Introduction

The anterior approach is the most direct route into the hip and has been described by many authors. It was advocated for hip arthroplasties by Smith-Petersen more than 60 years ago and well described by Lowell and Aufranc in 1968 [1–3]. It was shown to be feasible in total hip replacements in the 1970s [4].

We have been using this approach for more than 30 years through a modified shorter Smith-Petersen incision in over 6000 primary and revision hip replacements [5–8]. Even though it is possible in thin patients with small acetabulums to perform the operation through a very short incision (5 cm, with proximal and distal instrument portals), it has always been our belief that the clinical success of the anterior approach is primarily based on the sparing of the major hip muscles, their innervation and their function. The entry into the hip is muscle splitting and through an “internervous line” between the muscles innervated by the femoral and superior gluteal nerves. We think of it as an anterior Muscle Sparing Approach (MSA™) that can be used in all types of patients and could also be called minimally invasive.

The hip capsule is easily exposed and, once excised, allows exposure of the femoral neck and head in their anatomical position. After the removal of the femoral head, the acetabulum is visualized and easily prepared for prosthetic replacement. If properly mobilized and brought up into the wound, the femur is also easily prepared and replaced, but this requires understanding of the muscles, tendons and ligaments that have to be released from the proximal femur. Some specially designed instruments may also be required.

The femoral replacement has been simplified by modular components which do not require major muscle releases and femoral mobilization. The variety of modular components also allows better reconstitution of the patient’s hip anatomy. The body of the prosthesis is inserted through a second proximal incision. The shoulder and neck components are introduced through the main anterior incision and are then affixed in situ to the main portion of the prosthesis.

Techniques

General Exposure and Acetabulum

The patient is in the supine position with a small sand bag or radiolucent rolled towels under the sacrum to slightly tilt the pelvis away from the operating table (Fig. 7.13). The leg is draped free. The iliac crests, the thighs, the patellae, the medial malleoli and the feet are visible or palpable throughout the procedure which facilitates the orientation of the prosthetic components and the estimation of the leg lengths. We frequently perform bilateral hip arthroplasties, and the supine position allows this to be done without repositioning or redraping during the case [9, 10].

The incision is made from a point just distal to the anterior superior iliac spine to what is estimated to be the midpoint of the anterior intertrochanteric line (Fig. 7.14). Its length depends on the patient’s size, the subcutaneous fat and/or the muscle mass. We try to make it as short as possible but will not hesitate to extend it if indicated for proper exposure and component placement.
Even though the skin will stretch slightly, the length of the incision is also dictated by the size of the femoral head that has to be removed, and by the acetabulum that has to be inserted. If indicated, the incision can be extended distally and curved along the lateral thigh down to the knee if necessary in femoral fractures, femoral grafting or other complex shaft procedures [11–13]. If greater acetabular exposure is needed, it can be curved proximally along the anterior border of the iliac crest.

Another advantage of the anterior approach is access to the abdomen. It can be draped free, should there be concern about vascular, intestinal and bladder injuries in complex revisions or acetabular reconstructions. In case of an intra-pelvic or abdominal catastrophe, rapid access to the injured structures may mean the difference between life and death.

Once the subcutaneous fat has been dissected, the tensor fascia lata is identified and split along its anterior margin. The thin strip of muscle and fascia left medially protects the lateral femoral cutaneous nerve and allows better wound closure.

The anterior hip capsule is visualized and the reflected head of the rectus femoris is elevated from the underlying capsule by blunt or sharp dissection (Fig. 7.15). The ascending branch of the lateral femoral circumflex artery is identified and coagulated. The main transverse portion of the lateral circumflex artery and vein is identified and protected if possible. If more exposure is needed, they are transected and controlled by coagulation, clips or ligatures. In the case of resurfacing arthroplasties where the blood supply to the femoral neck and head is critical, these vessels must be protected with maximum care [14].

For many years we have used Cobras as the retractors of choice, but the Omni Tract self-retaining retractor (Arthrot-Tract Retractor System, Omni-Tract Surgical, St. Paul, Minnesota), fixed to the operating table by a rigid post, now gives us better exposure and stabilizes the operative field (Fig. 7.16). The medial blade is
placed behind the reflected head of the rectus, the lateral one between the superior capsule and the tensor fascia lata and the abductors. The blades are then ratcheted and locked in place giving an excellent view of the anterior hip capsule. If properly placed, these blades do not need to be repositioned during the capsular, femoral neck and acetabular phases of the operation and in some cases, depending on the patient's size and/or implant during the entire procedure. This single rigid placement of the retractors decreases the soft-tissue trauma caused by the repetitive placement, and replacement of Cobra retractors definitely decreases intra-operative bleeding and may decrease overall blood loss.

Once exposure has been achieved, a complete anterior capsulectomy is performed. At various times we have tried to perform the acetabular replacement with capsular incisions only, but have abandoned them for the sake of better exposure. A tight contracted anterior capsule can also be a contributing factor to posterior dislocations. There are advocates of capsular incision preservation and repair, but the operation is easier and probably safer with the excisional approach. The excision of the capsule may cause some more bleeding, but the bleeding tissues can be coagulated. Following the capsulectomy, Cobra retractors, when used, are now placed in the capsule with their tips under the femoral neck, but the rigid, well-placed Omni Tract retractor now gives excellent neck exposure without any change in the position of the blades. The leg is placed in a neutral, anatomical position, and the bony landmarks of the proximal femur can be identified by direct visualization or palpation. The cut of the femoral neck is determined by templating the X-rays prior to the operation and can be duplicated with relative ease on the visualized base of the femoral neck without dislocation. In severe deformities and contractures of the hip, a preliminary subcapital osteotomy can be done to place the femur in the anatomical position for the final neck cut. The position of the femoral cut varies, according to the anatomical configurations of each femur, but should be distal enough to allow neutral placement of the prosthesis in the medullary canal. The cut is completed, and the femoral head is removed with a skid and/or corkscrew device. The acetabulum is prepared with large curettes and basket reamers. The true medial wall is exposed in order to fully medialize the acetabular prosthesis and to recreate as much as possible the patient's normal center of rotation.

If the patient is large and bulky, it may be necessary to extend the incision distally or to retrograde standard straight acetabular reamers through a distal stab wound in order to get the desired 40–45° varus/valgus acetabular angle and the 15–20° of anteversion. The basket reamer and acetabular prosthesis can be attached in the main incision after inserting the shaft through the distal stab wound (Fig. 7.17). A dog-leg acetabular reamer may obviate the need for this particular step, but the stab wounds have been helpful and facilitated this surgery in patients as large as 450 lbs. Our experience and results in
obese patients have been excellent, and we do not hesitate to perform total hip arthroplasty in these weight-challenged individuals [15]. The acetabular preparation and insertion is relatively easy since it is done under direct vision.

For non-cemented prostheses the bony acetabulum is usually underreamed by 2 mm. It is over-reamed by 2-3 mm to achieve an even cement mantle in the cemented ones. The non-cemented metal acetabulums or shells are impacted into the bone, and in the majority of cases are stable without additional dome screws. The ceramic or polyethylene liners are then placed in the metal shells. Standard techniques are used to cement an all-polyethylene prosthesis if needed. All acetabular osteophytes are removed to allow maximum motion and to remove any possible fulcrum points that may contribute to post-operative dislocations. The posterior medial osteophytes must be handled with special care due to their proximity to the sciatic nerve.

The acetabular angles are determined by looking at the pre-operative X-rays, by examining the acetabulum, by palpating the iliac crests and by visualizing the position of the entire leg in its relationship to the acetabulum and pelvis. There are advocates of fluoroscopy or navigational systems to determine exact acetabular angles, and this is easily applied in this supine position on a radiolucent table, but with experience such aids may not be necessary and we have only used them rarely for teaching purposes.

Femoral Monoblock Prosthesis

Mobilization and exposure of the proximal femur is imperative for the safe and proper insertion of the monoblock femoral component. It is achieved in a step-wise manner.

The lateral blade of the Omni Tract retractor can be left in place or adjusted for modular femoral components, but in most monoblock prostheses it is removed and the leg is placed in external rotation. In thin and loose hips it may be possible to deliver the proximal femur in the anterior wound by using a bone hook placed around the lesser trochanter. Next, a pointed cobra-like trochanteric retractor or one of the long-handled straight or slightly curved ribbon retractors can be placed under the greater trochanter to lever the femur into an accessible position.

If femoral mobilization is difficult, a partial or complete posterior capsulectomy can be done. If necessary, the external rotators can be released from their insertion in the trochanteric fossa. The piriformis tendon can also be transected. The foot of the operating table can be dropped to extend the femur. There are recent advocates of the anterior approach who routinely do their total hip replacements on a "fracture table" that allows distraction and extension of the leg for access to the proximal femur, but we have performed our more than 6000 total hip replacements on regular operating tables. As a last resort, a trochanteric "fold-back" or "slide" osteotomy is possible, but this has been rarely necessary in the past 10 years [16]. A release or Z-plasty of the iliopsoas is another extreme step to achieve femoral exposure in complex primary or revision cases. The last two steps have been rare in our hands. In most cases, a partial release of the posterior capsule and short external rotators from the greater trochanter, as the femur is externally rotated and levered or pulled up into the wound, has been sufficient. We have never repaired these posterior releases and continue to have excellent functional results and a low dislocation rate of 1.3% in a consecutive series of 2132 primary total hips. During these soft-tissue releases the posterior circumflex vessels must be controlled, if at all possible, prior to their transection. If the capsule and rotator tendons are cut slowly, the vessels are easily visualized and coagulated. If they retract, the process is somewhat more difficult and may require traction on the leg for exposure of the bleeding vessels. The sciatic nerve is medial and posterior to the area of the tendon releases and has not been a problem.

Once the femur is mobilized and exposed, it is rasped to accept the prosthesis to be used. Curved anterior "Keggi" rasps facilitate this procedure (Fig. 7.18a). These rasps have been available through several orthopedic manufacturers (Howmedica, Zimmer, Smith-Nephew-Richards). In non-cemented devices where precise reaming of the femoral canal is required, the reamers are passed through a proximal stab wound or "second incision" (Fig. 7.18b). This stab wound or second incision is in line with the greater trochanter and the long axis of the femur close to the iliac crest. It cannot be posterior since a posterior incision can misguide the reamers, broaches and implants to the sciatic nerve. The reamer is inserted through the thin triangular fascia between the posterior proximal portion of the tensor fascia lata and superior border of the gluteus maximus muscles. It then
passes lateral to the medius and minimus, anterior medial to the maximus and posterior to the tensor fascia lata muscles. It is once more in an "internervous" line between the superior and inferior gluteal nerves. It passes through the greater trochanteric insertion of the gluteus medius or between the medius and the piriformis on its way into the proximal femur.

After the preliminary reaming of the medullary canal, the bent anterior hip rasp can be used to complete the femoral preparation through the main incision. Straight rasps with long handles are also available for preparation of the femur through the stab wound or second incision described above. Even though it is possible to insert the monoblock prosthesis through the second proximal incision, our preference is to mobilize the femur and to insert the prosthesis through the main incision when using nonmodular systems. If the various releases described previously are not sufficient to insert the femoral component, a release of the tensor fascia lata from its origin along the anterior portion of the iliac crest is done, but this has rarely been necessary. Both non-cemented and cemented devices can be used (Fig. 7.19).
Chapter 7.3 - The Direct Anterior Approach

We seek neutral anteversion of the neck and use trial heads to determine the final head height. Leg lengths are assessed by palpation of the iliac crests, patellas and medial malleoli. In less than 5% of our cases there may be a minor leg-length discrepancy (1.5 cm or less). As a rule, we are more concerned about hip stability than a minor leg-length discrepancy.

Pre-operative implant selection may be necessary to reproduce the patient’s anatomy and hip stability without leg lengthening. In the past 10 years there has been a greater variety of monoblock prostheses to accommodate individual femurs, but the process becomes easier with modular hips that allow greater range of neck shaft angles, varus, valgus offset, etc. The stability of the hip is tested with trial prostheses and again at the end of the operation with the permanent components.

On occasion, since the late 1980’s we have passed monoblock prostheses through the proximal incision, but our experience with this method has not been positive since the neck and/or collar of the devices tend to get caught in the abductor muscles. It has been easier with a press-fit collarless stem (Zweymuller), but we have had some tense moments with some of the cemented monoblock implants that have to pass through the muscles as the intramedullary cement is starting to set. For monoblock femoral prostheses we prefer the insertion through the main anterior incision with an appropriate posterior capsular release to mobilize the femur.

Femoral Modular Stems

Even though we continue to use some monoblock prostheses, since 2002 the majority of our hip replacements have been done with modular femoral components. The primary reasons for this have been the ease of their insertion and the variety of proximal neck configurations that provide for the more accurate reconstruction of the proximal femur, soft-tissue balancing, and leg-length adjustment.

We have been using three different devices of this type (Apex Modular™ Cementless Stem, OTI R-120™ and Cremascoli-Wright Medical™).

The body or intra-femoral portion of these devices is inserted into the femur after appropriate reaming and broaching through the proximal (second) incision. The femoral preparation and the insertion of the component itself does not require the extensive soft-tissue releases necessary for the safe insertion of the monoblock prosthesis. The posterior circumflex vessels do not present a problem. Even though trial components are available, the modularity of the proximal portion of the prosthesis makes them unnecessary in most cases.

The proximal component or shoulder and neck of these implants has to be small enough for insertion into the body of the femoral portion through the anterior incision (Fig. 7.20). Two of our implants (OTI R-120™ and the Cremascoli-Wright Medical™) are simply femoral necks and are easy to insert into the femoral stems. The Apex Modular™ device is the shoulder and neck of the prosthesis and is somewhat more difficult to assemble, but it has extremely solid fixation to the body of the prosthesis and a variety of neck configurations.

It is the variety of neck configurations of all of these prostheses that allows better reconstruction of the patient’s femoral anatomy. Varus, valgus, anteversion and retroversion can be dealt with, and this has the potential of a better clinical result.

The modular femoral components made the anterior approach to hip replacement safer and easier to teach. The modularity also allows for the salvaging of femoral components inserted with improper version. If the femoral component is in excessive retroversion, the neck can be inserted in anteversion, creating a neutral acceptable position.

Fig. 7.20. Modular prosthesis designs facilitate minimal incisions by reaming and then inserting femoral stem components through the proximal stab wound. These systems also allow a greater range of neck shaft angles, varus, valgus, offset and leg lengths than traditional monoblock femoral components.
The other major advantage of the modular femoral components is that the neck can be removed if it should be necessary to reposition the acetabulum during the primary procedure, or to revise it secondarily if there should be a failure of the device. With the neck component out of the way, the acetabular revision is easier and does not necessitate the removal of the entire femoral component. After the acetabular revision, a different neck may be necessary and can be used without problems.

### Conclusions

The anterior approach for total hip replacement is done with the patient in a supine anatomical position which allows better orientation of the prosthetic components. It is also a physiological approach since it accesses the hip through internervous planes and spares the major muscles. Finally it can be done in all patients with incisions short enough or long enough to achieve proper implant position without major complications. It can be as short as 5 cm but more often is 6–10 cm in length with or without proximal and distal accessory incisions or stab wounds for acetabular and femoral preparation.

The acetabular insertion is simple and the femoral portion of the operation has been simplified by modular components inserted through a second incision. With proximal and distal extensions of the incision, it can be used in all revisions, with the additional advantage that anterior revision surgery avoids significant scar tissue and the sciatic nerve.

A recent analysis of 2132 of our consecutive primary hips done through this approach revealed low rates of intra and peri-operative complications, short operative times, low blood loss and a few dislocations [6, 7]. We also reviewed 468 consecutive revision arthroplasties with few complications [8]. We continue to use this adaptable approach for all primary and revision hip arthroplasties as well as hemiarthroplasties for hip fractures. If properly performed, the anterior approach is physiological, muscle sparing and minimally invasive.

### References