

## Participation in Sports After Total Knee Replacement

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### ABSTRACT

Return to regular sports activity was evaluated in a retrospective review of 160 patients who had undergone total knee replacement surgery by a single surgeon (208 knee replacements). Mean age of the patients was 68 years (range, 27 to 87) at surgery and 73 years (range, 33 to 91) at review at a mean follow-up of 5 years (range, 3 to 7). Seventy-nine patients regularly participated in sports, at least once per week, before surgery, and 51 patients regularly participated in sports after surgery. Only eight patients took up sports after surgery who were not regularly involved in sports in the year before surgery. Patients were more likely to return to low-impact activities such as bowls (29 of 32, or 91 %) than to high-impact activities such as tennis (6 of 30, or 20% returned). Forty-three of 56 patients (77%) who had participated in regular exercise in the year before surgery returned to sports. Eighty patients did not participate in sports before surgery and 54 of these had coexisting disease that prevented sports. None of these patients returned to sports.

There have been a number of reports in the literature on patients returning to sports after total hip replacement, with 29% (156 of 539 patients) to 56% (62 of 110 patients) returning to sports.(5, 13,17,19,21) There are, however, no studies on patients returning to sports after total knee replacement (TKR) despite the fact that TKR is becoming increasingly common, with the replacement rate approaching that of the hip.(8,10) With increasing implant survivorship, patient expectation of a good functional result is also rising.(14) Despite advice that high-impact activity may jeopardize the result, many patients return to sports after TKR. We have reviewed patients operated on by one surgeon to assess their pre- and postoperative sports activity.

### PATIENTS AND METHODS

We reviewed 176 consecutive patients who underwent TKR (unilateral or bilateral) performed by the senior author (MJC). One hundred sixty patients (88 women and 72 men) were available for review, giving a total of 208 knees in this study. Fifteen patients could not be contacted because of address changes, one had died from unrelated causes. A retrospective review was conducted using notes and clinical review. In addition to notes review, postal and telephone questionnaires were used for 29 patients lived too far away for clinical assessment, although some immediately postoperative clinical assessments were available on these patients. A knee scoring sheet was used to assess the severity of disease preoperatively and the outcome of the knee replacement surgery (Fig. 1).

Information on the prostheses implanted is given in Table 1. The different prostheses used reflect the senior author's belief in evolving prosthetic design rather than a choice of prosthesis for a specific condition. Tricon (Smith and Nephew Richards, Memphis, Tennessee), Geomedic (this particular prosthesis is no longer made), and Kinemax (Howmedica, Warsaw, Indiana) prostheses were used first, then Miller Galante 1 (Zimmer, Warsaw, Indiana) and Miller Galante 2 (Zimmer), and finally Motus (Osteo, Montreaux, Switzerland).

One hundred ninety-nine of 208 knees were uncemented. The main indication for surgery was pain and failure of medical management such that the patient was no longer able to perform activities of daily living. Preoperative knee score of less than 100 of 200 was used as a guide to indication for replacement. Simultaneous bilateral TKR was performed if both knees were arthritic and sufficiently symptomatic, provided there were no medical contraindications and the patient agreed. Unilateral TKR was performed

if one knee was symptomatic but patient could tolerate symptoms from the contralateral knee. All operations were performed using a standardized technique by the senior author. A tourniquet was used unless contraindicated (for example, by atherosclerosis). All patients were given three doses of prophylactic cephalosporin antibiotic and all received perioperative prophylactic anticoagulation using calcium heparin unless contraindicated. Early postoperative mobilization starting on the first postoperative day after removal of the drain was encouraged. Full weight bearing was permitted as tolerated with initial supervision by a physical therapist. All patients were advised that a return to high-impact sports activity such as running or tennis was not recommended but that relatively low-impact activity such as bowls or golf was acceptable. Patients were reviewed at 6 weeks, 3, 6, and 12 months, and annually thereafter.

Demographic details, type of prosthesis and postoperative sports participation are shown Table 2. The number of patients participating in sports at least once per week before and after TKR as well as the total number of patients by preoperative diagnosis are given in Table 3. Severity of arthrosis was analyzed. Of the 142 patients who had osteoarthritis, 67 knees had joint space narrowing in one or more compartments, 105 had obliteration of joint line in one or more compartments, and 16 had bone loss. There was no significant difference in the distribution of these patients between the group of patients who returned to sports and the group of patients who did not.

## **RESULTS**

The overall average age at operation for both men and Women was 68 years (range, 27 to 87). The average age at operation of the patients who returned to sports was 67 years and of the patients who did not return to sports was 68 years. Average age at follow-up was 73 years.

### *Knee Score*

The mean preoperative knee score was 90 of 200 in those patients who returned to sports and 103 of 200 in those who did not. Thus, somewhat surprisingly, patients who returned to sports had a significantly poorer preoperative knee score than those who did not (Student's t-test,  $P < 0.05$ ). The mean postoperative knee score was 189 of 200 in those patients who returned to sports and 177 in those who did not.

### *Range of Motion*

The mean preoperative range of motion was  $4^{\circ}$  to  $111^{\circ}$  in patients who returned to sports, and  $4^{\circ}$  to  $109^{\circ}$  in those who did not. The mean postoperative range of motion was  $0.8'$  to  $112'$  in patients who returned to sports, and  $1'$  to  $112'$  in those who did not. Using the Student's t-test, we found no statistically significant difference in range of motion between the return-to-sports group and nonreturn-to-sports group pre- and postoperatively.

### *Walking Ability*

The patients' walking ability was analyzed using the knee score sheet and used as a measure of functional endurance (Fig. 1). Patients who returned to sports had a mean score of 30 of 50 preoperatively compared with those who failed to return to sports, who had mean score of 23 of 50 preoperatively. Although it seems logical that patients who did not return to sports would have a lower mean preoperative knee score, comorbidities such as cardiovascular disease could entirely explain this lower score. Postoperatively, the score for walking ability was 47 of 50 in those who returned to sports and 41 of 50 in those who did not. Once again this difference can be explained by the presence of comorbidities.

### *Return to Sports*

Eighty-one patients did not regularly participate in any sports before surgery, and none of these patients took up sports after surgery. Seventy-nine patients participated in sports before surgery. The type of sports played both before and after surgery is given in Figure 2. Patients were more likely to return to low-impact activities such as bowls (29 of 32, or 91%, returned) than high-impact activities such as tennis

(6 of 30, or 20%, returned). Overall, 79 patients participated in sports before surgery, and 51 (65%) returned to regular sports after surgery. Forty-three of 56 patients (77%) who had participated in regular exercise in the year before surgery returned to sports. Only 8 of 23 patients (35%) who had been inactive in the year before surgery returned to sports.

### *Unilateral Versus Simultaneous Bilateral Procedures*

One hundred twelve patients underwent unilateral TKR, 57 of whom participated in sports before surgery. Thirty-five of these patients (61%) returned to sports. Forty-two patients underwent simultaneous bilateral knee replacements and 20 of these patients participated in sports before surgery. Fifteen patients (75%) returned to sports. There were insufficient knees in the sequential bilateral group for analysis. It is the authors' belief that although patients with unilateral TKR may be able to tolerate the milder contralateral knee symptoms before surgery, contralateral knee pain becomes more obvious to the patient after surgery. This may be result from increased stress on the contralateral knee while favoring the operated knee in the first few weeks after surgery or by simple comparison of the contralateral knee with the postoperatively pain-free reconstructed knee. This is one explanation for the improved return to sports in patients who undergo bilateral procedures.

### *Coexisting Disease*

Patients undergoing TKR often have other factors limiting their activity besides the symptomatic knee(s). These factors will continue to limit their activity after successful TKR. Coexisting disease, or comorbiditors, considered in this study were coronary artery disease, chronic obstructive pulmonary disease, peripheral vascular disease, cerebrovascular disease, polyarthritis, and other systemic diseases. Fifty-five patients had comorbiditors that limited their activity and prevented their participation in sports before the operation. None of these patients returned to sports. Sixty-six patients had no pre-existing comorbiditors and engaged in sports before the operation. Fifty-one of these patients (77%) returned to sports.

### *Complications*

Fifteen knees underwent revision surgery, four (2%) for deep infection. Six knees required revision of the Miller Galante metal-backed patella implant because of polyethylene wear and metallosis. This is a well-recognized complication and is one of the reasons the senior author no longer uses metal-backed patella implants. Five (2%) knees underwent revision for loosening, four of the tibial component and one of the femoral components, at the bone-implant interface. Five of the 15 patients who required revision surgery managed to return to sports before revision, and four of these had revisions for patella wear. Ten patients, however, did not return to sports before revision.

## **DISCUSSION**

The primary indication for TKR has been, and still is, pain that is unresponsive to medical management.<sup>(16)</sup> With improvements in surgical technique and growing confidence on the part of surgeons because of increased survivorship of knee implants, younger patients are being offered the procedure.<sup>(6)</sup> Increasingly, patients are looking not only for an end to pain but also for increased function.<sup>(14)</sup> These factors, along with the increasing emphasis placed on the health benefits of exercise, place increasing demands on surgeons and the prostheses we implant.<sup>(15)</sup> Patients' return to sports after total hip replacement has been reported, but no reports exist on how many patients return to sports after TKR.<sup>(18,21)</sup> The rates of TKR are approaching that of hip replacements and may even overtake hip replacement in the near future.<sup>(8,10)</sup> It is therefore important that we understand the extent of patient demand as we formulate rational postoperative advice.

We found that overall, 51 of 79 patients with TKR (65%) who engaged in sports activity before operation returned to sports. If the patients have no comorbiditors that themselves prevent sports activity, the rate of return to sports may be as high as 75%. Dubs et al<sup>(5)</sup> found that of 110 patients who underwent total hip replacement, 86 (78%) had engaged in sports preoperatively and 61 (55%) postoperatively. These

figures are very similar to ours. Apart from the presence of comorbidities, it is difficult to explain why some patients managed to return to sports and others did not. Clearly, patients who have not participated in sports before the onset of arthritis or for a considerable time before surgery are unlikely to take up sports after a T.Y.R. None of our patients in this category did. Preoperative range of motion, walking ability, and radiographic grade of arthrosis were the same in both groups. The preoperative knee scores of patients who returned to sports after TKR were actually worse than those of patients who did not. One explanation is that patients who played sports preoperatively were more likely to return to sports because they were motivated to play sports in the first place. This motivation may have helped in their postoperative rehabilitation, making postoperative success, more likely.

Visuri and Honkanen (21) reported an increase recreational exercise after total hip replacement in 539 patients: 11 patients walked for exercise before surgery and 296 patients did so after (an increase from 2% to 55%), while 38 cycled before and 156 after the operation (an increase from 7% to 29%). Dubs et al (5) also found that low-impact activities such as hiking, swimming, and cycling were continued, but skiing, ball sports and contact sports were participated in far less often or discontinued. Our data support this, with golf and bowls being the most popular activities after surgery. Sports recommended by Dubs and colleagues in the first 6 months after total hip replacement to increase mobility and strength were swimming, cycling, rowing, and walking. Once strength, mobility, and coordination had improved, patients were allowed to return to tennis, cross-country skiing, jogging, hiking, and mountaineering. In the case of recreational exercise after TKR, we agree with allowing patients to return to low-impact activity, particularly swimming, walking, and cycling, but we do not recommend high-impact activities such as tennis.

Despite our slowly improving knowledge of sports activity in patients with joint replacements, there is considerable debate about the long-term effects of such activity on prosthetic wear, loosening, and revision rates. Many authors advise against a return to sports because of increased risk of reoperation or component wear after total hip replacement. (1,2,4,7,19) It is tempting to postulate that a return to sports activity increases the likelihood of polyethylene wear, loosening, and revision surgery. In our series, five patients underwent revision for femoral or tibial loosening and six for patella failure. However, only five of these patients had returned to sports before their revision. This cohort of patients would need to be observed for another 5 years for valid conclusions to be drawn on loosening and revision rates.(9) Mallon and Callaghan (12) reported that of 83 active golfers after TKR, 13 (16%) experienced mild ache in the operated knee while playing, and 30 (36%) experienced mild ache in the operated knee after playing despite the fact that 72 of the 83 golfers (87%) used a golf cart. More interestingly, the lead knee was usually more problematic. Stover et al (20) demonstrated that the torque on the lead knee is much greater during the swing. Wear rates of up to 0.39 mm/year in the polyethylene acetabular cup of a total hip replacement were found in patients who engaged in sports, which is between 5 and 10 times normal. (3,5)

Some studies do not take confounding factors into adequate consideration. Kilgus et al. (9) found that the risk complication in 688 patients with total hip replacements who engaged in heavy labor or sports was twice that of those who did not. The two groups, however, were not comparable: patients who engaged in heavy labor or sports were an average of 12 years younger than patients in the less-active group; 461 (67%) of the patients in the heavy labor/sports group were men, whereas there were 240 men (35%) in the less-active group; and the patients in the heavy labor/sports group were considerably heavier than those in the less active group. Furthermore, no adjustment was made for preoperative diagnosis in either group. When preoperative diagnosis (osteoarthritis versus non-osteoarthritis) and participation in low-impact activity was taken into consideration, there was no statistically significant difference between the two groups. Ritter and Meding (17) concluded that light exercise had no deleterious effect on replaced hips.

Some authors have found the risk of loosening to be lower in patients with total hip replacements who returned to Sports. (5,21) In one series, revision rates were nine times lower in patients who returned to sports, but this may be because the patients had less severe disease before operation.(5) It is possible that sports activity actually has a protective effect on the bone-implant interface by encouraging bone regrowth as long as the stress is below an as yet unidentified threshold.(5) What we do know is that

harmful effects are not seen until 10 years after prosthesis implantation.(9) We do know that the potential complications of returning to sports on the prosthetic knee must be balanced by the beneficial effects of low-impact exercise on the cardiovascular and metabolic systems.(11) We continue to advise against high-impact activity but allow low-impact sports and recreation after TKR.

## SUMMARY

We have shown that 65% of our patients who participated in regular exercise before TKR returned to sports after the procedure, a figure that rises to 77% if the patients have no comorbiditors. The majority returned to low-impact sports. The general benefits of recreational low-impact activity are well publicized and patient expectation of return to exercise after TKR are rising. It is too early to determine the effect of this activity on prosthetic wear and loosening, but it is becoming increasingly important for us to do so.

TABLE 1. Total Knee Replacements by Type of Prosthesis

<i>Prosthesis</i>	<i>Cemented</i>	<i>Number</i>
Geomedic	Yes	4
Kinematic	Yes	5
Miller Galante 1	No	15
Miller Galante 2	No	123
Motus	No	59
Tricon	No	2
Total		208

TABLE 2. Type of Prosthesis Used, Patient Demographics, and Postoperative Sports Participation

<i>Prosthesis</i>	<i>Number of Patients</i>	<i>Unilateral Implantations</i>	<i>Bilateral Implantations</i>	<i>Age (years)</i>	<i>Sex, by knee</i>		<i>Number of patients who resumed sports</i>
					<i>Male</i>	<i>Female</i>	
Geomedic	3	2	1	47	0	4	0
Kinematic	3	1	2	62	1	4	0
MG 1	14	13	1	62	6	9	6
MG 2	94	65	29	69	63	60	26
Motus	45	31	14	68	27	32	19
Tricon	1	0	1	68	0	2	0

Total	160	112	48*	97	111	51
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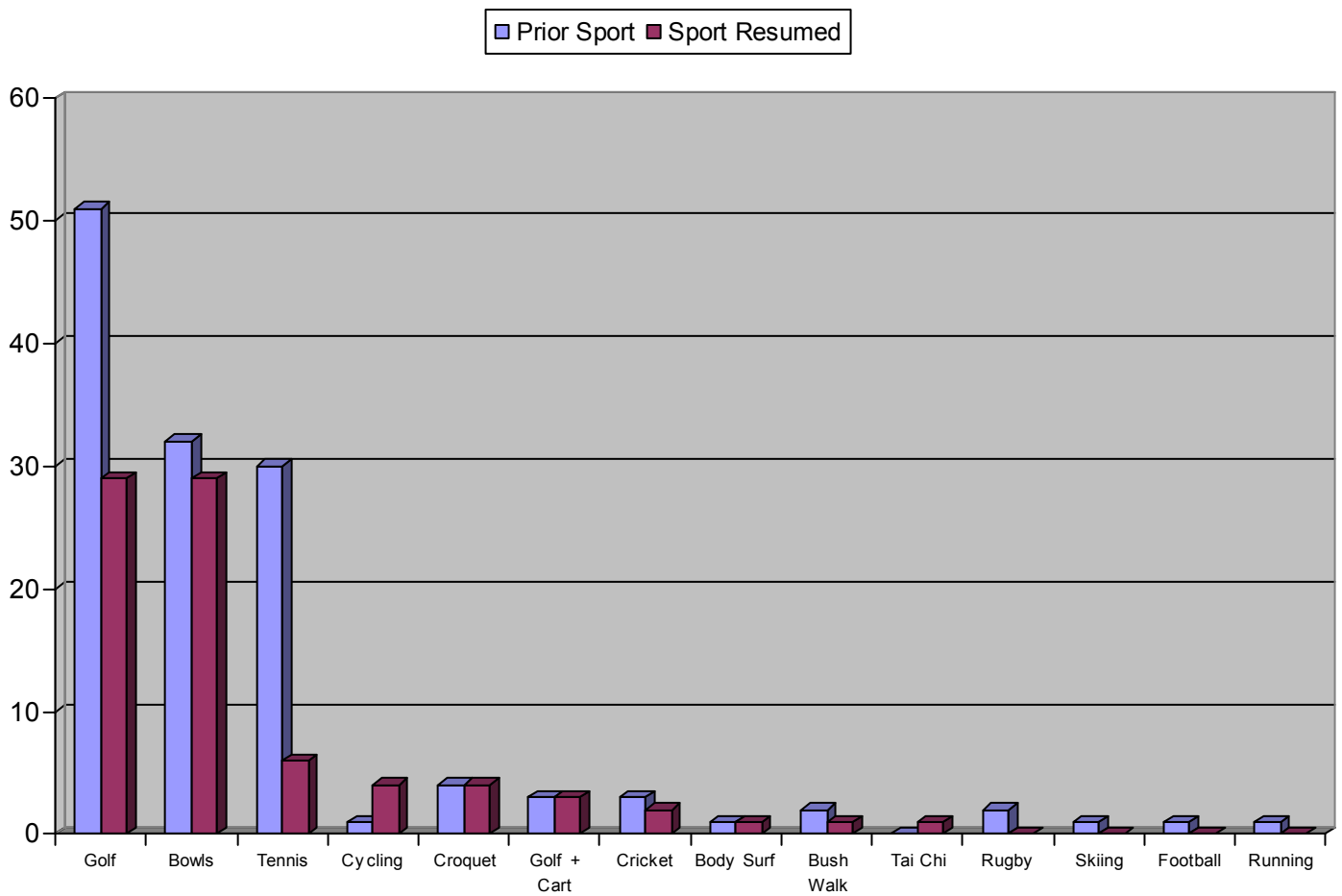
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\* Forty-two patients underwent simultaneous bilateral TKR.

TABLE 3. Preoperative Diagnosis and Sports Activity Before and After TKR

<i>Diagnosis</i>	<i>N</i>	<i>Patients participating in sports preoperatively (N)</i>	<i>Patients participating in sports postoperatively (N)</i>
Osteoarthritis	14	71	49
	2		
Osteonecrosis	7	4	1
Rheumatoid Arthritis	7	2	0
Chondrocalcinosis	3	2	1

FIGURE 2. Patients participating in various sports before and after surgery



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