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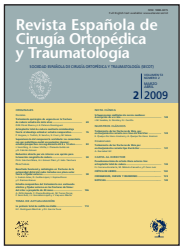

ORIGINAL PAPERS

MIS vs. standard total hip arthroplasty: a comparative study

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KEYWORDS
Hip arthroplasty;
Minimally invasive surgery;
Prospective;
Posterolateral approach

Abstract
Purpose: To prospectively evaluate the results of minimally invasive surgery (MIS) vs. the traditional approach in total hip arthroplasty
Materials and methods: We prospectively studied 70 consecutive patients subjected to total hip replacement with a posterolateral approach. In 49%of them, a traditional Moore approach was used and in 51%a minimally invasive approach (an incision of less than 10 cm); patients were distributed into the two groups randomly. We used hydroxyapatite-coated cups and stems. Patients were reviewed at 6 months. Quantitative variables were assessed using Student's "t" test, whereas categorical variables were compared with the chi square test.
Results: Comparison of our two groups revealed that OR time and hospital stay were longer with the standard approach, although this difference was not statistically signi cant. Stem malpositioning (placing them in varus or valgus) was signi cantly higher in the MIS group (p=0.018). The results of the SF-12 questionnaire and the Harris hip score were better with the standard approach.
Conclusions: In our experience, minimally invasive surgery for total hip replacement has not improved the results obtained with the traditional approach in terms of blood loss, pain or time to recovery. Better results are however obtained in terms of OR time and length of hospital stay, although this is overshadowed by a greater incidence of varus stem malpositioning and a poorer life quality at 6 months (SF-12 questionnaire).

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PALABRAS CLAVE
Artroplastia de cadera;
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Prospectivo;
Abordaje Posterolateral

Artroplastia total de cadera mediante miniabordaje frente al abordaje estándar: estudio comparativo

Resumen
Objetivo: evaluar de forma prospectiva los resultados de la técnica de abordaje mínimamente invasiva (MIS) frente al abordaje tradicional en la artroplastia total de cadera.
Material y método: se estudió, de forma prospectiva, a 70 pacientes consecutivos intervenidos de artroplastia total de cadera por vía posterolateral, el 49% mediante abordaje tradicional de Moore y el 51% mediante abordaje reducido (menos de 10 cm) distribuidos aleatoriamente. Se emplearon cotilos y vástagos con recubrimiento de hidroxiapatita y se revisó a los pacientes a los 6 meses. Las variables cuantitativas se evaluaron mediante la prueba de la t de Student, mientras que las variables categóricas fueron comparadas mediante la prueba de la χ^2.
Resultados: partiendo de 2 grupos comparables estadísticamente, el tiempo quirúrgico y los días de ingreso fueron mayores en el abordaje estándar, aunque sin significación estadística. La mala posición de los vástagos (colocación de éstos en varo o valgo) fue significativamente mayor en el grupo MIS ($p = 0,018$). El test SF-12 y el test de Harris a los 6 meses fueron mejores en el abordaje estándar.
Conclusiones: en nuestra experiencia, el abordaje reducido para artroplastia total de cadera no ha mejorado los resultados de la técnica tradicional en pérdidas hemáticas, dolor o rapidez de recuperación. Presenta una mejoría en el tiempo quirúrgico y en los días de hospitalización, con una presencia de vástagos posicionados en varo significativamente mayor y una peor calidad de vida a los 6 meses (test SF-12) de los pacientes.

Introduction

A growing interest developed in the last few years in the application of minimally invasive surgery (MIS) techniques to total hip replacement, which has led to the appearance of specific instruments and surgical techniques. All of this has resulted in a reduction in the size of incisions, allowing at the same time sufficient exposure for appropriate component placement.

In spite of the advances made, there persists a controversy regarding the definition of this technique and the results it can afford.[1] Most papers in the literature coincide in defining MIS as a type of surgery in which both incision length and surgical approach are diminished in an attempt to reduce tissue damage related to hip arthroplasty. An approach is called a MIS approach when the size of the incision is ≤10 cm.[2,3] The approach may be through a single incision, either anterior or posterolateral,[4-9] or through a combined incision.[10]

Those in favor of this technique[4,10-13] have submitted Studies where they explain its advantages over the traditional approach, i.e. less postoperative pain, less muscle dissection, less perioperative blood loss, better cosmesis and a Speedy rehabilitation that permits prompt resumption of walking and shorter hospitalization, which reduces the total cost of the process.[2]

Critics,[3,14-16] on the other hand, underscore the drawback of MIS surgery. The most significant of these is its greater technical difficulty, due especially to a smaller exposure of the surgical field, which leads to greater skin and muscle damage, higher risk of causing nerve damage and an intraoperative fracture and a higher incidence of mapoisitioning the prosthetic components. Another drawback is the learning curve, which tends to be longer for surgeons with little experience of hip prosthetic surgery.

In the midst of this dialectic battle between MIS supporters and critics, we designed a prospective randomized controlled comparative study of 70 patients in order to analyze whether the technical innovation embodied by MIS really entailed real and important advantages that may justify its widespread adoption.

Materials and methods

A prospective study was design where the target population we would obtain our sample from would be the patients treated in our hospital.

Patient selection criteria were defined as follows: from June 2004, 70 consecutive patients were recruited following informed consent. They were males or females over 45 years of age subjected to implantation of an uncemented THR (a press-fitted Shy®-Surgyval cup [Spain], implanted with or without screws, and a Furlong®-JRI stem [UK], both coated with hydroxyapatite) with a clinical diagnosis of primary hip arthritis or femoral head necrosis. Patients were operated by surgeons with a surgical experience of at least 50 THRs a year. Patients were randomly distributed into 2 groups. To that effect, we used the clinical records serial numbers, which allowed us to divide them up into 2 groups, depending on whether the Lumber was odd or even. Patient follow-up was of a minimum of 6 months.

All patients were placed in a lateral position on their healthy side and spinal anesthesia was applied. Antithrombotic prophylaxis was administered with low molecular weight heparin (3,500 U sodium bemiparin/ 24 h) and antibiotic prophylaxis was administered with 1 g cephazoline/ 6 h over the next 18 hours.

Patients in group A (odd-numbered clinical records) was operated by means of a reduced posterior approach, i.e. an incision ≤10 cm long (g. 1). Using the greater trochanter as a reference, the incision was made posteriorly; it started 1 cm proximal to the greater trochanter and was extended distally. The fasciotomy was made parallel to the skin incision and the short rotators of the hip were severed at the level of their femoral attachment. Subsequently a T-capsulotomy was performed to allow coxofemoral dislocation and femoral neck osteotomy. Soft tissues were dissected by means of 1 cm-wide and 90° angled custom-made retractors (g. 2). Conventional burs were used to ream the acetabulum (g. 3). Then, both the acetabular component and the polyethylene insert were placed. Conventional broaches were used for the femoral side prior to placing an uncemented stem. The wound was closed plane by plane and 2 Redon® vacuum drainage catheters were placed.

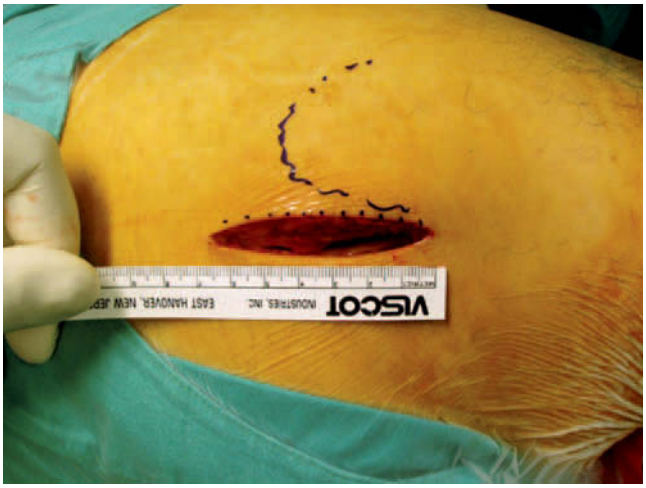

Figure 1 Measurement of the initial incision.

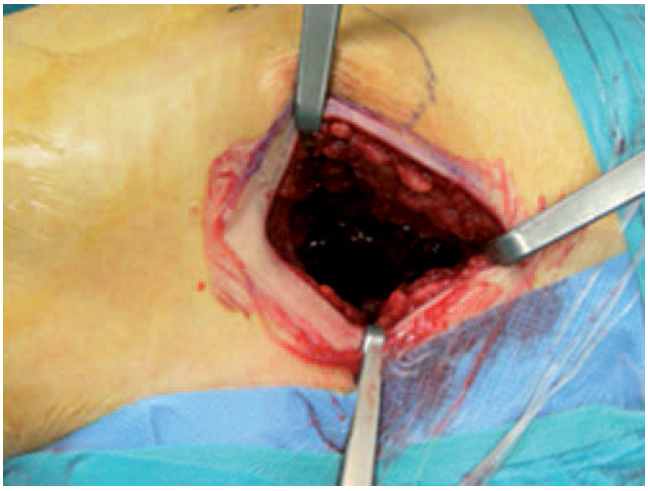

Figure 2 Exposure of the surgical approach by means of custom-made retractors.

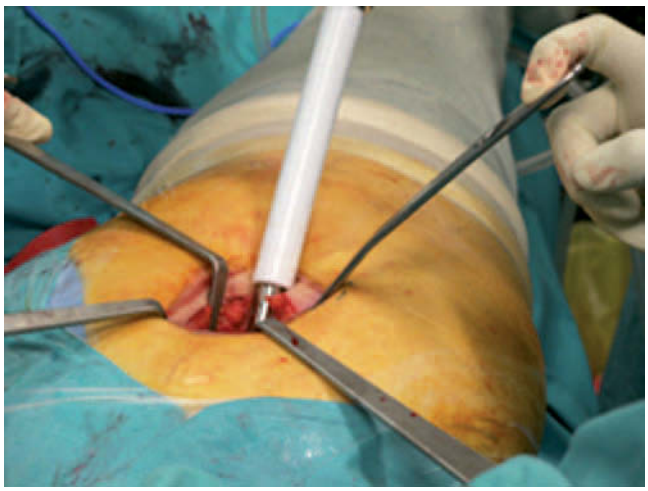

Figure 3 Reaming of the acetabulum.

Patients in group B (even-numbered clinical records) was operated by means a traditional Moore approach. The incision started 4 cm posterior to the tip of the anterosuperior iliac spine and 2 cm above the greater trochanter, curving anterolaterally over the greater trochanter and continuing until a point 8 cm from the center of the femoral Shaft. The remainder of the procedure was performed in the same way as for Group A.

Sitting was allowed 36 h after surgery, as tolerated by the patient. Walking was resumed 48 h alter surgery. It was recommended that on discharge patients should be able to walk and manage stairs independently.

Three identical observational periods were established for the 2 groups of patients, with a series of items of interest in each:

- Preoperative period. During this period the purpose was to gather personal information on the patients in order to determine if the groups were statistically comparable in terms of age, sex, body mass index (BMI), clinical diagnosis and anesthetic risk (ASA). The patient's functional status was determined by applying 3 evaluation scales:
  1. Visual analog scale (VAS). Values ranged between 0 (asymptomatic) and 10 (extreme pain).
  2. SF-12 Questionnaire. This is a quality of life questionnaire based on the lengthy SF-36 form, which evaluates the patient's subjective capacity to carry out certain everyday activities.
  3. Harris Hip Score. This is a speci c questionnaire for hip pathology that evaluates relatively objective parameters including coxofemoral mobility angles (with values ranging between 1 (the worst) and 100 (the best).
- Surgery and immediate post-operative period. Data was gathered regarding length of the incision at the beginning and at the end of the procedure (g. 4), OR time, intraoperative blood aspiration and total postoperative drainage at 48 h. Hemoglobin levels were measured

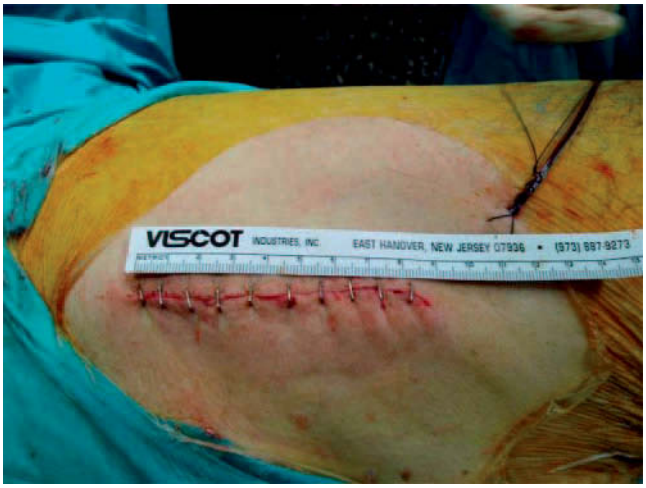

Figure 4 Final incision length.

preoperatively and 24 after surgery as well as the amount of red blood cell concentrate (RBCC) transfusions required. The following factors were recorded: the need for a transfusion in patients with hemoglobin levels below 8,4 g/dl, total days of hospitalization, the day patients started walking with a walking-frame. A functional rehabilitation protocol was followed whereby patients sat up in bed alter the rst 12 h, sat in a chair at 24 h and started standing and walking at 48 h. A record was kept of where patients were referred on discharge (to some rehab center or to their homes). The VAS scale was evaluated during hospitalization.

- Follow-up period: At 6 months a new evaluation was made of patients on the VAS scale, the Harris Hip Score and the SF-12 Questionnaire. A new assessment was also made of the condition and the size of their scar.

The placement of the prosthetic components (acetabular cup and stem) was assessed radiologically at 48 h and at 6 months from surgery. Using a goniometer and a placing a millimeter ruler over the radiograph measurements were taken of cup inclination, penetration and height, as well as of stem height and stem position both on the anteroposterior and axial views.

All existing complications that were related to the THR were recorded, as well as the details of the surgical procedure.

As regards the statistical comparison between the 2 groups, quantitative variables were analyzed by means of Student's "t" test and categorical (qualitative) variables were analyzed by means of Fisher's Exact Test or the χ^2 test. When making the inferences, we considered results with a p value <0.05 to be statistically signi cant. P values between 0.05 and 0.1 were considered not to be statistically signi cant, although it was acknowledged that they did show a certain trend.

Results

The Group samples were statistically comparable in terms of age, sex, ASA American Society of Anesthesiologists) anesthetic risk scale and BMI. Nor did values on pain scales (VAS), quality of life (SF-12) and on the Harris Hip Score show differences between the groups preoperatively (table 1).

As regards the perioperative period (that went from surgery and discharge), the following results were obtained (table 2):

- Mean incision length in group A (MIS technique). was 7.8 (range: 6–10) cm and 13.7 (range: 10.5–20) cm in group B.
- Mean OR time was 10 min Langer in group B (86 min in the MIS group MIS as compared with 96 min in the standard group). A statistical trend was noted (p=0.065).
- As regards blood loss, pre-operative hemoglobin levels were 13.74 g/dl on average for the MIS group and 13.63 g/dl on average in the standard group. Decreases observed at 24 h were 3.5 g/dl on average for the MIS group and 3.1 g/dl for the standard group (p=0.34), i.e. values were similar in both groups. Postoperative bleeding was higher in patients in group A, who required more blood transfusions than those in group B (1.03 red blood cell concentrates as compared with 0.85; p=0.696). There was one case in the standard group that required 13 concentrates. This was attributed to a gastric hemorrhage. Differences were not signi cant as regards the size of the groups of the available sample.
- The blood volume collected in the redon drainages over the 48 hs they were connected was 630 ml in the MIS group as compared to 660 ml in the standard group.
- Results of the VAS scale on admission showed a similar improvement in both groups with a mean value over the rst 3 days of 2 for the MIS group and 2.1 for the standard group (p=0.362).
- Functional recovery was similar in both groups. Patients began to walk with crutches at 4.7 days in the MIS Group as compared with 4.8 days in the standard group (p=0.821). No signi cant differences were found.
- As regards length of hospital stay, patients in the MIS group were in hospital for 9.47 days as compared with 12.06 days in patients operated with a standard incision (group B); a certain statistical trend was detected (p=0,084) pointing to a decrease in length of stay for patients in the MIS group. The long hospital stays found were related to the patient's age and by the scarce social and healthcare infrastructures available.

We also considered whether these patients had to be referred to some rehab center following discharge and found that around 17% in each group (5 patients) was taken to some specialized center.

Functional results following a clinical follow-up at 6 months were as follows (table 3): the SF-12 questionnaire showed signi cantly better results (p=0.015) in the MIS group, with a mean of 20.03 points as compared with 16.79 points on average for the standard group. The Harris Hip Score showed a certain statistical trend (p=0.064), with 91.71 points for the standard approach and 87.24 points for MIS. The VAS presented values with no statistical signi cance (p=0350) with a mean 0.84 points in the MIS group and 0.62 points in the standard group.

Table 1 Comparison of the study groups

Pre-op	MIS	Standard	Mean differences	p
n.	36	34	2	
Age	66.83	64.24	2.59	0.337
Males/females	15/21	16/18	1/3	0.650
BMI	31.5	33.7	2.2	0.356
ASA				0.234
I	3	0	3	
II	22	21	1	
III	8	9	1	
IV	0	1	1	
VAS	7.97	7.53	0.44	0.253
SF-12	39.5	38.4	1.1	0.749
Harris	40.5	44.3	3.8	0.212

ASA: anesthetic risk scale; VAS: pain assessment scale; BMI: body mass index; MIS: minimally invasive surgery. Statistical comparison of values. A p value <0.05 was considered statistically significant; p values between 0.05 and 0.1 were considered to indicate a certain statistical trend and a p value >0.1 was not considered statistically significant.

Table 2 Evaluation of the results of the perioperative variables measured

Perioperative period	MIS	Standard	Mean differences	P
Incision, cm	7.8	13.7	5.9	
Duration, min	86.18	96.5	10.32	0.065
Hb before	137.47	136.3	1.16	0.729
Hb after	102.88	105.79	2.9	0.34
Transfusion	1.03	0.85	0.18	0.696
VAS on admission	2	2.1	0.1	0.362
RHB crutches	4.7	4.8	0.1	0.821
Length hospital stay	9.47	12.06	2.59	0.084
Destination on discharge				0.572
Home	31	29	2	
Rehab center	5	5	0	

Hb: hemoglobin; MIS: minimally invasive surgery; RHB: rehabilitation, day when patient started walking with crutches. A p value <0.05 was considered statistically significant; p values between 0.05 and 0.1 was considered to show a certain statistical trend and p>0.1 was not considered statistically significant.

Table 3 Pain evaluation and quality of life test at 6 months

	MIS	Standard	Mean differences	P
VAS	0.84	0.62	0.22	0.35
SF-12	20.03	16.79	3.24	0.015
Harris	87.24	91.71	4.47	0.064

MIS: minimally invasive surgery. A p value <0.05 was considered statistically significant; p values between 0.05 and 0.1 was considered to show a certain statistical trend and p>0.1 was not considered statistically significant.

Radiographic evaluation at 48 h and 6 months from surgery showed (table 4) that mean cup inclination in group A was 44° as compared with 47° in group B (p=0.98), with no significant differences. In both groups there were 2 cases with angulation above 55°. Values for both cup penetration and cup height were similar. As regards stem placement, patients in the MIS group showed statistically significant values for poor stem positioning (p=0.018) in 36.1% of cases (with 27.8% of stems showing varus placement) as compared with 8.8% of cases in group B.

As far as complications are concerned (table 5), in the MIS group 22.2% of patients has some sort of complication: 1 case of superficial wound infection that resolved with antibiotic therapy, 2 cases of dislocation, 3 cases of non-

Table 4 Radiologic assessment of acetabular cup and femoral stem placement

Postoperative period	MIS	Standard	p
Cup	44°	47°	0.98
<55°	34 (94.1%)	32 (93.5%)	
>55°	2 (5.9%)	2 (6.5%)	
Stem			0.018
Neutral	23 (63,9%)	31 (91.2%)	
Varus	10 (27.8%)	2 (5.9%)	
Valgus	3 (8.3%)	1 (2.9%)	

MIS: minimally invasive surgery. A p value <0.05 was considered statistically signi cant; p values between 0.05 and 0.1 was considered to show a certain statistical trend and p>0.1 was not considered statistically signi cant.

Table 5 Complications

Postoperative period	MIS	Standard	p
Complications	22.8%	14.7%	0.322
Wound infection	1	2	
Dislocation	2	1	
Periprosthetic fractures	4	1	
Sciatic neuroapraxia	0	1	

MIS: minimally invasive surgery. A p value <0.05 was considered statistically signi cant; p values between 0.05 and 0.1 was considered to show a certain statistical trend and p>0.1 was not considered statistically signi cant.

displaced intraoperative fractures and 2 periprosthetic fractures. Osteosynthesis was required in only one case (cerclage wiring was used). In turn, in group B (standard surgery) 14.7% of subjects presented with complications: 2 wound infections that resolved with antibiotic therapy, 1 case of dislocation, 1 periprosthetic fracture and 1 case of sciatic nerve neuroapraxia that resolved uneventfully.

Discussion

The introduction of minimally invasive surgical techniques has been bene cial for hip arthroplasty as new instruments have been developed to optimize implant placement and OR time and soft tissue trauma have been reduced in the hope of decreasing recovery times and the number of infections.[4,17] Apart for its obvious cosmetic bene ts, it remains to be shown that the technique is actually superior than the traditional approach, which has allowed surgeons to score countless successes up to now.

Although our study sample is small, group randomization and the similarities between the groups allowed us to obtain statistically signi cant results.[9,18]

The analysis of the data contradicts claims that the MIS technique allows for less blood loss[15,17]. The greater blood loss associated with this technique is, in our view, derived from the greater dif culty to control bleeding when the eld of view is reduced. Paradoxically, in subsequent follow-up sessions, patients were more satis ed with the traditional technique, although presumably comfort-related results of both techniques will eventually stand within the same range. We have not found a real and objective reduction of postoperative pain with this technique, rehabilitation progressed similarly with both techniques. Demand for social assistance in the form of recovery centers is a factor that also stands in the way of improving length of hospitalization rates in our environment.

The results obtained in our study do not show advantages. In our view, the meager improvement in terms of OR time and length of hospital stay, even if compounded with the cosmetic bene ts mentioned, does not justify widespread use of this technique. On the contrary, use of this technique tends to improve the number of malpositioned stems and it produces discomfort to the surgeon due to poor visualization as well as soft tissue tension.[19]

The periprosthetic fractures that occurred in our study, mostly calcar cracks, resulted from the design of the implant (metaphyseal lling) and the technique, especially at the beginning of the learning curve. The instances of dislocation were not considered because of the small size of the sample.

In short, both techniques produce similar results; they are both safe and reproducible. However, we relieve that the MIS technique requires a long learning curve and should be practised by surgeons specialized in hip replacement. We believe that these results do not warrant widespread use of this technique. In line with other authors, we question the alleged bene ts of this surgical method.[2,20,21]

In spite of our conclusions, practice of MIS surgery had been an incentive for us since it has led us to perfect our surgical skills in an attempt to use increasingly reduced approaches. We think that with careful patient selection, MIS can be a valuable technique.

To conclude, more long-term studies will have to be made, perhaps with larger population samples, in order to determine the validity of MIS surgery. Nevertheless, we do not for the time being think it can be a substitute for the safety and good results allowed by the standard approach.

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Conflict of interests

The authors have not received any nancial support in the preparation of this article. Nor have they signed any agreement entitling them to receive bene ts or fees from any commercial entity. Furthermore, no commercial entity has paid or will pay any sum to any foundation, educational institution or other non-pro t-making organization to which they may be af liated.

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