the global burden of disease 2010 study. *Ann Rheum Dis*. 2014 Jul;73(7):1323-30
2. Nalam Middleton A1, Anu Mary Oommen2, Alfred Job Daniel3, Kuryan George2, A study on the prevalence of knee osteoarthritis and its effects among adults aged 50 years and above in a rural block in South India, DOI: 10.70034/ijmedph 2024.4.138, *Int J Med Pub Health* 2024; 14 (4); 740-744
3. Powers, C.M. (2003). The influence of altered lower-extremity kinematics on patellofemoral joint dysfunction. *Journal of orthopaedic & sports physical therapy*, 33(11), 639–646.
4. Felson, D. T., niu, j., goggins, j., neville, m. C., roemer, f., & guermazi, a. (2005). The prevalence of patellofemoral and tibiofemoral osteoarthritis as defined by MRI in a population-based cohort: the Framingham osteoarthritis study. *Osteoarthritis and cartilage*, 13(3), 193-198. Duncan, R., Hay, E. M., saklatvala, j., croft, p. R. (2006). Prevalence of radiographic osteoarthritis — is knee osteoarthritis being underdiagnosed? *British journal of general practice*, 56(525), 92-97. Hunter, D. J., guermazi, a., lo, g. H., Grainger, a. J., conaghan, p. G., boudreau, r. M., & roemer, f. W. (2011). Evolution of semi-quantitative whole joint assessment of knee OA: moaks (MRI osteoarthritis knee score). *Osteoarthritis and cartilage*, 19(8), 990-1002.
5. Merchant ac, mercer rl, Jacobsen rh, cool cr. Roentgen graphic analysis of patellofemoral congruence. *J Bone Joint Surg Am*. 1974; 56:1391–1396.
6. Crossley, K. M., Callaghan, M. J., & van Linschoten, r. (2015). Patellofemoral pain. *Bmj*, 351, h3939.
7. Dhivyadharshini V, Abinaya S, Muralisankar K.S, Sanjes Benny, Rakshini M, Effectiveness of Multiple Angle Isometric Exercise with Interferential Therapy in Patients with Osteoarthritis Knee - a Randomised Controlled trial (RCT), 2024 IJCRT | Volume 12, Issue 12 December 2024 | ISSN: 2320-2882.
8. T. Maurer, MS, Alan G Stern, MD, Bruce Kinossian, MD, Karen D. Cook, PhD, H. Ralph Schumacher, Jr., MD, Osteoarthritis of the Knee: Isokinetic Quadriceps Exercise Versus an Educational Intervention, *Brian, ch Phys Med Rehabil Vol 80, October 1999*.
9. Dr. Matcha Sresha Aishwarya, Dr. K. Senthil Kumar, Dr.C.Shanthi, Dr S. Raghava Krishna, Dr K. K.Madhavi, Effectiveness of Chair Aerobics Vs Theraband Exercises on Pain, Musclepower, and Range of motion in Subjects with Osteoarthritis of the Knee, 2024 IJNRD | Volume 9, Issue 2 February 2024 | ISSN: 2456-4184 | IJNRD.ORG
10. Roos EM, Roos HP, Lohmander LS, Ekdahl C, Beynnon BD. Knee Injury and Osteoarthritis Outcome Score (KOOS)—development of a self-administered outcome measure. *J Orthop Sports Phys Ther*. 1998 Aug; 28(2):88-96.
11. Samina Javed, Huma Riaz, Aruba Saeed, Ruqia Begum, Effects of biodex balance training on symptomatic knee osteoarthritis in Rawalpindi: A randomised control trial, (*JPMA* 71: 402; 2021) DOI: <https://doi.org/10.47391/JPMA.331>
12. Dhivyadharshini V, Barathkumar, Abinaya S and Manikandan M, To Evaluate the Effectiveness of Multiple Angle Isometric Exercises on Pain in Patients with Osteoarthritis Knee, ISSN No. (Print): 0975-1130, ISSN No. (Online): 2249-3239, *Biological Forum – An International Journal* 15(3): 589-591(2023).
13. Dr. Shreya More, Dr. Prachi V. Shah, Dr. Vibuti Joshi, 1.3mpt scholar, Parul University, Assistant Professor, Parul University “Isometrics on quadriceps strength in individuals with osteoarthritis knee. A randomised controlled study” 2022 ijcspub | volume 12, issue 1 march 2022 | issn: 2250-1770