Original Article

Two-incisions direct anterior approach for THR: Surgical technique and early outcome

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ABSTRACT

Purpose: In recent times the direct anterior approach for total hip replacement has gained considerable interest among orthopaedic surgeons because of the relative muscle-sparing nature than other surgical approaches. However, critics believe that this approach is associated with steep learning curve and high complication rates, mainly attributed to a more limited exposure to the femur. In order to make femoral access easier and implantation of acetabulum in anatomic plane, we designed a “two incisions anterior approach technique” for total hip replacement. The aim of the present study is to determine safety of this technique with respect to perioperative complications as well as early clinical outcome.

Methods: A retrospective review is carried out on a consecutive series of patients who underwent primary total hip replacement by the single surgeon through the two incisions direct anterior approach from 01/2014 to 11/2014. We analysed peri-operative complications and clinical outcome at two years' follow-up. **Results:** We observed 01(0.9%) intra-operative complication; calcar fracture and 01(0.9%) anterior dislocation in first post-operative week. All patients reported improvement of their symptoms. The mean modified oxford hip score was significantly better from 25(11–37), preoperatively to 46.97(33–48) at mean latest follow-up. The mean modified Merle d'Aubigné-Postel score improved to 16.84(12–18) from 9.25 (4–14) preoperatively.

Conclusion: The described surgical technique is simple and reproducible technique for easier exposure of femur and insertion of acetabulum in anatomic plane for total hip replacement through direct anterior approach. Easier and better femoral access helps to place implant in anatomical position as well as reduces the risk of femoral fracture associated with inadequate femoral exposure. The added advantage of this technique is, risks of injury to lateral femoral cutaneous nerve can be minimised by careful dissection and isolation of the nerve.

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1. Introduction

“Total hip replacement (THR) has proven to be a very effective and reproducible surgical procedure that provides significant improvements in patient mobility, pain relief and quality of life”.¹ Continuous research work is being undertaken in various aspects of THR to further improve the long term functional outcome.

In the past, attempts to improve traditional surgical approaches focused on minimizing the length of the surgical incision. A variety of so-called “minimally invasive surgery” techniques were

developed.^{2–4} As data began to accumulate, it became apparent that length of incision was less important to surgical outcome than disruption of muscles, impairment of soft tissue vascularization and innervations.

Hueter described the anterior approach for hip and has been used by Judet for hip replacement since 1947.⁵ The direct anterior approach (DAA) follows a true intermuscular and inter-neural plane to access the hip joint. In recent times the DAA for THR has gained considerable interest among orthopaedic surgeons because of the relative musclesparing nature than other surgical approaches.

Proponents of this technique believe the potential benefits to be a reduction in soft-tissue trauma,⁶ less perioperative blood loss, less postoperative pain⁷ and earlier hospital discharge. Functional

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recovery is believed to be faster in the early postoperative period with fewer narcotics needed.⁸

However, critics believe that this approach is associated with steep learning curve,⁶ and high complication rates,⁹ mainly attributed to a more limited exposure to the femur.

In order to make femoral access easier the senior author (AN) has designed a “two incisions anterior approach technique” for THR. With this technique two separate incisions are used to access acetabulum and femur.

In this study, we describe the surgical technique for a two incisions direct anterior approach total hip replacement. We also sought to determine safety of this technique with respect to perioperative complications as well as early clinical outcome.

2. Material and methods

A retrospective review is carried out on a consecutive series of patients who underwent primary THR by the senior surgeon (AN) through the two incisions DAA (AN) from 01/2014 to 11/2014, using an existing patient database. Only elective hip replacements without previous hip surgery were included in the study. Indications for surgery included advanced arthritis recalcitrant to conservative measures in the setting of primary osteoarthritis, posttraumatic arthritis, rheumatoid arthritis and avascular necrosis (AVN). For this study, formal consent as well as approval from ethics committee is not required.

Within this period, 104 primary THR procedures were performed for patients with end-stage hip osteoarthritis using the two incisions DAA. The senior author uses the custom made curved femoral stem for all primary THR (Symbios, Yverdon, Switzerland). A fracture table was used in all cases with no intraoperative fluoroscopy. The case notes of these study subjects were reviewed to identify information including patient demographics and perioperative complications.

Clinical outcomes were evaluated using the modified Oxford Hip Score (OHS)¹⁰ and the modified Merle d'Aubigné-Postel score (MAP).¹¹ OHS and MAP scores were collected preoperatively, 6 weeks postoperatively and at two years' follow-up. Standard radiographs of the involved hip were taken at initial consultation and 6 weeks postoperatively. All the patients had pre-op CT scan.

3. Surgical technique

3.1. Pre-operative planning

A preoperative CT scan is being carried out using a specific protocol.¹² CT scan data are analysed with the HIP-PLAN® 3D hip planning software (Symbios, Yverdon, Switzerland). The surgical approach as well as both femoral and acetabular components is planned on the bases of available information from CT-scan.

The proximal vertical incision is planned over anterior aspect of the proximal thigh along the lateral margin of the rectus femoris muscle extending from superior part of the femoral neck to the distal base of the neck. The exact location and size of the incision is measured with reference to Anterior Superior Iliac Spine (ASIS) on the pre-operative CT scan.

The second distal incision is placed once the cup position and orientation has been finalized, as the intersection of the cup axis in both AP and Lateral planes.

3.2. Operative technique

The patient is placed in the supine position on a traction table. Bony landmarks are marked.

The leg is prepared from umbilicus to the knee on the operative side and draped.

3.3. The proximal vertical incision

A vertical incision (Fig. 1) of 5–7 cm in length is made over the anterior aspect of the proximal thigh as per plan. Depending of particular bony and muscular anatomy of the patient, this incision may be medial or lateral to ASIS.

Careful dissection is carried out in the superficial plane to isolate and protect the Lateral Femoral Cutaneous Nerve (LCFN). After isolation of the LCFN, superficial plane is developed between the sartorius and the tensor fascia lata (TFL). The sartorius is retracted medially and the tensor fascia lata is retracted laterally. This exposes the lateral border of the rectus femoris.

The rectus muscle is retracted medially to expose the fascia overlying the lateral circumflex vessels and the femoral capsule. The lateral circumflex vessels are carefully isolated and ligated. The fat pad then is removed off the capsule over the femoral neck. The iliocapsularis muscle is retracted medially to get better exposure of the anterior part of the capsule of the hip joint.

Anterior portion of the capsule is excised from the edge of the acetabulum to the intertrochanteric line. The femoral neck then is observed from the acetabulum to the intertrochanteric line.

Femoral Neck osteotomy is done at desired level. For easier removal of femoral head, a second neck osteotomy is done 1 cm proximal to the first osteotomy.

The small wafer of bone is removed first and then with help of a corkscrew femoral head is removed. Gentle traction is applied on the leg to facilitate the removal of femoral head. Alternatively, a high-speed drill and the destruction-suction of femoral head can be carried out in patients with high muscle mass.

At this stage Charnley's self-retaining retractor is placed to expose acetabulum. The labrum is excised, exposing the entire peripheral bony rim of the acetabulum.

3.4. Distal transverse incision

The proximal vertical incision is placed more anterior and medial to facilitate easier exposure of femur. In order to achieve anatomic acetabular alignment, second incision is placed over anterolateral aspect of proximal thigh.

Second transverse skin incision (Fig. 2) of 1 cm is made about 7–10 cm distal to the distal end of first incision, depending of the orientation of the acetabulum and volume of the thigh. Blunt dissection is carried out and superficial fascia is divided to explore interval between TFL and rectus femoris.

Fig. 1. Proximal vertical incision.

Fig. 2. Distal transverse incision.

Fig. 3. Special instrument used for insertion of acetabular reamer.

3.5. Acetabular preparation

Because the distal incision is very short, instruments for acetabular preparation are inserted separately in the body. Acetabular reamers are inserted through the proximal incision with a special instrument (Fig. 3) while reamer shaft along with powered instrument are inserted through the distal incision. Inside the body, these instruments are coupled and preparation for cup is being carried out in anatomic plane.

After satisfactory preparation, real cup is inserted in similar fashion. Acetabular liner is inserted through the proximal incision and tapped with the device inserted from the distal incision. Now attention can be shifted towards the femoral preparation.

3.6. Femoral preparation

Operated leg is placed in full external rotation to release the capsule from medial side of the remaining neck. Release of the medial capsule allows further external rotation of the leg and aligns the long axis of femoral neck with the skin incision.

Level of the neck cut is re checked at this stage with palpation of lesser trochanter. Gentle longitudinal traction is applied to the leg.

With diathermy, capsule is incised anterior to greater trochanter (GT) along the long axis of the neck.

With the bone hook, femur is pulled anteriorly to bring GT anterior to the acetabulum. Now the traction is released completely, while surgeon pulling the femur forward, the leg is placed in slight hyperextension. These manoeuvres bring the femur forward in to the operating field.

A curved hohmann retractor is placed behind the greater trochanter to leaver the femur further forward. Now the femoral preparation can be done with relative ease.

3.7. Post-operative management

Patients were mobilized on the first postoperative day with weight bearing as tolerated. We recommended the use of crutches for approximately 2 weeks. No postoperative hip precautions were used.

4. Results

There were 104 patients in our study group (men, women) with a mean age of years (range, years). One patient died while rest of the patients were available for follow-up at two years.

Patients demographic details are given in Table 1.

There was one intra-operative femoral fracture (calcar fracture, 0.9%) during broaching of the femoral canal (Table 2). This fracture was treated by cerclage wiring, and went on to uneventful recovery. We did not observe trochanter avulsion fractures, femoral perforation, acetabular or ankle fractures in our series.

One patients (0.9%) had an anterior dislocation of the prosthesis within first week after surgery and underwent a revision surgery to realign the acetabular component in to more closed and less anteverted position. There was neither wound related complication nor femoral nerve injury in our study group.

All patients reported improvement of their symptoms. Functional outcome scores details are shown in Table 3. The mean modified OHS was significantly better from 25(11–37), preoperatively to 46.97(33–48) at mean latest follow-up. The mean modified MAP score improved to 16.84(12–18) from 9.25 (4–14) preoperatively.

5. Discussion

The described study evaluated the two incisions technique for DAA THR, where the femur and acetabulum are approached through different incisions; is safe and reproducible technique with promising short term clinical outcome.

In recent times the DAA for THR has gained considerable interest among orthopaedic surgeons because of the relative muscle-sparing nature than other surgical approaches.

The DDA has been shown to associated with difficulty in delivery of femur in the operative wound.^{13,14} The exposure of the femur becomes even more difficult in strong athletes or patients with high BMI.¹⁵ These difficulties with femoral exposure lead to increased risk of femoral complications i.e. femoral fracture or

Table 1
Patient demographic .

Total number of hips	104
Male/Female	59/45
Mean age	57.8(32.3–81.4)
Mean height	170.12
Mean weight	75.72
Mean BMI	26.07(–18.9–46.7)
Right/Left	58/46

Table 2
Complication.

Complications	Number	Percentage (%)
Intraoperative fracture	01(104)	0.9%
Postoperative infection	00	00
Postoperative dislocation	01(104)	0.9%
Femoral nerve injury	00	00

Table 3
Functional outcome score.

Score	Pre-op	6 weeks' post-op	Two-year post-op
Oxford hip score	25(37–11)	46.17(35–48)	46.97(33–48)
PMA score	9.25 (4–14)	15.89(10–18)	16.84(12–18)

stem malposition.^{16–19} Jewett and Collins reported 2.87% (23/800) of intra operative femoral fractures.²⁰

In such difficult situations, which we come across on regular basis, the technique described above offers an easier exposure of the proximal femur and avoids complications associated with femoral exposure. The incidence of femoral fracture in our series is 0.9% which might be attributed to the described surgical technique, curved design of the stem²¹ and experience of the surgeon (AN).^{19,22,23} We also acknowledge that the number of complications might increase with inclusion of larger cohorts and longer follow-up.

In our opinion placement of proximal incision along the lateral margin of the rectus femoris tendon facilitates the exposure of the femur. The senior author (AN) proposes that the exact position of the incision should not be described as a dogmatic place, based on bony landmark i.e. ASIS or greater trochanter, but rather customized on each patient depending on true muscular anatomy assessed on pre-operative CT scan. The customized proximal approach facilitates femoral exposure, even in patients with high BMI or with strong muscles and avoids complications. In comparison to the standard DAA, the amount of the movements (external rotation and hyper extension) of the leg is far less, as our incision is more medial and anterior.

The overall incidence of dislocation in the setting of primary THR varies widely, ranging from 2 to 5%.^{24–27} Dislocation rates with the direct anterior approaches for THR also vary, ranging from <1 to 3%.^{28–31} In the present study the dislocation rate of 0.9% is comparable to other series of THR. Precise placement of the acetabular explains the low incidence of dislocation in our series.^{32,33} This is because of pre-op 3D planning³⁴ and surgical technique that allows preparation of acetabulum in anatomical plane. The acetabulum is prepared through a second distal incision which is customized independently of the proximal incision over anterolateral aspect of proximal thigh. The second incision offers access to acetabulum in anatomic plane and avoids malposition of the cup associated with minimally invasive THR technique.^{35,36}

Femoral nerve injury in DAA THR occurs mostly during operation due to the use of a retractor or due to traction.^{37,38} We did not observe femoral nerve injury in our case series. The described surgical technique does not require an additional retractor over anterior aspect of acetabulum to retract iliopsoas. In order to avoid traction injury to femoral nerve, we never give traction to the limb in hyperextension position.

Another concern with the use of the DAA is the risk of injury to the LFCN. The incidence of the LFCN injury reported in the literature varied widely, ranging from 0.61% to 67%.^{39,40} Injury to this nerve is not considered a major complication as would be a femoral or sciatic nerve palsy, but it can cause some discomfort for the patients. We believe that damage to the LFCN is mainly

associated with a reversible neurapraxia of the LFCN because of traction rather than an irreversible dissection injury. In the described surgical technique, we always identify, isolate and protect the nerve during the surgery and incidence of the LFCN injury reduces with experience of the surgeon.⁴¹

Jewett and Collins reported high rates (4.6%)²⁰ of post-operative wound complications in their large series. However, in our study group we did not observe wound complication. The DAA THR with classic longitudinal skin incision in the intermuscular plane can be associated with scar widening. However, we have observed that skin incision described in this technique is associated with cosmetically acceptable scar.

All patients reported improvement of their symptoms. The mean modified OHS was significantly better from 25(11–37), preoperatively to 47(33–48) at mean latest follow-up.

The described technique is associated with a poor visualization of anterior column of acetabulum. We compensate this lack of information with a pre-operative 3D planning as well as by feel of the socket while acetabular reaming. In some extreme cases, we do use an endoscope to obtain video-assisted control of different stages of the procedure. The use of a 30° scope offers perfect visualization of anterior acetabular column. Video assisted control is also useful to explore medullary canal before implantation of the stem.

This technique can be used for primary THR; it is not suitable for the situations those demands complex acetabular as well as femoral reconstruction. Different types of femoral implants can be used with the described technique. We commonly use uncemented custommade stems that provide an optimal prediction of implant position and restoration of anatomy.

The weaknesses of this study are its retrospective design, the relatively short follow-up, no control group for comparison and the lack of complete data regarding radiological analysis of component alignment. Moreover, the observational nature of study design has its own inherent shortcomings. Other limitations are related to the small sample size, typical in surgical technique articles. The purpose of the study however, was to report the safety of the new surgical technique, rather than the long-term clinical data and survivorship of the implants.

Despite these limitations, we feel that this study does offer valuable information with regard to this surgical technique. This study is based on non-selected, consecutive, primary total hip replacements performed by a single surgeon.

6. Conclusion

We described a simple and reproducible technique for easier exposure of femur and insertion of acetabulum in anatomic plane for THR through DAA. Easier and better femoral access helps to place implant in anatomical position as well as reduces the risk of femoral fracture associated with inadequate femoral exposure. The added advantage of this technique is, risks of injury to LFCN can be minimised by careful dissection and isolation of the nerve. We have observed that incision placed medial to the Sartorius/TFL interval provide cosmetically better scar than one placed in the interval.

The ethical standard and conflict of interest

All patients gave the informed consent prior being included into the study.

All procedures involving human participants were in accordance with the 1964 Helsinki declaration and its later amendments.

The study was approved by the Institutional Review Board.

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