CLINICAL ARTICLE

Rotational Acetabular Osteotomy through an Ollier Lateral U Approach for Early-stage Osteoarthritis Secondary to Acetabular Dysplasia

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Objective: To explore the surgical technique and mid-term results of rotational acetabular osteotomy for early-stage osteoarthritis secondary to acetabular dysplasia.

Methods: Rotational acetabular osteotomies were performed on 14 hips of 12 patients from May 2000 to May 2006 and the patients followed up. All patients were female and their average age was 28.9 years (range, 13–46 years) at the time of surgery. The mean duration of clinical and roentgenographic follow-up was 6.0 years (range, 3.1–9.1 years). The lateral center-edge (CE) angle, acetabular roof angle and head lateralization index were measured on radiographs taken preoperatively, postoperatively and at the time of final follow-up. Clinical follow-up included use of the Harris hip score. The acetabular osteotomies were performed through an Ollier lateral U transtrochanteric approach and postoperative traction and cast immobilization were not used.

Results: All patients had satisfactory pain relief. The mean preoperative Harris score was 72 points; this had improved to a mean of 91 points at the time of last follow-up ($P < 0.05$). The mean CE angle improved from 0.9° preoperatively to 27° postoperatively ($P < 0.05$), the mean acetabular roof angle from 29° to 5° ($P < 0.05$) and the mean head lateralization index from 0.68 to 0.65. Solid bone-to-bone healing of the osteotomy sites and great trochanters occurred in all patients.

Conclusions: Rotational acetabular osteotomy through an Ollier lateral U approach, which provides wide exposure and technical ease, for early-stage osteoarthritis secondary to acetabular dysplasia can relieve pain and delay the appearance or reduce the severity of osteoarthritis. Satisfactory mid-term results can be obtained.

Key words: Acetabular dysplasia; Osteoarthritis; Rotational acetabular osteotomy

Introduction

Hip osteoarthritis is a common complication of acetabular dysplasia^{1,2} and is progressive in young adults in the absence of appropriate treatment until a joint replacement is performed. Acetabular osteotomy can stop or slow development of this condition. The technique of acetabular osteotomy has many variants, all of which have their own individual

advantages and disadvantages^{3–8}. One of these variants, rotational acetabular osteotomy, was first reported by Ninomiya and Tagawa in 1984⁶. This procedure ensures adequate coverage of the femoral head with acetabular cartilage and has favorable medium-term and long-term efficacy.

The aim of performing rotational acetabular osteotomy in young adults with acetabular dysplasia is to diminish

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contact stress on the femoral head, thus slowing or preventing exacerbation of secondary osteoarthritis⁹. We here present a detailed review of rotational acetabular osteotomies performed in our department via an Ollier lateral U approach, including evaluation of the essential surgical techniques and the medium-term efficacy of the procedure for early-mid-stage osteoarthritis secondary to acetabular dysplasia.

Materials and Methods

From May 2000 to May 2006, rotational acetabular osteotomy was performed in our department on 14 hips of 12 patients with early-mid-stage osteoarthritis secondary to acetabular dysplasia (two right, eight left and two bilateral hips). All the patients were female with an average age of 28.9 years at the time of surgery (range, 13–46 years). All patients underwent rigorous follow-up for a mean duration of 6.0 years (3.1–9.1 years).

After each patient had been placed in a lateral position, an incision was made anteriorly from the anterior superior iliac spine, downward to 2 cm distally from the base of the greater trochanter and then upward to the posterior superior iliac spine in a curved manner, following the requirement of the Ollier lateral U approach (Fig. 1). The gluteus maximus was bluntly dissected and the extortors (e.g. the piriformis and obturator internus muscles) were severed at their termination sites. With the quadratus femoris, care was taken to protect its blood supply from the medial femoral circumflex artery. Using an osteotome, the retained 1.0–1.5 cm thick greater trochanter was lifted proximally to expose the lateral surface of the iliac ala, anterior inferior iliac spine and posteroinferior part of the acetabulum. An electric scalpel was used to mark the osteotomy line periacetabularly, proximally 1.5 cm away from the acetabulum and posteriorly 1.0 cm from the sciatic notch. After a 1.0 cm vertical incision had been made with a straight

Fig. 1 Photograph showing patient placed in a lateral position mark-up for the Ollier lateral U approach.

Fig. 2 Curved osteotomes used in ilium part of acetabular osteotomy.

osteotome along the osteotomy line, the osteotomy was performed under fluoroscopy guidance using a curved osteotome (Fig. 2). Care was taken to ensure that the thickness of the acetabular bone block was greater than 10 mm to avoid secondary necrosis. The acetabular bone block was displaced laterally and anteriorly by rotation and fixed with long cortical screws (Fig. 3). Bone grafting was not necessary. The greater trochanter was instrumented with steel wire or cortical screws.

Postoperatively, external fixation was not used. Functional exercises for strengthening the quadriceps femoris muscle and maximizing the range of motion of the operated hip was scheduled as follows: partial weight bearing of the affected limb with the support of double crutches was commenced 4 weeks after surgery and full weight bearing without external aids encouraged 3 months after surgery.

Preoperatively, postoperatively and during follow-up (6, 12 and 24 weeks after surgery and annually thereafter), pelvic anteroposterior radiographs were obtained to assess the lateral CE angle (CE angle, α), acetabular roof angle (AR angle, β), head lateralization index ($B \div 1/2A$, Fig. 4) and minimum width of the joint space.

The functional performance of the hip joint was evaluated using Harris scoring. Data obtained from measurements on the radiographs were subjected to the paired Student's *t*-test using a statistical program (SPSS 13.0).

Results

As confirmed at final follow-up, all patients reported significant improvement in their symptoms such as pain. The preoperative mean Harris score was 72 (range, 50–97), which was significantly different from the mean postoperative score (at last follow-up) (mean, 91; range, 72–100; $P < 0.05$). The mean duration of surgery was 2.4 hours (range, 2.0–3.1 hours) and the intraoperative mean blood loss 650 mL (range, 400–1200 mL). The preoperative CE angle was significantly different from the postoperative one (0.9° vs. 27° , respectively; $P < 0.05$). The preoperative acetabular roof angle was 29° (normal value, 4° – 10°) and the postoperative one 5° . The preoperative head lateralization index (normal value, 0.60–0.65) was 0.68 and the postoperative one 0.65 (Table 1). The preop-

Fig. 3 The process of the rotational acetabular osteotomy. (a) Rotational acetabular osteotomy was performed by a curved osteotome. (b) The acetabular bone block was displaced laterally and anteriorly by rotation and fixed with long cortical screws.

erative minimum width of joint space was 2.0 mm and the postoperative one 2.2 mm. All the osteotomy bone blocks and operated sites on the greater trochanter healed well after 3 months without any infection or neurovascular complications (Fig. 5). No patient required joint replacement because of exacerbated osteoarthritis secondary to acetabular dysplasia.

Discussion

For early-mid-stage osteoarthritis secondary to acetabular dysplasia, several different surgical techniques for performing periacetabular osteotomy are available. Chiari pelvic

osteotomies ensure adequate coverage of the femoral head by bone but not by hyaline cartilage on the articular surface¹⁰. Salter osteotomies can provide mild improvement in the coverage of the femoral head in children, but are inappropriate for adult patients¹¹. Saegusa pelvic osteotomies can only provide adequate acetabular coverage by making the pelvis asymmetrical³. Although Ganz periacetabular osteotomies can modify the acetabular anteversion and reposition the femoral head medially; this procedure is limited by the fact that it is so complicated. In particular, exposure for osteotomy of the ischial ramus is difficult and accompanied by a high risk of internal

Fig. 4 Diagrammatic representation of the center-edge angle (CE angle, α), acetabular roof angle (AR angle, β) and head lateralization index ($B \div 1/2A$).

Fig. 5 Radiographs of a 38-year-old female patient who complained of a 6-month right hip pain and weakness. The preoperative Harris score was 78 and postoperative score 94. No pain has recurred in the affected hip in the 9 years since surgery. (a) Preoperative AP X-ray film. (b) Postoperative AP X-ray film of both hips. (c) One year postoperative AP X-ray film of both hips. (d) Nine-year postoperative AP X-ray film of both hips.

iliac vascular injury. Therefore, this procedure requires expert technique, prolonged training and much experience. In comparison with the above-mentioned procedures, rotational acetabular osteotomies have the following advantages: bone grafting is unnecessary, fixation is secure and good union is achieved postoperatively. In the present series, the patients recovered well with appropriate functional exercises and no complications such as screw fractures or bone block displacements occurred. However, the most serious problem with rotational acetabular osteotomy is lateralization of the center of the hip. Our patients evidenced obvious significant lateralization of their hip centers postoperatively. Lateralization of the hip center can cause limping and early progressive osteoarthritis. However, rotational acetabular osteotomy does avoid the disadvantages of the above-mentioned procedures and provides adequate lateral coverage of the femoral head.

The choice of surgical approach is crucial when performing rotational acetabular osteotomies. Currently, surgeons from western countries prefer a medial approach to the greater trochanter in order to avoid impairment of the abduction strength of the hip joint and reduce the incidence of localized ectopic ossification^{7,12}. However, the lateral approach is preferred by most surgeons from Asian countries in spite of its requirement for considerable experience in achieving the required exposure^{6,13–16}. The Ollier lateral U approach and greater trochanter osteotomy adequately exposes the lateral surface of the pelvis and the acetabular margin, simplifies the surgical procedure and ensures direct vision of the osteotomy. Ko *et al.* consider that the Ollier lateral U approach is easier than other approaches and guarantees performance of the acetabular osteotomy¹⁵. However, a potential complication of the greater trochanter approach is

TABLE 1 Measurements obtained from radiographs ($\bar{x} \pm s$ [range])

Radiographs	Preoperative	Postoperative	Final follow-up
CE angle (°)	0.9 ± 7.3 (–14–15)	27.0 ± 5.9 (20–36)	28.0 ± 6.3 (21–37)
AR angle (°)	29.0 ± 7.4 (12–42)	5.0 ± 8.1 (–10–22)	6.0 ± 8.3 (–11–23)
Head lateralization index	0.68 ± 0.09 (0.46–0.90)	0.65 ± 0.10 (0.45–0.88)	0.65 ± 0.09 (0.45–0.87)

nonunion of the osteotomy surface and necrosis of the osteotomy bone block, which may impair the abduction strength of the hip joint¹⁴.

In the present series, block necrosis did not occur and bone union was achieved in all patients by skillful amputation and reduction as well as fixation using steel wire and cortical screws.

Measurement of the CE angle can be used to evaluate the severity of hip dysplasia. The normal lateral CE angle is 25°–45°. A study by Stulberg and Harris reported a mean CE angle on radiographs of 60 healthy volunteers as 37° in male and 35° in female subjects¹⁷. Murphy *et al.* reported that the mean CE angle of 46 hips of adults aged more than 65 years who did not have hip osteoarthritis was 34°¹⁸. In this series, the postoperative CE angle was 27°, which is close to the normal range. However, it should be emphasized that if the bone block is positioned too far laterally, collision with the greater trochanter and migration of the acetabular piriform fossa to the weight-bearing position occurs.

The aim of rotational acetabular osteotomy is to ensure sufficient coverage of the femoral head by hyaline cartilage; this expands the weight bearing area of the acetabulum and reduces contact stress between the acetabulum and femoral head. Thus, improvement in the degree of acetabular coverage has a favorable impact on long-term postoperative efficacy¹³. Early failure of rotational acetabular osteotomy can be associated with poor preoperative status of the articular cartilage and postoperative chondrolysis. Preoperative articular cartilage degeneration may have a greater impact on postoperative efficacy in older than in younger adults. Chondrolysis

is mainly caused by incorrect surgical technique: if the retained amputated acetabular block is not thick enough it may necrotize and be absorbed, inducing cartilage lysis which is characterized radiographically by a narrowed joint space^{19,20}.

Rotational acetabular osteotomy can definitely relieve pain in young adults with hip dysplasia with a favorable mid- and long-term efficacy. Ko *et al.* reported a satisfactory rate of up to 84% in a series of 38 cases of rotational acetabular osteotomy treated by Ollier lateral U approach with a mean follow-up duration of 5.5 years (2–10 years)¹⁵. Hsieh *et al.* performed periacetabular osteotomies on 46 hips via a greater trochanter amputation approach and reported termination of progression of osteoarthritis in 41 hips (89%) after a mean follow-up of 4.2 years (2–5 years)¹⁴. Siebenrock *et al.* reported that in the 71 hips of patients who underwent Bernese periacetabular osteotomy and underwent follow-up for at least 10 years (mean, 11.3 years; range, 10–13.8 years), the rate of excellent results was 73% (52/71 hips)¹². In the present series, though the sample size was small, the patients had early-mid-stage osteoarthritis and the efficacy of the procedure was satisfactory as confirmed by follow-up for a mean duration at 6.0 years (3.1–9.1 years).

In conclusion, rotational acetabular osteotomy via an Ollier lateral U approach can provide sufficient exposure with technical ease for early-stage osteoarthritis secondary to acetabular dysplasia and can relieve pain and slow the development of osteoarthritis, with satisfactory mid-term results. However, more cases and longer term follow up is required to confirm these findings.

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