

Minimal Incision Protocols for Anesthesia, Pain Management, and Physical Therapy With Standard Incisions in Hip and Knee Arthroplasties

The Effect on Early Outcomes

Douglas G. Nuelle, MD, and Kathy Mann, CRNA

Abstract: Dramatic early outcomes with “minimal incision” surgery are attributed to patient selection, perioperative management, and the surgical procedure. This study was one on 50 patients in a single surgeon’s practice who underwent total hip and total knee arthroplasties with standard incisions. The first 25 patients had standard perioperative management, whereas the second 25 had the anesthesia, pain management, and physical therapy protocols described for minimal incision surgery. A dramatic reduction in the time it took to achieve the goals for discharge was observed in the second group. Most patients with the “mini” protocols were ready for discharge within 24 hours. The implications of these results are discussed.

Key words: minimal incision, anesthesia protocols, arthroplasty.

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In the past several years, surgeons and the public at large have shown considerable interest in “minimal incision” joint arthroplasty surgery. Although isolated surgeons have done this for some time [1,2], a broad marketing of this procedure both through print advertising and the internet has resulted in a considerable pressure on orthopedic surgeons to learn and apply this technique. However, there is a paucity of scientific articles demonstrating the value of this procedure.

Dramatic video demonstrations of total hip arthroplasty patients climbing stairs 4 hours after

surgery are impressive [3]. It is claimed that these early successes are caused by 5 factors [3,4]:

1. patient selection and preoperative preparation;
2. minimal tissue trauma from smaller incisions;
3. anesthesia protocols;
4. pain management protocols; and
5. early physical therapy protocols.

There is no information as to how much each of these contributes to the successes seen. The rush to develop new instruments and train surgeons implies that the smaller incision is the main factor. Most of the published data are about hip arthroplasty, but the rush to apply these techniques to knee surgery is just as vigorous with fewer published data.

Some studies critical of minimal incision surgery have shown no benefit to just changing the length of the incision [5]. The question we posed was, if there is no change in the surgical technique or incision length, what impact the “mini” protocols for anesthesia, pain management, and physical therapy alone have on the early results of total joint

From the Fannin Regional Hospital, Blue Ridge, Georgia.

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Douglas Nuelle, one of the authors, is a consultant for Zimmer, Inc. dealing with a soft-tissue balancing device known as the Natural Balance.

Reprint requests: Douglas G. Nuelle, MD, Fannin Regional Hospital, Blue Ridge, GA.

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arthroplasty. Can similar early rehabilitation, early discharge, and pain relief be obtained without changing the surgical procedure?

This study looked into the time it took to achieve certain goals for discharge from the hospital in 50 consecutive hip and knee arthroplasty patients treated by the same surgeon. The first 25 patients were treated with standard anesthesia, pain management, and physical therapy protocols. The second 25 were treated with the anesthesia, pain management, and physical therapy protocols as outlined in the minimal 2 incision hip surgery (MIS-2) procedure [7].

Materials and Methods

Patients

A consecutive group of 50 hip and knee arthroplasty patients was studied (Table 1). The patients were a consecutive all-inclusive group of 50 patients as they presented to a single surgeon's practice. The first group consisted of all 25 hip and knee arthroplasty patients who underwent surgery immediately before the institution of the mini protocols for anesthesia, pain management, and physical therapy. There were 9 men and 16 women. There were 11 hip procedures and 14 knee procedures. The average age of the patients was 69.2 years (range = 23-86 years). All surgeries were done for primary osteoarthritis. The second group consisted of the next 25 hip and knee arthroplasty patients who underwent surgery once the new anesthesia, pain management, and physical therapy protocols for the MIS-2 were instituted. There were 11 men and 14 women. There were 8 hip procedures and 17 knee procedures. The average age of the patients was 66.9 years (range = 34-88 years). All procedures were done for primary osteoarthritis. The same surgeon with the same anesthesia staff and the same physical therapy staff conducted all procedures.

Procedures

Hip. The hip arthroplasties were done through a standard posterolateral approach using the lateral

position. The length of the incision varied from 8 to 12 in, depending on the needs of each patient's anatomy. No incision was shorter than 8 in. The implant chosen was cementless Natural Hip (Zimmer, Warsaw, Ind) in all cases. Cell salvage was used intraoperatively, and no drain was used.

Knee. The knee arthroplasties were done through a standard anterior incision that was at least 8 in long in every case. The fascial incision was a subvastus approach with eversion of the patella. The implant used was the Natural Knee 2 (Zimmer), implanted with cement, in all cases. The soft-tissue balance was obtained with the use of a calibrated device known as the Natural Balance (Zimmer). Hemostasis was ensured with the use of autologous platelet-derived growth factors (platelet gel) applied in the wound at the conclusion of the procedure. Absolutely no attempt was made to decrease the length of the incision in either group.

Anesthesia and Pain Management

The standard protocol was as follows:

1. intraoperative continuous bupivacaine plus fentanyl epidural;
2. intraoperative sedation;
3. postoperative continuous epidural infusion with bupivacaine 0.1% and fentanyl 5 $\mu\text{g}/\text{mL}$ for 24 hours at 4 to 6 mL/h; and
4. at 24 hours, epidural stopped and patient changed to oral and intramuscular narcotics.

The mini protocol was as follows:

1. intraoperative continuous bupivacaine plus fentanyl epidural;
2. intraoperative sedation;
3. intraoperative before incision:
 - a. Ketorolac 15 to 30 mg intravenously
 - b. Dexamethasone 12 mg intravenously;
4. epidural discontinued in the operating room;
5. oxycodone extended release 10 to 20 mg per os twice a day for 4 doses, first dose in recovery;
6. cyclooxygenase-2 inhibitor daily, first dose in recovery;
7. dexamethasone 10 mg intravenously every 8 hours for 2 more doses; and
8. duramorph 1 to 3 mg to epidural before removal of the catheter (knees only).

Physical Therapy

The standard protocol for physical therapy began at the preoperative visit when each patient was evaluated for range of motion, gait, and strength. The in-hospital program was explained to the

Table 1. Patient Population

	Study	Control
n	25	25
Female/male ratio	14:11	16:9
Age (y)		
Average	66.9	69.2
Range	34-88	23-66
Hips	8	11
Knees	17	14
Osteoarthritis	25	25

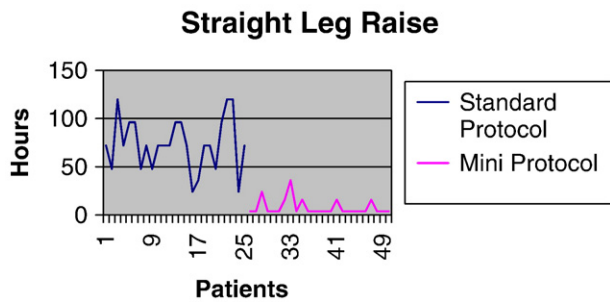


Fig. 1. Time to straight leg raise.

patients, and they were instructed on exercises as well as on use of a walker and were given a handout for exercises. The therapy began the day after surgery, twice each day consisting of exercise, gait training, and mobility transfers. On the second day, patients were transported to the gym, where more intense exercises and gait training were done. This was continued twice a day until the patients achieved goals for a safe discharge, including the following: able to straight leg raise, walk safely with a walker, get in and out of bed independently, and toilet transfer with minimal or no assistance. Knees also had to achieve 90° of flexion.

The new protocol was similar except that the therapy was begun 4 hours after returning from the recovery room and no restriction was imposed. Each patient was allowed to proceed through each task as rapidly as his or her comfort allowed. Those with cases finishing late in the afternoon were first seen early the next morning (~16 hours postoperation).

Chart Review

The study group began with the first patient on whom we instituted the new protocols. The time it took for the patient to achieve certain goals for discharge was recorded in a chart and documented

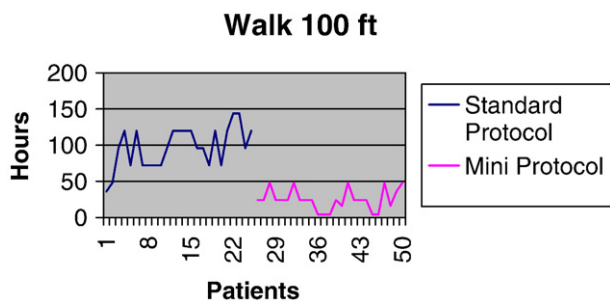


Fig. 2. Time to walk 100 ft with a walker.

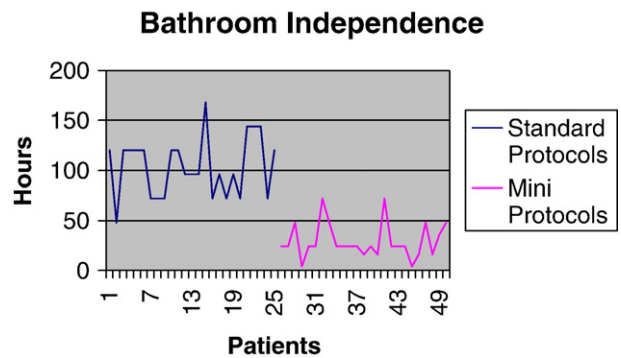


Fig. 3. Time to bathroom independence.

concurrently. The control group consisted of the previous 25 hip and knee arthroplasty patients from the same surgeon. We reviewed their medical records with particular attention to the physical therapy notes that documented the date and time that each patient had achieved those same goals for discharge. The data were analyzed statistically with the *t* test.

Results

We looked into the time in hours it took to achieve the goals for discharge. Those goals were ability to straight leg raise, walk 100 ft with a walker, and get in and out of bed with minimal or no assistance as well as bathroom independence. The knee arthroplasty patients also needed to achieve 90° of flexion before discharge.

As can be seen in Fig. 1, there was a dramatic reduction in the time it took to achieve straight leg raising. The average with the standard protocol was 73 hours; with the mini protocol, 8.0 hours. This difference was statistically significant ($P < .0001$). In fact, only 1 patient in the standard protocol group achieved straight leg raising within 24 hours,

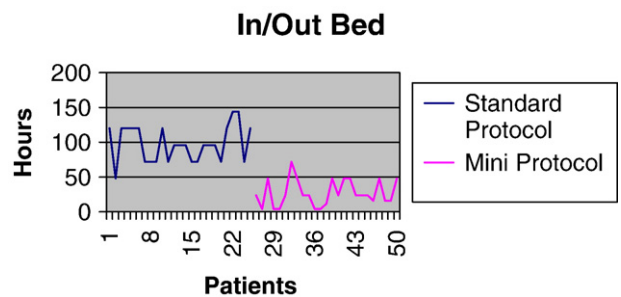


Fig. 4. Time to get in and out of bed with minimal or no assistance.

whereas 19 of the 25 patients in the mini protocol group achieved it within 4 hours.

Fig. 2 shows the time it took for patients to walk 100 ft comfortably with a walker. With the standard protocol, it took an average of 97.4 hours. With the mini protocol, it took an average of 24.6 hours. This difference was statistically significant ($P < .0001$). In fact, with the standard protocol, only 1 patient achieved it within 36 hours, with most taking 72 hours. However, with the mini protocol, 5 patients achieved it within 4 hours and all but 6 achieved it within 24 hours.

Fig. 3 shows the time it took for patients to achieve bathroom independence with minimal or no assistance. The average with the standard protocol was 103 hours. The average with the mini protocol was 29.3 hours. This difference was statistically significant ($P < .0001$). The earliest this was achieved in the standard protocol group was 48 hours by only 1 patient. Only 6 of the mini protocol patients took longer than 24 hours.

Fig. 4 shows the time it took for patients to be able to get in and out of bed with minimal or no assistance. The average with the standard protocol was 97.9 hours. The average with the mini protocol was 27.2 hours. The difference was statistically significant ($P < .0001$). Again, only 1 patient was able to do this within 48 hours using the standard protocol, whereas 5 patients were able to achieve independence within 4 hours on the mini protocol. Most patients were able to do this within 24 hours.

Fig. 5 shows the time it took for patients with knee arthroplasty to achieve 90° of flexion. The average using the standard protocols was 96 hours; that with the mini protocols, 25.6 hours. The difference in this smaller group was still statistically significant ($P < .001$). Two patients in the mini group achieved this within 4 hours, and 9 of 13 achieved 90° within 24 hours.

Fig. 6 shows the hospital stay in days. The average length of stay in the standard protocol

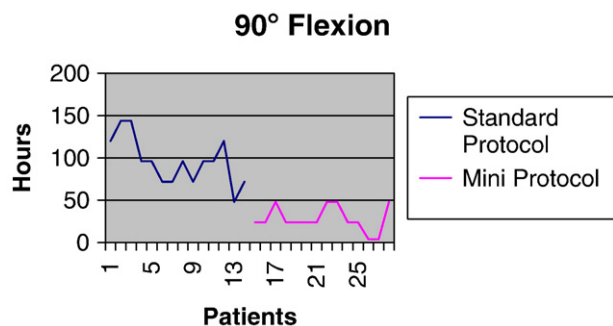


Fig. 5. Time for knee to gain 90° of flexion.

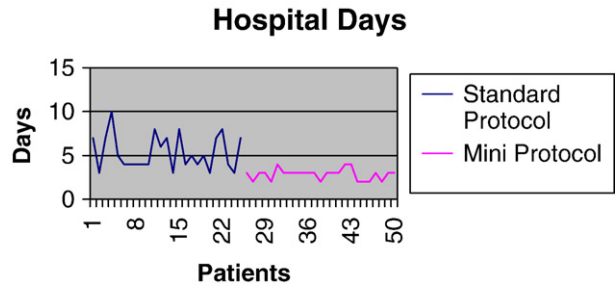


Fig. 6. Hospital length of stay.

group was 5.4 days; that in the mini protocol group, 2.8 days. The difference was statistically significant ($P < .001$).

Discussion

Arthroscopy introduced orthopedic surgeons to the possibility of less-intrusive surgery with the added benefit of better visualization, more accurate surgery, less pain for the patient, and quicker rehabilitation. Other endoscopic techniques in other surgical disciplines have achieved similar successes. Recently, similar claims to less pain and earlier rehabilitation have been made for open joint arthroplasties done through smaller incisions [4]. This has generated an implant industry response to provide new tools and courses aimed at providing surgeons with the ability to do these procedures. With considerable media influence, patients are beginning to put pressure on surgeons to do minimal incision surgery. However, limited objective data are available for surgeons to make the decision to change. Few would argue that the smaller incision restricts the visibility of surgeons to do the procedure. This is in contrast to arthroscopic procedures that actually allow better intraarticular views. The logical conclusion is that restricted visibility may lead to complications, particularly poor component placement and fractures. There have been isolated cases of surgeons reporting on minimal incision arthroplasties for quite some time [1,2]. The 2-incision hip procedure developed by Dr Richard Berger [3] is probably the most well known owing, in no small part, to the major network television publicity it has received. The demand by patients to have this procedure has prompted a multitude of centers to develop small-incision arthroplasty techniques. Proponents have claimed great success in achieving arthroplasties that are less painful, which translated to easier and shorter rehabilitation as well as quicker return to function [4]. Skeptics cite lack of data and the

obvious risk of increased complications as a result of poor visualization. These include infection, poor component placement, and femoral fractures [4,8].

We too were skeptical but were intrigued by the video footage of Dr. Berger's patients [3] walking up and down stairs 4 hours after hip arthroplasty. We felt that there must be something to this, so the surgeon took the course on MIS-2 offered by Zimmer. The course was excellent. However, after finishing the course, the surgeon felt that he was every bit as brutal to the soft tissues beneath the small skin incisions as he would have been just by lengthening the incision and having direct full view of the anatomy. Recently, Mardones et al [6] at the Mayo Clinic reported cadaver studies showing that the reaming of the femur did significant damage to the abductors, external rotators, or both in each and every cadaver studied. Yet Dr. Berger's patients clearly did remarkably well in the early days after surgery. These facts prompted us to look elsewhere other than the incision.

The mini incision approach is presented to orthopedic surgeons as a package of preoperative, operative, and postoperative protocols. Some studies have attempted to evaluate the effect of just decreasing the incision length [5]. Most of these failed to show a significant benefit of just making the incision smaller. At least one study showed significant complications [8]. There has been no study evaluating the effect of the new aggressive pain management, anesthesia, and physical therapy protocols without changing the surgical procedure.

Upon returning from the mini course, we applied slightly modified MIS-2 anesthesia, pain management, and physical therapy protocols to our first arthroplasty. The dramatic early results prompted us to do this study. As can be seen from the results, not every patient achieved the goals for discharge within 4 hours but most patients achieved the standard goals for discharge within 24 hours. Many of them had achieved their goals for discharge within 4 hours and could have been treated as outpatients. This was accomplished without changing the arthroplasty procedures or the length of the incision. We were apprehensive about discharging these patients early even if they had achieved their goals for discharge; hence, most patients were kept for at least 2 days. Even at that, our length of stay dropped to almost half of the control group.

In the excellent symposium on minimally invasive arthroplasty by the Journal of Bone and Joint Surgery [4], Dr. Jay Lieberman stated, "Often overlooked in the discussion of minimally invasive total hip arthroplasty is the role that an integrated program of anesthesia and accelerated rehabilitation

that is instituted with minimally invasive methods may play in facilitating shorter hospital stays." He further said, "Unless carefully designed and executed studies are performed in the future, it will be difficult to disentangle the effects of patient selection, altered patient expectations, and radically changed perioperative management from those of the changed surgical approach itself." With this study, we tried to isolate the perioperative management from the procedure itself. The patient selection was the same in the 2 groups. The patient expectations were no different in each group. Because the anesthetic and pain management protocols were accepted techniques only used in a new combination, we did not preoperatively influence the patients with new expectations. The procedures in both groups were the same. A single surgeon performed all the procedures, and no attempt was made to reduce the incision length or alter the procedure. The study only looked into the in-hospital experience, evaluating the time it took to achieve the standard goals for discharge. This was intentionally not a long-term study. The claims being made to persuade orthopedic surgeons to change to minimal incisions cite only early short-term advantages. Yet this study shows that just by altering the perioperative management of patients, one can achieve excellent short-term results without altering the procedure itself. This knowledge takes the pressure off of surgeons to rush out and start doing an entirely new procedure before its safety and long-term consequences have been carefully evaluated.

In conclusion, modification of the anesthesia/pain management and physical therapy protocols can significantly affect the early outcome of total hip and total knee arthroplasties. The dramatic change in the early outcomes of these procedures can be competitive with minimal incision surgery. The length of the incision may only be a small part of the dramatic early results reported with minimal incision techniques. A surgeon hesitant to use minimal incision techniques can obtain similar early results without changing the surgical procedure.

References

1. Berry DJ. Minimally invasive total hip arthroplasty. *J Bone Joint Surg Am* 2003;85:2235.
2. Lester K. A square peg in a round hole works in THA. *Hip Knee and Shoulder Arthroplasty Symposium*, Beaver Creek Colorado, 2001.
3. Berger R. MIS-2 hip arthroplasty. 2004 Lecture at *Emerging Techniques in Hip and Knee Arthroplasty* not a publisher Atlanta.

4. Berry DJ, Berger R, Callaghan J, et al. Symposium—minimally invasive total hip arthroplasty. *J Bone Joint Surg Am* 2003;85:2235.
5. Ogonda L, Wilson R, Archbold P, et al. A minimal-incision technique in total hip arthroplasty does not improve early postoperative outcomes. *J Bone Joint Surg Am* 2005;87:701.
6. Mardones R, Pagnano MW, Nemanich JP, et al. Muscle damage after total hip arthroplasty done with the two-incision and mini-posterior techniques. *Clin Orthop Relat Res* 2005;441:63.
7. Berger RA, Bertin KC, Duwelius PJ, et al. Surgical technique for minimally invasive total hip arthroplasty: the Zimmer 2-incision procedure. Warsaw, Ind: Zimmer Institute; 2004.
8. Fehring T, Mason JB. Catastrophic complications of minimally invasive hip surgery. *J Bone Joint Surg Am* 2005;87:711.