



A Study to Analyze the Role of Physical Therapy to Improve Balance, Proprioception and Kinesthesia in Patients with Knee Osteoarthritis : A Systemic Review

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ABSTRACT

Osteoarthritis is a major cause of musculoskeletal disability worldwide. Knee Osteoarthritis patients have proprioception deficits, alter balance and postural control due to that risk of falls is increase and affect the quality of life. A study to analyze the role of physical therapy to improve Balance, Proprioception and Kinesthesia in patients with Knee Osteoarthritis Authors searched Pubmed, the Online Library, the Archives, Google Scholar, MEDLINE, the Cochrane Library from 1999 to 2021. Total of 3264 participants were included in the 15 RCT studies. The result of the study showed that an improvement in proprioception, balance, and kinesthesia had a significant role in increased quality of life due to the decreased risk of fall in osteoarthritis knee patients. So, physical therapy treatment helps to improve the efficacy of Balance, Proprioception and Kinesthesia in knee Osteoarthritis patients.

Keywords: Knee Osteoarthritis, Balance, Proprioception, Kinesthesia, Physical Therapy.

INTRODUCTION

Osteoarthritis (OA) is one of the most prevalent forms of arthritis in contemporary. Knee osteoarthritis a chronic degenerative disease of an inflammatory nature which affect the entire synovial joint and exhibit multiple phenotypes [1]. OA can be characterized by two main features, The first features of OA are progressive damage of articular cartilage, bone remodeling and new bone formation, while the second features are when synovial inflammation, fibrosis of ligaments, tendons, menisci and capsules occur in the body, the presence of fibrillation areas, and cracking and thickening of the subchondral bone [2,3].



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Primary osteoarthritis is mostly related to aging [4,5]. Secondary osteoarthritis is caused by another disease or condition [6]. According to World Health Organization (WHO) 9.6% of men and 18.0% of women age over 60 years have symptomatic osteoarthritis worldwide. 80% of those with osteoarthritis have limitations in movement, and 25% cannot perform their major daily activities of life. In globally suffer from osteoarthritis, 100 million people reported worldwide in cause of disability. Osteoarthritis is the second most common rheumatologic problem and it is the most frequent joint disease with a prevalence of 22% to 39% in India [1]. Women are more affected by OA knee than men [7]. OA is strongly associated with aging and Asian countries are aging rapidly. Asian elderly aged ≥ 65 years old had increased from 7% in 2008 and is predicted to achieve 16% in 2040 [8]. Knee osteoarthritis is prevalent musculoskeletal condition affecting the people causing pain, functional disability and deterioration in the quality of life [9,10]. People with knee OA experience loss of proprioception, which may affect postural stability and risk of fall. osteoarthritis include joint pain particularly after prolonged activity and weight bearing, loss of motion, joint stiffness that is experienced after inactivity, decreased muscle strength, proprioceptive deficits, reduced balance, occasional swelling and crepitus [11,12,13].

Subjects with knee osteoarthritis have quadriceps muscle weakness as well as proprioceptive deficits, which can alter balance and postural control. Such deficits cause a change in dynamic stability provided by muscles around the joint, generating a functional instability that limits the individual's ability to perform ADL's [14,15]. The advantages of weight bearing exercises, strength training, gait training is becoming more accepted and used in clinical practice and are found to improve balance [16,17]. People with osteoarthritis knee sometimes report episodes of knee instability that may result in fall or limit their activities of daily living [18]. Imbalance in the center of gravity of the body could reduce stability and increases the risk of falls [19], which would result in bone fractures or fatal injuries for older adults. Meanwhile, proprioception could influence the ability of limb coordination, which played a great role in postural control [20]. Therefore, proprioception impairment was harmful to the balance of skeletal muscles around the knee joint and increased the risk of falling [21].

Kinesthesia, balance and agility is a form of proprioceptive training that has been gaining interest among researchers in the management of knee OA and knee-related injuries. The exercise is typically designed to improve dynamic joint stability and neuromuscular control using a series of physical activities that challenge the individual's neuromuscular system to maintain balance and coordination [22]. Knee osteoarthritis is a common degenerative disease, with its prevalence increasing with age and multifactorial aetiology. It is a common cause of disability worldwide. Many studies have demonstrated that impaired proprioception, balance, kinaesthesia may cause degenerative joint disease. Therefore, improvement in proprioception, balance, kinaesthesia have a significant role in increased quality of life due to the decreased risk of fall in osteoarthritis knee patients. So, need arise to find out the efficacy of Balance, Proprioception and Kinesthesia in Osteoarthritis of Knee Joint.

MATERIALS AND METHODS

The study based on the PICOS (participants, interventions, comparisons, outcomes and study design) format. We included randomised controlled trials (RCTs) and published in the English language. All studies involving individuals with knee Osteoarthritis. We were interested in the effects of physical therapy and efficacy of Balance, Proprioception and Kinesthesia in Osteoarthritis of Knee Joint. We selected the studies that investigated or compared the physical therapy interventions. Studies that evaluated other forms of therapy without exercise or other physical interventions were excluded. We also excluded studies of surgical or pharmacologic treatments for knee Osteoarthritis. The authors considered all interventions that involved an element of physical training such as balance training, proprioceptive training, kinaesthetic training, strength training, endurance training and physiotherapy interventions such as physical therapy.



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We searched Pubmed, the Online Library, the Archives, Google Scholar, MEDLINE, the Cochrane Library by using the following keywords: (knee osteoarthritis), (falls or falls risk), (balance), (proprioception), (kinesthesia) and (physical therapy) from 1999 to 2021. We searched ClinicalTrials.gov for completed trials related to the key questions. We did not contact primary investigators, but we did request additional information from sponsors of on-going trials.

RESULTS AND DISCUSSION

15 RCTs were selected for this systematic review, with the main characteristics summarised in Supplementary data, Appendix Table-1. Total of 3264 participants were included in the 15 RCT studies. The duration of intervention and follow-up ranged between 1 week to 30 months. The studies employed a large variety of physical therapy interventions. Balance and kinesthesia training, proprioceptive training, strengthening training mainly used in our selected studies. Common assessment tools (TUG, BBS, Step Test, 6MWT and WOMAC) were employed in 12 out of 15 studies. Three studies used TUG test, two studies used BBS, two studies used Step Test, one study used 6MWT and nine studies used WOMAC. Two studies used KOOS, two studies used physical function score. Osteoarthritis causes deficits in gait and balance which increases the risk of falls. Postural instability in individuals with OA may result from quadriceps muscle weakness, pain or altered neuromuscular control. Strengthening exercise can improve muscle strength and proprioception which may reduce the progression of OA. Thus, in order to improve balance and reduce falls risk in individuals with knee OA, any RCTs should include interventions that can improve muscle strength, reduce pain and improve neuromuscular control.

Proprioception is the awareness of joint position, whereas kinesthesia is the cognizance of joint movement. Mechanoreceptors (pacinian corpuscles, Ruffini endings, muscle spindle, and Golgi tendon organs located in muscles, capsules and ligaments provide sensory input into the central nervous system. These mechanoreceptors act together to give sensory awareness of joint position, movement via afferent pathways to the central nervous system. The central nervous system provides an efferent response to the surrounding joint musculature to elicit the desired response. Several authors have demonstrated a decline in joint position sense in subjects with osteoarthritic knees. A functional change with OA is reported to be alteration in gait patterns. It has been suggested that this altered gait may represent an effort to maximize proprioceptive input. Additionally, proprioception has been shown to decline with age. It has been suggested that reduced proprioception in the elderly and in patients with OA of the knee may be responsible for initiation and advancement of degeneration. It is also believed that impaired proprioception may be an important pathologic factor in determining the severity of OA. Some research suggests an increased likelihood of developing OA in the contralateral knee in subjects with unilateral disease. A decrease in proprioceptive sense may have a role in the pathogenesis of this OA.

Balance is generally defined as the ability to maintain the center of mass over the base of support. Balance can be disrupted when the mechanoreceptors found in the ankle, hip and knee do not properly detect or correct motion to preserve the center of gravity over the base of support. Multiple studies shown that knee osteoarthritis patients may suffer from impaired proprioceptive accuracy (for both position and motion sense). A few studies, however, did not find an impairment in knee osteoarthritis patients, possibly due to lack of power or an absence of patients with severe knee osteoarthritis. Unilateral knee osteoarthritis patients may have lack of proprioception in both knees. In our included studies Uzunkulaoğlu et al. concluded that "Both single- and dual-task trainings are effective in improving balance performance under single- and dual-task conditions in elderly patients with knee OA. Dual-task training is not superior to single-task training for balance improvement in elderly osteoarthritic patients." Braghin R.M.B. et al. concluded that "The practice of physical exercises is important for symptomatic individuals, in the self-perception of improvement in function and reduction of pain; for asymptomatic individuals, in transposition of step; and for both in decreases in the number of falls." J.E. Bullock-Saxton et al. concluded that "the knee JPS does not deteriorate with age in the FWB condition. It is proposed that this finding reflects the effect of maximised afferent inputs from all



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proprioceptors around the knee and associated joints. When the contribution for muscular activity was reduced, as in PWB, knee joint-position sensitivity was found to decrease as age increased.” Walter H. Ettinger et al. concluded that “Older disabled persons with osteoarthritis of the knee had modest improvements in measures of disability, physical performance, and pain from participating in either an aerobic or a resistance exercise program. These data suggest that exercise should be prescribed as part of the treatment for knee osteoarthritis.” David T. Felson et al. concluded that “Proprioceptive acuity as assessed by the accuracy of reproduction of the angle of knee flexion had modest effects on the trajectory of pain and physical functional limitation in knee OA.” L R Garsden et al. concluded that “Subjects with unilateral OA of the knee demonstrated poorer performance on both legs in a partial weight-bearing reposition test than did control subjects.” Pazit Levinger et al. concluded that “Balance exercises are key exercises recommended for fall prevention, carefully designing and evaluating an exercise intervention to address knee pain is crucial in order to develop safe, acceptable and effective fall-prevention interventions in this high-risk group.” Judit Takacs et al. concluded that “A ten week dynamic balance training program for people with knee OA 25 significantly improved self-reported knee pain, physical function, and fear of movement, 26 though there was no change in dynamic balance as quantified by the Community Balance and Mobility Scale.”

Demirhan Diracoglu et al. concluded that “Additive positive effects of kinesthesia and balance exercises in knee OA have been demonstrated. Used in clinical applications, they should be able to increase the functional capacities of patients.” Aysha I. Adhama et al. concluded that “the effectiveness of KBA exercise program and the ideal number of sessions needed to achieve the highest effectiveness, which may guide clinical practice and minimize waste of time and effort.” PeixinShen et al. concluded that “a 6-week PNF intervention positively affects KOA treatment by relieving pain, recovering proprioception, and improving joint force distribution in the elderly with KOA. The overall climbing stair function level was enhanced.” Omer Gezginaslan et al. concluded that “balanced strengthening of knee flexors and extensors in patients with knee OA may result in improvements with respect to pain, stiffness, ROM, balance, proprioception and functionality, and in a decrease in the risk of fall. Balanced strengthening of knee flexors and extensors exercises can be eligible therapeutic options for knee OA patients.” K. Kotteeswaran et al. concluded that “weight bearing exercises on wobble board might be a better therapeutic intervention as compared to weight bearing exercises on stable platform for treating subjects with OA knee.” Srinivas Mondam et al. concluded that “proprioceptive exercises could be a better choice of adjacent from physiotherapy point of view in the management of osteoarthritis of knee with conventional treatment.” Zehua Chen et al. concluded that “for KOA patients, 4-week BW combined with conventional therapy presented no significantly greater improvement in proprioception than conventional therapy used alone.”

In conclusion, our study analysis suggested that knee Osteoarthritis patients have impaired proprioception, balance and kinaesthesia. Therefore, improvement in proprioception, balance, and kinaesthesia have a significant role in increased quality of life due to the decreased risk of fall in osteoarthritis knee patients. So, physical therapy treatment helps to improve the efficacy of Balance, Proprioception and Kinesthesia in Osteoarthritis of Knee Joint.

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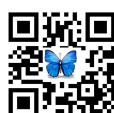
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Table 1 : Overview of the characteristics of the included studies.

Author, Year (Reference)	Study Size	Outcomes Assessment Tools	Time Interval	Protocol
Uzunkulaogla et al., 2019 [23]	50	BBS, kinesthetic ability trainer static and dynamic scores, TUG test and walking speed activities-specific balance confidence scale	4 weeks	Single-task balance training (group 1) and dual-task balance training (group 2).
Braghin R.M.B. et al., 2017 [24]	42	WOMAC, Step Up/Over test	8 weeks	Warm-up; strengthening exercises – SLR with hip flexion, abduction and extension; knee flexion in a standing position; isometry of the quadriceps; aerobic exercise on a stationary bicycle; balance training
J.E. Bullock-Saxton et al.; 2000 [25]	60	Three common tests - stamp out an imaginary fire, step up onto a block and kick a ball towards a target	5 trials	Full weight-bearing protocol and Partial weight-bearing protocol
Walter H. Ettinger et al., 2013 [26]	439	self-reported disability score ,knee pain score, performance measures of physical function, x-ray score, aerobic capacity, and knee muscle strength.	78 weeks	Eerobic exercise program, a resistance exercise program, and a health education program.
David T. Felson et al., 2009 [27]	2243	WOMAC, physical function score	130 weeks	proprioceptive acuity
L R Garsden et al., 1999 [28]	40	partial weight- bearing test	6 trials	Experimental set-up simulating single-leg stance in weight- bearing under low load
PazitLevinger et al., 2017 [29]	-	Feasibility and safety outcomes, Cognitive tests, WOMAC,	8 weeks	High-speed resistance training, High-speed



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		AQoL, IPEQ, Short FES-I, SAPS		resistance and balance training
JuditTakacs et al., 2017 [30]	36	Community Balance and Mobility Scale, WOMAC	10 weeks	Targeted dynamic balance training
DemirhanDiracoglu et al., 2005 [31]	66	WOMAC, SF-36 Form	8 weeks	kinesthesia and balance exercises, strengthening exercises
Aysha I. Adhama et al., 2017 [32]	84	Ibadan Knee and Hip Osteoarthritis Outcome Measure, VAS, KOOS, Osteoarthritis Knee and Hip Quality of Life Questionnaire	8 weeks	Ultrasound therapy, stretching and strengthening exercises
PeixinShen et al., 2020 [33]	27	WOMAC, knee joint proprioception test, ascent stair gait test	6 weeks	PNF stretching
Omer Gezginaslan et al., 2019 [34]	39	VAS, WOMAC-P, WOMAC-PF, TUG, Five Times Sit to Stand Test, 6MWT WOMAC-S, BBS	6 weeks	Isokinetic muscle strengthening exercises
K. Kotteeswaran et al., 2020 [7]	40	KOOS outcome and TUG test	4 weeks	Weight bearing exercises on wobble board along with interferential therapy, weight bearing exercises on stable platform along with interferential therapy
SrinivasMondam et al., 2012 [9]	50	WOMAC, VAS	2 weeks	Isometric quadriceps exercises, proprioceptive exercise, ultrasound therapy
Zehua Chen et al., 2021 [35]	48	Static stability, proprioception, NRS, WOMAC	4 weeks	Conventional treatment comprising acupotomy, medications, and routine exercise

