

Optimizing Knee Osteoarthritis Treatment: Strengthening VMO and Gluteal Muscle with Dry Needling

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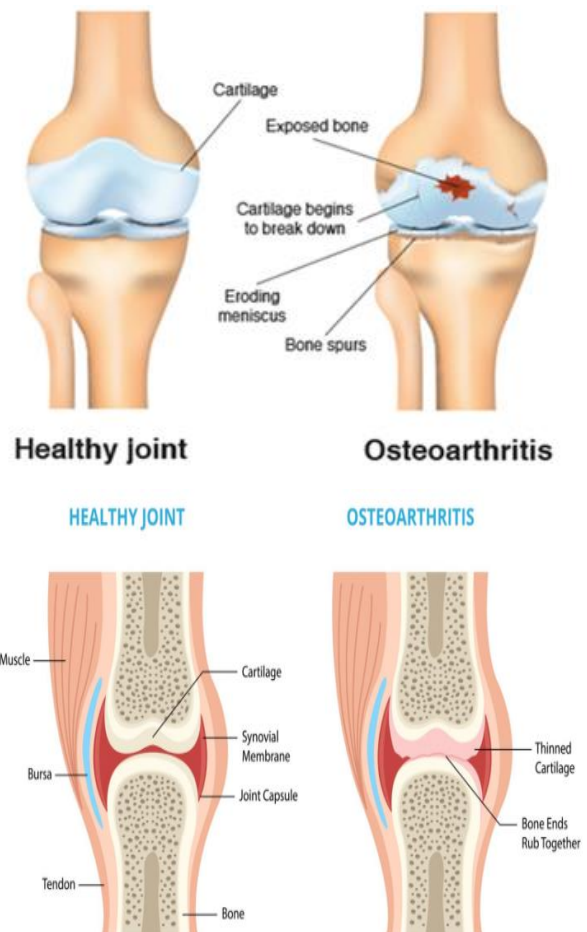
Abstract: Knee osteoarthritis (OA) is the most common and prevalent orthopedic condition progressing due to cartilage degradation, leading to pain, inflammation, and functional impairment, particularly in individuals over 50 years of age. Osteoarthritis is exacerbated by muscle loss, decreased bone density, and altered joint mechanics caused by aging. Muscle weakness around the knee joint, especially in the quadriceps and hamstrings, leads to increased joint stress and abnormal gait patterns, further accelerating cartilage breakdown. Key muscle groups such as the vastus medialis obliques (VMO) and gluteal muscles play a crucial role in stabilizing the knee and influencing joint function. Weakness in these muscles can result in improper patellar tracking and increased knee stress causing pain. While strengthening exercises can alleviate symptoms and improve knee stability one should be aware that over doing some exercises especially leading to end range knee flexion can increase pain. Effective rehabilitation protocol includes strength training of the VMO and gluteal muscles, combined with neuromuscular reeducation to enhance coordination and address muscle imbalances with functional strengthening. A comprehensive approach that includes these strategies can significantly ease the effects of knee OA, improve joint function, and enhance overall quality of life. Including dry needling before or after these treatments help improve muscle length tension, lead to muscle relaxation and reduce pain. Future research should investigate the impact of these interventions across different age groups to optimize treatment protocols for knee OA with dry needling treatments before exercise therapy.

Keywords: knee osteoarthritis, muscle weakness, knee joint stability, rehabilitation exercises, pain management

1. Introduction

Knee osteoarthritis is the most common orthopedic condition leading to the breakdown of cartilage, which provides smooth mobility between the joints during movement. This leads to bone - on - bone exposure, resulting in pain, swelling, bony changes, cartilage breakdown, and inflammation around the synovial membrane, which produces synovial fluid (Felson & Zhang, 1998). Osteoarthritis is extremely common in various age groups, with higher prevalence in those aged 50 years or more (Hunter & Bierma - Zeinstra, 2019). After the age of 30, humans start showing signs of muscle loss unless active efforts are made to maintain muscle volume. This muscle loss usually accelerates after the age of 50 due to a reduction in testosterone and muscle synthesis in the body. This is exacerbated by a lack of activity and a sedentary lifestyle. Loss of muscle mass leads to increased pressure on the joints and increased wear and tear between the cartilage as muscles can no longer support the joints as efficiently as before (Delmonico et al., 2009).

Decreased bone density also contributes to the development of knee valgus and varum, which can increase wear and tear medially in the case of valgus and laterally in the case of varum. These changes are exacerbated by a lack of muscle strength in the hip and tightness in the hip muscles, which can lead to hip external rotation in the case of varum and internal rotation with tightness around the groin region. Muscle lengthening around the hips can lead to weakness (Chughtai et al., 2016)



Impact on Knee Osteoarthritis

Muscles around the knee joint, especially the quadriceps and hamstrings, provide support and improve function by

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providing stability. Weaker muscles lead to a transfer of increased pressure onto the joints directly. This weakness also causes muscle imbalance and compensatory movements (Felson & Zhang, 1998).

Changes in joint mechanics lead to altered gait patterns, which in turn put more pressure on the knee joint. When all these changes set in, and cartilage around the knee joint is reduced or worn out, nerve endings around the joints are exposed. This results in increased inflammation, swelling, and sometimes exposure of nerve endings, leading to increased pain and nociceptive sensations (Hunter & Bierma - Zeinstra, 2019).

Functions of the Primary Muscles Around the Knee Joint

The major muscles around the knee joint are the gastrocnemius, soleus, vastus medialis obliquus (VMO), other quadriceps muscles, IT band, adductor magnus, gracilis, hamstrings, and pectineus. Hip muscles like the piriformis, hip flexors, iliopsoas, and gluteus muscles, especially the gluteus medius, play a significant role in knee functioning and its biomechanics (Delmonico et al., 2009).

All these muscles provide stability to the knee and have a role in patellar and knee joint positioning, which can influence the wear and tear of this joint. For example, tightness in the vastus lateralis and IT band can lead to lateral tracking of the kneecap (patella) and result in knee pain and lateral tibiofemoral joint and patellofemoral joint wear and tear/osteoarthritis (Ashwini Chougala et al., 2015).

Stronger hip muscles reduce pressure on the medial aspect of the knee joint. This occurs because they prevent hip adductors from causing hip internal rotation and increasing the 'Q' angle. Wider hips, especially in women, are responsible for medial knee joint pain related to osteoarthritis. This can also be misdiagnosed as IT band friction syndrome or pes anserine syndrome (Chughtai et al., 2016).

Strength Training of VMO and Gluteal Muscles

The VMO is a part of the quadriceps muscle group and is primarily responsible for patellar tracking. VMO weakness is usually associated with tightness of the IT band and vastus lateralis, leading to pain and functional impairments (Felson & Zhang, 1998).

Weakness and dysfunction causing delayed VMO activation can lead to an imbalance in knee stress, causing increased breakdown of cartilage, subchondral bony changes, and inflammation (Hunter & Bierma - Zeinstra, 2019).

Strengthening the VMO plays a critical role in the rehabilitation of knee pain related not only to osteoarthritis but also to other knee - related conditions to reduce knee stressors. Simple exercises can include short arc quadriceps strengthening, TKEs (total knee extensions), long arc quadriceps strengthening, straight leg raises, and long sitting straight leg raises. Adding a dorsiflexion component to these exercises can improve VMO activation even more (Delmonico et al., 2009).

To augment this effect, rehabilitation can also include IT band and TFL stretching, myofascial release for the IT band and

vastus lateralis. In active patients, self - rolling with a foam roller can also reduce lateral patellar tracking (Chughtai et al., 2016).

Gluteal muscle weakness leads to muscle imbalance, causing hip adduction and internal rotation. Overstretched gluteal muscles lose their ability to contract optimally and support the lower extremity, leading to increased pressure on the knee joint. This can also lead to an increase in hamstring tightness due to increased knee and hip flexion, causing knees to be positioned in a slightly flexed position compared to the normal positioning of the human body. These chains of events change the pressure - bearing points in the knee joint and cause an increase in arthritic changes in the knee joint. Before strengthening these gluteal muscles, it is important to assess their tightness and weakness compared to the other side to train the muscle to regain its optimal muscle tension (Ashwini Chougala et al., 2015).

Gluteal exercises can include simple knee fallouts in the supine position, clamshell exercises in the side - lying position, squats up to 90 degrees of knee flexion, bridging, monster walks, and squat holds. Including hip stability exercises helps with reducing hip and pelvic alignment issues, which can potentially affect knee function (Hunter & Bierma - Zeinstra, 2019).

Neuromuscular Reeducation

Once adequate basic strength training is performed, the focus should be on improving coordination between the gluteal muscles and VMO for enhanced functional activities. A combination of strength and balance exercises, such as single leg standing and the use of a Bosu ball for improved stability, should be encouraged (Delmonico et al., 2009).

Addressing the Kinetic Chain with VMO and Gluteal Muscles

Addressing the entire chain of muscles is important during knee rehabilitation. Weakness in the core can lead to reduced hip engagement and increased tightness and weakness. Increased calf tightness can lead to changes in knee alignment, resulting in altered weight - bearing patterns (Chughtai et al., 2016).

Role of dry needling

Trigger point dry needling uses stainless steel thin needling to be introduced in pain or a trigger point leading to relaxation of the targeted muscle along with activation of the muscle with a better ability to contract due to optimal length tension. Dry needling can be used to relax or simulate the gluteal minimums, Medius and maximus. This also helps to improve hip alignment and sometimes also reduces referred pain from the gluteal muscles down to the knee joint. Performing dry needling for the VMO can help activate the VMO and reduce its dysfunction. Using it in conjunction with VMO and vastus lateralis or IT band can reduce IT band tightness with activation for VMO for improving patellar tracking and mechanics of the knee more favorable for further strengthening.

2. Conclusion

Knee osteoarthritis is a dense and complex condition with major influence by both muscular strength, muscle imbalance, and joint mechanics, either directly or indirectly. The progressive wear and tear of cartilage, exacerbated by muscle weakness, sedentary lifestyle, and age - related muscle loss, leads to increased joint stress, altered gait patterns, and ultimately causing increased inflammation leading to increased pain and functional impairment. Strengthening key muscle groups, particularly the VMO and gluteal muscles, plays a vital role in alleviating the symptoms of knee osteoarthritis by improving joint stability, correcting imbalances, and reducing the load on affected joints. Additionally, a comprehensive rehabilitation approach that includes neuromuscular reeducation and addressing the entire kinetic chain is essential for optimizing knee function and delaying the progression of osteoarthritis. By focusing on being both preventive and proactive and using individualized rehabilitative strategies, individuals can maintain better joint health and improve their quality of life despite the challenges posed by knee osteoarthritis. Introducing dry needling helps improve rehabilitation but exercise therapy should be included after the needling and patients should be well educated that only pain relief from trigger point dry needling will not last for longer duration. Future studies could explore comparisons between different age groups performing exercises to improve VMO and gluteal strength, evaluated by assessing the development of osteoarthritis.

References

- [1] Felson, D. T., & Zhang, Y. (1998). An update on the epidemiology of knee and hip osteoarthritis with a view to prevention. *Arthritis & Rheumatism: Official Journal of the American College of Rheumatology*, 41 (8), 1343 - 1355. DOI: 10.1002/1529 - 0131 (199808) 41: 8<1343:: AID - ART3>3.0. CO; 2 - 9
- [2] Hunter, D. J., & Bierma - Zeinstra, S. (2019). Osteoarthritis. *The Lancet*, 393 (10182), 1745 - 1759. DOI: 10.1016/S0140 - 6736 (19) 30417 - 9
- [3] Delmonico, M. J., Harris, T. B., Visser, M., Park, S. W., Conroy, M. B., Velasquez - Mieser, P., . . . & Goodpaster, B. H. (2009). Longitudinal study of muscle strength, quality, and adipose tissue infiltration. *American Journal of Clinical Nutrition*, 90 (6), 1579 - 1585. DOI: 10.3945/ajcn.2009.28308
- [4] Chughtai, M., Khlopas, A., Goddard, M. S., & Khasanov, N. (2016). The role of gluteal muscles in knee osteoarthritis: A review of the literature. *Journal of Orthopaedic Surgery and Research*, 11, 33. DOI: 10.1186/s13018 - 016 - 0381 - 4
- [5] Ashwini Chougala, Vidit Phanse, Erohit Khanna, & Sudipta Panda. (2015). Screening of body mass index and functional flatfoot in adult: An observational study. *International Journal of Physiotherapy and Research*, 3 (3), 1037 - 1041. DOI: 10.16965/ijpr.2015.133