Single-incision minimally invasive anterior approach in total hip arthroplasty: surgical technique and literature review

Abstract The single-incision minimally invasive anterior approach to the hip with complete preservation of the musculotendinous structures offers excellent surgical exposure of both the acetabulum and the femur for the purpose of total hip replacement. Acetabular exposure corresponds to a modified and limited Smith-Petersen approach with intrinsic peculiarities. Femoral exposure in external rotation, adduction and extension of the leg is unusual for replacement purposes and is accomplished by the use of a traction table and a specially designed hook. Anterior single-incision exposure combines the advantage of intrinsic articular stability of anterior approaches with the advantages of preservation of lateral pelvitrochanteric and posterior myotendinous structures. An adequate learning curve must be overcome due to peculiar adaptations during the course of operation. A large variety of femoral components may be implanted by this approach; metaphyseal anchoring stems and femoral neck-preserving stems are particularly suited to this technique, combining both issues of minimally invasive surgery in total hip replacement: bone preservation and minimal surgical invasiveness. This article describes the surgical technique that we adopted in 2003 and compares it to other minimally invasive surgical techniques.

Key words Hip • Minimally invasive surgery • Total hip arthroplasty

Introduction

Primary total hip replacement (THR) has developed during the last decades into a highly predictable and successful procedure in the short and medium terms, and this has to be attributed to the continuing development of prosthetic design and implant manufacturing that has characterized the last decades with durable effects on primary and secondary stability. Continuous improvement in the knowledge of tribology and coupling materials seems to have contributed to reducing the problem of wear, so that lasting benefits extending to an increasing period of years can be expected, provided advantages and disadvantages of all bearing couples are considered [1].

When applied to THR, the term minimally invasive surgery is open to different interpretations. This apparently modern term which seems to have become a commercially viable solution for all problems, comprehends several issues; one of them, the preservation of bone stock, has already been addressed several years ago with the development of bone-preserving prosthetic stems [2–5].

Only recently has the surgical technique also been considered as a possible expression of minimal invasiveness. Limitation of the surgical disruption of anatomical structures was originally addressed by establishing less inva-
sive techniques of exposure applied to conventional later-
al [6] and posterolateral approaches, with consequent reduction of blood loss, postoperative pain, hospital stay and incision length [7–10]. Some authors attributed the benefits of less invasive approaches to computer-assisted surgery [11].

Protected postoperative treatment with particular regard to reconstructed anatomical structures, in order to prevent postoperative complications, is mainly a consequence of the surgical approach rather than implant stability itself. The more recently developed minimally invasive surgical techniques, with the peculiarity of maximally preserving anatomical myotendinous structures, reproduce in a more appropriate way the requisites of functional integrity and articular stability with a positive reflection on a quicker postoperative rehabilitation.

Minimally invasive techniques preserving anatomical integrity can be divided into 2 groups: limited single-incision anterior approach and in double-incision technique in which features of both the anterior and a limited posterior approach are combined.

### Surgical technique

#### Preoperative planning

Plain anteroposterior and lateral radiographs of the affected hip are obtained. A long line is drawn parallel and tangential to the ischiatic tuberosities across both femurs. The crossing point of the line with each femur is marked and the distance to a reproducible anatomical landmark (e.g. lesser tuberosity) on each side is determined.

#### Patient positioning

The patient is placed onto the trauma table. Both feet are securely fixed to the traction device and only moderate traction is applied so to ensure passive mobility of the hip. Horizontal and stable position of the pelvis must be assured before draping. Considering that during operation the leg will have to be brought into non-conventional positions, it must be checked prior to surgery that no part of the traction device will impinge when the leg is brought into the position of maximal adduction, external rotation and extension.

A fixing device is secured onto the lateral edge of the table at approximately the height of the greater trochanter. During the phase of sterile draping, a sterile rod is connected and fixed onto this device; a special hook is attached onto this system at a later stage of the operation (Fig. 1).

#### Draping

The surgical field is draped, leaving the foot at the surgical side free. After draping of the proximal part is completed, the foot is reconnected to the traction device and draping is completed.

The ASIS as the pelvic anatomical landmark is kept uncovered; it is important to extend the uncovered field beyond the patella as its orientation acts as a guide for femoral rotation that must be checked during operation. Control over femoral rotation may also be accomplished by inserting a K-wire through the femoral condyles in a parallel direction to the floor, with the leg in neutral rotation (patella facing the zenith).

#### Surgical exposure

On the skin, the anterior superior iliac spine (ASIS) and the tip of the greater trochanter are marked with a sterile marker pen. The muscular interval between the musculus tensor fasciae latae and the sartorius muscle is palpated through the skin and also marked.

The line of incision extends from 2 cm distal of the ASIS in slight inferolateral direction for 6–8 cm just lateral to the palpated muscular interval. The underlining fascia is incised more laterally over the medial fibers of the tensor muscle and the intermuscular space is developed in order to avoid the lateral cutaneous femoral nerve. The muscles are carefully and bluntly retracted by two conventional retractors without excessive traction. Blunt