

Management of Primary Knee Osteoarthritis and Indications for Total Knee Arthroplasty for General Practitioners

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Osteoarthritis (OA) of the knee, one of the most common causes of disability, continues to increase in prevalence as the older adult and obese populations grow. Often, the general practitioner is the first to evaluate a patient with a painful knee that has arthritis. Evidence-based evaluation and treatment guidelines recommend the use of nonoperative treatments before surgical treatment options such as total knee arthroplasty (TKA) are considered. Understanding available nonoperative treatment options is critical for physicians who first encounter patients with OA of the knee. The authors provide an overview of nonoperative treatment options for patients with OA, including weight loss, aerobic exercise, osteopathic manipulative treatment, non-steroidal anti-inflammatory drugs, and corticosteroid injections. The authors also discuss operative treatment options to be considered before TKA and review indications for TKA when other treatment options have been exhausted.

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By 2030, the number of US adults with arthritis is projected to reach 67 million.¹ Primary osteoarthritis (OA), the most common type of arthritis, currently affects 27 million US adults.² Primary OA of the knee is one of the most common reasons for disability,³ with older adults and obese individuals at the highest risk for developing the disease in this area.⁴ As these 2 populations continue to increase, osteopathic physicians will likely see an increase in patients with primary OA of the knee and should be aware of nonoperative and operative treatment options for these patients. In the present review, we address some of the latest nonoperative treatments for patients with knee OA, operative procedures that can be used before total knee arthroplasty (TKA), and indications for TKA when these options have been exhausted.

Epidemiologic Characteristics

Primary OA develops in a slow, progressive fashion and can affect 1 or all 3 major joint compartments of the knee. The risk of getting knee OA is a multifactorial, complex interplay of constitutional and mechanical factors. Osteoarthritis is directly linked to an increase in water content of the articular cartilage with a decrease in proteoglycan content.⁵ As collagenase levels increase, maintained collagen becomes severely disrupted. With elevated levels of proteolytic enzymes and inflammatory cytokines, the vicious cycle continues and the joint becomes more arthritic and painful.⁵

More than 50% of patients older than 65 years have radiographic changes in the knee that indicate arthritis.⁴ These radiographic changes include marginal osteophytes, narrowing of the joint space, subchondral degenerative cysts, and subchondral sclerosis. However, many patients are asymptomatic until after age 65 years. Internationally, there is a higher prevalence of OA among elderly women and Native Americans.⁴ Whites are more commonly affected than African Americans.⁴ Rates of OA have increased in the United States and internationally in recent years. The Framingham Osteoarthritis Study⁶ found that

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KEY POINTS

THE INITIAL VISIT FOR PATIENTS WITH PRIMARY OSTEOARTHRITIS of the knee should always begin with a discussion of and preparation for nonoperative treatment.

MAINTAINING AN IDEAL BODY WEIGHT, BODY MASS INDEX, and posture substantially decreases the joint reaction forces across the joint.¹¹

IMPAIRED POSTURE AND MALALIGNMENT OF THE LUMBAR spine and lower extremity change the body's overall mechanical alignment and can contribute to knee pain.

PHYSICIANS SHOULD INCORPORATE A TRIAL OF WEIGHT LOSS with diet and exercise in the initial nonoperative treatment of patients with primary osteoarthritis of the knee.^{9,19}

PHYSICIANS SHOULD FOCUS ON NORMALIZING MYOFASCIAL and lymphatic restrictions through techniques such as counterstrain positioning, lymphatic pump, trigger point injections, soft-tissue massage, and myofascial release.¹⁵

TOTAL KNEE ARTHROPLASTY IS INDICATED FOR PATIENTS who continue to have knee pain after 6 months of nonoperative treatment.⁸

cosamine.³ In 2008, the American Academy of Orthopaedic Surgeons (AAOS) released evidence-based clinical practice guidelines for nonoperative treatment of patients with primary knee OA.⁹ These guidelines, including levels of evidence and grades of recommendation, are listed in the *Table*.

Nonpharmaceutical Treatment

Weight loss—The AAOS recommends self-management, exercise, and integrated health care programs for patients with knee OA.⁹ Examples of these types of programs are listed in *Figure 1*. Of these, a trial of weight loss with diet and exercise received the highest possible AAOS recommendation for nonoperative management of knee OA.⁹

The Framingham knee osteoarthritis study¹⁰ showed a greater than 50% reduction in primary knee OA with a decrease in body mass index of 2 or more. To put this into perspective, the force on each knee per step is equivalent to approximately 2 to 3 times a person's body weight. Therefore, an additional 33 lb of body weight could add up to 100 lb of force on each knee per step. Assuming the average person takes roughly 2000 steps per day, this additional force could equal up to 100 extra tons of force on each knee per day. Thus, 33 lb of weight loss can have a dramatic effect on the amount of load bearing to the knee.

Aerobic exercise—According to a meta-analysis by Brosseau et al,¹¹ randomized controlled trials have shown that aerobic exercise contributes to better long-term function in active patients with primary knee OA. Home exercise programs and supervised exercise classes can substantially decrease pain and improve function in patients with knee OA.¹¹ Strengthening specific muscles such as the tensor fascia lata improves knee biomechanics. However, many patients have a tough time dedicating themselves to

prevalence of knee pain and symptomatic OA in the United States roughly doubled in women and tripled in men during the 20 years of the study after adjusting for age and body mass index. In Finland and Sweden, incidence rates for OA have increased almost tenfold from 1986 to 2003.⁷ With the increase in primary OA, there is a concomitant increase in TKA. However, TKA is an invasive procedure. In addition, younger patients are at an increased risk of having their knee replacement wear down and needing a second TKA later in life. For these reasons, at least 6 months of nonoperative treatment should be exhausted before TKA becomes an option.⁸

Nonoperative Treatment

The initial patient visit should always begin with a discussion about and preparation for nonoperative treatment. Nonoperative treatment is generally indicated for patients with generalized knee pain, especially young and middle-aged patients who have signs and symptoms of early knee OA and who wish to delay undergoing a surgical procedure. Initial management of knee OA may include nonpharmaceutical treatment, including weight loss, aerobic exercise, orthotics, and osteopathic manipulative treatment, or pharmaceutical treatment, including nonsteroidal anti-inflammatory drugs (NSAIDs), corticosteroid injections, hyaluronic acid (HA) injections, and glu-

Table.
AAOS Guidelines for Nonoperative Treatment Options for Patients with Osteoarthritis of the Knee⁹

| Treatment Option | AAOS Guideline | Level of Evidence | Grade of Recommendation |
|------------------------------------|-----------------|-------------------|-------------------------|
| Weight loss | Recommended | I | A |
| Aerobic exercise | Recommended | I | A |
| Heel wedges | Not recommended | II | B |
| Acetaminophen and NSAIDs | Recommended | II | B |
| Corticosteroid injection | Recommended | II | B |
| Hyaluronic acid injection | Not recommended | I and II | Inconclusive |
| Glucosamine or chondroitin sulfate | Not recommended | I | A |

Abbreviations: AAOS, American Academy of Orthopaedic Surgeons; NSAIDs, nonsteroidal anti-inflammatory drugs.

Self-Management

- Meditation
- Stress reduction
- Exercise
- Activity modifications
- Mutual support
- Positive attitude
- Medications
- Weight reduction

Exercise

- Aquatic exercises
- Yoga
- Stretching programs
- Quadriceps muscle strengthening
- Range-of-motion exercises
- Cycling
- Walking

Integrated Health Care

- Acupuncture
- Osteopathic manipulative treatment
- Intra-articular injections
- Nutrition
- Massage therapy
- Psychotherapy

Figure 1. Self-management, exercise, and integrated health care options for patients with primary osteoarthritis of the knee.

home exercise programs. In addition, if aerobic exercise and muscle strengthening regimens are not maintained, the benefits can be lost after 6 months.¹² Physicians should encourage exercise and weight loss during the initial office visit with patients who have early knee OA.

Orthotics—Because of a lack of concrete evidence, many physicians question the use of bracing and other orthotics for symptomatic relief and treatment of knee OA.⁹ However, a clinical trial by Brouwer et al¹³ has shown some benefit with the use of knee bracing to unload the diseased knee compartment affected by OA. Many patients with OA may have only 1 affected compartment of the knee, including patients with a history of trauma, patients who used to be athletes, and patients who have had a partial or complete meniscectomy. Knee braces can be designed to off-load the affected compartment in patients with monoarthritis of the knee, especially those who wish to delay undergoing a surgical procedure. Indication includes a passively correctable, unicompartamental varus or valgus disease in which the angle of the deformity is less than 10°. ¹² According to a review by Krohn,¹⁴ clinical and gait laboratory analyses also suggest that lateral wedge orthoses can play a role in the treatment of persons with medial

compartment knee OA. Functional improvement with lateral wedges is thought to reduce the external varus thrust and thus medial compartment load during ambulation.¹⁴ The prescription and use of these treatments should be specific to the patient and tailored to the patient's individual needs.

Osteopathic manipulative treatment—Osteopathic manipulative treatment and physical therapy can be an essential component of nonoperative care. A full appreciation of the somatic, sympathetic, and lymphatic systems and their integrated parts is essential for understanding the etiologic process and management of knee pain and inflammation. Part of the pathophysiology of the arthritic knee is related to changes in the autonomic nervous system, blood and lymph flow, fascial tension, limitations in range of motion, and relationships of the length and tension of the muscles around the knee.^{15,16} Often-times, a combination of these factors is contributing to the pain, inflammation, and impaired function of the knee. Therefore, to effectively manage arthritic knee pain, one must perform a thorough evaluation of the surrounding muscle strength, flexibility, tone, skin topography, range of motion, and soft tissues.

A trial of weight loss with diet and exercise received the highest possible AAOS recommendation.

Restrictions in soft tissues and motion about the knee can have important consequences on the functioning of the joint.^{15,16} Nutrition is brought to the cartilage via diffusion of synovial fluid.¹⁷ Appropriate diffusion is related to unrestricted blood and lymph flow and maintenance of motion and slight compression through the joint.¹⁸ Unfortunately, as motion decreases, the integrity of the cartilage also decreases because of impairment of nutrients entering and metabolites exiting the joint.^{16,18} As a consequence, attention must be placed on maintaining joint mobility and addressing imbalances in the quadriceps, hamstrings, and gastroc-soleus muscles. Other imbalances in the somatic system can include myofascial somatic dysfunction, which can impede motion, functions, and lymphatic flow around the knee joint.^{16,18} In this instance, attention should be focused on normalizing myofascial and lymphatic restrictions through techniques such as counterstrain positioning, lymphatic pump, trigger point injections, soft-tissue massage, and myofascial release.^{15,17,19}

Maintaining an ideal body weight, body mass index, and posture significantly decreases the joint reaction forces across the joint.^{11,19} Impaired posture and malalignment of

lumbar spine and lower extremity can change the body's overall mechanical alignment and contribute to knee pain. In addition, changes in the alignment of the lower extremity can place excess stress in a particular compartment of the knee and exacerbate cartilage damage.³ These abnormal changes in posture and alignment also facilitate increased sympathetic flow to the limb.^{15,17,19} Increases in sympathetic activity can further irritate pain receptors, thus increasing one's sensitivity to pain. Treatment can be focused on normalizing the sympathetic system with techniques such as rib-raising and soft tissue massage.^{17,19}

In summary, addressing particular somatic and sympathetic dysfunctions; maintaining ideal body weight; correcting posture, muscle, and alignment imbalances; improving myofascial tone; and normalizing blood and lymph flow should be goals in the treatment of patients with arthritic knee pain.

Pharmaceutical Treatment

NSAIDs—The AAOS clinical practice guidelines recommend acetaminophen or NSAIDs for initial nonoperative management of knee arthritis with a moderate level of clinical evidence.⁹ There has been some controversy about which of these medications is clinically superior and more cost effective. The cost of NSAIDs is roughly \$4 billion per year.²⁰ In addition, NSAIDs have complications that

Continued pain after 6 months of nonoperative treatment is an indication for TKA.

can increase overall health care cost with a projected overall increase of approximately \$1 billion per year for treatment.²⁰ Such complications include serious gastrointestinal side effects that have been reported to occur in roughly 4% of NSAID users. The use of NSAIDs has been thought to contribute to approximately 40,000 deaths per year.²⁰ Wegman et al²¹ conducted a meta-analysis on 5 studies comparing acetaminophen and NSAIDs. They concluded that acetaminophen was often just as effective as NSAIDs for controlling pain associated with OA.²¹ Acetaminophen also proved to result in fewer adverse reactions. They recommended a trial of acetaminophen with other non-pharmaceutical treatments before adding NSAIDs to the treatment plan.²¹

Corticosteroid injection—A common treatment for patients with knee arthritis includes intra-articular corticosteroid injection. Recently, there has been some controversy regarding its efficacy and duration of benefit in reducing knee pain.²² More questions have come up

regarding which type of corticosteroid provides the best pain relief. Valtonen²³ compared triamcinolone and betamethasone for the management of knee OA and found triamcinolone to be more effective in decreasing pain in elderly women. Pyne et al²⁴ found triamcinolone injections to be more efficacious in maintaining pain control than methylprednisolone injections 3 weeks after treatment in patients affected by primary knee OA. A review article by Hepper et al²² examined level 1 evidence on the efficacy and duration of steroid injections for primary knee OA. They concluded that intra-articular corticosteroid injections reduce knee pain for at least 1 week and that these injections are a short-term management option for a chronic problem.²²

Most importantly, these injections should be as painless as possible. In the experience of one of our authors (M.A.M.), the lateral infrapatellar injection site is less painful than the medial infrapatellar and suprapatellar injection sites for patients receiving corticosteroid injections. He stopped using the suprapatellar injection site after 9 consecutive patients complained of severe pain after receiving the injection. This emphasizes the importance of doing a painless injection to maximize patient outcomes. The AAOS recommends corticosteroid injections in the nonoperative management of knee OA.⁹ However, a recent study²⁵ has shown the use of lidocaine or bupivacaine hydrochloride with corticosteroids can be cytotoxic to chondrocytes. Therefore, injections containing these medications should be used with caution in young patients with early knee OA.

Hyaluronic acid injection—Intra-articular injections of HA have become an option for the management of symptomatic early knee OA. These injections provide a combination of viscoelastic properties with associated anti-inflammatory, anabolic, and chondroprotective effects.²⁶ Although the AAOS is unable to make a recommendation for or against the use of HA injections, in general, the literature supports the use and efficacy of HA. Many randomized controlled studies have demonstrated a longer-term effect in pain control with HA injections compared with corticosteroids.²⁷ Few adverse effects have been reported in the literature. With proper patient selection and injection technique, these injections are a viable treatment option for patients with early symptomatic knee OA.

Glucosamine—There has been some controversy in the use of glucosamine or chondroitin sulfate for the treatment of patients with symptomatic primary knee OA. Based on the clinical practice guidelines set by the AAOS, these supplements are not recommended for the management of OA.⁹ These recommendations were made on the basis of 1 randomized controlled trial and 6 systematic reviews all stating that these supplements have no clinical

evidence to support their use.⁹ However, in our experience, some patients have shown some relief in symptoms with these products. Therefore, glucosamine and chondroitin sulfate should be considered if patients feel these treatments provide some relief.

Operative Treatment Non-TKA Surgical Options

When nonoperative treatment fails, less invasive surgical options are available before consideration of TKA. Most surgical options before TKA involve the use of arthroscopy for debridement of arthritic compartments of the knee or meniscectomy for meniscal tears. However, the treatment of arthroscopic debridement for primary OA is controversial. Approximately 50% to 75% of patients will have some type of relief after arthroscopic knee debridement. However, 15% of these patients progress to TKA within 1 year, and only 44% have a statistically significant decrease in functional pain.²⁸ Certain factors have been identified in the literature that predict successful outcomes with arthroscopic knee surgical procedures. These factors include the presence of mechanical symptoms such as locking or catching of the knee that are associated with unstable meniscal tear or unstable chondral flap.³⁰

In turn, some preoperative factors have been associated with a poorer outcome after knee arthroscopy, including history of OA lasting longer than 24 months, obesity, medial tibial osteophytes, medial joint space less than 5 mm wide, and smoking.³⁰ A successful outcome after knee arthroscopy for primary OA involves proper patient selection with the discussion of the limited goals and outcomes associated with the procedure. Other options to consider before TKA include unicompartmental knee replacement and high tibial osteotomy. These surgical options are considered in patients who have unicompartmental knee arthritis or in patients who are younger and active and who want to pursue other options before TKA.

TKA

Orthopedic surgeons began performing TKA in the 1970s. Today it is a commonly performed surgical procedure that is beneficial to a majority of recipients and is cost effective for quality of life assessments.³ It is indicated for disability, pain, limited function from osteoarthritis, rheumatoid arthritis, or any type of arthritic deformity about the knee. The goals of TKA include reducing pain, returning to activities of daily living, restoring mechanical alignment, preserving the joint line, balancing the ligaments, and restoring a normal Q angle.

In 2008, 650,000 TKA procedures were performed in the United States.³ More than 77,500 primary TKAs were performed in the United Kingdom in 2009.³⁰ The rates for TKA in the United States have risen from 31.2/100,000

person-years in the 1970s to more than 220/100,000 person-years in 2008.³¹ Women are more likely to undergo TKAs than men with a ratio of 1.4/1, which was the same ratio 15 years ago.³² The main indication for TKA is OA, which accounts for more than 94% to 97% of TKA operations.^{30,33}

End-stage degenerative knee joint disease, as evidenced by radiographs, and persistent pain after all conservative treatment measures have been exhausted are the key indications for total knee replacement (*Figure 2*).³ On the basis of our experience, preoperative radiographic work-up should include standing anteroposterior radiography of knees on large cassettes, standing extension lateral radiography on large cassette, flexion lateral radiography, and a merchant view. However, radiographic findings alone are not enough. The patient history is equally important.

The patient must have substantial knee pain limiting his or her activities of daily living, especially persistent pain occurring at night or with weight-bearing activities. These symptoms must be refractory to conservative treatments.¹² Continued pain despite an attempt of a 6-month course of nonoperative treatment similar to that proposed by the Osteoarthritis Research Society International⁸ is an indication for TKA. There is no standard regarding the severity of symptoms in the indication of TKA because the decision to pursue TKA is partially subjective on the basis of the patient's response to nonoperative treatment.

Other factors such as age and weight need to be considered prior to proceeding with TKA. For instance, while not a contraindication, obesity or age younger than 60 years have resulted in more variable outcomes after TKA.³¹ Patients must be medically capable of undergoing a surgical procedure and be able to actively participate in the rehabilitation process. Patients must be informed of all

Radiographic Evidence of Primary or Inflammatory Degenerative Joint Disease

- Narrowed joint space
- Osteophytes (spurring) and bone cysts
- Squaring of condyles
- Bone sclerosis

Symptoms

- Severe, refractory knee pain, often at night
- Difficulty with activities of daily living
- Decreased mobility
- Failure to respond to conservative measures

Current Health Status

- Medically optimized for surgery
- No evidence of infection
- Intact extensor mechanism
- Informed consent obtained

Figure 2. Indications for total knee arthroplasty.

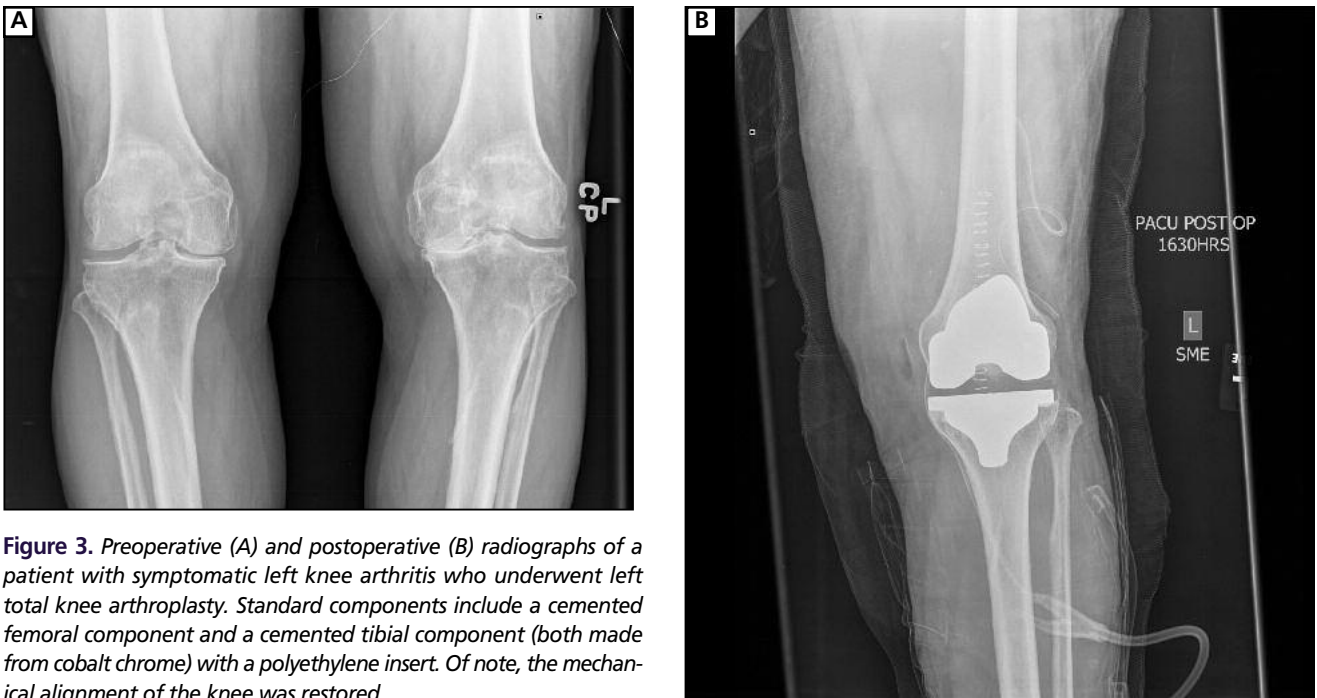


Figure 3. Preoperative (A) and postoperative (B) radiographs of a patient with symptomatic left knee arthritis who underwent left total knee arthroplasty. Standard components include a cemented femoral component and a cemented tibial component (both made from cobalt chrome) with a polyethylene insert. Of note, the mechanical alignment of the knee was restored.

the risks of, benefits of, and alternatives to surgery and provide informed consent for the procedure. Deciding when to proceed with TKA is a complex process for both the physician and the patient, a process that must take into account factors such as severity of symptoms, age, comorbidities, and socioeconomic variances. Although physicians may offer the option of TKA when clinically indicated, the ultimate decision to proceed with TKA is made with the collaboration of surgeon and patient.

A well-fixed, well-aligned TKA is considered successful when performed properly in the correct patients (Figure 3). The patient should have the correct diagnosis with substantial limitations in performing his or her activities. Conservative treatments such as weight reduction, aerobic activity, physical therapy, osteopathic manipulative treatment, and analgesic and anti-inflammatory medications should be tried without relief before TKA.

Conclusion

As the US older adult and obese populations grow, knee pain secondary to primary knee OA will continue to be a very common complaint seen in the primary care setting. Although TKA is a common treatment option for patients with knee OA, nonoperative options should be exhausted before TKA is considered. A better understanding of nonoperative and operative treatment options for patients with OA, including indications for TKA, should prove to be beneficial to general practitioners.

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