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Mini-incision posterior approach for total hip arthroplasty

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Abstract We compared the short-term outcomes of 50 total hip arthroplasties performed through a mini-incision posterior approach with those of 42 arthroplasties performed through a conventional posterior approach. There were no significant differences in age, gender, and bodymass index between groups. The mean operative time was shorter (99±26 versus 123±30 min), and the peroperative mean blood loss was smaller with the mini-incision (339±210 versus 422±177 ml). There was no significant difference between groups in post-operative mean blood loss, mean inclination angle of acetabular components, percentage of hips with good inclination angle, and mean hip score at 6 months after surgery. There was one infection in the conventional group but none in the mini group. There were no dislocations or symptomatic pulmonary embolism in either group. With the mini-incision posterior approach, surgical invasion was reduced, and short-term outcome was as good as with a conventional posterior approach.

Résumé Nous avons comparé les résultats à court terme de 50 arthroplasties totales de la hanche exécutées à travers une approche postérieure par mini-incision avec ceux de 42 arthroplasties exécutées à travers une approche postérieure conventionnelle. Il n'y avait pas de différences notables dans l'âge, le genre, et l'index de masse corporelle entre les groupes. Le temps opératoire moyen était plus court (99±26 contre 123±30 min) et la perte moyenne de sang plus faible avec l'incision mini (339 ±210 contre 422±177 ml). Il n'y avait aucune différence notable entre les deux groupes dans la perte de sang moyenne postopératoire, l'angle d'inclinaison moyen des composants acétabulaires, le pourcentage de hanches avec un angle d'inclinaison correct, et le score moyen de la hanche six mois après la chirurgie. Il y avait une infection dans le groupe conventionnel, mais aucune dans le groupe mini. Il n'y avait pas de luxation ni d'embolie pulmonaire symptomatique dans l'un et l'autre groupe. Avec l'approche postérieure par mini-incision, la chirurgie a été moins invasive et le résultat à court terme aussi bon qu'avec une approche postérieure conventionnelle.

Introduction

Minimally invasive techniques for total hip arthroplasty (THA) have been introduced in the last several years and are becoming popular mainly in North America [2]. These techniques are designed to allow THA to be done through smaller incisions, potentially with less soft-tissue disruption. There are three main methods, including a mini-incision anterior approach [6], a mini-incision posterior approach [3, 7], and a two-incision technique [1]. Concern has been expressed that minimally invasive procedures might introduce new potential problems related to a reduced visualisation at the time of the operation, such as implant malposition, neurovascular injury, poor implant fixation, or compromised long-term results [2]. Therefore, sufficient scientific evidence to support their safety and efficacy are needed.

There have been several reports on THA performed with minimally invasive techniques for patients in the USA, but there have been few reports for patients in other countries. Recently, Sherry [9] reported on outcomes of THA via a mini-incision posterior approach for 14 patients in Australia. Hip replacement with the use of small incisions seems to be effective for Asian patients with relatively small body constitutions. However, in the English literature, there has been only one report from

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Asian countries. Higuchi et al. [6] reported outcomes of THA through an anterior approach with a shorter skin incision. There has been no report concerning outcomes of THA via a mini-incision posterior approach for Asian patients.

We had performed THA via a conventional posterior approach with incision of 15–20 cm until June 2002 and have been using principally a mini-incision posterior approach since July 2002. The purpose of this study was to determine the clinical efficacy of the mini-incision posterior approach compared to the conventional posterior approach as measured by operative time, blood loss, acetabular cup inclination, short-term hip function, and complications.

Materials and methods

Between July 2002 and July 2003, we performed primary THA without cement for 54 hips in 52 patients. Fifty of these hips in 48 patients operated via a mini-incision posterior approach entered into the study group (the mini group). Of the four hips excluded from the study group, three had complicated deformities (one with high dislocation, one after rotational acetabular osteotomy, and one ankylosed hip) and were operated via a conventional posterior approach, and one hip was in a patient who uses a Japanese squat toilet, which requires deep flexion of the hip joint, and was operated on via a direct lateral approach.

Between June 2001 and June 2002, 46 hips in 43 patients underwent THA without cement. Of these 46 hips, four were excluded from the control group. Two hips (one with high dislocation and one after subtrochanteric valgus osteotomy) were operated via a transfemoral approach using femoral osteotomy, and two hips (one patient using Japanese toilet and one with excessive femoral anteversion) were operated via a direct lateral approach. Thus, the control group consisted of 42 hips in 39 patients operated via a conventional posterior approach with a 15–20 cm incision (the conventional group).

All patients in both groups donated autologous blood before surgery. Mean volume was 815 (range 400–930) ml in the mini group and 804 (range 600–900) ml in the conventional group. Components made of titanium alloy were implanted without cement in both groups. For both groups, femoral components were selected among the following three types using templates on radiographs before surgery: Anatomic (Zimmer, Warsaw, USA), Versys (Zimmer), and S-ROM (Depuy, Leeds, UK). Implanted femoral components were Anatomic in 34, Versys in 12, and S-ROM in four hips for the mini group, and were Anatomic in 29, Versys in six, and S-ROM in seven hips for the conventional group. Acetabular components were Trilogy (Zimmer) in all hips except one hip of the conventional group for which Duraloc cup (Depuy) was implanted.

One surgeon (SN) performed all operations without navigation for both groups. Details of the mini-incision techniques were as described below. Of the surgical techniques, implant fixation methods were principally the same for both groups except that specially designed instruments were used in the mini group. For both groups, the target angle of acetabular component position was 45° in inclination and 20° in anteversion. A drain was removed principally 48 h after surgery in both groups. The partial weight-bearing period after surgery was gradually shortened over the 2 years of this study. Therefore, it was 4–6 weeks in the conventional group and 1–3 weeks in the mini group. All patients in both groups were instructed to walk with a cane until 3 months after surgery, but some stopped using it much earlier.

Operative procedure of the mini-incision posterior approach

Patients were placed in the lateral decubitus position. The tip of the posterior aspect of the great trochanter was marked. A straight skin incision spanning 3–4 cm proximally and 6–9 cm distally was made through the marked point (Fig. 1). The incision was made slightly oblique from posterior-superior to anterior-inferior. The fascia was exposed and incised in line with the skin incision. The gluteus maximus muscle fibres were split and the leg internally rotated. The capsule was incised from the acetabular edge to the piriformis fossa between the piriformis tendon and the gluteus minimus. Then the capsule and rotators were incised together at the attachment to the femur leaving most of the quadratus femoris intact. The femoral head was dislocated posteriorly and the femoral neck cut by a reciprocating bone saw. After the head was removed, the retractors were positioned at the anterior and inferior edges of the acetabulum. The acetabular labrum was resected. The acetabulum was reamed to 1 or 2 mm less than the size of the planned acetabular component. The spherical acetabular component was impacted by free-hand technique using a specially designed cup holder with alignment frame. One to three screws were used for additional fixation, and a trial liner was inserted. For dysplastic acetabulum, the morselized bone obtained from reaming was grafted to the gap between the acetabular edge and the component. The leg was internally rotated and the proximal femur elevated with a specially designed elevator. The femoral canal was prepared with reamers and rasps. After the trial component was inserted into the femur, the neck length was checked by measuring the distance between the centre of the head and the lesser trochanter. After the stability of the hip joint was checked by trial reduction with trial components, the final acetabular liner, femoral component, and modular head were inserted. The posterior capsule and short rotators were re-attached together to the posterior femur through two drill holes. This capsular repair is similar to the technique of Hedley [5]. A wound drainage system was inserted and the wound closed.

Patient characteristics and operative data

For all patients, age, gender, diagnosis, height, and body weight were recorded and bodymass index (BMI) calculated. The incision length was measured at the start of surgery in the mini group. Operative data for evaluation of surgical invasion were operative

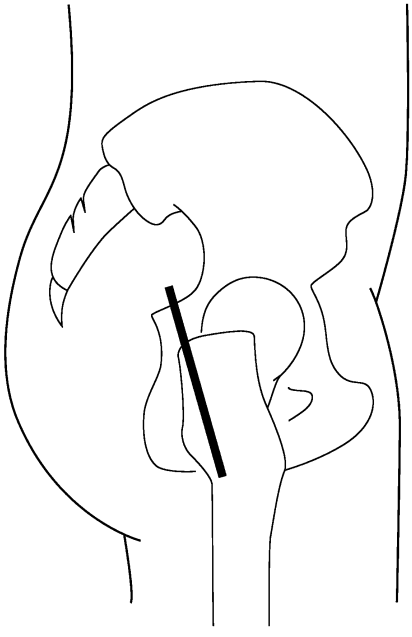

Fig. 1 Skin incision for the mini approach

time from skin incision to skin closure, blood loss during surgery measured in gauze and suction drainage fluids, and blood loss after surgery measured in the closed suction drainage. For assessment of the orientation of the acetabular components, its inclination (abduction) angle was measured in an antero-posterior radiograph of the pelvis with the patient in supine position after surgery. Acetabular inclinations from 35 to 55° were classified as good; those outside this range were classified as poor [10].

Post-operative data

The mean follow-up periods were 10 (6–18) months for the mini group and 20 (6–32) months for the conventional group. All patients were assessed clinically and radiographically by direct examination in our clinic at 6 months after surgery. For clinical assessment, we used the Merle d'Aubigné and Postel score [8]. It has a full score of 18 points—from 0 to 6 for each of pain relief, mobility restoration, and improvement in gait function. Complications including dislocation, pulmonary embolism, infection and a second operative intervention were recorded.

Statistical analysis

Mann–Whitney *U*-test was used to compare continuous variables. Fisher's exact test was used to compare categorical data between groups. Statistical significance was set at a confidence level of $p<0.05$.

Results

There were no significant differences between groups in age, gender composition, diagnosis composition, and BMI (Table 1).

Mean skin incision length was 10.3 (range 9–13) cm in the mini group. The mini group had significantly less mean operative time and less mean blood loss during surgery than the conventional group (Table 2). There was no significant difference in blood loss after surgery. No patient in either group required allogeneic blood transfusion. There were no significant differences between groups in inclination angle and the ratio of hips with a good angle (Table 2).

For complications, there was no dislocation and no symptomatic pulmonary embolism in either group. Infection occurred in one female patient in the conventional group who had had radiation therapy for uterus carcinoma. There was no infection in the mini group. A second surgical intervention was performed in two patients; one in each group. For the infection case in the conventional group, infection was controlled by surgical debridement without removal of the prosthesis. For the other female patient who received cable fixation for proximal femoral fracture during THA in the mini group, the cable was removed 5 months after index surgery because of local pain at the cable connector.

At 6 months after surgery, the sum of the Merle d'Aubigné and Postel score was 16.0 (range 13–18) in the conventional group and 15.9 (range 11–18) in the mini group. Mean of the pain score, mobility score, and gait score was 5.6, 5.5, and 4.9 for the conventional group and 5.6, 5.4, and 4.9 for the mini group. There were no significant differences for the sum or individual scores between the groups.

Table 2 Data comparison

	Mini group	Conventional group	*p*-value
Operative time (minutes)[a]	99±26	123±30	0.0001
Blood loss			
During surgery (ml)[a]	339±210	422±177	0.01
After surgery (ml)[a]	388±176	420±181	0.30
Acetabular component			
Inclination angle (degree)[a]	45.7±5.6	44.8±7.4	0.29
Hips in good angle (%)	92	88	0.73

[a]Values expressed as mean and standard deviation.

Discussion

Several reports on outcomes of THA via a mini-incision posterior approach for patients in the USA have been published recently. Chimento and Sculco [3] reported the details of surgical techniques of a mini-incision posterior approach and the rate of complications in their first 1,000 patients, but data for neither operative time nor blood loss was included. Lester and Helm [7] reported outcomes of 102 hip replacements via a mini-incision posterior approach using a 10–15 cm skin incision. They showed favourable outcomes of a mini-incision posterior approach, but no control group was included in their study. Wenz et al. [10] reported outcomes of THA via a mini-incision posterior approach comparing with those of THA via a direct lateral approach. In their study group, the mini-incision group had significantly less mean operative time (124 min) and less blood loss (598 ml) than the direct lateral group. No differences between the groups were noted with respect to complications after surgery. Their report was important in showing that a mini-incision posterior technique decreases operative invasion without

Table 1 Patient characteristics. *OA* osteoarthritis, *AN* avascular necrosis

	Mini group (*n*=50)	Conventional group (*n*=42)	*p*-value
Age[a]	62±11	59±10	0.41
Female/male	38/12	36/6	0.3
OA/AN	39/11	35/7	0.6
Bodymass index[a]	23.2±3.4	24.0±4.3	0.48

[a]Values expressed as mean and standard deviation

an increase in complication rates. However, the control group was patients with THA via a direct lateral approach.

Goldstein et al. [4] reported the results of a study in which 85 hips via a mini-incision posterior approach were compared with 85 hips via a conventional posterior approach. Mean incision length was 13 cm in the mini-incision group and 36 cm in the conventional group. The mini group had significantly less blood loss at surgery, but there were no differences between groups with regard to operative time. In their study, the surgeon determined the incision length at the time of the operation, generally on the basis of the patients' physical constitution. There was a selection bias for the mini group in thinner patients as reflected by a significant difference between the groups with regard to BMI; mean BMI was 27 for the mini-incision group and 31 for the conventional group ($p<0.001$). In our study, there were no significant differences between groups in BMI. Our study showed that less blood loss during surgery by the mini-incision technique was not coming from differencesin BMI.

Indications should be determined in respect with deformities of the hip joint. Lester and Helm [7] stated that contra-indications for the small incision include a planned simultaneous femoral osteotomy. We consider the following hips as contra-indications for the mini-incision posterior approach; high dislocation after developmental dysplasia, hips after acetabular or femoral osteotomy, and hips with bony ankylosis. Arthroplasties for these hips need wide exposure to confirm the abnormal bony landmarks or to perform simultaneous femoral osteotomy. We are currently using the mini-incision posterior approach technique with a 10-cm incision for almost all patients, except for those with these contraindications.

Our study used a historical control, not a randomised control. Nevertheless, we conclude that favourable short-term outcomes with less surgical invasion can be expected via a mini-incision posterior approach if the surgeons are already familiar with a conventional posterior approach.

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