The Role of Hip Arthroscopy in Investigating and Managing the Painful Hip Resurfacing Arthroplasty

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Purpose: To determine the safety and efficacy of hip arthroscopy performed in the peripheral compartment as a diagnostic and therapeutic treatment option for patients with hip pain after hip resurfacing surgery. **Methods:** Indications for hip arthroscopy after hip resurfacing included patients with a symptomatic hip-resurfaced arthroplasties who did not respond to nonoperative treatment. Patients who underwent a hip arthroscopy after a painful hip resurfacing were included with a minimum of 1 year follow-up. Subgroup analysis was performed according to whether an established diagnosis was made before arthroscopic intervention or not. Subjective measures were based on Western Ontario and McMaster Universities Arthritis Index (WOMAC) scores, and results were calculated and analyzed. **Results:** We included 68 patients (26 male [38%] and 42 female [62%]) who underwent subsequent hip arthroscopy from a population of 978 consecutive hip-resurfaced arthroplasties performed between 1999 and 2010. The average age was 58 (range, 37 to 78 years). The mean follow-up after hip arthroscopy was 3.4 years (range, 12 months to 5.8 years). Patients who had an established diagnosis (n = 41) before hip arthroscopy showed statistical improvement in their WOMAC scores (7 to 2, $P <$ .001). Only 3 (7%) of these 41 patients failed and were converted to a total hip replacement (THR); however, patients who did not have an established diagnosis (n = 27) before undergoing hip arthroscopy showed statistical worsening of the WOMAC (15 to 21, $P = .002$). Ten (37%) of these 27 patients without a diagnosis failed and needed to be converted to a THR. A significant correlation was found between the collections found on ultrasound (psoas bursa and/or in the hip joint) and the need for synovectomy ($P = .01$). The overall revision rate to THR after hip resurfacing in our group of patients was 1.3% (n = 13). Female patients were more likely to require postresurfacing hip arthroscopy with 42 (60%) female to only 26 (40%) male patients undergoing this procedure. In our study population, 70% (14/21, $P < .05$) of patients with hip pain caused by severe metal synovial reaction or metal-on-metal reaction were women. A total of 5 (7%) patients had minor-to-mild complications after hip arthroscopy. **Conclusions:** Hip arthroscopy is a safe surgical treatment option for those patients with a painful hip resurfacing arthroplasty. Having an accurate diagnosis before hip arthroscopy improves the likelihood a good outcome. **Level of evidence:** Level IV - therapeutic case series.

Hip resurfacing currently is considered a popular and successful option for the treatment of osteoarthritis in the younger, active patient.[1,2] The advantages of hip resurfacing include the preservation of bone stock, lower dislocation rates, increased activity levels, and ease of revision.[3-8] Hip resurfacing once again is considered an acceptable substitution for total hip arthroplasty in the younger patient, with up to 99% survivorship at a mean of 5 years.[9-12] Unfortunately, a few unique complications are associated with hip resurfacing arthroplasty: femoral neck fractures, implant loosening, metal-ion sensitivity, iliopsoas tendinopathy, impingement, metallosis, and osteolysis.[13,14] Several of these complications usually can be diagnosed with a thorough history, good physical examination, and the use of serial radiographs.[5] Special magnetic resonance imaging sequences have shown marked reduction of artifact and improved assessment of synovial reactions after metal-on-metal hip resurfacing.[15] Ultrasonography can be used to image joint effusion or reactive cysts when metal-on-metal reaction is suspected.[16] Hip joint aspiration and inflammatory markers, in conjunction with various

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nuclear scans, can help rule out an infection as a cause of pain.[17]

However, a group of patients can experience ongoing pain without an identifiable cause, creating a diagnostic and therapeutic challenge. Arthroscopy has proven to be a useful diagnostic and therapeutic tool in such cases and allows the possibility of preventing the need for revision arthroplasty.[18,19] Arthroscopy allows good visualization of the component surfaces, the adjacent synovium, and the surrounding soft-tissue structures, such as the Iliopsoas tendon, the reflected head of rectus femoris tendon, and the hip capsule. Arthroscopy also enables dynamic assessment of hip anatomy and motion, allowing the surgeon to assess subtle residual impingement or component micro-motion, potentially confirming the diagnosis of loosening. Once a diagnosis is made, many of the aforementioned pathologies can be addressed during the same procedure, whereas some may require revision surgery.[20] The purpose of this study was to determine the safety and efficacy of hip arthroscopy performed in the peripheral compartment as a diagnostic and therapeutic treatment option for patients with hip pain after hip-resurfacing surgery. Our hypothesis was that hip arthroscopy would be a low-risk surgical treatment option to diagnose and treat the symptomatic hip after hip resurfacing surgery to reduce need for conversion to total hip replacement (THR).

Materials and Methods

Study Design and Patient Selection

From 1999 to 2010, a retrospective study of 978 consecutive hip-resurfaced arthroplasties (HRAs) was performed at our institution. From this patient population, 68 who underwent subsequent hip arthroscopy after resurfacing from 2004 to 2012 were included in this study and retrospectively reviewed. The same surgeon performed the hip resurfacing and hip arthroscopy. No patient who underwent an arthroscopy with a resurfaced hip in situ was excluded. Those patients with less than 1 year follow-up after hip arthroscopy were excluded. The study received institutional review board approval, and informed consent was obtained from all subjects. Indications for HRA were active patients diagnosed with advanced hip osteoarthritis. The study was approved by the hospital institutional review board, and all patients were consented to participate in the study.

Indications for hip arthroscopy after hip resurfacing included patients with a symptomatic HRA who did not respond to nonoperative treatment. Before the hip arthroscopy was performed, patients underwent a thorough clinical examination, radiographic evaluation, and ultrasonography of the joint and surrounding structures. If femoroacetabular impingement (FAI) was suspected, patients underwent dynamic screening under fluoroscopy as well as 3-dimensional computed tomography. All patients also underwent blood tests, including a standard chemistry panel, C-reactive protein, and erythrocyte sedimentation rate, to rule out infection. When indicated, patients also underwent joint aspiration. Chromium and cobalt levels also were tested in both serum and hip aspirate synovial fluid if an aspiration was performed.

The standard of care in patients with HRA in our institution includes the monitoring of blood metal levels annually and joint synovial fluid analysis when present. Patients with ongoing symptoms that did not resolve with conservative treatment modalities for a minimum of 1 year were offered hip arthroscopy. Conservative measurements included physiotherapy, iliopasoas steroid injection when needed, restriction of activity that requires deep hip flexion, and nonsteroidal anti-inflammatory drugs. The same surgeon performed arthroscopy in all patients. Patients with a stress fractures ($n = 4$) or gluteal tendinopathy with trochanteric bursitis ($n = 3$) were excluded from the study, because arthroscopy was not indicated. Infection and implant loosening also were considered exclusion criteria, but we did not encounter these problems in our study population.

Surgical Technique

Arthroscopy was undertaken in all cases by the senior (D.A.Y.) and first (O.M-D.) authors with the patient lying supine on a standard traction table. The groin and foot were well padded to avoid nerve palsies. A 2- or 3-peritrochanteric portal approach was used in all cases. The first portal was made by inserting a spinal needle directly towards the lateral compartment (femoral neck) with the midanterior portal, and a second portal was placed approximately 5 cm distal to the first one (Fig 1) and 1 to 2 cm medial.

Traction was not used, because work was only in the peripheral compartment and surrounding tissues. Once the femoral neck was identified, the surgeon inspected the anatomy and treated any identified pathology.

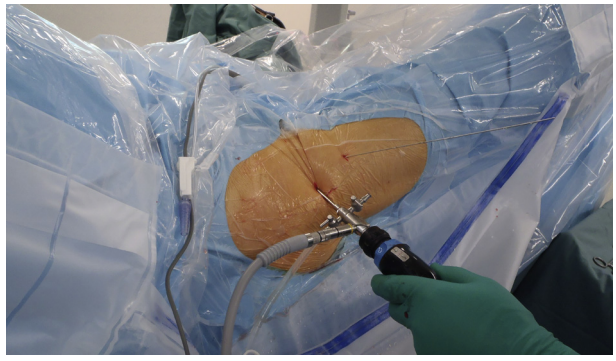

Fig 1. Right hip with the patient in the supine position shows the midanterior portal and the modified (inline-distal) anterolateral portal used for postarthroplasty hip arthroscopy. Figure courtesy of Dr. Omer Mei-Dan.

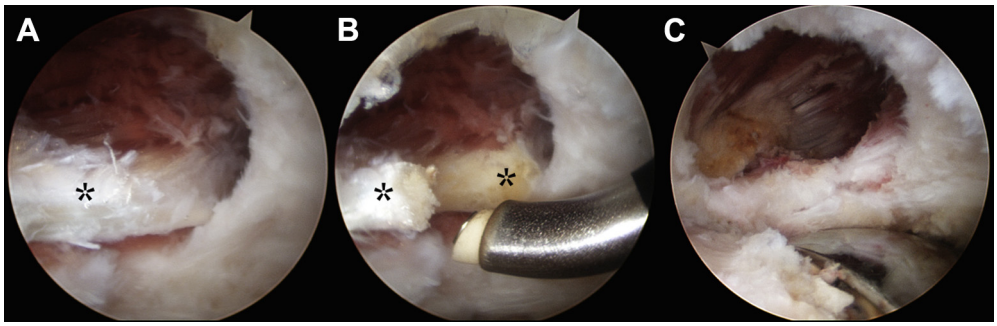

Fig 2. Liopsoas tendon before release viewed through a capsular window with 30° 2.9-mm arthroscope in the midanterior portal. Release was performed using a MultiVac 50 wand (Arthrocare). (A) iliopsoas muscle and frayed tendon on view, (B) during release, and (C) after release of iliopsoas tendon, iliopsoas muscle can seen in the background. Asterisks show the iliopsoas tendon. Figure courtesy of Dr. Omer Mei-Dan.

Iliopsoas release was performed from the peripheral compartment with a radiofrequency ablation wand (Fig 2). If the patient was diagnosed with a synovial reaction or metallosis, an extensive synovectomy was performed (Fig 3). For those patients diagnosed with residual bony impingement, pincer or cam resection was performed with a motorized (4 and 5.5 mm, respectively) burr (Figs 4 and 5).

Outcome Assessment

Only patients with a minimum 12-month follow-up were included for analysis. Questionnaires were administered preoperatively and 1 year postoperatively, and then annually or until revision was required. Subjective measures were based on the Western Ontario and McMaster Universities Arthritis Index (WOMAC) scores, and results were calculated and analyzed. For subjective outcomes, we used the most recent WOMAC score per patient. Surgical failure was defined as those patients converted to THR secondary to persistent symptoms.

Statistical Assessment

Descriptive statistics were calculated according to standard methods, including frequencies, means, standard deviations, and ranges when appropriate. Clinical outcome scores were analyzed at 2 time points: before

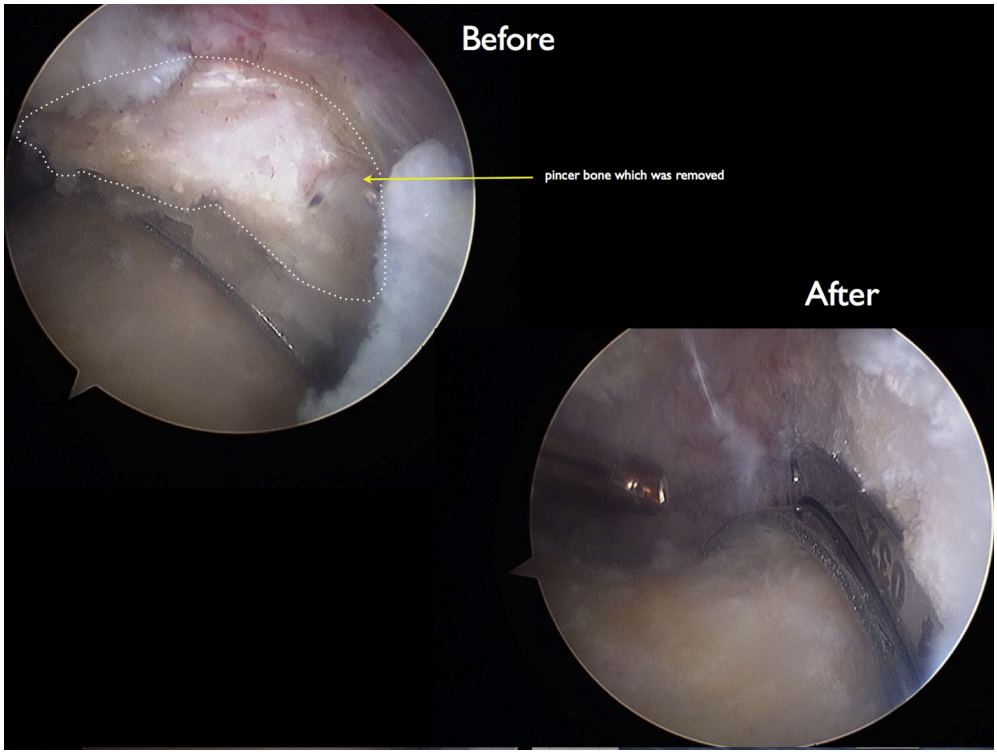

Fig 3. Left hip with the patient in the supine position and the 30° 2.9-mm arthroscope in the midanterior portal. Note the osteophyte covering the anterior cup (pincer type), resulting in femoroacetabular impingement and potential fraying of iliopsoas. Before and after pincer removal. Figure courtesy of Dr. Omer Mei-Dan.

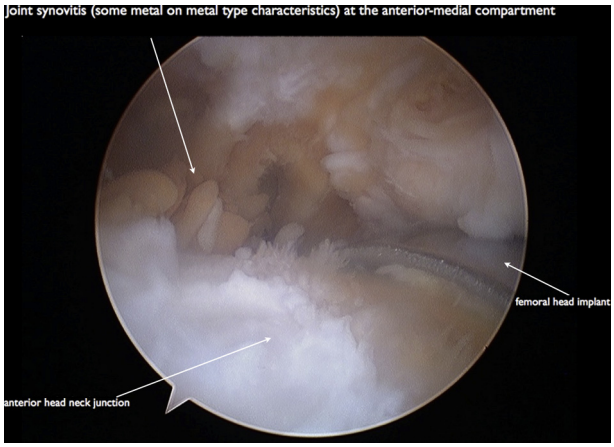

Fig 4. Left hip with the patient in the supine position and the 30° 2.9-mm arthroscope in the midanterior portal. Note the synovial reaction in the peripheral compartment in a patient with a symptomatic resurfaced hip. Figure courtesy of Dr. Omer Mei-Dan.

the hip arthroscopy and the most recent follow-up questionnaire data. Score improvement was analyzed with a paired *t*-test. Subgroup analysis was performed by 1-way analysis of variance with the Tukey post hoc test to determine differences among subgroups. Statistical significance was set at $P < .05$. Statistics were performed with GraphPad software (GraphPad Software, La Jolla, CA), SPSS version 15.0 (SPSS, Chicago, IL), and the G*Power statistical program.

Results

Implant distribution for the 978 consecutive HRAs was as follows: 1 Biomet Recap (Biomet Inc, Warsaw, IN), 13 Adept Resurfacing System (MatOrtho Limited, Surrey, UK), 18 ASR Hip System (DePuy Synthes, Warsaw, IN), 271 Mitch (Finsbury Orthopedics, Surrey, UK), and 675 were BIRMINGHAM HIP Resurfacing (BHR; Smith & Nephew, Andover, MA).

From the 68 patients included in the study, 26 were men (38%) and 42 were women (61%); 51 were BHR (51/675 or 7.6%); 12 were Mitch (12/275 or 4.37%); 1 was Adept (1/13 or 7%), and 4 were ASR (4/18 or 22%). Thirty-one had right hip involvement, and 37 had left hip involvement. The average age was 58 (range 37 to 78 years). The average time between HRA and hip arthroscopy was 5 years (range, 1 to 8 years). Clinical presentation was similar in those patients with early persistent pain post-HRA to those with late persistent pain post-HRA. Table 1 shows patients demographic for the study population. There were 646 HRAs in male patients (66%) and 332 resurfaced hips in female patients (34%) in our study group.

Patients were subcategorized into 2 different groups. The first group included 41 (62%) patients with an established working diagnosis. Arthroscopy was aimed at confirming the diagnosis and addressing the pathology. These included iliopsoas tendinopathy, synovial reaction, osteophytes, and impingement. The second group included 27 patients (38%) in whom the preoperative workup had failed to establish a conclusive diagnosis despite comprehensive clinical and radiologic analysis. This last population was considered as patients with hip pain post-HRA without an identified cause. Arthroscopy was the last tool used to establish a diagnosis and treatment strategy, in an attempt to avoid revision arthroplasty.

The mean follow-up after hip arthroscopy was 3.4 years (range, 12 months to 5.8 years). None of the patients had bilateral hip arthroscopy. Overall, statistically significant improvement (preoperative compared

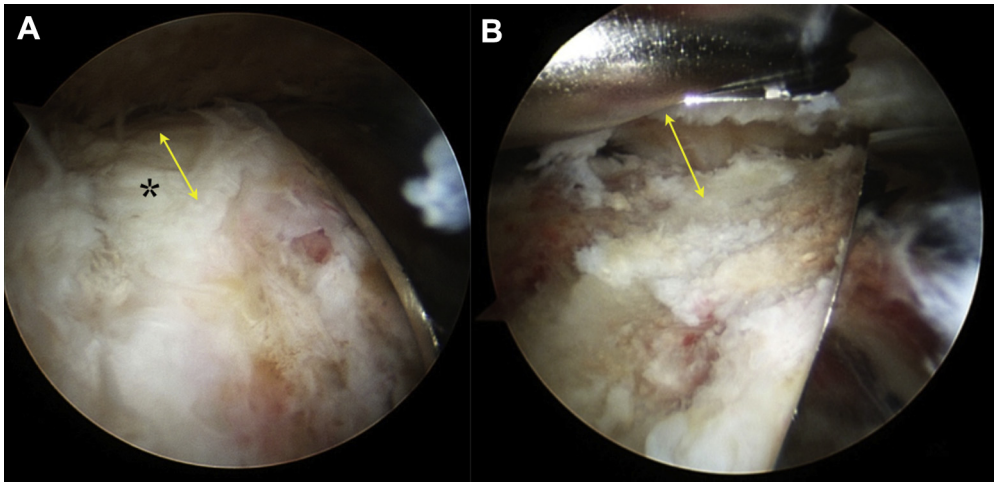

Fig 5. Left hip with the patient in the supine position and with 30° 2.9-mm arthroscope in the midanterior portal. (A) Cam lesion leading to femoroacetabular impingement in the resurfaced hip; (B) cam lesion resected. Arrows show the ammount of cam resected. The asterisk shows the cam lesion. Figure courtesy of Dr. Omer Mei-Dan.

Table 1. Demographic Data of the 68 Patients Undergoing Hip Arthroscopy After Hip Resurfacing

Parameter	Number
Male/female	26/42
Right/left side	31/37
Mean age, yr (standard deviation)	58 (±10)
Mean time from surgery to hip arthroscopy, yr	6.5 (range, 1-8)
Type of resurfacing	
BHR	53
Mitch	9
Adept	2
ASR	4

BHR, Birmingham Hip Resurfacing.

with postoperative) was seen for the WOMAC score (5 to 87 points, $P < .001$; Fig 6). In total, 47 of 68 (70%) patients with resurfaced hips that required arthroscopic intervention reported good-to-excellent short-to-medium outcome after arthroscopy. Of the remaining patients having undergone arthroscopy, 8 (11%) had fair outcomes, and 13 (19%) experienced poor outcomes, eventually leading to revision procedures. Female patients were more likely to require postresurfacing hip arthroscopy with 42 (60%) women to only 26 (40%) men undergoing this procedure. Time to arthroscopy from index procedure varied from 1 to 8 years (average, 6.5 years). From the entire population studied, 21 (30%) were diagnosed as hip pain secondary to severe metal synovial reaction or metal-on-metal (MoM) reaction. From these patients, 14 (70%, $P < .05$) were women.

Preoperative Ultrasonography Results

A significant correlation was found between the collections found on ultrasonography (psoas bursa and/or in the hip joint) and the need for synovectomy ($P = .01$). Sizes for joint effusion, iliopsoas thickening, and synovial thickening ranged from nil collection, to small, moderate, and large. The size of the collection was not a significant factor in determining the diagnosis or the extent of surgical synovectomy ($P = .548$). Outcome also was not significantly predicted by evidence of collection ($P = .149$), size of collection ($P = .232$), or level of capsular thickening ($P = .559$). A trend showed

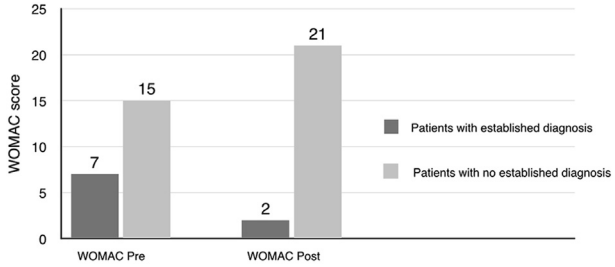

Fig 6. Pre- and postoperative Western Ontario and McMaster Universities Arthritis Index (WOMAC) scores according to subgroups. Figure courtesy of Dr. Omer Mei-Dan.

Table 2. Indications for Hip Arthroscopy in Subgroup With Presumed Known Etiology for Symptoms

Indications for Hip Arthroscopy	Number of Patients
IP tendinopathy	17
MoM or synovial reaction	17
Anterior hip pain/osteophytes	4
Impingement (cam type)	3

IP, iliopsoas; MoM, metal on metal.

that those with no significant findings on ultrasonography of joint effusion, iliopsoas, or synovial thickening were more likely to require a revision ($P = .06$).

Complications

A total of 5 (7%) patients had minor-to-mild complications after hip arthroscopy. Three patients had heterotopic ossification posthip arthroscopy, and 1 patient complained of numbness of the lower extremity that resolved within 6 months. One patient presented a superficial skin infection that was treated with oral antibiotic.

Analysis of Subgroups

Patients who had an established diagnosis (n = 41) before hip arthroscopy showed statistical improvement of the WOMAC score (7 to 2, $P < .001$). Only 3 patients (7%) from this group failed to improve after arthroscopic treatment and were converted to a THR. Two of these patients were confirmed by histopathology analysis with an ALVAL lesion (i.e., aseptic lymphocyte-dominated vasculitis-associated lesion). The third patient was diagnosed with a severe synovitis reaction. Time from arthroscopy to conversion to THR averaged 12 months (range, 4 to 12 months). Tables 2 and 3 show the indications and procedures performed in patients with an established diagnosis before arthroscopy (Figs 4-6). In this group, arthroscopy did not add any additional diagnosis but confirm the preoperative diagnosis.

Patients who did not have an established diagnosis (n = 27) before undergoing hip arthroscopy showed statistical worsening of the WOMAC (15 to 21, $P = .002$). A definitive diagnosis could not be established in 10 of these 27 patients (37%). Also, a high incidence of

Table 3. Procedure Performed in Patients With a Known Etiology Before the Arthroscopy*

Diagnosis	Surgical Treatment
IP tendinopathy	IP release
Bone impingement	Pincer resection
MoM or synovial reaction	Synovial removal/debridement
Anterior hip pain/osteophytes	Removal of osteophytes

IP, iliopsoas; MoM, metal on metal.

*For some patients, several procedures were performed during the arthroscopic procedure.

failure was evident in this group. Ten patients (37%) were converted to a THR after hip arthroscopy. Four of these patients were diagnosed with an MoM reaction, 3 had a severe synovial reaction, and in 2 patients, hip arthroscopy failed to assist in establishing a conclusive diagnosis. Most patients in this group that were diagnosed intraoperatively with a synovial reaction experienced symptomatic improvement after hip arthroscopy (Appendix Fig 1).

Discussion

Persistent pain after hip resurfacing can be a diagnostic and therapeutic challenge. The current study presents a series of 68 resurfaced hips that underwent subsequent arthroscopy to address ongoing symptoms, with or without an established diagnosis. Patients with an established diagnosis for their symptoms showed statistically significant improvement in WOMAC scores following arthroscopy, whereas patients without a diagnosis before arthroscopy had statistically worse scores. A greater incidence of resurfacing failure also was seen in this group of patients without a prearthroscopic diagnosis. Intraoperative diagnosis of synovitic reactions had better symptom resolution after arthroscopy. The overall revision rate in our group of patients was 1.3% (n = 13), which is similar to current literature demonstrating up to 99% survivorship of the resurfaced hip at least 4 year follow-up.[19]

This study demonstrates that arthroscopy of the peripheral compartment is a safe procedure in resurfaced hips and allows good visualization of the component surfaces, synovium, and surrounding tissues, with the advantage of dynamic joint and component evaluation. It highlights the ability of hip arthroscopy of the peripheral compartment to assist in treating challenging patients presenting with ongoing symptoms post hip resurfacing. The only other published report of arthroscopy of a resurfaced hip presents a case report of a patient with persisting pain.[18] After conventional investigations were found to be normal, arthroscopy was used to reveal loosening of the acetabular cup. Two previous case series have studied the role of arthroscopy after THR. Khanduja et al.[20] analyzed the use of hip arthroscopy to diagnose and treat ongoing postoperative pain. The authors retrospectively reviewed 16 hips in 14 patients with 1 to 10 years' follow-up. Arthroscopy was performed with the patient in the lateral position and the hip distracted. Twelve of the hips were considered diagnostic dilemmas, and in 4 patients, arthroscopy was used as a treatment modality after a diagnosis had been established. Of the diagnostic dilemmas, arthroscopy revealed scar tissue and synovitis in 9 patients, which were found to be suffering from sepsis, corrosion of the head and neck junction, impingement, and a loose acetabular component. Of the 4 patients in whom a diagnosis was established before arthroscopy, 1 had sepsis, 2 had migrated wires, and 1 had a loose screw, all of which were successfully treated with arthroscopy. Overall, 4 patients (25%) required revision, and 9 patients had successful outcomes (56%). Limitations of this study include the retrospective aspect of the study and the fact that only medical records were used without the patients being directly contacted. Also, standardization of symptoms, follow-up or outcome scores were not undertaken. These studies support the findings in the current study that the presence of a prearthroscopy diagnosis affects patient outcomes. It highlights arthroscopy as an efficient and important tool assisting in the diagnosis and treatment of short- and long-term complications after hip joint arthroplasty. The procedure can yield good clinical outcomes and reduce revision rates in appropriately selected pathologies.

In our series, ultrasonography was found to be a helpful diagnostic and screening tool. This correlates with the current literature, which confirms the ability of ultrasonography to detect fluid collections or a mass adjacent to the implant, such as a pseudotumor. It also can diagnose a fluid collection in the joint or iliopsoas bursa, as well as estimate its size.[21-23] In our study, there was a trend suggesting that lack of a collection on ultrasonography also proved to be a helpful predictor of requiring revision surgery to hip arthroplasty ($P = .06$).

In hip-resurfaced patients suffering anterior groin pain during flexion and passive extension, iliopsoas tendinopathy should be considered. This occurs in approximately 5% of patients presenting with post resurfacing pain.[17] It is thought to be caused by tendon impingement over a prominent acetabular component[24] and often is accompanied by bursitis. Diagnosis may be confirmed with local anesthetic injection.[25] Treatment options include botulinum toxin infiltration,[26] tendon release,[27] excision of osteophytes under the tendon's tract, or revision of the offending components[24,28]; however in our population, we found generalized synovitis to be the predominant cause for the ongoing pain whereas the prearthroscopy diagnosis of psoas impingement, or irritation, was found not to appear as commonly at arthroscopy. We hypothesize that this generalized synovitis, when present in the first 2 years after resurfacing surgery, may be the result of the period of time the metal components take to settle into their permanent position.

In addition to the aforementioned theory, the high incidence of synovitis in our patient population may, in some cases, also be explained by the pseudotumors associated with MoM hip resurfacings described by Pandit et al.[23] These pseudotumors were described as occurring in 1% of cases and are thought to be exacerbated by malpositioned components,[29,30] specifically, steep inclination of the acetabular cup resulting in

metal debris due to increased edge-loading.[23] These pseudotumors, however, predominantly seen in women, responded well to synovectomy.

Metal hypersensitivity, another specific complication seen in patients with HRA,[31] is an allergic type reaction, which can lead to pain, effusion, bursitis, and osteolysis, usually within a few years after the index procedure.[21] This complication is hard to conclusively diagnose with no predictive tests or noninvasive screening tools available.[30] Skin-allergy testing to cobalt may help identify these patients before surgery,[32] although dermal immunological reactions may not give a sensitive indication of articular reactions.[33] The testing and interpretation of cobalt values is controversial. The Food and Drug Administration cautions that the interpretation of cobalt levels in patients with MoM hip implants has not been clearly defined.[34]

Almost all patients suffering this complication are women,[35] which corresponds with our findings, where 70% of the patients suffering from this complication were women. If severe, this complication would lead to a revision surgery and implant removal,[21] which is known to yield good results with replacement of the offending MoM articulation.

Our results also demonstrate a greater revision rate in women, corrleating with the current literature, which suggests a 98% survival in 10 years for men and 89% in women.[36] Apparently, men tend to have better results not only because of their larger bone stock, reducing some of the more debilitating early complications such as femoral neck fracture, occurring in up to 4% of patients,[37-39] but they also are less likely to suffer from metal sensitivity,[24] likely the result of reduced exposure to cobalt found in jewelry, especially among those with pierced ears.[40]

Impingement is also a complication to be considered in patients with hip pain after HRA. As the natural head−neck junction and femoral neck is preserved in resurfacing arthroplasty, FAI can still be present and negatively affect a patient's outcome. The surgeon should be aware of an abnormal preoperative offset ratio (or alpha angle >50), which has been shown to occur in 57% of patients.[41] Correcting the offset during the operation could eliminate postoperative impingement of the femoral and acetabular components. In our series, 3 patients suffered from postresurfacing FAI, which was addressed arthroscopically.

Time from hip resurfacing to arthroscopy varied in our series, but with an average of 6.5 years it seems that arthroscopy is predominantly a tool used to diagnose and manage late complications. This may partly be attributable to the fact that early complications often are more easily identified, such as femoral neck notching, femoral neck fracture, stress fracture, nerve palsy, or infection, and can rarely be treated with arthroscopy.[42] Of our original study population of 978 patients, these early complications included stress fractures (n = 4) and gluteus minimus and medius tendinopathy with trochanteric bursitis (n = 3), all of which did not undergo arthroscopy. Appendix Figure 1 shows a treatment algorithm that can be used to guide management of the painful HRA.

Limitations

Limitations of this study include the partial retrospective nature of the data collection and the lack of standardized preoperative symptomology and diagnostic functional outcome scoring for hip resurfacing. However, the WOMAC scores were reviewed retrospectively whereas the data were collected prospectively at the time of follow-up in all patients.

Also, an accurate diagnosis of MoM reaction requires the quantification of blood metal levels.[43] Although, this test was performed in most of patients, testing was inconsistent. Blood metal levels were performed annually in each patient after hip arthroscopy; however, the results were not included in the current study.

Conclusion

Hip arthroscopy of the peripheral compartment is a safe surgical treatment option for those patients with a painful hip-resurfacing arthroplasty. Having an accurate diagnosis before hip arthroscopy is improves the likelihood a good outcome.

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Appendix Fig 1. Management algorithm for the painful hip-resurfaced arthroplasty. Figure courtesy of Dr. Omer Mei-Dan.