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Original Article

Comparing the Effectiveness of Otago Exercise Program and Proprioceptive Training on Balance in Knee Osteoarthritis with Genu Varum: A Comparative Study

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ABSTRACT

Background: Patients with knee Osteoarthritis (OA) have balance problems and a higher risk of falling, but it's not apparent whether proprioceptive training or the Otago Exercise Programme (OEP) can help with balance and fall prevention. In order to better understand the benefits of OEP and proprioceptive training on the senior population with OA associated with genu varum deformity, a comparative study was conducted. **Patients and Methods:** 30 patients with genu varum deformity and knee OA were randomly assigned to groups A (OEP) and B. (proprioceptive training). Both groups received Interferential Therapy (IFT) as a standard form of treatment. Both before and after the intervention, the Time Up and Go test (TUG) and the Knee Osteoarthritis Outcome Score (KOOS) were evaluated as outcome measures. **Results:** Using a paired *t* test, demographic data were compared within and between groups with a statistical significance threshold of $p<0.05$. The pre-post comparison shows a considerable shift. According to the study, there is a statistically significant difference between the two groups in terms of improved balance and decreased fall risk. **Conclusion:** For older patients with knee OA and genu varum deformity, OEP and proprioceptive training with traditional (IFT) were beneficial in reducing pain, improving balance, and lowering fall risk. Both groups had a significant change between the pre- and post-test periods, but when the post-test results were compared between the two groups, the OEP group's KOOS and TUG scores showed a more pronounced improvement.

Keywords: Osteoarthritis, Genu Varum, Balance, Fall Risk, Elderly Population.

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INTRODUCTION

Knee joints are frequently affected by Osteoarthritis (OA), a chronic degenerative condition.[1] People over 65 with knee OA are more likely to fall and have postural imbalances.[2,3]

About 12.2 percent of senior people have knee OA, and women are more likely than males to have it (14.9 percent) (8.7 percent).[4,5]

Because of osteoarthritis is commonly associated with decreased mobility brought on by pain and muscle wasting. It is recognised as a known risk factor for falling. Among older adults, falls and osteoarthritis are frequently co-present.[6-8] The majority of people with knee OA experience the worst pain, stiffness, and dysfunction, which increases their risk for instability, muscular weakness, and ultimately falls.[2,9,10]

Falls and falls related injuries are a major cause of morbidity and mortality in the elderly, posing a serious public health concern.[10] Recent studies have demonstrated the efficacy of exercise programmes in lowering fall rates among older individuals with knee OA and improving balance.[11,12]

The most comprehensive fall prevention programme is the Otago Exercise Program (OEP). It was created at Otago Medical School and used by the Accident Compensation Corporation in New Zealand.[13,14]

The OEP programme is a strength and balance retraining regimen that incorporates walking. These kinds of exercises lower the risk of falls by enhancing physiological processes (by improving sting balance and strength), and they also lower the risk of falls in older adults.[15,16]

The OEP has been identified by several research, including systematic reviews with meta-analysis, as an efficient exercise prevention method with advantages for physical functioning and a reduction in falls in people with knee OA.[9,10,16,17]

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In the population with knee OA, proprioceptive exercises are beneficial for reducing pain and functional limitations, as well as for increasing physical function and balance. Additionally. Proprioceptive training enhanced the weight-bearing ratio and foot progression angle, decreased the first peak of adduction moment, and even slowed the advancement of degenerative arthritis.[18-20] additionally proprioceptive training has better KOOS results.in terms of improved strength and balance may be used as an alternative to more time consuming and damaging conventional exercises.[21,22]

Weight bearing lines are shifted toward the medial compartment and compressive stresses across the medial section of the knee are enhanced in genu varum deformity. This difference might enhance the asymmetry of weight-bearing and the likelihood of illness progression. The higher load flows medially than laterally during the knee adduction moment of the stance phase.[18]

The size of the knee adduction moment increases with increasing varus alignment and the projected progression of knee osteoarthritis Varus alignment can also lead to postural instability, increase medial-lateral postural sway, and lead to balance disturbance by raising the chance of falling risk indices. According to studies, the results would be much more useful if they were obtained from elderly participants.[22,23]

TUG test has the good measuring qualities in patients with OA and other populations, according to authors.[24,25]

TUG tests can be used to identify elderly people with OA and predict mobility loss and fall frequency. TUG tests are frequently used as clinical assessment tools for maintaining balance and are helpful for assessing balance and differentiating between mild and moderate to severe OA.[26,27]

The KOOS is a self-administered test that is valid, reliable, and responsive and can be used for both short- and long-term follow-up of a variety of knee injuries, including osteoarthritis.[28-31]

PATIENTS AND METHODS

The studies approach was quantitative to examine methods of rehabilitation based on outcomes to the patients with the knee OA. Informed consent form is obtained from all the participants. Randomization done using convenient sampling technique, 30 participants were selected based on the selection criteria.

Name of the ethical committee: IEC (Institutional ethical committee).

Ethical committee approval number: 01/004/2021/ISRB/PGSR/SCPT

Research design: A comparative study.

Source of data collection: The participants was recruited from the Saveetha medical college and hospital, Saveetha Nagar, Thandalam, Chennai 66726630.

Duration of the study: 8 Weeks

Outcome measure: KOOS (knee osteoarthritis outcome score) and TUG (Time Up and Go) test

Selection criteria

Criteria for inclusion

Participants with both unilateral and bilateral genu varum, any gait abnormalities, postural imbalances, and challenges performing ADL, as well as both gender, age of the participants who are at least 50 years old. Limb length descriptivity, NPRS pain score of 5 or less, and grade 1 or 2 genu varum (2.5 cm/2.5-5 cm).

Criteria for Exclusion

Exposed wounds or recent surgery, other joint inflammatory conditions like rheumatoid arthritis, osteomyelitis, age < 40 years, genu varum grades 3 and 4, significant physical disability, and serious mental disease.

The participants were instructed to stand with their backs, buttocks, and both heels on the wall in an anatomical stance, barefoot, to assess the varum of the knee joint. The patients were then instructed to join their feet. Genu varum was defined as a space of greater than 3 cm between the two medial knee epicondyles.[32]

KOOS Score

The Knee osteoarthritis outcome score is straightforward to use and simple to administer: five patient-relevant subscales are rated independently: ADL Function (17 items), Pain (9 items), Symptoms (7 items), Quality of Life (4 items), and sports and recreational function (5 items). Each of the five scores is determined as the sum of the items included. A Likert scale is employed, and each issue has five alternative answer options scored from 0 (No Problems) to 4 (Extreme Problems), with a score in between. Scores are converted to a scale of 0–100, with 0 signifying severe knee difficulties and 100 signifying no knee problems.[28-30]

TUG Test

The "Timed Up and Go" test is a practical, dynamic balance test with established validity and reliability that is also simple to use. The TUG test calculates how long it takes an individual to get out of a chair with armrests, walk three metres at a comfortable and safe speed, turn around, then return to the chair and sit down.

Subjects with a score of less than 10 sec are regarded as normal, those with a score of < 15 sec are at risk of falling, those with a score < 20 sec are independent in ambulation and can climb stairs, and those with a score of > 30 sec require assistance with a chair or the toilet and are unable to climb stairs.[26,27]

To both groups, regular conventional physiotherapy was administered. IFT stimulation helps manage pain and makes it more comfortable to treat the underlying OA illness.

The knee area was covered with electrodes that were intensified to the threshold for tactile sensation. IFT was carried out using electrode pads of a comparable form and an iso planar vector field with a 6:6 sweep mode, a carrier frequency of 4 kHz, a beat frequency of 100 Hz, and a sweep frequency of 150 Hz. IFT sessions lasted 20 min each day during the eight-week regimen.[34]

The OEP is a balance and strength retraining programme consist of the following.

Strengthening exercises with varying degrees of difficulty include hip abduction, knee extension, knee flexion, ankle plantar flexion, and ankle dorsiflexion.

The exercises for improving balance: sit to stand, knee bends, walking backwards, walking backwards and turning around, sideways walking, tandem stance, tandem walk, heel walking, toe walking, one-leg stand, heel-toe walking backward, and tandem walking.[17]

Given for 8 weeks, three times per week for around 30 min per session.

In accordance with each participant's capacity, ankle weights were also provided for use with the appropriate strengthening exercises.

Proprioceptive exercise

Week 1-3

Maintaining equilibrium while closing your eyes (Modified Romberg exercise): On a hard and soft (on mat) surface, Walking the past, walking heels, stepping on one's toes, strolling while blindfolded all of these for about (25 m), Spending 30 sec standing on one leg (repeated in both extremities), Standing on one leg and swaying from side to side (eyes open and closed), Slowly get up from a high chair.

Week 3-6 (in addition)

Slowly rise from a low chair, slowly walking in a large circle and narrow circle, quickly moving in a broad circle, narrowly walking fast.

Week 6-8 (in addition)

Stand on two legs while keeping your eyes open and facing all directions, stand upright on two legs while keeping your eyes closed, maintain one-dimensional balance while standing on one leg, One-legged balance with eyes open and closed and in three dimensions, the Carioca crossover manoeuvre performed for 8 weeks three times per week for about 30 min each.[18-20]

KOOS and TUG TEST are used to measure pre-test and post-test data for both groups.

RESULTS

The data were dispersed normally. The pre-test and post-test values of both groups were compared using the independent t test. Using a paired t test, demographic data were compared within groups; the statistical threshold for significance was set at $p< 0.05$.

In Group A, the mean pre-test KOOS sub score value of PAIN is (40.2), SYMPTOM (63.93), ADL (37.066), SPORT (16.6), QUALITY OF LIVING (25.6) and the mean post-test value of PAIN is (31.67), SYMPTOM (56.20), ADL (50.133), SPORT (20.533), QUALITY OF LIVING (38.066). from the data analysis, it shows that there is significant difference between pre-test and post-test. The mean pre-test TUG SCORE is 17 and the mean post-test value is 12.066. from the data analysis, it shows that there is significant difference between pre-test and post-test as shown in (Table 1).

In Group B, the mean pre-test KOOS sub score value of PAIN is (37.466), SYMPTOM (62.93), ADL (36.133), SPORT (16.466), QUALITY OF LIVING is (27) and the mean post-test value of PAIN is (32), SYMPTOM (57.6), ADL (46.533), SPORT (19.333), QUALITY OF LIVING (36.66). from the data analysis, it shows that there is significant difference between pre-test and post-test. In Group B, the mean pre-test TUG SCORE is 17.27 and the mean post-test value is 13.066 there is significant difference between pre-test and post-test as shown in (Table 2).

Comparing the post-test value of Group, A and group B the mean post-test value of KOSS sub score PAIN (GROUP A 31.67, GROUP B (32), SYMPTOM (GROUP A 56.20, GROUP B 57.6) ADL (GROUP A 50.133 GROUP B 46.533) SPORT (GROUP A 20.533, GROUP B 19.333) QUALITY OF LIFE (GROUP A 38.066, GROUP B 36.66) from the data analysis, there's significantly higher difference in Group A than Group B. The mean post TUG TEST value of GROUP A is 12.066 and GROUP B is 13.066 from the data analysis, there's significantly higher difference in Group A than Group B as shown in (Table 3).

As shown in the result there was a statistically significant improvement in balance and functional outcomes for both the groups OEP (GROUP A) and proprioceptive training (GROUP B) $p<.05$ in pre-test comparison of both the groups, there is no significant difference, in the pre-post comparison there is a significant changes seen among both the groups, in the post-test comparison of KOOS SCORE and TUG test values shows significantly higher difference in group A than group B.

Table 1: Pre-Post Values for Otago Exercise Paired *t* Test.

Group	Koos score	Pre-test values		Post test values		*t*-value	*p*-value	Results
A	SUB SCORE	OTAGO EXERCISE		OTAGO EXERCISE		-12.91114	<.00001	*p*<0.5
		MEAN	SD	MEAN	SD			
	PAIN	40.2	3.61	31.67	3.77			
	SYMPTOMS	63.93	2.96	56.20	3.53	-6.639032	.0001	*p*<0.5
	ADL	37.066	3.58	50.133	6.85	7.410372	<.00001	*p*<0.5
	SPORT	16.6	3.46	20.533	4.37	7.424888	<.00001	*p*<0.5
	QUALITY OF LIVING	25.6	2.80	38.066	2.52	13.949232	<.00001	*p*<0.5
GROUP A	TUG TEST(S)	17	1.69	12.066	3.28	-5.201107	.00013	*p*<0.5

KOOS-Knee osteoarthritis outcome score, S-Seconds, TUG-Time up and go test.

Table 2: Pre-Post Values for Proprioceptive Training [Group B] Paired *t* Test.

Group	Koos score	Pre-test values		Post test values		*t*-value	*p*-value	Results
GROUP B	SUB SCORE	PROPRIOCEPTIVE TRAINING		PROPRIOCEPTIVE TRAINING		-6.010224	.00003	*p*<0.5
		MEAN	SD	MEAN	SD			
	PAIN	37.466	4.42	32	2.90			
	SYMPTOM	62.93	3.28	57.6	3.64	-5.816307	.00004	*p*<0.5
	ADL	36.133	5.89	46.533	4.14	6.084156	.00003	*p*<0.5
	SPORT	16.466	3.34	19.333	3.20	6.762764	<.00001	*p*<0.5
	QUALITY OF LIVING	27	3.53	36.66	4.20	8.351717	<.00001	*p*<0.5
GROUP B	TUG TEST (S)	17.27	1.75	13.066	2.40	-10.69267	<.00001	*p*<0.5

KOOS-Knee osteoarthritis outcome score, S-Seconds, TUG-Time up and go test.

Table 3: Post Test Values of Otago Exercise Program and Proprioceptive Training (Group A And B).

Group	Koos score	Post -test values		Post test values		*t*-value	*p*-value	Results
GROUP A AND B	SUB SCORE	PROPRIOCEPTIVE TRAINING		PROPRIOCEPTIVE TRAINING		-0.27116	.394127	*p*<0.5
		MEAN	SD	MEAN	SD			
	PAIN	31.67	3.77	32	2.90			
	SYMPTOM	56.20	3.53	57.6	3.64	-1.06927	.14704	*p*<0.5
	ADL	50.133	6.85	46.533	4.14	1.74142	.046294	*p*<0.5
	SPORT	20.533	4.37	19.333	3.20	0.8577	.199171	*p*<0.5
	QUALITY OF LIVING	38.066	2.52	36.66	4.20	1.106336	.138993	*p*<0.5
GROUP A, B	TUG TEST (S)	12.066	3.28	13.066	2.40	-0.95168	.174702	*p*<0.5

KOOS-Knee osteoarthritis outcome score, S-Seconds, TUG-Time up and go test.

DISCUSSION

In this study, proprioceptive training and the OEP were evaluated and compared for their effectiveness in improving balance and reducing fall risk in senior people with genu varum deformity and knee OA.

However, no studies have been found to be applied for genu varum deformity among elderly people with knee OA, despite the fact that genu varum deformity is one of the major causes of postural instability and may increase postural sway in the medial-lateral direction and cause balance distress.[22,23]

Yumi Cho and others (2014) According to this study, proprioceptive training raised the foot progression angle and weight-bearing ratio while lowering the first peak knee adduction moment. Integrating proprioceptive training into a physical therapy exercise programme may enhance functional ability and slow the progression of degenerative OA.[18]

According to Hee Seong Jeonget *et al.* (2019)'s research. They found that Proprioceptive training effectively promoted pain relief and completion of functional daily activity among patients with knee OA.[19]

According to Suraj Kumar's (2012) analysis. Strengthening the muscles that surround the hip and knee joints as well as proprioceptive training will help people with knee OA feel less pain and have less physical disability with knee OA. Additionally, the berg balance scale and KOOS scales indicated a considerable improvement.[21]

According to Ashish John Prabhakar *et al.* (2020), proprioceptive training could avoid impact loading of the joints, aid in halting the progression of the injury, and simultaneously boost strength and balance.[22]

According to Mat S *et al.* (2017).'s research, elderly fallers with OA and balance issues benefit from a home-based balance and strengthening training programme in the form of the OEP since it improves postural control and lowers fall fear.[33]

Mohan Ra RD *et al.* (2021) came to the conclusion that both groups OEP and Dual task net step exercises showed improvement in postural imbalances and immobility between TUG and BBS. However, OEP demonstrated a greater improvement in balance and functional mobility than dual net step exercise, with a p-value of 0.000 to.05. among community-dwelling elderly individuals with knee OA, respectively.[35]

KATRE, KANCHAN A., *et al.* (2019) demonstrates that the mean score of (TUG) between the Otago Exercise Program and Strength Training Program group shows an improvement. OEP training has a better result in the KOOS SCORE and TUG test when compared to STP, so these interventions can be used in clinical settings in conjunction with co-rehabilitation.[36]

Similar to the previous study, this one found significant effects in both groups (OEP and proprioceptive training), but OEP training has better results in the KOOS SCORE and TUG test. In addition, group A performs significantly better on the TUG test than group B in terms of time reduction in seconds, so these interventions can be used in a clinical setting in conjunction with traditional treatment for the best results. Over the course of the trial, no participant had any negative effects.

CONCLUSION

Study demonstrated that senior individuals with knee osteoarthritis and genu varum deformity responded well to the Otago Exercise Program (OEP), proprioceptive training, and conventional Interferential Therapy (IFT) in terms of pain relief, improved balance, and decreased fall risk. The comparison of the within-group results between the pre- and post-test shows a substantial difference.

However, the post-test comparison across groups revealed that the OEP group significantly outperformed the proprioceptive group in the KOSS SCORE and TUG tests.

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CONFLICT OF INTEREST

The authors declares that there is no conflict of interest.

ABBREVIATIONS

OA: Osteoarthritis; **OEP:** Otago Exercise Program; **TUG:** Time up and go test; **KOOS:** Knee Osteoarthritis Outcome Score; **IFT:** Interferential Therapy; **NPRS:** Numerical pain rating scale; **ADL:** Activities of Daily Living.

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