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CONSERVATIVE MANAGEMENT OF KNEE OSTEOARTHRITIS: A SYSTEMATIC REVIEW OF CONTEMPORARY APPROACHES

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ABSTRACT

Introduction: Conservative treatment of knee osteoarthritis includes all non-surgical methods aimed at relieving symptoms and improving joint function. It involves pharmacotherapy, including nonsteroidal anti-inflammatory drugs (NSAIDs) and analgesics, as well as intra-articular injections such as corticosteroids, hyaluronic acid, or platelet-rich plasma. An important component of therapy is strengthening exercises for the thigh muscles, physical therapy, and the use of braces and insoles to offload the joint. Additionally, lifestyle modifications, including regular physical activity, help control symptoms and slow disease progression.

Aim of the study: The aim of our study is to review the available literature on contemporary conservative treatment methods for gonarthrosis and to summarize current knowledge. We presented the mechanisms of action, clinical efficacy, and safety profile of various non-surgical interventions, including intra-articular injections, physical therapy, and exercise-based approaches.

Methods and materials: We reviewed the literature available in the PubMed database using the following keywords: “Gonarthrosis”; “Knee osteoarthritis”; “Non-surgical treatment of knee osteoarthritis”; “Exercise therapy”; “NSAIDs”; “Duloxetine”; “Opioids”; “Platelet-rich plasma”; “Corticosteroid”; “Hyaluronic acid”; “Intra-articular injection”.

Conclusion: Comprehensive treatment of knee osteoarthritis is based on non-pharmacological methods, which form the foundation of therapy and demonstrate effectiveness comparable to pharmacological treatment, with a more favorable safety profile. Pharmacotherapy, including NSAIDs, can effectively alleviate symptoms, but its use is limited by the risk of adverse effects, particularly in elderly patients. Intra-articular injections, especially with hyaluronic acid and platelet-rich plasma (PRP), represent an important adjunct to symptomatic treatment, with PRP showing longer-lasting effects. Individualizing therapy is crucial for optimal treatment outcomes.

KEYWORDS

Non-Surgical Treatment of Knee Osteoarthritis, Gonarthrosis, Intra-Articular Injection, Gonarthrosis Conservative Treatment

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1. Introduction

Knee osteoarthritis (KOA) is a condition characterized by the mechanical degeneration of articular cartilage, but it is also associated with concurrent structural and functional changes throughout the joint, including the synovial membrane, meniscus, periarticular ligaments, and subchondral bone. KOA is one of the most common degenerative diseases leading to disability in older adults (Kan et al., 2019). With increasing life expectancy worldwide, the burden of chronic diseases on society is growing. This trend also affects individuals suffering from one of the leading causes of chronic pain and disability globally: osteoarthritis (Dantas, Salvini, & McAlindon, 2021). Typical symptoms include muscle weakness, joint instability, brief morning stiffness, and joint crepitus (Hunter & Bierma-Zeinstra, 2019). These complaints often lead to reduced physical activity, which is associated with increased morbidity and mortality (Hoffmann et al., 2016). It is estimated that up to 25% of people over 50 years of age have KOA, and in many cases, disease progression necessitates surgical treatment in the form of knee arthroplasty. Current clinical guidelines recommend surgery only after conservative management and pharmacological symptom control options have been exhausted (Goff & Elkins, 2021). Management plans for osteoarthritis may include patient education, behavioral, psychosocial, and physical interventions, as well as local, oral, and intra-articular treatments. Therapy is individualized for each patient, as some may achieve symptom control with a single physical, psychosocial, or pharmacological intervention, while others may require multiple interventions, either sequentially or in combination (Kolasinski et al., 2020). The goals of treatment are to alleviate pain, slow disease progression, and improve quality of life, mobility, and gait (Michael, Schlüter-Brust, & Eysel, 2010).

2. Description of the State of Knowledge

Non-Pharmacological Treatment Approaches

Physical exercise

Physical exercise aims to reduce pain and improve overall joint mobility and function, with more intensive exercises capable of strengthening the muscles surrounding the knee joint (Kan et al., 2019). Seven studies involving 1,355 participants evaluated the impact of physical exercise on pain symptoms. The results showed that the exercise groups experienced less pain than the control groups; however, the quality of evidence according to the GRADE scale was rated as low due to a very serious risk of bias (Sasaki et al., 2022). In a randomized trial including 54 participants (aged 60–85 years, 61% women), both the group performing eccentric resistance training (ECC RT) and the group performing concentric resistance training (CNC RT) showed a 16–28% improvement compared to the control group (CON) in all lower limb muscle strength measurements, which contributed to reduced pain scores on the WOMAC scale (Vincent, Vasilopoulos, Montero, & Vincent, 2019). Physical exercise is currently recommended by all clinical practice guidelines for knee osteoarthritis. A 2024 review of 139 studies (12,468 participants) indicated that exercise can lead to modest improvements in pain immediately after intervention. Unfortunately, most studies were characterized by a high risk of performance bias (94%), detection bias (94%), selective reporting (68%), selection bias (57%), and attrition bias (48%) (Lawford et al., 2024). Exercises targeting the quadriceps using a leg extension bench have been shown to increase muscle mass. Consequently, regular practice of these exercises improves joint stability and reduces subchondral inflammation in the joint capsule, resulting in pain relief (Mintarjo, Poerwanto, & Tedyanto, 2023).

Yoga

To compare the effectiveness of yoga with conventional exercise, a randomized clinical trial was conducted involving 117 participants. The results showed that both activities reduced knee pain over a 12-week period, with no statistically significant differences between the groups. The main conclusion of this study was that yoga represents a non-inferior alternative to exercise in supporting the management of knee osteoarthritis (Abafita et al., 2025). A subsequent pooled analysis summarized the effectiveness of yoga based on nine studies involving 640 participants with knee osteoarthritis. The results of this meta-analysis indicate that yoga may be effective in improving pain, function, and stiffness in patients; however, due to the low methodological quality of the studies, it can only be considered as a weak recommendation (Lauche, Hunter, Adams, & Cramer, 2019).

Tai Chi

Tai Chi is considered beneficial; however, access to this method is limited. A 12-week, unsupervised, online Tai Chi program was conducted involving 178 adult patients with clinically diagnosed osteoarthritis (OA). The randomized clinical trial was supported by a mobile application designed to encourage participants to practice regularly. The results showed better outcomes in terms of knee pain reduction and overall functioning compared to the control group (Zhu et al., 2026).

Pharmacological Treatment Methods

Nonsteroidal Anti-Inflammatory Drugs (NSAIDs)

These drugs are classified according to their ability to inhibit cyclooxygenase (COX) isoenzymes into selective and non-selective NSAIDs. They are used to relieve pain and reduce fever due to their anti-inflammatory effects (Cooper et al., 2017). Due to their effective action, oral and topical NSAIDs are strongly recommended as first-line treatment for osteoarthritis (OA). However, they should be used with caution because of an increased risk of adverse effects in patients with chronic comorbidities (elevated cardiovascular risk) (Richard, Driban, & McAlindon, 2023). A meta-analysis of 192 studies including 102,829 participants evaluated the efficacy of NSAIDs, paracetamol, and opioids according to drug dosage. The results of this systematic review showed that etoricoxib at a dose of 60 mg/day and diclofenac at a dose of 150 mg/day appear to be the most effective oral NSAIDs in relieving pain and improving function in patients with osteoarthritis. Meanwhile, topical diclofenac at a dose of 70–81 mg/day, due to limited systemic absorption and thus a lower risk of systemic adverse effects, appears to be effective and safer than oral medications, and should therefore be considered as a first-line treatment (da Costa et al., 2021). The efficacy and safety of various NSAIDs were compared in a study compiling data from 31 trials, including a total of 68,539 patients. Compared to other NSAIDs, etoricoxib, tiaprofenic acid, naproxen, and diclofenac showed greater effectiveness in improving clinical OA symptoms. Ketoprofen was associated with a lower risk of gastrointestinal and cardiovascular adverse events (JiaoYi et al., 2025). The analgesic effects of physical exercise, NSAIDs, and paracetamol in patients with OA were compared. Data were obtained from randomized controlled trials published in PubMed, Embase, Scopus, Cochrane Library, and Web of Science up to 2022, including a total of 17,431 patients. The results showed that physical exercise has a similar effect on pain and functional improvement as oral NSAIDs and paracetamol. This highlights the importance of emphasizing physical exercise in patient care due to its excellent safety profile. It may be particularly useful for older adults with comorbidities, who are at higher risk of adverse effects associated with NSAIDs and paracetamol (Weng et al., 2023). In knee osteoarthritis, guidelines regarding first-line analgesics remain controversial. Randomized controlled trials including a total of 47,113 patients showed that oral NSAIDs are most effective in improving function, and topical NSAIDs are more effective than paracetamol. Moreover, clinical studies indicate that topical NSAIDs have a better safety profile (Zeng et al., 2021). A meta-analysis of 12 randomized controlled trials compared the efficacy of different topical diclofenac formulations. The study concluded that all topical forms of diclofenac (solution, gel, patch) improved pain intensity and function in OA patients compared to control, without a significant increase in the frequency of adverse effects (Chen, Chen, Li, & Feng, 2025).

Duloxetine

Antidepressants generally improve pain and physical function to a small extent, which may not be noticeable in everyday life. In some patients, however, the improvement may be greater—a reduction in symptoms by half or more (Leaney et al., 2022). Duloxetine may be effective in patients with OA in the treatment of pain as well as depressive symptoms (Zhou et al., 2022). Before initiating treatment, patient preferences, costs, and the clinical assessment of the case should be taken into account, due to the significantly higher risk of adverse effects associated with the use of the drug (Osani & Bannuru, 2019). Randomized controlled trials have shown that although duloxetine reduces pain and improves patient functioning within 24 hours, it does not lead to a significant improvement in the WOMAC pain subscale or quality of life compared with placebo (Chen et al., 2021).

Opioids

Initiation of opioid therapy is not recommended in patients with OA. A randomized controlled trial including 240 patients demonstrated that opioids did not provide better improvement in pain-related function compared with non-opioid medications over a 12-month period following treatment initiation (Krebs et al., 2018). Tramadol is commonly prescribed in patients with OA due to a lower incidence of adverse effects (e.g., gastrointestinal bleeding or renal complications) compared with NSAIDs. A meta-analysis including 3,871 participants randomized to receive tramadol alone or in combination with another analgesic, and 2,625 patients

in the placebo group, showed no significant benefits in reducing moderate pain or improving physical function in individuals with OA. Moreover, a substantially higher proportion of patients discontinued tramadol due to adverse effects (Toupin April et al., 2019). Despite these findings, nearly 9% of patients diagnosed with knee osteoarthritis use opioids on a chronic basis (Losina, Song, Bensen, & Katz, 2023). In a randomized, double-blind, placebo-controlled trial, the effects of different doses of extended-release tramadol on pain management in patients with OA were compared. The results showed that tramadol ER at a dose of 300 mg significantly improved joint stiffness in the WOMAC subscale and reduced pain intensity in affected joints. However, the effectiveness of lower doses of tramadol did not differ significantly from placebo. Adverse effects were also more frequently observed in the tramadol ER group compared with placebo (DeLemos et al., 2011).

Intra-Articular Injection Therapy

Platelet-rich plasma (PRP)

A pathological feature of OA is fibrosis and thickening of the synovial membrane of the knee joint, which contributes to stiffness and pain. Tissue repair may be supported by growth factors and cytokines contained in PRP, which exert anti-inflammatory, proliferative, chemotactic, and anti-apoptotic effects. Despite the potential to exacerbate synovial fibrosis, PRP demonstrates an inhibitory effect on cartilage degeneration and abnormal remodeling of subchondral bone (Zhang et al., 2025). The use of platelet-rich plasma injections containing growth factors is becoming increasingly common in the treatment of patients with OA; however, it is not yet considered a standard procedure due to insufficient evidence confirming its effectiveness (Katz, Arant, & Loeser, 2021). A meta-analysis of 18 randomized controlled trials showed pain relief at 3 and 6 months compared with placebo. Notably, PRP injections led to a clinically significant improvement in joint function observed at 1, 3, 6, and 12 months. It was also found that higher platelet concentrations in the preparation resulted in better therapeutic outcomes (Bensa et al., 2025). A meta-analysis including 1,403 knees in the PRP group and 1,426 knees in control groups demonstrated that intra-articular PRP injections produced better outcomes than other treatments. Effectiveness measured by the WOMAC score at 12 months was greater compared with placebo, and compared with corticosteroids, PRP showed greater improvements in pain assessed by the VAS, KOOS scores, and quality of life after 6 months of treatment. Despite the significant clinical improvement observed, the benefits remain partial and are supported by low-quality evidence (Filardo et al., 2021). An evaluation of optimal PRP treatment in terms of concentration, injection frequency, and early initiation was presented in a meta-analysis of 28 randomized controlled trials. PRP injections provided pain reduction comparable to hyaluronic acid, with superior functional improvement, particularly in combination therapy. PRP also outperformed corticosteroids (in combination treatment), as well as physiotherapy and exercise. The best outcomes were achieved with early use in patients with mild osteoarthritis (Kellgren–Lawrence grade I–II), platelet concentrations of $600\text{--}900 \times 10^9/\text{L}$, and 3–5 injections administered at 7–14-day intervals (Wang & Yao, 2025). A growing body of research suggests that PRP is more effective and provides longer-lasting effects compared with hyaluronic acid. Results from double-blind randomized trials indicate that PRP also outperforms other biological treatment modalities, supporting a reassessment of intra-articular treatment algorithms and positioning PRP as a preferred therapeutic option (Suarez-Ahedo, 2025). A meta-analysis of 18 randomized controlled trials confirmed a dose–response relationship between platelet concentration and improvements in pain reduction and joint function for preparations containing more than 10 billion platelets per single injection at 6 and 12 months of follow-up. This finding suggests the need for individualized treatment protocols rather than a one-size-fits-all approach. Additionally, PRP demonstrated longer-lasting therapeutic effects in reducing OA-related symptoms compared with corticosteroid injections (Corrêa de Araújo Moury Fernandes, Godoi, & Rodeo, 2026). Finally, a meta-analysis of 15 randomized, double-blind controlled trials including a total of 1,632 patients with Kellgren–Lawrence grade I–III OA showed that after 12 months, PRP was associated with lower WOMAC pain scores and lower total WOMAC scores, indicating superior effectiveness of PRP therapy in the treatment of knee osteoarthritis (Li et al., 2025).

Corticosteroids

Studies have shown that corticosteroids can be used during disease flares and provide short-term pain relief, which is why they have long been a cornerstone of treatment for patients with OA (Yaftali & Weber, 2019). Their effect is due to reducing cartilage damage associated with inflammation of the knee joint synovium; however, they may have adverse effects on the periarticular bone as well as the cartilage itself (McAlindon et al., 2017). Currently, several corticosteroids are approved by the U.S. Food and Drug Administration (FDA) for intra-articular use, with methylprednisolone acetate and triamcinolone acetonide

being the most commonly administered. Injections should be performed at intervals of at least 3 months, with an average dose of 40 mg of corticosteroid (Mintarjo, Poerwanto, & Tedyanto, 2023). Intra-articular corticosteroid injections (IACs) provide short-term pain relief and improvement in joint function and serve as an anti-inflammatory therapy for patients. Unfortunately, identifying patients suitable for this therapy is challenging because the inflammatory process is transient and does not occur at every stage of the disease. Nevertheless, in such patients, corticosteroid use may not only alleviate symptoms but potentially slow disease progression by preventing structural changes (Heidari, Heidari, & Babaei, 2020). In a study including a total of 684 participants, intra-articular corticosteroids were associated with worsening structural changes according to the Kellgren–Lawrence scale in individuals initiating IACs, with even greater deterioration observed during long-term use. Additionally, the risk of joint space narrowing was higher in these groups (Zeng et al., 2019). A comparison of the effects of 40 mg triamcinolone and 40 mg methylprednisolone was conducted in a randomized, double-blind, 24-week trial including 100 patients. Improvement in joint function and pain symptoms was similar between the two groups, as assessed by the Lequesne index, which evaluates the severity of knee osteoarthritis based on maximum walking distance, daily activities, and pain (Beggs, Stigleman, Vaughan, Pacious, & Hulkower, 2020). Safety concerns regarding corticosteroid use relate to their adverse effects on cartilage volume (Wernecke, Braun, & Dragoo, 2015). The occurrence of adverse effects during long-term therapy is associated with oxidative stress, altered gene expression in chondrocytes, and chondrotoxicity, which can accelerate the progression of osteoarthritis (Cai et al., 2022).

Hyaluronic acid (HA)

Hyaluronic acid (HA) in the knee joint is responsible for viscoelastic properties and is produced by chondrocytes, fibroblasts, and synoviocytes. Its concentration is reduced in osteoarthritic joints, which is why HA injections can relieve pain by decreasing the need for analgesics and improve knee joint function (Tang et al., 2020). Commercial HA preparations differ in molecular weight, structure, and source. Preparations with high molecular weight HA have been shown to be more effective than those with low molecular weight. Attention has been drawn to a higher incidence of inflammatory reactions with avian-derived and cross-linked products (Ferkel et al., 2023). A prospective, multicenter, longitudinal observational study including 254 knees demonstrated that HA provides clinical stabilization of patients over long-term follow-up. Although the therapy improves joint function and reduces pain, it does not prevent radiographic progression of degenerative changes. HA treatment is not associated with an increased rate of knee arthroplasty or a higher risk of lateral joint space narrowing (Bensa, Bianco Prevot, Peretti, & Filardo, 2025). Intra-articular HA administration shows moderate effectiveness in improving patient-reported pain, but combination therapies yield better clinical outcomes and may offer chondroprotective effects (Glinkowski & Tomaszewski, 2025). A meta-analysis of 11 randomized controlled trials found reductions in total WOMAC scores, Lequesne index scores, and visual analog scale (VAS) pain scores when PRP was combined with HA, making this therapy more effective than PRP monotherapy (Du & Liang, 2025). In a randomized clinical trial including 90 patients with knee osteoarthritis, the effects of HA and PRP were compared. Participants were divided into two groups and assessed using the McMaster (WOMAC) scale. Three months after the last injection, the PRP group showed significantly lower mean values for knee pain, physical function, stiffness, and total score compared with the HA group (Ghorbani, Mahdibarzi, & Yousefi-Tooddeski, 2024). Currently, HA has the strongest scientific evidence among intra-articular therapies, surpassing platelet-rich plasma (PRP) and corticosteroids (CS). Stem cell therapies are rapidly developing, and the number of studies in this area continues to grow. Guidelines from scientific societies in the field of orthobiologics require updating to align with the emerging evidence on the treatment of knee osteoarthritis (Bensa et al., 2025).

3. Conclusions:

Knee osteoarthritis leads to pain, functional limitation, and disability, and its treatment should be individually tailored to the patient. Physical exercise, yoga, and Tai Chi have been shown to reduce pain and improve joint function with minimal risk of adverse effects, making them the cornerstone of non-pharmacological management. Among pharmacological approaches, topical and oral NSAIDs remain effective in alleviating symptoms, whereas opioids and paracetamol offer limited clinical benefit. Intra-articular injections, particularly platelet-rich plasma (PRP) and hyaluronic acid, can provide additional functional improvement and pain relief, with PRP demonstrating longer-lasting and more clinically meaningful effects, especially when administered at appropriate concentrations and dosages.

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- Data analysis and interpretation: PK, PG
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- Critical review of the article: PG
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