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Mini-incision total hip replacement—surgical technique and early results

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ABSTRACT

Purpose. To compare the results of mini-incision total hip replacement (MITHR) to the standard posterior approach and evaluate the advantages and disadvantages of MITHR.
Methods. 60 patients with osteoarthritis of the hip underwent total hip replacement utilising a mini-incision technique. They were compared to a matched cohort of patients who received the standard posterior approach. The average follow-up period was 14 months. The patients were compared with respect to the length of the incision, surgical time, intra-operative blood loss, narcotic requirements, length of hospital stay, requirement for walking aids, Harris hip score, and complications.
Results. The length of the skin incision for MITHR, at an average of 9.2 cm, was half that of the standard approach. Statistically significant differences were found between the 2 groups in terms of intra-operative blood loss, length of hospital stay, and use of walking aids, all in favour of MITHR. There were no differences between the two approaches with regard to operating time, narcotic requirements, or Harris hip score. There were no cases of component malpositioning or major complications in the MITHR group.
Conclusion. Uncemented total hip replacement can be effectively performed through a smaller incision utilising MITHR without increased risk of complications. Significant benefits include less intra-operative blood loss, shorter hospitalisation, and cosmesis.

Key words: *arthroplasty, replacement, hip; hip prosthesis; prospective studies; treatment outcome; surgical procedures, minimally invasive*

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INTRODUCTION

Total hip arthroplasty has established itself as a routine and extremely successful procedure. It is a reliable operation with a high degree of patient satisfaction and reproducible results. Improvements in the last 10 years have focused on implant fixation, tribology, and bearing surfaces such that the indications have now been extended to include younger patients. Yet the conventional surgical technique has changed little over the past 3 decades.

In this paper, we describe our surgical technique for the mini-incision total hip replacement (MITHR) and review the early results of the first 60 cases in which this technique was employed.

MATERIALS AND METHODS

60 patients who underwent MITHR were reviewed. These were compared to a matched cohort of patients who were treated with the standard posterior approach. All surgeries were performed by one of the authors and were matched for age, weight, and diagnosis. Patients weighing more than 100 kg and those with semi-ankylosed joints, severe protrusio, or dysplasia were excluded from the study. The study was prospective but not randomised. Patients requiring total hip replacement for osteoarthritis who fulfilled the above selection criteria were allocated alternately to either the mini-incision or standard approach.

Comparisons were made with respect to length of the skin incision, operating time, total estimated intra-operative blood loss, postoperative narcotic requirements (as a measure of pain following the procedure), length of hospitalisation, and the use of walking aids. Complications and the incidence of component malalignment were also recorded for each group.

The patients were placed in a lateral decubitus position for both approaches. The mini-incision technique involves a posterolateral approach, with the skin incision biased more distally than usual over the proximal femur. Placement of the incision with two thirds distal to the tip of greater trochanter allows insertion of acetabular instrumentation without undue tension on the skin. We found the incision length to be approximately 25% longer than the acetabular diameter (estimated from templating the X-rays). The approach utilises a 'shifting window' technique whereby the opening is moved to centre over the area of interest. Partial release of the gluteus maximus tendon from the femur is performed, along with a limited quadratus femoris and appropriate anterior capsule release. No specialised equipment is required. However it is important to avoid excessive adduction of the hip during the exposure, and excessive hip flexion when dislocating the femoral head or working on the femur and acetabulum, as placing the femur in these positions tends to wind up the muscles, tendons, and soft tissues. It is also helpful to perform early acetabular osteophytectomy. The standard posterior approach was performed as per the Southern approach.[1]

All patients underwent the same operative regimen. Mild hypotensive anaesthesia was employed unless medically contra-indicated, and the blood pressure was restored to normal at the end of the operation. Haemostasis was ensured prior to closure. They all received a porous-coated Duraloc cup and an uncemented tri-planar wedge Summit stem (DePuy Orthopaedics / Johnson and Johnson, Warsaw, In, US). Clexane was used postoperatively for thromboembolism prophylaxis and the drains were removed after 24 hours. Prophylactic antibiotics were given with anaesthetic induction and continued for 24 hours. The incision length was measured using a ruler at the completion of closure of the wound. Intra-operative blood loss was calculated as the sum of the volume in the suction bottle plus blood weight in the sponges. Operating time was recorded as the period from initial skin incision to completion of wound closure.

The same postoperative clinical pathway was used in both sets of patients. Mobilisation was begun the day following surgery with weightbearing allowed as tolerated and walking aids provided as required by the patient. Each patient was placed on a standard analgesic protocol, consisting of patient-controlled analgesia for 24 hours, followed by intramuscular morphine or tramadol, oral rofecoxib 12.5 mg daily and panadiene forte 2 tablets 3 times daily. Analgesic requirement was defined as the number of days the patient required narcotics, the endpoint being the time when the patient was solely on oral analgesia. Hospital discharge was based on the patient's ability to ambulate safely and independently, including climbing stairs. Following discharge from hospital, walking aids were weaned as dictated by the patient's progress and confidence. We defined the requirement of walking aids as the time period up to when the patient was completely free of any aids including walking sticks.

Data were recorded prospectively on specially designed templates and entered into an Excel spreadsheet. The Harris hip score was collected by an independent evaluator who was blinded to the

Table 1
Demographics of 2 groups of patients

	MITHR	Standard
No. of patients	60	60
Sex (M/F)	24/36	28/32
Mean age (range) [years]	61 (41–83)	64 (48–81)
Mean weight (kg)	84	86.5
Diagnosis	Osteoarthritis	Osteoarthritis

patient's treatment group. Student *t* tests were employed to formally test the statistical significance of the results in this study. These tests were based upon the difference of the mean values for the 2 groups of data.

RESULTS

Of the 60 patients in each group, there were 24 males and 36 females in the mini-incision group and 28 males and 32 females in the standard posterior approach group. The 2 groups were matched for age, weight, and diagnosis, with all patients having osteoarthritis. Demographics of each group are shown in Table 1. Results of the study are summarised in Table 2. The mean follow-up period was 14 months (range, 9–26 months) and no patients were lost to follow-up. The mean length of the skin incision was 9.2 cm for the MITHR technique as compared to 20 cm for the standard posterior approach. Statistically significant differences were found between the 2 groups in terms of intra-operative blood loss, length of hospital stay, as well as the use of walking aids. The mean blood loss was 136 ml for the MITHR technique as opposed to 200.5 ml for the standard posterior approach. The length of hospital admission was on average approximately one day less for the MITHR while the requirement for walking aids decreased from 24.8 to 21.4 days.

Operating time was shorter in the MITHR group by just over 6 minutes and this was not statistically significant. No significant differences were found in terms of narcotic requirements or Harris hip scores. The mean Harris hip score, at the last follow-up, was 95.5 for the MITHR group and 93.5 for the standard posterior approach group.

There were 3 and 5 deep venous thromboses in the MITHR and standard groups, respectively. However, there were no dislocations in either group at short-term follow-up. In addition, there were no obvious implant insertion errors or cases of component malalignment. All femoral stems were within 3 degrees of neutral alignment with respect to the femoral shaft axis, and all acetabular components were inserted within the 40- to 50-degree abduction angle range.

DISCUSSION

Total hip replacement has become one of the most successful procedures performed today, with predictably excellent and reproducible results. Hozack et al.[2] used the Medical Outcomes Study Short Form–36 to show that primary total hip arthroplasty dramatically enhanced the patient's quality of life. Recent advances have focused on improving fixation of components and wear properties of the bearing surfaces in order to guarantee longevity.[3] Long-term outcome studies are now available which prove the durability of both cemented and cementless components.[4–6] Although improved anaesthesia and accelerated rehabilitation have reduced the morbidity and mortality associated with hip replacement, the surgical approach and technique has changed little in the past 3 decades. The rationale of a minimally invasive or mini-incision technique is that it is a less intrusive or destructive surgery. Possible benefits include less intra-operative blood

Table 2
Results of 2 groups of patients

	MITHR	Standard
Mean length of skin incision (range) [cm]	9.2 (6–11)	20.0 (15–28)
Mean operating time (range; SD) [min]	49.0 (35–65; 9.4)	55.1 (30–90; 17.9)
Mean blood loss (range; SD) [ml]	136.0* (75–250; 41.1)	200.5 (95–300; 65.2)
Mean length of narcotic use (days)	2.2	2.64
Mean length of hospital stay (range; SD) [days]	4.41* (3–7; 1.1)	5.34 (4–9; 1.4)
Mean period with walking aids (range; SD) [days]	21.4† (14–30; 4.8)	24.8 (14–30; 5.4)
Mean Harris hip score	95.5	93.5

* 99% confidence interval, $p<0.01$
† 95% confidence interval, $p<0.05$

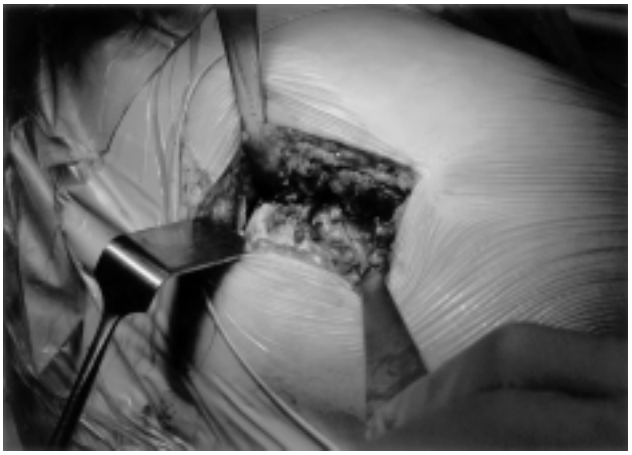

Figure 1 Shifting window technique. The wound opening is moved to the area required. Note that the incision is relatively distal over the femur rather than the acetabulum.

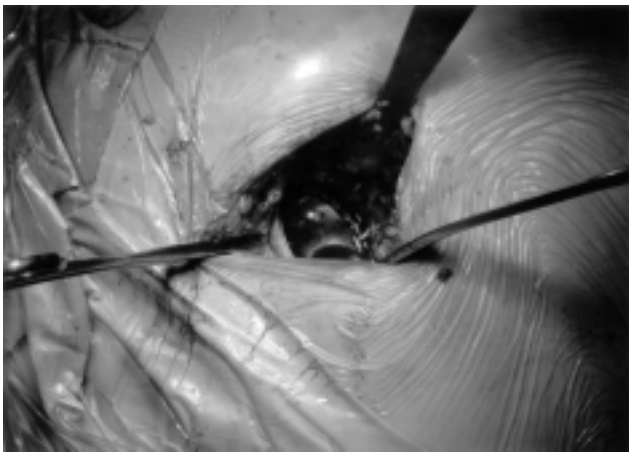

Figure 2 Insertion of acetabular component, which is aided by keeping the leg in minimal adduction and flexion.

Figure 3 Insertion of uncemented femoral component.

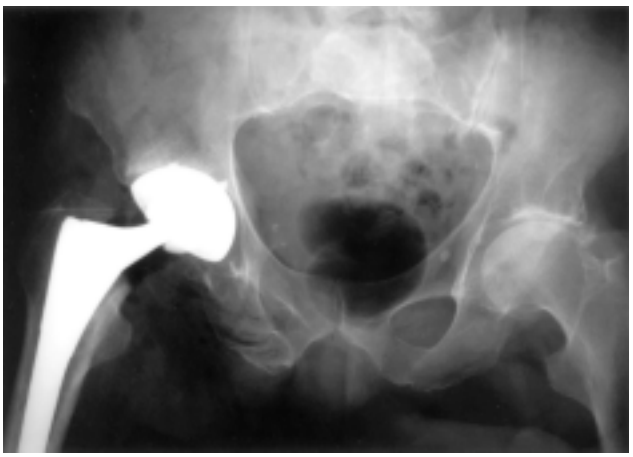

Figure 4 Postoperative radiograph of an MITHR.

loss, less postoperative pain, less soft-tissue scarring, shorter rehabilitation time, and cosmesis. However, concerns remain regarding the indications for the technique (in terms of weight limit and diagnosis), the operating time, fixation and alignment of implants given potentially a more limited view, and most importantly the increased risk of complications such as fracture and neurovascular injury. For a mini-incision technique to become widely accepted, it must show a clear benefit without an increased risk of complications.

We describe an MITHR technique that has been developed and used by one of the authors. The average length of the incision was reduced by over 50% from 20 cm to 9.2 cm. Compared to a cohort of patients who underwent hip replacement via the standard posterior approach by the same surgeon and were matched for age and weight, the MITHR approach has significantly reduced intra-operative blood loss, length of hospital stay, and the use of walking aids. We could only collect the data for intra-operative blood loss as we did not have the means to accurately determine postoperative blood loss. There was little difference in the operating time, postoperative hip scores, or complication rates. Most importantly, the dislocation rate was not increased. There were no cases of nerve palsy, wound problems, or component malposition. Radiologically, all components were inserted within the limits of acceptability; all femoral components were within 3 degrees of neutral alignment and all acetabular components within 5 degrees of the 45 degrees abduction. We

did, however, exclude obese patients and those with significant dysplasia or deformity. With our technique, no special instruments are required. However, we found it important to perform most of the operation with the femur in minimal flexion and adduction to enhance the exposure and aid the preparation and insertion of the components. The other important aspect of the technique is to base the incision more distally over the proximal femur than with the standard posterior approach. This aids reaming of the acetabulum without contusing the skin at the distal end of the wound. It also facilitates insertion of the acetabular component in the correct abduction angle. With a small incision, the tendency is to place the cup too vertically as the distal end of the wound restricts adduction of the inserter handle.

This study consisted of a prospective cohort matched for diagnosis, age, weight, surgeon, prosthesis type, and postoperative protocol. The patients were allocated alternately to receive either an MITHR or standard posterior approach. The hip score evaluator was blinded to the patient's treatment group and no patients were lost to follow-up, hence decreasing the chance of selection bias. Potential limitations of the study include unknown confounders which may not have been controlled for and measurement error resulting from patient bias as they were not blinded to their treatment group. A randomised controlled trial would be required to eliminate these possible errors. However, it would be extremely difficult to blind the patient and surgeon to the trial. In spite of the limitations of the study design, we have shown that there are definite advantages of the MITHR.

There have been few reports in the literature on the minimally invasive technique. Wenz et al.[7] published their series of mini-incision total hip arthroplasties. They found that the mini-incision group had less mean operating time, blood loss, and intraoperative blood transfusion requirements. In addition, the mini-incision patients ambulated sooner and required less assistance for transfer. They reported no increase in complication rates or component insertion errors with the mini-incision technique. Their series, however, was a comparison with the direct lateral approach and consisted of both cemented and uncemented components. Pavone et al.[8] prospectively randomised a group of 46 patients to receive incisions of either 8 cm or 15 cm. They found that the group with the shorter incision had significantly less intraoperative blood loss, postoperative drainage, and total blood loss. Fewer patients in the small incision group were limping at 6 weeks. In contrast, Wright et al.[9] described their abridged incision posterolateral approach and found no significant difference in blood loss, length of surgery, and duration of hospitalisation with their first 42 cases. Sherry et al.[10] described their technique through a 5-cm incision, utilising centering jigs, specialised reamers, and the SE–Hip System. Berger[11] presented a technique that utilises 2 incisions and the aid of image intensifier to position the components. Specially designed instruments are used to place the acetabulum through an anterior incision and the femoral component via a lateral incision similar for a femoral intramedullary nail. He presented the results of his first 100 hips, and found that 80% could be performed as out-patients with discharge on the day of surgery. The results of both techniques in significant numbers are yet to be published. Dorr[12] also presented a mini-incision technique using specifically designed retractors and a curved reamer. Analysis of 105 hips showed that gait was improved and less patients required rehabilitation. Our series is the first that we know of to directly compare a mini-incision technique with the posterior approach utilising an uncemented prosthesis in all patients. Furthermore, our technique does not require specialised instrumentation.

The attraction of the minimally invasive technique is obvious, with the reduction of surgical morbidity and recovery time among the many possible benefits. The use of image guidance as well as new techniques, such as transfemoral acetabular preparation and cup insertion, need to be refined and then proved in clinical practice to be beneficial. Randomised controlled trials as well as long-term follow-up studies are required to prove its superiority over the standard approach.

In retrospect, we found that in MITHR, uncemented total hip replacement can be effectively performed through a much smaller incision than the standard posterior approach without increasing the risk of component malposition or complications. Less intraoperative blood loss and shorter hospitalisation are significant benefits of this less intrusive surgery.

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