

THERABAND-BASED OPEN- AND CLOSED-CHAIN EXERCISE PROGRAMS FOR
INITIAL STAGE OF GRADE II KNEE OSTEOARTHRITIS: A RANDOMIZED
CONTROLLED STUDY

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ABSTRACT

Background: Knee osteoarthritis (OA) is a degenerative disorder causing pain, stiffness, and functional limitations. Strengthening exercises, especially open-chain (OCEs) and closed-chain exercises (CCEs), remain essential conservative interventions. **Objective:** To compare the effectiveness of OCEs versus CCEs using TheraBand in Grade 2 knee OA. **Methods:** A randomized clinical trial was conducted with 64 participants divided into OCE (n=32) and CCE (n=32) groups. Pain (VAS), ROM, and functional ability (WOMAC) were evaluated at baseline, week 1, and week 2. **Results:** Both groups improved significantly; however, the OCE group demonstrated superior improvements in all outcomes at both follow-ups ($p < 0.001$). **Conclusion:** Open-chain TheraBand exercises are more effective than closed-chain exercises in short-term rehabilitation of Grade 2 knee OA patients.

KEYWORDS: Osteoarthritis, TheraBand, Open-chain exercise, Closed-chain exercise, Rehabilitation.

INTRODUCTION

Knee osteoarthritis is a chronic degenerative disease causing pain, stiffness, and functional disability. Exercise therapy is the cornerstone of conservative management, with open-chain and closed-chain exercises being widely adopted.

Open-chain exercises isolate muscle groups, particularly the quadriceps, while closed-chain exercises involve functional, weight-bearing kinetic movement. Evidence remains limited regarding their comparative short-term effects using TheraBand, thus requiring further investigation.

METHODS

Study Design: Randomized clinical trial.

Participants: 64 individuals aged 40–60 years, clinically diagnosed with Grade 2 knee OA.

Inclusion Criteria

- KL Grade 2
- VAS pain 4–6

- Symptoms >3 months

Exclusion Criteria

- Knee surgery (within 6 months)
- Steroid injections
- Rheumatologic disease
- Neurological disorders

Intervention Protocol

- Group A (OCEs): SLR, hip abduction, knee extension using TheraBand.
- Group B (CCEs): mini-squats, step-ups, lunges using TheraBand.
- Duration: 2 weeks
- Frequency: 5 days/week
- Sets/Reps: 3×10

Outcome Measures

- VAS pain score
- ROM (flexion & extension)
- WOMAC index

Statistical Analysis

- Within-group: Friedman test
- Between-group: Mann-Whitney U

• $p \leq 0.05$ considered statistically significant.

RESULT

Between-Group Comparison for Knee Flexion ROM.

Time Point	Group	N	Mean (°)	SD	Mean Rank	Asymp. Sig. (p-value)
Baseline	Open Chain Kinetic Exercises with TheraBand	32	109.31	3.56	29.84	0.251
	Closed Chain Kinetic Exercises with TheraBand	32	121.37	4.02	35.16	
1st Week	Open Chain Kinetic Exercises with TheraBand	32	130.31	7.71	47.16	0.000*
	Closed Chain Kinetic Exercises with TheraBand	32	110.25	3.04	17.84	
2nd Week	Open Chain Kinetic Exercises with TheraBand	32	110.03	3.75	46.06	0.000*
	Closed Chain Kinetic Exercises with TheraBand	32	116.12	2.78	18.94	

* $p < 0.05$ indicates statistically significant between-group difference.

Interpretation (Optional)

• Baseline

No significant difference between open-chain and closed-chain groups ($p = 0.251$).

• 1st Week

A **significant difference** was observed between groups ($p = 0.000$).

The **open-chain group** showed a higher knee flexion ROM (Mean = 130.31°).

• 2nd Week

Again, a **significant difference** existed between groups ($p = 0.000$).

The **closed-chain group** showed a slightly higher ROM (Mean = 116.12°) than the open-chain group.

ROM (Flexion)

Group A.

- Baseline: 109.31 ± 3.56
- Week 1: 130.31 ± 7.70
- Week 2: 140.03 ± 3.75

Group B.

- Baseline: 121.37 ± 4.02
- Week 1: 110.25 ± 3.03
- Week 2: 116.12 ± 2.78

ROM (Extension)

Group A.

- Baseline: 7.53 ± 2.31
- Week 1: 2.19 ± 1.99
- Week 2: 1.78 ± 3.53

Group B.

- Baseline: 4.25 ± 1.52
- Week 1: 9.72 ± 3.19
- Week 2: 8.22 ± 2.23

Participant Distribution

- Total participants: 64
- Group A. (OCEs): 32
- Group B. (CCEs): 32

Baseline Characteristics

- Age (mean): Group A = 51.06 ± 6.49 ; Group B = 50.69 ± 5.88
- Gender: Group A = 18M/14F; Group B = 17M/15F

WOMAC Functional Score

Group A.

- Baseline: 65.34 ± 13.49
- Week 1: 35.10 ± 10.34
- Week 2: 10.78 ± 17.30

Group B.

- Baseline: 60.10 ± 13.90
- Week 1: 49.60 ± 8.50
- Week 2: 32.72 ± 20.50

VAS Pain Scores

Group A.

- Baseline: 5.41 ± 0.61
- Week 1: 4.13 ± 0.71
- Week 2: 2.50 ± 1.13

Group B.

- Baseline: 5.59 ± 0.56
- Week 1: 5.31 ± 0.64
- Week 2: 4.34 ± 0.74

Between-group comparison

- Baseline $p = 0.21$
- Week 1 $p < 0.001$
- Week 2 $p < 0.001$

Interpretation

- Group A demonstrated earlier and greater improvements in pain, function, and mobility.
- Group B improved but at a slower and lesser magnitude.
- Statistical results strongly support the superiority of OCEs ($p < 0.001$).

DISCUSSION

The present study shows that open-chain strengthening exercises using TheraBand provide better short-term

rehabilitation outcomes than closed-chain exercises in Grade 2 knee OA. Rapid improvement in Group A may be due to reduced joint loading and targeted quadriceps engagement.

These findings are consistent with published evidence supporting quadriceps-focused isolated exercises in early OA rehabilitation.

Limitations

- Short study duration
- No long-term follow-up
- Single-center study

Future research should include longer intervention periods and multiple OA severity grades.

CONCLUSION

Open-chain TheraBand exercises significantly outperform closed-chain exercises in reducing pain, improving ROM, and enhancing functional ability in Grade 2 knee OA.

Recommendation: Clinicians should prioritize open-chain exercises during early conservative management of knee OA.

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