



## A New Era of Minimally Invasive Surgical Approaches for THA

By Timothy McTighe, Editor  
Executive Director, JISRF

### Introduction

What's old is new again! Over the past year there has been considerable interest, debate and controversy over the role of minimally invasive surgical approaches for both total hip and uni-compartmental knee replacements. This edition of JISRF *Update* will review both the current trends and reflect on the historical evolution of these techniques for THA.

In discussing the current trends on mini-surgical approaches it is important to understand the specific terminology and surgical approach and not to lump all small incisions into one simple category – “mini-incisions.” There are single, dual, and even three mini-incision techniques utilizing the anterior or posterior approach.

What are the indications, contraindications, advantages, disadvantages, and more importantly, the outcomes for these surgical approaches? Recent reports from a study on the feasibility and potential benefits of Zimmer's 2-incision\* total hip replacement found that in the first 50 consecutive cases mean operative time averaged 100 minutes with no intraoperative complications. No patient stayed in the hospital more than 23 hours and 75% went home the day of surgery. (\*Zimmer Holdings, Inc. 7/23/02)

Is outpatient total joint surgery the future or a passing fad? Let's remember the principal necessity for surgery is to fix or correct a problem. The incision provides both the access and exposure necessary to enable correction of the problem. In my opinion most surgeons would agree that if visualization is poor, complications are more likely to occur. Also, for a surgical procedure to be widely accepted it must be simple in its execution and demonstrate good reproducible clinical results.



Incision needs to be just large enough to insert the cup. Keggi

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## Current THA Trends:

Mini-Incisions  
Hard-On-Hard Bearings  
Large Diameter Heads  
Surgical Navigation Systems  
Increased Femoral Offset  
Increased Use of Constrained Sockets  
Reduced Hospital Stay

Trends often appear to provide short-term gains while setting up long-term disadvantages. Hopefully our contributing articles will address some or all of the following questions and concerns:

1. Can you see what you are doing?
2. Do you require additional or modified instruments?
3. Do you need surgical navigation tools?
4. Do you increase chances for component malposition?
5. If so, do you increase chances for dislocation?
6. Do you increase chances for fracture and/or neurovascular injury?
7. Does ultra-early discharge put the patient at increased risk for bleeding and/or DVT?
8. Does the procedure provide for reproducible good results?
9. What skills and/or implant designs aid in reproducible good results?
10. Will this surgical approach provide an improvement in long-term results for THA?

## F E A T U R E A R T I C L E

### Anterior Approach THA Via Mini-Incision Technique

By Kristaps J. Keggi, M.D.

In recent years there has been increased interest in minimally invasive total hip arthroplasty. A number of different techniques have been described with the goal of minimizing soft tissue dissection, decreasing perioperative complications and accelerating soft tissue rehabilitation. This article reports on the one, two or three mini-incision technique through an anterior approach.

This anterior approach has been employed by us over the past thirty years with excellent results in over 6,000 cases including both cemented and cementless prostheses as well as both primary and revision THA. Experience to date has demonstrated short operative times, small blood loss and few complications both in the perioperative period and over a long period of follow-up. While this approach is technically more demanding than the standard operations with wide exposure, the results have been quite satisfactory.

As with all surgical experience my technique has evolved using a modified anterior approach with one, two or three mini-incisions, whichever best fits the surgical profile of that patient.

#### Single Small Incision

The incision is made from a point just distal to the anterior superior iliac spine to the anterior border of the greater trochanter. The incision is curved with its convexity in a lateral direction. The average incision in a thin patient is approximately 5 to 8 cm.

The subcutaneous tissues are transected in line with the skin incision and the medial skin is undermined to the anterior (medial) border of the tensor fascia lata muscle. There are only a few bleeders in this area. They are easily controlled by electrocoagulation.

The tensor fascia lata muscle is then split along its anterior

margin. A strip of muscle is left medially to protect the lateral femoral cutaneous nerve and to facilitate closure.

The anterior capsule of the hip is identified by blunt dissection. Cobra retractors are placed on the superior and inferior aspects of the capsule. They retract the tensor fascia lata with the abductor muscles laterally and the rectus femoris with the sartorius medially.

An anterior capsulectomy is then performed. If possible the lateral femoral circumflex artery and vein are preserved. They lie in loose connective tissue at the base of the femoral neck and are easily identified. If these vessels are transected to achieve better exposure they are controlled with suture ligatures or electrocoagulation.

After the anterior capsulectomy the femoral neck is visualized. The Cobra retractors are placed within the hip capsule on the superior and inferior borders of the femoral neck. The placement of these Cobra retractors is important. They expose the femoral neck once the capsulectomy has been completed. The lesser trochanter and the trochanteric fossa are palpated to facilitate orientation. The excision of the anterior capsule, especially if it was contracted, now allows the femoral neck to be put into a neutral or slightly extended position for better orientation purposes and the pre-planned neck transection.



Anterior small single incision approach (Keggi).

The femoral neck is cut with an oscillating saw. The placement of the cut has been predetermined by preoperative templating of the patient's x-rays and is easily determined because the base of the neck is fully visualized. Restoration of the patient's normal neck shaft angle and neutral seating of the prosthesis within the femoral shaft are the two major concerns with the templating and the femoral cut. Insufficient removal of the femoral neck makes it difficult to rasp the femoral shaft and can lead to varus placement of the component within the proximal femur. This does not mean the femoral neck is removed down to the lesser trochanter. The femoral cuts can be at different levels based on the patient's neck anatomy. The base of the calcar must be preserved since this is a solid bony structure and contributes to the stability of the components be they cemented or uncemented.

After the osteotomy of the femoral neck has been completed the femoral head is removed. In most instances the head can be removed with a standard hip skid with or without the assistance of

a "cork screw" extractor. Occasionally the head must be fragmented and removed in piecemeal fashion. In cases of severe ankylosis or fusion the femoral head may have to be curetted or reamed out of the acetabulum. After removal of the femoral head, the acetabulum is easily exposed. This is truly one of the advantages of the anterior



Head removal.

approach since the acetabular exposure is excellent, the position of the pelvis can be palpated on the table and orientation by direct visualization is simple. If the surgeon feels uncertain about the exact position of the acetabulum, the procedure can be done on a radiolucent table and the position of the acetabulum can be checked fluoroscopically. In our own experience this has never been necessary and we have used fluoroscopy only for educational and training purposes.

The acetabular exposure is best achieved by the insertion of a sharp tipped Cobra retractor under the bony rim of the inferomedial acetabulum. This solid fixed Cobra allows retraction of the anteromedial tissues (rectus, sartorius, fat, skin). A second Cobra placed on the lateral ilium just proximal to the acetabulum retracts the tensor fascia lata. If necessary, a third retractor (usually a Homan) can be inserted carefully over the rim of the pelvis anteriorly for further soft tissue retraction and exposure of the anterior acetabular rim and any osteophytes that may be present anteriorly and medially.

The acetabulum is then prepared with large curettes and

acetabular reamers. Significant amount of variation in acetabulums exist. There are the obvious congenital dysplasias, but some acetabulums have been grossly deformed by the degenerative process. The reaming must be performed in such a manner as to preserve as much of the acetabular walls as possible. Thus, for example, if the anterior wall of the acetabulum is defective, the centralization of the reamers should be more posterior. It is our preference to medialize the acetabulums as much as possible.

We expose the true medial wall by curettes and small sized reamers. After we have established this point of reference we then centralize our final reamers in such a manner as to preserve both the anterior and posterior walls of the acetabulum. Our goal in acetabular placement has been to recreate as much as possible the patient's own normal anatomical center of rotation. We remove as much bone as necessary to do this but do not feel it is necessary to have the entire acetabulum down to soft bleeding cancellous bone.

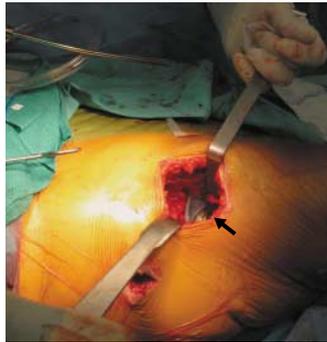


Floro image reaming socket.

Over the years both cemented and cementless acetabular components have been used. The supine position and the ability to palpate the axis of the pelvis facilitate visualization of the acetabular angles. We have always thought in terms of a 45 degree varus/valgus angle but have tended to err on a more horizontal (or valgus) side. Thus, our average acetabular angle is closer to 40 degrees than 45 degrees. In the valgus position the implant is more horizontal and more stable within the bony acetabulum. This gives better coverage to the femoral head, transmits forces to the acetabular prosthesis and the pelvis in a more even manner, and makes dislocation less likely. In this anterior position it is also easy to establish the exact anteversion (approximately 15 to 20 degrees) which corresponds to the normal anatomy. Once the acetabulum is in place, peripheral osteophytes, if they are present, are removed with special attention paid to the anterior osteophytes. They, more than any others, would act as fulcrums for dislocations. Large lateral medial and posterior osteophytes are also removed.

Attention is now directed to the femur. Sponges are placed within the acetabulum to protect it from injury during the manipulation, rasping and positioning of the femur. The patient's leg is placed in maximum external rotation and the osteomy of the base of the femoral neck is visualized. This visualization is facilitated by the use of a bone hook placed around the femur at the level of the lesser trochanter. Traction on this bone hook frequently is sufficient to deliver the proximal femur into the operative site. A curved pointed Cobra-like trochanteric retractor placed under the greater trochanter can also lever the femur into view. The foot of the table can also be dropped although this is a step that we have

used only on rare occasions. Exposure of the proximal femur is extremely important since inadequate mobilization of the femur is likely to lead complications in the course of femoral shaft preparation and prosthesis insertion (perforations, fractures, etc.). If necessary to achieve this we perform a posterior capsulectomy and release the short external rotators and piriformis near their insertion along the posterior greater trochanter. We have never re-attached them at the end of the procedure.



Dual incision cup and stem in place without neck.

After adequate mobilization and exposure of the proximal femur has been achieved, the rasping of the femoral shaft is started. The first step is curettage of the neck osteotomy along its lateral aspect in order to allow insertion of the rasps in the long axis of the medullary canal. Modified angled rasps have been used for this purpose although a straight

rasp can also be inserted if the femur has been well mobilized. A straight rasp can also be inserted through a stab wound or "second" incision in the region just proximal to the greater trochanter. A short starter rasp is used at first and gradually the size and length of the rasp is increased until the largest possible rasp has been inserted into the femoral shaft in a position of anteversion.

After the femoral shaft has been rasped, trial prostheses are inserted in the femur and reduced into the acetabular component. The neck selection is based on the appearance of the patient's proximal femur. If the patient has a high offset varus type neck, a high offset varus type neck is selected if such is available in the system used. The most

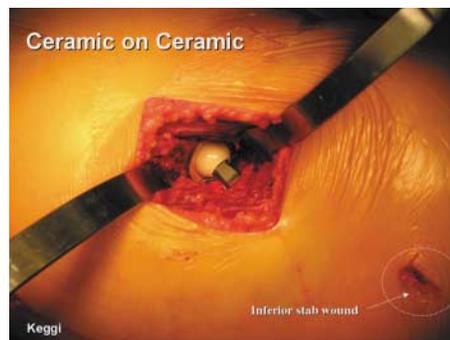
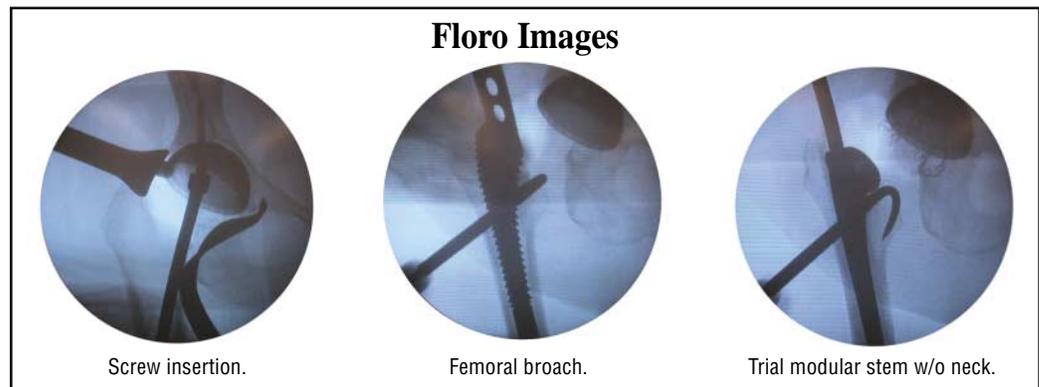


Apex Modular™ Cementless Stem



R-120™ Cemented Stem featuring IMIN™ Neck

important factor is a stable hip. In our own experience we have estimated approximately 4 percent of our hips to be slightly longer (usually 1/4 to 1/2 an inch) because leg length has been sacrificed for hip stability. After the proper neck length, head size and stem size have been determined by means of the trial prostheses, a permanent prosthesis of the selected size is inserted into the femur. Either a cemented or a cementless device is chosen depending on the patient's age, bone quality, and activity level. Between 1970 and 1985 we have had experience with a variety of cementing techniques, bone plugs, chrome cobalt plugs, silicon plugs, pressurized cement, low viscosity cement, refrigerated cement, centrifuged cement and syringe injected cement. In 1985, however, we returned to a finger packing method with a catheter in the femoral shaft and Palacos cement. This has produced excellent results since the dough-



like mass of Palacos is sucked into the femoral canal (as if injected) and its distal portion acts as a plug due to its doughy characteristics. In the proximal portion of the femur the cement can be pressurized into cancellous bone by direct finger pressure.

It is of note that recently we have used a variety of newer modular femoral devices (Apex Modular™ Cementless Stem and OTI R-120™ Cemented Modular Neck) which now allow for more accurate reproduction of the biomechanics of the hip and minimize the need for the posterior capsular and external rotator releases.

### Dual Mini-Incision Technique

For close to twenty years I have also been using a dual incision approach which originated in response to the need for more precise preparation of the femoral canal in non-cemented total hip devices. By using a stab wound or a short second incision just proximal to the greater trochanter, it has been possible to insert cylindrical reamers and rasps of all types to prepare the femoral canal. We have also inserted the actual prosthesis through the second incision but in most instances with the standard (non-modular) prosthesis we still prefer to insert the prosthesis through the main anterior incision after the appropriate mobilization and delivery of the proximal femur into the wound. As stated in the previous paragraphs, in order to achieve this we have done posterior capsulectomies, released the short external rotators and piriformis and, if necessary, the anterior origin of the tensor fascia lata from the iliac crest.

The second incision has allowed us to do non-cemented devices with shorter skin incisions and it is also of note that we have not used any special retractors or instruments other than our Cobras and Homans.

We have, however, modified the rasp handles on the prosthesis we have used. In some systems we have bent the rasps and have been able to insert the prosthesis without a second stab wound. In other systems we have had nothing but straight rasps inserted through the stab wound (Zweymuller and more recently Spectron, SNR)

We have not used surgical navigation techniques nor fluoroscopy to insert our rasps. The pictures in this article were taken on a radiolucent operating table for teaching purposes. If there is any doubt in the surgeon's mind about the rasp and prosthetic placement, fluoroscopy techniques can be easily applied to the process.

### Three Mini-Surgical Incision Approach

The third mini-incision is basically a stab wound distal to the main anterior incision. Through this stab wound acetabular reamers and acetabular inserters can be retrograded to allow reaming and prosthetic placement through the short anterior incision; the acetabulum exposed by the standard Cobra retractors. We have used this in obese patients and patients with large muscles. At the end of the



Inferior stab wound aids in placement of the acetabular reamer.



Inferior stab wound serves for placement of suction drain.



Superior stab wound aids in placement of femoral instruments.



procedure this third incision or stab wound is used for suction drains.

By using three short incisions we have been able to do both cemented, non-cemented, and hybrid procedures in the obese and/or very muscular patients without making long skin incisions, undermining thick layers of fat and cutting muscles unnecessarily (heaviest patient 450 lbs.).

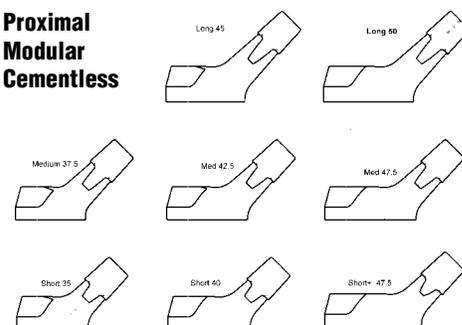
Our outcomes in this subset of large patients have also been good and we do not hesitate to perform total hip arthroplasties in these weight challenged patients.

### Clinical/Surgical Impression of Newer Proximal Modular Designs

Implant orientation is always a significant part of any total hip technique. The mini-incision approach places a higher demand on awareness of implant positions due to the limitations of exposure and the increased risk of hip dislocation. Proximal modular stems provide for final mechanical adjustments thus reducing the risk of implant impingement, leg length discrepancy, and soft tissue laxity. These newer designs should aid surgeons who are not familiar with the anterior mini-incision approach to be confident in their ability to routinely implant components in their proper biomechanical orientation.



Proximal Modular Cementless



## Minimal Invasion Incision Using the Posterior Approach

By Lawrence D. Dorr, M.D.

The MIS posterior hip incision can be performed in a majority of THR patients with a length of 5-10 cm placed along the posterior border of the greater trochanter from the level of the tip of the trochanter to that of the vastus tubercle (Figure 1). This incision can be used in patients who have a body mass index (BMI) that is between 26.0 and 50.0. With a BMI above 30 the incision for us averages 13 cm. The patients for whom an MIS incision is most difficult are those who have a very thick gluteus maximus muscle and these are

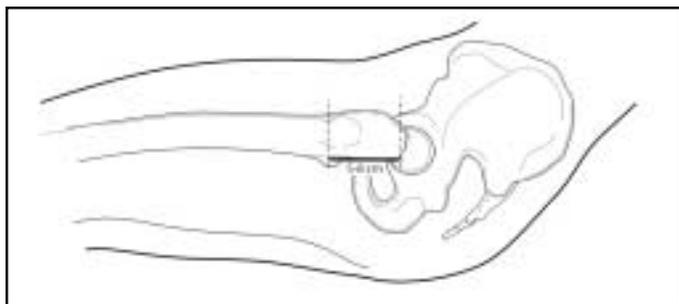


Figure 1: Incision.

big men. The learning curve to become proficient with a 5-10 cm incision, so that it can be predictably and reproducibly employed, will be 40 hip replacements with appropriate instrumentation. With the appropriate instrumentation the components can be implanted in 30-40 minutes and the closure, which includes the capsule and use of a subcuticular suture for skin, will take approximately 20 minutes.

Our data with 76 consecutive hips is that 60 (80%) could be done with a 10 cm or less incision (16 others averaged 13 cm). These operations were done with specifically designed instruments including a curved reamer (Figure 2). Our data

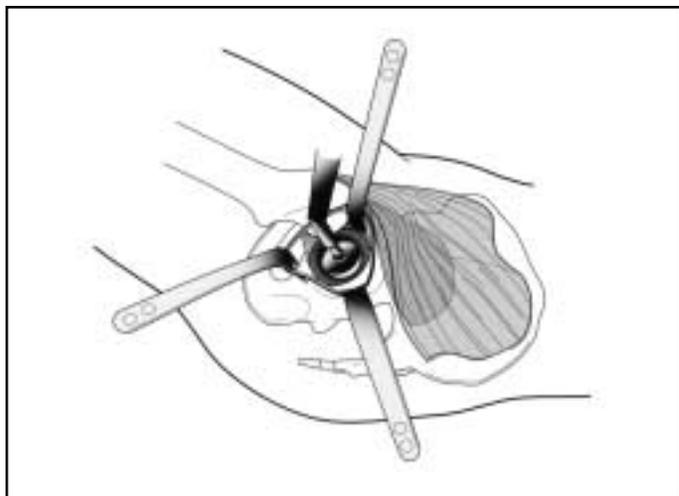


Figure 2: Curved reamer.

showed discharge was 1.5 days quicker with only two patients having to go to rehabilitation (previously 33% did so). Complications included one infection, one transient sciatic palsy which resolved within one month, and no dislocations. Pain scores (1-10 with 10 being worst) were 2-3 on the three postoperative days in the hospital, and 3-4 pain tablets being used per day. No narcotics are used by us. Ropivacaine is used in the epidural for an average of 20 hours and Toradol is given intravenously for two days. One-third of patients go home on a cane and by six weeks 80% are on no assistive device (we use non-cemented implants). Gait analysis shows cadence, stride length, and gait velocity

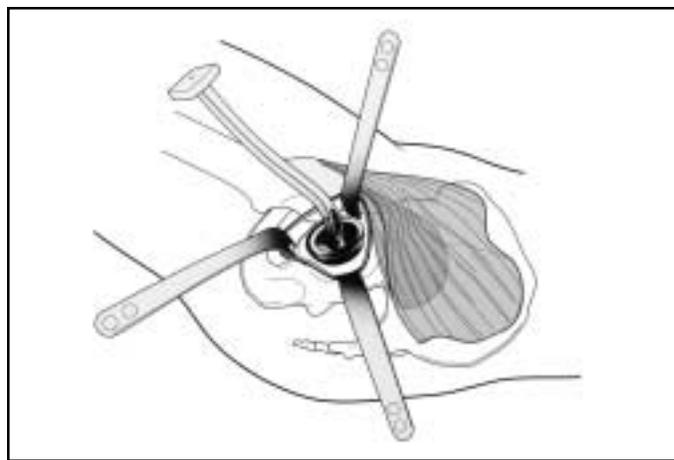


Figure 3: Cup insertion.

all are 80-90% within normal by six weeks. Stride length is only 60-70% of normal at six weeks because extension of the hip is limited by still abnormally firing flexor muscles. All other hip muscle studies are essentially normal for phasic function by 6-12 weeks.

MIS hip surgery has tremendous mental benefits for patients. They feel their body is less violated and less injured. This positive mental attitude accelerates recovery, decreases pain medicine use, and decreases postoperative depression. Providing this mental comfort for the patient is as much a responsibility of the surgeon as the physical care, as long as the operation can be predictably and reproducibly performed by the surgeon with the small incisions of 5-10 cm. It remains the responsibility of the surgeon to perform a predictable and reproducible operation as this is a more important responsibility of the surgeon to the patient than the length of the incision. However, if the experience and skill of the surgeon allows the small incision to be used, there are benefits for both muscle recovery and mental recovery of the patient.

## Is Surgical Navigation the Answer and Is Real Time Intra-operative Documentation Needed?

By H.M. Reynolds, M.D. and Timothy McTighe



There has been growing interest in surgical navigation in part due to continued problems with dislocation. Dislocation have been reported in primary surgeries from 1-10% and as high as 29% in revisions. This senior author has revised over a hundred loose cementless cups just in the past year due to a well known recall of hip implants with fabrication problems. These have increased our dislocation rate from 2% to over 20%. Many of these revised cups present significant problems in determining proper cup orientation, cup stability, and added problems to joint stability due to compromised soft tissue integrity.

Intense and excess rehab, along with reduced levels of activity, post-op bracing and modification of life styles have allowed some patients to go back into reduced normal physical routines.

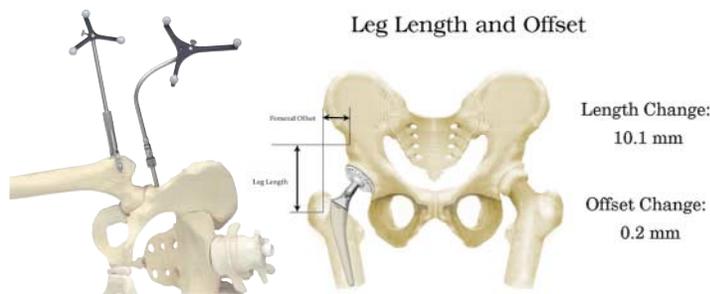
Limb alignment, implant position and soft tissue balance have become significant problems. There is no easy and accurate way to track the relationship between pelvis and the femur during surgery. Certainly patient position and limitations of conventional instruments can affect cup positioning. Drapes obscure the patient and make leg alignment for orientation difficult. In addition we are often dealing with significant loss of bone and orientation landmarks.

Leg length measurement is difficult at best. Pelvic tilt can confound intra-op leg length checks. One solution would be to use trackers fixed to the pelvis and femur that can record their relationship to dislocation to ensure the desired leg length and femoral offset is achieved.

This intra-operative documentation system will provide real time feed back that will aid the surgeon in knowing where he is and where he needs to go to correct the biomechanical aspects of his hip reconstruction. Possible additional benefits of such a system would be to document surgical results such as cup position (abduction=45°), (anteversion=20°); femoral offset 45 mm, leg length +2mm and femoral version angle 15°.

Printouts for posting in the patient's chart should immediately be made available, reducing the chance of error during transcription.

A simple reproducible system of documenting limb alignment and implant orientation that does not require special operators or expensive preoperative preparation and does not add more than ten minutes to current OR time would be a system that could have a positive affect on outcomes.



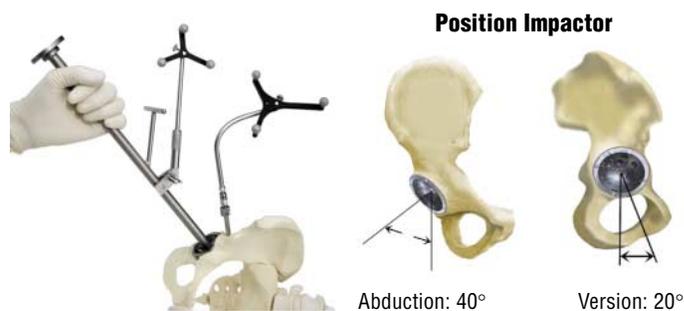
One such system is the NaviPro™ System from Kinamed. This system is based on digital technology. It allows for checking relationship between femur and pelvis before and after implantation without imaging technologies. Basic components include a mobile trolley cart that holds a stereo camera, low-profile computer, flat-panel display, foot controls and a mini-printer.

Surgical instruments include passive trackers for the pelvis, femur and a calibrated probe. The technique requires location and marking pelvic landmarks, both ASIS joints, and the Mid-Pubis. Draping, soft-tissue or the patient holder may obscure landmarks. A calibrated patient holder is helpful for the posterior approach. Recording the native pelvis-femur relationship prior to dislocation can be done with manual manipulation of the leg.

At this point standard surgical technique for acetabulum preparation is carried out. During insertion of the trial cup, a tracking probe can be attached to the shaft of the cup impactor and cup position can be registered by engaging a foot pedal. The LED screen provides real-time feedback on cup position (abduction & anteversion).

A tracking device is attached to the greater trochanter for referencing leg length and femoral offset. Standard femoral preparation of the femur is carried out and with femoral trials in place, the reduced hip measurement is carried out by a click of the foot pedal. The NaviPro™ software computes the new pelvic-femur relationship, registering leg length and offset.

A simple printout summarizes results of the surgical case accurately, documenting implant orientation and biomechanical restoration. We are excited about the prospects of this technology and will report our particular experience with it in the future.



## Surgeon Highlight

### Prof. Kristaps J. Keggi, M.D.

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Honorary Doctor of Humane Letter Degree, Quinnipiac College, 2000  
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Latvian Academy of Science, June 1990, Honorary Member  
Russian Academy of Medical Science, 1993  
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## Commentary

This edition of JISRF Update provides stimulating material for consideration of two “hot” topics in reconstructive surgery. Both the less invasive hip replacement surgery and navigation systems have gained greater interest and consideration by reconstructive surgeons.

Just as arthroscopic assisted surgeries have revolutionized many knee and shoulder reconstructions, less invasive exposure, perhaps in conjunction with navigation or other imaging techniques, hold promise for diminished patient pain, quicker rehabilitation and more accurate placement of components. This should result in better clinical outcomes and improved long term implant durability.

From the outset it is important to realize, and accurately convey to our patients, that hip replacement still remains an invasive procedure with inherent risks regardless of approach. Early reports come from very experienced hip surgeons with a wealth of experience and expertise. These reports suggest benefits including diminished blood loss, decreased length of stay and earlier return to more normal gait. However, minimally invasive approaches should not be pursued at the expense of inadequate visualization or sub optimal component positioning and stability. The advent of modular femoral components should facilitate less extensive exposure as well. Modularity also allows adjustment of leg length, offset, anteversion and most importantly improved hip stability.

The second hot topic concerns the utility of navigation systems. Current interest in these systems would seem to stem from two concerns, dislocation and leg length discrepancy. Although several large studies suggest that a posterior approach is not associated with a statistically higher incidence of dislocation, many surgeons have abandoned this approach despite its ease. Navigation clearly should optimize acetabular cup position, which is the most common cause of hip instability regardless of approach. Leg length discrepancy remains the number one basis for legal action. Again, navigation systems are capable of accurately determining and documenting changes which occur during arthroplasty. When used in conjunction with a modular system, the surgeon can manipulate leg length, offset and resultant hip stability.

All of the above issues require further investigation and consideration. Further refinements certainly will be made. This clearly represents an exciting direction in reconstructive surgery.

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