Clin Orthop Relat Res (2009) 467:760–768
DOI 10.1007/s11999-008-0618-4

SYMPOSIUM: FEMOROACETABULAR IMPINGEMENT: CURRENT STATUS OF DIAGNOSIS AND TREATMENT

Complications of Arthroscopic Femoroacetabular Impingement Treatment

A Review

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Published online: 19 November 2008

Abstract Recent developments in hip arthroscopy techniques and technology have made it possible in many cases to avoid open surgical technique for treating pincer-type and cam-type femoroacetabular impingement and rather treating it arthroscopically. Early reports suggest favorable results using arthroscopic techniques. The frequency of complications reported for hip arthroscopy for all indications is generally less than 1.5%, suggesting the procedure is safe. Little information is available on complications directly related to the arthroscopic treatment of femoroacetabular impingement. Failure to recognize and treat or incompletely reshape impingement deformities may be the most frequent cause for a second hip arthroscopy and redébridement of the deformity. There has been no report of avascular necrosis related to the arthroscopic treatment of femoroacetabular impingement; only one femoral neck fracture after arthroscopic cam remodeling has been reported in a large series of patients. Other clinical concerns include hip dislocation secondary to extensive capsulotomies or overresection of the anterior acetabular rim in the case of pincer impingement.

Level of Evidence: Level V, therapeutic study. See the Guidelines for Authors for a complete description of levels of evidence.

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Introduction

Femoroacetabular impingement (FAI) has been recognized as an etiology of hip osteoarthritis [13]. Surgical hip dislocation and open osteochondroplasty have been considered the standard of treatment [2] as described by the group that developed the concepts of FAI [14]. Arthroscopic treatment of FAI was introduced by Sampson [31] and further developed by other authors [6, 17, 22, 30]. The arthroscopic technique is an adaptation of the open surgical procedure and follows the same steps and precautions of the open surgical technique in combination with standard techniques for arthroscopy of the central and peripheral compartment of the hip [6, 11]. Proper patient selection is the first step for successful arthroscopic treatment of FAI as it is for the open procedure [6]. In most patients, the central compartment (iliofemoral joint) abnormality is treated first. Traction is used to access the central compartment. Traction is then released and the hip periphery accessed. Pincer impingement is typically treated at the central compartment [30] and cam deformities are treated at the peripheral compartment [6, 17, 22].

Although the arthroscopic surgical technique is an adaptation of the open surgical procedure, there is a series of steps that are specific for hip arthroscopy and present special challenges to the surgeon and the possibility of complications directly related to these steps. Other possible complications are similar to those of the open technique.

The purpose of this report is to: (1) present key aspects of the surgical technique for arthroscopic procedures in the hip; (2) review the reported complications in the literature for hip arthroscopy in general; and (3) present the complications that are directly related to the arthroscopic technique in the treatment of FAI.

Search Strategies and Criteria

A literature search was performed to identify the frequency of complications in hip arthroscopy using the PubMed and Science Direct databases. Only studies in English were included. The words "complications and hip arthroscopy" and "revision and hip arthroscopy" were typed in the search engines. One hundred forty-nine items in the PubMed database and 32 items in the Science Direct database were found when performing the search. We selected studies that included more than 500 cases with more than 4 years' followup. Only two studies met the selection criteria [9, 32].

In the revision and hip arthroscopy search, 12 items were found in the PubMed search and four items in the Science Direct search. Only two studies [18, 29] presented results of revision hip arthroscopy after failed hip arthroscopy index procedures.

A literature search on arthroscopic management of FAI was also performed in the PubMed and Science Direct databases using the words "femoroacetabular impingement and arthroscopy." Twenty-nine items were identified in the PubMed database and 19 items in the Science Direct database. Only studies that presented the arthroscopic technique and clinical results were included [17, 19, 22, 25, 31].

Study quality was not assessed.

Hip Arthroscopy General Technique

Patient positioning is the first step in hip arthroscopy and two different methods are used today: the supine and lateral positions [5, 16, 20]. Both methods of patient positioning are used in the treatment of FAI [17, 22, 28, 31]. The objective of both methods of patient positioning is to achieve sufficient traction to separate the femoral head from the acetabulum and provide access to the central compartment of the hip. The positioning technique should also allow traction release and provide hip flexion of up to 40°, abduction to relax the anterior hip capsule, and external rotation to facilitate the surgeon's access to the front of the hip (when the surgeon is standing in front of the patient) for arthroscopic access to the hip periphery and permit lateral images of the hip for fluoroscopic examination of the anterior femoral head-neck junction. After the cam-type deformity is remodeled, the hip is flexed more than 90° to evaluate the decompression as the femoral head-neck junction enters the acetabulum. Arthroscopic access to the hip is achieved using specially designed hip arthroscopy cannulated instruments and techniques [17].

Complications Related to Hip Arthroscopy for All Indications

Most of the complications related to hip arthroscopy are usually preventable and related to patient positioning and fluid management. In 2003, Clarke and Villar [9] reported 15 complications (1.4%) in a consecutive series of 1054 hip arthroscopies. In the same series, they reported 30 cases (3%) in which hip arthroscopy could not be performed because of difficulties with access. The main complications were three sciatic neuropraxias and one femoral neuropraxia that resolved spontaneously. They also reported one vaginal tear that healed without further intervention probably related to excessive lateral traction force, two postoperative portal bleedings, two hematomas that resolved spontaneously, two cases of intraarticular instrument breakage, and one infection. Two patients underwent arthrotomy, one for débridement and one to remove a loose body that could not be removed arthroscopically.

In 2005, Sampson [32] reported his complications in a consecutive series of 1000 patients. Twenty neuropraxias that resolved spontaneously were reported: 10 perineal, four pudendal, one lateral femorocutaneous, one combined femoral and sciatic, and four sciatic. He also reported 10 intraabdominal fluid extravasations, three cases of instrument breakage, three cartilage scuffings, one avascular necrosis of the femoral head in a patient treated with labral débridement without any FAI remodeling, and one femoral neck fracture related to overresection of the femoral neck when treating cam impingement. Byrd [8] reported 20 complications (1.34%) in a consecutive series of 1491 patients reviewed among several experienced surgeons and those reported in the literature. Thirteen neuropraxias were reported: six pudendal (the most frequent), four sciatic, one femoral, and two lateral cutaneous. Only one case had permanent damage from laceration of the lateral femorocutaneous nerve. He found one case of scrotal necrosis secondary to pressure from the perineal post, one retrieved broken instrument, and one case of heterotopic bone formation. Three cases of extraabdominal fluid extravasation were also reported.

Although most cases of intraabdominal fluid extravasation present with severe lower abdominal pain secondary to peritoneal irritation and are treated by overnight intensive care unit observation and analgesia, it is a potentially devastating complication. Bartlett et al. [1] reported a 50-year-old man who had hip arthroscopy performed by the lateral approach 12 days after open reduction of an acetabular fracture, which was performed 5 weeks after initial injury. Within 2 hours of the arthroscopic procedure, the patient presented a progressive decrease in heart rate that led to a cardiac arrest despite pharmacologic intervention and assisted ventilation with 100% oxygen.

The abdomen was tense and grossly distended. Eight liters of clear fluid were drained through a supraumbilical laparotomy followed by a spontaneous abrupt return of circulation.

Intraabdominal fluid extravasation is related to arthroscopy postacetabular fractures or periarticular hip endoscopy (procedures at the iliopsoas bursa or the peritrochanteric space). Byrd and Chern [7] have recommended performing the operation in an expeditious fashion, and if difficulties are encountered and extravasation becomes a problem, it is better to terminate the procedure. A high-flow fluid management system is recommended, allowing adequate flow without excessive pressure. It is advisable to wait several weeks for hip arthroscopy after acetabular fractures.

Most neurologic and soft tissue lesions are secondary to traction forces or compression generated by the positioning systems. Careful patient positioning with adequate padding of the perineal post (extra padding of at least 9 cm in diameter) and the foot fixation device is the first and most important step in hip arthroscopy. Traction time must be limited to less than 2 hours to prevent neurologic injury [32]. If more time is necessary, the traction should be released and restarted after a rest period of at least 15 minutes.

Cartilage injury secondary to instrument passage is probably underreported. It was considered to be less than 1% in the series by Sampson [32] and only mentioned by Clarke and Villar [9] (Fig. 1). Adequate femoral head-acetabular separation is the first step in avoiding this complication. The most separation is achieved by a combination of traction and hip capsule distension by introducing air or saline when the first spinal needle is positioned inside the hip [7] (Fig. 2).

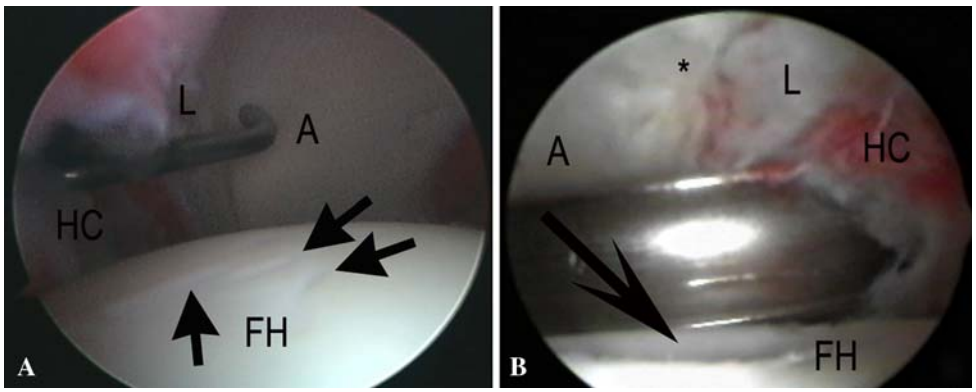

Fig. 1A–B Arthroscopic photographs of two different cases are shown. (**A**) In this arthroscopic photograph of a left hip, the hip capsule (HC) is to the left. The acetabulum (**A**) and labrum (L) are at the top of the photograph. Cartilage lesions (black arrows) are observed on the superior femoral head (FH) produced at the moment of the insertion of the spinal needle from the anterolateral portal. A probe is being introduced from the anterior portal on to the anterior acetabulum. (**B**) In an arthroscopy photograph of a left hip, the acetabulum (**A**) and labrum (L) are at the top of the photograph, and cartilage lesions caused by a cam impingement deformity are at the anterior rim (*). The hip capsule (HC) is to the right. A slotted cannula is being introduced through the anterior hip capsule. The black arrow points to a deep scuff on the femoral head (FH).

Fig. 2A–C A fluoroscopic series of images from the same operative procedure is shown. (**A**) The hip is distracted, and a needle is being introduced into the hip from the anterolateral portal. The needle is close to the femoral head to avoid labrum perforation and the tip of the needle is in the opposite direction to the femoral head to prevent cartilage injury. (**B**) Saline has been introduced through the needle into the hip. The space between the acetabulum and the femoral head has increased because of distension not an increment in traction. (**C**) A flexible guidewire has been introduced through the needle into the hip and the needle removed.

When the femoral head and the acetabulum cannot be separated at least 10 mm measured at the image intensifier [26], access to the hip periphery should be performed first. In treatment of cam-type impingement, a resection of rim osteophytes along with capsulotomies may facilitate femoral head-acetabular separation and access to the central compartment [12]. Instrument or portal exchange should always be performed using a cannula to prevent cartilage damage by instrument passage.

Deep venous thrombosis (DVT) and pulmonary embolism (PE) have not been reported in relation to hip arthroscopy. In a recent literature review of DVT and PE in arthroscopic procedures of the lower limb, Bushnell et al. [4] reported a 0% incidence in over 5500 cases of hip arthroscopy but suggested prophylaxis should be established based on the patient's risk factors, including advanced age, personal or family history of venous thrombosis or PE, obesity, tobacco use, and so on.

Complications Related to the Arthroscopic Treatment of Femoroacetabular Impingement

Incomplete Reshaping

Incomplete reshaping of the FAI deformity is probably underreported and is possibly more frequent with the arthroscopic technique. Although incomplete reshaping has not been presented as a major problem in the literature of arthroscopic treatment of FAI, it is the most frequent indication in revision hip arthroscopy procedures. Philippon et al. [29] reported it was the reason for repeat arthroscopic reshaping in 92% of their revision cases. In another revision series by Heyworth et al. [18], repeat arthroscopic reshaping was the reason for revision arthroscopy in 79% of the cases. To achieve complete remodeling, a preoperative understanding of the deformity is essential. Imaging techniques such as three-dimensional computed tomography and magnetic resonance arthrography with radial cuts are powerful tools that help to understand the shape of the deformity [13–15, 23]. Adequate exposure of the deformity on the acetabular and femoral sides is mandatory. Exposure of both sides of the deformity is achieved by a technique that involves a capsulotomy and sometimes a capsulectomy. Fluoroscopy is used to assist in navigating the depth of the resection and the extent of the lateral decompression on the femoral neck. A complete lateral decompression is important to avoid impingement in high degrees of motion.

The crossover sign described by Tannast et al. [33] can be used to plan the distal limit of resection of the anterior acetabular rim during arthroscopy. This crossover can be identified at the preoperative studies. The anterior wall is identified at the image intensifier; the crossover may not be apparent because of patient positioning but rim trimming is carried out distally to the level of the crossover as identified in the preoperative studies (Fig. 3). Philippon observed that during rim trimming, 1.5 mm of resection corresponds to 1° of acetabular coverage. His observation is not yet presented in the peer-reviewed literature (Marc Philippon, MD, 2006, personal communication). A center-edge angle less than 20° is a contraindication for rim trimming to prevent hip instability [30]. The pincer deformity is usually exposed using an anterior hip capsulectomy parallel to the anterior acetabular rim. If the labrum can be detached for rim trimming and reattached in the remodeled rim, it should be carefully preserved and retracted while rim remodeling is performed (Fig. 4). Sometimes the labral lesions make it impossible to preserve it.

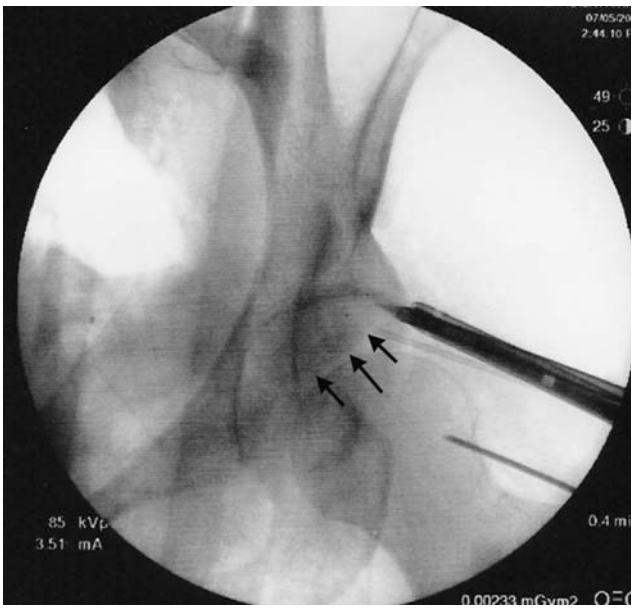

Fig. 3 Fluoroscopy of a left hip during rim trimming in a pincer impingement case is demonstrated. Note the position of the burr and the arthroscope on the acetabular rim. The crossover sign is hard to see in fluoroscopy during arthroscopy because of patient positioning. The anterior wall is clearly visible. To identify the site of the crossover preoperatively, studies can help to limit the resection distally during arthroscopy.

On the femoral side, the cam deformity is usually exposed using a combined capsulectomy-capsulotomy technique [6, 17, 21, 22, 30]. The deformity is identified arthroscopically and at the image intensifier. A multiplane examination of the femoral head-neck junction at the image intensifier is necessary to understand the three-dimensional pattern of the deformity and to ensure a complete circumferential resection [21, 22] (Figs. 5, 6) (Table 1). When using the lateral approach, the hip can be moved to flexion, abduction, and external rotation to obtain a lateral view of the femoral neck. The medial synovial fold is a

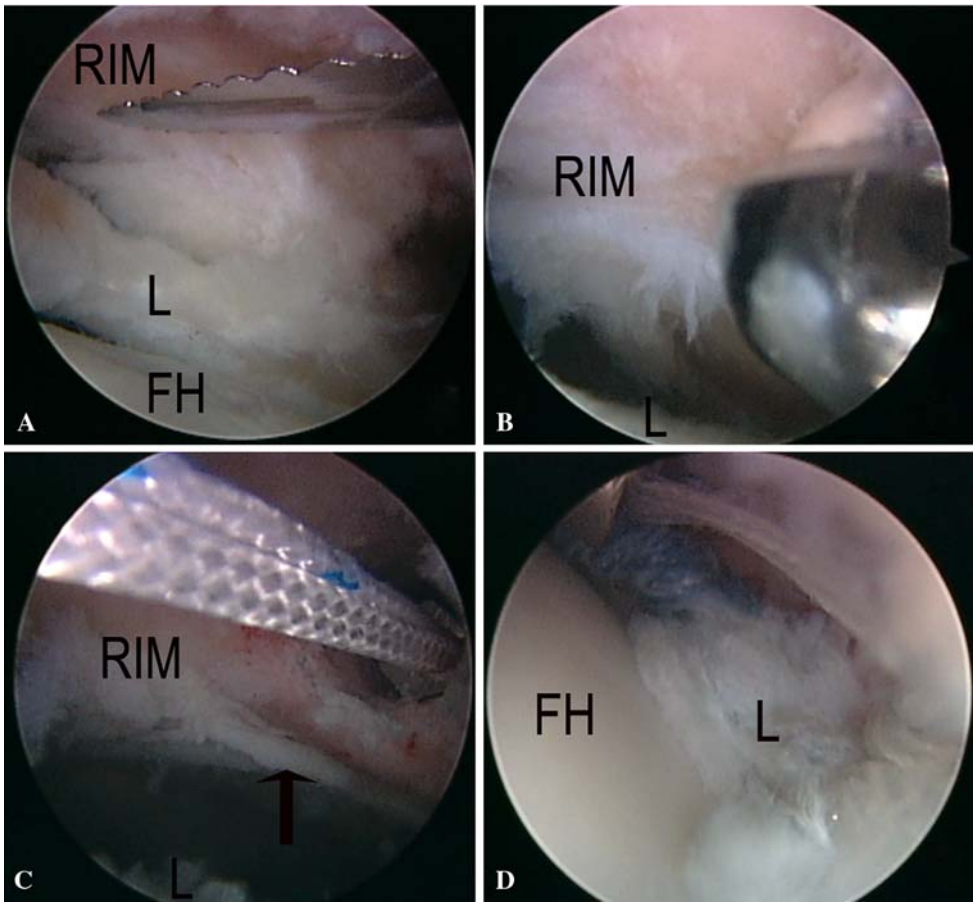

Fig. 4A–D A series of arthroscopic photographs taken from a right hip is shown. (**A**) A capsulotomy-capsulectomy of the anterior hip capsule has been performed. The labrum (L) has been detached from the acetabular rim (RIM) using an arthroscopic knife. The femoral head (FH) is at the bottom. (**B**) The acetabular rim (RIM) is being reshaped using an arthroscopic burr. The labrum (L) is at the bottom of the photograph. (**C**) A suture anchor has been introduced in the acetabular rim (RIM). The black arrow points to the articular on the anterior acetabular wall. The labrum is at the bottom of the photograph. (**D**) In this photograph, two anchors have been implanted and the labrum (L) reattached. Traction has been released. Recreation of the labral seal around the femoral head (FH) is demonstrated.

Fig. 5 Fluoroscopy of a right hip is shown. A lateral view of the hip is obtained by traction release, abduction, flexion, and external rotation of the hip. Note how the arthroscopic burr is at the anterior femoral neck as the arthroscope provides direct visualization. The probe is being used to retract the hip capsule.

very reliable landmark indicating the most inferior portion of the femoral head-neck junction.

We reported successful reshaping based on correction of the alpha angle to values below 45° in cam-type impingement in every case in a consecutive series of 19 patients [22]. In a different series focusing on cam impingement secondary to pediatric hip disease, we reported inadequate reshaping in one of 14 cases [21]. Sampson [31] reported successful arthroscopic reshaping of cam deformities in a consecutive series of 120 patients.

Philippon et al. [29] reported a consecutive series of patients treated with revision hip arthroscopy after a failed hip arthroscopy procedure. In this series of 37 patients, revision hip arthroscopy was indicated for untreated FAI in 22 cases and for repeat reshaping of FAI deformities in 12 patients. Heyworth et al. [18] reported a series of 24 revision hip arthroscopies after a failed hip arthroscopy. Nineteen patients in the series were treated for FAI deformities, nine of which had been treated for FAI at the index arthroscopic procedure. May et al. [25] reported revision open osteochondroplasty of FAI deformities in a series of five patients after arthroscopic treatment of labral pathology without addressing the FAI. Although these

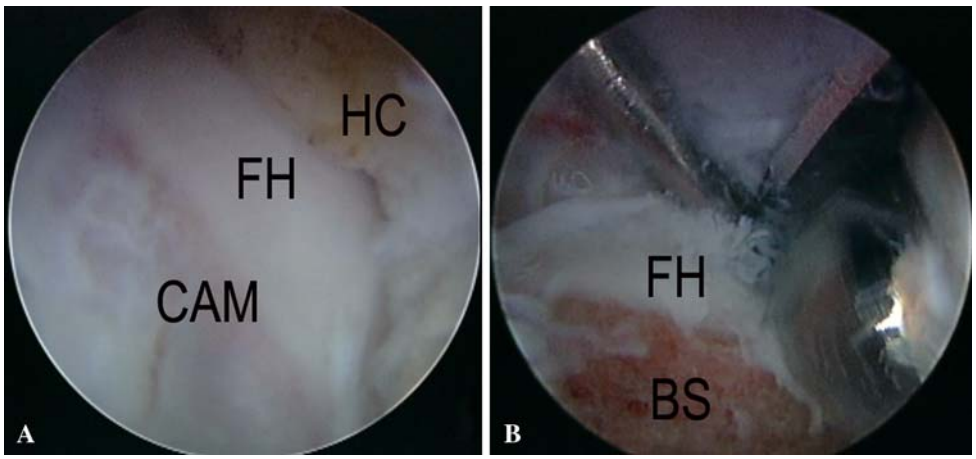

Fig. 6A–B Arthroscopic photographs of a right hip with a cam impingement deformity are shown. (**A**) The cam (CAM) deformity is observed at the femoral head (FH) and neck junction. The deformity has been exposed through a capsulectomy. The medial margin of the hip capsule (HC) is to the right. (**B**) The cam deformity has been reshaped using a burr. The burred surface (BS) is at the bottom. Articular cartilage from the femoral head (FH) is observed medial to the burred surface (BS). A probe is used to retract the hip capsule.

Table 1. Arthroscopic reshaping for treatment of femoroacetabular impingement deformities: review of the literature

Author (year)	Study type	Number of hips	Followup (months)	Diagnosis	Positioning	Capsulotomy/ capsulectomy	Complication(s)
Byrd (2006) [6]	Review	—	—	Cam and pincer	Supine	Yes	—
Crawford and Villar (2005) [10]	Review	—	—	Cam	Supine or lateral	Yes	—
Guanche and Bare (2006) [17]	Review	10	16	Cam	Supine	Yes	—
Ilizaliturri et al. (2007) [21]	Original paper	14	30	14 cam, one mixed cam and pincer	Lateral	Yes	One incomplete reshaping (alpha angle)
Ilizaliturri et al. (2008) [22]	Original paper	19	24	19 cam	Lateral	Yes	Four nonimprovements, one of which had THA
Philippon et al. (2007) [29]	Review	—	—	Cam and pincer	Supine	Yes	Neurologic; femoral neck fractures; avascular necrosis; deep venous thrombosis
Sampson (2005) [31]	Original paper	120	12	Cam	Lateral	Yes	Three THAs for osteoarthritis progression; one femoral neck fracture

studies report anecdotal evidence, one must acknowledge the main reasons for hip arthroscopy revision are likely incomplete or inadequate remodeling of FAI deformities and revision after arthroscopic procedures in which FAI was not recognized and treated.

Avascular Necrosis

Avascular necrosis after treatment of FAI is more a hypothetical concern than an actual clinical problem. The deep branch of the medial femoral circumflex artery is the primary blood supply to the femoral head. The medial femoral circumflex artery enters the hip capsule at the level of the superior gemellus and gives rise to two to four intracapsular superior or lateral retinacular vessels [16]. In the surgical dislocation procedure, the medial femoral circumflex artery is protected by the anterior hip dislocation achieved with a trochanteric flip osteotomy and anterior hip capsulotomy and by protecting the short external rotators from stretching or avulsion thereby protecting the hip blood supply [23].

In the arthroscopic procedure, the blood supply is at most risk when cam reshaping is performed. If posterior or lateral rim trimming is performed, the blood supply may also be jeopardized by a far-posterior capsulotomy. The inferior

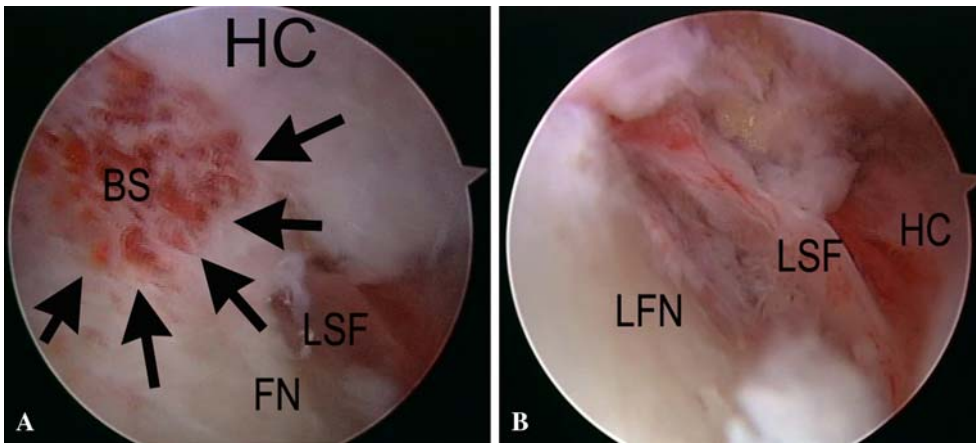

Fig. 7A–B Arthroscopic photographs of a left hip are shown. (**A**) A cam-type deformity has been removed from the anterolateral femoral neck (FN). The burred surface (BS) on the femoral neck is to the left of the photograph indicated by black arrows. The hip capsule (HC) is observed behind the burred surface (a capsulectomy was performed to expose the cam deformity). The intact lateral synovial fold (LSF) is observed undamaged behind the posterior femoral neck (FN). (**B**) The arthroscope has been further introduced under the lateral hip capsule (HC). The lateral synovial fold (LSF) is clearly visible. The vascularity of the hip is behind this structure. The femoral neck (LFN) is observed to the left of the photograph.

femoral neck-head junction is usually identified by the medial synovial fold [11]. Anterior capsulotomies and capsulectomies put the hip blood supply at no risk and can be performed extensively to adequately expose the anterior aspect of the cam deformity. The most lateral aspect of the cam deformity is closer to the critical area where the blood supply enters the hip. A constant and reliable landmark to identify the hip blood supply arthroscopically is the lateral synovial fold (Fig. 7A–B). The branches of the medial femoral circumflex artery are behind this landmark [11]. The lateral synovial fold can be identified arthroscopically with a 30° arthroscope viewing from the anterior portal or an anterior accessory portal. No capsular or bony resection must be performed posterior to the lateral synovial fold [20–22, 30].

No avascular necrosis has been reported in relation with arthroscopic reshaping of FAI. Sampson [32] reported one case of avascular necrosis in a series of 1000 consecutive hip arthroscopies 7 months after a partial labral resection and débridement for osteoarthritis without treatment of FAI deformities.

Femoral Neck Fractures

Overresection of the femoral neck associated with the treatment of cam deformities is a concern. In the open procedure, the volume of resection can be estimated directly by complete exposure of the femoral neck-head junction. Because the field of view of the arthroscope limits complete visualization of the femoral head-neck junction, a complete examination with the arthroscope in different positions is necessary to understand the shape and size of cam deformities (Fig. 6). The limits of the deformity should be identified (medial, lateral, superior, and inferior). This should be performed before the first bone cut is started. Capsulectomies and capsulotomies are used to help in exposure of the deformity.

In a cadaveric study to determine the safe volume of bone that could be removed from the femoral neck, Mardones et al. [24] concluded resection of up to 30% of the anterolateral quadrant of the femoral head-neck junction did not alter the load-bearing capacity of the proximal femur. However, a 30% resection decreased the amount of energy required to produce a fracture by 20%. Based on these findings, they recommended 30% as the largest amount of bone resection. In a cam-type deformity, the objective is to restore the anatomy of the femoral head-neck junction to eliminate the abutment phenomenon. When removing a cam-type deformity, the resection is usually carried out to the depth of the normal neck profile, typically 15% of the bone volume at the most and loss of volume of up to 30% is rarely, if ever, necessary [2, 22].

Sampson [28] reported one femoral neck fracture after arthroscopic reshaping of a cam deformity in a series of 120 cases. This fracture probably occurred because of overresection combined with premature load bearing. Most authors agree partial load bearing should be indicated during the first 6 postoperative weeks after an arthroscopic cam reshaping [17, 22, 30, 31].

Hip Instability

Instability of the hip is rarely an issue. Hip instability can be of traumatic or atraumatic origin and is difficult to

diagnose [3]. Traumatic instability may be the result of dislocation or subluxation of the femoral head produced by high-energy mechanisms that injure the iliofemoral ligament and anterior labrum. Atraumatic instability may be the result of overuse (participants in the martial arts, golf, baseball, and so on) [27, 28] or hyperlaxity syndromes (Ehlers-Danlos, Marfan, Down) [28, 34]. There is a concern that the anterior hip capsulotomy or capsulectomy may reproduce the situation of injury to the iliofemoral ligament resulting in hip instability; however, this phenomenon has not been reported in the literature and the author is not aware of any cases developing instability after extensive anterior hip capsule release. Bony hip instability may develop in relation to excessive bone removal from the acetabular rim. Different from soft tissue instability, excessive bone resection from the anterior acetabular rim may result in anterior hip dislocation. This complication has yet to be presented in the published literature, but the author is aware of two cases of anterior hip dislocation after arthroscopic excessive bone removal from the acetabular rim (case presentation, AANA Master Instructor Course in Hip Arthroscopy, Chicago, 2007). A careful study of the preoperative radiographs and evaluation of the center-edge angle is mandatory before bone resection from the acetabular rim. No bone resection must be performed in cases that have center-edge angles of 20° or less as measured in the anteroposterior pelvis radiograph [30]. Bony instability is a devastating complication that may result in more surgical procedures, including reverse periacetabular osteotomy and THA.

Discussion

The purpose of our report was to present key aspects of the surgical technique for arthroscopic procedures in the hip. Hip arthroscopy is a very technical procedure that requires a methodical setup and specially designed instruments and techniques [19]. We also summarized the key aspects of the procedure and reviewed complications related to hip arthroscopy and presented them in this text. It is well established in the published literature that includes a considerable number of patients [9, 32] that most of the complications related to hip arthroscopy in general are related to patient positioning, traction, and fluid management. Adequate padding of compression points on the perineum and the feet is the first step to successful hip arthroscopy. The perineal traction post must be well padded and of large diameter (more than 10 cm) to distribute the traction forces on a larger surface and protect the perineal nerve. Compression of genitalia should always be avoided by careful positioning. Traction time should be limited to 2 hours [9, 19, 32].

There is little information in the published literature about complications related to the arthroscopic technique for FAI reshaping. Most technique papers and early original studies agree in the key aspects of the procedure: the central compartment is accessed with traction and the hip periphery without traction. Capsulectomy and capsulotomies are necessary to expose deformities related to FAI (cam and pincer). The published literature on hip arthroscopy presents an acceptable frequency of complications, which is usually below the 1.5% threshold [8, 9, 32], but most of these cases occurred in the pre-FAI arthroscopy era and were related to particular aspects of the arthroscopic technique, especially patient positioning and fluid management. Although favorable results have been reported for arthroscopic treatment of FAI [6, 17, 21, 22, 30], the literature regarding this topic is small and anecdotal. As more experience is obtained with the arthroscopic technique, one must expect reports on complications to grow as more literature becomes available.

FAI is becoming one of the most frequent indications for hip arthroscopy, but an impingement case is not the ideal situation for the novice hip arthroscopist to start developing experience in the procedure. The technical complexity of an arthroscopic FAI case and the knowledge of the arthroscopic anatomy and the anatomy of the impingement deformities required leave this procedure exclusively for the experienced hip arthroscopist. Some more complex deformities like coxa profunda and secondary cam impingement (Perthes' disease, slipped capital femoral epiphysis, and so on) may be more suitable for an open surgical dislocation or for a true hip arthroscopy expert.

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