

# Total Hip Arthroplasties in Patients Younger Than 45 Years

## A Nine- to Ten-Year Follow-Up Study

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Eighty-one cemented total hip arthroplasties in patients younger than 45 years were reviewed with an average 9.2-year follow-up interval. The results were compared with the same group previously reported at an average follow-up time of 4.5 years. Clinically satisfactory results were 58% compared with 78% at 4.5 years. The revision rate almost tripled to 33%. Impending failure was present in 56% of those hips not yet revised. In the first study, technique was a primary determinant of success. In this report there was no influence of technique on the incidence of revision. Age did not influence revision rates either, with 35% in patients younger than 30 years and 32% in patients aged 30-45 years. Patients younger than 30 years had fewer satisfactory clinical results and a higher rate of impending failure. As in the first study, the best results were obtained in patients with inflammatory collagen disease aged from 30 to 45 years.

This report provides further evaluation of patients included in a previously published study.<sup>4</sup> These patients were treated with total hip arthroplasties (THA) using cemented stems and sockets from 1971 to 1978. Four surgeons were the attending staff. The purpose of the present study was to determine the outcome of this group of young patients at an average follow-up time of nine to ten years.

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### MATERIALS AND METHODS

The initial study evaluated 108 hips in 81 patients. Eight hips were eliminated for acute infection. One hundred hips without failure from acute infection were reviewed again. Nineteen hips in 12 patients were lost to follow-up examination, leaving 81 hips in 69 patients for evaluation. Eleven patients with 11 hip replacements died; three of these hips were revised before the patient's death and are included in revisions. Eight of these patients were clinically satisfactory and are also included. All but four of the remaining 58 patients had follow-up examinations within 12 months of this review. All hips had a minimum follow-up time of five years (average, 9.2 years; range, five to 16.5 years). Patients were graded as clinically satisfactory if they had a pain score above 3 using the d'Aubigné-Postel hip scoring system. Roentgenograms were evaluated for component migration, progressive cement-bone demarcation, and osteolysis. Osteolysis was divided into loss of the entire neck to the lesser trochanter or involvement of the diaphyseal cortex.

All hips had cemented stems and sockets. Prostheses used were Charnley, Charnley-Müller, and Aufranc-Turner. The criteria for the correct technique of the arthroplasty were established in the initial study.<sup>4</sup> The femur should have an intact cement mantle of 3 mm around the stem, with 1 cm at the tip, and the femoral component should be in neutral or valgus. The socket should have no more than 1 cm superior displacement with an intact cement column around it.

The criteria for impending failure were also established in the first study.<sup>4</sup> Impending failure was defined as roentgenographic evidence that the femoral or acetabular component was in jeopardy of requiring revision surgery. The definition of impending failure of the socket included migration of the socket of 3 mm or more and a complete radio-

lucent line of 2 mm or more around the entire socket. Impending failure of the femoral component included subsidence or a radiolucent line or cement-bone demarcation of 2 mm or more around at least the proximal one-half of the femoral stem. In the first study, calcar resorption of 1 cm or more was also included as a criterion of impending failure. With this follow-up study, the inclusion of calcar resorption does not appear to be valid for impending failure and has been deleted.

In the first study, patients were evaluated with regard to six major factors: age, disease, Charnley category, prior operations, length of time since arthroplasty, and technique. The same six categories were again used. Patients with roentgenographic impending failure in the first study were tracked to determine if indeed this category was predictive of impending revision. The current incidence of impending failure in this study was also determined. The chi-square test was used for statistical analysis.

### RESULTS

Twenty-nine patients (of 81) required removal of components. Two had late hematogenous infection, and 27 had revision for aseptic mechanical failure. Thus 36% of the patients had components removed, and 33% were revised for aseptic failure. In the first five years postoperatively, three femoral components and one socket were revised; between five and ten years, four femoral components, three sockets, and both components in 11 hips were revised; between ten and 15 years, one socket and both components in four hips were revised. Examination of revision by components does not indicate the rate of loose components because often at the time of revision for one loose component, the other was also changed. Seven of the 27 revisions have had a second revision between two and ten years after the first revision. One hip had a third revision. In hips that required revision for a loose femoral stem, osteolysis of cortical diaphyseal bone was present in 100% (Fig. 1). The two late infections occurred at seven and 13 years. One was caused by *Hemophilus influenzae*, which originated in a sinus infection; and one was due to alpha streptococci of unknown origin. A third infection after revision also occurred in this part of the study.



FIG. 1. A loose stem and socket with osteolysis of the proximal femoral bone.

Overall, 47 hips (58%) were clinically satisfactory. If one assumes that the 19 lost hips are still clinically satisfactory, then 66% would be satisfactory (66 of 100). With the same assumption, the revision rate would drop to 27%. Because of the high failure rate in all groups in this study, the lost group is assumed to have the characteristics of the whole group and will be ignored.

In the first study, four hips were graded as clinically unsatisfactory (pain score of 3 points or fewer). In this study, five were clinically unsatisfactory. Three of the four in the initial study developed a loose socket, and two were revised. One of these is now classified as an impending failure. One hip remains clinically unsatisfactory, and four additional hips in this review also had a low pain score. In this study the cause of pain was known in four of five patients with impending failure of the socket.

Patients were divided into two groups, younger than 30 years and 30–45 years of age. Thirty-seven hips were in patients younger than 30 years, and 44 were in the older age group. Satisfactory results were seen in 54% (20 of 37) of the group younger than 30 years and in 66% (29 of 44) of the older group. Impending failure was present in 78% of the younger group and 38% of the older group ( $p < 0.01$ ).

Revision rates of the age groups were nearly identical, with revision in 35% (13 of 37) of hips in patients younger than 30 years and 32% (14 of 44) of hips in patients aged 30–45 years. Revision rates by disease and age groups are shown in Figure 2. The group requiring fewest revisions comprises patients with inflammatory collagen disease aged from 30 to 45 years. The THAs of patients younger than 30 years with inflammatory collagen disease failed between five and ten years, a relatively greater rate than any other group.

When evaluated by the disease process that caused hip destruction, 66% (19 of 29) of hips in the inflammatory collagen disease group (rheumatoid arthritis, rheumatoid variants, psoriasis, and inflammatory bowel arthritis) were clinically satisfactory. The patients younger than 30 years of age had most of the failures in this group. Fifty-five percent (12 of 22) of the group with osteonecrosis were satisfactory as were 50% (14 of 28) of the hips with osteoarthritis. Neither patient with prior in-

fection was clinically satisfactory because one required revision and one had pain. According to activity graded by the Charnley categories, satisfactory results were present in 52% of Category A, 41% of Category B, and 68% of Category C.

When results were evaluated according to prior surgery, cup arthroplasty was not different from the group as a whole. Six of 15 cups (40%) were revised, and four had impending failure. However, the results with Austin Moore hemiarthroplasty were poor: five were revised (83%), and the remaining hip had impending failure. Patients with prior implants for trauma, fusion, or osteotomy were not different from the entire group.

In the initial review of these patients,<sup>4</sup> technique significantly influenced results, both in revision rate and the incidence of clinically satisfactory hips. Clinically satisfactory results in that study were 93% in hips with a correct technique and 78% in hips with a poor technique. In the present review, 62% of hips with a correct technique and 53% with a poor technique were clinically satisfactory. In this study, technique at the time of index operation no longer influenced either the revision rate or impending failure. Revisions were done in 32% (11 of 34 hips) classified as having a correct technique and 34% (16 of 47) of those classified as having a poor technique.

Impending failure was present in 60% of hips with correct technique and 53% of those with poor technique. In the initial study, 13 hips had impending failure of the femur, and seven (54%) required revision. Eight hips had impending failure of the acetabulum, and none had revision. Of 50 hips without impending failure, eight (16%) were revised. Two facts are evident from these results. First, impending failure is more predictive when present on the femoral side, and second, patients tolerate loose sockets better than they do loose stems.

In the current review, 29 of the remaining 52 hips (56%) had impending failure (Fig. 3). Impending failure in inflammatory collagen disease was 67%; in osteonecrosis, 50%; and

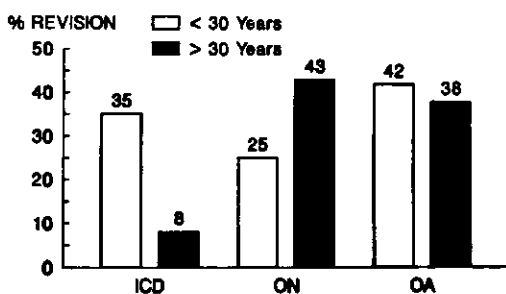


FIG. 2. A bar graph illustrates the difference in revision rate according to age groups within each disease category. ICD, inflammatory collagen disease; ON, osteonecrosis; OA, osteoarthritis.

in osteoarthritis, 43%. Therefore, although inflammatory collagen disease had the most clinically satisfactory hips, more of the remaining hips were in danger of revision.

Combining impending failure and progressive cement-bone demarcation, only seven of 81 hips showed no progressive cement-bone demarcation. Only one hip had no radiolucent lines around either the socket or stem, and this was in a patient with rheumatoid arthritis who was confined to a wheelchair.

Of the 39 hips in patients rated clinically satisfactory, 22 had osteolysis. Nine of these involved the diaphyseal cortex (Fig. 3), while 13 had complete resorption and dissolution of the femoral neck.

This study had an average follow-up time of 9.2 years, which was five years more than



FIG. 3. Osteolysis of the proximal femur with a stem that remains well fixed. The socket shows osteolysis and migration, which may be tolerated by the patient.

the initial study.<sup>4</sup> Overall, clinically satisfactory results deteriorated from 78% to 58%. The revision rate tripled from 12% to 33%. Impending failure doubled from 27% to 56% and, in the socket, quadrupled from 10% to 42%. Technique was no longer a factor in results. Time influenced all groups by any criteria of measurement. Only patients with inflammatory collagen disease aged 30-45 years had satisfactory clinical results (80%).

## DISCUSSION

A dramatic deterioration of results occurred between the first and second reviews in this group of patients aged 45 years and younger. The revision rate of 33% for aseptic failure was three to 11 times higher than that reported for older patients at ten years.<sup>2,10-12</sup> Other studies published on younger groups of patients are not truly comparable to this population of patients because their average ages were between 40 and 50 years,<sup>3,9</sup> whereas the average age in this study was 30 years.

In this study, failure was not influenced by how well the index operation was accomplished. Technique was an important differential in the first review<sup>4</sup> but not in this current study. This fact suggests that cemented THA in this age group has a time-related failure mechanism. Improved cement techniques will decrease early failure rates<sup>6</sup> but may not influence failure rates after ten years. This study suggests that in patients younger than 45 years, cement fixation will fail in one-third between five and 15 years postoperatively, regardless of initial technique. No definite cause for this could be identified among the six factors studied.

The most successful patient group was the one with inflammatory collagen disease that included patients aged 30 to 45 years. This success is attributed to decreased activity levels. The poor predictive value of impending failure for the socket should change as osteolysis increases around loose and migrated sockets. Likewise, the better results now seen in patients with inflammatory collagen disease may be lower than those of all other

groups because of the high incidence of impending failure of the socket that is present in this disease category. Patients younger than 30 years with inflammatory collagen disease often are juvenile rheumatoid patients. These patients have greater technical problems at surgery related to their small bones, which influence the durability of the hip components.

Age separation into patients younger than 30 years and those aged 30-45 years did not show a difference in the rate of revision. Patients younger than 30 years had fewer clinically satisfactory hips and a statistically significant higher incidence of impending failure.

Prior surgery was detrimental only when hemiarthroplasty was used to treat osteonecrosis. This rate of revision should be lower in the future because Amstutz and Smith<sup>1</sup> emphasized the necessity for removal of the femoral fibrous membrane at the time of conversion to THA from hemiarthroplasty.

The findings in this study indicate that in this population of patients, the primary reason for unexplained pain that causes a clinically unsatisfactory result is loosening of the acetabular socket. Three of four patients who originally had a painful and unsatisfactory hip had failure of the acetabulum. In addition, four of the five hips in this current review that are clinically unsatisfactory have impending failure of the acetabular component. Early microloosening of the socket might also be the cause of previously reported unexplained deterioration of gait from five to ten years postoperatively in THA patients.<sup>8</sup>

Criticism of the first study of these patients included the fact that more than one surgeon was involved with the operation.<sup>4</sup> Because of this factor, the failure rate was suggested to be falsely high. The loss with time of the influence of technique on the revision rate blunts this criticism. Furthermore, Charnley's results reported by Halley and Wroblewski<sup>5</sup> in patients aged 30 years and younger primarily with rheumatoid arthritis show 30% with revision or to be revised at an average of 9.5 years. This is near the 35% rate of revision

reported in this study for the same subgroup of patients.

The findings of this study indicate that alternative hip procedures such as fusion and osteotomy should be considered in patients younger than 45 years. Cemented arthroplasty has a high incidence of revision and often results in osteolysis, which compromises the clinical results and durability of revision surgery.<sup>7</sup> The results of cementless arthroplasty confined to this age group have not yet been reported.

#### REFERENCES

1. Amstutz, H. C., and Smith, R. K.: Total hip replacement following failed femoral hemiarthroplasty. *J. Bone Joint Surg.* 61A:1161, 1979.
2. Charnley, J., and Cupic, Z.: The nine and ten year results of the low-friction arthroplasty of the hip. *Clin. Orthop.* 95:9, 1973.
3. Collis, D. K.: Cemented total hip replacement in patients who are less than fifty years old. *J. Bone Joint Surg.* 66A:353, 1984.
4. Dorr, L. D., Takei, G. K., and Conaty, J. P.: Total hip arthroplasties in patients less than forty-five years old. *J. Bone Joint Surg.* 65A:474, 1983.
5. Halley, D. K., and Wroblewski, B. M.: Long-term results of low-friction arthroplasty in patients 30 years of age or younger. *Clin. Orthop.* 211:43, 1986.
6. Harris, W. H., McCarthy, J. C., Jr., and O'Neill, D. A.: Femoral component loosening using contemporary techniques of femoral cement fixation. *J. Bone Joint Surg.* 64A:1063, 1982.
7. Pellicci, P. M., Wilson, P. D., Jr., Sledge, C. B., Salvati, E. A., Ranawat, C. S., Poss, R., and Callaghan, J. J.: Long-term results of revision total hip replacement: A follow-up report. *J. Bone Joint Surg.* 67A:513, 1985.
8. Perrin, T., Dorr, L. D., Perry, J., Gronley, J., and Hull, D. B.: Functional evaluation of total hip arthroplasty with five- to ten-year follow-up evaluation. *Clin. Orthop.* 195:252, 1985.
9. Ranawat, C. S., Atkinson, R. E., Salvati, E. A., and Wilson, P. D., Jr.: Conventional total hip arthroplasty for degenerative joint disease in patients between the ages of forty and sixty years. *J. Bone Joint Surg.* 66A:745, 1984.
10. Salvati, E. A., Wilson, P. D., Jr., Jolley, M. N., Vakkil, F., Aglietti, P., and Brown, G. C.: A 10-year follow-up study of our first one hundred consecutive Charnley total hip replacements. *J. Bone Joint Surg.* 63A:753, 1981.
11. Stauffer, R. N.: Ten year follow-up study of total hip replacement: With particular reference to roentgenographic loosening of the components. *J. Bone Joint Surg.* 64A:983, 1982.
12. Yao, J., Amstutz, H. C., Kilgus, D. J., and Doug, F.: Long term results of T28-TR28 hip arthroplasty. AAOS 54th Annual Meeting, San Francisco, California, Jan. 22-27, 1987.