



The Role Of The Otago Exercise Program In Managing Strength And Balance Deficits In Knee Osteoarthritis: A Narrative Review

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Abstract: Knee osteoarthritis (OA) is a prevalent degenerative joint condition among older adults, often resulting in reduced strength, impaired balance, and an increased risk of falls. The Otago Exercise Program (OEP), initially developed to prevent falls in community-dwelling older adults, has gained attention as a targeted intervention to improve lower-limb function in this population. This narrative review explores the application of the OEP in individuals with knee OA, focusing on its effectiveness in enhancing muscular strength, balance, and functional mobility. Evidence from randomized clinical trials and cohort studies suggests that OEP contributes to significant improvements in lower-extremity strength, static and dynamic balance, and overall quality of life. The review underscores the potential of OEP as an accessible, cost-effective physiotherapeutic strategy for managing functional impairments in older adults with knee osteoarthritis.

Index Terms - Otago Exercise Program, Knee Osteoarthritis, Strength, Balance, Fall Prevention, Older Adults, Physiotherapy

I. INTRODUCTION

Knee osteoarthritis (OA) is one of the most common causes of disability in the elderly, with its prevalence increasing with age due to progressive cartilage degradation and biomechanical changes. These degenerative alterations often lead to muscle atrophy, particularly in the quadriceps and surrounding stabilizing musculature, and are accompanied by impaired proprioception and balance, thus significantly increasing the risk of falls.^[1] Exercise-based interventions have become a cornerstone in managing OA-related symptoms, promoting joint health, and preserving functional autonomy. The Otago Exercise Program (OEP), developed at the University of Otago, New Zealand, is a structured, evidence-based home exercise regimen focusing on lower-limb strengthening, balance training, and walking routines.^[2] Originally intended for fall prevention in community-dwelling older adults, the program's principles align well with the functional deficits experienced by those with knee OA. This review aims to critically examine the clinical utility of the OEP in improving muscular strength, balance, and overall functional capacity in older adults with knee OA.

2. THEORETICAL BACKGROUND AND MECHANISM

The Otago Exercise Program is grounded in the principle that neuromuscular conditioning can substantially reduce fall risk and improve motor function in older adults. The physiological basis of OEP involves enhancing muscle fiber recruitment, improving joint proprioception, and stimulating neuroplasticity through repetitive movement patterns.^[3] It typically consists of five progressive strength exercises, including knee extension, hip flexion, and ankle dorsiflexion, performed using body weight or light resistance. These are complemented by balance-focused tasks, such as single-leg stands, heel-to-toe walking, and dynamic weight shifts.^[4] By progressively challenging the neuromuscular system, the program helps retrain the postural

control mechanisms that are often compromised in OA due to joint pain, instability, and disuse. Unlike generalized exercise programs, OEP's gradual progression, individual tailoring, and home-based delivery make it particularly feasible for older adults with joint limitations, allowing for better adherence and long-term maintenance.

3. OEP AND LOWER LIMB STRENGTH

Muscle weakness, especially in the quadriceps and hip abductors, is a prominent feature in knee OA and is directly linked to joint instability, pain, and reduced mobility. The OEP addresses these issues through specific strength-training exercises that are safe and accessible to older adults. A randomized controlled trial by Lee et al. demonstrated that a 12-week implementation of OEP led to significant increases in isometric quadriceps strength in older individuals with knee OA, as measured using a dynamometer ^[4]. The study reported improved weight-bearing capacity and stair-climbing performance, emphasizing the link between increased muscle strength and functional mobility. Similar outcomes were noted in earlier studies where consistent participation in OEP resulted in muscular hypertrophy and reduced perceived exertion during ambulation ^[5]. By strengthening the kinetic chain around the knee, OEP enhances joint support, reduces mechanical stress on the cartilage, and improves overall gait mechanics, which are critical for mitigating OA progression.

4. OEP AND BALANCE IMPROVEMENT

Balance impairment is another major contributor to functional disability and fall risk in individuals with knee OA. The Otago Exercise Program incorporates a variety of static and dynamic balance exercises designed to stimulate sensory integration from the visual, vestibular, and somatosensory systems. In a controlled trial by Suh et al., older adults with knee OA who completed an 8-week OEP showed significant improvements in dynamic balance, as measured by the Timed Up and Go (TUG) test, and static balance, assessed using the Berg Balance Scale ^[6]. These improvements were attributed to better proprioceptive feedback and increased confidence in maintaining postural stability during movement. Additionally, the balance component of OEP trains anticipatory and reactive postural adjustments, essential for preventing falls during real-life perturbations. The consistent challenge to the balance system fosters motor learning and functional balance control, which are often diminished in OA due to joint discomfort and fear of movement. ^[7]

5. FUNCTIONAL OUTCOMES AND QUALITY OF LIFE

Functional limitations in knee OA extend beyond physical impairments, often affecting psychological health, social participation, and overall quality of life. Incorporating the OEP into OA management not only leads to physiological gains but also supports emotional well-being and self-efficacy. In a study by Ribeiro et al., older adults who engaged in the OEP for six months experienced substantial improvements in their Western Ontario and McMaster Universities Arthritis Index (WOMAC) scores, indicating better pain management, increased physical function, and enhanced daily living activities ^[8]. Participants also reported higher levels of confidence, reduced fear of falling, and a more active lifestyle. The home-based nature of the OEP further encourages autonomy, enabling participants to integrate the program into their daily routines without needing frequent clinical supervision. These psychosocial benefits are crucial in addressing the multifactorial nature of disability in knee OA and contribute to long-term treatment adherence.

6. CLINICAL INTEGRATION AND IMPLICATIONS

From a clinical standpoint, the Otago Exercise Program offers a low-cost, scalable solution for managing functional impairments associated with knee OA. It is especially advantageous in resource-limited settings, as it requires minimal equipment and can be administered by trained physiotherapists or through self-directed instruction. Clinicians should begin by evaluating the patient's baseline strength, range of motion, balance capability, and fall history to tailor the program accordingly. Progressions should be gradual to accommodate joint sensitivity and prevent overexertion. The adaptability of the OEP allows it to be integrated with other treatment modalities, such as manual therapy, education, or pharmacological management, creating a holistic rehabilitation approach. Furthermore, the emphasis on progressive overload and periodic reassessment ensures that patients continue to benefit from the intervention over time.

7. CONCLUSION

The Otago Exercise Program presents a low-cost, evidence-based intervention for addressing key impairments in older adults with knee osteoarthritis. Its structured approach to lower-limb strengthening and balance training aligns with the therapeutic needs of this population and has demonstrated consistent improvements in strength, balance, and functional mobility. While short-term outcomes are promising, further longitudinal

studies are required to establish the sustainability of these effects and optimize delivery models for diverse clinical settings.

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