

Total Joint Replacement: Optimizing Patient Expectations

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Abstract

Rehabilitation of the patient who has undergone total hip or knee replacement embraces many facets of care, including prevention of complications, patient education, and a program of gradual resumption of normal functions. This program may be divided into three phases. In the perioperative phase, elimination of factors that contribute to morbidity will facilitate resumption of physical activities. In the interim phase (the first year following surgery), the patient's desire to return to full activities must be tempered by the goal of preserving for the longest possible time the mechanical-biologic construct of the joint replacement. Although a final functional result is usually achieved in the first 2 to 3 years following surgery, the patient must be followed up indefinitely. During this third phase of long-term assessment, the question of whether total joint arthroplasty was a success must be answered by the surgeon, by the patient, and by society.

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This review will address the educational, rehabilitative, and medical aspects of total hip and knee replacement surgery that contribute to reduced morbidity, optimal restoration of function, and realization of the patient's expectations. Rehabilitation can be divided into three phases: phase 1, the immediate perioperative period, in which preventive measures reduce morbidity and allow the patient to participate fully in the early physical rehabilitation program; phase 2, from hospital discharge through the first 9 to 12 months following surgery, when the patient gradually resumes normal function; and phase 3, of unlimited duration, when the patient, the surgeon, and society decide whether the operation fulfilled its promise.

Each year approximately 120,000 total hip and 120,000 total knee replacement procedures are performed in North America.^{1,2} Appropriate preoperative education regarding the risks and benefits of the proposed surgery enhances the

likelihood that the result achieved will be viewed as successful. To this end, the surgeon should document the patient's current symptoms and functional disabilities in a standardized way and then use these data as a baseline against which future evaluations can be compared.

Phase 1: Perioperative Period

Because most patients are now admitted on the day of surgery, perioperative education, training in the use of crutches, and medical and anesthetic preoperative evaluation must be done in the outpatient setting.

Preventive Measures

All medications that can adversely affect the clotting mechanism, such as aspirin and non-steroidal anti-inflammatory drugs (NSAIDs), are discontinued prior to surgery. A recent study found that bleeding complications were signifi-

cantly higher in patients taking anti-inflammatory agents that had a long half-life. Aspirin and piroxicam have the longest half-lives (more than 15 hours)³ (Figs. 1 and 2).

All my patients receive perioperative intravenous antibiotics. The lowest incidence of wound infections seems to occur in patients in whom the initial infusion of antibiotics is given during a time period not longer than 2 hours prior to incision.⁴

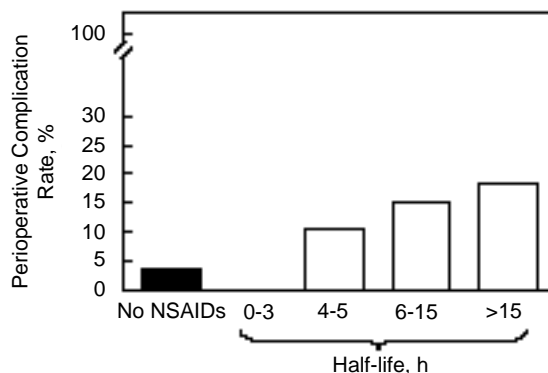
In patients at risk for postoperative urinary retention, an indwelling catheter should be placed preoperatively in the operating room, after anesthesia has been induced.⁵ There are at least two advantages to this practice: the operating room is the most sterile environment for this procedure, and the bladder is decompressed during the operation. When regional anesthesia is used, the likelihood of urinary retention is increased. In total knee replacement surgery in particular, it is now our practice to continue epidural anesthesia for the first 48 to 72 hours to enhance early and maximal knee range of motion. Urinary bladder decompression should be maintained until bladder sensation is restored.

It is now recognized that the majority of deep vein thromboses

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Fig. 1 Perioperative complication rates for patients taking NSAIDs. Drugs are grouped by pharmacologic half-life (for aspirin, the half-life of the effect on platelet function was used). Drugs with a half-life of 0 to 3 hours were fenoprofen, ibuprofen, meclofenamate sodium, and tolmetin; those with a half-life of 4 to 5 hours were indomethacin and ketoprofen; those with a half-life of 6 to 15 hours were diflunisal, naproxen, and sulindac; and those with a half-life of more than 15 hours were aspirin and piroxicam. Differences between groups were statistically significant. (Reproduced with permission from Connelly CS, Panush RS: Should nonsteroidal anti-inflammatory drugs be stopped before elective surgery? *Arch Intern Med* 1991;151:1963-1966.)



that occur following total joint arthroplasty are silent, without symptoms or physical signs. Increasingly, the perioperative prevention of thromboembolism involves some use of mechanical measures, such as pulsed pneumatic stockings or boots, and chemical prophylaxis, such as administration of heparin or warfarin. Still unre-

solved are questions regarding the cost-effectiveness of surveillance before and after hospital discharge and the optimal duration, if any, of postdischarge prophylaxis.⁶

When a patient is at risk for heterotopic bone formation (e.g., due to diffuse idiopathic skeletal hyperostosis or spondyloarthropathy), effective prophylaxis can be obtained with

a single dose of postoperative radiation in the range of 700 to 800 cGy. Indomethacin (25 mg three times a day for 6 weeks) has been shown to be effective as well. A recent study reports that indomethacin at this dose but given for only 10 days is effective in prevention of heterotopic bone formation.⁷ Either regimen is effective when instituted within 24 to 72 hours after surgery.

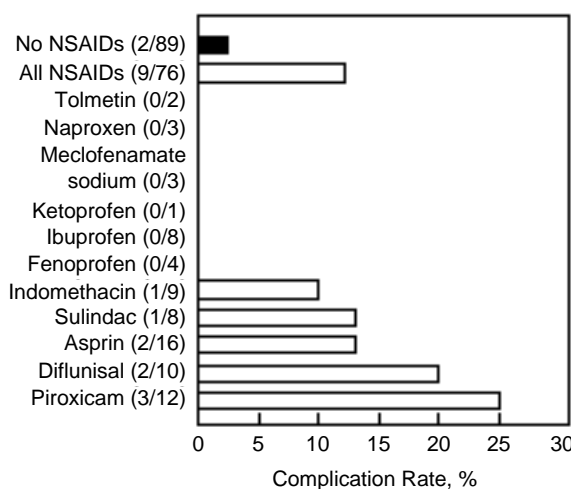
In addition to these general preventive measures, patients with systemic diseases or multiple joint involvement require special planning. For example, the surgical care of the patient with rheumatoid arthritis must carefully integrate the many facets of medical, surgical, anesthetic, and rehabilitation needs. Such patients often are taking corticosteroids and methotrexate, which require special attention during the perioperative period. Prednisone is supplemented by hydrocortisone during the perioperative period to prevent adrenal insufficiency due to surgical stress. Methotrexate is usually discontinued the day before surgery and then begun again upon hospital discharge.

The sequence of joint replacement surgery in these patients is critical. Will the upper extremities be able to support the planned lower-extremity joint replacement? Will skin breakdown under a deformed metatarsal head jeopardize the continuing sterility of a total knee replacement? Will cervical spine involvement create anesthesia demands?⁸ Each of these issues must be addressed in the preoperative evaluation.

Physical Rehabilitation

Recognition of the magnitude of the forces generated across the hip and knee suggests a rehabilitation protocol that guides the patient to a gradual resumption of full joint loading over a period of many weeks to months.

Fig. 2 Postoperative complication rates for patients taking NSAIDs. Complication rate (numbers in parentheses) is expressed as number of complications per number of patients taking a given NSAID. (Reproduced with permission from Connelly CS, Panush RS: Should nonsteroidal anti-inflammatory drugs be stopped before elective surgery? *Arch Intern Med* 1991;151:1963-1966.)



Important insights into the forces across the hip in the early postoperative period were gained in studies of an instrumented total hip replacement.⁹ This study reported the average dynamic loads during activities of daily living for the first 31 days after a patient underwent implantation of an instrumented total hip replacement (Table 1). With increased weight bearing (and presumably patient comfort) the average loads increased with time. The resultant force was directed to the anterosuperior portion of the femoral head, demonstrating that with each loading cycle there are significant out-of-plane (coronal) forces. During stair climbing or straight leg raising, the out-of-plane orientation of the resultant force increased substantially. These data suggest that certain aspects of the early postoperative rehabilitation program place significant out-of-plane forces on the prosthesis and substantially test the torsional stability of the implant.

Out-of-plane (coronal) forces should be minimized following total knee replacement as well. The forces of greatest magnitude following this procedure occur in the sagittal plane with activities such as going up or down ramps and stair climbing. These forces reach levels of approximately five times body weight.^{1,2}

The goals of the immediate physical rehabilitation program following total hip or total knee arthroplasty are to commence early active assisted range of motion, achieve independent transfers, and begin sitting, standing, and walking with support in the first few days. Progression to an independent partial weight-bearing gait has as its goal that at discharge the patient is both comfortable and safe using two crutches at all times. Other important aspects of the immediate postoperative program are to teach the safe performance of the activities of daily living and to

Table 1
Maximum Joint Loads During Various Activities

Activity	Maximum Resultant Force, % body weight			
	3 Days	6 Days	16 Days	31 Days
Straight-leg raising	—	1.0	1.5	1.8
Getting out of bed	0.8	1.0	1.2	1.4
Getting into bed	0.8	1.0	1.5	1.5
Double-limb stance	0.5*	0.7†	0.9	1.0
Ipsilateral single-limb stance	1.2*	1.3†	1.4†	2.1‡
Walking with aid	1.0*	1.5§	2.6§	2.4 , 2.8¶

*Using a walker.

†Ipsilateral hand on crutch, contralateral hand in attendant's hand.

‡Contralateral hand in attendant's hand.

§Using crutches.

||Between parallel bars.

¶With crutches, unsupported ipsilateral stance.

(Reproduced with permission from Davy DT, Kotzar GM, Brown RH, et al: Telemetric force measurements across the hip after total arthroplasty. *J Bone Joint Surg* 1988;70A:45–50.)

teach the use of accessory devices that facilitate comfortable and safe function (e.g., elastic shoe laces and elevated toilet seats).

Following total hip replacement, the goal of achieving a normal range of motion must be tempered by the need to achieve a safe range of motion. Depending on the surgical approach, certain combinations of flexion, rotation, and abduction or adduction should be limited. Most dislocations occur in the first few weeks following surgery, and the majority do not recur. One can infer that intensive educational efforts in the immediately postoperative period will prevent most dislocations.

As rehabilitation progresses, the patient must use the newly restored range of motion and normal alignment to relearn a normal gait pattern. We ask patients to use two crutches for a period of 6 to 12 weeks (depending on the type of fixation used and the surgeon's judgment of its initial stability), to advance to a single crutch, and then to rapidly advance to

a single cane in the hand opposite the affected side. The criteria for advancement to less ancillary support are decreased fatigability, decreased pain, and absence of a limp even with less weight-bearing support. It is unusual for a patient to be able to abandon all support and walk normally for time periods of more than 10 minutes before 3 months has elapsed after the surgery. Between 3 and 6 months after total hip replacement, muscle strength is usually only 50% of normal. While patients may then begin walking with less support, or even with no support for short time periods, they will most likely experience easy fatigability and require the use of a cane. Between 6 and 12 months, muscle strength is restored to approximately 80% of normal. Therefore, with time, patients will gradually assume more normal function with less fatigability and a more normal gait.¹⁰ Hydrotherapy is an excellent modality that combines range of motion, low-impact loading, and gentle resistive exercises.

Following total knee replacement surgery, a major goal is rapid institution of maximum range of motion. To this end, regimens including prolonged epidural anesthesia or patient-controlled analgesia are often combined with the use of a continuous passive motion (CPM) machine. While CPM is commonly used in this setting, its efficacy has yet to be conclusively established. A recent randomized, controlled study compared standard physical rehabilitation regimens with and without CPM.¹¹ The CPM group was not significantly improved regarding postoperative pain, active and passive extension, quadriceps strength, or length of hospital stay. A significant increase in immediate flexion (82 degrees versus 75 degrees) in the CPM group was rendered insignificant by the 6-week measurements. However, the modality was considered cost-effective because the need for knee manipulation was eliminated in the CPM cohort. While this rigorous study failed to demonstrate significant functional differences between groups, CPM continues to be a commonly used modality, supported by the impression of many patients and surgeons that it facilitates a more comfortable perioperative course.

While the major emphasis in range-of-motion exercises following total knee arthroplasty is on maximizing flexion, it is equally important to achieve as much extension as possible. A patient who walks with a permanent knee-flexion contracture not only fails to achieve a normal gait, but walks with an increased energy expenditure as well.

In summary, the goals of rehabilitation in the early period following lower-extremity total joint replacement are to maximize range of motion and to try to restore to the fullest extent the anatomic arc of motion so that the functional range

of motion can be achieved with utmost safety. In addition to the type of fixation employed and the time it takes to reach maturity, one must consider the large loads across prosthetic joints as a result of muscle action.

Phase 2: Interim Period

For the first 6 weeks following hospital discharge, patients are advised to perform range-of-motion exercises and use two crutches full-time. Depending on their level of comfort and their muscle strength, many will advance to a single crutch or to a cane indoors. At the first postoperative visit the average patient is ready to advance activity levels and generally will ask many questions about resumption of certain activities. Listed below are some of the questions most commonly asked at the initial visit after total hip arthroplasty.

When May I Resume Sitting in a Low Chair?

Problems that arise with sitting in a low chair are associated more with how a patient arises from it than with the sitting position itself. Depending on the surgical approach, the surgeon and the therapist must instruct the patient to avoid those positions that might engender prosthetic impingement and dislocation. With the commonly used posterolateral approach, hip flexion of more than 90 degrees associated with adduction and internal rotation should be avoided. With the lateral or modified lateral approach, extreme external rotation and hyperextension should be avoided because of the risk of anterior dislocation.

When a patient arises from a chair with minimum hand assist, the sum of hip and knee flexion generally exceeds 180 degrees. The degree to

which knee flexion is limited will place additional flexion requirements on the hip. Patients with rheumatoid arthritis and multiple lower-extremity joint involvement therefore find it particularly difficult to arise from a low chair—even more so if they have upper-extremity involvement as well.

When May I Resume Driving?

MacDonald and Owen¹² designed an experimental driving simulator that tests the patient's ability to switch the right foot from the accelerator to the brake in a timely manner and with appropriate force. By 8 weeks after left total hip replacement, patients had generally improved to the point at which their reaction time and the force generated by their right foot approached those of normal control subjects. In contrast, patients who underwent right total hip replacement had mean reaction times preoperatively and at 8 weeks postoperatively that were significantly increased compared with normal control subjects and with patients undergoing left total hip arthroplasty. This study suggests that patients who undergo left total hip replacement can safely resume driving by 8 weeks postoperatively. However, patients with right total hip replacement who resume driving by 8 weeks should understand that their reaction times may be prolonged, and driving should be resumed in a controlled environment. This study also found a cohort of patients with right total hip replacement who were progressing well by other clinical criteria but continued to have prolonged and "unsafe" reaction times well after 8 weeks. Therefore, the decision about independent driving, particularly by elderly patients with right total hip replacement, must be individualized. It should also be remembered that elderly patients may have other cognitive or sensory

deficits that may further compromise their ability to drive safely, regardless of the surgical site.

When May I Resume Sexual Activity?

This subject was recently reviewed by Stern et al.¹³ Of 86 patients who had successful total hip replacement, 55% were able to resume sexual intercourse by 1 to 2 months postoperatively. Patients preferred the supine position (patient on bottom) as sexual activity was resumed. The next most comfortable position for men was prone, whereas for women it was side-lying on the nonoperative side. Of particular note, 46% of patients experienced significant preoperative sexual difficulties attributable to their hip disease, whereas only 1% felt that the status of their hips precluded satisfactory sexual function postoperatively. One of the most interesting aspects of this study was the universal desire of patients to have more information regarding sexual function following total hip arthroplasty and at the same time their reluctance to ask for it. This information indicates that sexual function should be part of the preoperative discussion of the benefits of total hip replacement.

Another study analyzed the relationship between sexual difficulties and total hip replacement in patients with rheumatoid arthritis. The vast majority of the patients with sexual difficulties attributable to their hips resumed more satisfying sexual relations following total hip replacement. However, almost 25% reported that other problems still rendered sexual function difficult.

When May I Resume Sports?

The literature generally supports the view that high activity levels, particularly those associated with

high-impact loading, and increased body weight adversely affect the longevity of total hip replacement. A recent review of this subject by Kilgus et al.¹⁴ supports this contention. They categorized competitive tennis, jogging, horseback riding, backpacking, racquetball, handball, and heavy labor as high-impact activities. Low-impact activities were defined as swimming, golf, bowling, hiking, bicycling, skiing on groomed surfaces, and occasional social doubles tennis. Active patients who participated in high-impact sports activities had twice the risk of aseptic loosening compared with their less active counterparts. Notably, the differences in implant survival between these groups were not dramatically different at 5 years postoperatively but were appreciably apparent at 10 years postoperatively (Fig. 3).

A survey of members of the Hip Society found that patients who resumed golf did not sustain

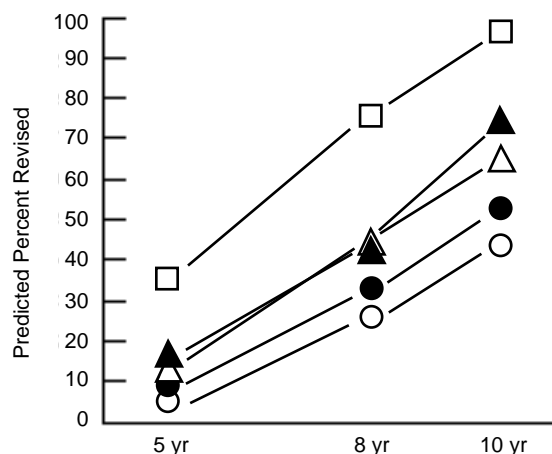
increased rates of complications after total hip replacement when compared with their nongolfing counterparts. Of interest, most golfers experienced an increase in their handicaps following total joint arthroplasty. While most golfers did not experience pain while playing golf, they did report a mild ache in the thigh after playing.

A literature review suggests that most authors allow and encourage their patients to participate in low-impact sports such as walking, golf, bowling, cycling, and swimming. One study particularly commended the benefits of cycling and swimming.

Phase 3: Long-term Assessment

Patients generally achieve 90% functional return 1 year following surgery. During the next 1 to 2 years, they usually report further improvement in function and muscle strength, so that the "final"

Fig. 3 Predicted risk of implant failure at 5, 8, and 10 years for osteoarthritic (OA) patients and non-osteoarthritic (non-OA) patients (those with all other diagnoses) according to activity level. Rectangles represent non-OA patients who regularly participate in high- or low-impact activities; solid triangles, less active non-OA patients; open triangles, OA patients with high-impact activities; solid circles, OA patients with low-impact activities; open circles, less active OA patients. (Reproduced with permission from Kilgus DJ, Dorey FJ, Finerman GA, et al: Patient activity, sports participation, and impact loading on the durability of cemented total hip replacements. *Clin Orthop* 1991;269:25-31.)



functional result is usually achieved by the third year postoperatively. It is at this time, therefore, some 2 to 3 years postoperatively, that the success or failure of the procedure can finally be assessed.

Today, the rendering of such judgment has become an increasingly complex issue. Success or failure must now be assessed not only by the surgeon, but by the patient and by society as well. In the past few years there has been an increasing emphasis on acquiring the patient's, as well as the surgeon's, assessment of success following total joint replacement. Outcome studies will play an increasingly important role in society's judgment on the cost-effectiveness of these procedures. In a recent prospective study in Canada,¹⁵ patient assessment of the quality of life before and after total hip arthroplasty was measured by a variety of contemporary outcome measures. The cost-effec-

tiveness of total hip arthroplasty, particularly in comparison with other surgical procedures, was dramatically demonstrated.

Although some assessment of the success of total joint replacement may be made after the first 2 or 3 years, it remains of great importance that patients continue to be followed up at regular intervals by the surgeon for an unlimited period of time. I advise my patients of the desirability of antimicrobial prophylaxis when they undergo surgical or dental procedures that might produce bacteremia. Patients with rheumatoid arthritis, in particular, are at increased risk for hematogenous seeding of total joint replacements from any number of foci of infection.

Regular clinical and radiographic examinations (annually for the first 2 years, then every 2 years), even in the asymptomatic patient, are advisable and necessary because significant radiographic changes often

precede symptoms, particularly in patients with emerging osteolysis caused by particulate debris. The osteolytic lesion can be aggressive. It is far better to consider early revision when bone stock is being rapidly lost, even in an asymptomatic patient.

Finally, patients and surgeons, as participants in the continuing evolution of total joint arthroplasty, have an obligation to contribute to the documentation of long-term results of these procedures. There are now efforts under way to encourage institutions and individual clinicians to share data in an international database¹⁶ that uses a constant nomenclature.¹⁷ Through such a powerful database, capable of accumulating large numbers of comparable data in a short period of time, early detection of problems can be more rapidly assessed and the necessary changes in technique or technology can be made.

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