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Slower Recovery After Two-Incision Than Mini-Posterior-Incision Total Hip Arthroplasty

Surgical Technique

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ABSTRACT FROM THE ORIGINAL ARTICLE

BACKGROUND: It has been claimed that the two-incision total hip arthroplasty technique provides quicker recovery than other methods do. To date, however, there have been no studies that have directly compared the two-incision technique with another method in similar groups of patients managed with the same advanced anesthetic and rehabilitation protocol. We posed the hypothesis that patients managed with two-incision total hip arthroplasty would recover faster than those managed with mini-posterior-incision total hip arthroplasty and designed a randomized controlled trial specifically (1) to determine if patients recovered faster after two-incision total hip arthroplasty than after mini-posterior-incision total hip arthroplasty as measured on the basis of the attainment of functional milestones that reflect activities of daily living, (2) to determine if the general health outcome after two-incision total hip arthroplasty was better than that after mini-posterior-incision total hip arthroplasty as measured with Short Form-12 (SF-12) scores, and (3) to evaluate the surgical complexity of the two procedures on the basis of the operative time and the prevalence of early complications.

METHODS: Between November 2004 and January 2006, seventy-two patients undergoing total hip arthroplasty were randomized to two treatment groups: one group was managed with the two-incision technique, and the other group was managed with the mini-posterior-incision technique. The two-incision group comprised thirty-six patients (twenty men and sixteen women) with a mean age of sixty-seven years and a mean body mass index of 28.7. The mini-posterior-incision group comprised thirty-six patients (twenty men and sixteen women) with a mean age of sixty-six years and a mean body mass index of 30.2. All patients received the same design of uncemented acetabular and femoral components and were managed with the same comprehensive perioperative pain management and rapid rehabilitation protocol. Operative times and complications were recorded. At two months and one year, all patients were assessed with regard to functional outcome and general health outcome.

RESULTS: The patients in the two-incision group recovered more slowly than did those in the mini-posterior-incision group as measured on the basis of the mean time to discontinue a walker or crutches, to discontinue all walking aids, and to return to normal daily activities. The clinical outcome as measured on the basis of the SF-12 scores was similar at both two months and one year postoperatively. The two-incision total hip arthroplasty was a more complex surgical procedure, with a mean operative time that was twenty-four minutes longer; however, the rate of complications (2.8%; one of thirty-six) was the same in the two groups.

CONCLUSIONS: Our hypothesis that the two-incision technique for total hip arthroplasty would substantially improve the short-term recovery after total hip arthroplasty compared with the mini-posterior-incision technique was not proved; instead, the patients managed with the mini-posterior-incision technique had the quicker recovery.

LEVEL OF EVIDENCE: Therapeutic Level I. See Instructions to Authors for a complete description of levels of evidence.


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INTRODUCTION
Since the year 2000, minimally invasive techniques for total hip arthroplasty have generated substantial interest among patients and surgeons alike. The various techniques are predicated on the concept that a smaller skin incision and less dissection of the muscles, tendons, and other soft tissues around the hip should cause less postoperative pain and facilitate a quicker recovery for patients. The concepts surrounding minimally invasive tech-

FIG. 1-A
Preoperative anteroposterior (Fig. 1-A) and lateral (Fig. 1-B) radiographs are templated to determine the expected implant sizes and to determine the level of the femoral neck resection. The lateral radiograph is inspected to ensure that there is not an excessive anterior bow to the femur that would interfere with placement of the femoral component.
niques are inherently appealing to patients and surgeons alike. However, the true value of these approaches remains the subject of considerable debate. Most reports on minimally invasive techniques have coupled changes in the surgical technique with substantial changes in anesthesia, pain management, patient education, and rehabilitation protocols, making it difficult to quantify the contribution of the change in surgical technique alone to any observed improvements in outcome.

The standard posterior approach for total hip arthroplasty is familiar to many surgeons, and the mini-posterior approach represents a logical refinement of that technique. The mini-posterior approach is differentiated from the standard posterior approach on the basis of a smaller skin incision, less muscle dissection, no capsular excision, no incision in the iliotibial band, and no incision of the gluteus maximus insertion. Should difficulties be encountered intraoperatively, the mini-posterior approach can be converted to a standard posterior approach, allowing rapid, wide exposure of the femoral and acetabular sides of the hip joint.

The two-incision technique is a substantially different approach to total hip arthroplasty. The patient is positioned supine on the operating table, and a small, anteriorly-based incision is used to access the interval between the rectus femoris and the tensor fasciae latae to expose and prepare the acetabulum under direct vision. Many surgeons have found acetabular preparation to be relatively straightforward with the two-incision technique. Femoral preparation is done through a small posterior incision to access the piriformis fossa and to prepare the femur as one might perform closed femoral intramedullary nailing. While fluoroscopy can be used at various intervals and small glimpses of the femur can be obtained through the anterior incision, the femoral preparation is largely done in a blind fashion. Many surgeons have found femoral preparation to be technically challenging, and most of the reported complications associated with the two-incision technique have occurred on the femoral side. Early claims that the technique could be done without damaging hip muscle or tendon have been discounted on the basis of cadaver-based and clinical evidence of measurable muscle damage.

**OPERATIVE TECHNIQUE**

**Mini-Posterior-Incision Total Hip Arthroplasty**

Anteroposterior and lateral hip radiographs are templated prior to surgery.
to surgery to determine anticipated implant sizes and the level of the femoral neck cut relative to the superior margin of the lesser trochanter (Figs. 1-A and 1-B).

The patient is placed in the lateral decubitus position and is translated toward the posterior edge of the operating table. Pelvic support devices are positioned to hold the pelvis firmly. The posterior pelvic support is tall enough to cross the midline and to support the operative side of the pelvis, whereas the ante-

The fascia of the gluteus maximus is incised in line with the skin incision. This incision is not through the iliotibial band but instead is more posterior through the thinner fascia of the gluteus maximus. Distally the incision ends at the gluteus maximus tendon insertion, and proximally it is carried to the tip of the trochanter. The fibers of the gluteus maximus muscle are divided in line with the posterior border of the underlying gluteus medius muscle.

FIG. 3

Fig. 4-A After the interval between the gluteus medius and gluteus minimus is identified by means of blunt dissection, a retractor is placed to translate the gluteus medius anteriorly and thus to expose the underlying gluteus minimus. Fig. 4-B The deep exposure is done by incising the external rotators and underlying hip capsule as one layer down to the underlying femoral head and neck. The dashed line shows the proper orientation of the deep incision, with the proximal part parallel to the posterior border of the gluteus minimus and the distal extent ending at the quadratus femoris.
rior pelvic support is shorter and is placed against the anterior superior iliac spine of the contralateral (uninvolved) hip and the pubis. The chest and the shoulders are supported such that the tip of the shoulder and the high point of the iliac crest on the operative side are colinear with the long axis of the operating table. The hip is then placed through a range of motion to ensure that the pelvic supports will hold the pelvis firmly but will not interfere with intraoperative testing of hip stability. This is confirmed by testing the hip in full extension with

**FIG. 6**

A double-bent Hohmann retractor is placed under the muscle fibers of the quadratus femoris and around the lesser trochanter to expose the femoral neck.
maximum external rotation, in 45° of flexion with maximum adduction, and at 90° of flexion with maximum internal rotation.

Our approach involves slight modifications to the technique advocated by Inaba et al.1. The initial skin incision is made along the posterior border of the greater trochanter and typically measures 7 to 10 cm in length. Extending the incision proximal to the tip of the greater trochanter improves visualization of the femur, whereas extending the incision distal to the vastus lateralis tubercle (which corresponds to the vastus lateralis origin) improves visualization of the acetabulum (Fig. 2).

The fascia of the gluteus maximus is incised in line with the posterior border of the greater trochanter to expose the lateral part of the femur (Fig. 3). Care should be taken not to make this fascial incision too far anteriorly as it will involve the thicker tissue of the iliotibial band itself and will make subsequent tissue retraction more difficult. The fascial incision is carried proximally to the tip of the greater trochanter and then slightly posteriorly to split the gluteus maximus fibers in line with the posterior border of the underlying gluteus medius muscle. A more anterior fascial split leaves excess gluteus maximus muscle that must be retracted anteriorly and interferes with femoral exposure during reaming and component insertion.

The abductor muscles are identified, and the interval between the gluteus medius and minimus is developed by means of gentle blunt dissection with the surgeon’s index finger. A Deaver retractor or 90°-bent Hohmann retractor is then placed in this interval to retract the gluteus medius anteriorly and to expose the underlying piriformis tendon along the inferior border of the gluteus minimus (Fig. 4-A). The involved lower extremity is positioned in neutral abduction-adduction, is flexed approximately 30°, and is

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**FIG. 7**

The specialized retractors used for the mini-posterior surgical technique include a double-bent Hohmann retractor, a femoral elevator, a broad cobra retractor, and a narrow cobra retractor. The cobra retractors have a minimal radius of curvature, which improves their mechanical advantage, whereas the long handles keep the hands of assistants away from the operative field.
placed in gentle internal rotation to put some, but not excessive, tension on the external rotators and the posterior capsule. Any prominent vessels coursing along the external rotator muscles are identified and coagulated.

The external rotators and the underlying posterior hip capsule are incised (Fig. 4-B) and preserved as one layer (Fig. 5). The incision is made with electrocautery by releasing the piriformis and the underlying capsule from their insertion on the greater trochanter and then extending the capsular split proximally and slightly posteriorly, parallel to the posterior edge of the glutus minimus muscle, stopping at the osseous margin of the acetabulum after incising the labrum. Attention is then turned distally. Beginning at the piriformis fossa, the hip capsule and the external rotators are incised as one layer from the pos-

FIG. 8
The height of the femoral neck is measured in millimeters preoperatively. A paper ruler, introduced along the medial part of the femoral neck, is bent to that distance. The resection line is marked with electrocautery.

FIG. 9
The femoral neck resection level can be seen clearly after marking the bone with electrocautery. Alternatively, an osteotome can be used to score the bone along the line of resection.
terior border of the greater trochanter down to the proximal border of the quadratus femoris muscle. In many patients, the quadratus femoris can be left intact and the underlying hip capsule can be released with electrocautery. In very stiff hips, the quadratus femoris may need to be released as part of the exposure. A number-5 suture is placed through the posterosuperior hip capsule and the piriiformis tendon as a tag suture on a clamp to facilitate retraction of the posterior capsule and the external rotators during trial reduction of the hip later in the procedure (Fig. 6).

The hip is dislocated, and the femoral head and neck are exposed. A second Deaver retractor or 90°-bent Hohmann retractor can be placed along the femoral head to retract the skin posteriorly. A specialized double-bent Hohmann retractor is placed under the quadratus femoris, with its tip on the lesser trochanter to facilitate vi-
sualization of the psoas tendon insertion on the lesser trochanter (Fig. 7). A ruler can be used to measure the position of the femoral neck cut proximally from the lesser trochanter or distally from the center of the femoral head. We often pre-bend a paper ruler to the appropriate neck length as measured in millimeters on the basis of our preoperative planning and then slide that ruler in the small incision and mark the neck cut with electrocautery (Figs. 8 and 9).

The femoral neck cut is made with a single-sided reciprocating saw to avoid damaging the skin edges (Fig. 10). The femoral head is then removed in a
FIG. 14

Exposure of the proximal part of the femur is improved by internally rotating the femur >90° as the posterior border of the greater trochanter is then moved out of the incision. In addition, the medial part of the femoral neck is elevated, making it easier to insert femoral broaches and the final femoral component without impinging on the skin and posterior soft tissues.

FIG. 15

Care is taken to avoid damage to the abductor muscles during reamer and broach insertion. Introducing reamers in slight varus allows them to be advanced until the cutting teeth are distal to the muscle, at which point they are then translated laterally into the trochanter to ream in a neutral position.
single piece without substantial difficulty (Fig. 11).

Femoral preparation with the mini-posterior approach requires a specialized femoral retractor that will translate the skin and the posterior portion of the gluteus maximus posteriorly (Fig. 12). That retractor is placed on the anterior surface of the femoral neck, just distal to the neck cut (Fig. 13). The assistant then flexes the hip to position the neck optimally in the incision by following the rule that more distally-based incisions will require more hip flexion for ideal femoral exposure, whereas more proximally-based incisions will require less hip flexion. The hip should be internally rotated to >90°. When the hip is rotated to >90°, the greater trochanter and the attached gluteus

![Femoral broach in place](image1)

**FIG. 16**
The femoral broach is inserted and then is left in place to protect the proximal part of the femur during the retraction needed to expose the acetabulum.

![Narrow short-tipped cobra retractor is placed just distal to posterior inferior iliac spine and retracts against the medial edge of the cut femoral neck to translate femur anteriorly](image2)

**FIG. 17**
Acetabular exposure begins with the placement of a narrow cobra retractor through the hip capsule that lies just distal to the anterior inferior iliac spine, followed by retraction against the posterior portion of the remaining portion of the femoral neck to translate the femur anteriorly.
medius tendon are moved more laterally away from the edges of reamers and broaches that are targeted down the middle of the femoral canal (Fig. 14). Care must be taken not to damage the proximal skin margin, which is under substantial tension, when inserting and removing femoral reamers and broaches. In most cases, the reamers are best introduced in a slight varus position and are advanced until the proximal cutting teeth are safely past the skin and abductor muscle before being brought back into a neutral position to carry out the reaming. Similar precautions are taken when inserting and removing femoral broaches (Fig. 15).

After appropriate rotational and axial stability have been obtained, the femoral broach is left in place and attention is turned to the acetabular side (Fig. 16). A narrow short-tipped cobra retractor is placed along the anterior margin of the acetabulum, just distal to the anterior inferior iliac spine (Fig. 17). The tip is placed through the soft tissue of the capsule in that region and rests on the bone of the anterior wall of the acetabulum.
which provides excellent leverage for translating the femur anteriorly (Fig. 18). This narrow cobra retractor then rests against the medial edge of the femoral neck, which is protected by the femoral broach that was left in place, and the entire femur typically can be translated anteriorly to facilitate reaming of the acetabulum under direct vision.

The anterior part of the inferior hip capsule, extending from the ischium to the anterior aspect of the femoral neck, is then incised with electrocautery down to, but not through, the transverse acetabular ligament (Fig. 19). Care is taken to not cut deeper than the capsule in this region as the medial circumflex artery and vein run directly adjacent to the capsule. This incision allows the posterior hip capsule and attached external rotators to be translated further posteriorly, providing better visualization of the postero-inferior part of the acetabulum. That exposure is maintained by placing a broad cobra retractor adjacent to the transverse acetabular ligament inferiorly, with the tip of the broad cobra retractor resting against the hard cortical bone of the cotyloid notch inferiorly.

Posteriorly, a specialized double-bent Hohmann retractor with a short tip is impacted with a mallet into the bone of the posterior column in the interval between the hip capsule and the labrum, with care being taken not to direct the tip into the acetabulum, where it would interfere with reaming (Fig. 20).

Acetabular reaming is carried out under direct vision, and the transverse acetabular ligament is used as a guide to appro-
Acetabular reaming is carried out under direct vision with use of the transverse acetabular ligament as a guide to anteversion.

Good visualization of the entire acetabulum is obtained when the retractor is appropriately placed.
The final acetabular component is impacted into place. In most cases, the appropriate anteversion and vertical inclination are obtained when the socket is placed parallel to the transverse acetabular ligament, with the inferior edge of the socket recessed deep to the ligament and with 2 to 4 mm of the posterosuperior edge of the socket exposed.

The acetabular liner is inspected to ensure accurate and complete seating.
appropriate anteversion of the reamer (Fig. 21). We typically prepare the acetabulum by starting with a reamer that is 3 mm smaller than the templated acetabular component size. We then finish the acetabular preparation with a reamer that is 1 mm smaller than the actual acetabular component to allow for a secure press-fit (Fig. 22). Preoperative templating of the acetabular component size allows this simple two-reamer preparation to be done routinely. Minimizing the number of reamers is efficient and reduces the risk of damaging the skin edges. While specialized reamer-drivers with either a curved or offset shaft and low-profile reamer heads are available, they are not required for routine cases.

The acetabular component

![Image](http://example.com/image.png)

**FIG. 25**

A secondary check of limb length can be done by assessing the position of the prosthetic femoral head relative to the posterosuperior acetabular rim before attempting to reduce the hip. Typically, the equator of the head will rest at the level of the acetabular rim.

![Image](http://example.com/image.png)

**FIG. 26**

The hip is reduced, limb length is assessed, and the hip is put through a range of motion to assess for impingement. Specific testing is done to look for impingement in full extension with maximum external rotation and at 90° of flexion with maximum internal rotation (while maintaining 5° to 10° of hip abduction).
is then impacted into place under direct vision with a goal of 20° anteverision and 40° to 45° inclination. The cup is typically oriented parallel to the transverse acetabular ligament as a guide to anteverision and is positioned such that 2 to 4 mm of the pos-
teriorsuperior edge of the compo-
ment is uncovered by host bone. This typically ensures that the cup is inclined 40° to 45° in the frontal plane (Fig. 23). Supple-
mental fixation of the cup with screws can be carried out at the discretion of the surgeon. A trial acetabular liner or the final ace-
tabular liner is then placed ac-

A secondary check of soft-tissue tension in the hip is done by flexing the hip 30° and then lifting the entire limb by the foot, which encourages maximum internal rotation of the femur. The femoral head should not subluxate from the socket in this position when appropriate offset and leg length have been restored.

The final femoral component is inserted by repositioning the femoral retractors and internally rotating the femur to expose the femoral canal.
According to surgeon preference (Fig. 24).

A trial reduction is then performed. The trial femoral neck and head can be challenging to assemble through the small incision, particularly when using a larger-diameter femoral head. Typically, the femur must be flexed 45° and maximally internally rotated to expose the femoral neck for assembly. The tag suture that was previously placed through the capsule and the piriformis tendon is used to assemble through the posterior capsule and piriformis (held here with a tag suture) back to the anterosuperior capsule and the posterior border of the gluteus minimus. This repair effectively eliminates any dead space between the metal prosthetic head and the posterior capsule.

The deep closure is done by twice passing a number-5 suture from the piriformis and posterior capsule through the anterosuperior capsule and posterior edge of the gluteus minimus. In addition to closing the posterior dead space, this closure acts as a dynamic repair as the gluteus minimus will tighten the posterior capsule whenever it fires.
retract this tissue so that it does not become incarcerated between the acetabular component and the trial femoral head. In cases in which there is no intention to gain limb length, it is typical for the equator of the femoral head to be lying on the posterosuperior edge of the acetabular component prior to the reduction maneuver (Fig. 25). Hip stability is assessed by confirming an impingement-free range of motion that includes (1) full extension with maximum external rotation (impingement occurs if the cup is over-anteverted); (2) the position of sleep, with 45° of hip flexion and maximum adduction (impingement occurs if there is insufficient offset); and (3) 90° of hip flexion with 10° of abduction, allowing at least 75° of internal rotation (impingement occurs if the cup is not anteverted enough or if there is insufficient offset) (Fig. 26). We add one additional test of soft-tissue tension. The hip is flexed...
to 30° and the limb is held by the foot to allow maximum internal rotation to occur (Fig. 27). If the hip subluxates posterosuperiorly in this position, it indicates poor soft-tissue tension that is typically occurring because of insufficient femoral offset. Once a stable configuration is obtained, the final femoral component is impacted into place and the hip is reduced and

FIG. 33

The patient is positioned supine on a radiolucent table for the two-incision technique.

FIG. 34

Placement of the anterior incision is aided by fluoroscopy. The incision starts at the base of the femoral neck and extends to the middle of the femoral head and typically measures 5 to 6 cm.
is placed through a final range of motion to confirm appropriate stability, limb length, and offset (Fig. 28).

The wound is thoroughly irrigated with a pulsatile lavage system and is closed in layers. The deep layer involves a soft-tissue repair of the piriformis and the posterior capsule back to the anterosuperior capsule and the posterior border of the gluteus minimus with use of a heavy nonabsorbable suture (Fig. 29). This soft-tissue repair has several theoretical advantages over a more traditional osseous repair of the capsule and external rotators back to the greater trochanter. First, it allows obliteration of any posterior dead space as the capsule and external rotators are advanced directly against the edge of the prosthetic femoral head (Fig. 30). Second, the repair will not pull apart with internal rotation of the femur, as often occurs with osseous repairs through drill-holes in the greater trochanter (Fig. 31). Third, by suturing the posterior capsule and piriformis to the posterior border of the gluteus minimus (in addition to the anterosuperior capsule), some degree of dynamic stabilization may be conferred when the gluteus minimus muscle fires.

The remainder of the wound is closed with multiple interrupted sutures in the gluteus maximus fascia and subcutaneous tissues (Fig. 32). The skin is closed with a running absorbable suture and steri-strips, and an immediate postoperative radiograph is made.

Patients are encouraged to sit up in a chair within four to six hours after surgery and then begin walking the following morning with progressive weight-bearing as tolerated.
Two-Incision Total Hip Arthroplasty

The patient is positioned supine on an operating table that is radiolucent to allow fluoroscopic imaging of both the femur and the acetabulum intraoperatively (Fig. 33). A 6-cm anterior incision is centered over the base of the femoral neck as assessed fluoroscopically (Fig. 34). The Smith-Petersen interval is then used to expose the hip, to cut the femoral neck, and to prepare the acetabulum (Fig. 35). Fluoroscopy is used intermittently to verify acetabular reaming depth, sizing, and positioning. The acetabular component is then impacted into place (Fig. 36). A second incision measuring 3.8 to 5 cm is made in the buttock, and the abductors and external rotators are identified (Fig. 37). The femur is sequentially reamed and broached through the piriformis fossa in a blind fashion but with use of intraoperative fluoroscopy at key intervals to aid in appropriate alignment and sizing (Fig. 38). The posterior hip capsule must be incised to allow passage of the trunnion of the femoral compo-
Femoral broaching is largely done in a blind fashion through the posterior incision. Care must be taken to protect the skin and the underlying muscle from damage during insertion and extraction. Appropriate anteversion of the femoral broach can be confirmed by palpating the broach and the medial aspect of the calcar of the femoral neck through the anterior incision. Retractors also can be placed anteriorly to visualize the broach and the femoral neck at key intervals.

The femoral component is then impacted into place in a blind fashion. During femoral component insertion, the lesser trochanter and the neck or collar of the femoral component can be palpated through the anterior incision to help to guide the anteversion of the femoral stem (Fig. 39). Trial reduction is carried out, and limb length, offset, and hip stability are assessed. After assembly of the final femoral head, the hip is reduced and the two incisions are closed in layers.
CRITICAL CONCEPTS FOR THE MINI-POSTERIOR-INCISION TECHNIQUE

INDICATIONS:
• Primary total hip arthroplasty in patients who are not morbidly obese and who are without substantial osseous deformity that would require concomitant osteotomy

CONTRAINDICATIONS:
• Marked hip stiffness requiring extensive soft-tissue releases
• Substantial retained hardware that requires removal
• Fragile skin that is at risk with moderate retraction force
• Extreme obesity
• Substantial osseous deformity

PITFALLS:
• Limited skin incision puts the skin edges at risk of damage from saws, reamers, and retractors.
• Limited exposure can make preservation of the full length of the piriformis tendon and the external rotators more difficult.
• Limited exposure can make control of bleeding more difficult if the medial femoral circumflex vessels are inadvertently injured during acetabular preparation.
• Assembly of the trial femoral neck and head, as well as reduction of the hip without incarcerating soft tissue in the acetabulum, can be more difficult. That is particularly true when using a femoral head with a diameter of >32 mm.

AUTHOR UPDATE:
On the basis of the results of our study, the two-incision technique for total hip arthroplasty is no longer used at our institution.

REFERENCE