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Research Article

EFFECT OF SENSORIMOTOR TRAINING ON FUNCTIONAL STATUS AND QOLLN OLDER ADULTS WITH CHRONIC KOA : A RANDOMIZED CONTROL TRIAL

Rajasekar M V [1], R. K. Sharma[2], Soumita Das[3]

1 MOT (Orthopedics) Student, Santosh College of occupational therapy, Ghaziabad, Uttar Pradesh, India
2 Professor and Dean Paramedical and Principal, Santosh College of occupational therapy, Ghaziabad, U.P.
3 Assistant Professor, Santosh College of occupational therapy, Ghaziabad, Uttar Pradesh, India

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Abstract:

Background: Knee osteoarthritis (KOA) is a long-term musculoskeletal disorder frequently seen in older adults and may lead to pain, restricted activity, reduced neuromuscular control, and poorer QOL . Sensorimotor exercise may complement conventional rehabilitation by addressing sensory and motor control deficits.

Methods: A randomized controlled trial involving 66 participants with chronic KOA was conducted. Participants were assigned to an experimental group receiving sensorimotor training and a control group receiving conventional exercises. The programme was provided for 40 minutes per session, five sessions each week, over four weeks. Functional status was measured with the KOOS and QOL was evaluated with the SF-36.

Results: The groups were comparable in baseline KOOS scores ($p = 0.478$), while a statistically significant baseline difference was identified for SF-36 ($t = -5.331$, $p < 0.001$). After treatment, the experimental group showed significantly better SF-36 results than the control group ($t = 2.298$, $p = 0.025$). A significant between-group difference was also found for KOOS ($t = 3.285$, $p = 0.002$).

Conclusion: Adding sensorimotor training to rehabilitation was associated with greater improvement in knee-related functional status and QOL than the conventional exercise programme alone. Sensorimotor activities may therefore be considered as an additional component of rehabilitation for older adults with chronic KOA .

Keywords: Sensorimotor training; KOA ; functional status; QOL ; KOOS; SF-36.

1. Introduction

Knee osteoarthritis is a common musculoskeletal disorder across populations and is an important source of pain, disability, and reduced mobility in later life. It predominantly affects weight-bearing joints such as the knee and is characterized by progressive changes involving articular cartilage, joint space, subchondral bone, and overall joint function. In India, KOA has been reported with an estimated prevalence of approximately 28.7%, highlighting its contribution to functional restriction and dependence among older people. (1,2) People with chronic KOA may present with ongoing pain, stiffness, limited movement, reduced muscle strength, balance impairment, and difficulty completing everyday activities. Tasks such as walking, climbing or descending stairs, moving from sitting to standing, squatting, kneeling, prolonged standing, and travelling by public transport may become progressively more challenging. Such limitations can reduce independence and adversely affect QOL . (4,5)

In addition to structural joint changes, chronic KOA can involve deficits in proprioception and neuromuscular regulation. Diminished sensory feedback associated with ageing and changes in joint mechanoreceptor function can affect joint-position awareness, balance, gait control, and fall risk. Although conventional rehabilitation commonly emphasizes pain management, strengthening, and restoration of range of motion, sensorimotor deficits may receive comparatively less attention. (6)

Sensorimotor training seeks to improve the relationship between incoming sensory information and motor responses. Its exercises can challenge proprioception, postural control, balance, coordination, and neuromuscular regulation through static, dynamic, and task-oriented activities. By improving awareness of joint position and movement control, such training may support joint stability,

***R K Sharma**, Professor, Dean Paramedical and Principal Santosh College of Occupational Therapy, Ghaziabad U. P.
E mail: hod.occupationaltherapy@santosh.ac.in,
ORCID ID: 0000-0002-1780-4967
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mobility, functional performance, and QOL in people with chronic KOA . (7,8)

Earlier studies have described beneficial effects of sensorimotor approaches on joint-position awareness, balance, functional ability, pain, muscular strength, and QOL in people with KOA . Nevertheless, evidence specifically addressing functional status and QOL in older adults with chronic KOA remains comparatively limited, particularly within the Indian context. (13,14,15)

Therefore, this study was undertaken to determine the effect of sensorimotor training on functional status and QOL among older adults with chronic KOA .

2.0 .MATERIALS and METHODS

2.1 STUDY DESIGN and SETTING

This randomized controlled trial received approval from the Institutional Ethical Committee of Santosh College of Occupational Therapy (Ref. No. SCOT/JULY-25/EC-ORTHO-10). Participants were recruited and assessed at Santosh Medical College and Hospital and at the Doctor's Wing Habilitation and Rehabilitation Center according to the predetermined eligibility criteria. Written informed consent was obtained before participation.

2.2 Participants

Sixty-six participants meeting the study requirements were recruited. Eligible participants included males and females aged 45–65 years with a clinical diagnosis of unilateral KOA made by an orthopedic specialist. Participants with tibiofemoral and/or patellofemoral OA graded I, II, or III using the Kellgren–Lawrence radiographic classification were eligible. Individuals with a low to moderate fall risk who voluntarily agreed to participate were also included.

Participants were not eligible if they had cardiorespiratory problems such as ischemia, arrhythmia, chest pain, or exercise-induced bronchospasm. Exclusion also applied to people with previous knee surgery or major knee pathology, including ligament injury, total knee replacement, or meniscal injury; a recent intra-articular steroid injection; rheumatoid arthritis; neurological disorders affecting the lower limbs; or reliance on an assistive device for walking.

The 66 enrolled participants were assigned equally between the experimental and control groups, with 33 participants in each group. Allocation was performed in a 1:1 ratio using a computer-generated random-number sequence.

2.3 Intervention Protocol

Both groups followed their assigned four-week intervention, with five sessions delivered each week by an occupational therapist. Each treatment session lasted 45 minutes.

GROUP A (EG) (N=33)

The experimental group received the structured sensorimotor programme in addition to the conventional exercise regimen. The programme progressed through activities intended to address proprioceptive awareness, postural regulation, balance, neuromuscular coordination, and performance of functional tasks.

- TABLE 1.0 SENSORIMOTOR TRAINING (adapted from Patel H. and Balaganapathy M., 2024)
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Exercises	Repetitions	Sets	Weeks
First phase(static)		3 times	1st week
Maintain upright standing for 30 seconds on a firm surface and then 30 seconds on a soft mat (mat density 36–40 kg/m^3).	30-60 sec		
With eyes closed, perform a 10-second single-leg stance first on the affected side and then on the unaffected side; progress from a firm surface to the soft mat.	10 sec		
Hold a half-step standing position for 10 seconds.	10 sec		
Maintain single-leg standing for 10 seconds.	10 sec		
Dynamic phase: introduce the following activities:	10 reps	3 sets	2nd addition (in addition)
Forward stepping using a lunge pattern.			
Kicking against resistance-band resistance.			
Single-limb standing balance activity.			
Functional phase: add the following activities:		3 times	
Walking drills are completed first on a firm surface and then on a foam surface.			

Toe-skipping for 20 m with toes forward, followed by 20 m with external rotation and 20 m with internal rotation.			3rd and 4th week (in addition)
Heel-skipping for 20 m with toes forward, followed by 20 m with external rotation and 20 m with internal rotation.		3 times	
Functional squat practice.			
Perform wall-supported and unsupported squat holds.	10 sec holds		
Single-leg squats on both the affected and unaffected limbs.		3-5 times	
Balance-training activities:			
Walk 20 m with eyes open and closed in forward, backward, and sideward directions.			
Walk on an incline in forward, backward, and lateral directions; 20 m for three repetitions.			
Ascend and descend the stairs from the front and sides; three repetitions of ten stairs.			
Walk around a small circle using both faster and slower speeds.		3 times	
Walk around a large circle using both faster and slower speeds.			
Take long steps while walking forward, backward, and sideways; 20 m for three repetitions.			

GROUP B(n-33): Traditional exercise program

CG

The control group completed a conventional therapeutic exercise programme for KOA. The exercises were intended to maintain or improve knee mobility, muscular strength, flexibility, and performance of functional activities.

TABLE 2.0 TRADITIONAL EXERCISE PROGRAM (adapted from Patel H. and Balaganapathy M., 2024)

Knee flexion and extension range-of-motion exercises	10 rept	Three sets	During the first two weeks
Stretching of the hamstrings and calf muscles	Hold 30 sec	Three sets	
Quadriceps and hamstring isometric strengthening	Hold 10 sec	Repeated 8–10 times	
Straight-leg raise exercises through 30°–40°	Hold 10 sec	Repeated 8–10 times	Week 3 (additional exercises)
Short-arc terminal knee-extension exercise	Hold 10 sec	Repeated 8–10 times	
Isometric strengthening for hip adductors and abductors	Hold 10 sec	Repeated 8–10 times	
Apply additional resistance to the Week 3 exercises during Week 4	10 rept	Three sets	Week 4 (advanced exercises added)

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- **2.4 Outcome Measures**
- Standardized outcome assessment tools were administered at baseline and again following completion of the intervention. the KOOS was used to evaluate functional status, while the SF-36 was employed to assess participants' overall health-related QOL .
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- **2.5 Statistical Analysis**
- The data collected in the study were analyzed statistically using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics were employed to summarize the participants' demographic and baseline characteristics. Independent-samples t-tests were conducted to compare the outcomes between the EG and CG, while paired-samples t-tests were used to evaluate changes within each group. A p-value of less than 0.05 was considered indicative of statistical significance.

3.0 RESULTS

All 66 participants completed the study and were included in the final analysis. Thirty-three participants were included in each group. KOOS and the Short Form-36 Health Survey (SF-36) were administered before and after the four-week intervention to assess functional status and QOL .

Table 3.0: Descriptive Statistics of Eg and CG

Variable	Category	CG n (%)	EG n (%)
Age (years)	Mean ± SD	57.85 ± 4.75	57.70 ± 4.25
Gender	Male	22 (66.67%)	17 (51.52%)
	Female	11 (33.33%)	16 (48.48%)

Table 4.0: Within Analysis of Both the Group EG vs CG

Independent Samples Test									
Pre-Post	**Variances**	**Levene's test for equality of variances**		**t-test for Equality of Means**					
		F	**Sig.**	**t**	**Significance**	**Mean Difference**	**Std. Error Difference**	**95% Confidence Interval of the Difference**	
					Two-Sided p			**Lower**	**Upper**
pre-sf- 36	Equal variances assumed	0.04	0.845	-5.33	<.001	-18.29	3.43	-25.14	-11.43
	Equal variances not assumed			-5.33	<.001	-18.29	3.43	-25.14	-11.43
pre Koos	Equal variances assumed	6.3	0.015	0.714	0.478	2.94	4.12	-5.28	11.16
	Equal variances not assumed			0.714	0.478	2.94	4.12	-5.32	11.20
post sf-36	Equal variances assumed	0.09	0.764	2.298	0.025	7.89	3.43	1.03	14.75
	Equal variances not assumed			2.298	0.025	7.89	3.43	1.03	14.75

post Koos	Equal variances assumed	8.46	0.005	3.285	0.002	13.45	4.09	5.27	21.63
	Equal variances not assumed			3.285	0.002	13.45	4.09	5.23	21.68

Table 5.0: Between Analysis of Both the Groups EG vs CG

Test Statistics[a]				
	pre sf- 36	pre koos	post sf-36	post koos
Mann-Whitney U	182.500	485.000	380.500	290.000
Wilcoxon W	743.500	1046.000	941.500	851.000
Z	-4.643	-.763	-2.103	-3.265
Asymp. Sig. (2-tailed)	<.001	.445	.035	.001
a. Grouping Variable: EG =1, Control=2				

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4. 4. Discussion

This study examined whether sensorimotor training influenced functional status and QOL in older adults with chronic KOA . Improvement was observed in both study groups after the four-week programme; however, the group receiving sensorimotor training in addition to conventional exercises demonstrated greater changes in both KOOS and SF-36 than the group receiving conventional exercise alone.

The functional gains observed in the experimental group may be related to repeated challenges to proprioception, postural control, neuromuscular regulation, and coordinated muscle activity. These components can support more stable and efficient movement, which may translate into improved performance during everyday functional tasks and less activity limitation.

The present results are comparable with the findings reported by Patel H. and Balaganapathy M. (2024). In that study, adding sensorimotor training to conventional exercise was associated with greater improvements in pain, proprioception, KOOS, and functional performance than conventional exercise alone. The authors proposed sensorimotor training as a useful addition to rehabilitation for chronic KOA .

The findings also correspond with the systematic review and meta-analysis by Guede-Rojas et al. (2024), which examined the influence of strengthening exercise on knee proprioception in people with KOA . Improvements in proprioceptive function may contribute to better awareness of joint position and, consequently, improved functional performance during rehabilitation.

Kuş, Tarakçı, et al. (2023) similarly reported that sensory-motor training and resistance training produced comparable effects on symptoms and QOL in individuals with KOA . Their results provide further support for considering sensory-motor exercise within rehabilitation programmes directed toward functional improvement.

Evidence from the meta-analysis by Jeong et al. (2019) also supports proprioceptive exercise for people with KOA , with reported reductions in pain and improvements in functional performance. The authors emphasized the potential role of proprioceptive activities in supporting everyday functional abilities.

The improvement in QOL may be associated with better mobility, balance, physical function, and independence in daily activities, together with reduced pain. As physical abilities improve, older adults may find routine occupations easier to perform and may experience greater participation in everyday life.

Taken together, the results of this study indicate that sensorimotor exercise can be incorporated alongside conventional rehabilitation for older adults with chronic KOA . The observed changes in KOOS and SF-36 suggest potential benefits for functional status and QOL , while the sensorimotor components specifically address balance, proprioception, neuromuscular control, and movement performance.

Several limitations should be considered. The intervention lasted only four weeks, and participants were not followed for a longer period; therefore, the persistence of the observed changes was not

examined. The sample was also relatively small. Future studies could use longer follow-up periods and multicentre designs to examine whether treatment effects are maintained and whether the findings are applicable to broader populations. Comparisons with other rehabilitation approaches may also be useful.

5.0 CONCLUSION

The study findings indicate that sensorimotor training, when added to a conventional exercise programme, was associated with greater improvement in functional status and QOL among the study participants with chronic KOA . Both groups improved after intervention, while the experimental group showed significantly greater changes in KOOS and SF-36. These results support the inclusion of sensorimotor activities addressing proprioception, balance, neuromuscular control, and functional movement within a conventional rehabilitation programme.

6.0 DECLARATIONS & ETHICAL STATEMENTS

- The authors gratefully acknowledge all individuals who provided assistance, supervision, encouragement, and constructive feedback during the completion of this research.
- RSMV contributed to study conceptualization, protocol development, data collection, and preparation of the initial manuscript. RKS provided project supervision and undertook critical revision of the manuscript. SD contributed to manuscript editing and coordinated the submission process. All authors reviewed and approved the final version.
- Ethical Approval and Consent: Reference No. (SCOT/JULY-25/ECOrtho-10). Written informed consent was obtained from all participants for involvement in the intervention and for publication of the study data.
- Financial support: No dedicated financial support or external grant was received from government, private, commercial, or non-profit organizations for this study.
- Conflict of interest support: The authors declare that they have no competing interests.
- Data Availability Statement: The datasets produced and analyzed during this study can be obtained from the corresponding author upon reasonable request.
- AI Disclosure: AI-assisted language editing/paraphrasing was used in preparing this revised manuscript. The authors should review this statement against the journal's current AI-disclosure requirements before submission.

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