"I think the exposure of the acetabulum never gets anything like mine and there have been catastrophic results on the femur ... I absolutely am opposed to its use by beginners but even with experts it is nothing like as good as the lateral exposure." (Professor Sir John Charnley, personal correspondence in reference to the Hardinge approach to Richard H. Rothman)

In 1982 Hardinge published a new surgical approach to total hip arthroplasty [1]. The benefit of this new approach was that it offered improved conditions for implant orientation as well as the correction of leg-length discrepancy. It also avoided the pitfalls of trochanteric osteotomy with its inherent risk of non-union and wire breakage. Technically, the approach was challenged as providing only limited surgical visualization while damaging the nerve supply to the hip abductors as well as placing other neurovascular structures at risk. These criticisms were countered by well-performed studies in the orthopedic literature which established the utility of the approach [2–5]. Despite initial strong criticisms, the Hardinge surgical approach to total hip arthroplasty – and various modifications thereof – has certainly withstood the test of time and is now used routinely for both primary and revision hip arthroplasty.

Today minimally invasive hip arthroplasty is being promoted as a new surgical approach to total hip arthroplasty. Again criticisms of this approach revolve around poor surgical visualization with all of its inherent risks. The comparison to the introduction of past surgical approaches such as that of Hardinge is both a good one and yet at the same time a poor one. Like previous surgical approaches, minimally invasive hip surgery should be judged in terms of the usual standards of hip arthroplasty: component positioning, dislocation risk, infection rate etc. Unlike its predecessors, this new surgical approach does not attempt to address some specific surgical shortcoming such as trochanteric non-union or acetabular cup mal-position. Rather the promotion of this technique has revolved around cosmesis and post-operative expediency: shorter hospital stay, less pain, less in-patient rehabilitation, quicker return to function. This is not to say that such goals are poor ones, since all surgeons would promote these benefits for their patients. However, these ends do not justify the means of a new surgical approach if it introduces new problems which are more significant than those encountered with established surgical approaches.

So far there are little peer-reviewed published data regarding minimally invasive hip arthroplasty, particularly when compared with its level of advertisement. The published data available would seem to fall on the side of the minimalists. Berger has recently published his results utilizing a two-incision minimally invasive technique [6]. His study involved 100 cases in which the average patient age was 55 and the average weight was 176 lbs. All of the patients were discharged to home with 75 patients going home the day of surgery. The complication rate was 1% due to one proximal femoral fracture. Radiographic analysis was performed on the first 30 patients and showed 91% of the femoral stems to be in neutral alignment and the average abduction angle of the acetabular component to be 45°. Wenz published data on a series of 124 minimally invasive hip-arthroplasty cases [7]. The approach used involved a modified posterior approach utilizing a single incision. The operation was performed more quickly and with less blood loss when compared with the traditional direct lateral
approach. The rates of intra-operative and post-operative complications were comparable. The length of hospital stay was also comparable, although the minimally invasive surgery patients seemed to do better with their post-operative physical therapy. A higher percentage of these patients were also discharged to home.

Studies such as these are quite suggestive but lack the power of a randomized controlled study. In addition, anecdotal non-published data has not always been so supportive. To an outsider this would all seem to appear like the often-repeated cycle of some new idea, struggling to break into an established field. And this is certainly true. However, some relevant background information is needed to clarify this struggle.

Fixing What is not Broken

As with nearly anything touted as an innovation in hip arthroplasty, minimally invasive surgery faces an uphill battle for acceptance. The reason for this is that it must equal or outperform the current impressive standards of total hip arthroplasty. Total hip arthroplasty is currently one of the most successful of all surgeries performed. A recent review [8] has reinforced the low incidence of peri-operative complications encountered in the Medicare population with this surgery (1.0% mortality, 0.9% pulmonary embolus, 0.2% wound infection, 3.1% dislocation). Despite the success of innovations such as the use of cementless components, the fact remains that cemented Charnley prostheses have demonstrated excellent survival rates out to 20 years [9]. Such results are at once extremely satisfying to the orthopedist in terms of providing confidence in what can be offered to patients. These results are at the same time somewhat frustrating to those who wish to put forth what is felt to be a true innovation. All of this is further complicated in that it often takes 5-, 10- and 15-years follow-up to adequately judge the success or failure of any change.

Therefore, any potential innovation in hip arthroplasty is accompanied by a substantial risk. This risk is balanced by the potential benefit of the innovation. In the case of the Hardinge approach, any hip surgeon who has fought with the problem of trochanteric non-union can appreciate the benefit of this approach. A similar argument for minimally invasive hip replacement, in terms of correcting particular surgical shortcomings, cannot yet be made. While the goals of minimally invasive surgery are clear (i.e., better cosmesis and quicker post-operative recovery), the attainment of these goals is less clear. It can be argued that the patient population presented by Berger in his report of his two-incision technique is not the typical patient population for total hip arthroplasty. While the goals of minimally invasive surgery were achieved in this study, these results may not translate so well to those achieved with a more typical elderly-patient population encumbered by their usual medical co-morbidities. Therefore, even if the risk of the operation remained constant, the benefits of the surgery likely do not. Compounding the difficulty in judging the effectiveness of minimally invasive surgery in achieving its stated goals is the undeniable fact that several of these goals are influenced by other disciplines. As an example, improved pain-management techniques may contribute significantly to the successes which are often credited to minimally invasive surgery alone.

Revolutionary?

In many respects the concept of minimally invasive total hip arthroplasty is hardly revolutionary. It makes no pretences towards improving prosthesis fixation or decreasing osteolysis. It contributes nothing towards solving one of the greatest problems in the field; that is, providing younger patients with a lifelong prosthesis. Nonetheless, it is a revolutionary concept in other respects. Today’s hip arthroplasty patients have benefited significantly from decades of bio-engineering advances; however, the topics of wear rate, free-radical polymerization and alumina-grain size are rather mundane to the general public. What patients do understand and find revolutionary are promises of shorter hospital stays, less need for in-patient rehabilitation and a quicker return to their daily activities. Understandably, the public excitement over minimally invasive total hip arthroplasty has been tremendous.

Unfortunately, this excitement is often mixed with misinformation. One by-product of the promises of 23-h hospital stays with a discharge to home has been a lessening of the perception of total hip arthroplasty as major surgery. Another very common misperception is the universality of minimally invasive surgery. Most physicians would agree that the minimally misperception is the universality of minimally invasive surgery. Most physicians would agree that the minimally invasive approach becomes tenuous with obese patients. The responsibility falls upon the physician to properly edu-
cater patients and temper their expectations with regard to minimally invasive surgery. Surgeons must also remind themselves that the usual medical risks of total hip arthroplasty, such as post-operative myocardial infarction or venous thromboembolism, do not evaporate simply because a patient goes home after 23 h.

Finally, for minimally invasive arthroplasty to truly revolutionize the field of hip replacement it must be broadly applicable. That is, any well-trained orthopedic surgeon specializing in joint replacement should be able to competently perform the procedure. In a practical sense, anything short of this makes minimally invasive surgery more of a dream than a reality for the average patient.

Judging Minimally Invasive Hip Arthroplasty

Although it promises new advances with regard to improved cosmesis and post-operative expediency, minimally invasive hip replacement must be ultimately judged by the same criteria as have previous surgical exposures. These criteria are nothing more than the classic surgical principles of obtaining good visualization, treating tissues in a gentle and atraumatic fashion, avoiding damage to nerves and blood vessels, obtaining absolute hemostasis and performing the surgery in a swift and efficient manner. The achievement of these principles translates into measurable parameters, such as correct component position which minimizes the risk of dislocation. Atraumatic treatment of tissues decreases the risks of infection, heterotopic ossification and postoperative limp. Currently, at our institution we use a lateral Hardinge-type surgical approach for hip arthroplasty. The operation can be performed efficiently with an average operative time of 45 min. Adherence to the surgical principles just described have led to good results with minimal complications: 0.4% neurovascular injury, 0.2% dislocation rate, 0.4% infection rate. It is not obvious that minimally invasive hip arthroplasty presents any particular advantage in achieving any of these surgical goals. Using the minimally invasive approach, good visualization of the acetabulum is more difficult to achieve, thereby increasing the risk of poor component positioning. Because of the smaller working space, great care must be taken to not traumatize soft tissues by vigorous retraction. Care needs to be taken in reaming the acetabulum and broaching the femur in order to insure that the skin edges of the incision are not damaged. Repeated contact of surgical instruments with damaged skin edges during these procedures risks pulling skin flora into the operative wound.

These obvious increased risks have not simply been ignored in minimally invasive surgery. The two-incision approach incorporates the use of fluoroscopy to compensate for visual deficits in placing the acetabular component. With this technique, Berger has reported good results with component placement [6]. Others are trying to take advantage of the emerging technology of computer navigation in a similar way to improve the more limited visualization inherent in minimally invasive surgery. Specifically, DiGioia et al. [10] reported on 33 mini-incision cases in which computer navigation was employed. They found no difference in the acetabular cup alignment in the mini-incision technique compared with that obtained using a traditional posterior approach. Overall, the cup alignment for both groups was within 5° of the pre-operatively planned alignment of 45° of abduction and 20° of flexion. While the use of additional technology may allow for the maintenance of good component placement, it is not clear that similar advantages are obtained in minimizing neurovascular injury. Also it is important to appreciate that good cup placement can still be obtained even if poor techniques of acetabular reaming are done. For example, an acetabulum can be over-reamed with significant damage done to the anterior or posterior column, although the radiographic appearance of the cup placement may be excellent. At the time of revision surgery this can become a major problem which could have been easily avoided during the primary procedure.

Other modifications introduced for minimally invasive hip replacement have also included the introduction of new instrumentation which is meant to facilitate the procedure and minimize the risks of soft-tissue trauma. Some of this new instrumentation is clearly beneficial; however, it also represents an area where the marketplace has collided with a surgical innovation. As a new surgical approach, minimally invasive surgery provides some promotional advantage for surgeons. However, the approach itself offers little advantage to orthopedic companies because it employs no new special prosthetic components. Where companies have capitalized on this new technique has been in promoting new instrument systems that are “essential” to performing this new approach. Unlike in the case of new prosthetic components, where there is usually at least some available supportive biomechanical data, these new instrument systems are being rigorously promoted while there is still
relatively little data or experience to support their effectiveness. Clearly, the surgeon needs to maintain a certain level of healthy skepticism to evaluate which of these new company-driven “improvements” are truly necessary. Unfortunately, it has been the aggressive commercialization of minimally invasive surgery which has turned many orthopedists against it.

**Conclusions**

In conclusion, minimally invasive hip arthroplasty represents nothing more than the introduction of new surgical approaches into the field of hip replacement. At its best, minimally invasive surgery is a true revolution which can potentially benefit a significant number, albeit not all, hip arthroplasty patients. If so, it deserves its current attention and should be offered as a real alternative to traditional total hip arthroplasty. It should be capable of being performed competently by any well-trained hip arthroplasty surgeon. At its worst, minimally invasive surgery is the latest in a long litany of promised innovations which have failed to advance the field. The only way to judge minimally invasive hip arthroplasty is to perform well-controlled unbiased multicenter trials with adequate and appropriate follow-up. In the meantime, surgeons need to provide their own honest self-assessment of whether minimally invasive hip arthroplasty in their hands can deliver benefits without undue risks to patients. This is nothing more than a reaffirmation of the old surgical adage *primum non nocere.*

**References**