

Modern Treatment Methods for Hip Osteoarthritis

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Abstract: Hip osteoarthritis is a progressive degenerative joint disease that causes chronic pain, impaired mobility, functional limitations, and reduced quality of life. The increasing prevalence of the disease, particularly among aging populations and individuals with obesity, previous trauma, developmental hip disorders, and other risk factors, emphasizes the need for effective and individualized treatment strategies. This review analyzes modern approaches to the management of hip osteoarthritis, including non-pharmacological interventions, pharmacological therapy, intra-articular injections, surgical procedures, and emerging technologies. Particular attention is given to patient education, weight management, exercise therapy, physical rehabilitation, walking aids, non-steroidal anti-inflammatory drugs, corticosteroid injections, hyaluronic acid, platelet-rich plasma, and stem cell-based therapies. Surgical options such as hip arthroscopy, corrective osteotomy, and total hip arthroplasty are also considered, with total hip arthroplasty remaining the most effective treatment for end-stage disease. In addition, the review examines the growing role of robotic-assisted surgery, computer navigation, and artificial intelligence in improving surgical precision, implant positioning, treatment planning, outcome prediction, and personalized rehabilitation. The analysis indicates that a multidisciplinary and patient-centered approach provides the most appropriate framework for managing hip osteoarthritis, while emerging regenerative and digital technologies may contribute to further improvements in long-term clinical outcomes. Continued high-quality clinical research is required to establish the safety, effectiveness, and long-term benefits of innovative treatment methods.

Keywords: hip osteoarthritis, coxarthrosis, conservative treatment, pharmacological therapy, physical therapy, intra-articular injections, platelet-rich plasma, stem cell therapy, total hip arthroplasty, robotic-assisted surgery, computer navigation, artificial intelligence, regenerative medicine, personalized rehabilitation.

Introduction

Hip osteoarthritis (OA), also known as coxarthrosis, is one of the most common degenerative joint diseases affecting adults worldwide. It is characterized by the gradual destruction of articular cartilage, remodeling of subchondral bone, osteophyte formation, synovial inflammation, and progressive joint dysfunction. Hip OA is a major cause of chronic pain, reduced mobility, disability, and decreased quality of life, particularly among older adults. However, younger individuals may also develop hip osteoarthritis due to trauma, developmental dysplasia of the hip, femoroacetabular impingement (FAI), obesity, avascular necrosis, or genetic predisposition[1].

The prevalence of hip osteoarthritis continues to increase because of population aging, increasing life expectancy, obesity, and higher physical activity demands. The disease not only affects patients'

daily activities but also imposes a substantial socioeconomic burden through healthcare costs, work absenteeism, and long-term disability. Therefore, early diagnosis and appropriate treatment are essential to slow disease progression, relieve pain, and maintain joint function[2].

Modern management of hip osteoarthritis follows a patient-centered and multidisciplinary approach. Treatment is selected according to disease severity, patient age, activity level, comorbidities, and expectations. Current therapeutic strategies include lifestyle modification, physical therapy, pharmacological treatment, biologic therapies, minimally invasive procedures, and total hip arthroplasty for advanced disease[3].

Research Methodology

The study employed literature review, systematic analysis, comparative analysis, and evidence-based assessment methods to evaluate modern approaches to the treatment of hip osteoarthritis. Existing treatment methods were systematized into conservative, pharmacological, injection-based, surgical, and innovative technological approaches, and their effectiveness, advantages, and limitations were compared. In addition, the clinical potential of modern surgical technologies and artificial intelligence was comprehensively analyzed.

Results and Discussion

The analysis of modern approaches to the treatment of hip osteoarthritis demonstrates that non-pharmacological management should form the foundation of treatment regardless of disease severity. Patient education, weight management, exercise therapy, physical therapy, and the appropriate use of walking aids are important components of conservative management. Patient education improves adherence to treatment and helps patients develop realistic expectations regarding disease progression and therapeutic outcomes [4]. Weight reduction is particularly important in patients with obesity because it decreases mechanical loading on the hip joint, reduces pain, and may improve mobility [5].

Exercise therapy was identified as one of the most effective conservative approaches. Individualized exercise programs incorporating muscle strengthening, range-of-motion exercises, flexibility training, balance exercises, aerobic conditioning, and functional movement training can improve joint stability, gait mechanics, and physical function. Particular attention should be given to strengthening the hip abductors, extensors, and core muscles. Physical therapy can complement exercise-based treatment through manual therapy, stretching, hydrotherapy, gait training, postural correction, and functional rehabilitation. The use of walking aids, particularly a cane held in the hand opposite the affected hip, may further reduce joint loading and improve walking efficiency [6].

Pharmacological treatment is primarily aimed at controlling pain and improving functional status. Acetaminophen may provide mild pain relief, although its effectiveness is limited in moderate and severe hip osteoarthritis. NSAIDs, including ibuprofen, naproxen, diclofenac, celecoxib, and etoricoxib, remain important pharmacological options for symptomatic patients. However, their use requires consideration of potential gastrointestinal, cardiovascular, and renal adverse effects [7]. In contrast, topical NSAIDs have limited applicability to hip osteoarthritis because the hip joint is located relatively deep beneath the surrounding soft tissues. Opioids are generally not preferred because of the risks of dependence, sedation, and other adverse effects and should therefore be reserved for carefully selected patients with severe symptoms when other treatment options are unsuitable.

Injection-based therapies provide additional options for selected patients. Intra-articular corticosteroid injections administered under ultrasound or fluoroscopic guidance may provide temporary pain relief by reducing synovial inflammation, although the duration of benefit is generally limited. Repeated injections should therefore be used cautiously because excessive

administration may adversely affect cartilage health [8]. The effectiveness of hyaluronic acid injections remains inconsistent, and this treatment cannot be considered universally appropriate for patients with hip osteoarthritis [9]. PRP therapy has demonstrated potential for reducing pain and improving function in selected patients with mild to moderate disease; however, differences in preparation and administration protocols limit the ability to establish standardized treatment recommendations [10]. Similarly, mesenchymal stem cell therapy has attracted considerable interest because of its potential regenerative effects, but available evidence remains insufficient to support its routine clinical use, emphasizing the need for further high-quality clinical trials [11].

Surgical treatment becomes particularly important when conservative management fails and patients continue to experience persistent pain, functional limitations, and reduced quality of life. Hip arthroscopy may be beneficial in carefully selected patients with early-stage disease associated with labral tears, femoroacetabular impingement, or intra-articular loose bodies, whereas its effectiveness is limited in advanced cartilage degeneration [12]. Corrective osteotomy may be considered in younger patients with structural abnormalities such as developmental hip dysplasia because redistribution of joint loading may delay the progression of osteoarthritis [13].

For end-stage hip osteoarthritis, total hip arthroplasty remains the principal surgical treatment. Replacement of the damaged acetabular and femoral surfaces can provide substantial pain relief, improve walking ability and range of motion, and enhance overall quality of life. The development of cemented, cementless, and hybrid fixation methods, together with advances in ceramic and highly cross-linked polyethylene bearing materials, has contributed to improved implant durability and reduced wear. These developments support the continued role of total hip arthroplasty as an effective treatment for advanced disease.

The findings also demonstrate the increasing importance of modern technologies in hip osteoarthritis management. Robotic-assisted surgery can improve the accuracy of implant positioning and component alignment, potentially reducing technical errors and increasing surgical reproducibility; however, its long-term superiority over conventional arthroplasty remains under investigation [14]. Computer navigation provides real-time intraoperative guidance and can assist in achieving appropriate cup inclination and anteversion, restoring leg length, and optimizing femoral offset.

Artificial intelligence represents another rapidly developing direction. Its potential applications include automated radiographic assessment, implant selection, surgical planning, outcome prediction, risk assessment, and personalized rehabilitation planning. These technologies may improve clinical decision-making by integrating imaging and patient-specific information; however, their effectiveness should continue to be evaluated through clinical validation and long-term outcome studies.

Overall, the findings indicate that no single treatment method is universally optimal for all patients with hip osteoarthritis. The choice of treatment should depend on disease severity, clinical symptoms, functional limitations, patient characteristics, response to previous treatment, and expected outcomes. A stepwise and patient-centered approach, beginning with non-pharmacological management and progressing to pharmacological, injection-based, or surgical interventions when clinically indicated, provides a rational framework for treatment. At the same time, regenerative medicine, precision surgery, artificial intelligence, digital health technologies, wearable sensors, and personalized rehabilitation represent promising directions for future development. Further research into cartilage regeneration, gene therapy, tissue engineering, and biological treatments may eventually contribute not only to symptom control but also to modification of disease progression [15].

Conclusion

Modern treatment of hip osteoarthritis requires an individualized and multidisciplinary approach. Conservative management remains the cornerstone of early disease, while pharmacological therapy and injection techniques provide symptom relief in appropriate patients. Total hip arthroplasty continues to be the most effective treatment for advanced hip osteoarthritis, offering excellent pain relief and functional recovery. Emerging technologies such as robotic-assisted surgery, computer navigation, biologic therapies, and artificial intelligence are transforming the management of hip osteoarthritis and may further improve clinical outcomes in the future. Continued research and high-quality clinical trials are essential to establish the long-term effectiveness and safety of these innovative treatment strategies.

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