



EFFECTIVENESS OF SENSORIMOTOR TRAINING IN POSTMENOPAUSAL WOMEN WITH BILATERAL KNEE OSTEOARTHRITIS

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ABSTRACT

Background: OA is the most common disorder and most frequent joint disease with prevalence of 22% to 39% in India. Approximately, 45% of women above the age of 65 years have symptoms of OA while radiological evidence found that 70% of women above 65 years have OA. Women have higher incidence and prevalence of knee Osteoarthritis, irrespective of age, genetics, ethnicity, race, socioeconomic status and demographic factors. Individuals with knee OA experience loss of proprioception which affects postural stability (static and dynamic balance) and increase risk of fall. Sensorimotor training is nothing but a special form of balance and proprioceptive exercises that was designed for management of individuals with chronic musculoskeletal pain syndromes such as osteoarthritis.

Aim: To study and find the effectiveness of sensorimotor training in postmenopausal women with bilateral knee osteoarthritis.

Methodology: Postmenopausal women above 50 years with grade 2 bilateral knee osteoarthritis were selected for the study. Subjects were selected by simple random sampling method according to inclusion and exclusion criteria. Balance of all patients in static and dynamic posture were measured before and after treatment. Performance based measurements of balance, such as Berg balance scale, Timed up and Go Test and Romberg's test were used to measure static and dynamic postural balance and coordination.

Result: The Berg Balance Scale and the Timed Up (p = 0.001) and Go Test (p = 0.005) showed a statistically significant improvement of balance and postural stability in the interventional group. Romberg's test showed statistically significant improvement in interventional group.

Conclusion: Sensorimotor training along with strengthening and stretching exercises shown more effects on balance, postural stability, proprioception, and thereby provided improvement in functional activities in OA knee patients.

Keywords: Bilateral knee OA, Postmenopausal women, Sensorimotor training, Balance,

INTRODUCTION:

Osteoarthritis is a non-inflammatory degenerative disorder of the joints characterized by progressive deterioration of the articular cartilage and formation of new bone which mainly involves weight bearing joints such as hip, knee ankles.¹ Knee OA results in progressive loss of function including gait, balance, and other physical activities involves lower limb, which affects the quality of life. Pathological changes affect articular cartilage and also the joint structures. These changes results in reduced muscle weakness and joint proprioception. Patients with knee Osteoarthritis mainly complains of pain, reduced ROM, and joint instability, which leads to loss of function.

Women have higher incidence and prevalence of knee Osteoarthritis, irrespective of age , genetics, ethnicity, race , socioeconomic status and demographic factors.² OA is the most common disorder and most frequent joint disease with prevalence of 22% to 39% in India.^{3,4} Approximately, 45% of women above the age of 65 years have symptoms of OA while radiological evidence found that 70% of women above 65 years have OA.^{5,6,7} Eventhough articular tissues have been considered unresponsive to oestrogen deficiency, now there is evidence that oestrogen influence the activity of joint tissues through complex molecular pathways that act at multiple level. Studies shown that primary osteoarthritis is mostly associated with age. The ageing process is accompanied by a decline in function of the systems that are responsible for balance control.^{8,9}

Individuals with knee OA experiences loss of proprioception which affect postural stability (static and dynamic balance) and increase risk of fall.¹⁰⁻¹³ Postural stability, balance and coordination is essential during daily living activities and ambulation. Static balance means maintaining equilibrium while standing in one spit while dynamic balance refers to maintaining equilibrium during locomotion. Loss of balance and fall will most commonly occur during movement related activities like walking. Balance defect were associated with pain , reduced muscle strength and loss of proprioception.^{14,15} Proper balance is necessary for maintaining postural stability while performing various functional activities and for the reducing risk of fall. Balance is a complex function which requires integration of sensory information regarding body position and the ability to make appropriate motor response to movement of body.

Proper balance training is required for improving balance and proprioception in patients with OA thereby reduces the risk of fall and hospitalizations.^{16,17} Balance training helps the individual to improve adequate motor skills for dealing with potentially destabilizing forces on knee there may be encounter during daily living activities. Sensorimotor training is nothing but a special form of balance and proprioceptive exercises that was designed for management of individuals with chronic musculoskeletal pain syndromes such as osteoarthritis.^{18,19,20} It is based on the concept that , not only focusing on muscle strength around the knee joint but also we should realize the importance of the central nervous system in regulating movement in order to reach proper firing patterns for maintaining joint stability. The purpose of this study is to improve balance, coordination, and postural stability in postmenopausal women with bilateral knee Osteoarthritis and also to determine the

effectiveness of sensorimotor training in postmenopausal women with bilateral knee osteoarthritis.

METHODOLOGY:

Patients and study setting

This study was approved by ethical committee of Krishna Vishwa Vidyapeeth 'Deemed to be University', Karad, Maharashtra. Subject who are attained menopause and have already diagnosed with grade 2 bilateral knee osteoarthritis were selected for the study. Subjects were selected by simple random sampling method according to inclusion and exclusion criteria. Inclusion criteria includes patients already diagnosed with grade 1 knee osteoarthritis, Postmenopausal women above 50years, patient who is able to walk without assistive device whereas exclusion criteria includes patients who have undergone any previous knee surgery, patient who is unable to walk independently, visual deficiency, auditory or vestibular deficiency, advanced locomotor disease, progressive neurological or unstable cardiovascular disease.

Patients were randomized into two equal groups. A control group (group A) received a conventional exercise programme (normal OA knee exercises) and an interventional group (group B) received sensorimotor training in addition to normal OA knee exercises.

Outcome measures

Balance of all patients in static and dynamic posture were measured before and after treatment. Performance based measurements of balance , such as Berg balance scale, Timed up and Go Test and Romberg's test were used to measure static and dynamic postural balance and coordination.

Interventions

Conventional exercise programme:

It includes isometric and isotonic exercises. Isometric exercises were given for 10s with 5 repetitions and given rest period of 4s. Isotonic resisted exercises started from 5th week. The maximum weight that could be lifted up to 10 times was determined; the exercises were then done as 10 repetitions with half of this weight, then 3 quarters of these weight and finally the whole weight. The 10 repetition maximum was determined again at 6th week²¹. These exercise programme was carried out according to the following protocol:

1st and 2nd weeks: ROM and stretching exercises applied to hamstring and calf muscle, and quadriceps and hamstring isometric strengthening exercise.

3rd and 4th week: in addition to previous exercises, straight leg raise exercise, short arc terminal extension exercise for knee joint, and isometric exercises for hamstrings, quadriceps, abductors and adductor muscles.

5th and 6th week: in addition to previous exercises, short arc terminal extension exercise with resistance for knee joint, isotonic strengthening exercise with resistance for the hamstring muscles.

Sensorimotor training programme

Patients were trained through three stages: static, dynamic and functional. Each exercises was repeated 3-5 times during a session and enough periods of rest between each sets of exercises

were given. The exercises conducted from easy to more difficult and the patients were not given more difficult stage until they perform the easier one according to following protocol.^{19,20,22}

1st and 2nd weeks: Static phase

1. Standing upright position (30s) on a firm surface , then on a soft surface
2. Single leg stance with eyes closed for 10s on firm surface , then on a soft surface
3. Half step position for 10s
4. One leg balance for 10s

3rd and 4th weeks: Dynamic phase

1. Forward stepping lunge
2. T-band kick exercise

5th and 6th weeks: functional phase

1. Walking exercise on a firm surface , then on a foam surface:
 - a) Toe skipping with toe straight ahead for 20m
 - b) Heel skipping with toes straight ahead for 20m
2. Squatting exercises: against a wall and away from the wall
3. Balance exercises on wobble board :
 - a) Multidirectional rolling movement from sitting
 - b) Multidirectional rolling movement from standing on both legs between parallel bars with eyes open , then eyes closed.
 - c) Multidirectional rolling movement from standing on one leg between parallel bars with eyes open, then eyes closed
 - d) Balance with two legs, eyes open, multidirectional, then eyes closed
 - e) Balance with one leg, eyes open, multidirectional, then eyes closed

RESULT:

Table 1 shown that, the Berg Balance Scale and Timed up and Go Tests showed statistically significant improvement in balance and postural stability measures in the interventional group trained with sensorimotor training in addition to normal OA knee exercises.

Table 1: Performance based test (static and dynamic balance test) results at 4 weeks and 6 weeks

	Intervention group			Control group			p- value (6 weeks)
	Mean time (seconds) at			Mean time (seconds) at			
	Baseline	4 weeks	6 weeks	Baseline	4 weeks	6 weeks	
Berg Balance Scale ^a	49.23 (46.63- 51.83)	46.11 (45.56- 46.66)	42.27 (40.47- 44.07)	48.52 (38.72- 58.32)	49.10 (38.35- 59.85)	50.15 (44.95- 55.35)	0.001*
Timed Up and Go Test ^a	8.89 (6.77- 11.01)	7.27 (6.16- 8.38)	6.74 (5.84- 7.64)	9.95 (6.46- 13.44)	10.43 (5.92- 14.94)	10.64 (6.62- 14.66)	0.005*

^aValues are presented as mean (\pm SD)

*Significant result

Table 2 shown that coordination and postural balance using Romberg's test showed statistically significant improvement in interventional group, compared with control group received no intervention apart from normal OA knee exercises. Result were also significant for closed eye but not with open eyed test.

Table 2: Static postural balance tests' results at 4 weeks and 6 weeks

	Intervention group			Control group			p- value (at 4 weeks)	p- value (at 6 weeks)
	Average radius (mm) of body centre movement circle			Average radius (mm) of body centre movement circle				
	Baseline	4 weeks	6 weeks	Baseline	4 weeks	6 weeks		
Romberg 1 (open- eye) ^a	14.25 (11.65- 16.85)	12.05 (9.25- 14.85)	10.47 (8.77- 12.17)	13.73 (10.49- 16.97)	14.83 (11.85- 17.81)	14.50 (12.12- 16.88)	0.09	0.001*
Romberg 2 (closed- eye) ^a	20.87 (18.17- 23.57)	18.27 (16.37- 20.17)	16.07 (13.87- 18.27)	19.76 (16.16- 23.36)	20.88 (18.48- 23.28)	19.75 (17.15- 22.35)	0.01	0.001*

^aValues are presented as mean (\pm SD)

*Significant result

The Berg Balance Scale and the Timed Up (p = 0.001) and Go Test (p = 0.005) showed a statistically significant improvement of balance and postural stability in the interventional group

DISCUSSION:

Examination of balance is an important part of exercise programme. Balance based disorders are growing public health problem due to their relation falls and fall related injuries. Osteoarthritis of knee is associated with loss of proprioception in lower limb and which may be the cause of balance impairment. Reduced postural control cause difficulty in performing daily living activities and would affect the quality of life of the patients.^{16,23}

In this present study, we have investigated the effect of sensorimotor training in postmenopausal women with bilateral knee Osteoarthritis. Sensorimotor training is a special type of exercise programme aimed at restoring motor control through increasing sensory inputs from various parts of body to improve balance, coordination, postural stability and overall functional level of the patient.^{19,20} For this purpose, we measured balance, coordination and postural stability of patient before and after treatment sessions. The balance, coordination, and postural stability examination of present study prove that sensorimotor training along with strengthening and stretching exercises, can improve balance parameters of postmenopausal women with knee osteoarthritis. The relation between OA and

proprioception loss declines sensory output from knee joint which affects sensorimotor function and thereby results in impairment of balance.^{15,24,25}

Present study finding shown that sensorimotor training along with normal OA exercise programme made significant improvement in balance and postural stability, whereas patient given with normal OA exercises alone shown non- significant improvement in balance measures. Sensorimotor training improved balance and coordination and also improved sensory information response. In sensorimotor training, improvement of patient through exercises in various postures, BOS, COG. Therefore , each exercises elicit reflexive and automatic muscular stabilization demanding the patient to maintain postural stability under various activities.

There are various studies that have investigated the effect of exercises in management of OA knee and reported reduced pain, increased muscle power, improved proprioception and functional level. However , based on present study, this type of exercises is not enough and cannot achieve optimal functional capacity level . Exercises should improve neuromuscular control and attain the needs of activities of daily living.

The present study result show that there was significant positive corelation between balance and functional level at pre and post exercises. Increased postural sway is an evidence of balance impairment. Patient with OA knee shows increased postural sway during both closed and open eye situation. This result agrees with the study conducted by Hassan et al. who measured postural sway , proprioception and maximal voluntary contraction of quadriceps in patients with OA knee and concluded that reduced postural stability is associated with decreased functional performance.²⁶ Study conducted by Hurley et al. regarding sensorimotor changes and functional performance in OA knee patients concluded that postural stability was associated with changes in functional level.²⁷

Addition of sensorimotor training along with normal OA knee exercises, such as strengthening and stretching exercises could provide increased motor control and also helps in neuromuscular restoration of balance and improve functional levels during various activities in OA patients. However , the present study investigated the short term effect of sensorimotor training , but more studies with long term follow up are required.

CONCLUSION:

This study aimed to evaluate the effectiveness of sensorimotor training in reducing risk of fall by improving both static and dynamic balance in postmenopausal women with bilateral knee osteoarthritis. Sensorimotor training along with strengthening and stretching exercises produced more effects on balance, postural stability, proprioception, and thereby provided improvement in functional activities in OA knee patients. Statistically it was found that the result showed significant difference before and after 6 weeks of treatment.

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