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TECHNIQUE

TOTAL HIP ARTHROPLASTY THROUGH AN ANTERIOR HUETER MINIMALLY INVASIVE APPROACH

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Introduction

This approach was introduced by Robert Judet ^[1] nearly fifty years ago and was derived from the Hueter approach ^[2]. It usually requires an orthopaedic table or an extension system that can transform a regular table. It is highly anatomical because it preserves the peri-articular muscles and is one of the preferred approaches for a prosthetic implantation according to a minimally invasive protocol ^[3,4].

Standard operative technique

Orthopaedic table

The use of an orthopaedic table is recommended since

this tool greatly facilitates the surgical act. It constitutes a worthwhile alternative to operative assistance and allows the most efficient exposure of both the acetabulum and the femur. The intervention may go without this table but in this event, it will be utilising retractors that are far more aggressive towards the skin and muscles and the assistance of one or two persons will be necessary ^[5].

The orthopaedic extension table should allow the hip to be moved in the flexion-extension plane, in the abduction-adduction plane, and around the rotation axis.

We developed a special extension table that can be affixed to nearly any kind of table and give the surgeon all the possibilities of a classic Judet table ^[2]. With this new extension device it is impossible to put the leg in

hyperextension with traction at the same time. With the traditional Judet table this is possible and could damage the femoral nerve.

Patient positioning

The surgical team consists in at least the surgeon, scrub assistant, and a non-sterile table operator (usually the non sterile nurse).

The patient can wear support socks (stockings) or dynamic systems to avoid venous stasis during the operation. The patient is positioned supine with a perineal support. This perineal support must have a diameter of about 10 cm and whenever possible it should be coated with a gel so as to protect the perineum. The foot on the operative side is secured in its orthopaedic boot, then light traction is applied to the lower limbs, so that the pel-

vis is balanced and horizontal. The upper limb ipsilateral to the operated hip is placed on the chest and stabilized with adhesive tape, or put on a support.

Operative field preparation

First an instrument shelf is fastened to the table, so that the surgeon has the instruments in front of him or her. After the operative site has been washed according to the recommended protocols and painted twice with iodine solution, translucent adhesive drapes are used to define the operative area including the anterior superior iliac spine, the anterior half of the iliac crest, the anterolateral aspect of the thigh, and ending four fingerbreadths above the patella. Translucent draping will allow the surgeon to check the movement of the lower limb.

Skin incision

The incision is about 5 to 8 cm long. It is one inch lateral to the external edge of the anterior superior iliac spine, and runs obliquely downwards and slightly outwards towards the middle of the external condyle. Usually the incision is centred on a vertical line passing over the superior part of the greater trochanter.

Intermuscular approach

After haemostasis of the subcutaneous tissue, the sheath of the tensor fascia lata is identified. This sheath is incised longitudinally at a slight slant downwards and outwards. The surgeon is guided towards the space between the tensor and sartorius, sparing the sheath of the sartorius in order not to injure the femoral cutaneous nerve, the gluteal branch of which is most often severed, which is not an inconvenience.

Then the intermuscular space is approached with scissor tips. Special Beckmann retractors are put into place. Splitting this space reveals the superficial aponeurosis of the rectus femoris. This aponeurosis is incised longitudinally, the muscle body is retracted medially to expose the deep aponeurosis. After haemostasis of a small arteriole from the anterior circumflex pedicle, the deep aponeurosis is opened with the knife, then the circumflex pedicle is lifted up with a Lambotte raspatory, dissected and ligated. At the beginning of the learning curve or in very dysplastic acetabulum it is useful to cut the reflected pars

of the rectus. In this case, the tendon is placed on bridge forceps and cut with electrocutter. The last muscular plane before the capsular approach consists of the iliocapsularis muscle. In some varus hips this muscle may cover the capsule and it may be necessary to separate the muscle from the capsule. This is done following a curve from the anterior edge of the hip bone to the lower edge of the femoral neck. It crosses an arteriole which should be coagulated. Using the Lambotte raspatory the deep aspect of the iliopsoas is separated from the anterior side of the capsule; up and outwards, they are fibrous bundles which can be cut with the knife (Fig. 1).

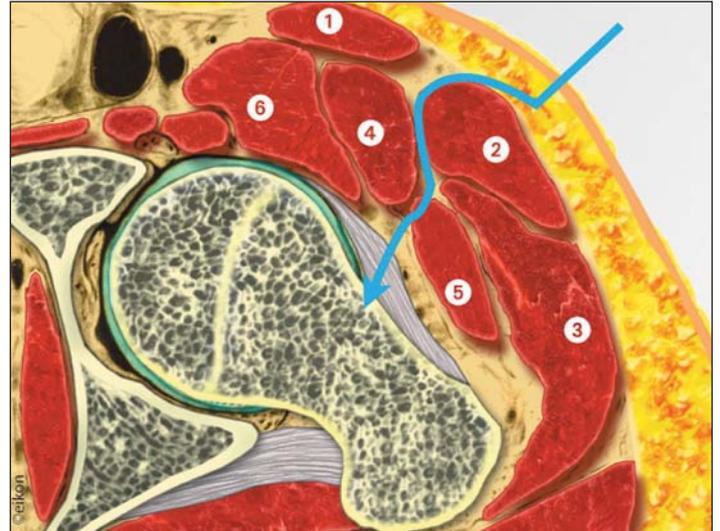


Figure 1 : Abord intermusculaire

1. Sartorius - 2. Fasciae latae tensor - 3. Vastus lateralis - 4. Rectus femoris - 5. Gluteus minimus - 6. iliopsoas

In almost all cases it is not necessary to do such an incision and we think that it is preferable to leave the iliocapsularis muscle attached to the capsule.

It seems useful to us to remove a sort of fat pad placed just in front of the capsule. By removing this small zone of fat, one sees the capsule better and its lower

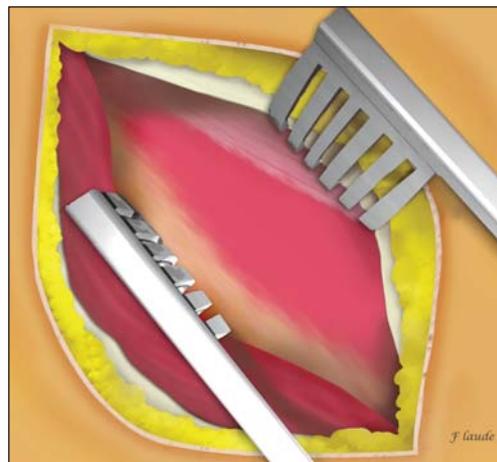


Figure 2a

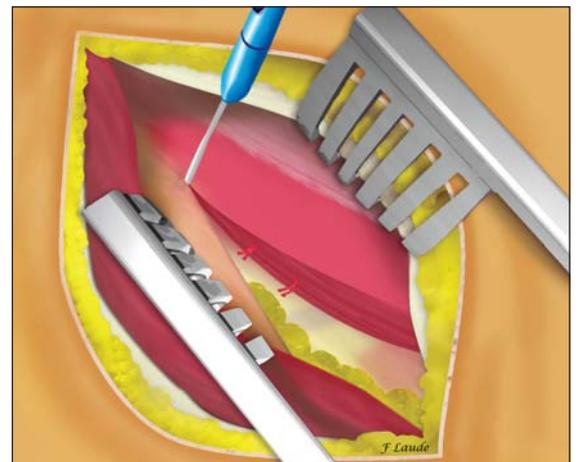


Figure 2b

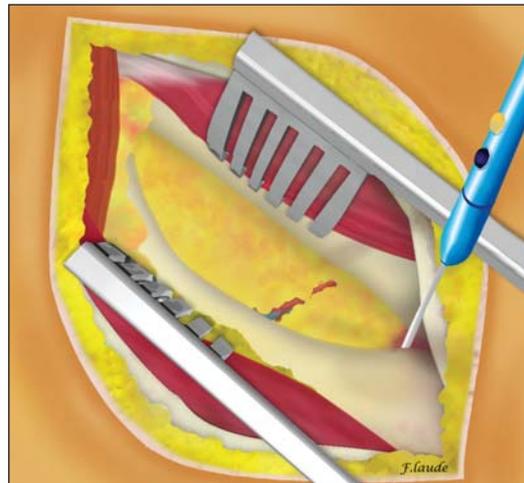


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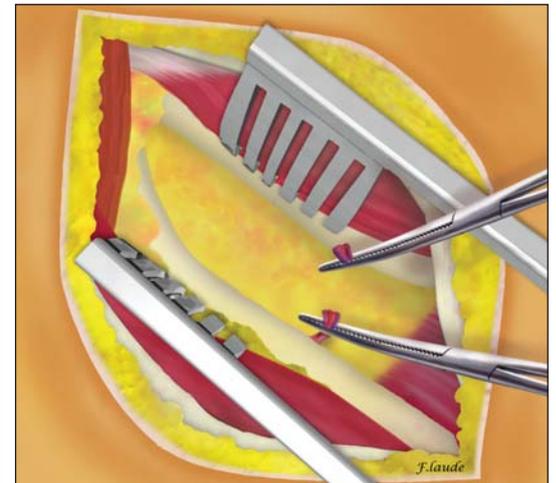


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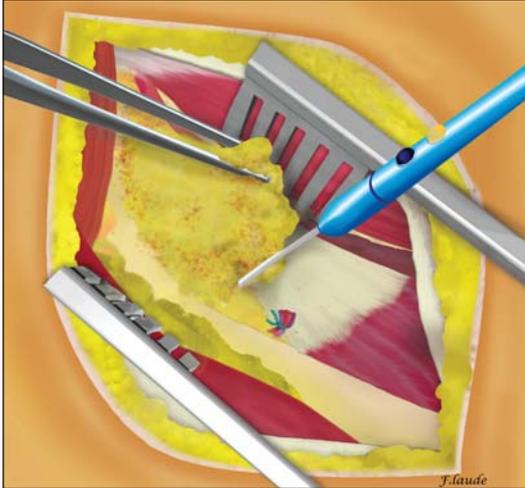


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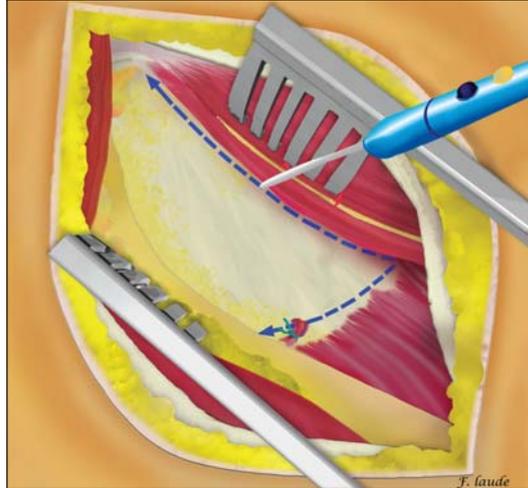


Figure 2f

insertion just above the insertion of vastus lateralis. The localisation of the upper insertion of the vastus lateralis muscle is essential since it corresponds with two important anatomic structures: the capsule of which the anterior lower insertion is located at the place where the upper fibres of the vastus lateralis are inserted. By locating these fibres, one may clearly view the area of insertion of the capsule which must be detached from the femur. Finally, the anterior, lateral, upper insertion of vastus lateralis fibres allows finding the tendon of the small gluteal muscle, if necessary. Precise knowledge of the place where the fibres of the small gluteal muscle are inserted is important since there is a risk of lesion associated with the capsule detachment.

Articular approach

This involves either an anterior capsulectomy, or a capsulotomy. It is possible and probably better to conserve the whole capsule and to close it at the end. If one decides to keep the capsule, the best way is to open it along the lateral border of the iliocapsularis from the acetabulum to the inferior insertion and then to do a

desinsertion of the lower capsulae following the anterior intertrochanteric line just above the superior insertion of the vastus lateralis. The detached lateral flap may be held with a traction suture. It is also possible to improve the view of the acetabulum by detaching the superior capsule along the border of the acetabulum, just over the labrum by a few centimetres.

This allows clear visualisation of the anterior intertrochanteric line and the cervicotrochanteric junction.

Therefore, capsule insertions will be preserved at the acetabular level whereas they will be preferably detached from the femur. At the posterior part of the femoral neck, the joint capsule is quite free. The front part of the capsule, on the contrary, is very thick and there are 3 Z-shaped capsule reinforcements, the role of which is to be stretched for an external rotation/extension so as to increase the hip coaptation. From top to bottom, these 3 reinforcements are the following :

The upper bundle or the ilio-pre-trochanteric bundle that is inserted into the upper part of the acetabulum and from the outside

heads obliquely for the antero-external base of the femoral neck, just inside the insertion of the gluteal small muscle on the pre-trochanteric tubercle. It is the strongest of the three ligaments.

The lower bundle or the ilio-pre-trochanteric bundle is inserted into the acetabulum just beneath the ilio-pre-trochanteric bundle and then, quite vertically, it heads for the anterior part of the calcar, on the femur. It goes along the ilio-capsular muscle and generally, it is incised for capsule opening.

The pubio-femoral ligament is inserted at the acetabulum-pubis junction and it goes downwards, from the outside, towards the calcar.

At the level of the upper and lower parts of the capsule, there is a fourth reinforcement: the ischio-femoral bundle which is inserted in the posterior edge of the acetabulum and goes towards the femur at the upper edge of the femoral neck just ahead the piriformis tendon with which it shares the same general direction. It curbs the internal rotation. It may be retracted in case of osteoarthritis with impaired external rotation.

The knowledge of the anatomy of these four capsule bundles is important because their sequential detachment will allow extraction and externalisation of the femur during the femoral preparation (Fig. 2).

The cutting of the pubo-femoral bundle favours the implementation of an external rotation since the ilio-pre-trochanteric bundle detachment facilitates external rotation and femur externalisation. In case the greater trochanter overhangs the femoral neck significantly, such as in severe coxa vara or in osteochondritis sequelae, the non detachment of the ischio-femoral bundle may result in bundle winding

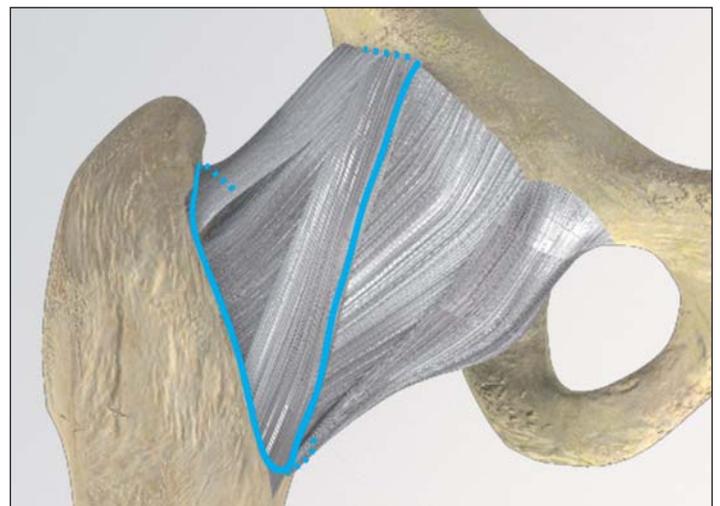


Figure 2g : Capsule incision

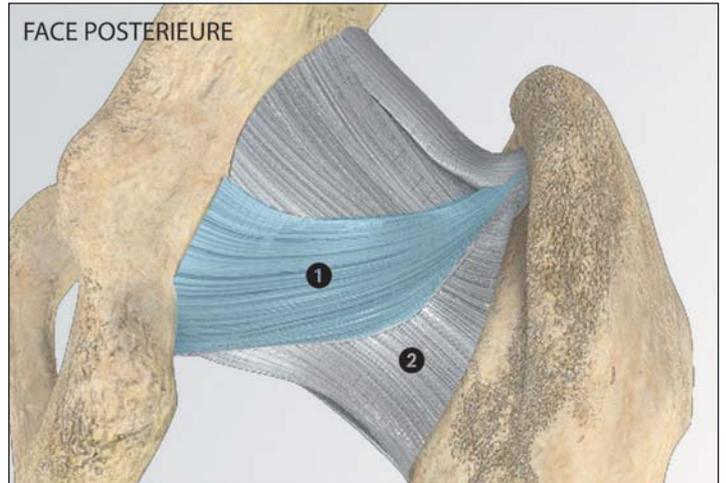
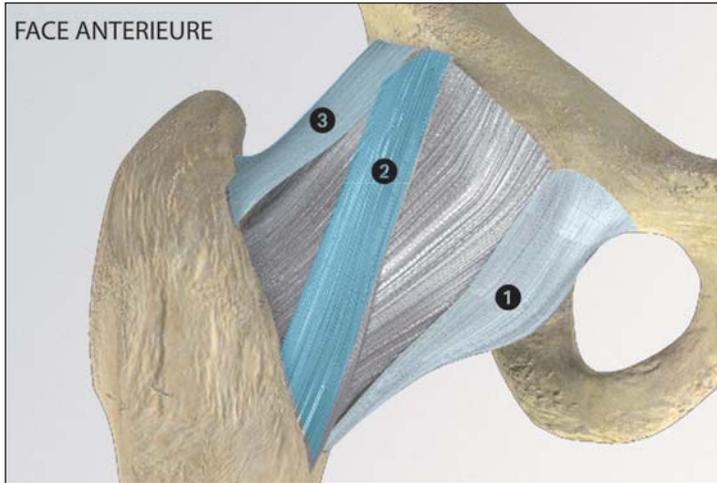


Figure 3a : Anterior view of the capsule. 1. Pubofemoral Lig. - 2. Inf. iliofemoral lig. - 3. Sup. iliofemoral lig.
Figure 3b : Posterior view of the capsule. 1. Ischiofemoral lig. - 2. Ischiocapsula lig.

around the trochanter at the moment of external rotation initiation and in the “down fixation” of the femur which will make its preparation hazardous (Fig. 3).

Femoral neck cutting

After capsulotomy, it is possible to place a special modified Charnley retractor on the capsule (Fig. 4). The modified Charnley is very aggressive and should only be placed against the capsule. The longer arm of the retractor is put inside the medial capsule and firmly pressed against this strong connective tissue. The assistant holds the retractor in that position, then the surgeon places the second arm

of the retractor on the lateral capsular flap and fixes it with a lot of pressure on the Charnley frame. The two valves of the retractor are sharp and may only be placed on the capsule. If the retractor slides and touches the muscle, it may damage delicate anatomical structures.

The cutting level is identified basically with reference to the cervicotrochanteric angle from the preoperative drawing. Before cutting the neck, using an oscillating saw, the position of the lower limb should be checked by palpating the patella.

At the level of the junction: vastus lateralis upper insertion / lower capsule inser-

tion; there is a little depression ahead of the pre-trochanteric tubercle, which is an excellent bench mark for the femoral neck osteotomy (Fig 5). A cutting initiated at this level is always perfect. For the protection of the posterior capsule and gluteal muscles, a large pad is placed using a rugine on the upper part of the femoral neck. This large pad placed behind the neck protects the vessels of the posterior capsule from the oscillating saw.

The haemostasis of a branch of the circumflex artery, posterior at this place, is uneasy and it is preferable to avoid this act. It may be important to recall the fact

that the posterior circumflex artery reaches the femoral neck after passing the deep and lateral faces of the obturator externus tendon. Then, it is divided into 4 or 5 small branches that penetrate the femoral neck at its latero-posterior face. These arterioles are generally supported by a small connective (?) lamina which may be well individualized when the upper part of the femoral neck is visualized. Logically, they should be preventively coagulated prior to neck cutting. After it has been cut, using the oscillating saw at the cervicotrochanteric junction, the head and neck can be extracted using a corkscrew. It is recommended to put 45° of external rotation and small traction with the extension table. This will open and present the osteotomy line. Usually before the extraction of the femoral head, in some cases, one must cut the posterior capsule which may be still attached to the femoral neck.

The cutting plane can be checked using a second landmark, which is the lesser trochanter. Most often, there is a small fingerbreadth between its base and the cutting plane.

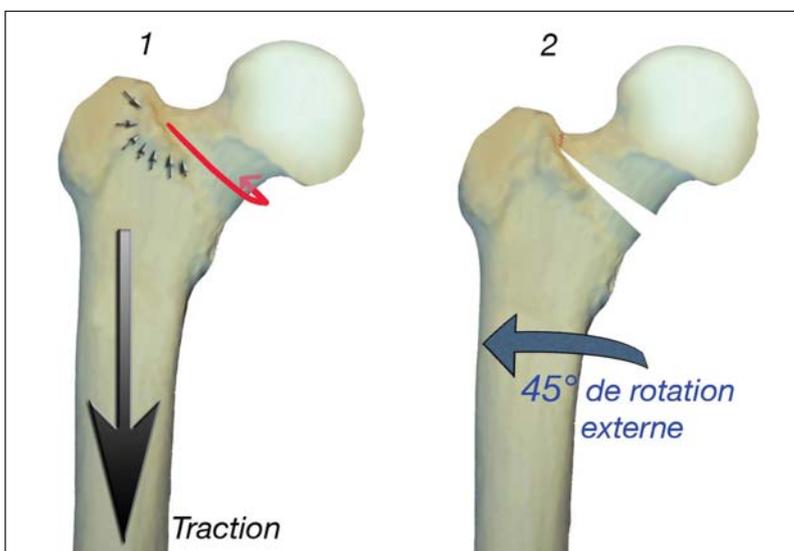


Figure 4 : Femoral neck cutting - the pretrochanteric tubercle is located (small arrows). Only calcar is cut with the oscillating saw. Traction will break automatically the superior aspect of the neck. The foot is placed in a 45° external rotation position in order to mobilize the femoral head.

Acetabular preparation

First, the Extension Table is adjusted so that the lower limb is slightly upward-sloping. The lower limb is already 45° externally rotated since the extraction of the femoral head. This position relaxes the iliopsoas.

If the modified Charnley retractor is well positioned, the acetabular rim is visible or palpated around its entire circumference. If the anterior wall of the acetabulum is still difficult to visualize, it is possible to place an Homann retractor at the bottom of the anterior inferior iliac spine. The whole articular crescent should be seen. The labrum and round ligament are excised, the fossa is identified, and the transverse ligament may be cut.

The reaming operation can be initiated. A circular reamer, which is indispensable, is easily inserted into the acetabulum; a bayonet holder can be used to avoid any conflict with the distal end of the incision, which would damage the teguments, and a lever effect which would result in excessive reaming of the anterior wall of the acetabulum. It is possible to place inside the acetabular a free circular reamer alone and only afterwards clip the reamer handle inside the joint on to the reamer. If the hole is narrow, this will allow placement of the reamer head without the handle. It will benefit the soft tissue. In the same way, one can remove the two components: first the handle after unclipping it, then the circular reamer with a strong grip.

As usual, the reaming operation should preserve the



Figure 5 : A special modified Charnley retractor is placed against the capsula. Its jaws get into the capsula. It stays during the whole acetabular and femoral step.

subchondral bone and, if some areas appear insufficiently abraded, it is better to make them bleed using an aggressive curette rather than reaming excessively with a risk of implanting an acetabular cup on too cancellous bone. After the acetabulum has been prepared, and the horns preserved and freshened close to the acetabular fossa, a trial cup is inserted, with the understanding that, through this approach, and especially in minimally invasive protocols, care should be taken to avoid implant verticalization or excessive anteversion. The implant should be under the acetabular rim in order not to cause conflict with the psoas. The final acetabular component is impacted, and a pull-out test is performed. The acetabular insert is placed. In fact, the retention of the posterior capsule makes posterior dislocation nearly impossible.

Femoral preparation

Adequate acetabular preparation consists generally in

selective detachment of the joint capsule at the level of femoral insertions. It is definitely not useful to perform large anterior capsulectomy, supposedly because this would facilitate the femur mobilisation. As exposed above, 3 insertions link the femur to the capsule. Detaching the two anterior (upper and lower) insertions makes the femoral external rotation easier. An inadequate detachment may result in an external rotation less than 90°. The detachment of the upper ilio-femoral bundle of Bertin's ligament allows upward externalisation of the femur whereas the detachment of the pubo-femoral bundle allows its lateralisation. Cutting this lower bundle makes visible the calcar which may be utilized as a mark to calculate the prosthesis length. The capsular ischio-femoral bundle must not be cut systematically. It has to be cut only in case the femur cannot be externalised and does not allow catheterization of the femoral medullary channel.

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The extension table should be adjusted. First cautiously rotate the boot externally up to more than 90°. At this time it is possible to add some traction to place a Homann retractor on the top of the greater trochanter between the insertion of the gluteus minimus and the gluteus medius and just over the insertion of the piriformis. This Homann retractor is useful because it protects both the skin and the tensor muscle of the fascia lata from the femoral rasps aggressiveness. Usually, this retractor needs very little pressure and in most cases the assistant holds it on one finger only.

Then, it is necessary to release all traction in order not to stretch the crural nerve, and lower the arm of the extension table to the floor and under the contralateral lower limb. Now the femoral neck cutting plane is horizontal. A Homann retractor is placed on the posterior side of the femoral neck for lateralization medial to the insertion of the obturator externus.

Femoral preparation first involves opening the medullary channel using a starter rasp.

A flexible aspirator is used to palpate the cortical bones with a suction noise. The femoral preparation continues with the removal of cortical bone along the inner part of the greater trochanter. Modern prostheses often have a large shoulder and to avoid conflicts with the greater trochanter, it is preferable to remove that bone with the curette or with the gouge.

At this stage, rasps suited to the chosen implant, which should not have any tro-

chanteric wing, are inserted sequentially. Here again, we recommend the use of a straight broach handle to avoid any conflict with the tensor fascia lata. Each rasp should be inserted as deep as possible, flush with the femoral cutting plane.

This preparation is considered completed when the last inserted rasp reaches the preoperatively planned level, the basic landmark being palpation of the lesser trochanter. The absence of risk of posterior dislocation should not cause the surgeon to modify the physiological anteversion of the femur. After the stem has been inserted, a femoral head is selected. Its height depends on the implant position with reference to the preoperative drawing. It is also possible to compare the final stem with the natural femoral head to improve precision. Knowing that, with some experience in this approach, there is no need to perform tests at the end of the operation.

Reduction

This is performed by returning the lower limb into the slightly upward-sloping plane, applying relatively strong axial traction, especially for a minimally invasive technique. Finally, gentle internal rotation is associated with the usual push on the prosthetic head. After reduction, traction should be released, the patella should be facing upwards and the version of the prosthetic system should be analysed.

Closure

Closure is preceded by careful haemostasis. Light bleeding often occurs on the anterior side of the posterior capsule. After thorough



figure 6 : A pneumatic arm maintains a homann retractor. The surgery can be made alone.

washing, a suction drain is put into place for one or two days. This closure is performed in four layers including capsule, tensor fascia lata aponeurosis suturing, a subcutaneous plane and a cutaneous plane.

Postoperative care includes heparinotherapy for 21 days and prophylactic antibiotic therapy for 24 hours, raising the foot of the bed with the knee in slight flexion and the patella up. Re-education involves getting up the day after the operation. Patients decide for themselves if they will use crutches to balance their first steps. Most of them will not use them after 8 days. Exercising the gluteal muscles which have not been affected by the approach is possible immediately.

Results

For several years we have been using this technique in our department, with various implants. In this study, we have reviewed a homogeneous series of 83 consecutive patients having undergone this surgery between 1st January 2005 and 30th September 2005. In all

cases, we have used an uncemented femoral stem Quadra, and an uncemented Pressfit acetabulum Versafit (Medacta). In patients less than 70 years of age, a ceramic-on-ceramic combination was used as a matter of principle^[6]. Beyond 70 years of age, a double mobility ceramic-on-polyethylene combination is preferable. In one female patient, a Pressfit acetabulum displayed perioperatively an insufficient stability and was replaced by a cemented implant.

All patients having necessitated a primary arthroplasty have been operated using this technique, whatever their height, weight, or musculature. In two patients, posterior access was required since they had already experienced this access in a previous intervention. In one of them some material was to be removed and in the other there was a femoral malunion; it appeared reasonable to re-utilize the same access. In a female patient with pseudo-arthritis of the femoral neck, a trochanterotomy was performed. After exclusion of these three patients from the series, there were 80 patients in this series.

All Patients were admitted the day before the surgical intervention. None of them underwent autotransfusion. The cell saver is systematically utilized, at the request of the anaesthetists. In about 40% of the patients, the amount of re-infused product is less than 100 cc, the mean duration of an intervention is 55 minutes (40-80). Eight patients had no postoperative drainage. No patient necessitated a transfusion. It was not easy to calculate the mean blood loss per patient because several patients left the hospital after two days and our results were biased due to insufficient data. Among the 35 analyzed cases (patients with a hospital stay of at least 5 days), the mean loss of haemoglobin was about 3g. A sural phlebitis was systematically discovered the fourth postoperative day.

One patient was re-operated after 5 days due to a non tolerated difference of less than 1 cm in prosthesis length, despite the fact that she had been walking since the second day without a walking stick. She was discharged 3 days after the re-intervention. Another had a difference of 5 to 10 mm. This patient was naturally longer at the operated side. She had a very narrow femur and the smallest prosthesis with a billet "minus 3.5" resulted, although a quite well tolerated lengthening corrected by a heel pad. All the other 78 patients had no differences in length exceeding 5 mm. In this series no significant stem impaction was observed. In two patients, a partial calcar fracture occurred preoperatively, at the time of prosthesis impaction. In these

two cases, the fissure synthesis was performed using a 3.5 mm lagscrew. The cement-free prosthesis was replaced and impacted as usually and the standard protocol was pursued unchanged.

Analyzing the durations of hospital stay is uneasy because since the 1st March 2005, the minimum hospital stay for a hip arthroplasty is 6 nights. According to figures of 2004, when this law was not yet in effect, 45% of the patients were discharged at D2, 27% at D3, and 28% between D4 and D10. About 15% of the patients go to rehabilitation centres. Three of our patients meant to be referred to such centres chose to go back home between D6 and D8 since their condition was compatible with normal home living. Thirty-five patients were able to walk adequately without a walking stick at the time of hospital discharge.

The patients were re-examined 3 weeks after the intervention. Three patients necessitated 2 walking sticks; they were referred to a rehabilitation centre where the physician recommended them to keep the sticks for walking. Twenty patients were still utilizing one walking stick for practical reasons. Generally, they stop this use at this moment. At the M3 visit, no patient was still using any stick in relation with the operated hip. The PMA (??) score at M3 was 18 in more than 93% of the patients.

No dislocation was observed in this series. X-ray images were analyzed at M3 for an assessment of the implantation quality. In only 1 case, there was a

varus stem of 5. In all other cases, the stem was well centred, in full-face and in profile views. In 90% of the cases, the acetabulum was placed in an ideal manner. In 1 case it was too horizontal and in 8 patients it was too vertical. In 2 out of these 8 cases, the slope in the frontal plane is of 55. These vertical acetabuli occurred in obese patients, the first part of the year, when we had no acetabular support tailored at the scar size. The use of an ancillary adapted for acetabular impaction has almost completely ruled out this problem in the subsequent period of the study.

In a preceding series reported at the Sofcot 2004, we had more frequent varus stems (15%). At this time, the tool utilised for the femur preparation was a rasp for posterior access. The availability of a right rasp support handle, more suitable for such access, should theoretically solve this problem.

Conclusion

This arthroplasty technique is inherently minimally invasive, which reduces the frequency of potential local complications. More generally, the rate of vein thromboses is reduced because blood flow is not interrupted during the operation. Lastly, transfusion becomes exceptional. Recovery is fast, and in our experience, 50% of the patients can be discharged from the hospital after 2 days. The risk of dislocation is minimal and the post operative limitation of movements, usually prescribed in other techniques, is not necessary. n

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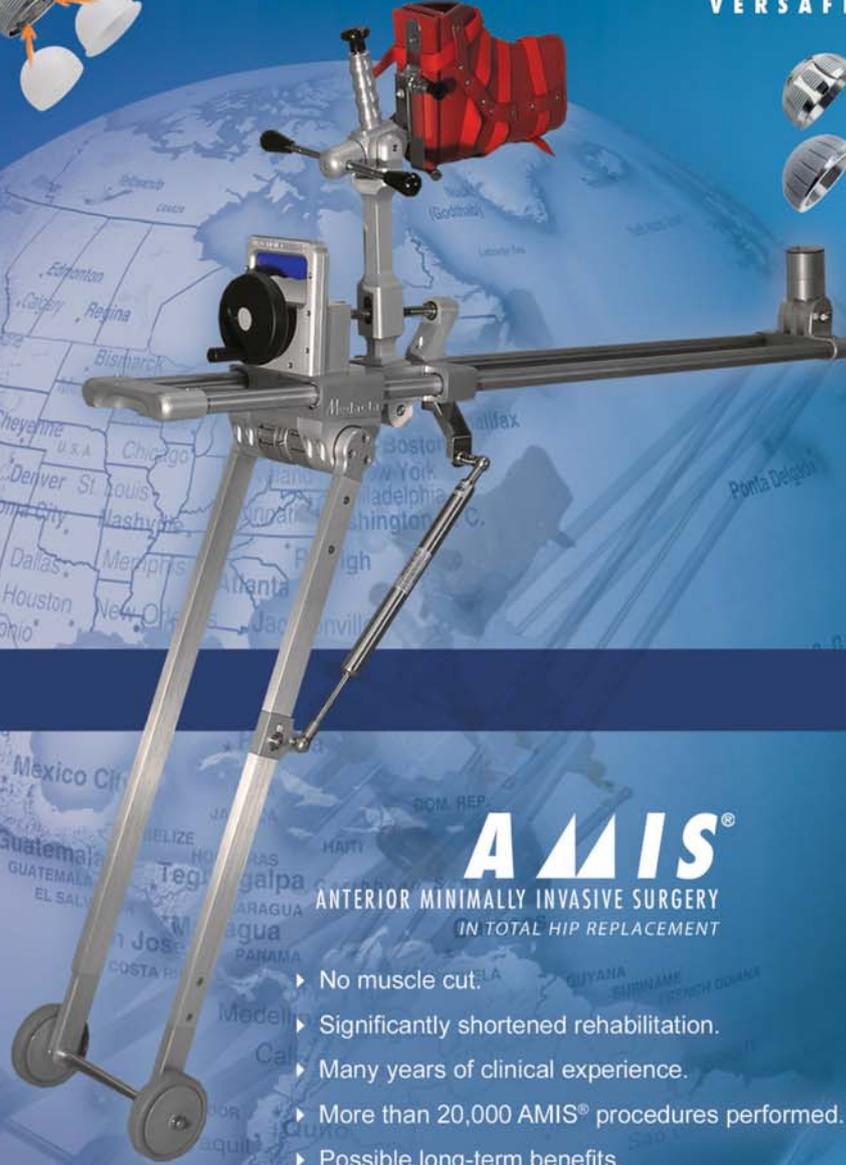
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