

# Hospital Course and Early Clinical Outcomes of Two-incision Total Hip Arthroplasty

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**Background:** Minimally invasive total hip arthroplasty has been reported to have a better functional recovery by minimizing soft tissue trauma as compared with the conventional approach. This study analyzed the hospital course and early clinical outcomes of a series of 63 two-incision total hip arthroplasties.

**Methods:** Sixty patients (63 hips) were enrolled between September 2003 and July 2004 and followed for two years. Preoperatively, demographic data, body mass index, and diagnosis were recorded. Hip function and quality of life were assessed using the Harris hip score and the Western Ontario and McMaster University Osteoarthritis Index (WOMAC).

**Results:** The mean operating time, blood loss, wound length, and hospital stay were 151 minutes, 700 ml, 9.9 cm, and 5 days, respectively. The mean cup abduction angles were 42.9° and the mean cup anteversion angles were 17.9°. Transient lateral femoral cutaneous nerve injuries occurred in 15.9% of cases. Intraoperative femoral fracture occurred in 2 cases and superficial wound infection occurred in 1 case. Despite these incidents, overall results show a majority of patients can achieve quicker recovery and satisfactory functional results with minimally invasive total hip arthroplasty.

**Conclusions:** This study analyzed the accuracy and quality of total hip arthroplasty using a minimally invasive approach and found the post-surgery results were not compromised by sparing muscles and limiting surgical field exposure. We suggest using the minimally invasive approach for total hip arthroplasty based on the encouraging clinical outcomes documented in this study.

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**Key words:** minimally invasive, arthroplasty, hip, two-incision, outcome

Minimally invasive total hip arthroplasty has been reported to allow better functional recovery by minimizing soft tissue trauma as compared to the conventional approach.<sup>(1-6)</sup> However, others have suggested the small incision would compromise sur-

gical field visualization and increase the risk of implant malposition, perioperative complications, prolonged operation times, and surgical site infection rates.<sup>(7-10)</sup> In a recently published prospective randomized controlled trial, the minimal-incision posterolat-

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eral technique showed no advantage over the conventional approach for early postoperative outcomes.<sup>(11)</sup>

Two-incision total hip arthroplasty theoretically spares all muscle sections and preserves soft tissues and nerves around the hip. The approach utilizes the interval between the gluteus medius and rectus femoris for cup implantation and the interval between the gluteus medius and piriformis for stem insertion. Early clinical trials reported higher complication rates from proximal femoral fractures (2.8%) and partial, temporary injuries to the lateral femoral cutaneous nerve.<sup>(3)</sup> Unfortunately, existing literature about the two-incision technique is too limited to provide objective evidence for risk-benefit assessment. The purpose of this study was to analyze the hospital course and early clinical outcome for a series of 63 operations using minimally invasive two-incision total hip arthroplasty (MIS-2 THA).

## METHODS

From September 2003 to July 2004 sixty-four patients (67 hips) received MIS-2 THA in our institute. Two cases were lost after the first year of follow-up. Another two patients received the same surgical technique but a different type of prosthesis. These four patients (4 hips) were excluded from the study. The remaining 60 patients (63 hips) who had more than 2 years follow-up were included for analysis. For the two cases excluded on account of a different prosthesis, at the most recent follow-up, clinical results and functional outcomes were not different from those of the study cohort.

Preoperatively, demographic data, body mass index, diagnosis, and scores based on the system of the American Society of Anesthesiologists (ASA)<sup>(12)</sup> were recorded. Hip function and quality of life were assessed using the Harris hip score,<sup>(13)</sup> and the Western Ontario and McMaster University Osteoarthritis Index (WOMAC).<sup>(14)</sup>

A single surgeon (Mel S. Lee) performed all 63 two-incision total hip arthroplasties. All patients underwent a cementless total hip arthroplasty using Triology cup (Zimmer, Warsaw, Indiana) and Fiber Metal Taper (FMT) stem (Versys; Zimmer, Warsaw, Indiana). The choice of anesthesia was up to the anesthesiologist, with 47 receiving general anesthesia and 16 receiving spinal anesthesia. Surgical time,

wound length, and complications or technical difficulties encountered during the operation, and length of hospital stay were recorded. Intraoperative blood loss was estimated measuring the volume of blood in the suction bottles and weighing the swabs used and the total amount of blood replacement during hospitalization was recorded. Postoperatively, patients were encouraged to ambulate as soon as possible. Protective weight bearing using double crutches for 6 weeks and a single crutch for 6 weeks was recommended. The patients were evaluated at 3 weeks, 6 weeks, 12 weeks, 6 months, and yearly after surgery. They were assessed using the Harris hip score and WOMAC scale. Injuries to the neurovascular component (lateral femoral cutaneous nerve in particular), and the need for analgesics were recorded.

## Surgical technique

The patient is put in the standard lateral decubitus position. Care should be taken to expose the iliac crest and groin area during preparation and draping. The first incision is placed about 4 finger-breadths below the anterior superior iliac spine and parallel to the inguinal ligament. The incision spans the femoral neck width an average of 5 to 6 cm. Branches of the deep circumflex femoral artery will routinely be encountered and should be ligated securely at this stage. The interval between the tensor fasciae latae and the sartorius superficially, and the rectus femoris and gluteus medius, can be easily identified. The anterior hip capsule is cut with a medial-base U-flap. A double neck cut without hip dislocation is done. The oscillating blade should aim away from the pelvis to avoid accidental injury to the acetabulum. Preparation of the acetabulum can be done by retracting the proximal femur posteriorly with a Hoffman retractor. Implantation of the socket in the lateral position may be more comfortable for surgeons who are familiar with the procedure. Additional screw fixation is usually needed to avoid accidental bumping on the socket edge during stem preparation. Because the anterior incision is rotated 90 degrees from the originally suggested incision, better visualization of the posterior structure and the proximal femur can be facilitated. The posterior entry point between the piriformis and the gluteus medius can be easily identified and a curved pointer guide is inserted through the anterior wound. Another stabbing incision of about 2 to 3 cm is made

on the pointer guide and with the same orientation along the first incision. Blunt dissection of the gluteus maximus is performed to create space for stem preparation. Femoral broaching and stem insertion are similar to intramedullary nailing and can be monitored by direct visualization during the entire procedure. Trial reduction and assembly of final components are checked through the anterior wound. The procedure is completed after capsular repair and wound closure.

### Radiographic analysis

Radiographs taken immediately post-operation and at intervals of 6 weeks, 12 weeks, 6 months, and yearly were used for analysis. The cup abduction angle, anteversion angle,<sup>(15)</sup> stem alignment, and canal filling ratio were recorded. Stem alignment was measured as the angle between the long axis of the femoral stem and the anatomical axis of the femur on the anteroposterior radiograph.<sup>(11)</sup> The canal filling ratio on the anteroposterior radiograph was calculated by dividing the width of the stem by the inner cortical width at a point 5 cm distal to the lesser trochanter.<sup>(16)</sup>

In accordance with the literature, mal-positioning of the cup was defined as the abduction angle of the cup being more than 55 degrees or less than 35 degrees or the anteversion angle being more than 30 degrees or less than 0 degree (retroverted),<sup>(17-19)</sup> and the rotation center of the cup was defined as being more than 3.5 cm higher than the true hip center.<sup>(20,21)</sup> Mal-positioning of the stem was defined as the stem alignment being more than 5 degrees in either varus or valgus position. Mismatched implant size was defined as (1) less than 70% coverage of the cup by the host bone and (2) a canal filling ratio of the stem lower than 80%. During the follow-up, complications including early loosening, implant subsidence, fractures, dislocations, and infection were recorded as adverse events. A relatively poorer and slower functional recovery after three months, and a Harris hip score and/or WOMAC scale less than 80, were also categorized as adverse events.

## RESULTS

Of the 63 hips, except one patient (case 41) who died from a traffic accident 14 months after the arthroplasty operation, all could be followed com-

pletely with functional and radiographic studies.

There were 30 men and 30 women with a mean age of 54 years (range, 24 to 79 years). The mean body mass index was 24.6 (range, 19.5 to 39.6). The operation was done on the right side of 32 hips and on the left side of 31 hips. The ASA classification was I in 13 hips, II in 38 hips, III in 11 hips, and IV in 1 hip. The primary diagnosis was osteonecrosis of the femoral head in 33 hips, osteoarthritis in 9 hips, dysplasia in 14 cases, rheumatoid arthritis in 4 cases, sequelae of Legg-Calvé-Perthes' disease in 2 cases, and traumatic osteoarthritis in 1 case. Prior surgeries included core decompression in 2 cases, pelvic osteotomy in 1 case, and the use of a Jewett nail for femoral neck fracture in 1 case.

### Hospital course

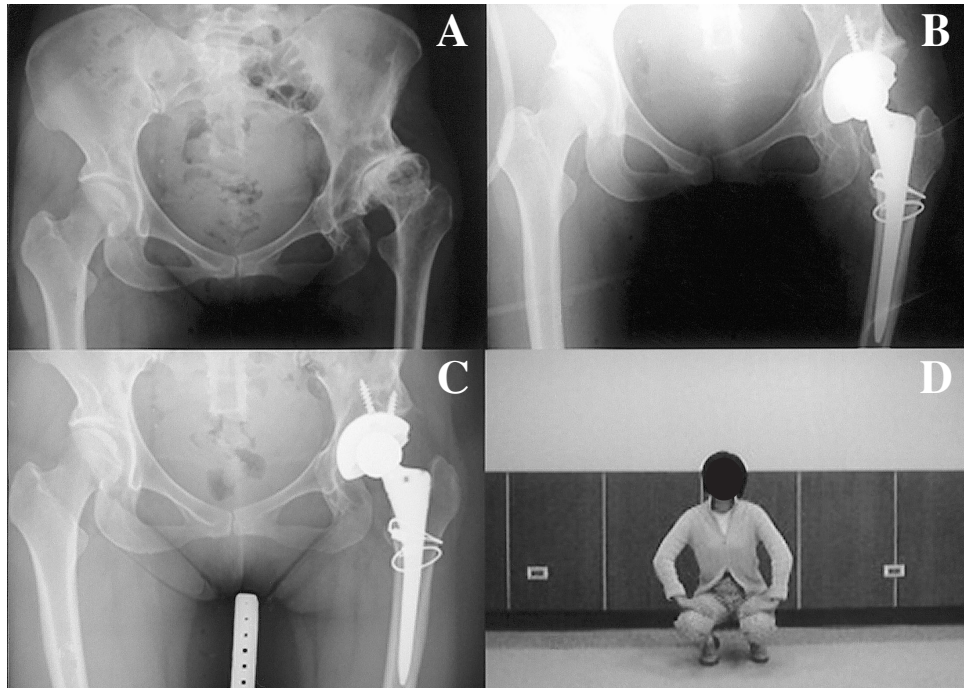
The mean operation time was 151 minutes (range: 85 to 275 minutes). The mean blood loss was 700 ml (range: 100 to 1700 ml). The mean blood transfusion volume was 1.6 units (range: 0 to 8 units). The mean wound length, combining the two incisions, was 9.9 cm (range: 8 to 13 cm). The mean antibiotic use was 2 days (range: 1 to 3 days). The mean hospital stay was 5 days (range: 3 to 11 days).

There were no major complications. No perioperative mortality, no fatal pulmonary embolism, and no vascular injuries were seen in these 63 procedures. Fractures of the proximal femur were encountered in 2 instances (3.2%) and were successfully managed by cerclage wiring. (Fig. 1)

The mean cup abduction angle was 42.9° (range: 35° to 55°). The mean cup anteversion angle was 17.9° (range: 10° to 35°). A cup abduction angle greater than 55° was not found. A cup anteversion angle greater than 30° occurred in 1 case (1.6%). The mean stem alignment was 0.4° in valgus (range: 3.8° varus to 4° valgus). The mean canal fill ratio was 93% (range: 80% to 100%). At the final follow up, there was no cup loosening. Limited subsidence of the stem without loosening was found in 1 hip.

### Functional recovery

The mean Harris hip score preoperatively was 57 (range: 23 to 78). The mean WOMAC scale preoperatively was 58 (range: 40 to 86). The Harris hip score improved to 85 ± 7 at 3 weeks, 92 ± 6 at 6 weeks, 96 ± 5 at 3 months, 98 ± 3 at 6 months, 99 ± 2 at 1 year, and 98 ± 4 at 2 years. The WOMAC



**Fig. 1** Case 50, 41-year-old female patient with developmental dysplasia of the left hip. (A) Pelvic osteotomy had been done at childhood. (B) Intraoperative femoral fracture was managed with wiring. (C) The fracture was healed and the implant was stable at 2 years postoperatively. (D) The hip function was excellent.

scale improved to  $88 \pm 6$  at 3 weeks,  $93 \pm 5$  at 6 weeks,  $96 \pm 4$  at 3 months,  $98 \pm 3$  at 6 months,  $99 \pm 3$  at 1 year, and  $98 \pm 4$  at 2 years. At 3 weeks postoperatively, 76% of the cases had a Harris hip score and WOMAC scale higher than 80. At 6 weeks this rose to 98% and to 100% at 3 months.

#### Adverse events in the follow-up

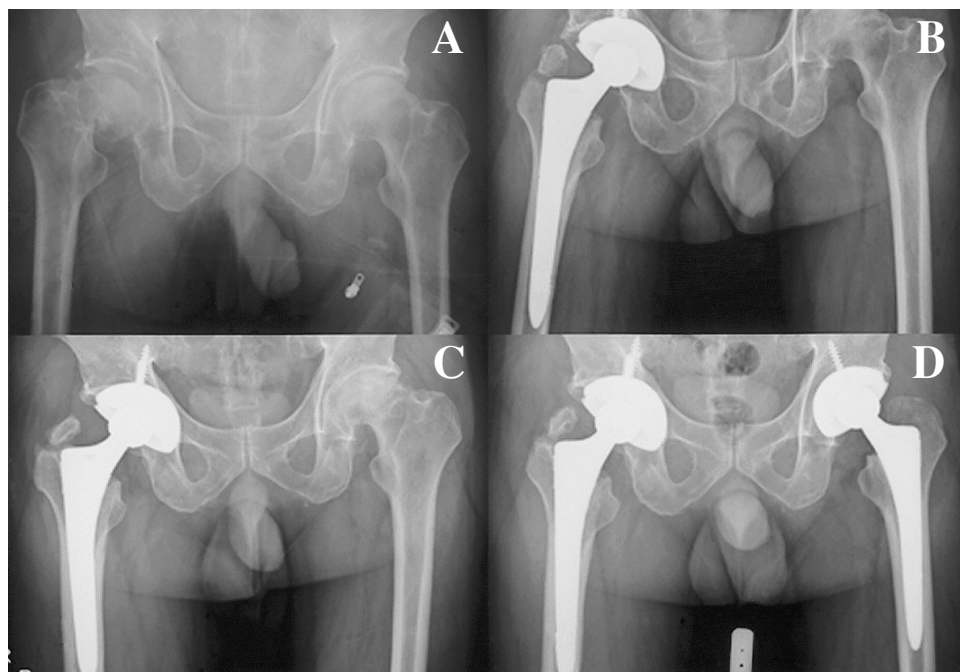
Injury to the lateral femoral cutaneous nerve occurred in 10 out of the 63 cases (15.9%) that presented with numbness or paresthesia over the anterolateral thigh, mostly temporary. The symptoms persisted for more than one year in two cases. No deep infection was seen in any of the 63 hips, however, superficial wound infection occurred in 1 instance (case 41) and was successfully managed by oral antibiotics. Greater trochanter fractures occurred in 2 hips (3.2%) and were successfully managed nonsurgically. (Fig. 2) Periprosthetic fracture (Vancouver type II-A) without stem loosening occurred in one hip after a traffic accident. The fracture was linear and non-displaced. It was managed successfully with

protected weight bearing.

## DISCUSSION

Minimally invasive total hip arthroplasty has attracted great attention and sparked controversy in the past few years. The minimal invasive surgical (MIS) approach has been interpreted as faster surgery, quicker recovery, shorter hospitalization, and fewer complications. Pressure from patients and peers forced the orthopaedic society to embrace minimally invasive total hip arthroplasty. However objective evidence of its potential benefits has been insufficient. The introduction of a new technique, on the other hand, is usually associated with poorer initial results and more complications as a result of an inevitable "learning curve." Currently, the MIS total hip arthroplasty can be divided into two categories. One type minimizes the wound and muscle cutting and emphasizes tissue repair through either an anterolateral or a posterolateral route.<sup>(3,22-25)</sup> The other avoids any muscle sectioning during the procedure





**Fig. 2** Case 63, 55-year-old male patient with osteonecrosis of the femoral head. (A) Right femoral neck fracture through the osteonecrotic lesion. (B) Greater trochanter fracture was found postoperatively. (C) There was no proximal migration of the greater trochanter because the gluteus medius and the vastus lateralis muscle were not divided. (D) He had excellent functional recovery and had another total hip arthroplasty on his left hip 2 years later.

through one,<sup>(26,27)</sup> two,<sup>(1,2,28)</sup> or three<sup>(4)</sup> incisions. The first abridges the incision and can be extensible when difficulties are encountered during operation. The second, including the two-incision technique, uses different surgical planes for implantation and could be detrimental when complications happen. In addition, complication rates are significantly higher for surgeons with a smaller volume of total hip arthroplasties in their practice.<sup>(28)</sup> To avoid complications, patients with morbid obesity, heavy muscular, anatomical abnormalities and a history of previous surgery are not recommended for the approach.

In this study, we documented a single surgeon's learning curve in a series of 63 cases with a minimal follow-up of 2 years. We strictly defined any adverse events after the two-incision procedure. Complication rates for the total 63 MIS-2 THAs included intraoperative femoral fracture in 2 cases and a superficial infection in one case. The intraoperative femoral fracture could be due to difficulty in verifying the proximal femoral anteversion using the two-incision technique or could be related to the use of

the triple taper FMT stem (Versys, Zimmer, Warsaw, In) which progressively loads the medial calcar during stem advancement. In contrast to pooled data reporting 851 cases from 159 surgeons, the prevalence of nerve injury was only 3.2%.<sup>(28)</sup> The current study had higher incidence of lateral femoral cutaneous nerve injuries in the early follow-up period, but most resolved in 6 months.

Implant malposition was not problematic in this study. Excessive cup anteversion of 35° was seen in one hip. However no hip dislocation was seen during follow-up. There was one hip (1.6%) with limited stem subsidence but the patient was asymptomatic. Greater trochanter fracture occurred in 2 hips (3.2%). Both might be related to overzealous removal of cancellous bone from the greater trochanter to facilitate lateralization of the stem. As for quicker recovery, 76% of cases had a Harris hip score of higher than 80 at 3 weeks; 98% at 6 weeks; and 100% at 3 months.

This study is limited because the follow-up period was short, but all cases could be followed up in the critical time frame when the benefits of the mini-

minimally invasive approach to total hip arthroplasty are supposed to be maximal. Longer-term follow-up and a prospective randomized controlled trial are required to investigate the impact of the MIS two-incision technique on the quality and durability of hip arthroplasties.

Many surgeons have practiced total hip replacement through a reduced wound for many years. However, the MIS concept had not been proposed until about 5 years ago.<sup>(3)</sup> MIS approaches using similar surgical planes as conventional approaches have been shown to have comparable results without increasing the risk of complications.<sup>(4-6,11,22,23,26,27)</sup> In contrast, highly variable results for MIS-2 THA have been reported in the literature.<sup>(1-3,7,8)</sup> These have been attributed to experience, surgical technique and the learning curve among surgeons, sparking controversies.<sup>(28)</sup> Unfortunately, clinical results of MIS-2 THAs are less available in the literature for comparative analysis. In this report, rapid recovery with satisfactory functional results could be achieved in a majority of cases after MIS-2 THA. This study analyzed the accuracy and quality of total hip arthroplasty after the minimally invasive approach and found the results were not compromised by avoiding muscle-cutting or limiting surgical field exposure. We recommend using the minimally invasive approach for total hip arthroplasty based on the encouraging clinical outcomes from this study. However, more advanced studies using a prospective randomized design to compare the results of the MIS-2 THA approach to other approaches are needed for evidence-based analysis.

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# 極小侵襲性雙刀口人工髖關節置換臨床追蹤 與住院過程之分析報告

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**背景：**極小侵襲性人工髖關節置換，由於減少組織的破壞，據信其臨床功能恢復應比傳統手術方法好。本研究目的藉由 63 個極小侵襲性雙刀口人工髖關節置換病例之臨床追蹤與住院過程分析，探討此項手術的成效。

**方法：**本研究蒐集 2003 年 9 月至 2004 年 7 月間 60 位病人 (63 個關節) 追蹤期程超過 2 年以上，作為研究分析的樣本。病人手術前基本資料、身高、體重、診斷均加以記錄，髖關節功能與生活品質以 Harris hip score 及 Western Ontario and McMaster University Osteoarthritis Index (WOMAC) 來評估。

**結果：**手術平均時間為 151 分鐘，失血量為 700 毫升，手術傷口總共 9.9 公分，平均住院日為 5 日。髖臼杯的外展角平均為 42.9°，而前傾角為 17.9°。在 15.9% 的病人術後追蹤，發現有暫時性的外股骨皮神經麻痺，所有的病人中有 2 例術中發生股骨骨折，1 例術後發生表淺傷口感染。髖關節功能與生活品質分析發現，絕大多數的病人都得到迅速的恢復與滿意的結果。

**結論：**本研究分析使用極小侵襲性雙刀口人工髖關節置換的臨床結果，發現此項手術的正確性與品質，並不會因為肌肉組織不切斷或手術視野較小而有所犧牲。由於這個令人鼓舞的結果，我們認為人工髖關節置換使用極小侵襲性手術是非常有前景的方法。

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**關鍵詞：**微創，關節重建，髖關節，雙刀口，結果

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