

## **Impact of Strengthening and Proprioceptive Exercises on Balance and Activities of Daily Living (ADLS) In Knee Osteoarthritis Patients from West Delhi, Indian population**

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### **ABSTRACT**

**Background:** Knee osteoarthritis (OA) is a chronic joint disease, primarily occurring in aged population. Rehabilitation of knee osteoarthritis aims to reduce pain and disability by strengthening, raising endurance, range of motion, proprioception and improving aerobic fitness.

**Aim and Objectives:** This study aimed to analyse and compare the impact of strengthening and proprioceptive exercises on balance and activities of daily living in knee OA in population of west Delhi, India.

**Material & Methods-** Thirty OA patients were enrolled from Khetarpal hospital, Delhi, after taking ethical approval and informed consent. A study was explained to subjects and data was obtained as per proforma. Age of patients ranged from 50-80 years. Diagnosis was established based on radiological examination shown in the knee joint X-ray. Statistical analysis was performed by using SPSS software (Version 26).

**Results-** Patients treated with the strengthening and proprioceptive exercises showed t-value on Berg balance scale (BBS) as -16.12 and 13.15 respectively, and the parameter of Knee Injury and Osteoarthritis Outcome Score (KOOS) showed -13.21 and 13.481 respectively, were statistically significant.

**Conclusion-** The study groups showed, both the exercises helped reduce pain and improved the balance of daily-based activities. Furthermore, both the groups showed a significant improvement in BBS and KOOS scales.

**KEYWORDS:** Osteoarthritis (OA), Strengthening, Proprioceptive, exercise, Berg balance scale (BBS) and Knee Injury and Osteoarthritis Outcome Score (KOOS)

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### **INTRODUCTION**

Degenerative knee arthritis is a chronic joint disease, primarily occurring in aged population.<sup>(1)</sup> It is characterized not solely by ache, but appears along with muscle weakness causing restrictions in performing daily activities and leads to inability to bear stresses occurring due to work overload.<sup>(2)</sup> The general changes occur in the knee complex, wherein articular cartilage gets eroded, organic chemistry changes and certain modifications occur in the membrane, joint capsule

and lining of bones. Bones are hypertrophied (bones tend to have increased mass with extra bone growth in an area), and have conical shape.<sup>(1)</sup> Bone marrow density (BMD) gets reduced, leading to unstable joint, loss of movements and increased propensity of trauma to the joint. Knee OA involves the whole complex, which affects the cartilage (presence of crystals) and the ligaments along with surrounding structures such that it leads to alteration in function.

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Knee OA is a painful condition and causes exhaustion in affected individuals.<sup>(3)</sup> Patients suffering from this disorder complain of pain, stiffness of the joint, reduced strength of the muscles and instability within the joint leading to reduced function. Proprioceptive activity also gets limited or reduced and leads to reduced ADLs.<sup>(2, 4, 5)</sup> In an earlier study, examination on osteoarthritic patients with age and sex controls showed that the quadriceps muscle strength and proprioception reduce while postural sway increase in individuals with knee osteoarthritis.

Many researches have dealt with the risk factors, which include increased weight, age and any history of injury to the knee. Conditions with peripheral nerve involvement such as leprosy, syphilis etc also predispose to knee OA.<sup>(1, 8, 9, 10)</sup> Presence of osteoarthritis in hand, history of diabetes in the patient, and comorbid conditions such as cardiovascular conditions are also related to increased risk of knee OA. Crouching and twisting for about more than 2 hours per day can be a cause for increased danger of knee OA varying from moderate to extreme. Moreover, a low level of training is also related to OA of the knee

The latest WHO report on the worldwide accountability of disease shows that OA of the knee is the fourth most important reason for handicap in women and the eighth-most common cause in men. Individuals affected with symptomatic knee OA are more prone to increase in symptoms and the rate of corpulence or overweight with increase in age. Females, especially those over 55 years, are more predisposed to last stage OA inside the knee joint than of any another joint. The research outcome have illustrated various sex variations of knee arthritis (with precedence measure was markedly higher in women than in men), mainly during the menopausal age period which rose considerably with age.<sup>(11)</sup>

In clinical practice, treatment and rehabilitation for knee OA generally aims to reduce pain and disability by strengthening, raising the endurance, range of motion, proprioception, and improving aerobic fitness.<sup>(1, 12)</sup> It includes drugs (NSAIDs, mucopolysaccharide injection, glucosamine and chondroitin sulphate), exercises, physical therapy, techniques for restoring knee alignment and diet modification for weight loss. Numerous parts of the human body, such as the sensory system, proprioception, muscle quality, sight, and cognition, are all connected with balance control, a vital capacity in everyday life.<sup>(13)</sup>

The knee is one of the most important weight-bearing joint and OA of the knee is thought to be a significant risk factor for fall injuries. Thus, it may be necessary for OA patients to get training connected with counteracting falls. Rehabilitative instructions can be instituted once evaluation of their daily living activities and balance control abilities is done. Clinical balance analysis tests such as TUG (Timed Up and Go),

FRT (Functional Reach Test), 10-meter walking test, the Berg balance scale (BBS) and Knee Injury and Osteoarthritis Outcome Score (KOOS) have high intraclass correlation and reliability.<sup>(14, 15, 16)</sup> The BBS is used to measure balance in elderly people by checking out the attainment of functional tasks. Scoring is done by a five-point scale, extending from 0-4 where "0" denotes functional activity at the lowest level and "4" at the highest level of function. Total Score is calculated out of 56, is interpreted as: 41 to 56 = low fall risk, 21 to 40 = medium fall risk and 0 to 20 = high fall risk. The KOOS survey is utilized to assess the individual's condition about knee and related issues like knee OA. It comprises of 5 sub-components which incorporates pain (36), symptoms (28), ADL (68), function in sport and recreation (20) and QOL (16). Everything in KOOS is scored from 0 to 4, the crude score for every segment is the total of thing scores. The scores are then changed to a 0 to 100 scale. A higher score indicates lesser problems.

Transformed score:  $100 - \text{actual raw score} \times 100 / \text{possible basic scale range}$

With the magnitude of problem at hand, more emphasis should be given on the advancement of preventive methodologies utilized as a part of shielding the knee joint from mechanical harm and stretch. Thus, the present study was conducted on knee OA patients to evaluate the impact of strengthening and proprioceptive exercises on balance and activities of daily living (ADLs) and compare the outcome difference of two exercises. It is a pioneer step to establish whether or not, one type of exercise is better than another.

### AIM AND OBJECTIVES

1. To study effects of strengthening and proprioceptive exercises on balance and ADLs in knee OA
2. To compare effects of strengthening & proprioceptive exercises on balance and ADLs in knee OA.

### MATERIAL & METHODS

Thirty patients were enrolled in the study based on the inclusion criteria, from Khetarpal hospital Delhi. Ethical approval from the institutional ethical committee and written informed consent from subjects was taken. A detailed explanation of the study was given to the patient and details collected as per proforma.

**Sampling method:** Convenience sampling

**Inclusion Criteria:**

Patients between age – group of 50 – 80 years.

Patients diagnosed with bilateral knee OA based on radiological examination (as shown in the X-ray of the knee joint).

Patients presenting with symptoms for more than 3 months like pain, joint stiffness, functional disability, decreased muscle strength, and limitations in performing ADLs.

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## Exclusion criteria:

Any patient with history of knee, hip or ankle surgery.  
 Patients with history of, or on treatment with any intraarticular injection to the knee joint.  
 Mentally deficits patients, patients with peripheral vascular disease, cerebrovascular disease.  
 Statistical analysis was performed by using paired sample t-test. We have used an independent sample t-test concerning the BBS and KOOS. KOOS includes knee-related quality of life (QOL), pain, activities of daily living (ADLs), symptoms, and function in sports and recreation activities (SRA).

## Methods

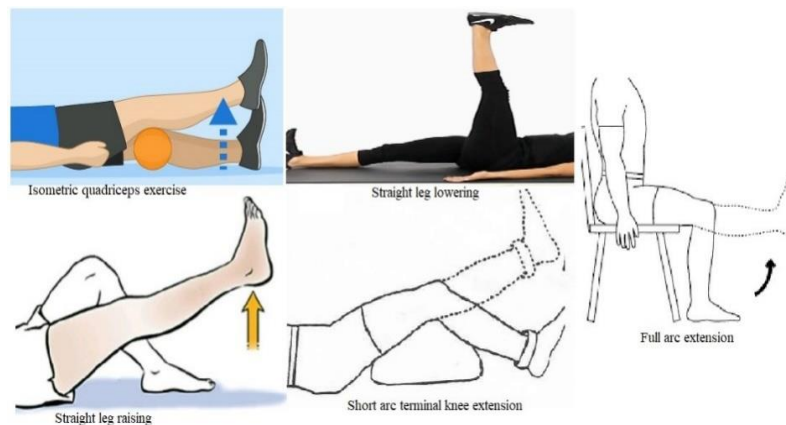
Both BBS (Berg Balance Scale) and KOOS (Knee Injury and Osteoarthritis Outcome Score) were done before and after the treatment. To calculate balance and ADLs, the patient was

asked to mark the points on BBS and KOOS to know their functional status both before and after the treatment.

After the pre-exercise measurements on BBS and KOOS by the patients, the subjects were allocated randomly into two groups-Group A and Group B consisting of 15 patients in each group. 5 training sessions per week for 5 weeks were given. After the treatment again BBS and KOOS scores were measured to know the effectiveness of the treatment.

For Group A, strengthening exercises<sup>(1, 17)</sup> were undertaken. 5 exercises (15-20 repetitions of each) per session, one session per day from Monday to Friday for 5 weeks.

- (1) Isometric quadriceps exercise
- (2) Straight leg lowering
- (3) Straight leg raising
- (4) Short arc terminal knee extension
- (5) Full arc terminal knee extension



Group B: Proprioceptive exercises<sup>(1, 17)</sup> were undertaken, 5 exercises (15-20 repetitions of each) per session, one session per day from Monday to Friday for 5 weeks.

- (1) One-leg balance

- (2) Toe walking
- (3) Heel walking
- (4) Cross-body leg swings
- (5) Blind advanced one leg balance



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### RESULTS

Out of 15 patients in Group A 5 were males and 10 females. The mean age of patients was 58±4.69. Out of 15 patients in

Group B 9 were males and 6 females. The mean age of patients was 62.53±7.12.

**Table1. depicts Group A Comparison of BBS and KOOS for pre and post treatment**

		Pre (Mean ± SD)	Post (Mean ±SD)	t-value
<b>BBS</b>		34 ± 3.590	52.50 ±1.509	-16.123*
<b>KOOS</b>	Pain	47.80 ± 9.773	86.30 ± 7.134	-13.21*
	Sym	41.40 ± 8.972	86.40 ± 3.688	-12.814*
	ADL	59 ± 6.928	93.20 ± 1.874	-15.475*
	SRA	23.50 ± 11.068	69.50 ± 9.265	-12.65*
	QOL	33.70 ± 4.762	84.50 ± 3.689	-43.349*

‘\*’ represents significant at p<0.05

Patients treated with the strengthening exercises showed t-value of BBS scale was -16.123 (at p<0.000), and the parameter of KOOS scale such as pain showed -13.21, other symptoms showed -12.814 (at p<0.000), ADL showed -

15.475 (at p<0.000), SRA showed -12.65 (at p<0.000) and QOL showed -43.349(at p<0.000). Thus all the above parameters showed a significant difference in all the above parameters.

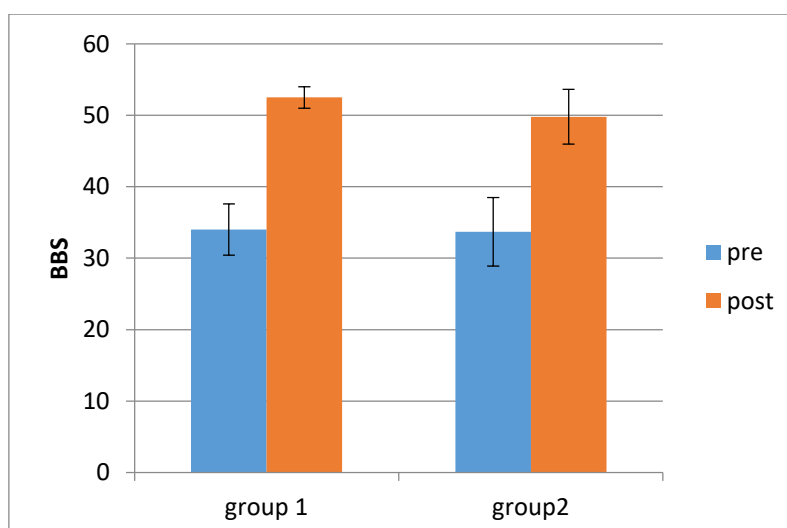
**Table2. depicts Group B Comparison of BBS and KOOS for pre and post treatment**

		Pre (Mean ± SD)	Post (Mean ±SD)	T value
<b>BBS</b>		33.70 ± 4.809	49.80 ± 3.824	-13.15*
<b>KOOS</b>	Pain	50.80 ± 10.612	86 ± 6.146	-13.481*
	Sym	41.70 ± 8.820	83.20 ± 8.244	-12.907*
	ADL	57.10 ± 8.006	88.20 ± 5.391	-9.568*
	SRA	27.50 ± 13.994	61.50 ± 13.550	-16.333*
	QOL	31.50 ± 4.813	84.50 ± 3.689	-27.349*

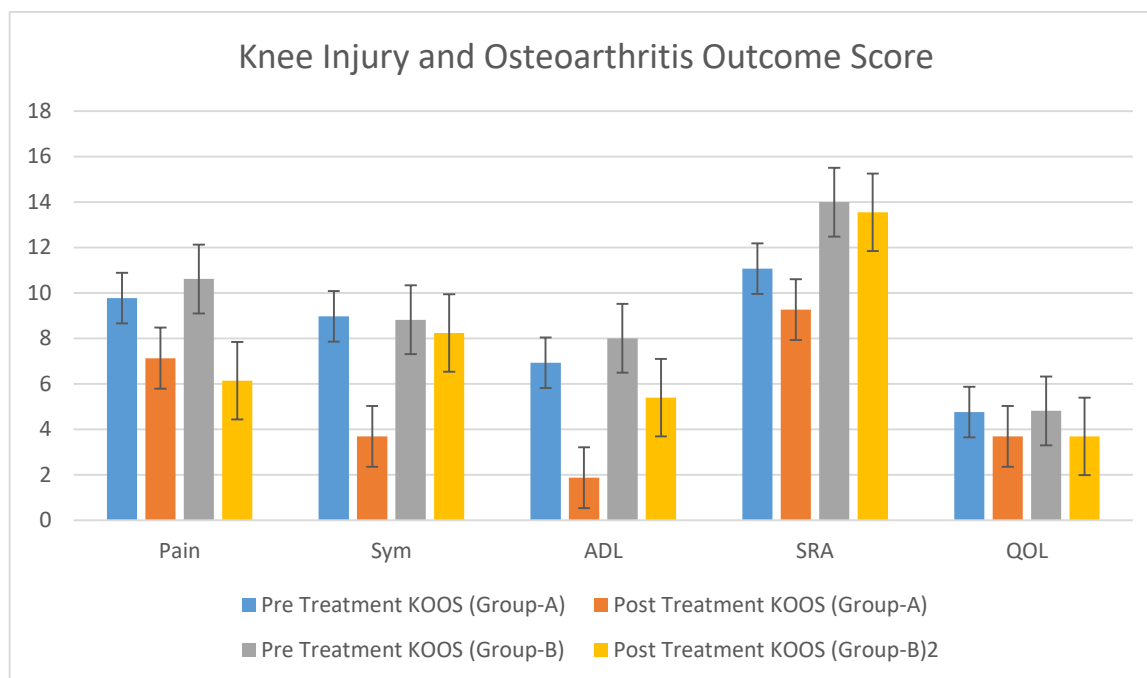
‘\*’ represents significant at p<0.05

Patients treated with the proprioceptive exercises showed value of BBS scale was -13.15 (at p<0.000) and the parameter of KOO Scale such as pain showed-13.481(at p<0.000), other symptoms showed-12.907(at p<0.000), ADLshowed-

9.568(at p<0.000), SRAshowed-16.333(at p<0.000) andQOLshowed-27.349(at p<0.000). Thus all the above parameters showed a significant difference in all the above parameters.



**Graph 1-** Graphical representation of BBS



**Graph 2-** Graphical representation of KOOS

Significant difference was observed in BBS and KOOS pre and post treatment in both Group A and B.

## DISCUSSION

Knee OA is a debilitating condition that impairs the normal functioning of an individual and society at large. It leads to various complications like pain, swelling around the knee joint, stiffness, decreased range of motion, loss of balance control, reduced function in daily living, thus affecting the quality of life of an individual.

Scheila C O'Reilly, in his study, determined the quadriceps strength, function, structural changes, and psychological status of subjects with knee pain. Results affirmed that lower quadriceps strength and activation is strongly associated with knee pain and disability. Pain and lack of activity in turn leads to further weakness of quadriceps muscle. This cycle induces lack of balance control and increases the proneness to fall injuries. Many studies support that due to increased pain and decreased muscle strength, proprioception leads to postural instability.

In a trial DaHon Lin, investigated the outcomes of two different non-weight-bearing exercises program, i.e., proprioceptive training versus strength training in knee OA patients. He determined that both strengthening and proprioceptive training exercises show significant improvement in the patients. Balance training has a leads to considerable improvement in proprioceptive function, while strengthening has a more profound effect in increasing in knee extensor strength. In the present study also, a significant improvement was observed in both the exercises regimes.

Though this study shows that both the strengthening exercise as well as proprioceptive exercise groups benefitted, in the

inter-comparison of both the groups a significant difference in the BBS scale was observed. However, daily living activities were improved in subjects treated with strengthening exercises as it involves non-weight bearing exercises, thus leading to a decrease in pain, increase in muscle strength and subsequent increase in the range of motion of knee joint.

A trial by Srinivas Mondan revealed that the experimental group, which received the proprioceptive exercises had shown an average reduction in pain according to the VAS score and WOMAC Indus score. Enhancement in the active range of motion of patients in this group led to an assumption that in the knee OA management, the best treatment selection could be a proprioceptive exercise.

Whereas in this study, subjects who were given proprioceptive exercises, showed an improvement in balance, along with a reduction in the symptoms. A plausible explanation of this improvement can be, the correct mechanical loading, which enhances the joint's stability and thus leads to extended range of motion, quality of life and proprioception.

In this study too, the females were found to be more prone to knee OA. A plausible explanation to this female preponderance is the menopausal age group (50 to 80 years) of study population. Menopause in females is characterized by various hormonal changes, which lead to many complications such as inappropriate nutritional supply to the body, reduction in the bone calcium levels (reduced bone mass density) etc. Lack of inactivity is also a contributing factor.



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It was also observed that changes in the lifestyle affects both males and females as it tends to increase weight, leading to transfer of more stress forces on the knee. The knee is one of the most important weight-bearing joints of the human body, so increase in stress load will result in a reduced cushioning effect due to decreased amount of GAGs (Glycosaminoglycan sulfation). GAGs are hydrophilic in nature, so result in immediate change in the knee complex.

Strengthening exercises (given to Group A) resulted in much improvement in individuals who cannot exercise in a weight-bearing posture, i.e., who are incapable of proprioceptive exercises due to pain or other reasons.

As osteoarthritis is a progressive condition that cannot be cured completely, proper management can only alleviate symptoms, prevent or at least delay further progression. The subjects are treated with therapeutic modalities and exercises, which vary from strengthening exercises to proprioceptive exercises.

The present study involved subjects affected with mild to moderate knee OA which is best treated with exercise therapy. No surgical procedures were done. In this study, one group has been given strengthening exercises and the other group was assigned to proprioceptive exercises. It was observed that the former group showed a better improvement in both balance and activities of daily living as per the BBS and KOOS. The strengthening exercises proved better than the proprioceptive exercises. Strengthening exercises led to increased muscle strength of the quadriceps. Non-weight bearing exercises, are not only easily accessible to the patients, they can be performed regularly and are less painful. Sometimes, minor varus deformity is seen in the patients treated with strengthening exercise, while flexion deformity is seen in some patients treated with proprioceptive training.

### FUTURE SCOPE

The sample size of the study and time duration can be increased. Also, in this study patients affected from severe knee OA were not included, so, future studies can be taken up on such patients, to observe the effect of two types of exercises in them. Female centric studies can be undertaken since females are more prone to knee OA.

### Limitations

The present study has few limitations, like a short duration of treatment. This study has not taken the severely affected patients of knee OA, because, in severe conditions, it becomes challenging for the patients to perform the exercise.

### CONCLUSION

This study shows statistically significant results on knee osteoarthritis patients' west Delhi (Indian) population in pain reduction and improved balance of daily-based activities in strengthening exercise and proprioceptive exercise groups.

Furthermore, both the groups have shown a significant improvement in BBS and KOOS scales. Thus the study fails to reject the null hypothesis that there is no significant difference between the strengthening exercises and proprioceptive exercises on balance and ADLs in knee osteoarthritis.

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