Management of Osteoarthritis of the Knee in the Active Patient

Abstract

Total knee arthroplasty has been extremely successful in elderly patients with osteoarthritis. However, there is considerable controversy regarding how best to treat the younger, athletic patient with advanced arthritis. Treatment options range from nonsurgical management with exercise and nonsteroidal anti-inflammatory drugs, to joint arthroplasty with activity modification. When properly indicated, arthroscopic débridement, high tibial osteotomy, unicompartmental knee arthroplasty, and total knee arthroplasty allow younger patients with arthritis to maintain an active, healthy lifestyle.

Persons in the United States tend to remain physically active and participate in demanding athletic events well into their fifth, sixth, and even seventh decades. However, with this increase in activity comes an increased risk of developing a chondral injury that may lead to early onset of arthritis in the knee. The recent literature on osteoarthritis (OA) in patients aged 40 to 60 years indicates that successful outcomes can be gained with surgical treatment. Figure 1 illustrates a recommended treatment algorithm for early knee OA.

Nonsurgical Management

In an effort to delay major surgery, many younger patients with early knee OA are offered a variety of nonsurgical modalities, such as exercise and physical therapy, bracing, orthoses, nonsteroidal anti-inflammatory drugs (NSAIDs), and intraarticular viscosupplementation or corticosteroid injection. In general, the goals of these therapeutic options are to decrease pain and improve function. Some of these modalities may also have a disease-modifying effect by altering the mechanical environment of the knee. Appropriate use of specific nonsurgical modalities requires knowledge of evidence-based practice guidelines, careful patient selection, patient education, and adequate long-term follow-up.

Exercise

Several large randomized controlled trials have shown that exercise reduces pain and improves function in patients with early OA.1,2 Two recent meta-analyses also demonstrate that muscle strengthening and aerobic exercise are important in the management of OA.3,4 Muscle strengthening exercises are superior for specific impairment-related outcomes, such as pain, but aerobic exercise contributes to better long-term functional outcomes. An individualized, multimodal approach tailored to specific symptoms and patient expectations is recommended to maximize pain relief and functional outcomes. Patient compliance with a regimen of exercise or physical therapy is a sig-
significant concern. The best available evidence shows that supplementation of a home exercise program with supervised exercise classes results in the largest gains in pain relief and locomotion at 12-month follow-up. Exercise must also be sustained because any beneficial effects are lost 6 months after an exercise program is terminated.2

**Bracing and Orthoses**

Knee bracing and foot orthoses are popular nonsurgical treatment options for patients with early OA. These modalities are used primarily by patients who wish to continue to pursue an active lifestyle. This includes younger patients with early to moderate disease, former athletes with posttraumatic OA, and postmeniscectomy patients with isolated unicompartmental disease. The ideal candidate for bracing has unicompartmental arthritis and wishes to delay surgery.

The primary goal with use of a brace or orthosis is to improve function by reducing symptoms. With the knee brace, this is accomplished by reducing biomechanical load in the involved compartment or by reducing the patient’s perception of instability. Bracing should be used almost exclusively in patients with symptomatic, passively correctable, unicompartmental varus or valgus disease <10°. Significant medial collateral ligament laxity and lateral collateral ligament laxity are contraindications for valgus and varus unloading braces, respectively. Several clinical trials and a recent systematic review have demonstrated the efficacy of this treatment modality, showing significant improvements in pain and function using a valgus knee brace compared with a simple neoprene sleeve or medical treatment alone.6-8 Clinical and gait laboratory analysis also suggest that there is a role for lateral wedge orthoses in persons with medial compartment knee OA.9 Evidence suggests that pain relief and functional improvement in these patients is achieved by a reduction in external varus moment and medial compartment load.9 (The AAOS Clinical Practice Guideline on the Treatment of Osteoarthritis of the Knee [Nonarthroplasty] is unable to recommend for or against the use of a brace either with a valgus-directing force for patients with medial unicompartmental OA of the knee or with a varus-directing force for patients with lateral unicompartmental OA of the knee. The Guideline also suggests that lateral heel wedges not be prescribed for patients with symptomatic medial compartmental OA of the knee. The Recommendation is graded B, equivalent to level of evidence II. The complete Clinical Guideline is available at http://www.aaos.org/research/guidelines/GuidelineOAKnee.asp.)

**NSAIDs**

Oral NSAIDs are often prescribed to reduce pain and inflammation caused by early knee OA. The authors of a recent systematic review of the use of NSAIDs for knee OA selected 16 double-blind randomized controlled trials, representing eight different medications.10 Significant design flaws in individual trials made it impossible to distinguish a difference in efficacy between equivalent recommended doses of NSAIDs. Instead, the authors concluded that NSAID selection should be based on physician preference, relative safety, patient acceptability, and cost.

Serious gastrointestinal (GI) side
Intra-articular Viscosupplementation

Intra-articular viscosupplementation is an increasingly common nonsurgical option in the management of knee OA. The injection of hyaluronic acid (HA) into the knee joint has theoretic benefits for early knee OA because of a combination of its viscoelastic properties as well as its anti-inflammatory, anabolic, analgesic, and chondroprotective potential. The utility of the current literature is limited by lack of uniform patient populations and study designs, heterogeneous drug types and delivery methods, and use of diverse outcome measures.

A systematic review of 76 randomized controlled trials also demonstrated the efficacy of HA versus placebo. The 5- to 13-week postinjection period showed the largest percent improvement, from a baseline of 28% to 54% for pain and from 9% to 32% for function. In general, comparable efficacy was noted with NSAIDs, and longer-term benefits were noted in comparison with intra-articular corticosteroids. Few adverse events were reported in the hyaluronan/hylan trials included in these analyses. Of note, there were few randomized head-to-head comparisons of different viscosupplements. Thus, caution must be exercised in drawing conclusions regarding the relative value of different products from this systematic review. Overall, these results support the efficacy of both HA and steroids for the temporary symptomatic management of early knee OA. Recent studies, however, have demonstrated that lidocaine alone and intra-articular corticosteroids in combination with lidocaine cause considerable cytotoxicity to the native chondrocytes. Thus, corticosteroid injections must be used with caution, especially in patients with early arthritis. (The AAOS Clinical Practice Guideline on the Treatment of Osteoarthritis of the Knee [Nonarthroplasty] is unable to recommend for or against the use of intra-articular HA for patients with mild to moderate symptomatic OA of the knee. The Guideline suggests the use of intra-articular corticosteroids for short-term pain relief for patients with symptomatic OA of the knee, with a Grade of Recommendation of B.)

Surgical Management

Arthroscopy

The role of arthroscopy in the treatment of OA is controversial. Approximately 50% to 75% of patients have an initial benefit following arthroscopic débridement; however, 15% progress to total knee arthroplasty (TKA) within 1 year following surgery, and only 44% have a clinically significant reduction in pain. Despite these modest results, arthroscopic débridement remains one of the most commonly performed procedures for OA. Critical analysis of the literature is hampered because many of the studies are retrospective, evaluate different patient populations, or lack generalizability to larger patient cohorts.

Several recent studies have suggested that the benefits of arthroscopic surgery are minimal or may even be attributable to a placebo effect. In 2002, Moseley et al reported on a randomized controlled trial at the Houston Veterans Affairs Medical Center, in which patients were subject to arthroscopic lavage, débridement, or placebo surgery. One hundred eighty patients were enrolled and followed for a mean of 2 years. The average age was 53 years, and approximately 65% of the patients in each group had moderate to severe arthritis. During the 2-year follow-up period, there was no benefit in terms of pain scores or outcomes measures with arthroscopic management versus placebo surgery. The authors concluded that the outcomes after arthroscopic lavage or arthroscopic débridement were no better than those after a placebo procedure. The results of this study have been criticized by many who believe that the patient population—mostly men—was not representative of the general population. In addition, the study used a composite scoring system for osteoarthritic changes that resulted in a patient with severe OA in one compartment having the same score as a patient with minor OA in all three compartments.

Although the study by Moseley et al is often criticized by arthroscopic knee surgeons, another recent randomized trial found similar results. However, this more recent study focused on a civilian population and included an equal number of men and women in each treatment arm. Patients were randomly assigned to either surgery or physical/medical therapy. At 2-year follow-up, there was no difference between the groups based on either the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score or the Medical Outcomes Study 36-Item Short Form physical component score. However, this study excluded patients with a large or symptomatic meniscal tear. The authors concluded that arthroscopic débridement was no better than an
optimized medical/physical therapy program in patients with isolated OA.

Dervin et al\textsuperscript{15} performed a prospective evaluation of 126 patients who failed nonsurgical treatment of OA of the knee. Unstable chondral flaps and degenerative meniscal pathology were resected at the time of surgery. In this study, 57\% of patients had grade III or IV changes according to the classification of Dougados et al,\textsuperscript{18} and 63\% had an unstable meniscal tear. Only 44\% of patients had a clinically important reduction in pain as determined by the WOMAC scale at a mean follow-up of 2 years. The only factors that predicted improvement at the time of surgery were medial joint line tenderness, a positive Steinman test, and the presence of an unstable meniscal tear at the time of surgery. The authors found that physicians were unable to accurately predict who would benefit from arthroscopic débridement.

Despite these and other studies that have shown minimal benefit with arthroscopic débridement, this procedure may be beneficial in select patients. Steadman et al\textsuperscript{19} evaluated 69 knees in 61 patients with grade 3 or 4 OA according to the Kellgren-Lawrence radiographic scale. This study excluded traumatic chondral lesions, but all other patients with advanced OA were included. Average patient age was 57 years (range, 37 to 78 years), and follow-up was >2 years. At the time of arthroscopy, the affected knee was insufflated to expand the joint capsule, and particular attention was paid to performing an aggressive lysis of adhesions to improve joint volume. At the time of follow-up, 9 knees (13\%) had been revised to a TKA. The presence of kissing femoral-tibial chondral lesions, a lower insufflation volume, and increasing patient age resulted in a poorer outcome. The authors concluded that arthroscopic management of advanced OA could be beneficial in many patients, especially with aggressive lysis of adhesions in the suprapatellar pouch and anterior interval.

Most patients with advanced OA are found to have meniscal tear on MRI. It is unclear what role, if any, meniscal tear has in the progression of knee pain in these patients. Bin et al\textsuperscript{20} evaluated 68 patients with Outerbridge grade IV OA and a medial meniscal tear at a mean follow-up of 52 months. Following surgery, 82\% of patients reported a reduction in pain, 14\% had no change, and 4\% had an increase in pain. At 75 months postoperatively, 75\% of patients had not required further surgery. Dervin et al\textsuperscript{15} found that medial joint line tenderness preoperatively and the presence of an unstable meniscal tear at the time of surgery predicted a better outcome. These studies suggest that meniscal débridement can be beneficial in patients with mechanical symptoms that are attributed to a degenerative meniscal tear.

Spahn et al\textsuperscript{11} examined factors that affected the outcome of arthroscopy in medial compartment OA in 156 patients at a mean follow-up of 49 months. The average age was 51.6 years, and all patients had Kellgren-Lawrence grade 2 OA. Seventy-one percent of patients had poor outcomes overall. Factors that were associated with worse outcome included history of OA >24 months, obesity, medial tibial osteophytes, medial joint space <5 mm, smoking, the presence of a tibial chondral grade IV defect, and the need for subtotal or total meniscectomy. Significantly worse outcomes were noted in patients with four or more of these factors (Figure 2).

The role of arthroscopic management of OA in the younger patient population remains controversial, with the literature suggesting that arthroscopy helps in some patients but that others fail to improve. Successful management of OA with arthroscopy is likely the result of proper patient selection and discussion of the limited goals of the procedure. Younger patients with mechanical symptoms from a meniscal tear, with normal knee alignment, and without tibial chondral lesions will likely benefit from a trial of arthroscopic treatment. However, these patients must be counseled that any surgical benefits may be of brief duration and that they may require arthroplasty in the future (Table 1). (The AAOS Clinical Practice Guideline on the Treatment of Osteoarthritis of the Knee [Nonarthroplasty] suggests that needle lavage not be used for patients with symptomatic OA of the knee. The Recommendation is graded B, equivalent to level of evidence I/II. The Guideline recommends against performing arthroscopy with débridement or lavage in patients with a primary diagnosis of symptomatic OA of the knee. The Recommendation is graded A, equivalent to level of evidence I/II.)

**High Tibial Osteotomy**

High tibial osteotomy (HTO) was popularized by Coventry and Insall in the 1970s,\textsuperscript{22} and it remains an attractive option in the attempt to prolong the lifespan of the native joint. The basic premise of an HTO is to redirect the mechanical axis from the degenerated area of the joint to the relatively well-preserved compartment. In most instances, the weight-bearing load is shifted from a worn medial compartment and passed through the healthier cartilage of the lateral joint space.

Patients are not required to modify their activity levels, as they would be with arthroplasty procedures. Thus, HTO is indicated for patients who wish to remain active in high-load
activities. In such patients, HTO can be performed as an isolated or a combined procedure. The most common indication for HTO is the treatment of unicompartmental varus or valgus gonarthritis; however, HTO also can be effective in unloading pressure on the focal cartilage lesions, such as in osteonecrosis and adult osteochondritis dissecans. Similarly, HTO has been recently applied as an adjunct in chondral resurfacing and meniscal transplantation procedures in which malalignment has been considered to be a contributor to the cartilage injury.

Despite its potentially broad indications, the clinical applicability of HTO has been refined by several contraindications. Because HTO shifts the mechanical axis away from the most severely degenerated area to another, less affected area of the joint, the procedure is contraindicated in persons with previous meniscectomy and/or significant degeneration of the other knee compartment. Persons with inflammatory diseases (eg, rheumatoid arthritis) and/or those aged >65 years are less desirable candidates because of the high likelihood of diseased cartilage in all compartments of the knee. Patients with symptomatic patellofemoral arthritis are not considered to be good candidates for HTO. Patients should also have range of motion of ≥90°. Because of a frequent necessity to overcorrect the malalignment, HTO should not be performed in patients who are unwilling to accept a valgus deformity. Some have suggested that obesity is a relative contraindication to HTO.

Several techniques, including opening wedge, closing wedge, oblique plane, and ball-and-socket osteotomy, have been described. Because of their relative technical ease, opening wedge and closing wedge osteotomies are the most commonly performed types of HTO. They are distinguished by two important differences. First, opening wedge HTO involves incision and osteotomy on the same side as the joint degeneration, such as a medial incision and osteotomy for medial compartment disease, whereas a closing wedge osteotomy requires work on the opposite side, such as a lateral incision and osteotomy for medial compartment disease. Second, opening wedge osteotomy may require the insertion of a wedge-shaped cortical bone graft between the cut bone edges (Figure 3), whereas with closing wedge osteotomy, angular correction is attained by removing a wedge of bone.
In the past 20 years, more than a dozen articles have been published documenting the outcomes following HTO for unicompartmental gonarthritis. Comparisons are limited by varied fixation techniques and measures used to assess outcome. Survivorship (judged as conversion to TKA) has been reported to be as high as 98%24 and 70%25 at 10- and 20-year follow-up, respectively; Omori et al26 reported good and excellent function in 77% of patients at 17 years (Table 2).

Several factors have been identified that contribute to deterioration over time. The most important factor, as initially described by Insall and Aglietti,31 is time. HTO should not be perceived to be the ultimate solution to the problem of joint degeneration; rather, it is a procedure that can delay TKA, sometimes for >20 years. Another important factor is the degree of correction, which must fall between acceptable parameters, such as 5° to 13° of valgus for varus gonarthritis. Finally, increasing age and obesity have been confirmed by several studies to be detrimental to the long-term effectiveness of HTO.12,33

Table 2
Results of Select Recent Series of High Tibial Osteotomy to Manage Varus Gonarthritis

<table>
<thead>
<tr>
<th>Study</th>
<th>Number</th>
<th>Mean Follow-up in Years (range)</th>
<th>Mean Age (yr)</th>
<th>Technique</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Niemeyer et al28</td>
<td>43 pts</td>
<td>2 (6-24 mo)</td>
<td>47.3</td>
<td>Opening wedge, using plate and autologous iliac crest bone graft</td>
<td>68% good or excellent</td>
</tr>
<tr>
<td>Omori et al26</td>
<td>37 pts</td>
<td>17 (14-24)</td>
<td>59</td>
<td>Closing wedge using threaded pins and figure-of-8 wiring</td>
<td>77% good or excellent</td>
</tr>
<tr>
<td>Akizuki et al24</td>
<td>132 pts</td>
<td>16 (16-20)</td>
<td>63</td>
<td>Closing wedge using a plate</td>
<td>98% survival at 10 yr, 90% survival at 15 yr</td>
</tr>
<tr>
<td>Gstöttner et al27</td>
<td>111 pts</td>
<td>12 (1-25)</td>
<td>54</td>
<td>Closing wedge using a staple</td>
<td>80% survival at 10 yr, 66% survival at 15 yr</td>
</tr>
<tr>
<td>Chiang et al29</td>
<td>16 pts</td>
<td>15 (13-16)</td>
<td>58</td>
<td>Dome-shaped, using external fixation</td>
<td>68% good or excellent</td>
</tr>
<tr>
<td>Polyzois et al30</td>
<td>95 pts</td>
<td>8 (5-11)</td>
<td>69</td>
<td>Closing wedge using plate</td>
<td>61% good/excellent</td>
</tr>
<tr>
<td>Tang and Henderson25</td>
<td>67 knees</td>
<td>6.5 (1-21)</td>
<td>49</td>
<td>Closing wedge using plate or staple</td>
<td>75% survival at 10 yr, 67% survival at 15 yr</td>
</tr>
</tbody>
</table>

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Patients with isolated lateral compartment OA can be treated with distal femoral osteotomy. The indications and contraindications are
largely the same as those for HTO. The intent of the osteotomy is to place the plane of the joint parallel to the ground or to have a minimal degree of obliquity relative to the normal anatomy. Recent studies have demonstrated results similar to the outcomes of patients who underwent HTO. Backstein et al. followed 40 patients with distal femoral osteotomy for 10 to 15 years. The 10-year survival rate of the distal femoral varus osteotomy was 82%, but the 15-year survival rate was just 45%. (The AAOS Clinical Practice Guideline on the Treatment of Osteoarthritis of the Knee [Nonarthroplasty] cannot recommend for or against an osteotomy of the tibial tubercle for patients with isolated symptomatic patellofemoral OA.)

The indications for UKA have changed significantly in the past 10 to 15 years. Classically, low-demand patients aged >60 years who have a low body mass index, intact ligamentous structures, and isolated medial compartment OA, but who have no flexion or extension contractures, are candidates for UKA. With improvements in UKA prosthesis design, wear properties of the polyethylene, and surgical technique, the indications have expanded to include younger patients, patients with mild patellofemoral OA, and some patients with anterior cruciate ligament (ACL) deficiency (Figure 4).

Recent studies have specifically addressed the outcomes of UKA in a younger patient population. Schai et al. evaluated 28 UKAs in patients aged ≤60 years, with patient age at the time of surgery averaging 52 years. Follow-up was 2 to 6 years. Good or excellent results in terms of function and pain relief were achieved in 90% of patients. The average activity level according to the Tegner and Lysholm score improved slightly, from 2.3 points preoperatively to 2.7 points at follow-up. Of the 28 knees, 9 (32%) demonstrated radiolucent lines about the tibial component, and 2 had incomplete radiolucent lines at the bone-cement interface on the femoral side. The authors found no correlation between activity level and the presence of tibial radiolucent lines. Loosening of the femoral component at the prosthesis-cement interface necessitated revision in two patients; one underwent another UKA and the other was converted to TKA. Asymptomatic slowly progressive radiolucency was noted in one tibial component. The authors concluded that UKA in middle-aged patients was successful but that it was not better than TKA in terms of survival. Pennington et al. reviewed 41 patients aged ≤60 years who underwent UKA (average age, 54 years). At 11-year follow-up, the Hospital for Special Surgery score was excellent in 93% of patients and good in 7%. Three patients required revision: two for extensive tibial osteolysis.

Unicondylar Knee Arthroplasty

Early outcomes of unicondylar knee arthroplasty (UKA) in the 1970s and early 1980s were disappointing, with the result that many surgeons treated unicondylar OA with either HTO or TKA. However, with the growing interest in less invasive procedures and the publication of better long-term results in several recent series, UKA has undergone a resurgence.

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sis, and one for continuing knee pain and a progressive tibial radiolucent line. Nine knees showed progression of OA in the unsurfaced compartment, but none required conversion to TKA, and none of these patients had a worsening Hospital for Special Surgery score. The overall survival rate was 92% at 11 years.

Chronic ACL deficiency leads to medial meniscal tears and medial compartment OA; treatment options for these patients are limited. Traditionally, ACL deficiency was a contraindication to UKA for the management of medial compartment OA because eccentric loading and excessive wear occurred on the tibial polyethylene component. However, this has not always been borne out in the literature. Hernigou and Deschamps\(^{38}\) retrospectively reviewed the results of 99 UKAs at a mean follow-up of 16 years. At the time of the arthroplasty, the ACL was considered to be normal in 50 knees, damaged in 31, and absent in 18. Of the 18 knees with ACL deficiency at the time of surgery, 11 had not failed at final follow-up. The mean posterior tibial slope in these 11 knees was \(<5^\circ\). Seven knees in which the ACL was absent at the time of the arthroplasty were revised. In these knees, the tibial prosthesis was implanted with a posterior slope of \(>8^\circ\). The authors concluded that results in the ACL-intact and ACL-deficient groups were similar when the tibial component had a slope of \(<7^\circ\).

Another option for persons with ACL deficiency is to reconstruct the ACL in conjunction with the UKA. Pandit et al\(^{19}\) performed ACL reconstruction in conjunction with UKA in 15 patients and matched these results to a group of 15 patients with intact ACL. At 2.5 years after the procedure, no difference was found between the groups with regard to Oxford Knee Scores and Knee Society scores. Both groups had an average functional Knee Society score of 96 (out of 100). Although there was only short-term follow-up, it is worth noting that no patient in either group had radiologic evidence of loosening. In vivo kinematics of the knees that underwent ACL reconstruction and UKA in a step-up exercise and in deep knee flexion have been shown to be equal, as well.\(^ {39}\) Thus, combined management of ACL deficiency with medial compartment OA with ACL reconstruction and UKA warrants further investigation and long-term follow-up studies because the early results are quite promising.

**Total Knee Arthroplasty**

Results of knee replacement have continued to get better with improvements in polyethylene durability and prosthesis design. Advances in design have led to survivorship rates of 90% at 10 to 15 years, as well as better pain relief and functional improvement.\(^ {40}\) Despite good clinical results with long-term follow-up in older persons, TKA is usually reserved as a final treatment option, especially in younger, active patients.

Few studies have specifically evaluated the results of TKA in patients aged \(<60\) years. This is likely because, until recently, most surgeons believed that age \(<60\) years was a contraindication to TKA. Dalury et al\(^ {41}\) reviewed 103 cemented TKAs in patients aged \(<45\) years, most of whom were diagnosed with rheumatoid arthritis or juvenile rheumatoid arthritis. At 7-year follow-up, there were no revisions for aseptic loosening or wear; however, this population is likely not as high-demand as a similar cohort with posttraumatic or primary OA. Similarly, Spahn et al\(^ {21}\) reported no revisions in 57 patients aged \(<50\) years at 9 years following surgery. Duffy et al\(^ {43}\) recently reviewed the results of 52 cemented TKAs in patients aged \(\leq 55\) years (average age, 53 years; range, 29 to 55). Average time to follow-up was 12 years (range, 10 to 15 years). Only two patients required revision at \(<10\) years, one for sepsis at 1 year and one for instability at 8 years. Six patients required revision at \(>10\) years, all for osteolysis and loosening. The overall survival rate was 96% at 10 years and 85% at 15 years.

Although these studies document acceptable survival rates, a significant limitation is that activity level before and after surgery is not documented in any of them. In an earlier study, Duffy et al\(^ {45}\) found that although objective knee scores and survival were good in a group of patients aged \(\leq 55\) years who underwent TKA, the functional score improved from 45 points to 60 points (range, 0 to 100). It will be important to determine functional outcome and ability to return to an active lifestyle in younger, higher-demand patients with tricompartmental OA who require TKA.

The types of acceptable activity following TKA are of considerable debate as well. Bradbury et al\(^ {44}\) found that 49% of patients participated in sports at least once a week before TKA, and 65% returned to sports after TKA. Most of these patients returned to activities such as bowling, but 20% returned to higher-demand activities such as biking and tennis. Healy et al\(^ {45}\) reviewed athletic activity after joint arthroplasty. They included responses from 58 members of The Knee Society who were surveyed to determine recommendations for sports participation for patients following knee replacement surgery (Table 3).

**Return to Sports**

Traditionally, most outcome data following knee procedures have been
used to define success or failure based on return to activities of daily living. Recently, however, because of changing attitudes and technological advances, treatment goals for OA have advanced beyond performance of basic activities. Within the past few years, there has been an increasing interest in defining acceptable athletic activity and expectations following surgical intervention for knee OA. Little information is currently available to guide athletes following HTO. The assumption is that HTO is performed to allow the patient to return to her or his desired level of sporting activities.

Several articles have addressed the topic of athletic activity in persons undergoing UKA and TKA; the guidelines for activity following arthroplasty are summarized in Table 3. Although the recommended list of activities does not differ between UKA and TKA, the expected athletic activity does. Separate studies have reported that >90% of athletically active patients who undergo UKA can expect to return to their desired sporting and recreational activities. In contrast, only 63.6% of patients were able to return to sports following TKA. Even among those who are able to return to sport after TKA, most return to a lower level of activity and at a decreased frequency. The reasons for such a low return to sport after TKA are varied, but >40% curtail athletic activity as a precaution. Despite concerns of both surgeons and patients, no evidence exists correlating increased nonimpact athletic activity with aseptic loosening. Dahm et al found that 12% of patients who underwent TKA participated in activities that were not recommended by their physician; however, this group did not have a higher incidence of complications or failure. Mont et al recently compared the outcomes of high-activity versus low-activity patients following TKA. At a mean follow-up of 7 years, the outcome score was 96 in low-activity patients and 95 in high-activity patients. There was no difference in the failure rate.

### Summary

The treatment of OA of the knee in the young, active patient remains a challenge to the orthopaedic surgeon. Initial nonsurgical management with exercise, activity modification, NSAIDs, and viscosupplementation may improve symptoms but will not dramatically alter the natural history of the disease process. Surgical treatments, when used for the proper indications, offer patients a good potential solution for their arthritis and allow for a return to athletic activities. Treatment should be guided based on the patients’ symptoms and expectations.

### References

Evidence-based Medicine: Levels of evidence are described in the table of contents. In this article, references 6, 16, and 17 are level I studies. References 2 and 5 are level II studies. References 7, 8, 40, 46, and 51 are level III studies. Level IV studies in-

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### Table 3

<table>
<thead>
<tr>
<th>Activity</th>
<th>Recommended/Allowed</th>
<th>Allowed With Experience</th>
<th>Not Recommended</th>
<th>No Conclusion</th>
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<tbody>
<tr>
<td>Low-impact aerobics</td>
<td></td>
<td>Road cycling</td>
<td>Racquetball</td>
<td>Fencing</td>
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<td>Stationary cycling</td>
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<td>Squash</td>
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<td>Rock climbing</td>
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<td>Soccer</td>
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<td>Stationary skiing*</td>
<td>Volleyball</td>
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<td>Football</td>
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<td>Gymnastics</td>
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<td>Weight machines</td>
<td>Lacrosse</td>
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<td>Ice skating</td>
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<td>Handball</td>
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* NordicTrack

clude references 15, 19-34, 36-39, 42, 43, and 47-50. References 1, 3, 4, 9, 10, 12, 13, 35, 44, and 45 are level V expert opinion.

Citation numbers printed in bold type indicate references published within the past 5 years.


