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THE EFFECTIVENESS OF TERMINAL KNEE EXTENSION WITH TENSION BAND VS WALL SITS ON PAIN AND FUNCTION IN GRADE 2 OSTEOARTHRITIS OF KNEE: A COMPARITIVE STUDY

SHIVANGI P[1] AND GAURAV P[2*]

1: Master in Physiotherapy, Department of Neurological and Psychosomatic Disorders, Ahmedabad Physiotherapy College, Parul University, Gujarat, India

2: Principal, Master in Neuroscience, Ahmedabad Physiotherapy College, Parul University, Gujarat, India, Orchid Id: 0000-0002-7741-1786

***Corresponding Author: Dr. Gaurav Patel: E Mail: dr.gauravpatel24@gmail.com**

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ABSTRACT

Background:

Knee pain is a prevalent condition affecting individuals of all age groups, often resulting from injuries, arthritis, infections, gout, or repetitive strain. The knee joint, composed of bones, ligaments, tendons, and muscles, is essential for mobility and stability. Strengthening exercises and physical therapy play a critical role in enhancing knee joint function, reducing pain, and preventing further injury by improving biomechanical efficiency.

Methodology:

A total of 30 participants diagnosed with Grade 2 knee osteoarthritis were enrolled and randomly divided into two equal groups (n = 15). Pain and functional status were assessed using the Numeric Pain Rating Scale (NPRS) and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) before and after a four-week intervention. Group A performed Terminal Knee

Extension (TKE) exercises with a tension band, while Group B performed Wall Sits (WS). Both groups followed a five-day-per-week regimen.

Results:

Both interventions yielded significant improvements in pain and functional scores ($p < 0.05$). Group A (TKE with tension band) showed superior effectiveness in pain reduction, whereas Group B (WS) demonstrated greater improvements in functional capacity. Despite these variations, overall performance between the two groups was found to be statistically comparable.

Conclusion:

The study concludes that both TKE with a tension band and wall sits are effective in managing knee osteoarthritis symptoms. TKE is more effective in pain relief, while wall sits offer greater functional enhancement.

Keywords: Terminal knee extension (TKE), Wall sits, Osteoarthritis knee, closed kinetic chain (CKC) exercises

INTRODUCTION

Knee pain is commonly experienced across all age groups and is a major reason for medical consultations and reduced function. It can arise from trauma, arthritis, infections, or conditions like gout. The stability of the knee is provided by primary stabilizers (ligaments inside the joint) and secondary stabilizers (muscles surrounding the joint). When the knee becomes chronically unstable, these muscles play an essential role in compensating for the compromised joint integrity. Notably, in older adults, functional limitations from chronic knee pain are not always directly correlated with the severity of degenerative changes seen in osteoarthritis (OA) **[1]**. In India, OA affects about 4–6% of the adult population and is among the top five chronic diseases. Globally, OA is a major musculoskeletal disorder, contributing to disability in over 100 million people. Knee OA ranks eighth in men and fourth in women among chronic musculoskeletal conditions **[2, 3]**.

The knee joint consists of two articulations—the tibio-femoral joint and the patella-femoral joint—encapsulated in a single joint capsule. Functionally, it is a hinge joint that primarily allows flexion and extension. The medial femoral condyle has a greater articular surface area than the lateral side, causing combined rolling and sliding movements during knee extension. The Q angle, typically 15–20°, describes the line of force of the quadriceps muscle. An increased angle can cause lateral

patellar subluxation. At full extension, the collateral and cruciate ligaments tighten, stabilizing the joint. The screw-home mechanism occurs in the last 20° of extension when the tibia externally rotates due to asymmetry between femoral condyles. The patella, the largest sesamoid bone, articulates with the femur and enhances the mechanical advantage of the quadriceps. it is stabilized by surrounding soft tissues including the patellar tendon and retinacula **[4]**.

Closed kinetic chain (CKC) exercises involve fixed distal limbs, causing coordinated multi-joint movements and muscle activation **[6]**. They enhance joint stability, eccentric control, and proprioceptive input **[7]**. Functional exercises like squats, step-ups, wall sits, and terminal knee extensions (TKE) target the vastus medialis oblique (VMO), improving patellar tracking **[8]**. CKC exercises are preferred in knee rehabilitation for mimicking daily activities and reducing joint stress. Osteoarthritis (OA) is classified as primary, due to aging, obesity, or wear and tear, and secondary, linked to trauma, infection, or inflammatory arthritis. In India, primary OA is common due to habits like squatting and sitting cross-legged. Contributing factors include obesity, sedentary lifestyle, endocrine disorders, and sports overuse.

OA involves cartilage matrix loss, leading to collagen breakdown, subchondral bone exposure, microfractures, and subchondral cysts visible on X-rays. Symptoms include pain with movement, stiffness, crepitus, swelling, and reduced ROM. Clinical signs include joint line tenderness, effusion, and deformities like genu varum **[5]**.

TERMINAL KNEE EXTENSION (TKE):- TKE is a simple and effective CKC exercise used in knee rehabilitation. It is performed using a resistance band and targets quadriceps activation. The intensity of the exercise can be increased by adding repetitions, tightening the band, or using higher resistance. TKE enhances strength and functional performance, particularly in home-based rehab programs **[9]**. Elastic Resistance Training (ERT) principles apply here: resistance increases with band elongation, providing a progressive and consistent stimulus for muscle strengthening. ERT is also advantageous for involving multi-joint movement, making it highly functional **[10]**.

WALL SITS (WS):- Wall sits are another effective CKC exercise, where an individual supports their back against a wall and bends the knees at various angles. This posture activates the hip extensors, knee extensors, and plantar flexors. Although resistance is limited to body weight or portable weights, it

effectively enhances joint stability and endurance **[11]**.

Various physiotherapy treatments—including exercise, bracing, manual therapy, and foot orthotics—are effective for managing OA symptoms. These interventions may also reduce disease progression by redistributing joint load **[12]**.

Despite their individual benefits, limited research has directly compared TKE and wall sits in knee OA rehabilitation. This study aims to explore their effects on pain relief and functional outcomes, providing evidence to guide rehabilitation strategies for knee OA patients.

OBJECTIVE

This study was to compare the effectiveness of Terminal Knee Extension using a tension band versus Wall Sits on pain reduction and functional improvement in individuals with grade 2 osteoarthritis of the knee**.** The study aimed to determine which of the two closed kinetic chain exercises is more beneficial in improving clinical outcomes, specifically focusing on pain levels assessed through the NPRS and functional performance measured using the WOMAC over a four-week intervention period.

MATERIALS AND METHODS

Study design: Experimental study

Sample size: 30

Sample design: Simple Random sampling

Duration of study: 5 days/ week for 4 weeks

INCLUSION CRITERIA

- Knee pain without restriction in range.
- Age between 45 years to 60 years.
- Degenerative changes in knee joint.
- With grade 2 OA of knee radio graphically by Kallegrane Lawrence Grading system.
- With NPRS more than 3 and less than 8.
- With WOMAC more than 15 and less than 60 score.

EXCLUSION CRITERIA

- Any recent fracture in lower limb.
- Any meniscal or ligament injury in knee joint.
- Having patellar dysfunction.
- Having osteoporosis or any bone related disorders.
- Obesity, diabetes, hypertension.
- Any deformity in lower limb.
- Who are mentally unstable
- Those who are non-cooperative.
- Any nerve injury or any neurological involvement.

Thirty patients aged 45–65 with radiographic grade 2 knee osteoarthritis were included. After informed consent, participants were randomly divided into two groups (n=15

each): Group A received terminal knee extension (TKE) with a tension band, and Group B performed wall sits (WS). Pain and function were assessed using the NPRS and WOMAC scales before and after the 4-week intervention. Both groups followed their respective exercise protocols five days per week. Post-treatment assessments were conducted for comparison.

Outcome Measures:

1. **WOMAC**

   A self-administered questionnaire used to assess pain, stiffness, and physical function in knee and hip OA. It includes 24 items divided into three subscales:

- **Pain (5 items, score 0–20)**
- **Stiffness (2 items, score 0–8)**
- **Physical Function (17 items, score 0-65)**

Each item is rated from 0 (none) to 4 (extreme), with a total score range of 0–96. Higher the scores indicate greater pain, stiffness, and functional limitation **[13, 14]**.

2. **NPRS**

   A simple 0–10 scale where patients rate their pain, with 0 indicating no pain and 10 indicating the worst possible pain. It is widely used for assessing pain severity **[15]**.

STATISTICAL ANALYSIS

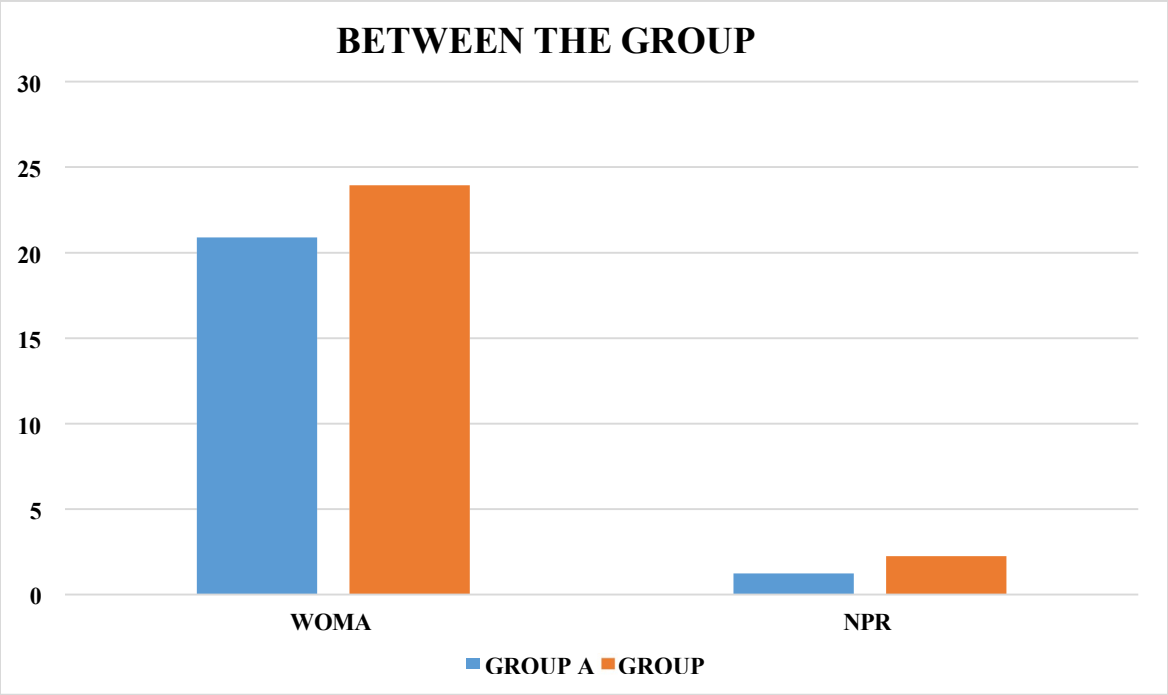
This study compared the effectiveness of TKE with tension band (Group A) and wall sits (Group B) for grade 2 knee OA in terms of pain and function. Data analysis using Excel and SPSS 27.0 showed normal distribution, so parametric tests were applied. Both groups showed significant improvement, with Group A being more effective for pain relief and Group B for functional improvement. However, overall results were similar for both groups. Significance was set at $p<0.05$.

RESULT

In terms of pain management, this indicates a statistically significant improvement; group A's TKE with tension band is more successful, whereas group B's WS are more effective in terms of function.

Table 1: Between group analysis of all outcome in Group A and Group B

OUTCOME MEASURES		MEAN	SD	t VALUE	p VALUE
WOMAC SCALE	GROUP A	20.89	4.40	2.16	0.02
	GROUP B	23.93	4.86	2.27	
NPRS	GROUP A	1.24	0.96	5.38	0.05
	GROUP B	2.26	0.79	3.91	



Graph 1: Between group analysis of all outcome in Group A and Group B

DISCUSSION

This study aimed to evaluate the effectiveness of Terminal Knee Extension (TKE) with a tension band versus Wall Sits (WS), both closed kinetic chain (CKC) exercises, in reducing pain and improving function in patients with grade 2 knee osteoarthritis (OA). OA is a leading cause of disability and decreased quality of life among adults worldwide. Its clinical manifestations include joint pain during activity, stiffness after rest, limited range of motion, muscle weakness, inflammation, and joint swelling **[16]**.

A total of 30 participants (50% male, 50% female) aged 45–65 years were randomly divided into two groups of 15. Group A performed TKE with a tension band, while Group B performed WS, both for 5 days per week over 4 weeks. Outcomes were measured using the WOMAC and NPRS scales before and after the intervention.

Paired t-tests showed significant within-group improvements:

- Group A: WOMC ($p < 0.001$), NPRS ($p = 0.02$)
- Group B: WOMAC ($p < 0.001$), NPRS ($p = 0.009$)

Unpaired t-tests between the groups showed statistically significant differences in WOMAC ($p = 0.02$) and borderline significance in NPRS ($p = 0.05$). This indicates that TKE was more effective in reducing pain, whereas WS improved functional ability more effectively.

The study aligns with prior research by Sakanoue *et al.,* **[17]**, which quantified resistance in tension-band exercises and supported personalized band selection for knee extension. Chang *et al*., **[18]** found that elastic-band exercises significantly improved function and reduced pain in OA patients, echoing our findings. Similarly, Li *et al*., **[19]** confirmed the benefits of resistance training for pain relief and enhanced quality of life in OA.

Abtahi *et al*., **[20]** showed that CKC terminal knee extensions significantly improve muscle activation (VMO and VL) in patellofemoral pain patients, while WS exercises mimic functional tasks and enhance quadriceps, hamstrings, and calf strength **[21, 22]**. These improvements contribute to knee stabilization and reduce joint degeneration.

Overall, the study confirms that both TKE and WS are effective for managing knee OA, with TKE favoring pain reduction and WS favoring functional improvement. Thus, validating the role of both interventions in comprehensive OA rehabilitation.

CONCLUSION

The purpose of this study is to evaluate the efficacy of the TKE with tension band compared to effectiveness of wall sits in patients with grade 2 OA knee. So, according to the statistical data analysis both group have similar effect, but Group A (TKE with tension band) showed more effect on pain factor and Group B (wall sits) showed more effect on functional factor. This means that Group A was more efficient and effective on reducing the pain and Group B has showed more improvement in the functional impairment.

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