

Modified rotational acetabular osteotomy (RAO) for advanced osteoarthritis of the hip joint in the middle-aged person

First report

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Summary. Classical methods for pelvic osteotomy, such as those of Salter, Pemberton, Chiari, and Wagner, have been developed for reconstruction of the subluxed hip joint in children and young adults [5, 7, 12, 18, 25, 26, 30, 31, 37, 39]. Regarding pelvic osteotomy involving a middle-aged patient, however, there are not as many operation methods to consider, and it is difficult to choose the most suitable technique for alleviating advanced osteoarthritis [9, 18, 20, 26, 29, 32, 33, 35, 38]. Based on current practice, total hip replacement (THR) seems the accepted method, though it presents problems such as loosening, sinking, and infections; because of these factors physicians hesitate to recommend THR surgery, particularly if the patient is otherwise healthy and appears to have many good years ahead of him [1, 2, 4, 8, 10, 11, 15, 19, 21, 24, 28, 36]. As an alternative, we have been developing and improving the acetabular osteotomy, based on Tagawa's rotational acetabular osteotomy (RAO) [20, 35] and Wagner's acetabular osteotomy (type II) [38]. In this paper we present the results of a modified RAO operation performed on 50 middle-aged patients with an average age of 42 years and 2 months (31–61). The average follow-up was 3 years and 3 months (1–9 years). In 82% of patients the result was satisfactory (41 of 50 cases). A similar osteotomy technique has been used by Eppright [9] and Wagner [38]. We feel that our method achieves a more favorable result for an older patient with severe osteoarthritis, since both the surgery and the follow-up rehabilitation are more comprehensive. A modified acetabular osteotomy should not be regarded as merely an alternative to total hip replacement, but as the preferred choice for hip-joint reconstruction.

Method

Following the protocol for hip-joint assessment of the Japanese Orthopedic Association (JOA hip score), which takes the condition of advanced osteoarthritis into account [9], a retrospective study of 50 patients was carried out. The assessment score is concerned mainly with pain; mobility and walking ability are covered by another scoring system (ADL) [16]. Former patients were contacted by letter and asked to appear for a follow-up examination and a radiological evaluation (Fig. 1).

In RAO surgery three factors are crucial: the operational technique, the reconstruction and resetting, and joint mobility. Each is commented upon below.

Operational technique

To ensure safe surgery and a successful outcome, thorough knowledge of the anatomy and alignment of the hip joint is essential. During the operation, it is necessary that the visual range be broad, for a long incision is made: a longitudinal backward convex curve of about 20 cm, from the uppermost part of the iliac crest to a point approximately 5 cm below the greater trochanter on the lateral shaft of the femoral bone [13].

Next, utilizing the anterior approach method of Smith-Petersen, the m. rectus femoris at its straight origin is cut from the anterior inferior iliac spine. At this point, it is necessary to identify the reflect origin of the m. rectus femoris along the upper border of the joint.

After this maneuver, the operative field of the inner side of the pelvis must be exposed. Then the iliac muscle must be detached from the pelvis until the sciatic notch, the minor foramen of the pelvis, and a further bony bulge, the eminence, which comprises the lower part of the acetabulum to the side of the pubic bone, is reached. To reach this eminence is the first objective of the surgery. On this eminence, the cutting of the lower inner side of the acetabulum from the pelvis is easily performed.

Then, utilizing the same incision and the Southern-Moore posterior approach, the short external rotator muscle covering the capsule is detached from the neck of the femur, and is then reflected sufficiently to reveal the posterior acetabular edge. This maneuver is the second objective, and it is important that the full end of the lower side of the acetabulum be visible.

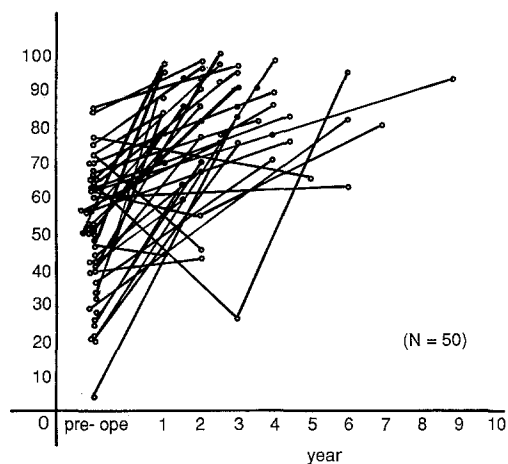


Fig. 1. JOA hip scores, pre- and postoperative, for 50 patients

Table 1. Summary of results of modified RAO in 50 patients (1977–1987)

Total patients	50
Female	44 (88%)
Male	5 (12%)
Average age at operation	42.2 years
Average follow-up	3.2 years
Subjective rating	
Satisfactory	41 (82%)
Unsatisfactory	4 (8%)
Undecided	5 (10%)
Use of cane	
Always	6 patients
Occasionally	10 patients
Trendelenburg gait	28 patients
Nonunion	None
Paresthesia of n. cutaneus femories	8 patients
Postoperative use of crutches	
< 1 year	41 patients
> 1 year	9 patients

The third objective is to release the piriformis and a portion of the gluteus minimus to expose the posterior side of the sciatic notch. Then a posterior cut is made 1 cm anterior to the sciatic notch, along the curvature of the joint.

The fourth objective involves the lateral pelvis, where, after the iliotibial muscle and a portion of the gluteus medius are partially reflected, a cut is made 1 cm superior from the reflect origin of the tendon at the end of the lateral acetabulum, separating the undersheath of the muscle on the posterolateral acetabular edge.

Keeping the acetabulum curvature and these four objectives of the osteotomy in mind, the surgery is performed easily and safely, though it is very important not to cut into the weight-bearing surface of the acetabulum.

Reconstruction and resetting

The successful outcome of this surgery is dependent on the surgical maneuvers that are now described. One is the alignment of the weight-bearing surface (WBS), for the force exerted on the joint must be vertical and not shear, so as to keep the WBS on a hori-

Table 2. JOA hip score assessment

Pain (score)	None 40	Light 30	Moderate 20	Severe 10	Very severe 0
Mobility					
Flexion	> 90° 12	> 60° 9	> 30° 6	< 29° 3	None 0
Abduction	> 30° 8	> 20° 6	> 10° 4	< 9° 2	None 0
Walking ability					
Normal					20
Slight limp					15
Severe limp					10
Possible indoors, impossible outdoors					5
Impossible					0
ADL (normal movement)					
Sitting on chair					2
Japanese sitting					2
Japanese bowing					2
Sitting down					2
Putting on/taking off stockings					2
Cutting toenails					2
Standing up					2
Walking with one aid					2
Going up stairs					2
Going down stairs					2

zontal plane. The next maneuver requires the adjustment of the medial transition of the acetabular roof [3, 5, 32], based upon the lever-arm theory, to decrease the force of the mechanical loading [22, 23, 27, 34]. Should the repositioned medial border of the femoral head resist the inner side of the acetabulum, even after cancellous bone of the pelvis has been removed, a partial acetabulectomy or a resection of the deformed spur of the femoral head is necessary [6]. In case of a severe deformity in the middle-aged patient, this procedure is inevitable.

Joint mobility

This last factor is crucial for postoperative recovery of joint utility. Contracture of the joint is liable to destroy the patient's mobility [5, 6]. Conversely, the patient's immobility can also bring on contracture. Complete mobility of the soft tissue surrounding the hip joint must be achieved for the success of this operation [5], so, in some cases, saucerization may be found necessary to remove the intra-articular free bodies, or extirpation of a synovial chondroma and the degenerated big limbus.

Results

Fifty patients underwent the operation, 45 women and five men, ranging in age from 31 to 62 years. The mean average age at operation was 42.2 years. The mean follow-up was 38 months (3 years 3 months). The abnormality in all cases was congenital acetabular dysplasia.

All patients had complete saucerization intra-articularly. Forty-two underwent release of soft tissue, such as

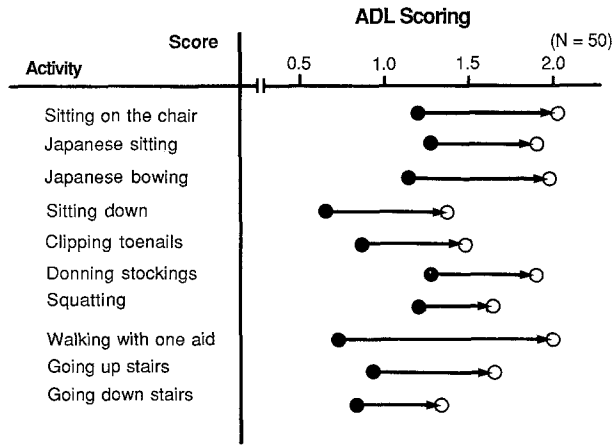


Fig. 2. Average improvement (●→○) in activities of daily life (ADL) for 50 patients: 2.0 = normal, 1.0 = done with assistance, 0 = incapable of performing

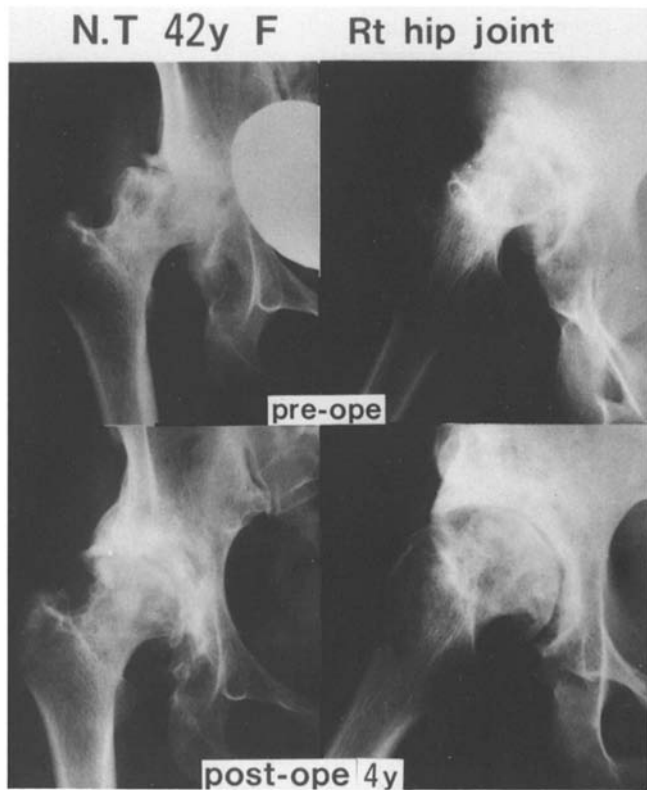


Fig. 3. Case 1: the score that corresponded to the JOA hip score changed for the better postoperatively; “pain” from 5 to 40, “walking ability” from 5 to 20, ALD from 6 to 18, and ROM from 5 to 20. In all, the total score went from 20 to 98

the iliopsoas tendon or capsular ligaments. In 14 cases, the medial spur had to be shaved so as not to resist medial transposition of the femoral head. Our results have been evaluated according to the JOA hip score, established in 1976 (Tables 1 and 2). The total average score was 81.2, showing improvement over a preoperative average score of 48.2.

In flexion and extension, the range of motion (ROM) average, which had encompassed 48.5° to -5.2°, im-

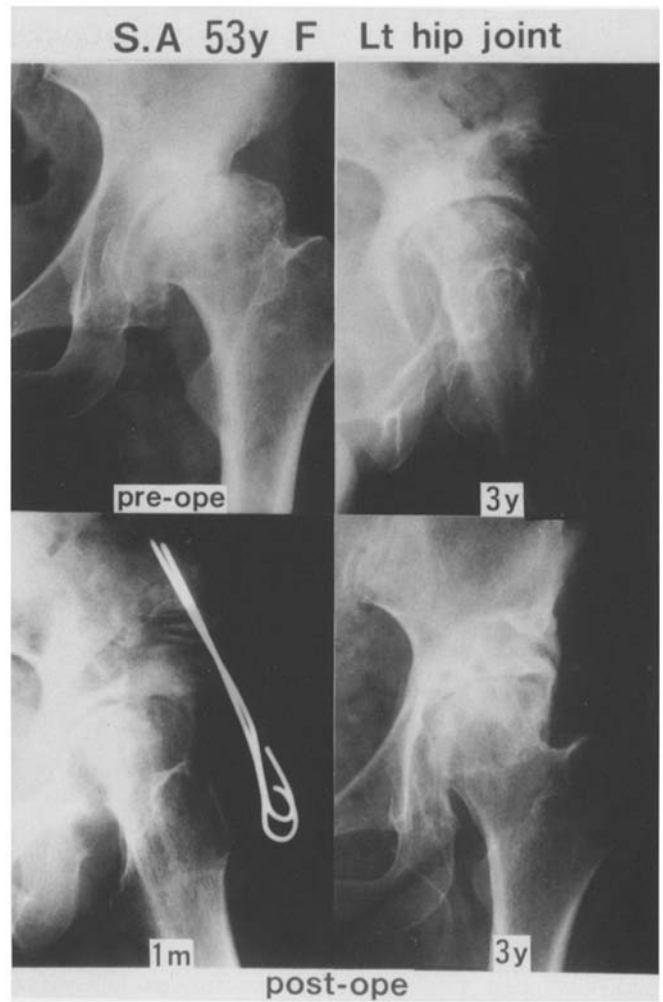


Fig. 4. Case 2: the score that corresponded to the JOA hip score changed for the better postoperatively; “pain” from 10 to 40, “walking ability” from 10 to 10, ADL from 14 to 18, and ROM from 16 to 17. In all, the total score went from 50 to 85

proved postoperatively to between 61.2° and 3.5°. The range for abduction and adduction, which had encompassed 20.2° to 5.8°, improved postoperatively to between 25.1° and 15.4°.

Improvement in the joint is dependent on two factors: reduction of the patient’s pain and ROM exercise of the joint. As for the first factor, the cause of the severe contracture is relieved by the operation. Although joint contracture is remedied by the operation, secondary contracture is liable to occur if exercise therapy is not vigorously pursued. As for the second, postoperative exercise extends the patient’s ROM. Thorough rehabilitation accustoms the remodeled hip to its new environment, and proper weight bearing enhances the recovery of bone atrophy. The pre- and postoperative X-ray photos of a female patient shown below (Fig. 5) testify to the excellent recovery achieved. Figures 1 and 2 show the patients’ pre- and postoperative scores.

Case 1. Figure 3 is a roentgenogram of a nurse, showing a typical deformity in its terminal stage. Because the patient’s occupation involved a great deal of walking, she

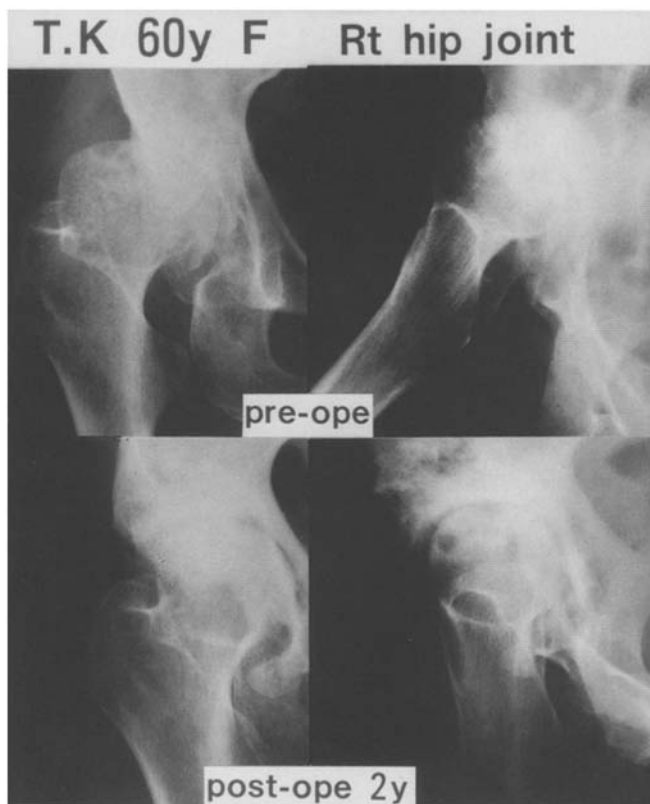


Fig. 5. Case 3: the score that corresponded to the JOA hip score changed for the better postoperatively; “pain” from 10 to 40, “walking ability” from 10 to 10, the ADL from 14 to 18, and ROM from 16 to 17. In all, the total score went from 50 to 85

had developed a persistent and painful coxalgia which had been keeping her awake at night for 3 years. This finally prevented her from working. As can be seen from the figure, the acetabulum and femoral head were in a state of collapse, and the head had elevated laterally.

After an RAO with a complete medial transition and a lowering of the elevation by an iliopsoas tendon resection from the lesser trochanter process, the femoral head came into its normal position and, with gradual recovery, both the acetabulum and the head made a good adjustment. It is expected that the patient’s improvement will be even better in the future. At present, she is back at work in the hospital supply room.

Case 2. A 53-year-old woman who was employed in boxing school lunches had difficulty doing her work. An RAO operation was required, since the acetabular roof was too narrow and the femoral head was unable to bear the weight (Fig. 4). Thus, plasty of the head was performed, and joint mobility and medial transposition were recovered. The patient has returned to work.

Case 3. A 60-year-old housewife had suffered from pain both on movement and at rest. An RAO, which involved a medial transposition and a widening of the acetabular roof, improved both weight bearing and mobility. In such cases where advanced age is a factor, rehabilitation exercise assumes great importance. Figure 5 shows both her pre- and postoperative X-rays.

Discussion

Postoperatively, even in patients with severe coxitis, the pain disappears in approximately 1 week. Remaining discomfort is due mainly to arthritis caused by friction and damage to the cartilage. As has been mentioned, if the alignment has been precise, the symptoms of severe osteoarthritis will decrease and ultimately disappear. Almost all patients who were treated by RAO felt no joint pain.

There are, however, other postoperative problems that sometimes may occur. One is a manifestation known as the Trendelenburg gait [27], caused by a decrease of muscular strength, since the muscle receives no assistance from either the N or Z capsular ligaments [14]. To overcome this, a cane is required, in many cases for approximately a year. Improvement in mobility is enhanced by rehabilitation exercises that strengthen the gluteus medius.

Another problem that may occur is the collapse of the femoral head within a year, as we have seen in four cases. This was thought to have resulted from the eagerness of the patients to walk without a cane too soon. Even though their mobility consequently suffered, they were able to walk without any pain. It is probable that the femoral head was too weak to sustain the thrust of the weight. Therefore, patients should be encouraged to rely on a cane until the body becomes adjusted to the new biomechanical environment of the remodeled hip joint.

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