

Hiroyuki Kanai · Yoshio Takatori
Takashi Umeyama · Shigeru Nakamura
Shuhei Morimoto · Setsuo Ninomiya

Rotational acetabular osteotomy for the treatment of dysplastic hips with end-stage osteoarthritis – a biological alternative to total hip arthroplasty?

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Abstract We evaluated the results of rotational acetabular osteotomy (RAO) for the treatment of dysplastic hips with end-stage osteoarthritis. Sixteen patients, aged 15–45 years at the time of surgery, were reviewed at a mean follow-up of 8 years (range 3–17 years). Remodeling of the hip joint occurred in half of the patients, with significant clinical improvement. A subsequent total hip arthroplasty, however, was done within 2 years after RAO in two other patients who had had large bone cysts in the femoral head and acetabulum. We suggest that RAO may be the procedure of choice for selected young patients, especially teenage patients, to postpone total hip arthroplasty.

Introduction

It is still a challenge for orthopedic surgeons to treat dysplastic hips in young patients with end-stage osteoarthritis. Despite continuing progress in the techniques used to deal with osteoarthritis, the results of total hip arthroplasty in these patients have been controversial. Moreover, the eventual failure of artificial joints presents a difficult problem, i.e., a serious loss of bone stock. Efforts are thus made to keep the patient's own hip joint functioning as long as pos-

sible. However, compared with the abundance of information on artificial joints, only limited information is available regarding 'joint-preserving' procedures.

Rotational acetabular osteotomy (RAO) is one of the reconstructive pelvic osteotomies for dysplastic hips [5, 6]. Although a good candidate for RAO should have a dysplastic hip with little or no osteoarthritis [4], we have been performing RAO on selected younger active patients with end-stage osteoarthritis. We expected subsequent remodeling of the hip joint and a significant postponement of total hip arthroplasty in these patients.

In this report, we describe 16 patients who underwent a RAO and were followed up for a minimum of 3 years.

Patients and methods

Between 1979 and 1991, RAO was performed on 16 patients who had a symptomatic dysplastic hip with end-stage osteoarthritis at the time of surgery. End-stage osteoarthritis was defined by an extensive loss of joint space on radiographs. RAO was indicated when better congruity could be predicted after the redirection of the acetabulum. There were 3 male and 13 female patients; their average age at the time of surgery was 35 years (range 15–45 years). All the patients had a flexion arc of at least 80 deg. Seven patients had been treated for congenital dislocation of the hip in childhood. The contralateral hips were also dysplastic in 15 patients.

Operative technique

The operation is performed with the patient in the lateral decubitus position on a standard operating table. A curved skin incision is made connecting three points: 1.0 cm distal to the apex of the iliac crest, the middle point between the apex of the greater trochanter and the anterior superior iliac spine, and 6.0 cm distal to the apex of the greater trochanter. A skin flap is elevated from the fascial plane and reflected posteriorly. The approach to the hip joint combines the anterior iliofemoral and posterior approaches. The osteotomy is done using a special curved osteotome with a radius of 50 mm, which approximately corresponds to the circumferential curvature of the acetabulum. On completion of the osteotomy of the pelvis, the joint capsule is the only soft-tissue attachment to the acetabulum. In 11 patients, the osteophytes of the femoral head and the acetabular floor were excised at this stage through an incision of the medial joint capsule to improve the congruency of the joint. The acetabulum is then shifted *en bloc* anterolaterally to

H. Kanai · Y. Takatori (✉) · T. Umeyama
Department of Orthopaedic Surgery, Faculty of Medicine,
The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku,
Tokyo 113-8654, Japan
Tel.: +81-3-3815-5411, Fax: +81-3-3818-4082

S. Nakamura
Department of Orthopaedic Surgery,
Teikyo University School of Medicine, Tokyo, Japan

S. Morimoto
Department of Orthopaedic Surgery, Ichihara Hospital,
Teikyo University School of Medicine, 3426-3 Anezaki,
Ichihara, Chiba 299-01, Japan

S. Ninomiya
Department of Orthopaedic Surgery, Saitama Medical School,
38 Morohongo, Moroyama-machi, Iruma-gun,
Saitama 350-04, Japan

cover the femoral head. Bone grafts are cut from the anterior iliac crest and interposed between the bony surface of the ilium and the transferred acetabulum. Two Kirschner wires are drilled to transfix both osteotomy fragments and the grafts. No postoperative cast is used. Partial weight-bearing is allowed in the 7th week postoperatively after removal of the Kirschner wires.

Clinical and radiological assessments were made of all 16 patients. Preoperative and postoperative clinical data were analyzed using the Merle d'Aubigné and Postel score [3]. In this system, pain, mobility, and ability to walk were scored on a scale of 0 to 6. If the sum of three scores was increased by two or more points at the time of follow-up, we concluded that the function of the hip had improved significantly. For the hips that required and underwent a total hip arthroplasty during the follow-up period, we assessed this score just before the total hip arthroplasty.

Anteroposterior roentgenograms were made preoperatively, just after the operation, and at the time of follow-up. In the radiological assessment, we evaluated the changes in the center-edge angle [11], the position of the femoral head, and the width of the joint space during the postoperative period. As to the position of the femoral head, we measured the vertical distance from the head

center to the inter-teardrop line and the horizontal distance from the head center to the ipsilateral teardrop. When the distance changed in either direction by more than 3 mm, we assumed that the femoral head had migrated [7]. Regarding the width of the joint space, we assumed that remodeling of the joint had occurred when the radiographs showed an even joint space wider than 2 mm.

Results

Table 1 summarizes the clinical details of the 16 patients. Two patients (case nos. 7 and 14) had a total hip arthroplasty within 2 years after the RAO. The other 14 patients were followed for 3–17 years (mean 8 years). Table 2 shows the Merle d'Aubigné and Postel scores before RAO and at the time of follow-up. In the complete series of 16 patients, the mean pain score improved from 2.8 (range 2–4) to 3.9 (range 2–6) points, and the ability to walk score improved from 3.3 (range 1–4) to 4.1 (range 2–6) points,

Table 1 Clinical details of 16 patients with end-stage osteoarthritis treated by rotational acetabular osteotomy (RAO) (THR total hip replacement)

Case	Gender	Side	Age at osteotomy (years)	Age at follow-up (years)	Duration of follow-up (years)	Subsequent operation	Contralateral hip at follow-up
1	M	R	17	33	16		Dysplastic
2	F	R	35	52	17		Valgus osteotomy
3	F	L	44	54	10		Valgus osteotomy
4	F	L	19	28	9		Dysplastic
5	F	R	37	47	10		Dysplastic
6	F	R	44	53	9		Valgus osteotomy
7	F	R	45	46	1	THR	Dysplastic
8	F	R	44	51	7		THR
9	M	R	36	39	3		Dysplastic
10	F	R	37	46	9		THR
11	F	L	42	51	9		Dysplastic
12	M	R	15	18	3		Normal
13	F	L	36	45	9		Dysplastic
14	F	R	37	39	2	THR	Schanz osteotomy
15	F	L	32	37	5		Dysplastic
16	F	R	45	48	3		Dysplastic

Table 2 Merle d'Aubigné and Postel scores in 16 patients before RAO and at follow-up

Case	Preoperative score			Score at follow-up		
	Pain	Mobility	Ability to walk	Pain	Mobility	Ability to walk
1	2	5	4	4	4	5
2	2	5	3	3	4	3
3	2	5	1	3	3	2
4	3	4	4	4	5	5
5	4	5	3	5	3	4
6	4	5	3	6	5	6
7	2	5	3	2	3	3
8	2	4	3	4	4	4
9	3	5	4	4	5	4
10	3	4	4	3	3	3
11	3	4	4	4	4	6
12	3	4	4	6	4	4
13	3	5	4	6	4	6
14	3	5	3	2	4	3
15	2	6	2	2	5	3
16	3	5	4	4	6	4
Mean	2.8	4.8	3.3	3.9	4.1	4.1

Table 3 Radiographical assessment in 16 RAO patients (*CE angle center-edge angle, Wiberg*)

Case	CE angle (deg)		Migration	Remodeling
	Pre-operative	Post-operative		
1	10	40	-	+
2	-15	60	+	-
3	15	60	-	-
4	14	60	+	+
5	20	52	+	+
6	-5	60	+	+
7	-5	35	+	-
8	-10	60	+	-
9	-10	60	-	-
10	-5	60	+	-
11	0	50	+	+
12	0	55	-	+
13	0	50	+	+
14	10	40	+	-
15	5	40	+	-
16	0	45	-	+
Average values	2	52		

but the mobility score decreased from 4.8 (range 4–6) to 4.1 (range 3–6) points. Hip flexion was reduced from a preoperative mean of 98° (range 80°–120°) to a postoperative mean of 73° (range 40°–115°), and abduction was also reduced from 15° (range 0°–35°) to 12° (range 0°–30°). Eight patients (case nos. 1, 4, 6, 8, 11, 12, 13, and 16) showed significant functional improvement, including all three of the teenage patients. Excision of the osteophytes had no significant influence on the clinical outcome.

Table 3 summarizes the results of radiographical assessment. The average preoperative center-edge angle was 2° (range -15°–20°), and the average postoperative center-edge angle was 52° (range 35°–60°). Migration of the femoral head occurred in 11 patients following flattening of the femoral head or collapse of the transferred acetabulum in the first postoperative year. The direction of migration was superior in six patients, superomedial in four, and superolateral in one. Remodeling of the hip joint occurred in eight patients 2–6 years after surgery, including all three teenage patients. The pain and the ability to walk scores of these eight patients were both more than 3 points at the time of follow-up. In five patients, remodeling occurred after migration of the femoral head (Fig. 1).

In two patients (case nos. 7 and 14), there had been large bone cysts in the acetabulum and the femoral head preoperatively. These hip joints deteriorated rapidly after surgery and were replaced with artificial joints within 2 years (Fig. 2).

Discussion

Since 1979, we have performed RAO on selected younger patients who had a dysplastic hip with end-stage os-

teoarthritis. The aim of this surgery is to produce a functioning hip joint which will last until the patient is over 50 years old and becomes a more suitable candidate for total hip replacement. We also assume that RAO at least does not worsen the outcome of the subsequent joint replacement surgery, since RAO provides superior bony support for the acetabular component. This expectation may seem too optimistic; however, we believe that only biological joints can work more than 10 years in young and active patients.

In our present patient series, 8 patients obtained pain relief and were able to walk a long distance within 2–6 years after surgery. In 7 of these patients, a 'joint space' appeared in radiographs in the course of remodeling of the hip joint. The outcome was fair in 7 patients in whom remodeling of the hip joints had not occurred. Thus, good results seem to be related to the capacity of remodeling after osteotomy. However, we found no significant factors that influence the capacity of remodeling except for the status as teenage patients. In our series, five patients reached the age of 50 and still had a functioning hip joint 7–17 years after RAO. This is an encouraging result; however, we still have no direct confirmation that RAO does not worsen the results of the subsequent joint replacement surgery.

Trousdale et al. [10] reported on the results of the Bernese periacetabular osteotomy, which is a pelvic osteotomy similar to RAO. They analyzed the data in relation to the preoperative severity of osteoarthritis using the criteria of Tönnis and stated that the risk of a second major operation was significantly greater in the patients who had had grade 3 (end-stage) osteoarthritis. Although the severity of the osteoarthritis decreased postoperatively from grade 3 to grade 2 in two of their nine patients, they did not describe these patients' characteristics.

Several authors published long-term results of other osteotomies in patients who suffered mainly from advanced-stage primary osteoarthritis. In those papers, the authors wrote a few remarks about patients who had a dysplastic hip with severe osteoarthritis. Maistrelli et al. [2] reported satisfactory results of valgus-extension osteotomy in 56% of 62 patients with severe osteoarthritis and suggested that this osteotomy alone was not adequate for hips with severe acetabular dysplasia. Reynolds [9] reviewed the results of the Chiari medial displacement osteotomy and noted that severe degeneration was one of the predisposing factors for poor results. Calvert et al. [1] also questioned the indication of this osteotomy in patients with existing osteoarthritic change. These authors were thus rather pessimistic about the efficacy of those osteotomies in the management of patients who have a dysplastic hip with end-stage arthrosis.

Poss [8] stated that total hip arthroplasty and osteotomy were complementary rather than competitive procedures. If we wish to perform osteotomies as useful procedures, we need to continuously assess the indications and the limitations of these procedures over a long period. Although a longer follow-up study is necessary,

Fig. 1 **a** A 42-year-old woman with end-stage osteoarthritis of the left hip. **b** Rotational acetabular osteotomy was performed with excision of the osteophytes. **c** One year later, migration of the femoral head occurred. **d** Three years later, remodeling of the hip joint was in progress. **e** Nine years later, the joint space was well remodeled

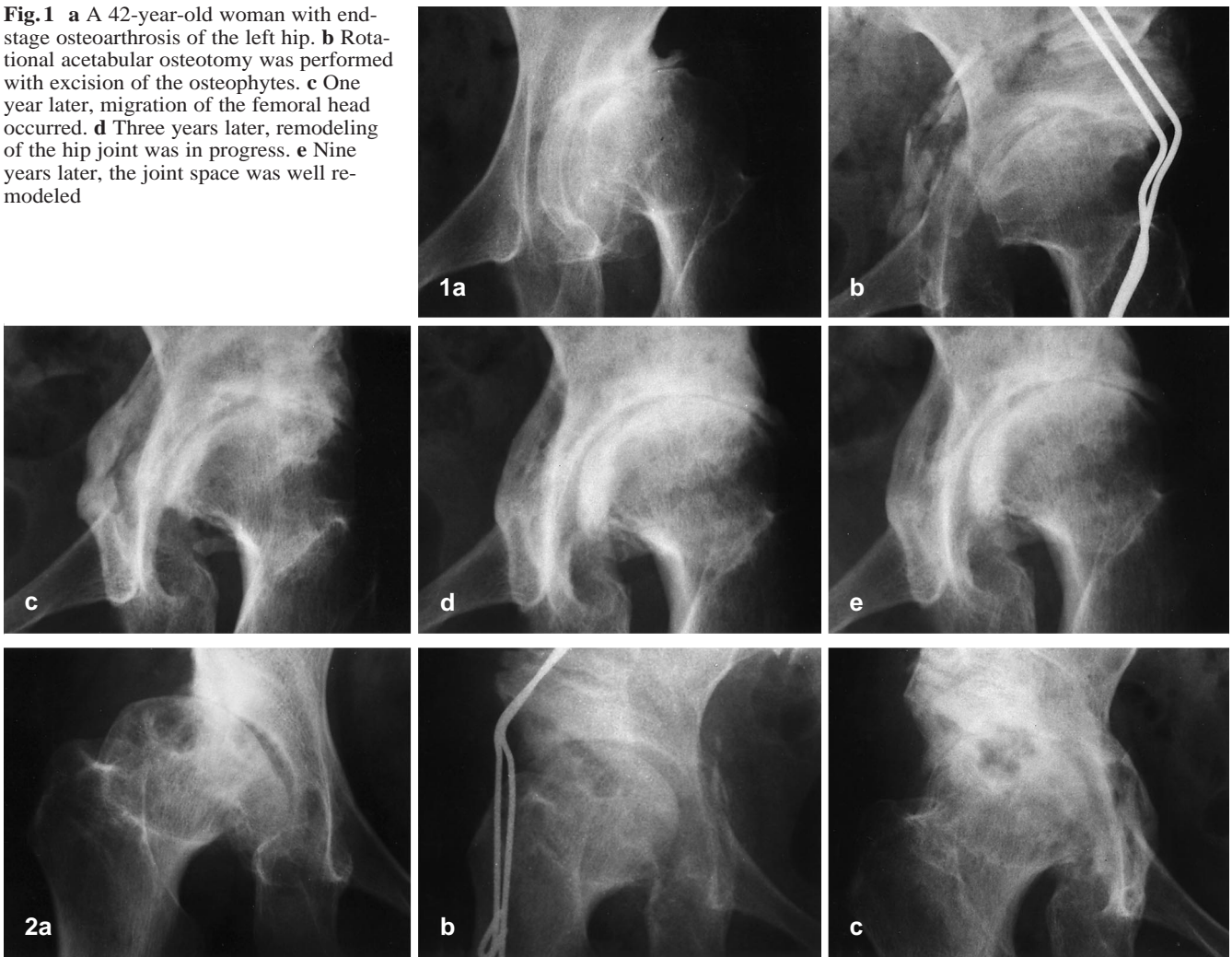


Fig. 2 a-c A 45-year-old woman with end-stage osteoarthritis of the right hip. The femoral head was flat and contained a large bone cyst in the lateral part of the surface area (**a**). Rotational acetabular osteotomy was performed with excision of the osteophytes (**b**). Five months later, migration of the femoral head occurred and the pain increased considerably (**c**). One year later, the hip joint had severely deteriorated, and the patient requested total hip arthroplasty

we suggest, based on the present findings, that RAO can be the procedure of choice for selected younger patients who have a dysplastic hip with end-stage arthrosis.

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