

[Original Paper]

Long-term outcome of rotational acetabular osteotomy for hip dysplasia

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SUMMARY

Objective: To evaluate the long-term outcome of rotational acetabular osteotomy (RAO) by the cumulative 15-year survivorship with conversion to total hip arthroplasty.

Methods: We retrospectively reviewed 30 joints in a cohort of 25 patients, who underwent RAO for hip dysplasia between August 1985 and August 2001.

Results: The cumulative Kaplan-Meier survivorship was 100% at 15-years postoperatively. However, 6 joints were converted to THA after those 15 years and survivorship was 80% at final follow up of 19.5 years.

Conclusion: RAO is an effective surgical procedure for treating symptomatic dysplastic hips in preosteoarthritis and early-stage osteoarthritis, and it maintained good or excellent hip function in the majority of patients at 15 years after the surgery.

Key words: Long-term outcome, Rotational Acetabular Osteotomy, Hip joint

I. Introduction

Acetabular dysplasia is the most common cause of secondary hip osteoarthritis. In patients with acetabular dysplasia, advanced osteoarthritis often develops with time[1]. Total hip arthroplasty (THA) is an excellent

option to regain hip function in older patients, but it is a less desirable solution in young and active patients in whom one or several revisions can be anticipated[2]. Joint-preserving hip surgery in these younger patients should be considered to correct the dysplastic abnormalities, with the aim of preventing or delaying the development of secondary osteoarthritis [3-5]. Pelvic osteotomy is frequently used in treating

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Abbreviations: Total hip arthroplasty (THA), Rotational acetabular osteotomy (RAO), Japan Orthopaedics Association (JOA), Center-edge angle (CEA)

acetabular dysplasia at various stages of osteoarthritis in adults and adolescents[6]because it redistributes the loads across the hip by providing femoral head coverage, which decreases symptoms and prevents the progression of osteoarthritis of the hip[7]. Rotational acetabular osteotomy (RAO), first described by Ninomiya and Tagawa in 1984[8], is a common technique in acetabular osteotomy. Although favorable outcomes have been reported for this technique, its long-term outcome is controversial according to patient age, disease stage, and joint congruency at the time of surgery[9-12].

The purposes of the present study were to evaluate the long-term outcome of RAO by clinical scores, radiographic outcomes, and cumulative 15-year survivorship with conversion to total hip arthroplasty as the end point.

II. Materials and Methods

We retrospectively assessed all 49 hips in 45 patients who underwent RAO at our institution between August 1985 and August 2001. We excluded 19 hips from the study because they had a follow-up of <15 years. Of the remaining 30 joints (in 25 patients), all the patients were women. Their average age at the time of the osteotomy was 27.5 years (range, 18 to 40 years). The mean follow-up period was 19.5 years (range, 15 to 31 years). All procedures performed were in accordance with the ethical standards of our institutional or the National Research Committee, and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. For this retrospective study, formal consent was not required.

Patients were retrospectively assessed clinically and radiographically by one of the authors at every visit in the outpatient clinic, and the findings were recorded. Clinical evaluation with the Japan Orthopaedics Association (JOA) hip score was performed. Osteoarthritis of the hip was classified according to the radiographic appearance based on the system of Ninomiya and Tagawa[8]; stage 1 indicates no osteoarthritic change in 6 hips; stage 2, slight narrowing

of the joint space associated with sclerosis of the subchondral bone in 23 hips; stage 3, marked narrowing of the joint space associated with cystic lucencies and small osteophytes in the femoral head and acetabulum in 0 hips; and stage 4, no joint-space width with marked osteophyte formation at the margins in 0 hips.

Surgical indication and procedure

Our indications for the RAO were (1) acetabular dysplasia with a center-edge angle of <10°, (2) spherical femoral head, (3) age <40 years, (4) joint congruity and femoral head coverage in maximum abduction, and (5) pre- or early stage osteoarthritis.

The patient was placed in a lateral decubitus position. We used an Ollier incision. The greater trochanter was detached and the gluteus medius and minimus muscles were reflected proximally from the acetabular rim, and were held with a pin retractor fixed in the ilium. The osteotomy site was approximately 20 mm from the joint space, and the angle and direction of the osteotomy were determined using an X-ray image. The osteotomy was completed with a curved chisel. To avoid osteonecrosis, care was taken not to make the acetabular fragment too thin. The coverage of the femoral head by the rotated acetabular fragment was verified by X-ray imaging before fixation of the acetabular fragment. The greater trochanter was repositioned and was fixed with screws.

Statistical Analysis

A Mann-Whitney *U* test was performed to determine differences between groups with or without THA. A Wilcoxon signed-rank test was performed for JOA score at 15 years and at final follow up. The Kaplan-Meier method was used to analyze survivorship. $P < 0.05$ was considered significant.

III. Results

When conversion to total hip arthroplasty was used as the end point, cumulative Kaplan-Meier survivorship was 100% at 15 years postoperatively (Fig. 1). However, 6 joints were converted to THA after that, and survivorship declined to 80% at final follow up. In

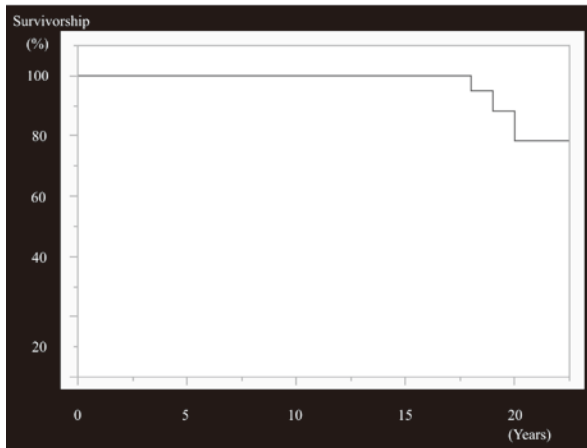


Fig. 1 Kaplan-Meier survivorship analysis of RAO. Survival with conversion to a total hip arthroplasty as the endpoint at 15 years was 100%. However, the survival rate decreased after 15 years.

detail, twenty-four joints (80%) were preserved until the final follow-up, however, the other 6 joints (20%) were converted to THA at the mean of 19.7 years (range, 17 to 23 years). The mean JOA hip score of 79.3 points (range, 63 to 93 points) preoperatively improved to a mean of 85.5 points (range, 45 to 100 points) at 15-years postoperatively ($P=0.001$). However, the score was significantly reduced to a mean of 81.0 points (range, 32 to 100 points) at the final follow-up of 19.5 years ($P=0.028$). Patients who were converted to THA were older at the time of their osteotomy than patients who were preserved, but the difference was not significant (32.6 years versus 27.0 years of age). Patients who were converted to THA had a lower preoperative JOA hip score than patients who were preserved, but again the difference was not significant (76.0 points versus 79.6 points).

Case report

A 37-year-old woman had pain beginning around the groin when she walked. Her preoperative JOA score was 69 points and center-edge angle (CEA) was 10° . RAO was applied to her acetabular dysplasia with a favorable outcome of postoperative JOA score of 93 points, and sufficient coverage of 33° of CEA with a spherical femoral head at 15 years (Figure 2a). However, she suffered from progressive pain again with degenerative change of her hip when she was 60 years

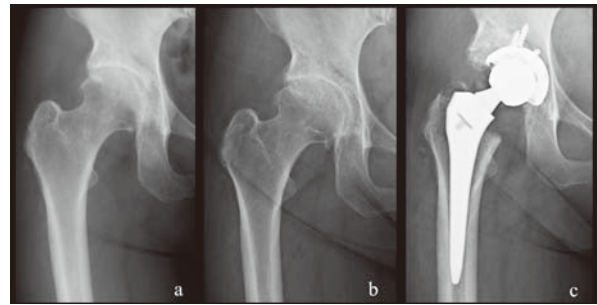


Fig. 2 A 37-year-old woman who underwent RAO. Anteroposterior X-ray image of the pelvis at 15 years (a), at 23 years (b), and after THA (c).

old (Figure 2b). Her JOA score declined to 49 points and she underwent THA at 23 years postoperatively (Figure 2c).

IV. Discussion

The 15-year survival rate of RAO was 100% using total hip arthroplasty conversion as an end point. However, the survival rate decreased after 15 years postoperatively, requiring THA in 20% of the patients at a mean of 19.5 years. We suggest that 15 years is a turning point for the joint preserving effect of RAO; in other words, conversion to THA is predisposed to increase 15 years after RAO. In previous studies, Yasunaga et al.[13]reported a survival rate of 89% at 10 years using osteoarthritis progression as an end point, and Hasegawa et al.[14]reported a survival rate of 97% using total hip arthroplasty conversion as an end point.

Prognostic factors for RAO are of great interest. Yasunaga et al.[5]reported 2 factors associated with radiographic OA progression: age at the time of surgery (>46 years) and postoperative joint congruency (fair). Hasegawa et al.[3]described 4 factors leading to a poor outcome: a small preoperative minimum joint space (<2 mm), joint congruency, simultaneous intertrochanteric valgus osteotomy, and lateral subluxation of the femoral head postoperatively. Several authors have emphasized that postoperative good joint congruency is essential for a favorable outcome after periacetabular osteotomy and rotational acetabular osteotomy[3,5]. Patients with previous surgery or who need simultaneous femoral osteotomy are at risk

of unfavorable postoperative joint congruency, and favorable long-term results cannot be expected. We believe that our favorable outcome was because of our stringent indication for RAO: (1) acetabular dysplasia with a center-edge angle of $<10^\circ$, (2) spherical femoral head, (3) age <40 years, (4) joint congruity and femoral head coverage in maximum abduction, and (5) pre- or early stage osteoarthritis.

There were several limitations to this retrospective cohort study. First, the number of patients was small because of the long-term follow-up. Some patients did not return for a follow-up visit, and all male patients dropped out. We were able to contact 20 patients (44%) with a questionnaire by mail or telephone for follow up. Second, we were not able to compare patients who were converted to THA with patients who were preserved. And we did not evaluate radiography such as the anterior coverage with a false profile view or the minimum joint space before surgery and clinical information such as quality of life after RAO. Further study is needed to document patient satisfaction. Third, we were not able to standardize follow-up duration, so we used the Kaplan-Meier method to analyze survivorship in 15 years. Since the introduction of highly cross-linked polyethylene (XLPE) in the 1990s, the outcome of THA has shown a dramatic improvement. Ranawat et al. [15] showed 97% of survival rate of THA with highly cross-linked polyethylene at 11.5 years in young and active patients of 53 years of age. But, Bradley et al. [16] warned that sporting activity would be a potential risk for early failure of the implant, and that it was controversial to recommend sports after THA. Some patients were allowed to return to low-impact activities, but be careful to high-impact activities. Thus, we believe that joint preserving procedure, RAO, is still a treatment option for such young patients with acetabular dysplasia.

In conclusion, RAO was an effective surgical procedure for treating symptomatic dysplastic hips in preosteoarthritis and early-stage osteoarthritis, and it maintained good or excellent hip function in the majority of patients at 15 years after surgery.

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