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Review Article

KNEE OSTEOARTHRITIS IN WOMEN: ANCIENT AND MODERN TREATMENT MODALITIES

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ABSTRACT

Knee osteoarthritis (OA) is a common and debilitating condition that predominantly affects women. This article explores the historical and contemporary treatment modalities for knee OA in women, highlighting the evolution of therapeutic approaches over time. Ancient treatments for knee OA primarily focused on natural remedies and lifestyle modifications. These included the use of herbal medicines, dietary adjustments, and physical therapies like hot and cold compresses. In modern times, treatment options for knee OA in women have significantly evolved. While conservative measures such as physical therapy, weight management, and non-steroidal anti-inflammatory drugs (NSAIDs) are still important, advanced interventions are available. These include corticosteroid injections, hyaluronic acid injections, and platelet-rich plasma therapy, which aim to reduce pain and enhance joint lubrication. For severe cases, surgical interventions like arthroscopy, partial or total knee replacement, and osteotomy may be considered. The article also explores the emerging field of regenerative medicine, which offers promising avenues for the management of knee OA in women. Stem cell therapies and tissue engineering approaches show potential in regenerating damaged cartilage and slowing down disease progression. Additionally, the role of lifestyle modifications, exercise, and physical therapy remains crucial in the modern era, with a focus on tailored rehabilitation programs to improve strength, flexibility, and joint stability. In conclusion, the treatment of knee OA in women has transitioned from ancient remedies rooted in tradition to a modern, evidence-based approach that combines conservative measures with innovative medical interventions. The evolution of treatment modalities reflects advances in medical knowledge and technology, offering hope for improved quality of life for women affected by this condition.

INTRODUCTION

OA is a chronic joint condition characterized by the breakdown of the protective cartilage that covers the ends of the bones in the knee joint. As the cartilage deteriorates, bones may rub against each other, leading to pain, swelling, and reduced joint function [1]. The exact cause of knee OA is not fully understood, but it is thought to be a combination of genetic, mechanical, and environmental factors.

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Factors that can increase the risk of developing knee OA include age, obesity, joint injuries, genetics, and joint overuse. Common symptoms of knee OA include pain, stiffness, swelling, and reduced range of motion in the knee joint [2]. Pain is typically worse with activity and can improve with rest. It may be accompanied by a feeling of grinding or crepitus when the joint is moved. Diagnosis is usually based on a combination of medical history, physical examination, and imaging studies like X-rays or MRI scans. These tests help assess the severity of joint damage and rule out other potential causes of knee pain [3]. Knee OA is often categorized into four stages, ranging from mild to severe, based on the extent of cartilage damage, bone spurs, and joint space narrowing. The progression of knee OA varies from person to person. Early diagnosis and effective management can help slow down the

progression and alleviate symptoms, enabling individuals to maintain an active lifestyle [4].

Knee OA can affect both men and women, research has consistently shown that knee OA is more prevalent in women. Several factors contribute to this gender disparity in the prevalence of knee OA. Hormones, particularly estrogen, play a role in maintaining joint health and cartilage integrity. As women go through various hormonal changes throughout their lives, such as menstruation, pregnancy, and menopause, these fluctuations can influence the development and progression of knee OA [5]. Estrogen has been shown to have a protective effect on cartilage, and its decline during menopause may contribute to an increased risk of OA. Joint structure and alignment can differ between men and women. Women often have wider hips, which can lead to a different distribution of forces across the knee joint. These differences can place more stress on the knee joint, potentially leading to an increased risk of knee OA [6]. Muscular imbalances and ligament laxity can affect joint stability. Women may be more prone to muscular imbalances or ligament laxity, which can increase the likelihood of developing knee OA. Weaker quadriceps muscles, in particular, have been associated with an increased risk of knee OA. Obesity is a major risk factor for knee OA, and it is more prevalent among women, especially in certain age groups. Excess body weight places additional stress on the knee joints, accelerating the degeneration of cartilage [7]. Activities that involve repetitive stress on the knees can contribute to the development of knee OA. Women may be more likely to engage in certain activities or occupations that increase the risk of joint damage. Genetic factors can also play a role in the development of knee OA. While this is not specific to gender, family history can influence an individual's susceptibility to the condition. Societal and cultural factors can also contribute to the prevalence of knee OA in women [8]. Women are often encouraged to participate in activities that place stress on their knees, such as wearing high heels, which can affect joint health over time. The prevalence of knee OA in women tends to increase with age, with the risk becoming more significant after menopause. Lifestyle modifications, such as maintaining a healthy weight, engaging in regular exercise, and practicing joint-friendly activities, can help reduce the risk of knee OA in women and promote joint health throughout their lives. Early diagnosis and appropriate management, which may include physical therapy, pain management, and, in some cases, surgical interventions, can also help improve the quality of life for women living with knee OA [9,10].

Treatment of knee OA in women has evolved significantly over time, with both ancient and modern approaches aimed at relieving pain, improving function, and enhancing overall quality of life. Ancient cultures often relied on herbal remedies and traditional medicines to manage pain and inflammation associated with knee OA. Natural herbs like turmeric, ginger, and willow bark were used for their potential anti-inflammatory properties. Ancient practices like massage and manual manipulation were employed to alleviate pain and stiffness. These therapies aim to improve blood circulation and joint mobility. NSAIDs, analgesics, and disease-modifying drugs can help manage pain, and inflammation, and slow the progression of OA. Physical therapy is a key component of modern treatment. It includes exercises to strengthen the muscles around the knee, improve joint stability, and increase mobility. It can also incorporate modalities like heat and cold therapy [11-13]. Intra-articular injections, such as corticosteroids and hyaluronic acid, can provide temporary relief from knee OA symptoms. Platelet-rich plasma (PRP) and stem cell injections are also being explored as potential treatments. In severe cases of knee OA, surgical options like arthroscopy, realignment procedures, and knee replacement surgery may be recommended. Total knee replacement is a common surgical intervention that replaces the damaged joint with a prosthetic implant [14,15]. Modern technology has led to the development of assistive devices such as knee braces, orthotics, and mobility aids like canes and walkers to help manage knee OA and improve mobility. Lifestyle modifications remain important in the modern approach to knee OA. Maintaining a healthy diet, regular exercise, and weight which can significantly improve outcomes. Some individuals may also explore complementary therapies like acupuncture, hot & cold compress, *Janu basti*, *Marma* therapy, chiropractic care, and dietary supplements (e.g., glucosamine and chondroitin) to help manage knee OA symptoms [16,17]. This review aims to present a comprehensive and balanced perspective on the treatment of knee OA in women by considering both historical and modern approaches, facilitating a better understanding of the condition and its management.

Historical Background of Knee Osteoarthritis in Women

Knee OA has likely existed for thousands of years, but historical records from ancient civilizations often did not specifically mention this condition. Still, evidence of skeletal remains from different periods suggests that OA, including knee OA, was present in both genders. Women during the pre-modern eras were often involved in physically demanding activities, such as agriculture and household chores, which could

contribute to the development of OA in the knees due to the repetitive stress on the joints [18,19]. With the advent of the Industrial Revolution in the 18th and 19th centuries, women's roles in the labor force began to shift. While some women continued to engage in physically demanding work, others entered factory jobs that required long hours of standing and repetitive movements, which could also increase the risk of knee OA. In the early 20th century, the prevalence of knee OA in women started to gain more attention within the medical community[20,21]. Hormonal changes, such as menopause, were identified as potential risk factors, as they can affect joint health. In post-World War II, the roles and lifestyles of women changed as societies became more industrialized and technology advanced. Increased urbanization and sedentary occupations led to less physical activity and more time spent sitting, which could affect joint health [22]. In more recent years, a growing awareness of knee OA in women has prompted increased research and clinical efforts to address the condition. Women are now encouraged to maintain healthy lifestyles, including regular exercise and weight management, as part of a proactive approach to preventing and managing knee OA [23].

Statistical Analysis and Prevalence: Worldwide Data

The global incidence of knee OA was 203 per 10,000 person-years in individuals aged 20 and over. Correspondingly, there are around annual 86.7 million individuals (20 years and older) with incident knee OA in 2020 worldwide[24]. In the United States, it was estimated that over 30 million adults had OA, and the knee is one of the most commonly affected joints. The prevalence increases with age, with a significant portion of the population over the age of 65 being affected[25]. The ratio of knee OA in European countries also varies but generally follows a similar pattern to the United States. It is more common in older adults and varies by country and region. The prevalence of knee OA in Asian countries can also vary, with some countries having a higher prevalence due to factors like aging populations and lifestyle changes [26]. OA, including knee OA, is also prevalent in Africa, and its prevalence is expected to increase as the population ages. The prevalence of knee OA in the Middle East can vary among countries and regions but is generally influenced by lifestyle factors and an aging population. Knee OA is a common condition in South American countries, and its prevalence is influenced by factors like genetics, lifestyle, and access to healthcare [27].

Chronic Knee Osteoarthritis: A Comprehensive Analysis of Risk Variables

Degenerative joint disease, or OA, is a global health concern impacting millions of individuals. The protective tissue that cushions the bones in the knee joint, cartilage, begins to deteriorate. Knee discomfort, stiffness, and loss of range of motion may result from this breakdown. Compared to males, women are more prone to develop knee OA. Some are genetically predisposed to OA [28,29]. Excess weight places additional strain on the knee joints, hastening the cartilage's deterioration. The likelihood of developing OA in the knee might be elevated by a history of trauma to the joint, such as a fracture, dislocation, or ruptured ligament. Running, leaping, and squatting are examples of repetitive motions that exert stress on the knee joints and raise the risk of OA [30,31]. The likelihood of developing OA may rise if the muscles around the knee joint are weak. A higher chance of developing OA is linked to low bone density. The risk of injury and OA is higher in loose or unstable joints [32].

The degree of early cartilage damage, physical activity level, degree of initial cartilage damage, and other medical issues can all have an impact on how quickly knee OA progresses. While inactivity can cause muscular weakness and joint stiffness, which can exacerbate OA, excessive physical activity can hasten the disease's course. Rheumatoid arthritis and diabetes, for example, can exacerbate the course of OA and raise its risk [33,34]. Although OA cannot be cured, several things may be done to delay the disease's development and progression. One way to lessen the strain on the knee joints is to lose weight. Exercise can assist in increasing joint flexibility and strengthen the muscles surrounding the knee joint. Steering clear of painful activities can help stop the knee joint from getting worse. Assistive technology, such as walkers or canes, can lessen the strain on the knee joints. NSAIDs and painkillers are two examples of medications that can help control OA pain. In certain instances, knee replacement or restoration of the damaged cartilage may need surgery [35,36].

Pathophysiological Mechanism

The pathophysiological mechanism of knee OA is a complex process that involves multiple factors, including mechanical stress, age, genetics, obesity, and injury. These factors often interact and can lead to the gradual degradation of the knee joint, resulting in pain, reduced mobility, and functional impairment (Fig. 1). The breakdown of articular cartilage leads to many changes in the knee joint, including cartilage erosion, synovitis, subchondral bone sclerosis, and osteophyte formation[37,38]. These changes can lead to some

symptoms, including pain, stiffness, loss of range of motion, creaking or popping noises, and swelling. There is no cure for knee OA, but there are treatments that can help manage the symptoms and slow the progression of the disease. Treatment options include NSAIDs, corticosteroids, hyaluronic acid injections, physical therapy, weight loss, and surgery [39].

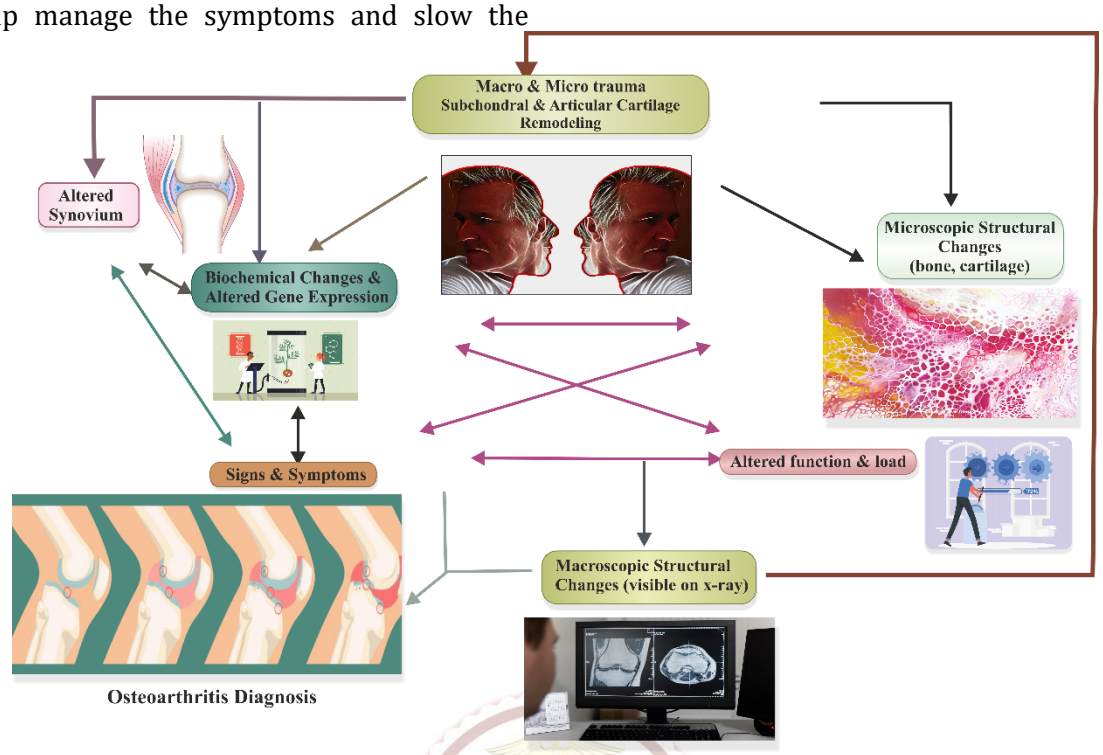

Figure 1: Pathogenesis and aetiology of Osteoarthritis

The primary hallmark of knee OA is the progressive degeneration of articular cartilage. Articular cartilage is the smooth, protective tissue covering the ends of bones in a joint. Over time, this cartilage undergoes wear and tear, losing its elasticity and ability to absorb shock. Chronic low-grade inflammation can be triggered by various factors, including injury, obesity, and genetic predisposition [40]. Inflammation can lead to the production of enzymes, such as matrix metalloproteinases (MMPs), that degrades the cartilage. The subchondral bone, located just beneath the cartilage, undergoes alterations in knee OA. It may become denser (sclerosis) in some areas and develop cysts or bone spurs (osteophytes) in others. These changes can alter the mechanics of the joint and contribute to pain and stiffness [41]. Hormonal changes, particularly in women, can influence the development and progression of knee OA. Estrogen, in particular, may have a protective effect on cartilage. Post-menopausal women, who experience a decline in estrogen levels, are at an increased risk of knee OA [42]. Excessive mechanical stress on the knee joint can accelerate the degenerative process which can be due to obesity, joint misalignment, overuse, or injury. Obesity, in particular, increases the load on the knee joint and is a significant risk factor for knee OA in women. Genetic factors can also contribute to the development of knee OA. Certain genetic variations may make some individuals more susceptible to cartilage degeneration and joint inflammation. The synovial membrane, which lines the joint capsule, can become inflamed and thickened in OA, which results in the production of synovial fluid that contains pro-inflammatory substances. This chronic synovitis can contribute to pain and further joint damage. Altered neuromuscular control of the knee joint, such as muscle weakness or imbalances, can affect joint stability and increase the risk of OA progression [43].

Women are more likely to develop OA as they get older, especially after menopause. The drop in estrogen levels during menopause may contribute to the development of knee OA in women. Estrogen has protective effects on cartilage and can help maintain joint health. Excess body weight is a significant risk factor for knee OA in both men and women. Being overweight or obese increases the mechanical stress on the knee joints, leading to more wear and tear. A family history of OA can increase the risk of developing the condition, and genetic factors can make women more susceptible to knee OA [44,45]. Women who have experienced significant knee injuries, such as ligament tears or fractures, are at a higher risk of developing knee OA. This is because joint injuries can lead to long-term joint instability and damage. Activities that involve repetitive stress on the knees or prolonged kneeling can increase the risk of knee OA. Women in certain professions, such as nursing or housekeeping,

may be more prone to this risk. Poor alignment of the knees or hips can increase the risk of knee OA [46,47]. Women may have a higher risk if they have conditions like genu valgum (knock-knees) or genu varum (bowlegs). Lack of physical activity can contribute to muscle weakness and joint instability, increasing the risk of knee OA. Weaker quadriceps and hamstring muscles can fail to provide adequate support to the knee joint, leading to increased stress on the joint and an elevated risk of OA. Certain medical conditions, such as rheumatoid arthritis, can increase the risk of knee OA. Women are more likely to have autoimmune conditions like rheumatoid arthritis. Frequent use of high-heeled shoes can alter the biomechanics of the knee joint and increase the risk of knee OA [48,49,50].

Management of Osteoarthritis in Various Aspects

(i) Ayurvedic Approach

Ayurveda is an ancient system of medicine that has been practiced in India for thousands of years. It offers a holistic approach to health and wellness, focusing on the balance of the body, mind, and spirit. While Ayurveda may not offer a cure for knee OA, it can provide relief from symptoms and improve the overall quality of life for individuals with this condition [51,52]. Some Ayurvedic approaches like as dietary changes, herbal remedies, massage and therapies, yoga and exercises, and lifestyle modifications may help women with knee OA. Consumption of foods that are known for their anti-inflammatory properties, such as turmeric, ginger, and green leafy vegetables may be helpful for knee OA patients [53,54]. However, processed and refined food items should be avoided as they can exacerbate inflammation and contribute to weight gain, which can worsen knee OA symptoms. In herbal remedies, turmeric (curcumin) is a well-known anti-inflammatory herb that can be consumed as a spice or in supplement form, also *Boswellia* (Indian frankincense) has anti-inflammatory properties which may help to reduce joint pain and stiffness [54,55].

Warm herbal oils are used for self-massage during Ayurvedic massages, such as *Abhyanga*, to relieve stiffness and soreness in the joints. Additionally, the Ayurvedic detoxification procedure *Panchakarma* treatment aids in the removal of impurities and the reduction of inflammation. Specific yoga postures can also help to improve flexibility and reduce pain in the knees, while certain Ayurvedic exercises are designed to strengthen the body and improve joint health. Excess weight can put additional stress on the knees, so Ayurveda encourages maintaining a balanced body weight. Also, regular, gentle exercise is essential for maintaining joint flexibility and preventing muscle atrophy [56,57]. Some Ayurvedic therapies are often used to help alleviate pain and inflammation associated with knee OA are depicted in Fig. 2.

Hot and Cold Compress Therapy

Both hot and cold compress therapy is a conservative and non-invasive approach to managing knee OA symptoms. It involves the use of temperature-based treatments to alleviate pain and inflammation in the knee joint. Applying a hot compress or heating pad to the affected knee can help relax the muscles, increase blood flow, and reduce stiffness. Heat therapy can be particularly beneficial in the morning or before engaging in physical activity to improve joint flexibility. In cold therapy, often in the form of ice packs, can help reduce inflammation and numb the area, providing relief from pain. Cold compresses are typically used after physical activity or when the knee is acutely inflamed. The general recommendation is to use hot or cold compresses for 15-20 minutes at a time, several times a day as needed. It's essential to wrap the hot or cold compress in a cloth to avoid direct skin contact, which can lead to burns or frostbite [58,59].

Janu Basti

This therapy specifically targets knee-related conditions, including knee OA. It involves creating a small well-like structure around the knee joint using dough made from black gram or wheat flour. Warm medicated oil, typically herbal oils like *Mahanarayan* oil or *Dashamoola* oil, is then poured and held within this well for a specified duration. The warm oil and the therapeutic properties of herbs penetrate the knee joint and surrounding tissues, reducing pain, inflammation, and stiffness. *Janu Basti* is believed to nourish the knee joint, improve circulation, and provide structural support [60].

***Marma* Therapy**

It is an ancient healing practice that originates from Ayurveda and focuses on vital energy points in the body known as "*Marma* points." These points are believed to be intersections of energy channels and can influence physical and mental health. In the context of knee OA, *Marma* therapy may involve gentle massage, acupressure, or stimulation of specific *Marma* points related to the knee and the lower limbs. This therapy improves energy flow, reduces pain, and enhances joint mobility [60,61].

Figure 2: Various Ayurvedic therapies for knee OS: (a) Hot compress (b) Cold compress (c) *Marma* (d) *Janu Basti*

(ii) Modern Approach

There are several treatment methods available, and the most appropriate course of action will change based on the needs and conditions of the individual. Alterations in lifestyle, such as Utilizing assistive technology, exercising often, and losing weight can all help to enhance function and lessen discomfort. Pain can be reduced with over-the-counter medications like ibuprofen or acetaminophen. Prescription pharmaceuticals can also be utilized, such as COX-2 inhibitors and NSAIDs. Exercises designed to enhance joint function and strengthen the muscles surrounding the knee can be taught by physical therapists [62, 63]. Additionally, they can offer therapies like massage and heat therapy that relieve discomfort. Injections of corticosteroids can reduce inflammation and discomfort momentarily. Injections of hyaluronic acid may also be beneficial for certain individuals [64]. Furthermore, arthroscopic surgery is a less invasive technique that may be used to fix damaged cartilage or remove loose bits of bone. In an osteotomy, the knee bones are sliced and realigned to release pressure from the injured joint [65]. A total knee arthroplasty (TKA) is a significant procedure in which an artificial implant is used to replace the damaged joint. Although TKA is a very successful therapy for severe knee OA, it is a significant procedure with risks. A novel therapeutic approach called stem cell therapy is being researched for its ability to restore damaged cartilage. Another novel therapeutic option being investigated is gene therapy, which may be able to decrease the progression of OA in the knee [66, 67].

CONCLUSION

Women are disproportionately affected by knee OA, a frequent and crippling illness. Even though there is no known cure for osteoarthritis, there are several treatment options that can help control pain and enhance function. Acupuncture, yoga, hot and cold compresses, *Janu basti, Marma* therapy, chiropractic adjustments, and other traditional therapies are used to treat osteoarthritis. Certain studies have demonstrated the efficacy of these techniques in lowering pain and enhancing function. Nevertheless, more investigation is required to validate these results. Surgery, physical therapy, and medication therapies are examples of contemporary OA treatment techniques. NSAIDs, opioids, and over-the-counter painkillers are examples of pharmacologic therapies. Strength, flexibility, and range of motion in the joints can all be enhanced with physical therapy. Although it is usually seen as a last option for OA patients, surgery can occasionally be successful in reducing pain and enhancing function. OA therapy in the future will probably include traditional and cutting-edge techniques. Researchers are actively looking at stem cell and gene therapy as potential new and better therapies for OA. The course of OA may be slowed down or even reversed with these therapies. Researchers are creating fresh approaches to OA prevention in addition to novel therapies. Keeping a healthy weight, working out often, and avoiding joint-stressing activities are some of these preventive methods.

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