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E – Manuscript Preparation
F – Literature Search
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MicroHip: A minimally invasive procedure for total hip replacement surgery using a modified Smith-Peterson approach

Key words: *hip, hip endoprosthesis, minimal invasive joint replacement, MicroHip*

SUMMARY

This article presents an anterior, minimally invasive surgical approach to the hip joint, aligned along an internervous plane. Positioning in lateral decubitus position on a regular operation table obviates the need for a special orthopedic or fracture table. Traction is not applied. Most of the instruments used for this procedure are standard instruments for reaming of the acetabulum and positioning of the cup; specific, angulated instruments are recommended at least for obese patients. Using an incision of < 6-8cm, this MI approach provides a perfect view of the acetabulum and proximal femur, including natural landmarks for proper implant positioning. The approach follows the gap between the tensor muscle and the gluteus medius muscle, using part of the anterior ilofemoral Smith-Peterson approach. No tendons or muscles are cut or detached. The joint capsule is split and left in place. The hip joint is not dislocated; we perform the osteotomy of the femoral neck in situ. To date we have performed several hundred MicroHip operations, with no nerve lesions or trochanter fractures. Definitive results are not yet available, but our experience to date shows that this method can be used with virtually any patient, while such factors as hospitalization time, pain, blood loss and work incapacity can be cut almost in half. The MicroHip technique, used by an increasing number of clinics around the world, can be successfully applied by good surgeons after suitable training.

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BACKGROUND

For a long time the received wisdom was "major operation, major incision", but with time biological understanding grew and the medical world became aware that every incision represents an additional trauma which may lead to permanent destruction of tissue. This not only causes post-operative pain, thus increasing hospitalisation and rehabilitation times, but may under some circumstances also lead to loss of fine motor skills. The significant factors here are certainly not just the length of the cut but also which structures are affected. Most important in this respect are undoubtedly muscles and ligaments, with the abductor muscles, particularly the gluteus medius and minimus, playing a particularly central role. These structures have a major influence on perception, in view of which damage to the nerve pathways should be kept to an absolute minimum.

Mini-incision total hip replacement (THR) has been pursued by various surgeons and different approaches have been described THR. [1,2 3]

Accordingly, an ideal minimally invasive approach would not only avoid muscles and ligaments altogether but also be situated on an internervous plane, i.e., one not traversed by nerve branches. This represents a difference between our technique described bellow and most of the other Mini-icision approaches described. Our technique involves using a short section of the Smith Peterson [4] approach, which is located in the internervous plane between the tensor fascia lata and rectus/sartorius muscles, whereas the Watson-Jones approach is located between the gluteus medius and the tensor facia lata, which is not an internerveous plane. and this does run along an internervous plane. The superior gluteal nerve whith a nerve branch to the tensor fascia lata passes through the section of the space between the gluteus medius and the tensor fascia lata muscle that is relevant for our purposes, and as a result every approach using the Watson-Jones interval involves a significant risk of damage to this nerve branch. This would lead to impaired functioning of the tensor fascia lata muscle, which is particularly important for persons pursuing sports such as running or cycling. This problem is circumvented by the MicroHip procedure which we describe below. This is because, as we noted above, it is aligned along an internervous plane and does not involve any damage to ligaments or muscles, and even the joint capsule remains intact. This is not only beneficial for stability: it has been shown that nerve fibres present in the joint capsule play a role in the fine control of the joint which should not be underestimated [5,6]. It should also not be overlooked that leaving the joint capsule intact greatly lessens the size of the wound surface, thus not only reducing pain but also the amount of blood loss and post-operative scar formation.

TECHNIQUE

The patient is operated on in the lateral decubitus position. One half of the distal operating table is removed, so that the leg can be placed dorsally in hyperextended position in order to display the femur. The patient is positioned on the remaining part of the table, as close as possible to the surgeon. Both knees are slightly flexed and the patient is stabilised with a strong support on the symphyisi and to the sacrum. The surgeon is positioned ventral to the patient. Three landmarks are required: The tip of the greater tochanter, the tuberculum innominatum and the superior anterior iliac crest. The incision begins mid-way along the greater trochanter on its ventral edge and runs for c. 5-7 cm in the direction of the anterior superior iliac spine (Fig. 1). It will mark a plane that defines the femoral neck axis. Using these precise landmarks minimises the risk of iatro-

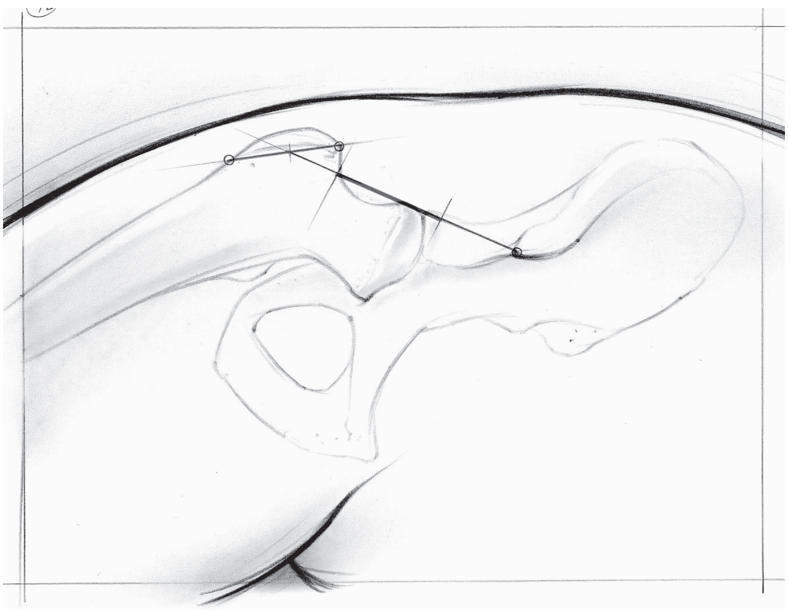

Fig. 1. Landmarks for the incision

genic injury of the lateral femoral cutaneous nerve. The incision is lateral to the potential region for iatrogenic injury to the LFCN [7] and should not interfere with the main braches of the nerve [8] even if the anatomical variability is height. The subcutis is severed, revealing the tract and the fascia. A minimal mobile widowis created by undermining the fatty layer, sufficient to expose the capsule but not to ectensive to risk necroses of the subcutaneous tissue. The fascia is incised approximately 2-5 mm medial to the underlying border of the fascia and the incision is extended distally and proximally in the direction of the fibres (Fig. 2). It is here that the fascia is of sufficient thickness to allow closure at the end of the procedure. Sissors and blunt dissection is the used to separate the tensor fascia lata vetrally from the fascia, following the intermuscular plane down to the femoral neck and the capsule. Next a straight Hohmann retractor is inserted between the tensor facia late muscle and the sartorius muscle, with the tip coming to rest on the femoral neck at the bottom of the greater trochanter. The Tesor muscle is then retracted laterally, together with the abductor Medius and Minimus muscle. A second retractor is placed on the femoral calcar to retract the Sartorius and Rectus muscles ventrally. This will expose the capsule over the femoral neck. A T-shape capsular incision is mad: inferior to superior, and along the border of the greater trochanter (Fig. 3). Both flaps of the capsule are fixed with holding stitches, ready for re-attachment. Hohmann retractors can then be inserted beneath the capsule (Fig.4) prior to osteotomising the femoral neck in accordance with pre-operative planning. The placement of

Fig. 2. Incision of the fascia 4mm in the tract at its ventral border

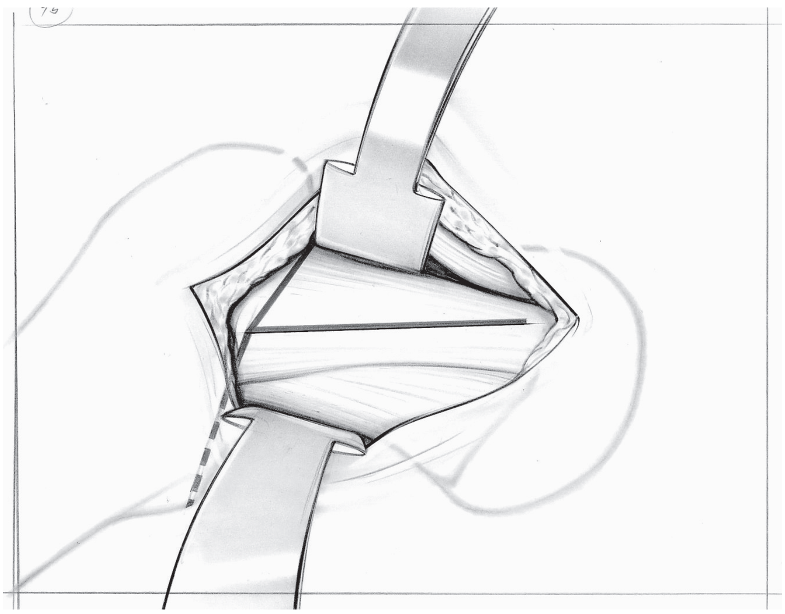

Fig. 3. T-shape incision of the capsule

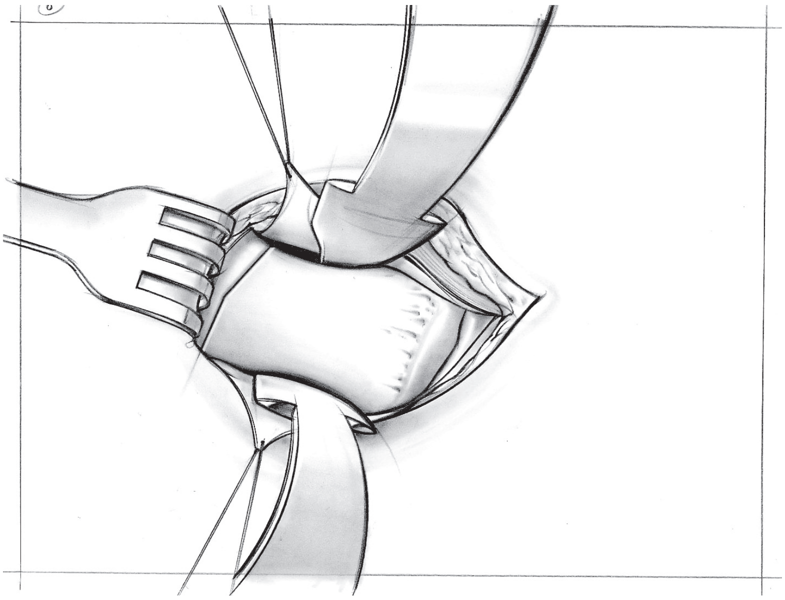

Fig. 4. Hohmann retractors inserted beneath the capsule

the lateral retractor has to be controlled precisely, because it gives the landmark for the osteotomy. With a long narrow saw blade the femoral neck is cut without dislocating the hip. After completing the osteotomy, a chisel is used to flip the femoral neck towards the front, allowing the corkscrew to be inserted axially in the femoral neck. Twisting several times allows the head to be freed before it is extracted. To reveal the acetabulum we insert two Hohmann retractors, one medially and one laterally, plus a third one, doubly bent, distally (Fig. 5). Next the acetabulum is reamed out in standard fashion using MI instruments before the cup, usually a press-fit cup, is inserted. Although standard straight instruments can be used on slim patients we recommend always using the angled MI instruments in order to familiarise yourself with them in straightforward cases rather than only using the angled MI instruments on obese patients who are initially more difficult to operate on. When inserting the cup great care must be taken to avoid excessive anteversion. To this end the fixation instrument must be aligned along the table axis at an inclination of 45 degrees. The course of the transverse ligament may be used as a control.

Following acetabular implantation, the leg is placed in abduction, external rotation and hyperextension and placed in a bag on the backside of the patient (Fig. 6). In order to evaluate the antetorsion of the femoral stem it is important for the lower leg to be aligned vertically to the ground. To display the femur a Hohmann retractor is first

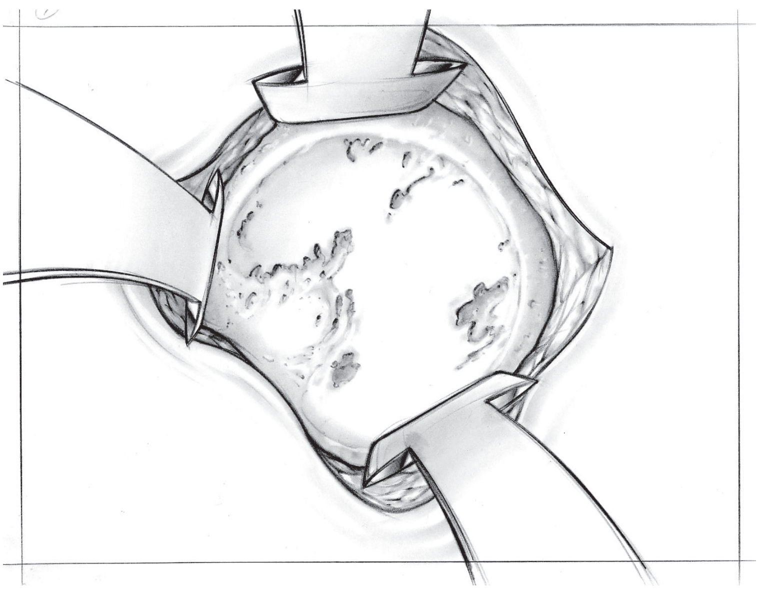

Fig. 5. View to the acetabulum with the three retractors in place

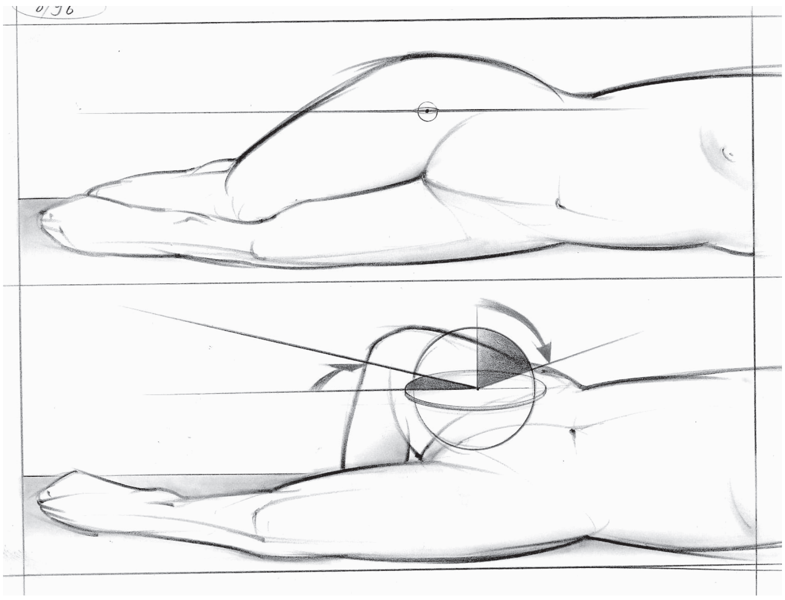

Fig. 6. Positioning of the leg to approach the femur

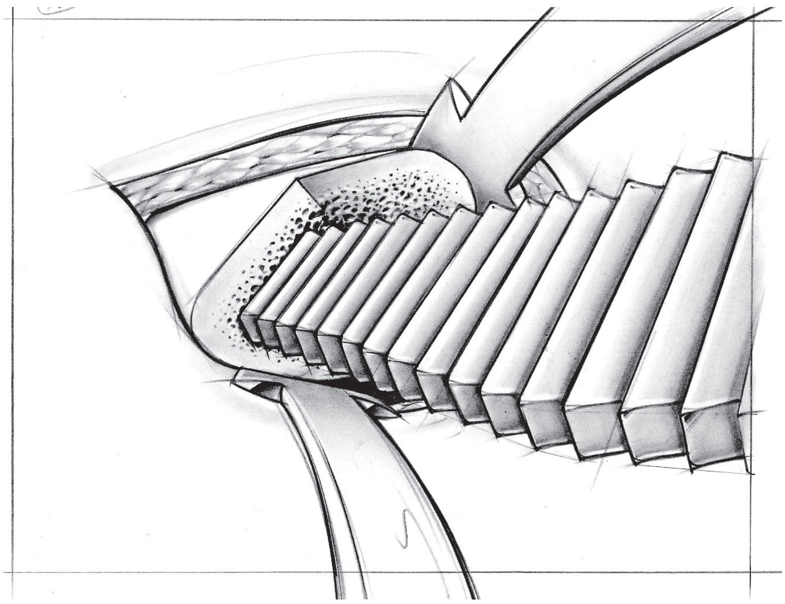

Fig. 7. Femoral broaching

inserted dorsolaterally on the tip of the greater trochanter to retract the Tensor, Glutaeus medius and minimus muscles to the lateral side. Next another Hohmann retractor is positioned at the femoral calcar. The entire femoral entry plane must now be displayed carefully to allow the precise opening point to be determined (Fig. 7). We normally use a sharp scoop to open the femur and then use medullary cavity reamers. The prosthesis is inserted taking careful account of the antetorsion. The leg length is determined by the distance from the tip of the greater trochanter to the implant which was precisely templated before the operation. After repositioning, the joint capsule is closed using the initial holding sutures and a few extra stitches. The fascia – tractus iliothibialis – is closed by using a running stitch. To get the best possible cosmetic result the skin is closed with a intracutaneous suture.

DISCUSSION

The procedure takes about 3/4 of an hour, and is performed in an internervous plane without detaching ligaments or muscles or resectioning the capsule. It can be performed on a regular table using standard instruments. To date we have performed several hundred MicroHip operations, and thus far we have never observed any nerve lesions or trochanter fractures. Our greatest initial difficulty was with the alignment of the acetabulum, but provided the above-mentioned guidelines are followed carefully it can be positioned securely. Calcar fissures do not as a rule pose any problem, but they can be avoided by displaying the femur correctly in order to ensure that the right entry point is chosen.

The implant design had to meet various specific requirements. The acetabulum can be seen very clearly, in view of which inserting the cup does not pose any great challenge, and most types of cup can be positioned without difficulty. A number of essential considerations lie behind the stem design. The operative technique we have developed does everything possible to avoid muscle damage, especially to the abductors. It is possible, albeit more difficult, to insert a straight implant with a lateral shoulder via this approach. However, this would make little sense given that a straight implant with lateral shoulder often has to be inserted so far into the greater trochanter that significant damage is done to the abductor tendons. In contrast, a straight implant with a minimized lateral shoulder is preferable both in that it is easier to insert and in that it does not have to be inserted as far into the trochanter region, as a result of which it does not come into contact with the abductor tendons. A further factor we regarded as important is that a hydroxyapatite-coated implant grows in significantly more rapidly, and this can certainly be advantageous in promoting a faster return to full use of the joint.

CONCLUSION

The MicroHip technique allows a hip joint replacement using a very short incision and without damaging the musculature. Definitive study results are not as yet available, but our experiences to date show that the method we have developed allows us to operate reliably on virtually any patient. However, a precondition for this is of course suitable training. The results are often so good that it can be difficult to persuade patients that it is important to carefully build up the loads exerted on the joint. Although the post-operative pain is far less, so that early full loading would be possible, the biology nevertheless remains the same, and this means that the healing of the wound and related muscle development takes time. Even in our ever more hectic world the patient should devote the necessary time to his or her new hip joint.

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