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GONARTHROSIS TODAY

***Stanislav Palija*[1,2], *Vesna Vujić-Aleksić*[1,2], *Dragana Dragičević Cvjetković*[1,2], *Tatjana Nožica-Radulović*[1,2], *Goran Talić*[1,2]**

[1]Institute for Physical Medicine, Rehabilitation and Orthopedic Ssurgery „Dr Miroslav Zotović“, Slatinska 11, Banja Luka, Bosnia and Herzegovina;
[2]Medical Faculty, University of Banja Luka, Save Mrkalja 14, Banja Luka, Bosnia i Herzegovina

Abstract. *Gonarthrosis, a related osteoarthritis of the knee, is one of the most common causes of chronic pain, joint deformities and functional limitations in the elderly and aging population. The modern understanding of gonarthrosis goes beyond the traditional concept of "worn cartilage" and views it as a disease of the entire joint, including the cartilage, subchondral bone, synovium, menisci, ligaments, muscles, and biomechanics of the lower extremity. The diagnosis is based primarily on the clinical presentation: pain during weight-bearing, stiffness, crepitus, reduced range of motion, swelling, and progressive loss of function. Radiological assessment plays an important role in evaluating disease severity and planning treatment; however, the extent of radiological changes does not always correlate with symptom intensity. Therefore, in the modern approach, it is essential to treat the patient, not merely the radiological finding. The treatment of gonarthrosis must be individualized, multidisciplinary, and focused on pain reduction, preservation of mobility, improvement of stability, functional capacity, and quality of life. The foundation of conservative treatment consists of patient education, therapeutic exercises, muscle strengthening, biomechanical correction, adapted physical activity, weight reduction in overweight patients, and the use of assistive devices when indicated. Pharmacological therapy, including topical and oral nonsteroidal anti-inflammatory drugs, should be rational, time-limited, and adjusted to the patient's comorbidities. Intra-articular injections, particularly corticosteroids, may have a role in painful, activated knees, although their effect is generally short-term. The use of hyaluronic acid, platelet-rich plasma, and other biological therapies requires careful patient selection and realistic presentation of expected outcomes. Arthroscopic lavage and debridement have no place in the routine treatment of primary degenerative gonarthrosis. In patients whose pain, deformity, and functional limitation significantly impair daily life, and in whom conservative measures are ineffective, assessment for surgical treatment is indicated. Available treatment methods include biological surgical procedures aimed at correcting deformity and redistributing mechanical forces, most commonly high tibial osteotomy, as well as partial and total arthroplasty. These procedures represent an effective therapeutic option in properly selected patients, provided that expectations are realistic and that adequate preoperative preparation and postoperative rehabilitation are ensured.Gonarthrosis today requires a modern, personalized, and team-based approach. The goal of treatment is not only pain reduction, but also preservation of function, independence, and an active life for the patient.*

Keywords*: therapy exercises, body weight correction, intra-articular injections, knee arthroplasty.*

Introduction

Knee osteoarthritis (KOA) is one of the leading causes of chronic pain, functional impairment, and reduced quality of life in adult and older populations. Clinically, KOA is two to three times more common than hip osteoarthritis and accounts for more than 30% of adult orthopaedic outpatient consultations. The increasing public health burden of KOA is further underscored by demographic projections indicating that the population aged 65 years and older will double by 2050. Such trends are expected to place substantial pressure on healthcare systems, both in terms of workforce capacity and financial resources [1]. The economic impact of the disease is already considerable; in 2013, knee osteoarthritis was reported to be the second most costly condition treated in U.S. hospitals [2].

Traditionally, KOA was regarded primarily as a progressive degenerative disorder characterized by the gradual loss of articular cartilage. Contemporary understanding, however, has moved beyond the concept of simple cartilage "wear and tear." Osteoarthritis is now recognized as a complex whole-joint disorder involving not only articular cartilage but also subchondral bone, synovium, menisci, ligaments, periarticular muscles, and neuroinflammatory mechanisms involved in pain generation and modulation [3]. Its development and clinical expression are additionally influenced by age, obesity, previous joint injury, lower-limb malalignment, instability, metabolic factors, genetic predisposition, and the magnitude and pattern of mechanical loading.

This biological and clinical heterogeneity helps explain the frequently observed discordance between structural joint damage and symptom severity. Patients with almost identical radiographic stages of osteoarthritis may present with markedly different levels of pain, disability, and functional limitation and may consequently require substantially different treatment strategies. Accordingly, contemporary guidelines increasingly emphasize that therapeutic decision-making should be driven by symptoms, functional impairment, patient characteristics, and individual treatment goals rather than by the radiographic severity of disease alone.

Few areas of orthopaedic practice encompass such a broad spectrum of conservative, biological, interventional, and surgical treatment options. In addition to patient education, exercise therapy, weight management, and conventional pharmacological treatment, current management may include orthotic interventions, intra-articular injections, denervation procedures, orthobiological therapies, joint-preserving corrective surgery, and partial or total knee arthroplasty. As a result, the contemporary challenge in KOA management is no longer the lack of therapeutic options, but rather the identification of the most appropriate intervention for the appropriate patient at the appropriate stage of disease.

This complexity is further increased by the fact that recommendations issued by major professional organizations are not always fully consistent. Differences may arise from variations in methodology, the quality and timing of the evidence assessed,

definitions of clinically meaningful benefit, evaluation of benefit–risk balance, cost-effectiveness considerations, and the characteristics of the healthcare systems for which individual guidelines were developed. Consequently, clinical guidelines should be interpreted as evidence-based frameworks for decision-making rather than rigid therapeutic algorithms.

The aim of this review is to critically evaluate contemporary clinical guidelines and scientific evidence regarding the management of knee osteoarthritis and to propose a practical framework for their integration into everyday clinical decision-making. The specific objectives are to compare recommendations issued by leading international professional organizations, identify therapeutic modalities for which a high degree of consensus exists, examine areas of discrepancy between current guidelines and emerging scientific evidence, and discuss the role of individualized and multidisciplinary approaches in the selection and sequencing of non-operative and surgical treatment.

Materials and Methods

For the purposes of this narrative review, clinical practice guidelines issued by leading professional organizations, together with relevant systematic reviews, meta-analyses, and randomized controlled trials addressing the management of knee osteoarthritis, were analyzed. Particular emphasis was placed on the 2021 *American Academy of Orthopaedic Surgeons* (AAOS) Clinical Practice Guideline for the non-arthroplasty management of knee osteoarthritis, the 2022 guidelines issued by the *National Institute for Health and Care Excellence* (NICE), the recommendations of the *Osteoarthritis Research Society International* (OARSI) for non-surgical management, and the joint *American College of Rheumatology/American Association of Hip and Knee Surgeons* (ACR/AAHKS) guideline addressing the indications and timing of total joint arthroplasty. The most recent ACR guideline update, published in September 2026, was also included, as it represents an update of previous recommendations. At the time of preparation of this manuscript, a summary of the updated recommendations had been released, whereas the full guideline manuscript was still pending publication. In addition, the PubMed/MEDLINE database was searched with particular emphasis on systematic reviews, meta-analyses, and randomized controlled trials relevant to the treatment of knee osteoarthritis. Priority was given to more recent publications and studies providing higher levels of evidence.

Discussion

Clinical practice guidelines play a central role in evidence-based medicine by enabling systematic appraisal of the literature, reducing unwarranted variation in care, and helping clinicians avoid interventions for which the anticipated benefit is not proportionate to the associated risks and costs. However, different guidelines are not always fully concordant, do not necessarily address identical clinical questions, and may rely on different methodological frameworks. AAOS primarily addresses knee osteoarthritis from an orthopaedic perspective, OARSI places greater emphasis on

distinct clinical phenotypes and comorbidities, NICE evaluates both the clinical effectiveness and cost-effectiveness of interventions within the healthcare system, whereas ACR strongly emphasizes individualized, multimodal, and patient-centered management. The most recent ACR recommendations, published in 2026, explicitly state that treatment should begin with interventions associated with the lowest potential toxicity and should be tailored to the patient's symptoms, comorbidities, values, preferences, and treatment availability. These differences highlight a central challenge in contemporary clinical practice: how to integrate guideline recommendations with emerging scientific evidence, clinical expertise, and the individual characteristics of each patient?

Non-Pharmacological Treatment

The highest degree of agreement among contemporary clinical guidelines relates to core non-operative, non-pharmacological management. Patient education regarding appropriate strategies for activities of daily living, regular therapeutic exercise, and weight reduction in individuals who are overweight or obese represent the cornerstone of contemporary non-operative treatment. Even modest weight loss may provide clinically meaningful benefit in overweight patients, while greater reductions in body weight may result in more pronounced improvements in symptoms and physical function [4–7]. A large network meta-analysis published in 2025, including 217 randomized controlled trials and more than 15,000 participants, confirmed the beneficial effects of different forms of exercise on pain reduction and functional improvement in patients with knee osteoarthritis [8].

Pharmacological Treatment

Pharmacological treatment should primarily be regarded as a means of controlling symptoms and creating conditions that enable patients to remain physically active and functionally independent. Topical non-steroidal anti-inflammatory drugs (NSAIDs) represent the preferred first-line pharmacological option and are particularly suitable for localized pain and prolonged use because of their lower systemic risk compared with oral formulations [4,7]. Oral NSAIDs may also provide effective symptom relief; however, prolonged use should generally be avoided whenever possible. Treatment should be based on the lowest effective dose and individualized according to gastrointestinal, cardiovascular, and renal risk. Paracetamol has only a limited clinical effect in many patients with knee osteoarthritis [7]. Particular caution is required with opioid analgesics, including tramadol. Routine long-term use should be avoided because of the risks of dependence, tolerance, and other adverse effects [4]. Oral supplements such as glucosamine, chondroitin, methylsulfonylmethane (MSM), and collagen are not recommended by most professional organizations because the demonstrated clinical effects are absent or, at best, modest. Nevertheless, these products are generally considered safe and well tolerated.

Intra-Articular Injections

There is relatively broad consensus that intra-articular corticosteroid injections may have a role in the management of symptomatic knee osteoarthritis. Their use may be considered when other pharmacological options are ineffective or unsuitable, or when short-term pain reduction is required to facilitate participation in therapeutic exercise. Their clinical effect is predominantly short term, usually lasting no more than several weeks to approximately two months, and repeated long-term use is not recommended as a routine treatment strategy.

Hyaluronic acid (HA) represents a good example of the discrepancy between clinical practice, individual patient experience, and guideline-level recommendations. Although most contemporary guidelines do not recommend its routine use, high-molecular-weight HA may provide symptomatic benefit in selected patients with mild-to-moderate knee osteoarthritis [9].

The 2021 AAOS guidelines state that platelet-rich plasma (PRP) may reduce pain and improve function, although the strength of recommendation was classified as limited because of heterogeneity among PRP preparations and inconsistency of the available evidence [5]. In contrast, the ACR recommendations published in September 2026 recommend against the use of PRP in knee and hip osteoarthritis, although the certainty of evidence supporting this recommendation is low. At the same time, several recent meta-analyses of randomized controlled trials suggest that PRP may provide superior improvements in pain and function compared with corticosteroids and hyaluronic acid, particularly at follow-up intervals of six to twelve months. One network meta-analysis including 48 studies and 9,338 knees demonstrated significant clinical improvement following PRP treatment [10]. A major limitation is that PRP is not a standardized biological product. Preparations differ in platelet concentration, leukocyte content, injected volume, activation method, number of applications, and preparation technique. Furthermore, study populations vary considerably with respect to radiographic severity and clinical phenotype. Because of this methodological and biological heterogeneity, routine PRP administration cannot currently be recommended for every patient with knee osteoarthritis.

Even greater caution is required with products promoted as stem-cell therapies or methods of cartilage regeneration, including bone marrow aspirate concentrate (BMAC) and mesenchymal stromal/stem cells (MSCs). Although individual studies have suggested potential clinical benefit [11], these therapies remain controversial because of unresolved ethical and commercial issues related to cost, safety, efficacy, and aggressive marketing, as well as important technical challenges, including substantial heterogeneity in preparation techniques and the need for appropriate carrier or scaffold systems capable of maintaining a favorable biological microenvironment. Some authors have also questioned whether part of the clinical improvement observed following MSC treatment could be attributable to the vehicle used for cell delivery. MSCs are commonly resuspended in saline solution, and intra-articular saline itself may exert a clinically measurable effect; consequently, saline is

increasingly recognized as an imperfect inert placebo in osteoarthritis injection studies [12,13]. Current guidelines therefore do not recommend stem-cell therapies for routine clinical use and generally suggest that their application should remain restricted to appropriately designed and registered controlled clinical trials [5,6,14].

Emerging Drugs and Procedures

Because currently available pharmacological and intra-articular therapies generally provide inconsistent and predominantly short-term symptomatic relief, particularly with respect to pain, the development of disease-modifying osteoarthritis drugs (DMOADs) would represent a major therapeutic advance. The objective of DMOAD therapy is not merely to alleviate symptoms, but to slow, halt, or potentially reverse structural degeneration of the affected joint. Several compounds have demonstrated promising results in preclinical studies and have subsequently progressed to clinical trials; however, none has yet received regulatory approval for routine clinical use. Among the eleven DMOAD candidates evaluated in the review by Brandt et al., six demonstrated statistically significant evidence of structural and/or symptomatic benefit without major safety concerns: lorecivivint, TG-C, sprifermin, TPX-100, MIV-711, and LNA043. The remaining five compounds—SAR113945, GLPG1972, cindunistat, UBX0101, and lutikizumab—either failed to demonstrate meaningful benefit or were associated with adverse effects, resulting in an unfavorable benefit–risk profile [14].

Surgical Treatment

A frequent dilemma in clinical practice concerns the transition from non-operative to surgical treatment: when has conservative treatment ceased to provide sufficient benefit, and when should surgery be considered? One common mistake is to continue conservative treatment simply because the patient is considered “too young” for surgery or because every available non-operative option has not yet been exhausted. The opposite extreme is to recommend arthroplasty prematurely on the basis of radiographic findings alone, particularly without a comprehensive discussion with the patient regarding surgical risks, expectations, functional goals, and rehabilitation potential. Most contemporary guidelines recommend consideration of surgical treatment in patients with moderate-to-severe symptomatic and radiographic osteoarthritis in whom appropriately conducted non-operative treatment no longer provides satisfactory symptom control or functional improvement [4]. Available surgical options may broadly be divided into joint-preserving procedures, including selected arthroscopic procedures and osteotomies around the knee, and joint-replacing procedures, including partial and total knee arthroplasty.

Arthroscopy

Arthroscopic lavage and debridement should not be routinely performed for pain caused by primary knee osteoarthritis, primarily because these procedures are more invasive and costly without providing proven additional benefit compared with

appropriate non-operative management. Nevertheless, arthroscopy may still have a role in carefully selected patients with a clearly defined concomitant intra-articular pathology—such as certain meniscal tears, unstable osteochondral lesions, or focal cartilage defects—in the presence of only mild-to-moderate radiographic degenerative changes [5]. In such cases, the indication should be directed toward the specific treatable intra-articular lesion rather than toward osteoarthritis itself.

Osteotomies Around the Knee

Osteotomies are most appropriate in younger, physically active patients in whom osteoarthritis predominantly affects a single compartment and excessive compartmental loading is related to a varus or valgus deformity. The aim is to redistribute mechanical load away from the affected compartment and thereby preserve the native joint and delay the need for arthroplasty. High tibial osteotomy (HTO) is the most commonly performed procedure, particularly in patients with medial compartment osteoarthritis associated with varus malalignment. Age and angular thresholds should not be regarded as absolute, and HTO may, when indicated, be combined with anterior cruciate ligament (ACL) reconstruction, meniscal transplantation, or cartilage restoration procedures such as mosaicplasty or matrix-induced autologous chondrocyte implantation (MACI) [15]. Distal femoral osteotomy (DFO) represents an analogous joint-preserving concept for patients with valgus alignment and isolated lateral compartment osteoarthritis, particularly when the deformity is predominantly of femoral origin.

Arthroplasty

In patients with isolated unicompartmental disease, partial knee arthroplasty may be considered. Unlike osteotomy, its principal objective is not correction of extra-articular deformity and redistribution of joint loading, but rather resurfacing of the damaged articular surfaces within the affected compartment. Successful unicompartmental knee arthroplasty requires preservation of the cartilage in the opposite compartment, functional stability of the collateral and cruciate ligaments, an adequate range of motion, and a correctable varus or valgus deformity [15].

Total knee arthroplasty is generally reserved for patients with advanced, symptomatic multicompartmental osteoarthritis that no longer responds adequately to non-operative treatment. Even at this stage, however, therapeutic controversies and clinical decision-making do not end. Contemporary total knee arthroplasty encompasses a range of concepts, including mechanical alignment, kinematic alignment, restricted kinematic alignment, and functional alignment; different surgical approaches and methods of ligament balancing; various strategies regarding preservation or substitution of the posterior cruciate ligament; cemented and cementless fixation; computer-assisted navigation; and robotic-assisted surgery. Advanced technologies may improve the precision and reproducibility of surgical execution. Nevertheless, appropriate patient selection and indication, a thorough understanding of knee anatomy and biomechanics, and, in particular, the experience

and technical expertise of the surgeon remain fundamental prerequisites for achieving a successful clinical outcome.

Conclusion

This review summarizes the major aspects of knee osteoarthritis management, with particular emphasis on a staged treatment approach according to disease severity. Guidelines issued by major professional organizations consistently emphasize the importance of non-operative management, particularly interventions for which there is a high degree of consensus and a favorable benefit–risk profile, including patient education, therapeutic exercise, and weight reduction. Importantly, pharmacological therapy should not be regarded as a substitute for these core non-pharmacological measures. For short-term pain control, the rational use of topical and oral non-steroidal anti-inflammatory drugs (NSAIDs) is generally recommended. Intra-articular corticosteroids may provide short-term symptomatic benefit, whereas no consistent consensus exists regarding other intra-articular therapies, including hyaluronic acid, platelet-rich plasma, and cell-based treatments. Following the publication of multiple randomized controlled trials and meta-analyses over the past two decades, the initial enthusiasm surrounding some of these interventions, often reinforced by aggressive marketing, has gradually become more cautious. Patients should therefore be clearly informed about the level and certainty of evidence, lack of standardization, expected magnitude and duration of benefit, treatment costs, and available alternatives.

While awaiting more definitive results from ongoing trials of disease-modifying osteoarthritis drugs, one of the most important future changes in the management of knee osteoarthritis is likely to be the transition from treatment based predominantly on “radiographic osteoarthritis” toward individualized therapy guided by specific clinical and biological phenotypes [16,17]. A patient with a predominantly mechanical phenotype, such as marked varus malalignment and isolated medial compartment overload, differs substantially from a patient with an obesity-related metabolic phenotype, pronounced synovitis, or predominantly centrally sensitized pain. In patients with a predominantly mechanical phenotype, biomechanical correction may be of primary importance. In those with a metabolic phenotype, weight reduction and metabolic optimization may represent fundamental components of disease management. Patients with a predominantly inflammatory phenotype may derive greater short-term benefit from anti-inflammatory treatment, including NSAIDs and intra-articular corticosteroids. By contrast, patients with pronounced central sensitization require a multimodal and multidisciplinary approach, as conventional therapies directed exclusively at the knee often provide limited benefit. In selected patients, duloxetine and radiofrequency ablation of the genicular nerves may also be considered, although the supporting evidence remains limited.

Finally, it should be emphasized that contemporary surgical treatment, despite its high effectiveness, continuous refinement of surgical techniques, and increasing use of advanced and often costly technologies, is not without the risk of serious

complications. Among these, periprosthetic joint infection remains one of the most challenging and devastating complications, with potentially major consequences for functional outcome, patient quality of life, and the subsequent course of treatment.

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GONARTROZA DANAS

***Stanislav Palija*[1,2], *Vesna Vujić-Aleksić*[1,2], *Dragana Dragičević Cvjetković*[1,2], *Tatjana Nožica-Radulović*[1,2], *Goran Talić*[1,2]**

[1]Institut za fizikalnu medicinu, rehabilitaciju i ortopedsku hirurgiju „Dr Miroslav Zotović“, Slatinska 11, Banja Luka, Bosna i Hercegovina

[2]Medicinski fakultet Univerziteta u Banjoj Luci, Save Mrkalja 14, Banja Luka, Bosna i Hercegovina

Sažetak. *Gonartroza, odnosno osteoartritis koljena, jedan je od najčešćih uzroka hroničnog bola, smanjene pokretljivosti i funkcionalnog ograničenja u odrasloj i starijoj populaciji. Savremeno razumijevanje gonartroze prevazilazi raniji koncept bolesti kao jednostavnog "trošenja hrskavice". Danas se gonartroza posmatra kao bolest cijelog zgloba, uključujući zglobnu hrskavicu, subhondralnu kost, sinoviju, meniskuse, ligamente, mišiće i biomehaniku donjeg ekstremiteta. Dijagnoza gonartroze temelji se prvenstveno na kliničkoj slici, koja uključuje bol pri opterećenju, ukočenost, krepitacije, smanjen obim pokreta, otok i progresivno ograničenje svakodnevnih aktivnosti. Radiološka obrada ima važnu ulogu u procjeni uznapredovalosti bolesti i planiranju liječenja, ali radiološki nalaz ne mora uvijek korelirati s intenzitetom simptoma. Zbog toga je u savremenom pristupu ključno liječiti pacijenta, a ne samo radiološku sliku. Liječenje gonartroze mora biti individualizovano, multidisciplinarno i usmjereno na smanjenje bola, očuvanje funkcije, poboljšanje kvaliteta života i usporavanje funkcionalnog propadanja. Osnovu terapije čine edukacija pacijenta, terapijske vježbe, korekcija tjelesne mase, prilagođena fizička aktivnost i biomehanička podrška. Farmakološko liječenje, uključujući topikalne i oralne nesteroidne antireumatike, treba primjenjivati racionalno, uz procjenu rizika i koristi. Intraartikularne injekcije mogu imati mjesto kod odabranih pacijenata, ali ne predstavljaju trajno rješenje, niti zamjenu za aktivnu rehabilitaciju, a naglašena je i komercijalizacija ove terapije. Kod uznapredovale gonartroze, kada bol, deformitet i funkcionalno ograničenje značajno narušavaju kvalitet života, a konzervativno liječenje više nije dovoljno, indikovana je ortopedska procjena radi mogućeg operativnog liječenja. Od metoda na raspolaganju su biološke operacije u cilju korekcije deformiteta i preraspodjele sila (najčešće se izvodi visoka tibijalna osteotomija), te parcijalne i totalne artroplastike. Ove operacije predstavljaju efikasnu terapijsku opciju kod pravilno odabranih pacijenata, uz uslov realnih očekivanja, adekvatne preoperativne pripreme i postoperativne rehabilitacije. Gonartroza danas zahtijeva savremen, cjelovit i personalizovan pristup. Cilj liječenja nije samo ublažavanje bola, nego očuvanje pokreta, samostalnosti i kvaliteta života pacijenta.*

Ključne riječi: *terapijske vježbe, korekcija tjelesne težine, intraartikularne injekcije, artroplastika koljena.*