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MIS Total Hip Replacement with a Single Posterior Approach

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The posterior single incision MIS total hip replacement is a safe and effective operation when performed by surgeons who have the skill to do it and have taken the time to learn how to perform it correctly. The operation is important to patients and improves their confidence in their operation as shown by our psychological survey. The focus of MIS surgery is to provide earlier functional improvement for patients. The posterior single-incision MIS operation does provide less pain and better function in the first 3 months as compared with a long incision. The posterior incision is equal, if not superior, to the anterior intermuscular incision, by gait studies, in the first 6 weeks postoperatively. For these reasons, surgeons who perform a long posterior incision, and want to do a hip replacement with a small incision, should do so with the single-incision posterior approach, which provides for them an anatomical familiarity.
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We have studied minimally invasive total hip replacement surgery performed through a single posterior incision for five years. This is an operation that is easiest for surgeons who have used the traditional posterior approach. Reduction in the size of the skin incision, and the hip tissues incised, increases the difficulty of the operation and increases the stress in the operating room for the surgeon. For that reason, some surgeons simply cannot perform this operation safely and effectively.[1] The published data of Woolsen and coworkers[1] showed failure to achieve satisfactory component positions and a conclusion that the operation was not safe for them. On the other end of the Bell curve (surgeons and their skills fit a Bell curve just as all other activities in life) are those surgeons who can perform the most difficult of small incision surgery, which is the two-incision MIS operation.[2] Berger has been the leader in describing this operation and publishing results with it.[2] Most total joint replacement surgeons (the body of the Bell curve) have the skills to perform small-incision surgery and want to accept the challenge to improve their skills and provide this option for their patients. They want the assurance that small-incision surgery can be performed safely and effectively and provides some benefit for the patient. The purpose of this report is to summarize our experience to date and detail the reasons that we continue to do this operation for our patients.

MIS total hip replacement with a single posterior approach should be the favorite operation by surgeons who currently use a long posterior incision. It can be easily learned with dedication of time to the learning process. It can be performed safely and effectively with no impact on durability of the operation, and it can provide a true sense of accomplishment for the surgeon who rises to the challenge and improves his/her surgical skills. It provides a clear benefit to the patient through an increased confidence in the operation.

Technique

The technique for this operation has been explained in detail, both visually and in words, in the book, *Hip Arthroplasty: Minimally Invasive Techniques and Computer Navigation.*"[3]

The incision must be made over the posterior one-third of the trochanter and, the bigger the patient is, the more posterior the incision must be. The incision extends from the level of the vastus tubercle at the distal end of the greater trochanter proximally to 3 cm cephalad to the posterior tubercle of the greater trochanter. The first incision into hip tissue is

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Table 1 Influence of Anterior–Posterior Pelvic Tilt on Inclination and Anteversion*

Computer Measurement	Posterior Tilt 10–20°	Posterior Tilt 1–9°	Anterior Tilt 0–9°	Anterior Tilt 10–20°	P Value
Computer inclination† (°)	40.4 ± 4.4	38.7 ± 3.5	42.0 ± 4.5	49.2 ± 4.2	0.001
Computer adjusted inclination (°)	41.7 ± 4.5	41.7 ± 3.6	40.6 ± 4.0	43.1 ± 4.0	0.38
Computer anteversion† (°)	24.2 ± 3.7	17.3 ± 5.9	29.5 ± 3.4	36.7 ± 3.9	0.001
Computed adjusted anteversion (°)	27.3 ± 3.2	26.8 ± 3.4	27.2 ± 2.2	27.2 ± 2.0	0.93

*The anteroposterior tilt of the pelvis is divided into four categories according to the number of degrees of tilt. The effect of adjustment by pelvic tilt is shown by the difference in unadjusted computer inclination and anteversion values compared to the similarity of adjusted inclination and adjusted anteversion values.

†The number of degrees of anterior–posterior pelvic tilt is statistically related to these measurements.

done in the gluteus maximus muscle, which is incised for 6 to 8 cm along the posterior border of the greater trochanter. The second incision into hip tissue is through the small external rotators and the posterior capsule. This incision is made as a single flap from just proximal to the quadratus femoris muscle through the piriformis tendon, including 3 cm of the gluteus minimus muscle that lies under the piriformis tendon. The third incision into hip tissue is the inferior medial capsule, which is incised from the anterior femur to the acetabulum through the transverse acetabular ligament.

Reaming is done with three sequential reamers. The first reamer size selected is 3 mm smaller than the anticipated cup size, the second is 2 mm smaller, and the third is 1 mm smaller, which means that the cup is 1 mm underreamed. The first reamer removes the acetabular ridge, and this reaming is done to the cortical bone of the cotyloid notch. The second reamer established the periphery of the acetabulum and began to form the hemisphere. The third reamer is a curved/angled reamer, which must be used with this small incision to produce a hemisphere accurately. The handle of a straight reamer abuts the distal edge of the wound, which sometimes can force the reamer into a superior position in the acetabulum and even ream away the superior wall of the acetabulum.

The implantation of the acetabular component requires a curved cup holder. With a straight-handled cup holder the handle may lever against the wound edges and alter the position of the cup. The inclination of the cup should be 40 to 45° to optimize the wear of the cup and to avoid impingement.[3] The anteversion of the cup should be 20 to 30°, depending on the anteversion of the femur, so the combined anteversion of the cup and stem is between 30 and 35°.[3] It is critical to avoid impingement between the metal neck and the cup or the trochanter bone and the pelvis, and these implant positions will help facilitate this. The other technical maneuver that helps avoid impingement is to use the largest femoral head possible to increase the head/neck ratio. Lateralization of the cup promotes impingement between the metal neck and the cup and also can cause iliopsoas tendonitis by the tendon rubbing on the anterior edge of the cup.

Preparation of the femur begins with exposure with three retractors. A retractor is placed under the anterior edge of the femoral neck, which elevates the femoral neck into the wound. A second retractor is placed on the medial femoral neck to retract the quadratus femoris muscle away from the bone, and a third retractor is placed against the gluteus medius tendon to retract it from the tip of the greater trochanter. The two techniques that should be used to avoid fracture of the femur are aligning the posterior edge of the femoral broach and stem with the posterior cortex of the femur and having the lateral side of the broach under the tip of the greater trochanter (antivarus sign) to ensure that the tip of the stem is in the center of the canal distally.

Closure of the wound is performed by repairing the posterior flap of the posterior capsule and small external rotator muscles to the cut edge of the gluteus minimus muscle. This closure eliminates dead space and provides tension to the gluteus minimus muscle (which functions to help hold the femoral head in place). The remainder of the closure is completed in layers of fascia, subcutaneous, and skin, with the skin being repaired with a subcuticular suture that does not require removal.

Technique with Computer Navigation

Our experience for the development of imageless computer navigation for total hip replacement has been published.[4] The advantage of computer navigation is to allow the acetabular component placement to be reproducibly and accurately performed. The computer allows this accurate placement by providing real-time intraoperative knowledge to the surgeon of the pelvic tilt. By knowing the tilt of the pelvis (pelvis position) at the time of cup placement, the cup can be reproducibly implanted in a format familiar to the surgeon (Table 1). The accuracy of the computer has been validated by us with 23 postoperative computed tomography (CT) scans, which showed that the mean difference between the Navitrack inclination and CT inclination was 0.6° and the mean difference between Navitrack anteversion and CT anteversion was a mean 1.6°. The intraclass correlation of the measurements was 0.9 for inclination and 0.79 for anteversion. The pelvic tilt was particularly important in obtaining accurate anteversion of the cup.

A second important lesson learned from the computer, and a second important feature that the computer provides intraoperatively, is the relationship of medialization of the center of rotation of the acetabulum to obtain inclination of 40 to 45° with correct coverage of the cup to avoid impingement. Medialization of the cup was statistically significant for avoidance of impingement when it was 6 mm. If impingement was present the medialization averaged 3 mm. Six millimeters of medialization can be assumed, without the computer, by eliminating all floor osteophytes and reaming through the acetabular ridge to the cortical bone of the cotyloid notch. The advantage of the computer is that the correct medialization for correct coverage of the cup can be both qualitatively and quantitatively achieved.

A third finding from our use of the computer is that the femoral component does not usually have 10 to 15° of anteversion. The femoral stem anteversion has been assumed to be 10 to 15° in most previous finite element studies of combined anteversion and impingement.[5,6] The average femoral anteversion in our patients was 7° with men having an average of 5° and women 9°. Therefore, if a computer is not available, the anteversion of the cup for men should be targeted for 25° while the anteversion for women could be targeted for 20°. Hips with dysplastic geometry (shallow acetabulum and neck shaft angle of 140° or more) have femoral anteversion that can be 15 to 20°, so the cup should be targeted to 20°. The advantage of the computer is the ability to know accurately the anteversion of the femur and thereby customize the anteversion of the acetabulum. The combined anteversion that correlated with avoidance of impingement was 34°. We have had anterior dislocations when the combined anteversion has been above 40° so that a target number for combined anteversion should be 35 ± 5°.

Summary of Studies with MIS Posterior Single Incision

Pain Management

One of the tremendous advantages in the postoperative care of patients with total hip replacement that was stimulated by small-incision surgery has been the change in pain management techniques.[7] The new fundamentals for successful pain management are 1) the prevention of pain and 2) the avoidance of intravenous narcotics. If pain can be prevented, the patients are not as afraid of the pain, do not develop a cerebral sensitivity to the occurrence of pain, and require much less pain medication. The avoidance of intravenous narcotics essentially eliminates lethargy, hallucinations, nausea, and vomiting, and mediates the inability of older patients to participate in physical therapy. A multimodal approach to pain management can very effectively prevent and control postoperative pain with total hip replacement and allow patients to feel better, function better, and be discharged home sooner. With the anesthesia/pain management program that we use, 105 patients with primary total hip replacement and a posterior mini-incision were prospectively followed in the year 2004. Only two patients required continuance of the epidural beyond the recovery room and only two others required any intravenous narcotic (Dilaudid) in the recovery room. Remarkably, 101 of 105 patients were managed without any intravenous narcotics (this program can be seen in detail by visiting our web site, www:dorrarthritisinstitute.org).

The multimodal program prevents pain at three sites: 1) the local wound in the hip, 2) spinal cord transmission, and 3) cerebral interpretation of the pain. The local pain is initially prevented for 18 to 24 h by an injection into the hip tissues. This injection should be 400 mg of Ropivacaine, 40 mg of DepoMedrol, and 4 mg of morphine delivered with saline in a volume of 100 mL. The spinal cord transmission of pain is, in part, accomplished with the Cox-2 enzyme. Therefore, Cox-2 inhibitors are given to help dull this spinal cord response. The only Cox-2 drug available now is Celebrex, which is given in a dose of 400 mg preoperatively (before the induction of anesthesia) and continued with 200 mg twice daily during hospitalization and 200 mg per day for 2 weeks after discharge. The Mu receptors are blocked by oral oxycodone with 10 mg given preoperatively, the evening of the first postoperative day, and then once a day on postoperative days 2 and 3. Patients who are especially sensitive to oxycodone do not need the doses given after the day of surgery. Oxy R, which is a more rapid acting oxycodone, is given in a dose of 5 mg in the recovery room. Breakthrough pain is treated with an intravenous administration of 30 mg of Ketorolac (15 mg for patients over the age of 70). Ketorolac is continued for the first 48 h on the floor with a dose of 30 mg or 15 mg up to three times per day. The Ketorolac also aids in helping to block Cox-2 function in the central nervous system. Acetaminophen (Tylenol) is given in a dose of 500 mg preoperatively and continued postoperatively to block the Cox-3 enzyme in the thalamus. The Cox-2 drugs, the oral opioids, and the Tylenol all help block the impact of pain signals on the thalamus. The cerebral cortex can be influenced by a preoperative class. In the preoperative class the patients are educated on the pain management program and the anticipated level of pain and this significantly reduces their anxiety and fear about pain and therefore their response to any pain is somewhat controlled. In the 2004 mini-incision group that had 101 of 105 patients that used no epidural or intravenous opioids, the pain scores were all 4 or lower during hospitalization. The patients self-assessed their pain on a scale of 0 to 10 with 10 being the worst pain. The pain scores and the pain medications used by these patients are displayed in Table 2.

Function at Discharge

All 105 patients of the MIS posterior single incision group from 2004 were found to have satisfactory reconstruction of their hip with their hip replacement (Table 3). The postoperative rehabilitation protocol for these patients allowed full weight bearing on the operated limb. The patient could advance to a cane as quickly as tolerated, and, inside the home, could eliminate the cane as soon they felt they were safe without it. At the time of discharge, all patients were on an assistive device. Fifty-eight percent were on a cane and 20% were on a single crutch, so 78% of patients were on a single assistive device. By 6 weeks after surgery, 78% of patients were using no device and 15% were using a cane, so 93% of patients were able to be active community ambulators. By 3 months after surgery, 98% of patients were using no device, and 2% of patients were using a cane so that all patients were

Table 2 Summary of Pain Score and Analgesia Requirements

Pain/medications	Mini-incision 2004 Group
Pain during hospital stay[a]	
Day of surgery	0.9 ± 0.9
Postoperative day 1	2.0 ± 1.0
Postoperative day 2	2.5 ± 1.1
Postoperative day 3	1.6 ± 0.8
Day of discharge	1.7 ± 0.7
Analgesia requirements (tablet/person)	
Opioid Analgesic Combinations	
Day of surgery	0.3 ± 0.6
Postoperative day 1	1.9 ± 1.7
Postoperative day 2	2.7 ± 2.0
Postoperative day 3	2.1 ± 1.5
Nonopioid analgesia	
Day of surgery	0.6 ± 0.6
Postoperative day 1	0.6 ± 0.7
Postoperative day 2	1.2 ± 1.0
Postoperative day 3	1.3 ± 0.8

[a]The self-assessment pain score (0–10) was used for the evaluation of pain during the hospital stay. Opioid analgesic combinations included Vicodin, Norco, Darvocet, and Darvon. Nonopioid analgesia included Tylenol and Ultram.

active community ambulators. At 6 weeks after surgery, muscle strength was graded as 4.7 for straight leg raising (scale 0 to 5), and side lying abduction was 4.8. At 3 months postoperatively straight leg raising graded a mean of 5.0 and side lying abduction also had a mean of 5.0. All patients regained excellent muscle strength by 6 weeks.

Psychological Survey

We were quite curious as to why patients so favored the small-incision operations. We therefore conducted a psychological survey of 210 patients, 144 of whom had MIS posterior single incision surgery and 66 of whom had a traditional long posterior incision. The patients were surveyed preoperatively, at 6 weeks, and 1 year postoperatively. The patients responded to 14 queries about the question that read, "Do you feel a patient who has a small incision is more likely to have the following. . . " with a yes, no, or no difference response. The general results of this survey at 6 weeks were that patients who had the MIS operation exceeded their expectations. The patients who had a long incision would have preferred to have an MIS incision, based on their answers to the questionnaire preoperatively and at 6 weeks.

Pain was the least important difference in the choice postoperatively between the operations because patients who had a long incision were quite happy with their pain treatment. Specific question results at 6 weeks showed that patients believed that an MIS operation resulted in less injury and an ability to be out of bed sooner. Functionally, patients believed the MIS operation resulted in quicker healing, being able to walk sooner without pain, and being independent sooner and having less of a limp. Perhaps most important were the answers to the questions in the domain of attitude. All patients believed that with MIS single posterior incision the body was less violated. All patients felt that an MIS operation would make them more confident of success, give them a more positive attitude toward surgery, and provide more satisfaction for them. At 1 year postoperatively, cosmesis was only important to 50% of the patients and yet the majority of them still preferred small-incision surgery. At 1 year, all 210 patients felt that the operation had met their goals and that they had a positive outlook for longevity. Eighty-one percent of the patients who had an MIS posterior single incision operation still cared that they had this approach. Only 10% of the 210 patients would have a long incision by choice. Of those who had a long incision, only 30% would have a long incision again by choice, even though they had met their goals with the long incision operation. Fifty percent of patients felt the incision size affected the outlook for their hip, but 82% felt that the incision size affected the confidence in their hip.

The conclusions from this study were quite clear that patients want small-incision surgery for total hip replacement as long as it is safe and effective. Patients believe that small incision surgery is better for pain, function, and their attitude toward their operation. The reason this is so is not specifically defined but it seems that, to patients, smaller is equated to a quicker, better, and more efficient operation.

Gait Studies

We have performed gait analysis studies on patients with long posterior incisions, miniposterior incisions, and anterior intermuscular incisions (Matta approach). These studies are still ongoing, and we do not have the numbers necessary to make the results statistically different. However, there are some trends that are significant and we anticipate a significant difference. In summary, the posterior mini-incision and the anterior mini-incision are similar for all the gait characteristics studied, except for the gait velocity at 6 weeks and the double limb stance support at 6 weeks, which favor the posterior incision. There is no difference at 3 months between stride length (with slow or fast walking), cadence (with slow or fast walking), and single limb support (with slow or fast walking). The greatest difference is between posterior long incisions and both the single small incisions. These differences are present through 3 months for single limb support (both slow and fast walking), and double limb support (both slow and fast walking), as well as gait velocity at 6 weeks between posterior long incisions and posterior mini-incisions (both slow and fast walking). Stride length was

Table 3 Summary of Radiographic Results

X-ray Measurements	Mini-incision 2004 Group
Cup abduction angle (°)	41.1 ± 5.1
Cup anteversion angle (°)	22.6 ± 3.8
Stem alignment angle (°)	0.6 ± 1.7
Leg-length discrepancies (mm)	0.1 ± 5.7
Offset discrepancy (mm)	2.2 ± 5.3

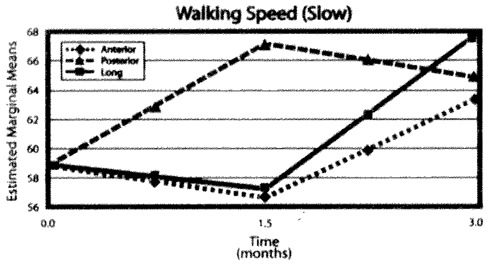

Figure 1 Gait velocity at 6 weeks and 3 months. The time periods are 1, preoperative; 2, 6 weeks postoperative; and 3, 3 months postoperative. The measurements were all normalized before the statistical comparison. The anterior and long-incision patients walked with less gait velocity at 6 weeks than did the posterior mini-incision patients. By 3 months, all three groups were the same. These data were for the patients using a normal walking speed (termed slow walk).

better in the posterior mini-incisions than either anterior or long incisions for both slow and fast walking at 6 weeks, but did not differ at 3 months. Figures 1 and 2 show the gait pattern of gait velocity with a slow walk and single limb stance with slow walk. These gait results mean that patients with a long incision do not have as much leg strength or confidence in their leg, therefore, their single limb stance time is shortened. The stride length and velocity are initially better in the posterior mini-incision patients because the anterior incision and the long-incision patients do not like to go into extension with their hip, which shortens their stride and slows their speed.

Randomized Study

We have been conducting a randomized study between miniposterior incision and long incision operations for more than 18 months and have only been able to enroll 57 patients to date. We plan to enroll 30 patients in each group and then stop the study because of the difficultly in enrolling numbers. Patients simply prefer to have a mini-incision and do not want to take the chance of getting a long incision, and that is the reason for the difficultly in enrollment. This prejudice to the mini-incision may be somewhat regional, but certainly exists in Southern California. The goals in this study were no intravenous narcotics would be needed; ambulation at the time of discharge would be with a single assistive device; and discharge would occur within 48 hours. Any patient who did not meet these challenges represented a failure of the goals of the study. The reason these goals were set was our belief that to truly test whether the mini-incision was better than the long incision there had to be definitive goals that the patient should meet to determine whether one approach or the other would be different. With pain control in the hospital, 7 of 28 patients with long incisions and 1 of 29 patients with a short incision required Dilaudid in the recovery room, and 1 long incision required a PCA versus none of the posterior mini-incisions. The pain levels on the floor were for each day of the stay and at discharge were not statistically different but favored the posterior mini-incision. On days 0, 1, and 2 the posterior mini-incision patients had a pain level mean score of 2.5, and the patients with a long incision had a mean score of 3.2. At the time of discharge the pain level was 2 for the mini-incision and 3 for the long-incision patients. More patients with a mini-incision met the 48-h discharge goal. On day 3, 18 of 28 (65%) long incisions were still in the hospital compared with 8 of 29 (28%) mini-incisions ($P < 0.01$). The mini-incision patients also better met the goal of a single discharge device. At discharge, 17 patients (60%) were on a single device and 11 patients (40%) were on a double support device in the long-incision group, whereas 26 (90%) were on a single support and 3 (10%) were on a double support in the mini-incision group ($P < 0.03$). The gait analysis of the patients in the randomized study mirrored the data results in the larger gait cohort study.

Discussion

The clinical studies that we have done with MIS surgery using a single posterior incision have demonstrated that this operation is safe and effective. For those surgeons who want to rise to the challenge of small incision surgery and who already perform a traditional posterior approach, these data can give them confidence that they are doing a better job for their patients if they become proficient at this operation. The psychological studies clearly show that patients want this operation. They would not sacrifice safety and durability of the operation for a small incision, but patients certainly have more confidence in the operation if a small incision is performed. The fact that patients at 1 year, even with a successful long incision that meets the goals of the patient, would choose a small incision for reasons other than cosmesis emphasizes the confidence that small incisions provide. It is not possible to completely understand the psychological dynamics of this choice by patients. However, the concept of implicit cognition[8] may explain some of it. Patients gain a prejudice through life that with injury or surgery "smaller is better." Most patients through life have also learned that, the more efficient a job is, the better the outcome, and smaller incisions seem more efficient to patients. When a surgeon can perform his physical task in a manner that increases the mental well-being of the patient, the surgeon should always

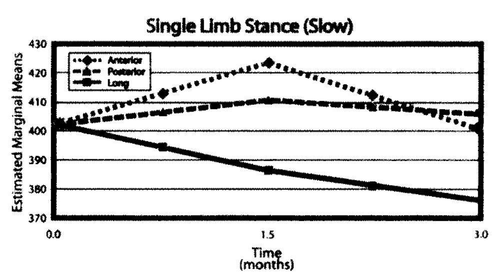

Figure 2 The single limb stance test is a measurement of leg strength and subconscious confidence in the leg. The measurements were normalized and the time periods are 1, preoperative; 2, 6 weeks; and 3, 3 months. The anterior and posterior incisions are essentially the same at 6 weeks and 3 months whereas the long incision does not show the same leg strength or subconscious confidence in the leg at 3 months as is present with the small-incision patients.

choose that method. This psychological survey accentuates once again that the outcome of a surgical operation is a mixture of the science and art of medicine, with the art of the treatment perhaps influencing the patient more than the science!

Patients do want small incision operations to be safe and effective. The data from almost all studies with small incisions show that this has been true. The study by Woolsen and coworkers[1] had component positions that were not satisfactory to those surgeons and they made the correct decision that this operation is not one that they can perform. The randomized study of Ogonda and coworkers[9] showed no difference between small incision and long incision posterior surgery, but the conclusion of these authors was that small incision surgery was safe. These authors did achieve good component positions and no unusual complications. Our ability to achieve satisfactory component positions with the posterior single incision operation has been confirmed by the operations of surgeons Sculco,[10] Wenz,[11] DiGioia,[12] and Beverland.[9] Surgeons Berger and Duwelius[2] have reported satisfactory component positions with the two-incision operation and surgeons Berger[13] and Duncan[14] have had satisfactory component position with the single anterior incision. There is absolutely no reason to suspect that a different long-term durability between small incisions and long incisions will occur if the same components are used and the same component positions are achieved. After all, long-term failure occurs from loss of fixation, which can be secondary to wear. The position of the components, combined with a satisfactory fixation and articulation surface, has been shown to be a prime determinant of durability. It is therefore easy to project the durability of a total hip replacement by 2 years postoperative because the quality of the articulation surface is known, the fixation is determined by this time, and the component positions are known. The 5-year follow-up of Sculco's operations reported by Wright and coworkers[15] clearly support the argument that the posterior single incision operation, correctly performed, will have the same durability as a long incision.

Our results, to date, of the randomized study differs somewhat from those of Chimento and coworkers[10] and Ogonda and coworkers[9] The differences are not great. The differences may perhaps be because we set definitive goals that the patients had to meet as criteria for comparison. A second reason for the difference may be the operative technique. Ogonda and coworkers,[9] (surgeon Beverland) performed the operations with just a smaller skin incision and then did all the tissue work the same below the skin. In our technique, there were five differences between the two operations: 1) no incision was made into the tensor fascia; 2) the gluteus maximus muscle was split for only 6 cm versus 10 to 12 cm with a long incision; 3) the only capsular incisions were a 3 to 4 cm posterior capsular incision and an incision through the medial capsule from the anterior femur to the cortical bone of the cotyloid notch. The posterior capsular incision was repaired. There was no excision or incision of the superior and anterior capsule. In the long incision the anterior capsule was excised and the superior capsule was incised, as was often the reflected head of the rectus; 4) the gluteus maximus tendon was not released in the mini-incision; and 5) the quadratus femoris muscle was not released in this mini-incision. In the randomized study, there were goals to be met by the patients, and the results showed that these goals were better met by the patients with the small incisions. The patients with the small incision used less intravenous narcotics in the recovery room; did have smaller, but rather insignificant, differences in pain scores in the hospital; did have statistically more patients that could go home sooner; and did have statistically more patients that achieved the functional level of a single assistive device in the hospital. These goals were important because the focus of doing a smaller incision is to give the patient more confidence in the operation. Confidence is increased with excellent pain control and rapid return of function. The gait studies objectively confirmed a rapid return of function with the posterior incisions being better than the long posterior incisions even to 3 months. The posterior incision, which does cut some muscle, was at least as good as the anterior incision, which promotes its superiority because it cuts no muscle, and was better than this anterior incision in extension of the hip in the first 6 weeks.

When a new technology is introduced there are always more complications. The main increase in complications with small-incision surgery has been an increase in fractures of the femur. This has been especially reported with the two-incision technique.[16] Our own experience with the posterior single-incision operation has also had an increase in fractures of the femur, both intraoperatively and postoperatively. In 5 years, we created three fractures of the femur intraoperatively by trying to increase the insertion depth of a collarless implant for balance of leg length and offset. When the quadratus muscle is saved there is not complete visualization of the femoral neck and the cut level of the femoral neck is not as accurate as when the lesser trochanter is visible. We made the error of trying to impact the stem deeper rather than simply removing more femoral neck. This complication can be avoided in the learning phase by initially releasing the quadratus femoris muscle so that the lesser trochanter is visible and the surgeon thereby has a better comfort zone for the level of the femoral neck cut. During this learning time, the surgeon can be educating himself/herself with the use of the tip of the greater trochanter or the inferior edge of the femoral head as a new landmark for measurement.

Interestingly, there have also been three postoperative fractures (rather than dislocation) that have occurred in patients who have had trauma, such as a fall at home, within weeks of their surgery. We assumed these fractures were caused by a more stable joint secondary to the lesser surgical tissue trauma to the hip capsules and muscles. Because the hip is a more stable joint, the patient jams the hip joint rather than dislocating. When the force of the trauma is absorbed by the hip joint, rather than dissipated by dislocation, the femoral component sinks into the femur and a fracture occurs. This fracture in our experience was mostly a proximal medial fracture that required a reoperation and repair (by wires) of the fracture and revision of the stem.

Different complications with new technology are not unusual and should not deter the progress of new technology. Surgeons who were in practice during the 1980s can remember the introduction of noncemented technology. There was a higher percentage of failure of noncemented stems with some designs, and noncemented cups with other designs, during this initial period of noncemented implantation. This failure of noncemented implants did not cause surgeons to stop the use of these implants and currently noncemented cups and stems are used with more prevalence than are cemented implants. Another example is arthroscopy. How many knees had articular cartilage injured by the use of the arthroscope in the formative years of learning that technique? There are few surgeons who would believe that an open knee operation is more beneficial for patients than arthroscopy despite the articular damage created in the early years. Small-incision surgery is so important to patients, and achieves its goal of better function early, that it too will become the standard.

Computer navigation will facilitate the technical performance of total hip replacement through small incisions. The ability of the surgeon to have real-time information of the component positions, and the avoidance of impingement, will be of tremendous benefit for the patient in securing long-term durability of the operation. The use of computer navigation will lead to even more advancement in reduction of intraoperative injury to the patient for performance of this operation. Providing intraoperative knowledge of the bone preparation and the component position will ultimately lead to less invasive surgery and less invasive implants. At this time the computer does allow nearly complete elimination of outliers of acetabular position and optimizes the avoidance of impingement. The use of the computer, when combined with the ability to use a good head/neck ratio (as with a 36 mm or larger femoral head) can provide nearly perfect cup positioning for avoidance of wear and instability caused by impingement.[17,18] Small-incision surgery can be satisfactorily performed without the computer, but, in my experience, it is raised to a higher level with the use of computer navigation.

Posterior single-incision MIS total hip replacement is a safe and effective operation that benefits patients. For those surgeons who have the skill to do so, and particularly those who have used a posterior long incision, this operation will improve the satisfaction of their patients as proved by the psychological survey. The attitude of the patient toward the operation has tremendous influence on the patient for not only day-to-day activities, but particularly if any pain or uncommon symptoms occur with the hip. Since there is no evidence that small-incision surgery will adversely impact durability, and there is evidence that it promotes better early recovery, the surgeon should learn this operation to provide this benefit for the patient and accept the increased intraoperative stress that may occur with small-incision surgery.

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