Hip arthroscopy after resurfacing arthroplasty: surgical technique, clinical examples and literature review.

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ABSTRACT

Surgical techniques for the conduct of hip arthroscopy in the evaluation and treatment of complications after hip resurfacing arthroplasty are described. Anterior capsular debridement and acetabular rim osteoplasty procedures may provide therapeutic benefit for both pain reduction and improved range of motion. Hip arthroscopy also enables the collection of diagnostic quality biopsy samples to assist in further management where required. At our institution, we have found arthroscopic intervention useful in the evaluation and management of selected patients after hip resurfacing arthroplasty.

KEYWORDS

Hip arthroscopy, hip resurfacing, technique, review.

INTRODUCTION

Hip Resurfacing Arthroplasty (HRA), in appropriately selected patients, is continuing to demonstrate excellent medium to long-term outcomes in multiple studies [1-9]. Although the incidence of complications after hip arthroplasty procedures is low, establishing an accurate diagnosis in a patient presenting with groin pain after hip arthroplasty is potentially difficult. In these situations, arthroscopy has been described as a useful tool for both diagnostic and therapeutic purposes.

Khanduja et al. [10] described the use of hip arthroscopy after HRA in the evaluation of a patient with residual pain in whom pre-operative testing remained inconclusive. Aseptic loosening of the acetabular component was subsequently established by stability testing during hip arthroscopy. Bajwa et al. [11] later published the use of hip arthroscopy in 24 patients with complications after hip joint arthroplasty, including 17 hip resurfacing prostheses. Arthroscopic evaluation successfully confirmed or assisted in establishing a diagnosis in 23 patients. Therapeutic interventions
resulting in improvement in symptoms were successfully conducted in 10 patients. Pattyn et al. [12] published their findings and results of hip arthroscopy in 15 patients presenting with persistent and incapacitating pain after HRA. Synovial biopsies were obtained in 7 patients, of which 5 were diagnostic. Therapeutic procedures included arthroscopic iliopsoas tendon release in 3 patients and arthroscopic femoral osteoplasty in 3 patients. Ultimately, revision arthroplasty for the diagnoses of adverse reaction to metal debris or infection were required in 7 patients. Arthroscopic intervention was judged as able to assist in either diagnosis or management in 13 of 15 the patients in this series.

We present a description of the operative techniques that we have developed for the conduct of hip arthroscopy after resurfacing arthroplasty at our institution, including illustrative examples of pathologic conditions managed by arthroscopic methods.

**SURGICAL TECHNIQUE**

Complete details of our surgical techniques for the conduct of standard hip arthroscopy have been previously described [13-15]. For hip arthroscopy after prosthetic arthroplasty procedures including HRA, we recommend conducting the procedure similar to a standard central compartment arthroscopy under traction in the majority of cases. We prefer to conduct hip arthroscopy with the patient in a supine position, although the surgical techniques used for evaluating HRA by arthroscopic methods are equally valid in the lateral decubitus position. The patient is placed supine with a well-padded traction post and particular attention is given to the adequacy of binding and pressure area care to the foot. The patient is administered a general anesthetic with muscle paralysis and the contralateral leg is placed in slight traction to stabilize the pelvis. Traction to the operative leg is applied in the line of the femoral neck by a combination of adduction and abduction across a broad padded traction post and longitudinal traction applied by a traction table device in the line of the leg. While under traction, the hip is placed in slight flexion and approximately 10° of internal rotation. Traction is applied to the hip joint before sterile preparation and draping to assess the adequacy of joint distraction by fluoroscopy. If inadequate distraction of the joint is observed at this stage, the reasons are identified and addressed. Traction is removed while the hip region is prepared with antiseptic solution and drapes are applied.

Administration of intravenous antibiotic prophylaxis is delayed until the intra-operative specimens of fluid and synovial tissue have been retrieved. We recommend the use of Cefazolin 2g followed by a slow infusion of Vancomycin 1g depending on patient weight and suitability. We do not use antibiotics for routine hip arthroscopy except in the presence of prosthetic implants.

Due to poor image clarity, we have found intraoperative ultrasound unreliable for the initial assessment of traction and the subsequent accurate development of the initial portals for hip arthroscopy when conducted after joint arthroplasty procedures. We therefore recommend the use of fluoroscopy by standard methods. In the majority of cases after arthroplasty procedures, the deep landmarks used for ultrasound assessment under traction are substantially distorted by artifact, precluding the conduct of hip arthroscopy using ultrasound imaging alone.

Consistent with our standard arthroscopic central compartment techniques, the first portal developed is the posterior trochanteric portal, located 1 cm above the posterior one-third of the greater trochanter. The greater trochanter is identified by direct palpation but can also be assisted by the use of fluoroscopy or ultrasound if the patient is obese. Traction is applied with visualization of the degree of distraction by fluoroscopy. Adequate distraction is judged to be on the order of 8 to 10 mm of excursion of the femoral component excursion in relation to the acetabulum. We have found the degree of distraction of the hip after resurfacing arthroplasty to be similar to standard (non arthroplasty) hips under traction – similar amounts of tension are required to obtain similar amounts of articular distraction (Figure 1).

After the initial posterior trochanteric portal needle has been placed (in slightly cephalic direction) and aspirate of synovial fluid taken, standard arthroscopic techniques are used with passage of a nitinol wire, then subsequent development of the portal by use of cannulated instruments. Further development of the portal may be conducted without further imaging or alternatively using fluoroscopy for sequential passage of portal dilating instruments or cannulas if the tissues are stiff and excessively fibrous (Figure 1). The posterior trochanteric portal is used for placement of a 70° arthroscope (4.0 mm × 70° video-arthroscope, 160-mm working length; Smith & Nephew, North Ryde, Australia), and initial evaluation can be conducted at this point under dry conditions without lavage fluid. Development of the anterior portal may be conducted without further imaging or alternatively using fluoroscopy for sequential passage of portal dilating instruments or cannulas if the tissues are stiff and excessively fibrous (Figure 1). The posterior trochanteric portal is used for placement of a 70° arthroscope (4.0 mm × 70° video-arthroscope, 160-mm working length; Smith & Nephew, North Ryde, Australia), and initial evaluation can be conducted at this point under dry conditions without lavage fluid. Development of the anterior working portal is conducted by direct vision without the use of imaging. Biopsy of soft tissues and synovium with further aspiration of fluid can be conducted at this point (Figure 2). After the working anterior portal has been developed, saline lavage fluid under pressure using an arthroscopic pump is delivered into the joint and joint assessment with corrective intervention can be conducted as necessary.

For patients who present with the formation of periarticular fluid collections or pseudotumours, arthroscopic instruments may be introduced into the pseudotumour...
Figure 1. Central compartment posterior trochanteric portal development sequence under fluoroscopic guidance with traction applied. Birmingham Hip Resurfacing in situ.

Figure 2. Left hip central compartment view of a hip resurfacing. Biopsy of soft tissues adjacent to prosthesis for histology and culture analysis.

Figure 3. Transverse view intra-operative ultrasound assessment of a pseudotumour cavity demonstrating communication with the prosthetic joint space posterior to greater trochanter. Large fluid cavity with internal loose fibrinous debris observed (GT: Greater Trochanter; F: Fluid collection cavity).

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cavity to obtain soft tissue biopsy, without the use of traction. In these situations we have found intra-operative ultrasound useful to accurately localize the collection and guide accurate portal placement and development (Figure 3). As adequate diagnostic information may be obtained from biopsy of tissues from within the pseudotumour, the application of traction to enable central compartment evaluation of the joint may not be necessary in these situations.

Post-operatively we place the patient on oral antibiotics for 5 days. Although we have not encountered any cases of prosthetic instability, we recommend the patient respect “standard hip precautions” for three months given that the soft tissues have been distracted under traction and also that a capsulotomy of variable degree has often been conducted during the procedure. We allow patients to full weight bear as tolerated, using walking aides as necessary (typically for 2-3 days).

**CLINICAL EXAMPLES**

*CONDITION 1: Prosthetic stiffness after HRA*

A 58-year-old male presented at 11 months post HRA with persistent symptomatic stiffness of the joint, resulting in difficulty with ordinary daily activities such as tying shoelaces. Although the patient had a pain-free joint with substantial improvement in function as a result of the hip resurfacing procedure, the degree of stiffness remained of functional concern. The patient had been previously managed with a Birmingham Hip Resurfacing (BHR) via a posterior approach using surgical techniques we have previously described [16] (Figure 4). Of note, is our routine practice during the conduct of HRA to ensure appropriate anteversion of the acetabular component such that the anterior edge of the acetabular prosthesis is seated below the acetabular rim and that excision of excess anterior osteophytes is conducted in order to avoid post-operative soft tissue iliopsoas impingement. We routinely treat patients with Celecoxib 200mg twice daily for 5 days and rarely observe heterotopic ossification using this protocol.

Radiographs taken at 11 months post surgery demonstrated well osseo-integrated and stable implants. Blood tests including Cobalt/Chromium levels, C Reactive Protein (CRP), Erythrocyte Sedimentation Rate (ESR) and White Cell Count (WCC) were normal. CT scan with metal artefact reduction sequences demonstrated an excess of acetabular bone about the anterior rim of the acetabulum, potentially restricting flexion range of the joint (Figure 5).

After discussion about management alternatives, the patient elected treatment by hip arthroscopy, conducted 14 months after the index resurfacing procedure. Examination under anaesthesia demonstrated 80 degrees of flexion. Central compartment evaluation demonstrated no effusion and macroscopically normal soft tissues. Arthroscopic recession of the prominent anterior acetabular bone was conducted together with a circumferential capsulotomy and limited anterior capsule debridement (Figure 6, Video 1). Improvement in flexion range under anaesthesia of approximately 20 degrees was obtained.

At 3 months post arthroscopy, the patient reported satisfaction with the functional improvement in his hip joint range of motion in flexion. He remained comfortable throughout all daily activities and was able to place his shoes and tie shoelaces without discomfort. At 18 months post arthroscopic intervention, the patient reported maintained improvement in range of motion with functional benefit as a result of his arthroscopic intervention.

*CONDITION 2: Delayed type hypersensitivity (ALVAL) associated with HRA*

A 53-year-old male presented 5 months after Birmingham Hip Resurfacing with a painless fluctuant swelling about the lateral aspect of his thigh of reasonable size (Figure 7). The patient demonstrated no systemic clinical features of infection and the joint was otherwise pain free and of good function.

WCC and CRP were normal and serum chromium level was within normal range. Serum cobalt level was elevated at 80 nmol/L (reference range 0-20 nmol/L). Aspiration drainage of the collection under ultrasound guidance demonstrated scanty growth of a coagulase negative staphylococcus in 1 of 4 fluid specimens. Repeated aspiration drainage demonstrated no growth. Given the clinical presentation and other supporting information available, prosthetic infection was judged unlikely but could not be excluded.

MRI demonstrated evidence of an effusion about the joint posterior to the proximal femur with communication with the arthroplasty (Figure 8). Skin patch testing for cutaneous allergy reactions (including methyl methacrylate, cobalt, chromium, nickel and molybdenum) was reported as normal.

At 10 months after the index resurfacing procedure the hip prosthesis remained pain-free with good functional result however the fluctuant swelling remained persistent. On the basis of this, decision was made to proceed with arthroscopic evaluation and biopsy of the peri-articular tissues to obtain a histologic diagnosis and exclude infection. Arthroscopic evaluation was limited to the cavity of the pseudotumour, without the use of traction, as evaluation of the central compartment or anterior rim of the acetabulum was judged to be unnecessary for diagnosis in this presentation.

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Figure 4. Post-operative radiograph in a patient presenting with persistent symptomatic stiffness after hip resurfacing (Case Example 1).

Figure 5. 2D and 3D CT scans with metal artefact reduction sequences demonstrating prominent bone about the anterior acetabular rim, resulting in limitation in hip flexion range.

Figure 6. Anterior acetabular rim osteophyte before and after excision conducted by central compartment hip arthroscopy.
Under ultrasound guidance, arthroscopic portals were established within the cavity of the pseudotumour (Figure 9). Stability assessment of both the femoral and acetabular arthroplasty components was conducted by direct visualization and probing via the communication between the pseudotumour and joint. Biopsy of local tissues and aspiration of pseudotumour fluid was undertaken (Video 2).

Subsequent analysis of the aspirate fluid and tissue biopsy specimens demonstrated no evidence of infection with negative culture growth and no amplifiable bacterial material detectable by Polymerase Chain Reaction (PCR). Histology of the peri-articular soft tissue specimens demonstrated evidence of a chronic inflammatory change with lymphocyte infiltration, including reactive lymphoid hyperplasia with perivascular localization, consistent with a diagnosis of ALVAL.

On the basis of these findings the patient was advised to undertake a single stage revision Total Hip Arthroplasty (Figure 10).

The histology specimens taken at the time of revision arthroplasty demonstrated features equivalent to those at the initial arthroscopic biopsy, with cultures also being negative. At 5 months post revision arthroplasty, the patient reported a pain-free well functioning hip prosthesis without recurrence of peri-prosthetic swelling.
A 29-year-old male underwent left Birmingham Hip Resurfacing for established osteoarthritis secondary to femoroacetabular impingement (Figure 11). At 5 months post intervention, the patient reported persistent residual groin discomfort of a nature different to his original arthritic pain. Clinical features were suggestive of iliopsoas tendinopathy, with irritation specifically in active and resisted flexion. The wound had healed soundly and blood parameters including ESR, CRP and WCC were normal. Ultrasound demonstrated no evidence of an effusion about the joint and an attempted aspirate was unsuccessful. Plasma chromium levels at 6 months surgery demonstrated chromium of 90 nmol/L (reference range 10-100 nmol/L) and cobalt level of 47 nmol/L. Bone Scan at 7 months post resurfacing demonstrated no abnormal features. Radiographs demonstrated stable well orientated implants. CT scans with metal artifact reduction sequences demonstrated an excess of acetabular bone about the anterior rim of the acetabulum, potentially contributing to iliopsoas tendon irritation (Figure 12).

At 9 months post resurfacing arthroplasty, the patient noted ongoing irritability in active hip flexion. Blood inflammatory markers remained negative and MRI demonstrated no evidence of fluid collections or pseudotumour formation. The provisional diagnosis of anterior soft tissue impingement and iliopsoas tendinopathy was made. Recommendation was made for arthroscopic evaluation and treatment.

At 10 months after the index resurfacing procedure, the patient underwent hip arthroscopy. The operative findings included a well fixed and stable HRA implants with

**CONDITION 3: Iliopsoas impingement after HRA**

A 29-year-old male underwent left Birmingham Hip Resurfacing for established osteoarthritis secondary to femoroacetabular impingement (Figure 11). At 5 months post intervention, the patient reported persistent residual groin discomfort of a nature different to his original arthritic pain. Clinical features were suggestive of iliopsoas tendinopathy, with irritation specifically in active and resisted flexion. The wound had healed soundly and blood parameters including ESR, CRP and WCC were normal. Ultrasound demonstrated no evidence of an effusion about the joint and an attempted aspirate was unsuccessful. Plasma chromium levels at 6 months surgery demonstrated chromium of 90 nmol/L (reference range 10-100 nmol/L) and cobalt level of 47 nmol/L. Bone Scan at 7 months post resurfacing demonstrated no abnormal features. Radiographs demonstrated stable well orientated implants. CT scans with metal artifact reduction sequences demonstrated an excess of acetabular bone about the anterior rim of the acetabulum, potentially contributing to iliopsoas tendon irritation (Figure 12).

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At 10 months after the index resurfacing procedure, the patient underwent hip arthroscopy. The operative findings included a well fixed and stable HRA implants with
prominence of the anterior bony acetabular rim, consistent with the previous CT evaluation. The synovium maintained normal macroscopic appearance and there was no visual evidence of infection. Anterior acetabular osteoplasty and soft tissue debridement was performed as well as synovial biopsy for histology and culture (Figure 13). As adequate correction of the impinging bone lesion could be obtained without significant capsulectomy, the iliopsoas tendon was not directly visualized.

Culture of the synovial fluid and capsular specimens revealed no growth or evidence of infection. Histology specimens demonstrated stromal fibrosis without evidence of acute or chronic inflammatory change.

At review at 4 months and 7 months post hip arthroscopy, the patient noted substantial reduction in left hip symptoms with inflammatory markers remaining normal. Cobalt and chrome levels were incidentally noted to be progressively reducing, as expected with increasing duration of time after the index arthroplasty procedure (33 nmol/L & 53 nmol/L respectively at 14 months).

**DISCUSSION**

Establishing an accurate diagnosis in a patient presenting with groin pain after hip arthroplasty is potentially difficult. For HRA, the diagnoses may include (but are not limited to) aseptic loosening, infection, iliopsoas tendonitis or an adverse reaction to metal debris. Many of these diagnoses share common clinical features. Often we have observed that the results of joint aspiration are inconclusive, due inability to obtain sufficient fluid volume to establish diagnosis. Furthermore, percutaneous joint aspiration cannot provide good quality soft tissue specimens for histologic assessment to evaluate for potential adverse reactions to the metal on metal bearing surfaces. As hip arthroscopy consistently provides both good quality tissue and fluid specimens, we have found this technique to be a useful in the evaluation of complications after HRA.

For the majority of diagnostic and therapeutic hip arthroscopy procedures after joint arthroplasty (including HRA), we recommend the conduct of a central compartment procedure using techniques similar to standard hip arthroscopy. While direct inspection of the bearing surfaces is unlikely to yield additional useful diagnostic information, the application of traction creates an anatomic gap into which instruments can be easily placed without necessitating resection of peri-articular capsule or scar tissue. Adopting this method minimizes the degree of surgical dissection required for portal development, potentially reducing the risk of post-arthroscopic prosthetic instability. Introducing the instruments into the central compartment under traction also facilitates accurate biopsy of the soft tissues anatomically closest to the bearing surfaces and also allows capture of the greatest amount of synovial fluid

Figure 14. Iliopsoas tendon irritation after left hip resurfacing arthroplasty. Central compartment arthroscopic view of anterior acetabular rim osteophyte, before and after excision. Anterior capsule also debrided during the osteoplasty procedure, demonstrating proximity of iliopsoas tendon (IP: Iliopsoas tendon; F: Femoral component; A: Acetabular component).
from within the joint. Under traction, the stability of bone-implant interfaces can be assessed and evaluation of the anterior-superior acetabular rim for rim lesions can easily be conducted.

Although iliopsoas tendon irritation or anterior soft tissue impingement after hip arthroplasty procedures are relatively uncommon diagnoses, the symptoms may be both persistent and also significantly limit function. Where non-surgical treatments including activity modification, physiotherapy and therapeutic injections fail to provide sufficient clinical improvement, arthroscopic intervention may be considered. While iliopsoas tenotomy may be conducted by either open or arthroscopic methods, the associated de-functioning of hip flexor strength concerns many patients, particularly those who are highly active. For patients with suitable anterior and superior acetabular rim lesions, arthroscopic osteoplasty and selective capsular debridement may be considered. In situations where more extensive bone resection is required, the iliopsoas tendon may be visualized and directly assessed to exclude ongoing mechanical irritation (Figure 14).

**CONCLUSION**

Hip arthroscopy is a useful minimally invasive technique for the evaluation and treatment of selected complications after Hip Resurfacing Arthroplasty. Anterior capsular debridement and acetabular rim osteoplasty procedures may provide therapeutic benefit for both pain reduction and improved range of motion. Hip arthroscopy also enables the collection of diagnostic quality soft tissue biopsy samples to assist in further management where required.

**REFERENCES**