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TINJAUAN PUSTAKA

Medical Rehabilitation Program for Knee Osteoarthritis: A Narrative Review

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Abstrak

Latar Belakang: Osteoartritis (OA) adalah artritis degeneratif paling umum pada usia lanjut, lebih sering pada wanita, dan menjadi penyebab utama disabilitas pada >65 tahun. Patofisiologi melibatkan penuaan sendi, trauma/overuse, faktor genetik, obesitas, dan perubahan hormonal. Penggunaan NSAID jangka panjang berisiko gastritis, perdarahan, dan gangguan ginjal. **Objektif:** Merangkum beban, mekanisme, gejala, serta strategi tatalaksana OA yang komprehensif dan berorientasi pasien. **Metode:** Tinjauan naratif atas literatur terkini mengenai epidemiologi, patofisiologi, manifestasi klinis, dan intervensi berbasis bukti pada OA. **Hasil:** Gejala berkembang perlahan dan dapat dipercepat trauma/beban berlebihan, menurunkan produktivitas dan kualitas hidup. Pendekatan bertahap meliputi edukasi, terapi fisik, dan latihan terstruktur; diikuti farmakoterapi (analgesik/NSAID dengan kewaspadaan efek samping) serta alat bantu. Pemilihan intervensi disesuaikan derajat keparahan dan jumlah sendi. Faktor perburukan meliputi kelemahan otot, obesitas, dan depresi. Intervensi dini multimodal menurunkan nyeri, mengoptimalkan fungsi, dan menekan progresivitas. **Kesimpulan:** OA umum namun dapat dikendalikan melalui tatalaksana personalisasi yang menyeimbangkan manfaat–risiko, menargetkan penguatan otot, pengelolaan berat badan, dan dukungan psikososial. Prognosis membaik bila terapi dimulai dini dan dijalankan konsisten.

Kata kunci: osteoartritis, sendi lutut, penyakit degeneratif, rehabilitasi, terapi fisik

Abstract

Background: *Osteoarthritis is the most prevalent degenerative joint disease, increases with age in Indonesia, affects all ethnicities, more in women, and is a leading cause of long term disability in adults 65 years or older. Prolonged NSAID use may cause gastritis, bleeding, and renal injury.* ***Objective:*** *To synthesize current understanding of osteoarthritis burden, mechanisms, and patient centered management.* ***Methods:*** *Narrative review of recent evidence on epidemiology, pathophysiology, clinical features, and treatment guidance.* ***Results:*** *Symptoms develop gradually and may accelerate after injury or overload. Drivers include joint aging, trauma or overuse, genetics, obesity, and hormonal factors. First line care comprises education, weight control, physical therapy, and structured exercise. Analgesics and NSAIDs with risk mitigation, intra articular injections, and assistive devices are added by severity and joint involvement. Early multimodal strategies reduce pain, improve function and quality of life, and may slow progression. Outcomes worsen with muscle weakness, obesity, and depression.* ***Conclusion:*** *Osteoarthritis is common yet manageable. Stratified individualized care started early and balanced for benefit and risk preserves mobility and independence and reduces complications.*

Keywords: *osteoarthritis; knee joint; degenerative disease; rehabilitation; physical therapy.*

INTRODUCTION

Osteoarthritis (OA) is a form of arthritis associated with bone and cartilage degeneration, often occurring in older age. It's the most common form of arthritis, sometimes referred to by experts as a degenerative joint disease or 'wear and tear' arthritis.[1] OA, also known as degenerative joint disease, osteoarthrosis, or hypertrophic arthritis, ranks among the most prevalent medical issues causing symptoms in both elderly and middle-aged individuals.[2]

Reportedly affecting 303 million people globally in 2017,[3] the prevalence of OA in Indonesia increases with age, reaching 5% in individuals under 40 years, 30% in the 40–60 age group, and 65% in those over 60. In Indonesia, the prevalence is approximately 5% in males and 12.7% in females.[4,5] Generally, OA is not fatal, but complications such as pain, joint deformities, and reduced joint mobility can significantly impact quality of life. Additionally, OA is associated with mental health disorders like depression, anxiety, and sleep disturbances.[1,6]

OA affects people of all ethnicities, more frequently women, and stands as the most common cause of long-term disability in patients over 65. Over a third of individuals over 45 report varied joint symptoms, ranging from occasional joint stiffness and intermittent pain associated with activities to limb paralysis and persistent intense pain often felt due to joint deformities and instability.[3,7]

The etiology of OA is categorized into primary and secondary forms. Primary OA results from cartilage degeneration without a clear cause, while secondary OA arises from degeneration due to preceding illnesses. While OA isn't fatal, its resulting complications can significantly impact the quality of life, such as pain, joint deformities, and reduced joint mobility.[2,8]

Joint degeneration leading to the clinical syndrome of OA most commonly occurs in the hand, foot, hip, and spinal joints, although it can affect any synovial joint. The prevalence of synovial joint damage increases with age.[9] Modifiable risk factors for knee OA include joint trauma, prolonged standing occupations, repetitive knee bending, muscle weakness, imbalance, and excess body weight. Non-modifiable factors include gender (with females more commonly affected), age, and genetics.[10]

Inadequate or delayed management of OA can lead to disability. The progression of clinical symptoms varies in intensity and frequency, often worsening and debilitating patients over time.[11] Management of OA is selected based on severity and the number of affected joints. Management aims to control pain, optimize joint function, reduce physical limitations, improve quality of life, and hinder disease progression.[12]

Medicinal management modalities are commonly used to alleviate pain symptoms, while surgical therapy involves joint replacement. The use of knee braces can also aid in knee OA management.[11,13] A comprehensive approach encompassing

promotive, preventive, curative, and rehabilitative aspects across various modalities is the best option to achieve recovery and prevent disability from OA. Exercise, sports, patient education, and weight reduction are recommended as primary strategies for managing OA symptoms. Furthermore, these interventions have shown beneficial effects, including sustained improvement in physical activity and quality of life after one year. These outcomes suggest that a combination of education and exercise can lead to long-term reductions in knee OA burdens and costs for patients and healthcare systems.[14,15]

Therefore, a fundamental understanding of rehabilitation modalities for knee OA is necessary to provide recommendations for interventions that enhance the quality of life for patients, particularly the elderly.

METHODS

This literature review employed a narrative methodology to synthesize relevant research. The initial phase involved sourcing articles from reputable journals via search engines such as PubMed, ScienceDirect, and Google Scholar, using specific keywords including osteoarthritis, knee joint, degenerative disease, rehabilitation, and physical therapy.

Inclusion criteria encompassed articles published in English within the last five years, with scrutiny applied to titles and abstracts. Exclusion criteria involved non-English articles, non-original studies, and content deviating from the specified keywords. The collected papers underwent a systematic analysis. The review comprised a comprehensive assessment of original articles within the scope.

RESULTS AND DISCUSSION

The Anatomy and Kinesiology of the Knee Joint

The knee joint is distinct compared to other joints in the human body due to the lack of congruence between the bones forming it. To compensate for this incongruence, there are menisci, joint capsules, bursae, and discs that enable extensive movement, reinforced by large muscles and various ligaments to ensure strength and stability. The knee joint comprises connections between the femur and tibia (tibiofemoral joint), femur and patella (patellofemoral joint), and tibia and fibula (proximal tibia-fibular joint).[16]

Passive stabilization of the knee joint is carried out by ligaments. Ligaments present in the knee joint include the cruciate ligaments, divided into the anterior and posterior cruciate ligaments. Collateral ligaments are also divided into the medial collateral ligament and lateral collateral ligament. The cruciate ligaments, particularly the strongest ones in the knee joint, control knee movements, limit extension, prevent rotational movements in the extended position and maintain the slide of the femur on the tibia in the front-back

direction, stabilizing the front and back parts of the knee joint.[17–19]

During external rotation, both cruciate ligaments align, reducing joint stability. On the medial and lateral sides of the knee joint are the medial and lateral collateral ligaments. The medial collateral ligament resists valgus and external rotation, while the lateral collateral ligament only resists varus movement. Both ligaments prevent the forward shift of the tibia from a 90-degree knee flexion position. Symmetrically, the femoral condyles and tibial condyles are covered by menisci composed of fibrocartilage, reducing upper femoral pressure on the tibia, distributing pressure between both condyles, reducing friction during movement, aiding the joint capsule and ligaments in preventing knee hyperextension, and preventing the joint capsule from folding into the joint.[18,19]

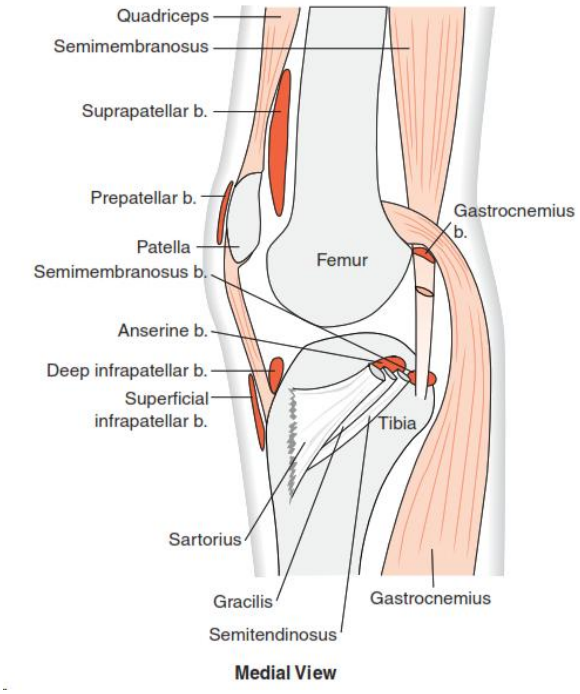
The medial meniscus is shaped like an open "C" ring, while the lateral meniscus is like an "O" ring. These structures help alleviate pressure on the upper tibia from the femur by spreading pressure on the articular cartilage and reducing pressure distribution between the two condyles during movement. They also assist the joint capsule in preventing hyperextension of the knee and prevent the joint capsule from folding into the joint. The knee joint also has an articular joint capsule attached to the articular cartilage; within the joint, the synovial membrane passes anteriorly through the attachment of the cruciate ligaments, making the cruciate ligaments intra-articular but extracapsular.[1,17]

The joint-forming bones are connected by a sheath called the articular capsule, encompassing the joint surfaces and enclosing the joint space between these bones. The outer layer of the articular capsule (fibrous layer) is a critical structure that binds the joint-forming bones together.[16,20]

The fibrous layer can withstand strong stretches. The inner layer of the articular capsule (synovial layer) is formed by the synovial membrane, which secretes synovial fluid (synovia) into the joint space. The articular ends of the bones are enlarged and have a thin but dense outer layer (compact), with a spongy bone meshwork on the inside. The knee joint capsule comprises avascular fibrous tissue, making healing processes challenging in case of injury.[19,21]

The muscles around the knee serve as active stabilizers and movers in knee joint activities, including the quadriceps femoris muscle (vastus medialis, vastus intermedius, vastus lateralis, rectus femoris). These four muscles form the extensor group, while the flexor group comprises muscles such as the gracilis, sartorius, and semitendinosus. Rotational movements at the knee joint are supported by the muscles in the flexor group, including the medial/endorotation group (semitendinosus, semimembranosus, sartorius, gracilis,

popliteus) and the lateral/exorotation group (biceps femoris, tensor fasciae latae).[17,22]



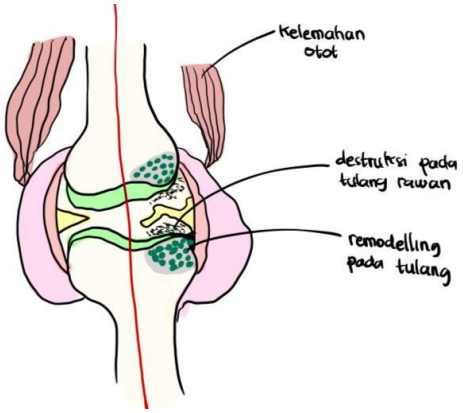
Picture 1. Anatomy of Knee Joint.[23]

Pathophysiology of Knee Osteoarthritis

The pathophysiology of osteoarthritis (OA) is primarily associated with joint aging physiologically, often referred to as degenerative joint disease. However, multiple factors play a role in the development of OA, such as trauma, overuse, genetic factors, obesity, and hormonal changes. These factors impose prolonged stress on the joints, disrupting the homeostasis of joint synthesis-degradation, and inducing morphological changes like cartilage damage, osteophyte formation, subchondral sclerosis, and subchondral bone cyst formation.[24]

The progression of OA is divided into three phases: proteolytic breakdown of the cartilage matrix followed by fibrillation and erosion of the cartilage surface, accompanied by the release of proteoglycans and collagen fragments into the synovial fluid. Lastly, the degradation process of cartilage products induces an inflammatory response in the synovium. Synovial macrophages, such as interleukin 1 (IL-1), tumor necrosis factor-alpha (TNF-α), and metalloproteinases, are increased. This condition manifests an impact on the cartilage, directly leading to its destruction and ultimately resulting in changes in joint architecture.[24,25] (Yunus, Nordin, and Kamal, 2020; Coaccioli et al., 2022).

An illustration of the pathophysiology of knee OA is depicted in Figure 2.



Picture 2. Pathophysiology of Knee Osteoarthritis.

Medical Rehabilitation Program for Knee Osteoarthritis (OA)

Knee OA Education

The provision of education and advice on weight reduction, physical therapy, and work therapy is performed as non-pharmacological modalities in the comprehensive management of OA. In education, it is crucial to persuade patients to be self-reliant, and not always

dependent on others. The quality of life for OA patients can be enhanced.[26]

Weight Reduction

Weight reduction is a crucial step, especially in obese patients, to reduce the load on affected joints and enhance patient agility during movement.[26] Patients with osteoarthritis or those at risk require education about lifestyle changes to reduce the risk of osteoarthritis and disease exacerbation. Prevention through lifestyle changes such as exercise, weight loss, and low-calorie diets is recommended. Regular check-ups annually or as agreed upon by the doctor-patient are necessary. Laboratory tests to assess liver and kidney function should be conducted every 3-6 months after oral therapy. Patients should be monitored promptly if symptoms worsen or if pain does not improve with treatment.[13,27]

Physical Therapy and Exercise for Knee OA

Physical therapy and work therapy aim to enable patients to achieve optimal activity levels and independence. This therapy involves cooling, warming, and exercise equipment use. It includes muscle strengthening exercises, joint range-of-motion expansion, and aerobic exercises. These exercises are not only for patients not undergoing surgery but also for those undergoing or planning surgery, enabling them to regain independence post-surgery and reduce surgical complications.[28]

a. Manual Therapy

Manual therapy involves passive movements by physiotherapists intending to enhance joint movement and reduce joint stiffness. Techniques involve passive range-of-motion training, passive training of tissues around joints, muscle stretching, or soft tissue mobilization, and massage. This exercise effectively improves walking distance and reduces pain, dysfunction, and stiffness in knee osteoarthritis patients.[29]

b. Flexibility Exercises

Joint mobility is crucial to maximizing joint range of motion, improving muscle performance, reducing injury risks, and enhancing cartilage nutrition. Flexibility exercises, performed in the initial stage of physical exercise, can increase muscle length and elasticity around joints. For OA patients, flexibility exercises aim to reduce stiffness, improve joint mobility, and prevent soft tissue contractures. These exercises are often incorporated during warm-ups or included in resistance or aerobic activities.[30]

Stretching techniques are employed to improve joint range of motion. These stretching exercises involve moving muscles, joints, and tissues around the joints. All movements should target the joint range of motion without causing pain. Applying heat therapy before stretching can reduce pain and enhance movement. Flexibility exercises can start with stretching each muscle group at least three times a week. Once accustomed, increase the repetitions gradually per muscle group. Exercises should involve major muscle and tendon groups in both upper and lower extremities.[31,32]

c. Strength Training

Strength training has similar effects to aerobic exercise in improving disability,

pain, and performance. There are three types of strength training: isometric, isotonic, and isokinetic. Isometric, isotonic, or isokinetic muscle strength exercises can reduce pain and disability and improve walking speed in knee osteoarthritis patients. Isotonic exercises provide greater improvement in pain relief. Strength training is recommended for initial strength training in osteoarthritis patients with knee pain during exercise. Isokinetic training significantly increases walking speed and reduces disability after therapy and during evaluation, thus recommended for improving joint stability or walking endurance.[33,34]

Isometric exercises are indicated if the joint experiences acute inflammation or is unstable. Isometric contractions apply mild pressure to the joint and are well-tolerated by osteoarthritis patients with joint swelling and pain. These exercises can improve muscle strength and static endurance by preparing the joint for more dynamic movements and serve as the starting point for strength training. As joint instability and pain reduce, the training program should gradually transition to dynamic exercises (isotonic).[35]

Isometric strength training should consider exercise type, intensity, volume, and frequency. Exercises should involve major muscle groups. Isometric contractions should start at low intensity, instructing patients to maximize contractions in the target muscles. Exercise intensity should start at around 30% of maximal effort. If tolerated by the patient, intensity can gradually increase to 75% of maximal contraction. Contractions should not be sustained for more than 6 seconds. Initially, one contraction for three muscle groups, then repetitions should be increased to 8-10, depending on patient tolerance.[36]

Patients are instructed to breathe during each contraction. A 20-second interval between contractions is recommended. Exercises should be done twice a day during acute inflammation. Subsequently, the number of exercises should gradually increase to 5-10 times per day, adjusted to the patient's condition. It's important to note the risk of increased blood pressure if contractions are held for more than 10 seconds. Isotonic contractions are used for daily activities. Isotonic strength exercises show positive effects on energy metabolism, insulin function, bone density, and functional status in healthy individuals. If there is no acute inflammation or joint instability, these exercises are well-tolerated by osteoarthritis patients.[37]

d. Aerobic Exercise

Aerobic exercises (walking, cycling, swimming, aerobic exercises, and pool aerobic exercises) can improve aerobic capacity, strengthen muscles, increase endurance, reduce weight, and decrease medication use in osteoarthritis patients. The choice of aerobic activity depends on factors such as disease status, joint stability, patient resources, and interests. Warm-water aerobic exercises can reduce muscle and joint pain, minimize joint load, improve painless movement, and

strengthen muscles around painful joints.[38,39]

Modality Therapy

Therapy using modalities like thermotherapy (heat or cold), hydrotherapy, and electrotherapy (Transcutaneous Electrical Nerve Stimulators - TENS) are utilized. Heat therapy methods such as Ultrasound, Microwave Diathermy (MWD), and Shortwave Diathermy (SWD) can be used as additional therapy, used alongside physical exercises and medications.[33,40] The expected effects are muscle relaxation, reduced pain, and strengthening of joint structures to support the joint. Wu et al. reported that TENS significantly alleviates pain, reduces dysfunction, and improves walking ability in knee OA patients but is not effective in addressing stiffness.[41] In line with this, Amalia et al. stated that heat therapy using IR and MWD contributes to tissue improvement and inflammation reduction in knee OA, thereby reducing OA-related pain. The choice of therapy type is adjusted based on individual response and acute/chronic processes.[42]

Orthotic Prosthetic

Efforts to reduce disability can be made using knee braces as orthotic aids. The benefits of using a Knee brace include preventing further advancement of genu varus and reducing the degree of existing genu varus. Genu varus deformity can be reduced or further prevented by using Knee Braces. AFO aids, besides acting as knee supports, can also correct or prevent further deformities. AFO knee significantly reduces the varus angle of the knee compared to shoes and both knee valgus supports when walking and climbing stairs, as well as the first peak of the external knee adduction moment when walking and the knee adduction angle impulse when climbing, compared to shoes.[43,44]

Improvements or prevention can be achieved by installing a single bar on the medial side, and as a counterforce, a strap crossing from the inferior medial crural side to the superior medial femur is added to the genu varus angle. This strap aims to press the apex of the genu varus toward the medial direction.[45]

Prognosis of Knee Osteoarthritis

First-line treatment for all patients with knee osteoarthritis symptoms includes patient education and physical therapy. A combination of supervised exercises and home exercise programs has proven to yield the best results. These benefits will diminish after 6 months if exercise is discontinued. The American Academy of Orthopaedic Surgeons (AAOS) recommends education-based treatment.[34,46]

Weight loss is highly beneficial at all stages of knee osteoarthritis. This is indicated in patients with arthritis symptoms with a BMI greater than 25. The best recommendation for achieving weight loss is dietary control and low-impact aerobic exercise. There is evidence of weight loss based on AAOS guidelines.[34] Knee support in osteoarthritis includes unloader brace types that redirect the load from the involved knee compartment. This is beneficial in conditions involving the lateral or medial compartments of the

knee, for example, valgus or varus deformities. Older patients (geriatrics) are the group most affected by OA due to degenerative processes.[47]

The prognosis for osteoarthritis can be good if it is detected at an early damage stage. To date, there is no definitive cure for osteoarthritis, and the disease often leads to complications such as impaired daily activities. The main complications of osteoarthritis are pain, risk of falls, joint deformities, and reduced joint scope.[1,11]

In addition to complications directly related to the disease, there are also possible complications due to management. Gastritis, bleeding, or kidney disorders due to long-term use of nonsteroidal anti-inflammatory drugs (NSAIDs) need attention.[48] Infections, joint stiffness, fractures, and joint instability can occur due to post-surgical complications. Clinical symptoms of osteoarthritis develop slowly over time, but these symptoms can be accelerated by trauma or excessive joint loading. Complaints due to osteoarthritis can reduce patient productivity and quality of life. Other factors that can worsen the prognosis of osteoarthritis are muscle weakness, obesity, and depressive disorders.[26,27]

CONCLUSION

Osteoarthritis (OA) is a type of joint inflammation characterized by severe degeneration of tendons and ligaments. This condition affects 303 million people worldwide and is more prevalent among the elderly, with higher prevalence rates in Indonesia. OA affects individuals of all ethnicities and is associated with a higher risk of joint disability in the elderly. The etiology of OA is influenced by cartilage degeneration and complications that can affect quality of life, such as joint pain, stiffness, and instability. Risk factors for OA include synovial joint damage, traumatic injuries, low physical activity, joint pain, and poor joint function. OA treatment involves a comprehensive approach encompassing prevention, treatment, and rehabilitation. The use of knee braces can also be utilized as a treatment strategy for OA. A combination of education and rehabilitation can help reduce the risk of osteoarthritis and enhance the quality of life for patients in the future.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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