Current Concepts Review

Athletic Activity After Total Joint Arthroplasty

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- Demand for total joint arthroplasty is projected to increase in the first three decades of the twenty-first century.
- With increasing frequency, patients who have a hip or knee replacement expect to, and choose to, participate in athletics following rehabilitation.
- In general, patients who have had a hip or knee replacement decrease their participation in, and intensity of, athletic activity following the total joint arthroplasty.
- The orthopaedic literature on athletic activity after total joint arthroplasty is limited to small retrospective studies with short-term follow-up.
- Expert opinion regarding appropriate athletic activity after total joint arthroplasty is available from the Hip Society and the Knee Society.
- When patients who have undergone joint replacements choose to participate in athletic activity, orthopaedic surgeons should provide information with which to evaluate the risk of sports activity and recommend appropriate athletic activity.

Total joint arthroplasty predictably relieves pain and improves function for patients with painful arthritic hip and knee joints. As the clinical success of total joint replacement has been documented and publicized, patients' expectations regarding the procedure have increased, with many expecting to participate in athletic activity postoperatively. However, there is a wide variation in patients' athletic experience before joint replacement as well as in their expectations regarding athletic activity after it. There is also little consensus among joint-replacement surgeons regarding sports that should be allowed or recommended after the procedure.

The orthopaedic literature includes limited peer-reviewed information for orthopaedic surgeons to use to advise patients on safe and appropriate athletic activity after total joint arthroplasty. Patients who participate in athletic activity after a joint replacement have increased force crossing the reconstructed joint, increased joint-bearing-surface wear, increased stress at the bone-implant fixation surface, and a higher prevalence of traumatic injury to the joint when compared with patients with a low level of activity[1-4]. Furthermore, implant wear has been shown to be related to use of the joint as opposed to the duration of implantation[1]. It is not clear how much athletic activity should be reasonably allowed or recommended following total joint arthroplasty in order to promote durability and survival of the joint reconstruction.

In this Current Concepts Review, we will evaluate the information available regarding athletic activity following total joint arthroplasty and present expert opinion from Hip Society and Knee Society surveys. The goal of this review is to present what is known and what is not known about athletic activity following joint replacement in an attempt to educate physicians and patients regarding risks associated with sports following joint replacement and to present them with reasonable expectations regarding safe athletic activity following total joint arthroplasty.

Outcome and Prevalence of Total Joint Arthroplasty

Total joint arthroplasty is one of the most successful medical innovations developed during the twentieth century. In fact, in

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October 2007, *The Lancet* published a review article entitled "The Operation of the Century: Total Hip Replacement"[5]. The results of joint replacements have been studied with pain scales, clinical scores, physical examinations, radiographs, activity measures, validated outcome instruments, and economic assessments. Joint replacements have been documented to relieve pain, improve function, correct deformity, increase social mobility, preserve an independent lifestyle, and contribute to psychological well-being[6]. Furthermore, joint replacements are cost-effective medical treatments that provide substantial improvements in quality of life[7].

The rate of total joint arthroplasty in the United States has increased in the last two decades, and it will increase further in the next two decades as a result of an expanding and aging population; the prevalence of osteoarthritis, trauma, and obesity; cultural values of "baby boomers"; and the demonstrated clinical success of joint replacement[8,9]. Between 2005 and 2030, the prevalence of primary total hip arthroplasty procedures in the United States is expected to increase 174%, from 209,000 operations to 572,000 operations; the prevalence of primary total knee arthroplasties is expected to increase 673%, from 450,000 operations to 3,480,000 operations; and the prevalences of revision hip and knee replacements are expected to increase 137% and 601%, respectively[8-10].

Indications for and Patient Expectations Regarding Joint Replacement

Arthritic joints are associated with pain, stiffness, reduced function, and limitation of activity. When joint replacements were being developed during the 1960s and 1970s, the primary indication was pain. In 2008, pain continues to be the principal reason patients choose joint replacement. However, patients with painful arthritic joints have become less tolerant of activity limitations, and they are increasingly choosing to have joint replacements to improve function. Frequently, the desire for functional improvement includes a desire for athletic activity, and many patients choose to have joint replacement to enable them to return to a specific sport[11].

Mancuso et al. documented that patients who undergo joint replacement have multiple expectations, including relief of symptoms, improvement in physical function, and improvement in psychosocial well-being[12]. Patients' expectations are formed by many factors, including their personality characteristics, social class, interactions with health professionals, and information obtained through their individual research. Furthermore, patient expectations can be modified with preoperative education.

In the early twenty-first century, patients' preoperative expectations regarding total joint arthroplasty frequently include a short recovery, little or no postoperative discomfort, no perioperative complications, relief of joint pain, increased joint mobility, improved function, long-term durability of the joint replacement, and no limitations of postoperative activity. These expectations are created by documentation of excellent outcomes of joint replacement, orthopaedic marketing, direct-to-consumer marketing, and information and misinformation on the Internet[13]. Patients frequently underestimate the challenges involved in the process of joint replacement and overestimate its outcome.

One reason for the escalation of patient expectations regarding total joint arthroplasty is the predominance of the "baby boomer" generation—Americans born in the United States between 1946 and 1964. The baby boomers currently include seventy-eight million Americans, or 26% of the U.S. population, and they are aging. In 2008, the first baby boomers will turn sixty-two years old and begin collecting Social Security benefits, and in 2011 the first baby boomers will turn sixty-five and be eligible for Medicare[14]. In general, baby boomers are more likely to be intolerant of discomfort and disability, and they do not accept limitations associated with arthritic joints. Compared with Americans in older age groups, baby boomers are demanding total joint arthroplasty at younger ages and at less severe stages of osteoarthritis[15]. Baby boomers will drive an increased demand for total joint arthroplasty, and they will drive patient expectations to include athletic activity.

Health Benefits of Exercise

The physical and mental health benefits of exercise are well known, and patients with arthritic joints frequently complain about their loss of aerobic and athletic activity. Regular exercise reduces anxiety, depression, and mortality, and it improves cardiovascular and bone health[16,17]. Regular exercise can also be beneficial for patients with obesity, high blood pressure, coronary artery disease, diabetes mellitus, osteoporosis, and low back pain[18]. Smoking cessation programs incorporate exercise programs to help patients to achieve their goals. Furthermore, the American College of Sports Medicine has determined that aerobic activity three times a week for twenty minutes per session is associated with improved psychological and physiologic well-being[19]. Exercise provides health benefits for Americans of all ages and with all health conditions.

Total joint arthroplasty allows patients with arthritic hip and knee joints to increase their physical activity, and joint replacements are associated with improved function, improved quality of life, and longer life[6,20-24]. Macnicol et al. reported that women with a unilateral total hip replacement had substantial postoperative increases in maximal walking speed, walking stride length, walking cadence, and oxygen consumption during gait[21]. Patients who had the most disability prior to hip replacement demonstrated the most improvement. Ries et al. reported that, following hip and knee replacement, cardiovascular fitness improved as measured by exercise duration, maximum workload, peak oxygen consumption, and percentage of predicted maximum oxygen uptake[22,23]. Roder et al. evaluated 12,925 patients and reported that 38.9% of those who could not walk more than ten minutes before hip replacement could walk more than sixty minutes after the operation and 57.1% of those patients who could walk more than ten minutes before hip reconstruction could walk more than sixty minutes after it[24].

Athletic Activity Before and After Total Joint Arthroplasty

The orthopaedic literature has not clearly defined the extent of athletic activity in which patients engage before and after joint replacements. Although a desire to return to athletic activity is frequently mentioned by patients as an indication for joint replacement, it is not clear how often and at what level or intensity patients return to athletic activity following total joint arthroplasty. Several retrospective studies with short-term follow-up have suggested that athletic activity decreases following joint replacement, and young patients are not necessarily more active than older patients after joint replacement.

Bauman et al. evaluated the physical activity of 242 patients at one year after hip replacement and 225 patients at one year after knee replacement[25]. The average UCLA (University of California, Los Angeles) activity score was 6 points, indicating that, after joint replacement, the patients achieve, on average, a moderate level of activity and may achieve a high or very high level of activity. The UCLA activity score is a validated 10-point investigator-rated scale used to assess the functional demands of patients with a total joint replacement[26]. Huch et al. evaluated 636 patients at five years after joint replacement[27]. Preoperatively, 36% of those with a hip replacement and 42% of those with a knee replacement participated in sports. At five years postoperatively, 52% of those with a hip replacement and 34% of those with a knee replacement engaged in sports. The authors suggested that the higher prevalence of postoperative athletic activity in the hip-replacement group than in the knee-replacement group was due to greater pain relief in that group. At five years, 9% of the patients with a hip replacement reported pain as compared with 16% of those with a knee replacement. Precaution (47%), pain elsewhere in the body (27.5%), and pain at the site of the replaced joint (12.7%) were mentioned as reasons for avoiding athletic activity following joint replacement.

Bradbury et al. evaluated the athletic activity of 160 patients with a total of 208 knee replacements at a mean of five years postoperatively[28]. Prior to the knee replacement, seventy-nine patients (49%) had participated in athletic activity at least once a week. Following the knee replacement, only fifty-one patients (32%) regularly participated in sports. Forty-three (77%) of fifty-six patients who had played sports preoperatively continued to participate in sports postoperatively. Chatterji et al. evaluated the athletic activity of 144 patients at one year after knee replacement[29]. Prior to the knee replacement, 122 patients (85%) had performed one or more recreational activities. Following the knee replacement, 108 patients (75%) participated in at least one athletic activity per week. The authors assigned a "sports score" to each patient, with 1 point assigned for each sport played. The mean "sports score" was 1.76 points preoperatively and 1.41 points postoperatively, a 20% reduction. Dahm et al. reviewed the cases of 1630 patients at a mean of 5.7 years after total knee arthroplasty[30]. The average UCLA activity score was 7.1 points, which is associated with athletic activity, and 91% of the patients were satisfied with their activity. However, only 187 patients (11%) reported participation in strenuous manual labor or strenuous sports.

In contrast to authors who have documented less athletic activity following joint replacement, Mont et al. suggested that patients can return to high levels of athletic activity following knee replacement[31]. These authors studied thirty-one patients (thirty-three knee replacements) who participated in high-demand sports (singles tennis, jogging, downhill skiing, racquetball, squash, and basketball) four times per week for a mean of 3.5 hours per week following knee reconstruction. At a mean of four years, thirty-two of the thirty-three knees had successful clinical and radiographic outcomes with high patient satisfaction scores. However, although Mont et al. documented that patients with a knee replacement can participate in demanding sports, they did not demonstrate, and could not state on the basis of their data, that high-demand athletic activity is prudent or wise. They did not follow their patients long enough to be able to comment on the impact of high-level activity on implant survival, and it is not clear that patients should participate in high-demand athletic activity after knee replacement.

Sechriest et al. evaluated the activity of thirty-four young patients (mean age, forty-two years) at a mean of 6.3 years after hip replacement[32]. The average number of gait cycles per year in this young cohort (1.2 million) was similar to that in a group of older patients treated with hip replacement (0.9 to 1.4 million). Diduch et al. evaluated eighty patients who had undergone knee replacement when they were less than fifty-five years old[33]. At the time of follow-up, only nineteen patients (24%) had Tegner and Lysholm scores of ≥5 points, indicating participation in strenuous work or sports. Dubs et al. evaluated the athletic activity of 110 young patients (average age, fifty-five years) at a mean of six years following hip replacement[34]. Eighty-six patients (78%) were active in sports preoperatively, and sixty-one patients (55%) were active in sports following the hip replacement. While younger patients who undergo joint replacement may have high expectations regarding postoperative function, the literature suggests that they may not actually participate in sports or achieve high functional levels postoperatively.

Hip resurfacing has evolved as an alternative to total hip arthroplasty, with the potential promise of a superior range of motion, improved joint stability, and reduced bearing-surface wear. Candidates for hip replacement who desire to pursue strenuous athletic activity with a high level of function frequently ask their surgeon about hip resurfacing. Naal et al. evaluated the athletic activity of 112 young patients (mean age, fifty-three years) at a mean of two years after hip resurfacing[35]. Prior to the hip resurfacing, 105 patients (94%) engaged in an average of 4.8 sports activities. After the hip resurfacing, 110 patients (98%) participated in an average of 4.6 sports activities. Thus, there was no major change in athletic activity after the hip resurfacing. Narvani et al. evaluated forty-three patients at a minimum of six months after hip resurfacing[36]. Prior to the hip resurfacing, 65% of this cohort participated in athletics compared with 92% after the surgery. Thus, hip resurfacing was

associated with an increase in the athletic activity of these patients. These studies document high levels of athletic activity prior to hip resurfacing and a high rate of return to athletics after hip resurfacing. However, the studies are limited by extremely short follow-up, and the authors did not evaluate the impact of athletic activity on the survival of the hip resurfacing implants.

The available literature does not allow an objective, evidence-based comparison of hip replacement and hip resurfacing with regard to their effects on athletic activity. Hip resurfacing has several theoretical advantages (a large femoral head, a greater range of motion, improved stability, and a metal-on-metal bearing surface) for patients who wish to participate in sports after hip reconstruction, but these design features have not been proven to be a clinical advantage. More importantly, advocates of hip resurfacing have not, to our knowledge, evaluated potential problems such as femoral neck fracture, femoral implant loosening secondary to osteonecrosis, and local inflammatory reaction due to metallic debris in patients who play sports. Furthermore, the long-term durability of hip resurfacing has not been determined. There is no evidence-based information to suggest that patients with hip resurfacing can return to sports more safely than patients with a traditional hip replacement.

Unicompartmental knee arthroplasty was designed as a surgical treatment for patients with painful unicompartmental osteoarthritis of the knee. As patients and surgeons have searched for less invasive surgical treatments, utilization of unicompartmental knee replacement has increased. One of the theoretical benefits of unicompartmental knee arthroplasty is a faster return to athletic activity. Naal et al. surveyed eighty-three patients at a mean of eighteen months after treatment with a fixed-bearing unicompartmental knee arthroplasty[37]. Prior to the unicompartmental replacement, seventy-seven (93%) had engaged in an average of 5.0 sports activities. After the replacement, seventy-three (88%) participated in an average of 3.1 athletic activities. Thus, fewer patients participated in fewer sports following the fixed-bearing unicompartmental knee replacement. Fisher et al. evaluated the athletic activity of seventy-six patients at a mean of eighteen months after treatment with a mobile-bearing medial unicompartmental knee arthroplasty[38]. Forty-two patients (55%) participated in sports activities prior to the operation, and thirty-nine patients (51%) participated in sports activities after it. Ninety-three percent of the patients successfully returned to their regular sports following the unicompartmental knee replacement. There was significant improvement in the mean UCLA activity score, from 4.2 to 6.5 points ($p < 0.01$).

Tennis After Total Joint Arthroplasty

Tennis is a popular lifetime sport. It offers players exercise and competition indoors and outdoors on hard surfaces and soft surfaces. Tennis is enjoyed by athletes of all ages, and the intensity of tennis can vary from aggressive competitive singles play to recreational social doubles play. However, many arthroplasty surgeons discourage patients with a joint replacement from playing tennis in order to avoid high-impact loading and twisting at the hip and knee joints, which might be associated with premature wear of the bearing surfaces, implant loosening, or joint trauma.

Mont et al. evaluated fifty-eight competitive tennis players at a mean of eight years after hip replacement[39]. All patients had returned to playing competitive tennis. Prior to the hip replacement all patients had hip pain while playing tennis, whereas at the time of follow-up nine patients (16%) had hip pain while playing tennis. The National Tennis Rating Program (NTRP) rating averaged 4.25 preoperatively and 4.12 at the time of follow-up. Following the hip replacement, the patients reported increased court mobility, a decrease in court speed, and pain relief. In a similar study, Mont et al. evaluated thirty-three competitive tennis players at a mean of seven years after knee replacement. All patients had returned to playing competitive tennis[40]. Prior to the operation all patients experienced knee pain or stiffness while playing tennis, whereas at the time of follow-up four patients (12%) had knee pain or stiffness while playing tennis. The NTRP rating averaged 4.35 preoperatively and 4.26 at the time of follow-up. The players noted increased court mobility and a loss of court speed following the total knee arthroplasty. All of the tennis players surveyed were satisfied with the result of the knee replacement and their ability to resume playing tennis.

These studies demonstrate that tennis players can return to playing competitive tennis after joint replacement and can regain their competitive skills. However, it is not clear if tennis players should return to high levels of tennis after joint replacement. The majority of the orthopaedic surgeons in these series discouraged their patients from playing tennis after the joint replacement, and the findings of these studies cannot be extrapolated to all patients with a joint replacement who play tennis. Furthermore, it remains to be seen how often recreational or social tennis players choose to return to playing tennis after total joint arthroplasty and whether their preoperative tennis skills remain intact. An eight-year follow-up period is too short to enable an evaluation of joint survivorship, and the authors provided no evidence that joint replacements will endure with the joint forces associated with competitive tennis.

Golf After Total Joint Arthroplasty

Golf is a popular sport around the world because it offers exercise, competition, camaraderie, and a pleasant walk over a beautiful landscape. In general, hip and knee replacement surgeons allow their patients to play golf because it is considered a low-impact athletic activity, and many golfers with painful, arthritic joints choose to have a joint replacement in order to be able to continue playing golf.

Mallon and Callaghan evaluated 115 amateur golfers at an average of six years following hip replacement[41]. All patients who played golf preoperatively returned to playing golf postoperatively. Eighty-seven percent of the golfers reported no hip pain while playing golf. Fifty-eight percent reported no hip pain and 41% reported mild pain or an ache in the hip after they played golf. Following the hip replacements, the average

handicap increased by 1.1 strokes and the average drive length increased by 3.3 yd (3 m). Eighty-nine percent of the golfers used a golf cart during play. Mallon and Callaghan also evaluated eighty-three amateur golfers at an average of 4.7 years after knee replacement[42]. Eighty-four percent of the golfers reported no knee pain while playing golf. Sixty-two percent reported no knee pain and 35% reported mild pain or an ache in the knee following golf. Following the knee replacements, the average handicap increased by 1.9 strokes and the average drive length decreased by 12.2 yd (11.2 m). Eighty-seven percent of the golfers used a golf cart during play.

Mallon and Callaghan compared discomfort in the right and left knees of golfers who had undergone a knee replacement[42]. Right-handed golfers had significantly more discomfort in the left knee, or the target-side knee, than in the right knee ($p < 0.01$). The authors used the mechanics of the golf swing to explain this difference. When a right-handed golfer performs a back swing, which is the first phase of the golf swing, the torque about the right knee is slow and controlled. However, during the subsequent down swing, impact, and follow-through, the weight is transferred from the right knee to the left knee, the golf club is accelerating, and more torque and shear stress occur in the left knee. This suggestion is consistent with the work of Stover et al., who demonstrated that right-knee torque was less than left-knee torque during the golf swing and that the maximum torque of the left knee occurs as the club head nears impact[43].

These retrospective evaluations of amateur golfers with a hip or knee replacement demonstrated that golfers can successfully return to playing golf after total joint arthroplasty with little change in their skills or handicap. It is interesting to note that the length of the drive was maintained following hip replacement but was reduced by 12 yd following knee replacement. The authors pointed out that one of their most important findings is the asymmetry of discomfort following knee replacement. After playing golf, right-handed golfers more commonly experienced discomfort in the left knee, which is subjected to greater force and more torque during the golf swing. The authors did not evaluate the durability of joint replacements in golfers, but they did note that a large majority of golfers with a joint replacement used golf carts, which can decrease joint loading and bearing surface wear[41,42].

Expert Opinion: Hip Society and Knee Society Surveys

Given a lack of evidence-based information with which to advise patients regarding appropriate athletic activity after joint replacement, expert opinion and surveys have been utilized to guide judgments. In 1995, McGrory et al. surveyed twenty-eight orthopaedic surgeons and fifteen fellows or residents at the Mayo Clinic regarding recommendations for athletic activity after joint replacement[44]. According to the respondents, participation in low-impact sports was encouraged, and recommended sports included bowling, cycling, golf, sailing, scuba diving, and swimming. Participation in high-impact sports was discouraged. Sports that were not recommended included baseball, basketball, football, handball, hockey, karate, racquetball, running, soccer, and water skiing. Cross-country skiing was allowed more frequently by consultants than by fellows or residents. Otherwise, the responses of the consultants, fellows, and residents were similar.

In 1999, Healy et al. surveyed fifty-four members of the Hip Society to ascertain which of forty-three athletic activities they considered to be "allowed," "allowed with experience," or "not recommended" after a hip replacement[45]. Power analysis demonstrated that a valid percentage of 73% was required for a recommendation to reach significance. If a valid percentage was not achieved for a specific recommendation, "no consensus" was listed for that activity. The Hip Society survey was repeated in 2005 (results not published), and sixty-three members rated thirty-seven athletic activities as "allowed," "allowed with experience," or "not recommended." During the six-year interval between 1999 and 2005, Hip Society members relaxed several restrictions of athletic activities after hip replacement. The number of "not recommended" activities decreased from twelve to four, and the number of "allowed" and "allowed with experience" activities increased from thirteen to twenty-two (Table I).

A similar survey was sent to members of the Knee Society in 1999[45] and 2005 (results not published). A similar power analysis was done, and it revealed that a valid percentage of 73% was required for a recommendation to reach significance. In 1999, fifty-eight Knee Society members evaluated forty-three athletic activities. In 2005, seventy members of the Knee Society evaluated thirty-seven athletic activities. From 1999 to 2005, the number of activities "not recommended" by the Knee Society members decreased from twelve to five, and the number of "allowed" and "allowed with experience" activities increased from eighteen to nineteen (Table II).

Comparison of the 1999 and 2005 Hip Society and Knee Society surveys revealed that both groups of joint-replacement experts allowed their patients to participate in more sports in 2005 and that they relaxed their restrictions of several specific athletic activities. Stationary cycling, ballroom dancing, golf, shuffleboard, swimming, and normal walking were "allowed" by both the Hip Society and the Knee Society in 1999 and 2005. Basketball, football, jogging, and soccer were "not recommended" by the Hip Society or the Knee Society in 1999 and 2005. However, baseball, gymnastics, handball, hockey, rock climbing, squash/racquetball, and singles tennis, which were "not recommended" in the 1999 survey by both societies, were in the category of "no consensus" in the 2005 surveys.

In spite of the fact that Hip Society and Knee Society members relaxed their collective restrictions on athletic activity between 1999 and 2005, when the members were asked whether they had changed their recommendations for athletic activity, 80% in both societies responded that they had not. This self-evaluation finding is interesting in the context of their collective trend to allow more athletic activity for their patients who had undergone a joint replacement. This trend was also observed in a survey of the American Association of Hip and Knee Surgeons (AAHKS). Klein et al. surveyed 522 members of the AAHKS and ninety-two members of the Hip Society regarding athletic ac-

TABLE I Results of the Hip Society Survey*[45]

Allowed			Allowed with Experience			No Consensus			Not Recommended		
	1999	2005		1999	2005		1999	2005		1999	2005
Stationary cycling	√	√	Bowling	√		Square dancing	√		Baseball	√	
Ballroom dancing	√	√	Canoeing	√		Fencing	√	√	Basketball	√	√
Golf	√	√	Road cycling	√		Rowing	√		Football	√	√
Shuffleboard	√	√	Hiking	√		Ice skating	√		Gymnastics	√	
Swimming	√	√	Horseback riding	√	√	Roller skating	√		Handball	√	
Doubles tennis	√		Cross-country skiing	√	√	Downhill skiing	√		Hockey	√	
Normal walking	√	√	Rowing		√	Stationary skiing	√		Jogging	√	√
Bowling		√	Ice skating		√	Speed walking	√		Rock climbing	√	
Canoeing		√	Roller skating		√	Weight lifting	√		Soccer	√	√
Road cycling		√	Downhill skiing		√	Weight machine	√		Squash/racquetball	√	
Square dancing		√	Stationary skiing		√	Baseball		√	Singles tennis	√	
Hiking		√	Doubles tennis		√	Gymnastics		√	Volleyball	√	
Speed walking		√	Weight lifting		√	Handball		√			
			Weight machine		√	Hockey		√			
						Rock climbing		√			
						Squash/racquetball		√			
						Singles tennis		√			
						Volleyball		√			

*This table is constructed to accurately compare the 1999 and 2005 Hip Society surveys. The 1999 survey asked about croquet (allowed), horseshoes (allowed), shooting (allowed), and lacrosse (not recommended), which were not included in the 2005 survey. The 1999 survey asked about high-impact aerobics (not recommended) and low-impact aerobics (allowed with experience). The 2005 survey combined these activities and asked about aerobics (allowed with experience). The 2005 survey asked about yoga (allowed with experience), which was not included in the 1999 survey.

tivity after joint replacement and reported greater than generally expected tolerance and acceptance of sports activity for patients with a joint replacement[46]. The trend for experts in the Hip Society, the Knee Society, and AAHKS to allow more athletic activity and relax restrictions of sports activity after joint replacements may be based on outstanding patient outcomes, increasing surgeon confidence in surgical technique, and innovations in joint implants. This trend may also be a response to patients' demands to participate in athletics after total joint arthroplasty. However, this trend in expert opinion is not based on evidence-based information and may not be in the best interest of patients.

Overview

Functional improvement and the ability to return to athletic activity are important to many patients who have undergone a joint replacement, and a return to a high level of athletic activity is possible following a joint replacement. However, participation in athletics and the intensity of sports activity generally decrease following joint replacement. This review documents a trend for hip and knee surgeons to allow more athletic activity after joint replacement, but there is no good evidence to support this trend. High levels of activity may compromise the durability of joint replacement and reduce implant survival. Innovations such as alternative bearing surfaces, large femoral heads, hip resurfacing, unicompartmental knee replacement, mobile-bearing knee replacement, and high-flexion knee replacement offer the potential for high-demand function with low rates of failure. However, these potential benefits have not been proven.

The orthopaedic literature regarding sports and total joint arthroplasty is not extensive, and high-quality, objective, evidence-based information is lacking. The current literature consists of retrospective studies. There have been no Level-I or Level-II studies, to our knowledge. The specific studies reviewed in this article were small retrospective series with insufficient power and short-term follow-up. The surveys of the members of the Hip Society and the Knee Society provide valid expert opinion, but those opinions are still subjective. Expert opinion has standing based on the experience and knowledge of the experts, but it is not a substitute for Level-I prospective controlled studies.

Our own patients choose to have joint replacement in order to relieve pain and improve function, and many patients elect to have joint reconstruction to enable them to play sports. In general, we follow the recommendations of the Hip Society and Knee Society surveys, but ultimately we allow our patients

TABLE II Results of the Knee Society Survey*[45]

Allowed			Allowed with Experience			No Consensus			Not Recommended		
	1999	2005		1999	2005		1999	2005		1999	2005
Bowling	√	√	Canoeing	√		Square dancing	√		Baseball	√	
Stationary cycling	√	√	Road cycling	√		Fencing	√	√	Basketball	√	√
Ballroom dancing	√	√	Hiking	√		Roller skating	√	√	Football	√	√
Golf	√	√	Rowing	√	√	Downhill skiing	√		Gymnastics	√	
Horseback riding	√		Ice skating	√	√	Weight lifting	√	√	Handball	√	
Shuffleboard	√	√	Cross-country skiing	√	√	Baseball		√	Hockey	√	
Swimming	√	√	Stationary skiing	√	√	Gymnastics		√	Jogging	√	√
Normal walking	√	√	Doubles tennis	√	√	Handball		√	Rock climbing	√	
Canoeing		√	Speed walking	√		Hockey		√	Soccer	√	√
Road cycling		√	Weight Machine	√		Rock climbing		√	Squash/racquetball	√	
Square dancing		√	Horseback riding		√	Squash/racquetball		√	Singles tennis	√	
Hiking		√	Downhill skiing		√	Singles tennis		√	Volleyball	√	√
Speed walking		√				Weight machine		√			

*This table is constructed to accurately compare the 1999 and 2005 Knee Society surveys. The 1999 survey asked about croquet (allowed), horseshoes (allowed), shooting (allowed), and lacrosse (not recommended), which were not included in the 2005 survey. The 1999 survey asked about high-impact aerobics (not recommended) and low-impact aerobics (allowed with experience). The 2005 survey combined these activities and asked about aerobics (allowed with experience). The 2005 survey asked about yoga (allowed with experience), which was not included in the 1999 survey.

to participate in athletic activities as they wish. We educate our patients regarding the risks associated with sports and higher levels of activity. This discussion includes the risk of instability, periprosthetic fracture, bearing-surface wear, early implant loosening, and premature revision. We advise our patients who play sports after joint replacement to train for their specific athletic activity. We recommend extensive back, hip, and knee rehabilitation with development of core strength. We believe that stretching and strengthening programs can enhance athletic performance, prevent injury, and protect joint reconstructions. We also teach our patients who have had a joint replacement to be cautious and to carefully assess the risks and benefits of their participation in athletic activity. The cardiovascular and mental health benefits and the enjoyment of athletic activity must be balanced with the potential risk of reduced survival of the joint replacement. If our patients understand the risks associated with their athletic activity, if they train for their sport, and if they choose to return to their sport, we encourage them to have fun.

Orthopaedic surgeons have a duty to recommend activities that promote durability and survival of the reconstructed joint. Unfortunately, there is limited evidence-based information on which to base these recommendations. Going forward, adult reconstructive surgeons should study the activities of patients who have had a joint replacement in order to define which ones to recommend and which to restrict. A national joint replacement registry may help in this endeavor. Surgeons who perform and patients who undergo joint replacement deserve Level-I-evidence information on which to base judgments regarding reasonable athletic activity following the procedure. ■

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