Anterior Minimally Invasive Surgery-Total Hip Arthroplasty

Dr John Rooney

Introduction

Osteoarthritis (OA) is the commonest form of arthritis in our population.[1] As our nation ages, its prevalence and relevance is becoming increasingly more important to our community.

The Australian Orthopaedic Association National Joint Replacement Registry, reported in 2008 that 31,333 conventional and revision total hip replacements were performed in Australia.[2] Total hip arthroplasty (THA) has been well established over the last 25 years and traditionally hip replacement surgery involves a posterior or lateral approach. However, in the past decade minimally invasive joint replacement of the hip has gained in popularity.

During my Post Fellowship training at the St Michael's Hospital, University of Toronto, I gained first hand experience and closely followed the developing trend of computer assisted surgery (CAS). In combination with minimally invasive THA using a Direct Anterior Approach (DAA) I have worked with some of the leading surgeons in this field. Following thorough research into the combination of the DAA and CAS, I have successfully introduced this technique into my practice for those appropriate patients.

This article briefly reviews the procedure including the use of CAS, the prosthetic design and the reported outcomes.

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The Procedure

The basic premise of minimally invasive hip surgery is to minimise the soft tissue disruption. Anterior minimally invasive surgery total hip arthroplasty using the DAA has been in practice since 2005.[3] The skin incision is small, approximately eight to 10cm in length (**Figure 1**) compared to the traditional 15-20cm with other approaches. The design of special instruments has allowed this evolution in minimally invasive surgery as it minimises soft tissue damage and importantly allows no muscle to be cut (**Figure 2 & Figure 3**). The procedure can be performed with or without the use of a traction table which has both its disadvantages and advantages.

Anterior minimally invasive surgery via the DAA has many benefits: a small anterior incision, minimal blood loss, no muscle is cut or compromised, less analgesia is required, and the patient has a quicker recovery leading to a shorter hospital length of stay with minimal hip precautions. The DAA technique has been shown to be suitable for primary and revision hip surgery as well as fractures of the femoral neck and therefore it is available to the vast majority of our hip patients.[3-8]

Computer Assisted Total Hip Surgery

Computer assisted surgery in total hip arthroplasty is an intra-operative tool to assist the surgeon with data to achieve the optimal implant position for the individual patient.[9] CAS is now common in orthopaedic surgery,[10-21] Leading surgeons in both Europe and North America have combined DAA with computer assisted surgery when undertaking a total hip replacement resulting in improved outcomes.

The smaller incisions used in a DAA, combined with computer assisted navigation (**Figure 4**) provides a more

accurate method in which to place the components with greater reproducible precision.[10, 12, 16, 19-21] Masonis et al (2008) performed a retrospective review on a single surgeon's initial consecutive series of THAs performed via a DAA. They found that measured parameters of cup abduction angle, dislocation rate, and leg length discrepancy were excellent.[5] Intra-operative radiographic imaging has been traditionally used in DAA, however the use of CAS has decreased this necessity.

The DAA with CAS gives the surgeon an added advantage to reconstruct hip joint biomechanics[5, 22] with excellent hip range of motion, a reduced dislocation rate[23] and the ability to minimise the risk of leg length inequality.[22]

Prosthesis Design for the Younger Patient

With a conventional femoral prosthesis hip design, the size and anchoring of the stem will result in a significant loss of bone mass due to the volume of the prosthesis and to frequent stress shielding.[24]

In younger patients particularly, this is a drawback in view of a possible exchange of the prosthesis in the future.[24] The conventional femoral prosthesis hip stem was redesigned to decrease its size and the principle of fixation changed to metaphyseal anchoring .[24] This has led to short femoral stem prostheses.

A short femoral stem prosthesis can be an attractive alternative to hip resurfacing arthroplasty in the same selected patients[4] and will fulfill their requirements in terms of quality of life and mobility in everyday life.[25,26] The early clinical and radiographic results have demonstrated good outcomes.[25,26] Combined with minimally invasive techniques, these implants allow preservation of muscle and bone stock without introducing some of the complications, such as femoral neck fracture, associated with resurfacing implants.[4]

Short femoral stem components combined with the DAA have three key advantages: it is as minimally invasive as possible; it has a modular design; and has

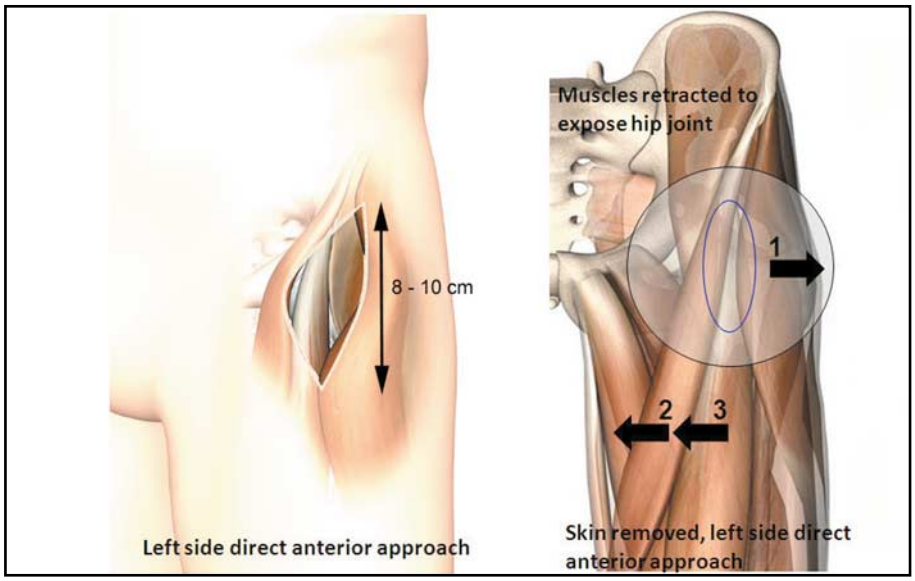

Figure 1: *Small incision and* ***Figure 2:*** *Muscles retracted and no muscles cut*

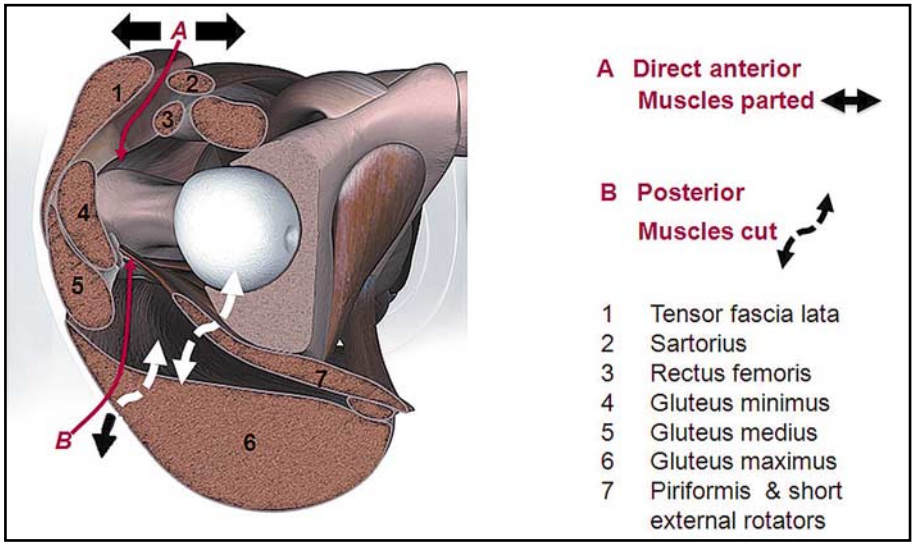

Figure 3: *Cross section of anterior and posterior approaches to the hip joint*

Figure 4: *Intra-operative Orthopilot navigation screen illustrating detection of reference frames*

minimal stem size that preserves bone stock. The modularity of the short stem allows for patient specific anatomical requirements and using the DAA approach the latest technology and techniques are applied. Thus short stem implants are introduced with preservation of bone, soft tissue and muscle. **Figure 5** shows a pre-operative diseased hip joint and **Figure 6** joint replacements utilising the conventional as opposed to the short modular femoral stems.

Results via Direct Anterior Approach

In 2008 Nakata et al classified 182 consecutive patients (195 hips) treated by primary cementless minimally invasive total hip arthroplasty (THA) into 2 groups via the surgical approach: group 1 (DAA-99 hips) and group 2 (mini-posterior approach-96 hips). Nakata's study showed a more rapid recovery for hip function and gait ability after DAA when compared to the mini-posterior approach. The study also found that DAA facilitated quicker and better recoveries as measured by single leg stance, walking time and the use of assistive walking aids.[6] Reassuringly, Rachbauer et al (2005) also concluded that the DAA technique was safe, reduced soft tissue damage, led to accelerated recovery and blood loss was minimal.[3]

Recent reports have found that the use of direct anterior approach for total hip arthroplasty have shown a lower dislocation rate and early functional recovery. Jayankura et al (2009) found that the DAA is a muscle-sparing procedure which theoretically ensures a fast recovery and in comparison to other studies with the same design of THA after posterior and particularly lateral approaches, muscle strength recovery seems to be faster and more complete with the DAA.[27] Finally, in another recent study by Oinuma et al (2009), it was found that the DAA provides immediate stability to the hip, decreasing dislocations associated with the release of muscles and therefore a reduced rate of postoperative dislocation.[28] Siguier et al (2004) reported a dislocation rate of 0.96 (10 out of 1037 cases) following computer assisted surgery.[29]

Figure 5: *Radiograph of a pre-operative diseased hip joint*

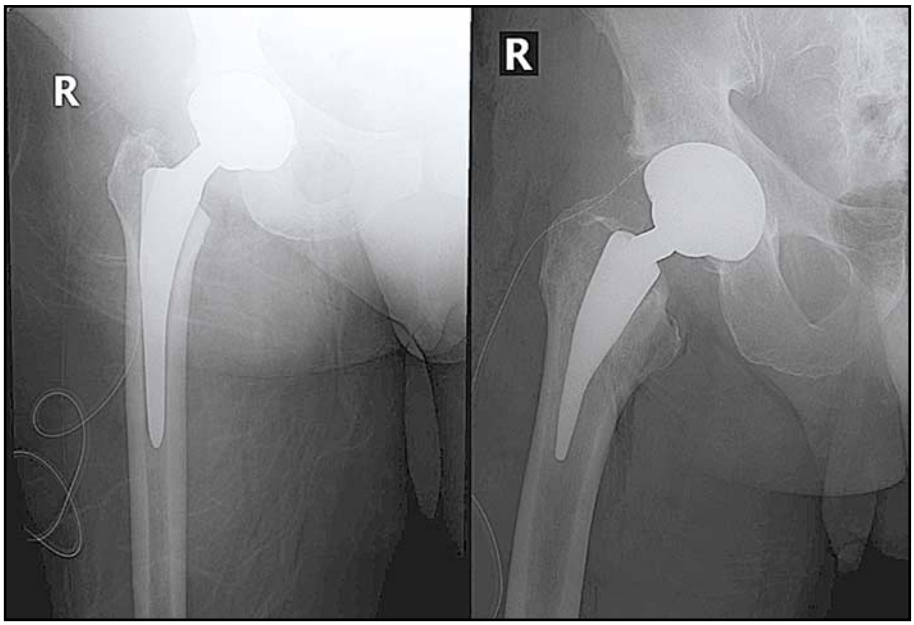

Figure 6: *Radiograph of the conventional and short modular femoral stems*

Summary

The DAA avoids any nonessential tissue dissection and allows easier access to the diseased hip joint which results in lower morbidity and rapid rehabilitation. The use of a short stem design, also allows for the maintenance of bone stock if revision becomes necessary in the future. The DAA method in combination with CAS is a safe procedure that allows correct placement of acetabular and femoral components. It is performed in a reasonable time, with minimal blood loss and in particular, the procedure preserves the muscles and leads to small, aesthetic scars.[7] By using computer assisted surgery DAA surgical interventions are further enhanced leading to better outcomes. The DAA approach is highly advantageous because it minimises interference with physiology, lifestyle and future treatment options.

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