Minimal Incision Surgery as a Risk Factor for Early Failure of Total Hip Arthroplasty

Bradley P. Graw MD, Steven T. Woolson MD,
Heather G. Huddleston MD, Stuart B. Goodman MD, PhD,
James I. Huddleston MD

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Abstract

Background Minimal incision total hip arthroplasty (MI THA) techniques were developed to decrease postoperative pain and recovery time. Although these techniques have increased in popularity, the long-term survivorship of these procedures is unknown.

Questions/purposes We therefore investigated whether the time to revision in our referral practice was shorter for patients who underwent primary MI THA compared to primary traditional THA.

Methods We retrospectively reviewed 46 revision THAs performed during a 3-year period. We excluded revisions performed for infection and rerevisions. Patients with incisions less than or equal to 10 cm were defined as having had MI THA. Fifteen of the 46 patients (33%) had undergone primary MI THA. At the time of primary index

THA, the mean ages of the MI and non-MI patients were 65 years and 55 years, respectively.

Results The mean time to revision was 1.4 years for the MI patients compared with 14.7 years for the non-MI patients. Twelve of the 15 patients having MI THA required revision within 2 years of primary THA compared to 4 of the 31 patients without MI surgery (OR = 26.5, 95% CI 4.4–160.0). There were no differences between the groups with regard to age, gender, or body mass index. The most common reasons for revision in the MI THA group were intraoperative fracture and failure of femoral component osseointegration.

Conclusions Our data suggest MI THA may be a risk factor for early revision surgery and the long-term survival therefore may be lower than that for non-MI surgery.

Level of Evidence Level III, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

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Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

This work was performed at Stanford University Medical Center, Redwood City, CA, USA.

B. P. Graw, S. T. Woolson, S. B. Goodman, J. I. Huddleston (✉)
Department of Orthopaedic Surgery, Stanford University
Medical Center, 450 Broadway Street, Pavilion A, Redwood
City, CA 94063, USA
e-mail: jamesh3@stanford.edu

H. G. Huddleston
Department of OBGYN and Reproductive Science, University of
California, San Francisco, San Francisco, CA, USA

Introduction

The concept of performing THA through “minimally invasive” techniques was introduced with the potential for decreasing patient pain, accelerating rehabilitation, and decreasing operative soft tissue trauma and blood loss [18, 23]. Although these procedures have increased in popularity [23], their potential risks and benefits have been debated and scientific conclusions have been made based on limited evidence [7, 9, 10]. Presently, the definition of minimal incision THA (MI THA) remains ambiguous. Innovators of the technique described the procedure based on length of skin incision [7, 9], and incisions ≤ 10 cm are generally considered minimal [23]. Others have incorporated accelerated rehabilitation protocols, alternative surgical

approaches, and new anesthetic options under the same definition [7, 17, 20, 21, 23]. It is difficult to quantify the impact these multiple surgical techniques and perioperative protocols have on the outcome of MI THA.

In support of MI THA, there is evidence that operative blood loss and total blood loss is less than with conventional approaches [7]. Earlier rehabilitation is reportedly associated with decreased pain scores and earlier discharge from inpatient care [9]. Multimodal pain and anesthetic techniques associated with MI THA may allow for earlier mobilization due to improved pain control postoperatively [17]. Although most authors recognize long-term THA survivorship should not be compromised by these approaches, present studies confirm early pain relief, improved function, and earlier hospital discharge after MI THA [3, 7, 9].

Major concerns remain about the safety and efficacy of these procedures: the two-incision technique [1, 18] and the anterior approach [25] are reportedly associated with high rates of intraoperative complications and short-term failures. The two-incision technique has a reported short-term reoperation rate of 10% for intraoperative fracture (2/99), dislocation (1/99), wound complications (2/99), and failure of femoral osseointegration (4/99) [1]. The anterior approach has a reported intraoperative fracture rate of 7.3% (18/247) with 3% (8/247) of the patients experiencing failure of osseointegration of their femoral components and 3/247 hips requiring immediate reoperation for limb length discrepancy [25]. The mini posterior incision is reportedly associated with less pain and earlier hospital discharge when compared to a standard length incision [9]. However, several studies have found no short-term differences in duration of need for assistive devices and overall mobilization between MI THA and traditional incision THA [9, 16, 24]. The cosmetic benefit of a smaller incision has also been disputed [15, 26].

Although the evidence surrounding the short-term benefit of MI THA is controversial, there is no evidence concerning the long-term survival of THA performed with MI surgery. Long-term survivorship of traditional THA remains high [6], and surgeons on both sides of the MI debate recognize that new techniques must maintain this standard. However, we noticed an increasing percentage of revision THA cases in our practice associated with small incisions.

We therefore compared the time to revision in our referral practice for those patients who underwent an MI THA versus a traditional incision THA. We also evaluated the two groups for differences in demographics and reasons for revision.

Patients and Methods

We retrospectively reviewed the records of 56 patients (59 hips) undergoing revision THA during a 3-year period

(2006–2009). We excluded 13 patients (13 hips) having revisions performed for infection or rerevisions, leaving 43 patients (46 hips) for review. Patients with surgical incisions less than 10 cm in length were included in the MI group [2, 7, 21]. All of the index MI THA procedures were performed at seven outside institutions. The index procedure for three of the 31 non-MI THA revisions were performed at our institution. Of the 59 revision THAs performed, 15 met the criteria for MI THA leaving 31 hips as non-MI THA. Thirty-nine of the 43 patients had a preoperative diagnosis of osteoarthritis, two had osteonecrosis and two had post-traumatic arthrosis. We reviewed the initial patient consultation, prior medical records, clinic notes, radiographs, and the operative report of the revision procedure. Data obtained on every patient included age, gender, body mass index (BMI), time to revision, reason for the revision procedure, intraoperative findings, implants revised, incision length, and type of surgical approach used for the index THA. The mean followup was 15 months (range, 4–30 months). In the MI THA revision group, the primary stems used were cementless, proximally-coated and included 11 flat-tapered designs and four dual-tapered designs. No patients were lost to followup. We had prior Institutional Review Board approval.

We determined differences in duration from index procedure to revision, age, and body mass index using the Kruskal-Wallis rank test. A multivariate logistic regression was performed to evaluate the odds of having revision surgery less than 2 years from the index THA. Statistical analyses were performed with the SPSS (Chicago, IL) statistical software package.

Results

The non-MI THA group had a greater ($p = 0.001$) average time to revision of 14.8 years compared with 1.4 years in the MI THA group. Eighty percent of the MI THA patients (12 of 15) were revised within 24 months of the index procedure as opposed to 13% (four of 31) of the non-MI THA patients (Table 1). When controlled for age, gender, and BMI, having MI THA conferred an increased risk of having revision surgery within two years of the index operation (OR = 26.5, 95% CI 4.4–160.0).

There was no difference in the likelihood of revision in the two groups between the genders (Table 1). The ages in the two groups were similar ($p = 0.84$) at the time of their primary THA (64.5 years for the MI THA compared with 54.7 years for the non-MI THA patients) and the age at the time of revision was similar ($p = 0.33$) (MI group 65.9 years versus non-MI group 69.8 years). There was no difference ($p = 0.87$) in BMI between the two groups (Table 2).

Table 1. Comparison of MI and non-MI THA failures

Variable	MI THA (N = 15)	Non-MI THA (N = 31)	p value	Odds ratio
Age at 1° THA (years)	64 (range, 44–84)	54 (range, 15–85)	0.84	
Gender (percent female)	60%	76%	0.71	
Body mass index (kg/m ²)	27.3	27.2	0.87	
Time to revision (months)	16 (range, 1–41)	177 (range, 8–453)	0.001	
Percent revised < 2 years	80%	13%		26.5

MI = minimal incision.

Table 2. Revision MI THA patient characteristics

N	Age at primary (years)	Gender	BMI (kg/m ²)	Diagnosis	Age at revision (years)	Time to revision (months)
1	49	M	28.2	OA	52.3	39
2	84	F	27.2	OA	84.1	1
3	70	M	27.2	OA	70.7	8
4	72	F	28.1	OA	75.4	41
5	58	M	34.4	OA	58.8	10
6	68	M	33.8	OA	69.1	13
7	55	M	41	OA	55.3	4
8	44	F	25	OA	45.3	15
9	76	F	22.7	OA	76.8	9
10	68	F	22.8	OA	70.6	31
11	68	F	22.8	OA	69.8	21
12	65	F	21.9	Posttraumatic	66.4	17
13	51	F	21.5	OA	52.0	12
14	65	M	26	OA	66.7	20
15	74	F	26.5	ON	74.8	10

MI = minimal incision; M = male; F = female; OA = osteoarthritis; ON = osteonecrosis.

The reasons for revision in the non-MI THA group included aseptic loosening (N = 23 hips), progressive osteolysis (N = 12 hips), an existing or pending periprosthetic fracture (N = 7 hips), instability resulting from acetabular malpositioning (N = 1), and polyethylene liner dissociation (N = 1). Fifteen patients in the non-MI group had more than one cause for revision. In the MI THA group, seven patients required revision for failed osseointegration of either the femoral and/or acetabular components, three for implant loosening, three for intraoperative periprosthetic fracture, one for ankylosis from heterotopic ossification, and one for an intolerable limb length discrepancy of 2 cm (Table 3).

Discussion

This analysis stemmed from our growing concern that many of our aseptic revision THA cases were performed for failed primary minimal incision procedures. As the debate of the merits of MI THA continues, the scientific

evidence showing benefits from MI THA has been limited. There are no data with regard to the long-term outcomes of MI THA. Specifically, authors have questioned the durability of MI THA, the economic impact of the subsequent early revision, and the poor level of evidence behind followup studies [3, 10, 23]. This study aimed to compare the time to revision from the index procedure for patients treated with MI THA versus non-MI THA. We also sought to identify differences in patient demographics and reasons for revision between the two groups.

Our study has several limitations. First is the small sample size. Although 15 failed MI THAs over a 3-year period is a small case series, the scope of this problem may increase substantially in the near future given the relatively recent adoption of MI techniques as well as the ongoing marketing campaigns produced by many surgeons. Second is a poorly characterized referral population. Our tertiary joint replacement practice accepts referrals from the local and regional communities. Although many of these referrals are for septic processes or rerevision (22% in this series of total hip revisions), most of these cases are for

Table 3. Operative data for MI THA patients

N	Approach	Reason for revision	Procedure
1	Lateral	Aseptic acetabular and femoral loosening	Revision of acetabulum and femur
2	Posterior	Unrecognized intraoperative acetabular fracture	Acetabular revision
3	Anterior	Failed femoral osseointegration	Femoral revision
4	Posterior	Failed acetabular osseointegration	Acetabular revision
5	Lateral	Unrecognized intraoperative femoral fracture	Revision of femur and acetabulum
6	Posterior	Ankylosis from heterotopic ossification	Resection of heterotopic ossification
7	Anterior	Failed acetabular osseointegration	Acetabular revision
8	Anterior	Leg length discrepancy	Femoral revision
9	Posterior	Unrecognized intraoperative femoral fracture	Femoral revision
10	Posterior	Failed acetabular osseointegration	Acetabular revision
11	Posterior	Failed acetabular osseointegration	Acetabular revision
12	Posterior	Aseptic acetabular loosening	Acetabular revision
13	Posterior	Failed acetabular osseointegration	Acetabular revision
14	Posterior	Failed acetabular and femoral osseointegration	Revision of acetabulum and femur
15	Posterior	Aseptic acetabular and femoral loosening	Revision of acetabulum and femur

aseptic failures. Without the benefit of a captured population as one might see within the Veterans' Health Administration or a closed model health maintenance organization, it is impossible for us to characterize the population that makes referrals to our practice and the number of MI THAs being performed within that group. Also, in the referral population seen at our academic medical center, we may be experiencing the learning curve of community orthopaedic surgeons who are introducing these techniques to their practice. Authors have described learning curves of between 10 and 60 cases for a variety of orthopaedic procedures to include MI THA and TKA and periacetabular osteotomy [13, 14, 19, 22]. Third, we chose a conservative definition of MI surgery of 10 cm by one that is substantiated by innovators of these techniques [2, 7, 21]. The surgical approach was excluded from our definition as was the perioperative rehabilitation protocol that the patient experienced during the primary THA. Finally, our data collection was subject to the accuracy of prior medical records and patient history. However, missing data does not affect the differences we found in the time to revisions and only the analysis of potentially confounding factors when that information was missing.

Our data show a substantial decrease in the time to revision for those patients who underwent MI THA compared to non-MI THA. This may confer an increased risk of early revision when MI THA techniques are used. At this point, studies in favor of MI techniques point to early hospital discharge and less pain in the immediate postoperative time period [7, 9]. Multiple studies point to short-term problems with these techniques that include an increased risk of fracture, nerve palsy, or early reoperation [1, 2, 15, 24]. Two reports, however, suggest no difference

in short-term complications and functional gains between MI and traditional techniques [11, 16]. Questions still remain concerning the long-term durability of these procedures [10, 21]. We should not compromise the long-term survivorship of THA for modest short-term gains that may be afforded by MI techniques.

There were no differences between the groups with regard to age, gender, and body mass index. The multivariate logistic regression analysis confirmed that these variables did not influence the risk of having revision surgery within two years of the index procedure.

The reasons for revision were different between the two groups. In the non-MI THA group, most revisions were, as expected, for wear-related causes. These data are consistent with previous reports that wear-related causes are the leading indication for revision THA in the United States in 2006 [5]. The MI THA failures were all directly related to errors in surgical technique. These failure modes highlight the technical challenges that exist with MI THA. However, we want to emphasize that these data cannot accurately predict the midterm and long-term survivorship of MI THA performed well.

The durability of THA may be judged by the rate of revision THA and the time elapsed before the need for revision surgery. While we could not determine the overall rate of revision THA without the denominator from the referral population, we could determine the time to revision surgery for our cohort of aseptic total hip failures. With a time to revision 10 times shorter for the subset of MI THA patients, we believe a MI technique may be a risk factor for early failure of primary THA. If generalizable, this finding could have a major impact on patients and the burden and expense of revision THA in this country [4, 8, 12].

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