



Received: 09-04-2025
Accepted: 19-05-2025

International Journal of Advanced Multidisciplinary Research and Studies

ISSN: 2583-049X

Analysis of Obesity Treatments and their Relationship with Knee Osteoarthritis: Conservative and Surgical Treatments

¹ Edmundo Medeiros Teixeira, ² Vinicius Ribamar Gonçalves Moreira, ³ Fernanda Grazielle da Silva Azevedo Nora

^{1,2} Department of and Traumatology, IOG - Instituto Ortopédico de Goiânia, Goiânia, Goiás, Brazil

³ LAM - Movement Architecture Laboratory UFG – Universidade Federal de Goiás, Avenida Esperança s/n, Campus Samambaia, Goiânia, Goiás, Brazil

DOI: <https://doi.org/10.62225/2583049X.2025.5.3.4340> Corresponding Author: **Fernanda Grazielle da Silva Azevedo Nora**

Abstract

The management of obesity and knee osteoarthritis (OA) demands a comprehensive approach integrating conservative and surgical strategies. Orthopedics plays a vital role in evaluating joint damage, guiding non-invasive interventions, and performing surgical procedures such as total knee arthroplasty (TKA). Conservative treatment emphasizes lifestyle modifications, nutritional interventions,

pharmacotherapy, and physical rehabilitation, while surgical options, including bariatric surgery, address advanced cases. The interdisciplinary collaboration among orthopedic surgeons, bariatric specialists, nutritionists, and physiotherapists is essential for optimizing outcomes. This holistic approach ensures symptom relief, functional improvement, and enhanced quality of life for patients.

Keywords: Orthopedics, Obesity, Knee Osteoarthritis, Bariatric Surgery, Total Knee Arthroplasty

1. Introduction

Obesity, recognized as a chronic disease with a multifactorial origin, is one of the greatest challenges in global public health. Epidemiological data indicate a significant increase in obesity prevalence, which not only contributes to the development of metabolic conditions such as diabetes and hypertension but also negatively impacts musculoskeletal conditions such as osteoarthritis (OA) (Eymard and Aron-Wisniewsky, 2024) ^[9]. The relationship between obesity and OA is mediated by mechanical and metabolic factors, with evidence suggesting that excess weight exerts direct overload on the joints while promoting a systemic inflammatory response (Binignat *et al.*, 2024) ^[2].

Knee OA is one of the most prevalent and debilitating forms of the disease, characterized by chronic pain, stiffness, and loss of functionality. In individuals with obesity, the impact is even more pronounced, with greater pain intensity, increased functional limitations, and accelerated progression of joint degradation (Carlesso *et al.*, 2022) ^[4]. Furthermore, obesity is associated with reduced efficacy of intra-articular treatments such as corticosteroid or hyaluronic acid injections (Eymard and Aron-Wisniewsky, 2024) ^[9].

In this context, weight loss is considered a cornerstone in the management of both obesity and knee OA. Studies suggest that even modest reductions in body weight can significantly alleviate symptoms and slow disease progression (Sept and Korownyk, 2022) ^[27]. Conservative approaches, including lifestyle modifications and pharmacological interventions, have proven effective for overweight patients and those with mild obesity. However, for individuals with severe obesity, these interventions are often insufficient, leading to consideration of surgical treatments such as bariatric surgery (BS) (Heuts *et al.*, 2021) ^[15].

BS is widely recognized as one of the most effective interventions for sustained weight loss in patients with morbid obesity. Beyond its metabolic benefits, including remission of type 2 diabetes and improved lipid profiles, there is growing evidence that BS also reduces pain and improves functionality in patients with knee OA (Mohamed and Juwaiber, 2023) ^[21]. Additionally, studies suggest that weight loss induced by BS may have a protective structural effect on the joints, slowing disease progression (Eymard and Aron-Wisniewsky, 2024) ^[9].

However, challenges and uncertainties remain regarding BS in the context of OA. A critical aspect is the optimal timing of BS in relation to total knee arthroplasty (TKA). While some studies suggest that performing BS before TKA reduces perioperative complication risks and improves functional outcomes (Dowsey *et al.*, 2022)^[8], others indicate that the long-term benefits of BS in preventing complications remain uncertain (Yan *et al.*, 2022)^[29].

Another relevant aspect is the potential adverse impact of BS. Rocha *et al.* (2023)^[25] observed that knee pain may temporarily increase following BS, possibly due to greater functional overload related to increased mobility. Furthermore, muscle mass loss after BS may contribute to an initial increase in pain and joint stiffness (Hamdi *et al.*, 2018)^[14]. These findings highlight the need for multidisciplinary follow-up to optimize the benefits of BS and mitigate its risks.

The integration of conservative and surgical interventions has proven essential for the effective management of obesity and OA. Programs combining physical therapy, nutritional interventions, and BS have demonstrated greater efficacy than isolated approaches. Domingue *et al.* (2023)^[7] reported a successful case in which a patient with morbid obesity and bilateral knee OA experienced significant improvements in quality of life following a multidisciplinary program that included BS and physical therapy.

Despite advancements, gaps persist in understanding the underlying mechanisms of the relationship between obesity, BS, and OA. Future studies should explore the impact of BS on the structural progression of OA and identify predictive factors for success across different patient populations. Moreover, standardizing follow-up protocols after BS is critical to ensuring long-term maintenance of its benefits.

Therefore, this study aimed to analyze the different treatments for obesity, with an emphasis on surgical and conservative treatments, and their relationship with knee osteoarthritis. The analysis seeks to understand the benefits, challenges, and limitations of these interventions, considering their impact on pain, functionality, and disease progression. The high prevalence of obesity and knee OA, as well as the significant impact of these conditions on quality of life, justify the need for an in-depth investigation of existing treatments. Understanding best practices for integrating conservative and surgical interventions is essential for developing more effective and personalized protocols, contributing to improved clinical and functional outcomes for patients.

2. Diagnosis

The diagnosis of knee osteoarthritis (OA) in patients with obesity is a multifaceted process that requires a detailed and comprehensive approach due to the interactions between mechanical, metabolic, and inflammatory factors. Initially, clinical history plays a fundamental role in identifying characteristic symptoms, including mechanical pain that worsens with joint use and improves with rest, joint stiffness, difficulty walking, and functional limitation. These symptoms tend to be exacerbated by obesity, which increases joint overload and contributes to low-grade systemic inflammation (Eymard and Aron-Wisniewsky, 2024; Carlesso *et al.*, 2022)^[9, 4].

The physical examination should complement the clinical history, allowing the assessment of range of motion, joint instability, and deformities. In obese patients, functional

limitations are more pronounced due to mechanical overload and reduced efficiency of periarticular musculature. Moreover, the presence of multi-joint pain, common in individuals with obesity, can complicate the distinction between OA and other joint conditions (Hamdi *et al.*, 2018)^[14].

Imaging studies play a crucial role in diagnosing OA, with simple radiography being the most widely used method. This imaging technique can identify classic signs of the disease, such as joint space narrowing, osteophytes, and subchondral sclerosis, aiding in confirming the diagnosis and classifying severity (Heuts *et al.*, 2021)^[15]. However, in more complex cases or for detailed evaluations of cartilage, meniscal lesions, or other structural changes, magnetic resonance imaging (MRI) is the modality of choice, providing detailed images for a more in-depth analysis (Gong *et al.*, 2018)^[11].

Joint ultrasound is another complementary diagnostic tool, particularly useful in detecting joint effusion and synovial inflammation. This method has the advantage of being accessible and non-invasive, though its reliance on operator skill may limit its accuracy (Yan *et al.*, 2022)^[29]. Additionally, inflammatory biomarkers such as IL-6 and TNF- α are being explored as potential diagnostic tools to assess the impact of systemic inflammation on OA (Eymard and Aron-Wisniewsky, 2024)^[9].

Another important dimension of diagnosis is the evaluation of functionality and quality of life using standardized questionnaires such as the Western Ontario and McMaster Universities Arthritis Index (WOMAC) and the Knee Injury and Osteoarthritis Outcome Score (KOOS). These instruments enable a detailed analysis of OA's impact on pain, joint stiffness, and daily activities, aiding in monitoring disease progression and treatment response (Dowsey *et al.*, 2022)^[8].

Finally, the assessment of body mass index (BMI) and fat distribution is essential to understand how obesity influences OA symptoms and progression. Studies suggest that visceral fat, in particular, plays a critical role in exacerbating systemic inflammation and intensifying OA symptoms (Binignat *et al.*, 2024)^[2]. Thus, combining clinical, imaging, and functional methods constitutes a robust approach for diagnosing OA in obese patients, ensuring more effective and personalized therapeutic management.

Furthermore, new technological tools are being developed to improve diagnostic accuracy and speed. Artificial intelligence (AI)-based models have been applied to imaging interpretation, enabling early detection of structural changes indicative of OA (Mohamed and Juwaiber, 2023)^[21]. These advancements can complement traditional methods and provide more detailed insights into disease progression.

The multidimensional approach must also consider the psychosocial impact of OA in obese patients. The combination of chronic pain and functional limitation often leads to social isolation, increased risk of depression, and worsened quality of life (Carlesso *et al.*, 2022)^[4]. Thus, questionnaires evaluating emotional and social aspects should be included in the diagnostic analysis to ensure a comprehensive understanding of the patient's condition.

Finally, it is crucial that the diagnosis be continuously reviewed during clinical follow-up, especially in cases involving interventions such as bariatric surgery. Changes in body weight and metabolic factors can significantly alter the

clinical presentation of OA, requiring adjustments in therapeutic management (Eymard and Aron-Wisniewsky, 2024) [9].

3. Conservative Treatment

The conservative treatment of obesity associated with knee osteoarthritis (OA) is a multifaceted approach that integrates various strategies aimed at improving quality of life, reducing pain, and controlling body weight. This method is particularly indicated for patients who cannot or do not wish to undergo surgical interventions, such as bariatric surgery (BS), or who require clinical stabilization before invasive procedures. The focus of conservative management lies in behavioral, dietary, pharmacological, and physical interventions, which have proven effective in modulating the progression of OA and promoting joint functionality (Eymard and Aron-Wisniewsky, 2024) [9].

One of the main components of conservative treatment involves lifestyle changes, including encouraging physical activity and adherence to balanced diets. Regular physical exercise, particularly low-impact activities such as walking, water aerobics, and yoga, plays a central role in preserving joint functionality and strengthening the musculature around the knee (Carlesso *et al.*, 2022) [4]. Studies indicate that engaging in exercise not only improves mobility but also contributes to reducing pain and lowering body mass index (BMI) (Panunzi *et al.*, 2021) [22].

Programs supervised by physical therapists have demonstrated positive results in postural reeducation and promoting joint movements that minimize cartilage wear. Moreover, regular physical activity improves cardiovascular health and provides systemic benefits, including the reduction of chronic inflammation associated with obesity (Binvignat *et al.*, 2024) [2]. Over the long term, these interventions offer better disease control, reducing the risk of progression to advanced stages of OA.

Diet plays a crucial role in the conservative management of obesity and OA. A dietary approach focused on adopting hypocaloric, balanced diets rich in anti-inflammatory nutrients such as omega-3 and antioxidants has proven effective in weight reduction and improvement of joint symptoms (Sept and Korownyk, 2022) [27]. Additionally, Mediterranean diets, which emphasize the consumption of vegetables, whole grains, olive oil, and fish, are widely recommended due to their proven anti-inflammatory effects (Eymard and Aron-Wisniewsky, 2024) [9].

Nutritional supplementation may also be indicated to address common deficiencies in obese patients. Vitamin D and calcium are often prescribed to improve bone health, while compounds such as glucosamine and chondroitin have been studied for their potential protective effects on joint cartilage (Goodpaster *et al.*, 2024) [12]. Nutritionist guidance is essential for personalizing dietary plans and promoting sustainable changes in eating habits.

Pharmacological management in conservative treatment is often necessary to alleviate OA symptoms and control body weight. Medications such as orlistat and GLP-1 agonists, such as liraglutide, are effective options for inducing weight loss in obese patients who do not respond adequately to behavioral interventions (Katz *et al.*, 2021) [17]. These medications contribute to reducing the mechanical overload on knee joints, indirectly alleviating joint symptoms.

For pain management, simple analgesics such as acetaminophen and nonsteroidal anti-inflammatory drugs

(NSAIDs) are widely used. In more severe cases, intra-articular injections of corticosteroids or hyaluronic acid may be applied to provide temporary pain relief and improve joint mobility (Eymard and Aron-Wisniewsky, 2024) [9]. However, prolonged use of these therapies should be monitored due to the risk of adverse effects, including the progression of joint degeneration.

The integration of complementary therapies in conservative OA management has proven to be a promising strategy for symptom relief and improving quality of life. Techniques such as acupuncture, massage therapy, and joint mobilization are often used as adjuncts to traditional treatment. Acupuncture, in particular, shows evidence of short-term efficacy in pain reduction, although its mechanism of action remains poorly understood (Heuts *et al.*, 2021) [15].

Nutritional supplements such as hydrolyzed collagen have been investigated for their potential benefits on joint health. Additionally, natural compounds such as turmeric and ginger possess anti-inflammatory properties that may help manage chronic pain (Goodpaster *et al.*, 2024) [12]. These interventions are generally well-tolerated and can complement conventional treatment methods.

The use of assistive devices, such as knee braces, canes, and orthopedic footwear, plays an important role in reducing mechanical stress on joints and promoting greater stability during daily activities (Yan *et al.*, 2022) [29]. Studies suggest that the regular use of braces can significantly alleviate OA symptoms, particularly in patients with joint misalignment or knee instability (Heuts *et al.*, 2021) [15].

Additionally, home environment adaptations, such as installing grab bars in bathrooms and removing architectural barriers, are recommended to increase patient safety and independence. These simple modifications have a significant impact on preventing falls and promoting greater autonomy, especially in individuals with reduced mobility.

Patient education about their condition and treatment options is essential to ensure adherence to proposed interventions. Educational sessions that address topics such as the importance of weight control, exercise, and proper medication use help patients understand the benefits of conservative strategies (Carlesso *et al.*, 2022) [4].

Psychological support is also crucial, given the significant emotional impact of obesity and OA. Cognitive therapies and support groups have shown efficacy in reducing depressive symptoms and increasing motivation to adhere to treatment (Eymard and Aron-Wisniewsky, 2024) [9]. Programs that integrate multidisciplinary approaches, including psychological assistance, achieve superior results in promoting overall health and patient well-being.

Conservative treatment of obesity and knee OA is a comprehensive approach that combines lifestyle changes, nutritional interventions, pharmacological and complementary therapies, as well as educational and psychological support. While it does not replace the need for surgical interventions in severe cases, this approach plays a vital role in symptom reduction, improved joint functionality, and prevention of disease progression. The implementation of personalized strategies, led by multidisciplinary teams, is crucial to meeting individual patient needs and maximizing the benefits of treatment.

4. Surgical Treatment

Surgical treatment is a crucial strategy for advanced cases of

obesity and knee osteoarthritis (OA), particularly when conservative treatments fail to alleviate symptoms or improve functionality. The main surgical modalities include bariatric procedures, aimed at controlling body weight, and orthopedic interventions, such as total knee arthroplasty (TKA), which directly address joint dysfunction.

Bariatric surgery has been shown to be highly effective in reducing body weight and alleviating mechanical overload on knee joints. Procedures such as Roux-en-Y gastric bypass, sleeve gastrectomy, and adjustable gastric banding are widely used and promote substantial weight loss in morbidly obese patients (Gong *et al.*, 2018) ^[11]. Beyond weight reduction, bariatric surgery is also associated with improvements in metabolic conditions, such as type 2 diabetes, which exacerbate systemic inflammation and OA progression (Eymard and Aron-Wisniewsky, 2024) ^[9].

In addition to metabolic benefits, weight loss induced by bariatric surgery has direct impacts on patients' functionality and quality of life. Studies show that patients undergoing these procedures report significant reductions in pain and greater ease in performing daily activities, such as walking and climbing stairs (Heuts *et al.*, 2021) ^[15]. This effect is attributed both to the decreased mechanical load on joints and to the reduction in systemic inflammatory processes, marked by lower levels of TNF- α and IL-6 (Eymard and Aron-Wisniewsky, 2024) ^[9].

Although bariatric surgery is a highly effective intervention, the optimal timing for subsequent orthopedic interventions, such as total knee arthroplasty, remains a topic of debate. Systematic reviews suggest that an interval of at least 12 months between bariatric surgery and TKA may offer significant benefits, including reduced risk of infections and operative complications (de Ree *et al.*, 2024) ^[6]. Moreover, this interval allows for physiological adaptation to the patient's new metabolic and structural condition, optimizing functional outcomes.

Weight loss resulting from bariatric surgery not only alleviates mechanical stress on joints but also contributes to reducing the pain and stiffness associated with OA. Patients who undergo these procedures often report a 50% reduction in knee pain intensity and significant improvements in mobility, outcomes attributed to both decreased joint load and lower systemic inflammation (Yan *et al.*, 2022) ^[29].

In addition to symptom reduction, bariatric surgery has the potential to alter the course of OA progression in obese patients. Clinical studies indicate that weight reduction can improve the integrity of joint cartilage and slow degeneration, especially when combined with conservative interventions such as physical therapy (Panunzi *et al.*, 2021) ^[22]. However, to maximize these benefits, a multidisciplinary follow-up that includes ongoing nutritional and metabolic evaluation is essential.

Despite its evident benefits, bariatric surgery is not without risks. Nutritional deficiencies, such as hypovitaminosis and anemia, are common complications requiring rigorous supplementation and continuous monitoring (Hald *et al.*, 2024) ^[13]. Other complications include anastomotic stenosis and internal hernias, which can negatively impact the patient's quality of life. However, with proper management, these issues can be minimized, allowing long-term benefits, such as pain reduction and improved functionality, to be fully realized.

Total knee arthroplasty (TKA) is often indicated for patients with advanced OA who do not respond to conservative

treatment. This procedure involves replacing the damaged joint with a prosthesis, resulting in significant pain relief and restoration of joint function. Studies indicate that TKA is highly effective in obese patients, although they present a higher risk of complications compared to normal-weight patients (Mohamed and Juwaiber, 2023) ^[21].

In addition to providing immediate pain relief, TKA significantly improves patients' functional capacity, enabling them to resume daily activities that were previously limited. However, the success of the procedure depends on careful preparation, which includes optimizing the patient's metabolic and nutritional status, especially in cases of morbid obesity (Dowsey *et al.*, 2022) ^[8].

To maximize the benefits of TKA in obese patients, many specialists recommend prior bariatric surgery. Weight reduction not only improves the mechanical conditions of the joints but also significantly reduces the risk of complications, such as infections and prosthetic failures (Liu *et al.*, 2021) ^[19]. This integrated approach has been shown to be particularly effective in patients with high BMI and associated comorbidities, such as hypertension and diabetes. On the other hand, performing TKA before bariatric surgery presents unique challenges. Studies indicate that obese patients who do not lose weight before TKA face greater difficulties in postoperative recovery, including higher incidences of joint stiffness and hospital readmissions (Mohamed and Juwaiber, 2023) ^[21]. Thus, the decision regarding the order of interventions must be carefully individualized, considering the specific risks and benefits of each case.

The postoperative period is critical for the success of TKA in obese patients. Intensive physical therapy programs, combined with nutritional and psychological support, are essential for optimizing recovery and ensuring lasting functional outcomes (Domingue *et al.*, 2023) ^[7]. Additionally, strategies for pain management, such as the use of regional blocks and controlled analgesics, are crucial for promoting patient comfort during recovery.

Another critical aspect of the postoperative period is the prevention of complications such as deep vein thrombosis and infections. Anticoagulant prophylaxis, combined with early mobilization measures, plays an important role in reducing these risks (Dowsey *et al.*, 2022) ^[8]. Obese patients, in particular, require additional vigilance due to the higher risk of anesthesia-related and wound-healing complications.

The combination of bariatric surgery with TKA has proven to be an effective approach for patients with morbid obesity and advanced OA. Studies indicate that performing bariatric surgery before TKA reduces orthopedic complications and improves long-term functional outcomes. Additionally, patients who lose weight before TKA experience shorter recovery times and greater overall satisfaction with the procedure (Panunzi *et al.*, 2021) ^[22].

Conversely, the reverse order—performing TKA before bariatric surgery—is associated with higher complication rates, including infections and prosthetic failures. Thus, it is recommended that bariatric surgery be prioritized in patients who require both procedures, provided that OA is not in a stage that severely compromises functionality and quality of life (Katz *et al.*, 2021) ^[17].

The success of surgical treatment depends on a multidisciplinary approach involving surgeons, endocrinologists, physical therapists, nutritionists, and

psychologists. This integrated team is essential for planning the optimal timing of interventions, minimizing risks, and maximizing benefits for patients (Goodpaster *et al.*, 2024) [12]. Furthermore, preoperative education about expectations and postoperative care plays a fundamental role in patient engagement and surgical outcomes.

5. Importance of the Orthopedic Surgeon's Role

Orthopedics plays a crucial role in both surgical and conservative treatments of obesity and knee osteoarthritis (OA). In the context of conservative care, orthopedic surgeons are responsible for assessing the degree of joint involvement and recommending the use of assistive devices, such as braces, which help redistribute the load on affected joints. These devices can alleviate pain and improve functionality by minimizing mechanical impact on damaged joints (Heuts *et al.*, 2021) [15].

Additionally, continuous orthopedic follow-up allows for adjustments to the treatment plan based on the progression of the disease and the patient's response to non-invasive interventions. For instance, in cases of increased pain or functional limitation, the orthopedic surgeon may recommend complementary therapies, such as intra-articular injections of corticosteroids or hyaluronic acid, to temporarily relieve symptoms and delay the need for surgical intervention (Eymard and Aron-Wisniewsky, 2024) [9].

In the surgical context, the role of the orthopedic surgeon is essential in determining the necessity and optimal timing for procedures such as total knee arthroplasty (TKA). The preoperative evaluation conducted by the orthopedic surgeon is fundamental in planning the surgery, including selecting the most suitable prosthetic materials and anticipating potential complications based on the patient's clinical condition. This step is especially critical for obese patients, who are at higher risk for complications such as infections and prosthetic failures (Dowsey *et al.*, 2022) [8].

After surgery, orthopedic support remains indispensable. Orthopedic surgeons play a vital role in postoperative care, monitoring patient recovery, guiding rehabilitation exercises, and adjusting pain management. Rehabilitation supervised by orthopedic surgeons, in collaboration with physical therapists, is crucial to restoring joint mobility and reducing the risk of stiffness or functional loss (Domingue *et al.*, 2023) [7].

Beyond clinical management, orthopedic surgeons also have a central role in patient education. They provide guidance on the importance of lifestyle changes, such as weight loss and regular exercise, to preserve joint functionality and prevent disease progression. This education is particularly important in conservative treatment, where patient adherence to recommendations is a key determinant of management success (Katz *et al.*, 2021) [17].

Collaboration between orthopedic surgeons and other specialists, such as nutritionists and physical therapists, is essential to achieve the best possible outcomes.

For patients undergoing bariatric surgery, for example, the collaboration between the bariatric surgeon and the orthopedic surgeon ensures an integrated approach that addresses both the metabolic and mechanical aspects of obesity and OA (Goodpaster *et al.*, 2024) [12].

Orthopedics also plays a vital role in the development and implementation of preventive strategies for patients at risk of OA. This includes prescribing muscle-strengthening

exercises to stabilize joints and providing guidance on ergonomics and low-impact activities, such as swimming or cycling, to avoid joint overload. These interventions not only slow disease progression but also improve patients' quality of life (Carlesso *et al.*, 2022) [4].

Another important aspect of orthopedic practice is the use of advanced technologies, such as high-resolution imaging, to monitor joint integrity and identify early signs of degeneration. This proactive approach allows for more precise and timely interventions, reducing the need for surgeries in advanced stages of the disease (Heuts *et al.*, 2021) [15].

The support provided by orthopedics in both surgical and conservative treatments of obesity and OA is indispensable. Its comprehensive approach, which combines clinical evaluation, therapeutic interventions, and patient education, significantly contributes to improving joint functionality and patients' quality of life. The integration of orthopedics with other medical specialties exemplifies the importance of a multidisciplinary approach in managing these complex conditions.

6. Conclusion

This study examined the relationship between obesity, knee osteoarthritis (OA), and various treatment approaches, emphasizing both conservative and surgical strategies. Orthopedics emerges as a central component, playing a critical role in the evaluation, management, and follow-up of patients across all stages of treatment. From supporting non-invasive interventions, such as the use of orthoses and patient education, to performing definitive procedures like total knee arthroplasty, orthopedic surgeons hold an indispensable position in ensuring therapeutic success.

Conservative treatment stands out for its integration of strategies such as lifestyle modifications, nutritional interventions, pharmacological management, and physical rehabilitation. Conversely, surgical approaches, including bariatric surgery and arthroplasty, provide effective solutions for more severe cases. In both scenarios, multidisciplinary collaboration among orthopedic surgeons, bariatric surgeons, nutritionists, and physical therapists significantly enhances patient outcomes.

In conclusion, managing obesity-associated knee osteoarthritis requires a holistic and individualized approach, where orthopedics plays a strategic and indispensable role. The seamless integration of conservative and surgical strategies, combined with orthopedic expertise, not only alleviates symptoms but also improves functionality and enhances the quality of life for patients. This highlights the necessity of adopting comprehensive, patient-centered protocols to address the multifaceted challenges of these conditions effectively.

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