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Function after revision of failed total hip arthroplasty

Measurements of functional performance were made before and 6 months after 31 primary total hip replacements and 31 total hip revisions for prosthetic loosening. After revision, functional performance returned to levels substantially the same as after primary hip replacement except for greater reliance on canes for patients in the revised group. Ratings of hip status and hip pain were slightly less satisfactory after revision as compared to after the primary operation.

Key words: arthritis; biomechanics; gait; hip joint; joint prosthesis; muscle strength.

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The purpose of this study was to do objective kinesiologic testing of the pre- and postoperative function of a group of patients with total hip arthroplasties revised because of noninfectious loosening. A control group with uncomplicated primary total hip arthroplasties provided baseline data to identify which components of function decline with prosthetic loosening (and to what degree), and to identify which components of function improve after revision.

Patients and methods

Originally, the sample of patients referred to us for testing prior to total hip revision consisted of 37 men. During the first 6 months postoperatively, eight patients were lost to follow-up: three suffered femoral fractures in the postoperative period; one developed a hip infection with subsequent removal of the prosthesis; one had dislocation of the operated hip; two had arthritic complaints related to the contralateral hip; and one had transportation problems. Thus, the group was reduced to 29 patients with 31 revisions.

The group with revisions averaged 61 (27–84) years of age. The original diagnosis was primary or secondary arthrosis or avascular necrosis in 28 hips and rheumatoid arthritis in three. The mean time between the primary total hip arthroplasty and revision was 46 months. Four hips were revised through an anterolateral approach and 27 through a posterior approach; one of these had osteotomy of the greater trochanter. The femoral component was found to be loose in all 31 cases, broken in four, and deformed in one. The acetabular component was loose in eight. Fifteen of the men had involvement only of the operated hip and the remaining 14 had bilateral involvement of joints of the lower extremities.

The control group consisted of patients who had uncomplicated total hip replacement with no prior hip surgery. This group comprised 28 men with 31 hip replacements. The average age was 61 (27–79) years. The preoperative diagnosis was primary or secondary arthrosis or avascular necrosis in 29 hips and rheumatoid arthritis in two. Twenty-two joints were operated through a posterior approach without osteotomy of the greater trochanter, and nine through an anterolateral approach; three of these had osteotomy of the greater trochanter. Fifteen had involvement of the operated hip only, and the remaining 13 had involvement of the hips or knees of both lower extremities.

Each patient was tested before surgery and 6 months after. At each test the following data were collected: range of motion of the hip, strength of hip abductor and adductor muscles during maximum isometric contractions, weight distribution between the feet during standing, forces applied to canes or crutches during walking, and multiple simultaneous displacement patterns during free-speed and fast walking. Each patient also answered a questionnaire about pain and performance of daily activities. Descriptions of the measurement techniques have

been reported previously (American Academy of Orthopaedic Surgeons 1965, Lazansky 1967, Murray & Sepic 1968, Murray & Peterson 1973, Murray et al. 1964, Seireg et al. 1968).

An analysis of variance and Tukey Gap tests were used to determine the significance of the differences between measurements of the control group and the revised group and between measurements from before to after surgery (Snedecor 1957). In addition, measurements of both patient groups were compared to standards of normal variability (Murray et al. 1969, Murray & Sepic 1968).

Results

Although most patients in both groups felt they were better after surgery, more patients in the control group than in the revised group rated their hips as "much improved" after surgery (Figure 1).

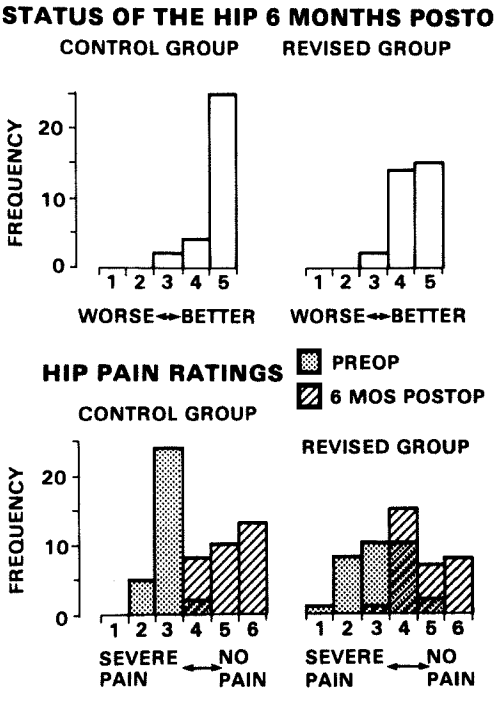

Figure. 1. Hip pain for groups with primary hip replacements (control group) and total hip revision; 31 cases in each group.

Pain ratings. There was more variability in the classifications of pain preoperatively for the group with revisions and better pain relief after surgery for the control group (Figure 1). All 31 in the control group and 23 in the group with revisions had sufficient pain relief to show an improved rating after surgery. The eight remaining hips in the group with revision had the same pain rating before and after surgery.

Range of hip motion. Before surgery the group to be revised had significantly better mobility than the control group. However, as compared to the control group 6 months after surgery, the group to be revised had significantly less abduction and inward rotation. From before to after surgery, the revised group lost flexion and gained inward rotation. From before to after surgery the control group improved in all motions except outward rotation. Postoperatively, there were no significant differences in hip motion between the groups.

Hip muscle strength. Hip abductor and adductor muscle strength was not significantly different between the patient groups, either before or after surgery, although preoperatively the control group tended to have slightly greater muscle weakness than the group to be revised. Prior to revision, the group with prosthetic loosening had significantly less hip abductor muscle strength than the control group 6 months after surgery. Both patient groups improved in abductor muscle strength from before to after surgery, but improvement in adductor muscle strength was significant for the control group only. Postoperatively, neither group reached the lower limits of the range of normal variability for muscle strength.

Use of assistive devices during walking. Preoperatively, most patients in both groups used assistive devices, with more crutches in the revised group. Approximately two-thirds of the patients in both groups who used devices preoperatively decreased the number of devices used to walk postoperatively, including 15 patients in the control group and nine in the re-

vised group who no longer used support postoperatively.

The amount of force applied to the assistive devices during the stance phase of the operative limb was less after surgery than before surgery, except for three cases in the revised group and one in the control group. The average decrease in force for patients who used devices before surgery was 7 kg for patients in the control group and 12 kg for patients in the revised group. Nevertheless, 6 months following surgery only four patients in the control group applied 5 kg or more of force to their canes as compared to 15 patients in the revised group.

Components of free-speed and fast walking. Several gait components typically disordered in patients with hip disability were measured in the revised and control groups and compared to measurements of normal men (Figure 2). The velocity index is a measure of uniformity in forward progression obtained by dividing the patient's forward speed during single-limb support on the unoperated limb by that during single-limb support on the operated limb. A measurement of 1.0, the normal average, indicates equal speed moving over both limbs, and values less than 1.0 indicate faster speed when passing over the operated limb.

The patients walked at more uniform forward progression after surgery. Walking velocity increased as a result of substantially longer step lengths and slightly faster cadences. The longer steps resulted mainly from increased excursions of hip flexion-extension used during walking. Lateral lurching of the upper torso improved by 3 cm after surgery.

With one exception, there were no statistically significant differences between the groups in measurements of various components of walking performance before surgery. The amount of hip motion used during both free-speed and fast walking was less for the control group than for the group to be revised. Prior to revision, however, the group with prosthetic loosening had a greater degree of abnormality in all of the components of gait, except free-speed cadence, than did the control group 6 months after surgery. In both groups,

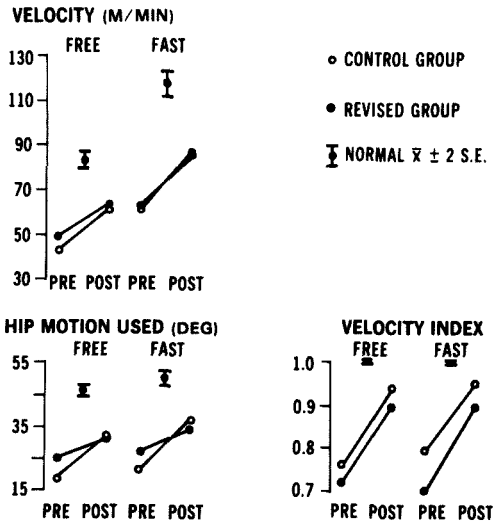

Figure 2. Mean values for components of free-speed and fast walking for a control group composed of patients with primary hip replacement and a group revised for prosthetic loosening as compared to the normal range of variability for normal men.

improvement occurred in all of the gait components from before to after surgery except for cadence during fast walking for the control group. Postoperatively, there were no significant differences between the groups in any of the measurements of walking performance. In all of the components of walking performance, measurements of the groups were still below the lower limits of the range of normal variability 6 months after surgery.

Weight distribution between the feet during standing. During quiet standing, patients with unilateral involvement in both groups bore an average of 36 per cent of body weight on the operative limb before surgery and 46 per cent 6 months after surgery. Improvement, measured as increased body weight borne on the operated limb after surgery, was found in all unilaterally involved patients except for two in the revised group.

Discussion

In the absence of postoperative complications, patients regain a significant amount of function as a result of primary total hip replace-

ment, but they do not reach normal levels of function. With loosening, most of these functional abilities of the hip decline to levels approximately the same as before the primary surgery. Interestingly, with prosthetic loosening there do not appear to be losses of motion into hip flexion and extension, decrease of hip adductor muscle strength, or decrease in the use of hip flexion-extension during walking to the degree found in coxarthrosis prior to the initial total hip replacement.

As a result of replacement of the loose prosthetic components, function in the patient returns to levels near those found after primary hip replacement; however, patients with revision tended to have a greater reliance on assistive devices after surgery than those in the control group.

Our results confirm the observation of Beckenbaugh & Ilstrup (1978) of an average increase in score from 40 points before revision to 89 points after revision, comparable to the increase in score from 45 to 92 points found for a larger series of patients with total hip arthroplasty.

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