Chapter 8
A Modified Anterolateral, Less Invasive Approach to the Hip: Surgical Technique and Preliminary Results of First 103 Cases

Herve Hourlier

Abstract One hundred and three (103) consecutive primary total hip arthroplasty cases were treated with a modified, anterolateral, minimally invasive approach and were prospectively followed to determine short-term outcome. A minimal dissection soft tissue-preserving technique was achieved by a slide osteotomy of the lateral facet of the greater trochanter through skin incisions which were less than or equal to 10 cm in length. The capsule was not excised but incised in the same line as the gluteus minimus. The prospective study group was operated in 2003 and compared to a retrospectively matched control group of patients, operated in 2002, that had received total hip arthroplasty using a conventional-sized lateral approach. The mini-incision, anterolateral, modified approach was found to be as safe as the standard approach while providing quicker patient recovery. The minimal invasive approach was not associated with improper component placement.

Keywords Total hip replacement • Anterolateral surgical exposurey • Postoperative bleeding

Introduction

Minimally invasive surgery (MIS) is thought to provide important benefits in comparison to traditional extensile exposure. Except for cosmetics, MIS is associated with lower blood loss, lesser pain, and faster rehabilitation. Because of the consistently reported high success rate of conventional total hip arthroplasty (THA), it is imperative to critically appraise these new MIS techniques. A variety of mini-incision techniques in THA currently exist. Besides an innovative, controversial, two-incision technique, assisted by fluoroscopy, and promoted by R. Berger [1],

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various single-incision techniques via anterior, anterolateral, or posterior approaches have been described. The results which have been reported differ in relation to the type of approach. For instance, improper component position has been reported with the mini-incision, posterior approach [2]. So far, studies using the mini-incision anterior or anterolateral approach have not reported this adverse outcome [3, 4]. Although no significant positive influence on recovery from decreased incision length was observed for the anterolateral approach in a recent report [4], minimizing incision length specifically for such a surgical approach should theoretically decrease muscle damage and risk of injury to both the superior gluteal nerve and to the transversal branch of the circumflex artery, both of which are located at the limits of the incision. Damage to these elements has been associated with abductor muscle weakness, delayed recovery, and persistent limp [5, 6]. These adverse consequences should be theoretically reduced by a smaller incision that respects the safety zone for the nerve and causes less trauma to the muscles [5, 7].

This chapter describes my surgical technique and reports on the early postoperative results of the first consecutive 103 THAs performed with a modified, anterolateral, minimally invasive approach. Outcome is compared retrospectively to a matched patient cohort of 88 cases performed with the conventional lateral approach.

Materials and Methods

Patient Population

From a pool of 165 consecutive primary total hip arthroplasties, 103 consecutive hips (102 patients) were selected for the minimal incision THA technique, defined as a skin incision that was less than or equal to 10 cm in length. Excluded from this prospective study group were patients with previous surgery of the joint or those suffering from post-traumatic arthritis, rheumatoid arthritis, and postinfectious arthritis. The mini-incision group of 103 hips was operated between February 2003 and March 2004 and compared with a population of 88 hips (88 patients) that were operated in 2002 with the use of a conventional incision (15–20 cm) via a modified, anterolateral approach. The control group was retrospectively matched using the same inclusion criteria as for the study group. Baseline data is listed in Table 8.1. No statistical significant differences between the two study arms were found with respect to age, gender, body mass index, preoperative functional Postel and Merle d'Aubigné score (PMA score) [8], fraction of patients operated for primary osteoarthritis (OA), or preoperative hemoglobin level. While care was exerted in matching the patients, there were more ASA 3 patients in the control group than in the study group (Table 8.1). All arthroplasties were performed cementless with use of a tapered rectangular titanium stem (SL-Plus®, Plus Orthopedics Ltd., Rotkreuz, Switzerland) and a press-fit metal-backed acetabular component. The bearing surfaces were mainly alumina ceramic-on-ceramic in both groups. All surgeries were performed in the same laminar airflow theater by the same surgeon under general

Table 8.1 Baseline characteristics in the two groups

Baseline values	Mini incision $N=103$	Standard incision $N=88$	p-value
Gender (M/F)	49/54	50/38	0.205*
Age	67.0 ± 10.9	67.3 ± 12.6	0.838**
Primary OA (%)	85.4 %	78.4 %	0.928**
BMI (kg/m^2)	27.2 ± 4.1	27.9 ± 4.4	0.272**
Preop PMA score	10.0 ± 1.4	9.6 ± 1.6	0.206***

*Chi-square, **Mann-Whitney, ***Fisher exact

anesthesia and using a hemocare device. The same rehabilitation protocol was prescribed. Immediate full weight bearing was allowed. All patients were free to ambulate the second day after the surgery. The use of one crutch was prescribed for minimum 1 month. The follow-up program included a clinical and x-ray exam done after 6–12 weeks and at 1 year. The PMA score was used to establish the postoperative rating. No patients in either group were lost to follow-up.

Statistical Analysis

Data were evaluated with Statistica 6.1 (StatSoft Inc., Tulsa, OK, USA). Alpha was chosen at 0.05. Between-group comparisons were performed with the Student's t-test or the Mann-Whitney test for continuous variables, the Mann-Whitney test for ordinary scaled variables, and the chi-square and Fisher exact test for nominal scaled variables.

Surgical Technique

Patient Positioning

The patient is placed on the operating table in the lateral decubitus position with the pelvis locked perpendicular to the table. The entire leg and hip are prepared and draped. A supplementary sterile pouch is dressed in front of the operating table in order to place the leg in a vertical position at the femoral preparation step.

Incision

The skin incision is made longitudinally in a straight line over the greater trochanter from 3 cm above the tip to 5 cm below (Fig. 8.1). The fascia lata is divided in a straight line and the gluteus maximus is splitted in line upwards. This division is

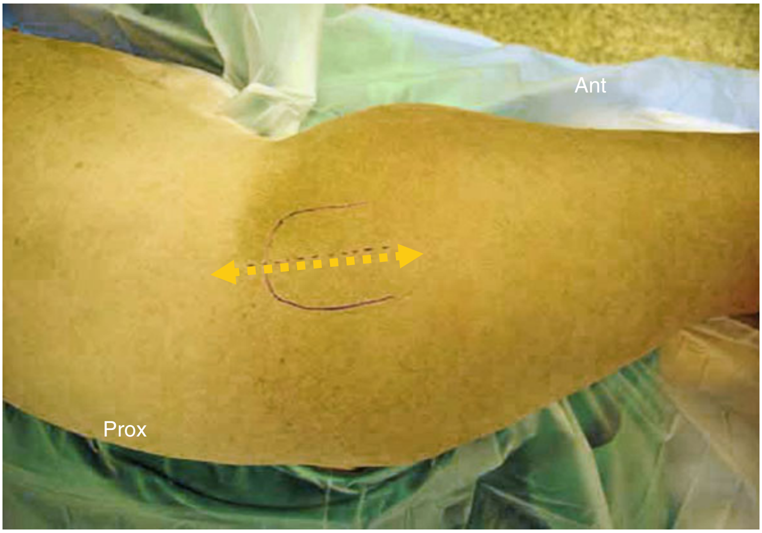

Fig. 8.1 Skin incision

extended 3 cm proximal and distal beyond the limits of the skin incision; the incision of the trochanteric bursa reveals the anterior and posterior borders of the great trochanter and its attaches. Using cutting diathermy, a longitudinal incision is made to divide the tendinous periosteum over the great trochanter centered midway between the anterior and posterior margins and extended distally in the middle of vastus lateralis tendon to a point 1 cm beyond the vastus ridge. The incision extends proximally to divide, in an anterior curved direction, 1/3 anterior of the gluteus medius muscle in direction of the fibers and not more than 2 cm above the tip of the great trochanter (Fig. 8.2).

Approach

With use of an oscillating saw, an osteotomy of the lateral aspect of the great trochanter is performed in an upward direction from the vastus ridge in order to preserve the transverse branch of the lateral circumflex artery (Fig. 8.3). The trochanteric fragment is vertical, linear, about 5–8 mm thick and carries with it the continuation of the anterior part of the gluteus medius and the vastus lateralis. It is attached proximally to the anterior part of the gluteus medius and distally to the anterior half of the vastus lateralis. Rotating the extremity laterally achieves a medial slide of the fragment which is then mobilized anteriorly to expose the gluteus minimus and the capsule which are incised in the same line. The distal part of the gluteus minimus is detached jointly from the capsule and from its femur insertion. The proximal part of the incision is extended along the femoral neck in an anterior direction toward the

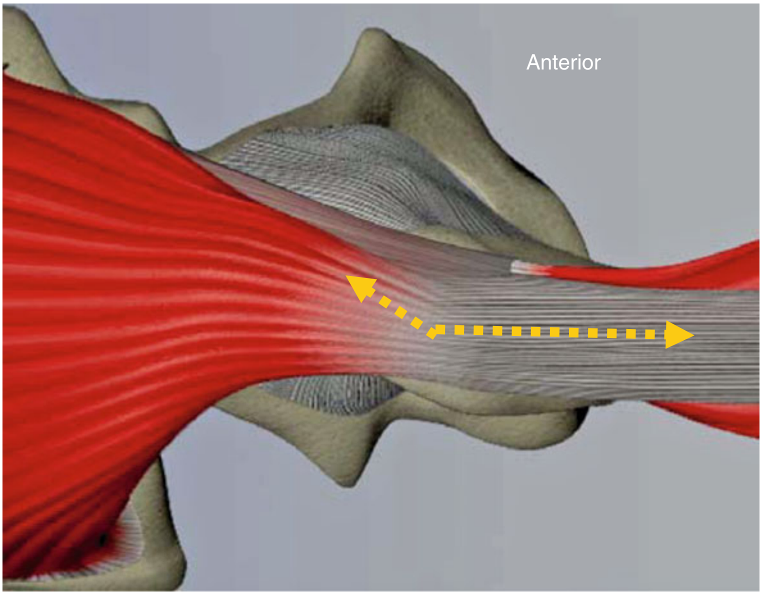

Fig. 8.2 1/3 gluteus medius-1/2 vastus lateralis digastric anterior flap developed with bony intermediate junction created by osteotomy of the lateral facet of the greater trochanter

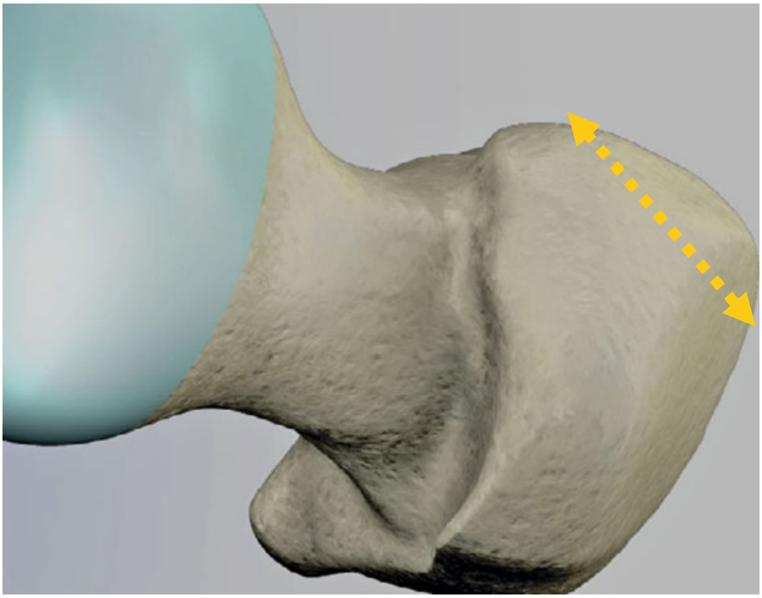

Fig. 8.3 Osteotomy of the lateral facet of the greater trochanter

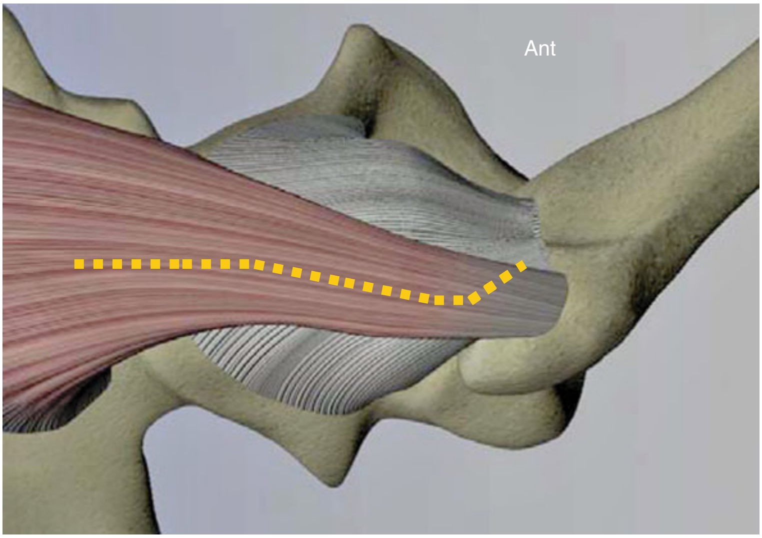

Fig. 8.4 Split of the gluteus minimus and incision of the capsule in the same line

superior acetabular rim (Figs. 8.4 and 8.5). The femoral neck is transected in situ or after dislocation; then, the femoral head is excised.

Acetabular Exposure

After removal of the femoral head, the position of the leg is adjusted to give the exposure of the acetabulum. In most cases, lateral rotation and slight flexion of the hip give the best access. After excision of the labrum, two spiked Hohmann retractors are inserted over the anterior and posterior edges of the acetabulum (at 4 and 8 o'clock). Then the capsule can be released if necessary to the medial border of the femur. A Steinman pin or a self-retaining retractor is placed proximally to retract the capsule and the gluteus muscles (Fig. 8.6). The entire acetabular cavity can now be seen and remnants of the labrum are excised.

The acetabular bony preparation is performed with an angled reamer handle designed for use in minimally invasive surgery of the hip. Either a curved impactor through the incision directly or a straight impactor through a separate percutaneous incision is used to insert the cup in proper position.

Femoral Exposure

The femoral preparation is made with the foot placed vertically. The exposure is provided by two spiked Hohmann retractors, one placed on the medial and the

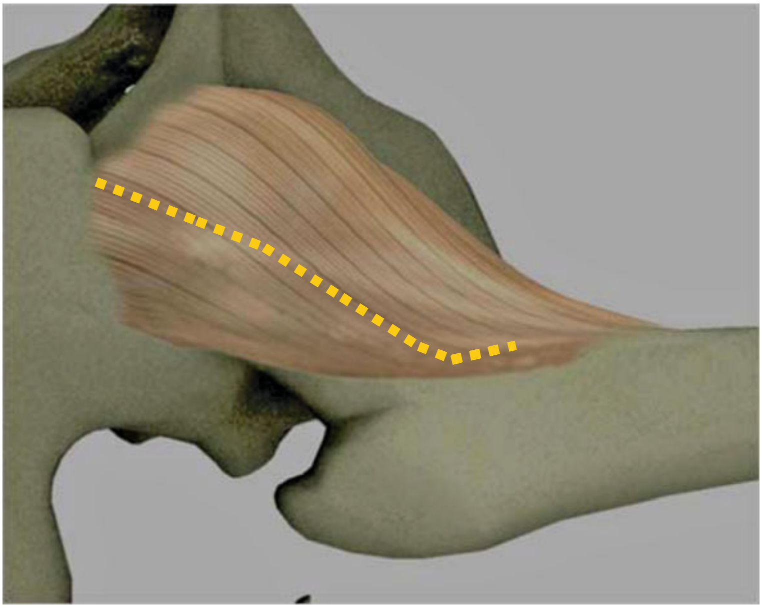

Fig. 8.5 Line drawing of the capsule incision

Fig. 8.6 Acetabular exposure is provided by two spiked Hohmann retractors and a Steinman pin

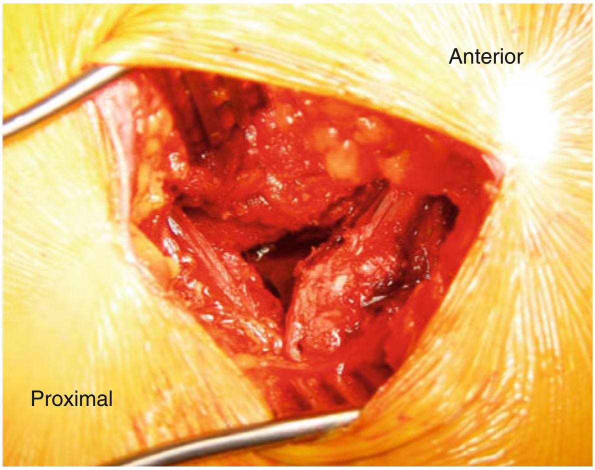

Fig. 8.7 Operative aspect before the closure (right hip)

other posterolateral side of the femur. A third spiked Hohmann can be placed advantageously under the posterior femoral neck anterior to the ventral gluteus medius part to prevent muscle damage possibly encountered by the femoral rasps. Sharp-cutting femoral rasps of rectangular cross section and increasing size are used with a pneumatic hammer to achieve direct anchorage by press fit. After satisfactory trial reduction with a trial device the definitive prosthesis is inserted and the hip is reduced.

Closure

The closure is made in layers. The capsule and the gluteus minimus are jointly sutured and can be reattached to the femoral bone (Fig. 8.7). Then the trochanteric slide fragment is reattached to the proximal femur by a single cerclage wire (monofilament 1.2 mm steel) passed anteriorly to the stem of the prosthesis through drill holes. The twist of the metal knot is placed under the vastus ridge to prevent trochanteric bursitis related to the cerclage wire (Fig. 8.8). The fascia lata, gluteus fascia, subcutaneous tissues, and skin are closed in usual fashion.

Clinical Results

Average time for surgery was 62 min for study group and 63 min for the control group ($p = 0.51$). No decreased time related to the learning curve was observed between mid-practice in the mini-incision group. Postoperative day 1 after surgery, the hemoglobin level was 11.8 g/l for the study group and 11.6 g/l for the

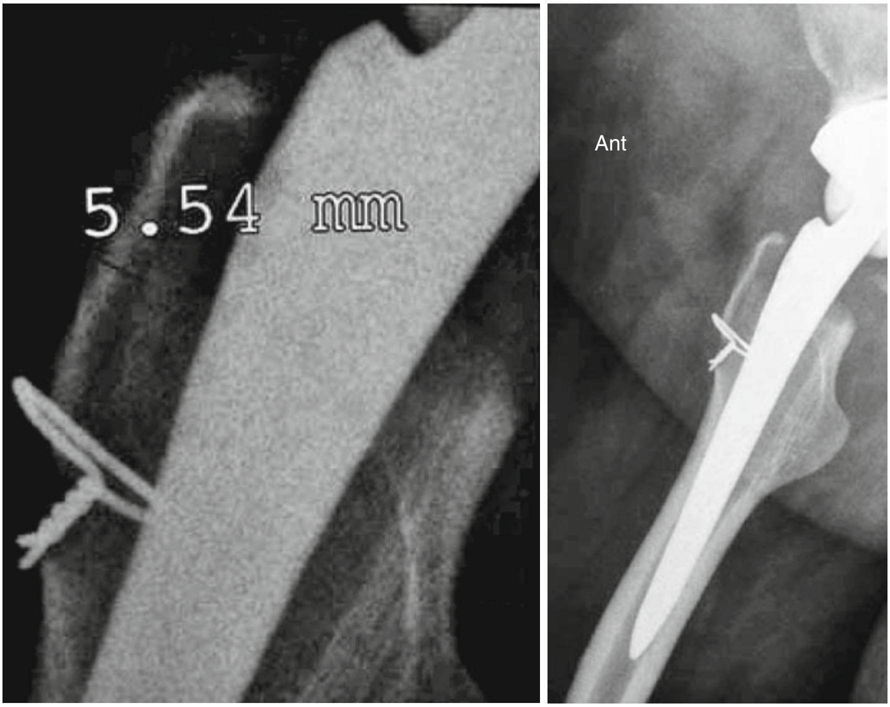

Fig. 8.8 The lateral radiograph and focus show the reattachment of the trochanteric fragment with a wire

control group ($p = 0.42$). However, fewer patients in the study group received blood autotransfusion with hemocare (16 % vs. 49 %, $p < 0.001$), and the amount of blood transfused was less for the study group (119 ml vs. 130 ml, $p < 0.001$).

Three patients were transfused with allogenic blood in the MIS group; all were older than 80 years. One of these patients had a preoperative hemoglobin level at 10 g/l; the two others received transfusion just prior to discharge (Table 8.2).

Complications

In the both groups, no wound healing, nerve palsy, infection, femoral fracture, or prosthetic dislocation complications emerged. In the mini-incision group, one malpositioned ceramic inlay required revision after 6 days. The inlay was replaced successfully. In each group, two cases of deep vein phlebitis were detected just prior to discharge.

Table 8.2 Comparison of hemoglobin levels and rates of blood transfusion in the two groups

Blood loss	MIS N = 103	Standard incision N = 88	*p*-value
Haemoglobine level Preoperative (gr/l) Postoperative day-1 (gr/l)	14.2 ± 1.3 11.8 ±1.4	13.8 ±1.1 11.6 ±1.5	.074 .423
Drop level	16 . 9 %	15.9 %	
Hemocare device % Patients re-infused with hemocare Average volume of re-infusion (ml)	16.5 117 ± 32	46.6 130 ± 78	.000
No. of patients having receiving allogenous blood transfusion	3	6	.313

Table 8.3 Comparison of operating time and outcomes in the two groups

Result	Mini incision group N=103	Standard incision group N=88	*p*-value
Surgical time (min)	61.9 ± 14.5	62.7 ± 12.9	.508*
Length of hospital stay (days)	8.3 ± 3.5	9.6 ± 3.6	.000*
Patients discharged home (%)	78.4	60.2	.01**
PMA at 1 year	17.3 ± .9	17.1 ± .8	.423*

Values are given as mean ± SD
*Mann-Whitney, **Chi-square

Clinical Evaluation

Hospitalization time was 8.3 postoperative days for the study group and 9.6 postoperative days for the control group ($p<0.001$). One year postoperatively, the PMA score was 17.3 for the study group and 17.1 for the control group ($p=0.42$) (Table 8.3).

Radiographic Results

Component position was not different between the two groups. Immediate postoperative X-rays showed excellent overall alignment and fit of all the components in the mini-incision group. The femoral stems were in neutral alignment in 95 cases and in varus alignment of less than 5° in the remaining eight cases. Cup abduction angle averaged 38.5° with all components between 30° and 48°.

At the last follow-up, no component in either group has shown migration.

Discussion

The direct lateral approach is attractive for THA since it provides excellent visualization of both acetabular and femoral regions through a comparatively small skin incision [9]. The quality of component placement is afforded by the straightforward and direct line of sight characteristic of the operative procedure. The risk of dislocation is lower than with posterior approach [6, 7, 9]. The trans-gluteal approach, with splitting of 1/3 of the abductors, was originally introduced by Bauer [10] to prevent muscle damage encountered when performing THA via the traditional Watson Jones, anterolateral intermuscular approach, between the gluteus medius and the tensor fascia lata.

Intraoperative damage to the anterior abductors and difficulties inherent in effectively repairing muscle to the bone have long been associated with the Watson Jones approach. In addition, the risk of postoperative heterotopic bone formation has been linked to this approach, despite it does not necessarily affect clinical outcome [7]. The direct lateral approach for THR was popularized by Hardinge [11], despite the inconvenience of delayed recovery and clinical abductor weakness. Postoperative abductor insufficiency after abductor split has been ascribed to injury to the vascular and nerve supply to the muscles [5, 7], when the safety zone of the superior gluteal nerve is not respected and muscle damage is incurred by dehiscence of the reattachment suture line [12]. The amount of the disruption in the abductors, which is related to the surgical point of entry into the abductor muscle mass, has been also considered as crucial [13].

For these reasons, several modified direct lateral approaches, including various flap designs and suture repair methods, have been proposed. To maintain the flap continuity and reinforce the tendinous junction between the gluteus medius and the vastus, McFarland and Osborne [14] originally advised attachment of some spikes of the bone to the trochanteric periosteum tendon [13]. In a similar way, McLauchlan [9], followed by Dall [15], has proposed greater trochanteric osteotomies with reattachment of bone to bone. However, the device of fixation for reattaching the fragment to the bone can cause potential trochanteric bursitis which may need reoperation. For instance, in using the Dall approach, Learmonth [16] reported a rate of 11 % of reoperation to remove the cerclage wire.

One distinct advantage of the partial anterior trochanteric osteotomy proposed by Ganz is that it preserves the whole gluteus medius and allows a rapid recovery of the abductor power. The nonunion of the fragment can occur but without any functional effect [17].

The minimally invasive approach described in this chapter is different from the other anterolateral exposures in several ways:

- The dissection is minimal.
- Approach to the hip is no vascular.
- Soft tissues connections between the fascia lata and gluteus medius and between the gluteus minimus and capsule are preserved.

- Each and every one of the gluteus muscle (maximus, medius, and minimus) is split in the direction of their fibers. Only the distal part of the insert of the gluteus minimus is detached from the femur.
- The capsular tissue is not excised but incised in the same line as the gluteus minimus is. Thus, at the time of the closure, it can be sutured jointly with the gluteus minimus and reattached back to the femur through osseous sutures.

Sliding of the lateral facet of the greater trochanter gives a number of advantages:

- This surgical approach is technically easy to perform.
- Dissection is minimized with all the soft tissue attachments conserved between the fascia lata and the gluteus medius. The use of thermal cautery to peel off the internal rotators from the greater trochanter is reduced. The internal rotators can be released with preservation of their attachments to the trochanteric fragment.
- Splitting and elevating the gluteus medius-vastus lateralis anterior flap avoid stretching damage to the glutei and/or the tensor fascia muscles.
- The junction of the flap is positively reinforced, especially in the face of a thin gluteal-vastus aponeurosis covering the greater trochanter. Hence, the continuity of the flap can be maintained with the strength of reattachment to the femur possibly increased.
- The risk of vascular injury of the transversal branch of the lateral circumflex artery is decreased. Moreover, the blood supply of the greater trochanter is preserved and the risk of nonunion of the fragment possibly reduced [6].
- The greater trochanter is in full view for femoral rasping and stem insertion. The point of entry into the femur is exposed in direct line of sight and then can be easily unlocked. Through a such approach, the penetration of the wing part of the SL-Plus® stem into the trochanter is not a concern because the partial trochanteric slide osteotomy facilitates the entrance and allows to achieve repeatedly a regular position of the stem in the longitudinal axis of the femur.
- The reattachment of the fragment, when closing, allows regulation for the tension of the internal rotators maintained to the fragment. In our department, a single cerclage wire has been used in over 400 total hip replacements. Several failures of union occurred with no evident functional repercussion. Therefore, no reattachment was required. Conversely, some breakages of the cerclage wire were associated to adverse repercussions needing a reoperation. For this reason, nonabsorbable osseous stitches are now preferred (Ethibon 6).

The learning curve for the modified direct lateral minimally invasive approach is by no means demanding; the technique is not much different than a standard total hip. Neither a specific operating table nor an unusual setting for the surgeon is required. Except for the curved acetabular reamer, conventional instruments are used. Any stem design can be implanted through this approach, but the Zweymüller stem offers the advantage that the stem fixation is unrelated to the level of the femoral neck osteotomy. Moreover, the Woodpecker pneumatic hip broaching system facilitates femoral preparation, sizing, and good primary fixation of the stem.

The hospital stay and the speed of functional recovery in this current report are far from the spectacular results described by Berger with the innovative two-incision technique, but the cohort of patients is different and the rehabilitation protocol has not been altered for this comparative study. Importantly, however, this mini-incision, anterolateral approach was not associated with any increase in the number or type of complications compared to the historic matched control group. Most reports of MIS surgery include an increased incidence of femoral fractures, component malposition, and early reoperation rates. Additionally, the mini-incision lateral approach offered a faster recovery to patients (1 day less in hospital) while reducing the total medical costs since 78.9 % of the patients were discharged directly to home in the mini-incision group versus 60.2 % of the patients in the standard group.

The mini-modified anterolateral approach is applicable to most patients, as demonstrated by our ability to use the approach in 62 % (103/165) of consecutive primary hip operations in this commencing series. For obese patients, the skin incision can easily be extended by 2 cm in each direction to make the exposure easier.

Conclusion

The mini-incision, anterolateral modified approach was found to be as safe as the standard approach while also achieving a shorter length of stay in hospital and a higher rate of discharge to home. We did use neither intraoperative fluoroscopy nor computer guidance, yet the quality of component positioning was not compromised. Sliding of the lateral facet of the greater trochanter minimizes dissection and facilitates implantation of a tapered stem in proper position. By combining a customized small incision size, a careful component positioning, as the use of hard-bearing surfaces demands it, and the famous, fully proven Zweymüller stem, we anticipate long durability of the arthroplasty, in addition to the advances in the early postoperative outcomes that we have documented in this study, compared to our prior surgical approach.

Perspective

This study has initiated at our institution a radical change of perioperative blood management in total joint arthroplasty. Because our results provided no evidence supporting the usefulness of perioperative cell saver system, we decided to stop the use of reinfusion system during primary THR in 2005.

At that moment, any autologous blood transfusion was implemented in our unit as preoperative autologous blood donation was not utilized either.

We replaced autotransfusion systems by a chemoprophylaxis in selected patients to reduce blood losses and transfusion requirements.

This blood-sparing transfusion strategy allowed us to perform a consecutive series of 221 unilateral less invasive THAs without any blood transfusion [18].

Thereafter, we also abandoned the use of wound drain because the volume collected by suction drain was regularly little.

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