



Component position following total hip arthroplasty through a miniinvasive posterolateral approach

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Implant malposition and poor fixation are potential risks of compromising long-term results after total hip arthroplasty performed with a minimally invasive technique.

Between September 2000 and February 2002, 120 cemented primary total hip arthroplasties were performed at the authors' institutions in patients with primary osteoarthritis of the hip and with BMI lower than 35. In 60 of these cases selected at random, a posterolateral incision no longer than 10 cm was used. The other 60 THA's were performed through a standard posterolateral approach. The inclination and anteversion of the cup and the position of the femoral stem were assessed on radiographs and statistically evaluated.

In the miniinvasive group, the average inclination angle of the cup was 42.3° (range : 36 to 52°) and the anteversion angle 13.6° (range : 6 to 29°). The coronal alignment of the femoral component was within 3° of neutral in 54 cases (90.0%). Following conventional implantation in the other group, the average cup inclination angle was 42.4° (range : 35 to 50°) and the anteversion angle 13.6° (range : 8 to 24°). A total of 53 stems (88.3 %) were implanted optimally. Statistical analysis found no significant difference between the two groups regarding components position.

These findings suggest that using a smaller posterolateral incision as was done in this study does not introduce a potential risk of compromising long-term results.

INTRODUCTION

Total hip arthroplasty (THA) performed with a conventional technique is associated with considerable blood loss and significant postoperative pain. Minimally invasive THA is defined as a procedure performed through a smaller incision (arbitrarily defined as ≤ 10 cm) or two smaller incisions (each defined as ≤ 8 cm). Its premise is to reduce soft-tissue trauma and thereby reduce perioperative blood loss, postoperative pain, the duration of the postoperative recovery, as well as the length of the surgical scar, and also the length of stay in hospital. Implant malposition and poor stability are potential risks of compromising long-term results. The purpose of this prospective randomised radiological

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study was to make a comparative evaluation of the positioning of the components after using either a conventional approach or a minimally invasive approach.

PATIENTS AND METHODS

Over a period of 18 months between September 2000 and February 2002, 120 cemented primary THA's were performed through a posterolateral approach in relatively slim patients with BMI of less than 35.0 at the authors' institutions. Sixty of these cases were randomly selected for operation with a minimally invasive technique. The median age at operation of the 40 male and 80 female patients was 72.4 years (range : 66 to 78 years), their mean body weight was 72.1 kg (range : 61 to 87 kg) and their body mass index (BMI) was 27.6 (range : 22.6 to 34.9). The selection criteria included age of more than 65 years, and BMI of less than 35.0. Patients affected by coagulation disorders were excluded from the study, as were relatively anaemic individuals on the basis of a preoperative haemoglobin level < 12 g/dl. The underlying pathology was grade 3 or 4 primary osteoarthritis in all cases. The mean follow-up was 39 months (range : 32 to 46). No patient was lost to follow-up.

All implantations were performed by two experienced senior surgeons (R.H. and M.J.). Patients received a cemented polyethylene cup and a straight cemented stem Centrament (B. Braun / Aesculap, Tuttlingen, Germany). Standard-viscosity Palacos-R bone cement (Biomet Merck, Darmstadt, Germany) was used in all cases after conventional mixing.

Technique

With the patient lying in the lateral decubitus position, a slightly curved incision was made at the posterior border of the greater trochanter. In cases operated with a miniinvasive technique, the incision length was 9-10 cm. The external rotators were tagged and then divided. The posterior capsule was excised and the femoral head was dislocated. After osteotomy of the femoral neck and removal of the femoral head, three standard Müller retractors were used for acetabular exposure. The anterior capsule was retained. The cup was cemented in standard manner. Then, a modified Müller retractor was applied to elevate the femur into the surgical wound, the femoral canal was opened with an osteotome, and the medullary cavity was prepared. An autologous bone

plug was placed into the distal part of the femur. The cement was introduced in a retrograde fashion from distal to proximal with a cement gun. The straight stem with a polyethylene centraliser was inserted. After reposition, one suction drain was introduced and the external rotators were sutured to the gluteus medius tendon in a separate layer. In cases implanted through a standard posterolateral approach, the procedure was similar, but the incision length was about 20 cm.

The duration of the surgery from incision to wound closure averaged 71 minutes (range : 55 to 84) in cases operated with the miniinvasive technique, and 70 minutes (range : 51 to 86) in those operated with a conventional technique. The mean intraoperative blood loss was 318.8 ml (range : 200 to 460 ml) in the miniincision group and 544.4 ml (range : 390 to 880) in the standard group. The mean postoperative blood loss into the drainage was 613.3 ml (range : 350 to 1180 ml) after miniinvasive operation and 853.7 ml (range : 510 to 1390 ml) after the standard procedure.

Radiographic examinations were undertaken 3 days after the surgery and at the last follow-up control in July 2004. The anteroposterior radiographs were performed according to the method of Ackland *et al* (1), the axial views were standard. All radiographs were reviewed by two observers (V.Š. and P.V.) who were unaware of the surgical method used. They independently measured the inclination and anteversion angles for all cases in both groups. Occasional measurement differences were solved by agreement of both observers ; interobserver variability was non-significant (fig 1). Alignment measurements were made on the radiographs with a pencil. Angles were measured to the nearest degree, using the same goniometer throughout the study. The Mann – Whitney U test was used for comparison of averages and the Bartlett test for comparison of standard deviations. The cement mantle continuity was evaluated in both views, anteroposterior and axial. Clinical results were graded according to Merle d'Aubigné's rating system taking into account Charnley's modification (9) ; they were evaluated before, 6 weeks, 6 and 12 months after the surgery.

RESULTS

The goal at operation was to achieve a cup inclination of 45° and an anteversion of 15°. The radiographic results in the miniinvasive group showed a mean inclination angle of 42.3° (range : 36 to 52°) and a mean anteversion angle measured according

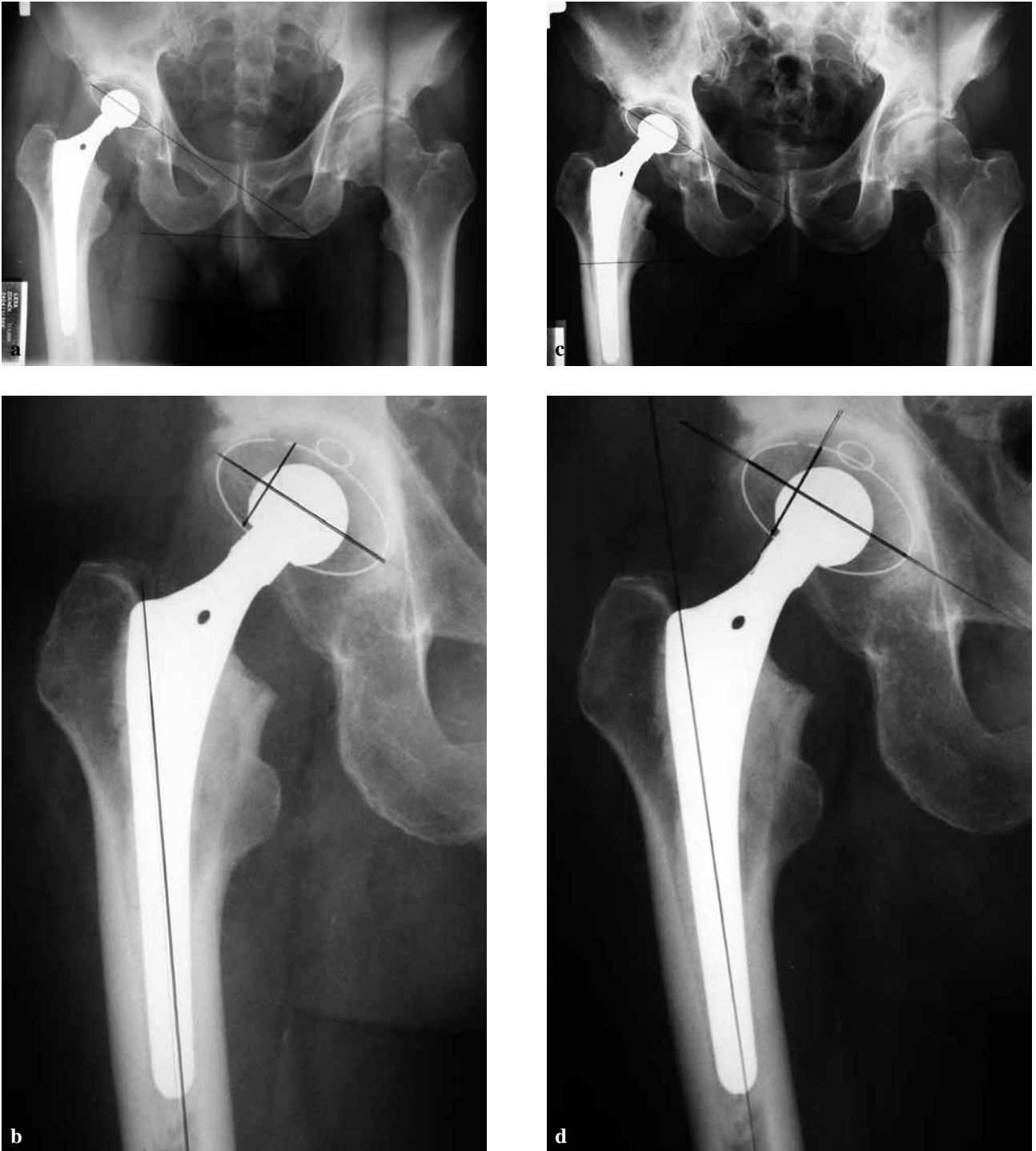


Fig. 1. — Radiographs of a THA after miniinvasive implantation. Measurements performed at one-year follow-up by two observers : observer A (fig 1a : inclination 38° ; fig 1b : anteversion 26°) and observer B (fig. 1c : inclination 38° ; fig 1d : anteversion 27°). The stem position is correct. The interobserver difference is non-significant.

Table I. — Average Merle d'Aubigné – Charnley clinical scores

	Pre-operative		Six weeks postoperative	
	Miniinvasive	Standard	Miniinvasive	Standard
Pain	2.7	2.7	5.6	4.2
Motion	4.2	4.2	5.8	5.1
Function	3.7	3.7	5.2	4.8
Overall	10.6	10.6	16.6	14.1

Maximum : 18 points.

to Ackland *et al* (1) of 13.6° (range : 6 to 29°). The femoral component coronal alignment was within 3° of neutral position in 54 cases (90.0%). Varus malalignment of more than 3° (range : 4 to 6°) was found in 6 hips (10.0%). A cement mantle without defects was found around all cups and stems. In the conventional group, the average cup inclination angle was 42.4° (range : 35 to 50°) and the mean anteversion angle 13.6° (range : 8 to 24°). A total of 53 stems (88.3%) were implanted optimally, 7 stems (11.7%) were in varus greater than 3° (range : 4 to 6°). No cup or stem had defects in the cement mantle. No aseptic loosening and no changes in component position were observed between the first and last postoperative radiographs in both groups. Statistical analysis using Mann – Whitney U and Bartlett tests found no significant difference in components position between the two groups.

The mean Merle d'Aubigné – Charnley scores 6 weeks after operation are shown in table I. The preoperative scores were similar in both groups. At the 6-weeks follow-up, the mean score had improved from 10.6 preoperatively to 16.6 points in the miniinvasive group, and from 10.6 to 14.1 points in standard cases. The Mann – Whitney U test revealed statistically significant differences between both groups in all three variables, pain, motion and function. Clinical evaluation 6 and 12 months after surgery revealed similar score values in both groups and found out no statistical difference between miniinvasive and standard procedures. The overall scores were 17.4 and 17.3 points, respectively.

There were in both groups no serious complications requiring further surgery, no haematomas, seromas or pulmonary emboli. There were no intra-operative complications such as femoral fracture or lesion of the sciatic nerve. No deep infection occurred. One postoperative dislocation two weeks after surgery was observed in each group ; it did not recur in either of them. In both cases, the cause of the dislocation was flexion of the hip of more than 90° together with internal rotation while sitting.

DISCUSSION

Minimally invasive joint replacement aims at reducing the amount of soft tissue trauma. Even though there is no universally accepted definition of what constitutes a miniinvasive technique, its focus is clearly to minimize soft tissue trauma and accelerate soft tissue regeneration (7). Regarding hip replacement, three main methods are available : /1/ a small-incision posterolateral approach as in this study, /2/ a miniinvasive anterior approach (8), and /3/ a technique using two small incisions, one over the Smith-Petersen interval and the other similar to the lateral approach used for femoral intramedullary nailing (2). There are as yet no long-term data available to compare the long-term outcomes of hip reconstructions performed through miniinvasive approaches with those of conventional THAs. Problems encountered in postoperative rehabilitation following conventional THA include persistent pain, muscle weakness, restricted range of joint motion in the lower extremities. After

minimally invasive surgery, an accelerated rehabilitation program is in theory possible. In our study, the clinical result 6 weeks after the surgery was better in the miniinvasive group; the difference was no longer discernable after 6 and 12 months. We observed better pain relief and quicker functional improvement with a low complication rate in these cases. This is indeed the most important argument of advocates of miniinvasive techniques. We think that the observation of lower external blood loss is another element in favour of minimally invasive techniques (3, 4). The duration of surgery was not reduced in the miniincision group.

Implant malposition and poor stability are thought to be the greatest potential risks of compromising long-term results. In our study, we observed no statistically significant difference in components position after standard and minimally invasive implantation. The use of an electronic navigation system can avoid or significantly decrease any potential positioning error (6). In both groups, there were no cement mantle defects. We also had no major problems related to reduced visualisation, such as neurovascular injury. It is clear however that the miniincision technique has a higher requirement for assistants and is not suited for the surgeon with limited experience in total hip replacement.

Our one-incision posterolateral technique can be performed with standard instruments and without fluoroscopy; the latter is necessary in the two-incision procedure. The only specific instrument used with our technique was a slightly modified broad Müller retractor. It is however impossible to compare the results of minimally invasive hip surgery performed through a single incision and that performed with two incisions because of the paucity of published data.

Minimally invasive hip surgery should not be attempted in patients with protrusio deformities, fibrous or osseous ankylosis, a hip scarred by pre-

vious surgery or in obese patients, as these factors would make the operation technically more difficult (10). No serious intraoperative or postoperative complications such as haematoma, seroma, deep infection, deep venous thrombosis, pulmonary emboli and dislocation were noted in the miniincision group more often than with the standard method in our study. The limitation of the minimally invasive technique described is the necessity for the surgeon's good experience in performing hip replacement, but our results appear encouraging (5).

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