Debate: Femoroacetabular Impingement
Friday, October 14, 2011 • 8:15 - 8:55am
General Session

FAI Done Open is Better
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FAI Done Arthroscopically is Better
J W Thomas Byrd, MD USA

FAI Done Arthroscopically With Mini Open Is Better
Manuel Ribas, MD SPAIN
Surgery of Femoroacetabular Impingement Using an MIS Antero-Lateral Approach: 118 cases with 2.2 years follow up

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Introduction:
Treatment of anterior femoroacetabular impingement (FAI) has gradually evolved from extensive surgical approaches with dislocation to arthroscopy. Treatment with reduced surgical approaches has rarely been assessed and the use of the anterolateral pathway reduced was not reported in this indication. A prospective study was conducted and continues to evaluate the surgical treatment of FAI by minimally invasive anterolateral [1].

Hypothesis:
A first reduced without anterolateral dislocation can correct abnormalities of the neck, the acetabulum and the labrum without significant morbidity.

Materials and methods:
The treatment of FAI 120 (108 patients, 16 women and 92 men, 12 cases bilateral surgery in one session, mean age 34 years (18.9 to 63.5 years) was done prospectively and continuously. Two cases were lost of view, leaving 106 patients (118 FAI) measured the decline minimum of one year. The assessment included the Non Arthritic Hip Score (NAHS), the WOMAC, the measurement of internal rotation to 90° of flexion and alpha angle on incidence of Nötzli facing 45 degrees of flexion, 45° of abduction and 30° of lateral rotation[2, 3].

Results:
Blood loss averaged 1.2 g / dl (- 0.5 to -2.7 g / dl) for an operating time 44.9 minutes (30-65). At a mean of 2.2 years (12 to 54 months), the NAHS progressed by 32.5 points (p <0.0001), internal rotation of 19.0 ° (p <0.0001) and the alpha angle of -24 , 9 (p <0.0001). Surgery eight times (6.8%), hematoma in 4, 2 capsular debridement and 2 acetabular complementary actions have had a favorable outcome and no complications or infectious nervous. Four failures (3.5%) were taken over by a joint replacement (2 residual pain and two rapid changes of osteoarthritis). Eighteen cases progressed one stage Tönnis. Ossification stage II and III Brooker in 12 cases (10.2%) did not alter the functional scores and the gain of joint mobility.
**Discussion:**

This prospective study and further suggests that it is possible to treat a CAFA incision anterolateral reduced reliably and reproducibly without muscle avulsion or dislocation with a low complication rate. This series is characterized by the fact that the labrum was reinserted once, the central acetabular joint space has not been explored, the osteoarthritis that type II (23.7%) and III (3.5%) were included and we have not learned from upper age limit. The response time was short with a low bleeding followed by a quick re-charge. Especially this technique had the potential to treat bilateral cases in the supine position during a single anesthetic which would be more difficult and trochanterotomy dislocation [4, 5] or arthroscopic orthopedic table with because of a long time to intervention exposing them to increased risk of compression of the pudendal nerve [6, 7].

This study was to limit the number of small inclusions (118 in 57 months). However some series [6, 7] have more than 100 cases and only the set of Byrd et al. [6] was like the prospective study. Most series analyzing the results of surgical treatment of CAFA are retrospective and generally low level of evidence but two level III studies. [6, 8] Our mean was only 2.2 years (12 to 54 months) which does not suggest the evolution of osteoarthritis in the longer term, but most series do not reach 5 years of decline.

The average duration of the intervention was relatively short (49.9 min, from 30 to 65 minutes) without the learning curve affects the operative time. Interventions are longer anterior combined with arthroscopy (mean 90 to 116mn) [9, 10] or by arthroscopy (mean 130-135 min) [11, 12]. The surgical procedure analyzed in this study is therefore subject to faster learning including operative time. Only two were found inadequate resection at the first cases (1 and 5) and should be attributed to inexperience, although this complication is more common arthroscopic.

Our functional results with a clinical success of 77.3% (up 32.5 points from NAHS, HHS of 29.9 points and - points of WOMAC 28) + 19° of internal rotation gain in flexion and 77, 9% of patients who have taken the desired activity are equivalent or superior to those obtained by other techniques [13] and the more so that bilateral disputes have been included which is not the case series presented by Philippon et al. [14]. Byrd et al. [6, 14] reported 20-point increase in the NAHS after arthroscopic correction of the CAFA, Laude et al. 29.1 points combined with anterior arthroscopy. Few authors report their results in gain of internal rotation: Lincoln et al. obtained 5.4° anterior, Horisberger et al. [11] 18° arthroscope.

The four stages of Tönnis III in our series had a good functional outcome and resumed sporting activity (Table 3). The lack of significant difference in terms of growth between hips classified NAHS 0 and I and II and III classified preoperatively (Table 3) suggests that a conservative surgical management of CAFA may be beneficial in the short term osteoarthritis. Some recent work confirms this fact [15, but other authors have opposed this approach [Stahelin, 2008 #203] Only the test of time will tell whether the gains observed in our series are sustainable beyond five years, which validates our position in the non-selective indications. In our series 22.9% of hips belonged to patients over 40 years and 27.1% were overweight without an increase in these groups significantly lower NAHS and the gain in flexion and rotation, that guides to a broad selection of patients (Table 2).

The impact of profile used [3] is reproducible and can track the results of surgery and postoperative distance. The arthro-CT does in our opinion that further information on the status of cartilage and labrum. We agree with Konan et al. and Barton et al. that X-ray quality standards, including an incidence of Dunn, are sufficient to quantify an impingement by CAFA. Like other authors we have made any type of impingement, and only isolated acetabular pincement. Larson et al. Philippon et al. reported a high percentage (31%) of such impingements. Every angle alpha measured postoperatively were lower than
46 ° with the exception of two patients taken during surgery and the learning curve (case 1 and 5) direct surgical view can properly evaluate the position and volume of the bone to be resected.

We realized that once a re-suture the labrum, the reported rate of rehabilitation is more important because the authors realized a acétabulaplastie by detaching the base of the labrum suture then what we think is harmful Laude et al. and Larson and Giveans showed that this gesture did not improve the result and could instead cause pain. Espinosa et al. [8] with greater decline in favor of the suture the labrum, when it is detached and vascularized and conservation or simple excision in the other cases. Gestures microperforations as practiced by some authors after removal of the cartilage have not been scientific proof of their effectiveness.

Our rate of conversion arthroplasty (n = 4, 3.4%) is low compared to treatment with dislocation (6% to 42%) [20, 44] and that of previous routes coupled with arthroscopy ( 6% to 11%) [24, 26, 32]. Our rate of serious complications is zero with no complications, in particular nerve or the lateral cutaneous nerve of the hip as described by Huet or the sciatic nerve as described by arthroscopy [16, 17]Meta-analysis reported a major complication rate for arthroscopic surgery (0-18%), some of which involve life-threatening.

Our complication rate in the short term is relatively high (6.8%) but serious complication and can be further improved although it is comparable to those reported by arthroscopy (1.5% to 27.3%) [6]while already much lower than those reported by dislocation (4.3 to 57%). Both capsular adhesions were observed. The question to resect the anterior capsule, such as arthroscopic, there is the risk of creating a joint instability in athletes. It is a real risk of hematoma (4 reoperations) we blocked the spongy bone made alive by surgical wax. Its use is discussed due to an increased risk of infection or in some cases the appearance of an inflammatory granuloma. Alternatives are to try, fibrin, hemostatic gel ... Careful hemostasis of the vessels seems to be the single most important thing.

A 36% decline in heterotopic ossification were observed. However study reports the observation of all cases of ossification, while some authors report that the number of cases that led to a recovery [28, 34, 41, 45]. Ossification stage I were observed in the immediate postoperative period in 11% of cases (pre-existing bone or residues), or 25% of progressive ossification of which 10.2% of stage II and III. Frequencies of 18.2% stage II and stage III anterior, and 1 to 12% are reported by arthroscopy. Studies to analyze the effectiveness of preventive treatments are more extensive (20-60%)[6]. In case of occurrence of ossification, no stiffness was observed and the functional results were comparable to those of the overall series (Table 2).

**Conclusion:**
The surgical approach to learning and achieving rapid, requires no special equipment (arthroscope, table orthopedic distractor, image intensifier) and allows for a reliable surgical procedure without serious complications. The results of this series in the short term, without exploration of the central compartment cartilage or labral suture on an unselected series (neither by age or overweight or stage of osteoarthritis), are encouraging, this technique helps to simplify treatment of this disease.

Level of Evidence: Level 3-type, no prospective control group.

Key Words : FAI, Antero latéral approach, hip osteoarthritis , labrum, sport, MIS.
References


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Debate: Femoroacetabular Impingement
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I. Overview
   A. FAI is not a cause of hip pain!
   B. FAI is a morphologic condition that predisposes hip to intraarticular pathology that then becomes painful
      1. Pincer type
         a) Primary labral pathology
         b) Secondarily develop articular breakdown
      2. Cam type
         a) Preferential articular delamination
         b) Associated labral pathology variable
   C. Arthroscopic observations of secondary damage important part of treatment algorithm
      - Impingement morphology may exist as coincidental finding in absence of observations of impingement pathology

II. Pincer Type
   A. Due to prominent anterior lip of bone or acetabular retroversion
      - Labrum crushed against femoral neck by prominent acetabular bone
   B. Radiographs (i.e. cross over sign & posterior wall sign) can be insensitive indicator of acetabular impingement
   C. Arthroscopic parameters more sensitive
      1. Presence of anterior labral pathology
         - Labral damage present in order to be symptomatic
      2. Difficulty with anterior portal placement despite adequate distraction
         - Hindrance from bony lip
      3. Lip of bone overhangs damaged portion of labrum
         - Normally should reveal capsulolabral reflection
   D. Selective labral resection technique
      1. Selective debridement of damaged labrum exposes impinging bone
      2. Normal acetabulum ends at articular labral junction
         - Creates margin for bony excision
      3. Inferomedial and superolateral excision defined by transition to healthy labrum
      4. Facilitated by switching arthroscope and instruments back and forth between anterior & anterolateral portals
         - Technically analogous to excising distal tibial spur of anterior ankle compartment
E. Rim trimming & labral refixation method
   1. Early experiences of favorable results of refixation compared to debridement\textsuperscript{2,3}
   2. Criteria
      a) Tear or impending failure due to pincer
      b) Quality of labral tissue sufficient to warrant repair
      c) Would not violate normal appearing labrum
   3. Technical considerations
      a) Labrum released from capsular side
         (1) Requires adequate release to assure proper acetabular recontouring
         (2) Care to avoid inadvertent resection of mobilized labrum
      b) Anchor placed from capsular margin of labrum
         (1) Anchor placed near articular edge for anatomic approximation of labrum
             and optimal reconstitution of labral seal function
         (2) Care is needed to avoid perforation of articular surface
             - Usually requires more distal portal entry site to assure divergence of
               anchor from articular surface
      c) Sutures passed to optimize reapproximation of good quality tissue
         (1) Simple suture through lateral half of labrum adequate for small size
             labrum, especially when chondrolabral junction is patent
         (2) Modified single limb mattress sutures necessary for larger labrum to avoid
             distortion and to reapproximate disrupted chondrolabral junction
         (3) Avoid interposing suture between labrum and femoral articular surface if
             possible

III. Cam Type
   A. Impingement from bony prominence of anterolateral femoral head/neck junction
      - Acetabular articular surface fails due to shear effect
   B. Anterolateral epicenter variable
      1. May be more anterior or more lateral
      2. Thus may be more evident on lateral or AP radiograph
      3. No lateral radiographic view is “ideal”
         - Optimal view of lesion depends on its epicenter
      4. Radiographs present poor two-dimensional image of three-dimensional problem
      5. 3-D CT scan excellent (!) at revealing bony architecture
         - Especially helpful in arthroscopic approach where visualization is
           suboptimal compared to open technique
C. Arthroscopic findings
   1. Important determinant for performing femoroplasty
      - Variable proximal femoral morphology may exist in absence of pathological FAI
   2. Anterolateral acetabular articular failure due to shear forces from cam lesion
      a) Articular delamination
         - Peel back phenomenon
      b) Closed chondral blistering
         - “Wave sign”; indicator of impending articular failure from shear forces
   3. Relative labral preservation
      - Variable amount of damage may be present

D. Technique
   1. Cam impingement addressed from peripheral compartment after addressing intraarticular pathology with traction
   2. Capsulotomy created by connecting anterior & anterolateral portals
      - Allows mobility of instruments to transition from central to peripheral compartment
   3. Traction released & hip flexed 35°
      a) Flexion relaxes anterior capsule opening space in peripheral compartment
      b) Excessive flexion blocks access to femoral lesion within acetabulum
   4. Capsular window enlarged as necessary to assure complete visualization of cam lesion
      a) Extent of capsulotomy titrated based on pathology
         (1) Extensive capsulectomy may be therapeutic in stiff hips
         (2) Minimize capsulotomy when instability a concern
            - i.e. borderline dysplasia in association with correction of cam lesion
      b) Capsular closure not routinely necessary
      c) T-shaped capsulotomy preferable when planning for capsular closure
         - Sutures used to close vertical limb of capsulotomy
   5. Cephalad anterolateral portal facilitates access to cam lesion
   6. Visualize and protect lateral retinacular vessels
      - Lateral synovial fold arthroscopic landmark of these vessels
   7. Overlying soft tissue debrided
      a) Often covered in mature fibrocartilage similar to native hyaline cartilage
      b) Define margin of resection at normal head/neck junction
   8. Resection begins at edge of articular surface and tapered distally
      a) Remove abnormal bone as indicated by preoperative studies (3D CT)
      b) Recreate normal concave relationship of head/neck junction
      c) Avoid notching of bone distally on cortical neck of femur; creating stress riser!
   9. Must be especially careful to avoid inadequate or excessive bony resection
IV. Results
A. First 100 cases with minimum two-year data (100% followup)\(^5\)
   1. 63 cam; 18 pincer; 19 combined lesions
   2. Secondary damage
      a) 97 acetabular articular lesions (53 Grade IV, 39 Grade III, 5 Grade I)
      b) 23 femoral lesions (11 Grade IV, 11 Grade III, 1 Grade II)
      c) 92 labral tears
   3. Cam type:
      a) Average age 33 years
      b) Male/female ratio 2.8:1
   4. Pincer type:
      a) Average age 38 years
      b) Male/female ratio 1.2:1
   5. Median improvement 20 points (preop 65; postop 85)
      a) 79% good & excellent results
      b) Continued improvement through first year; with one year results maintained at
         two year follow-up
      c) 18 microfractures: median improvement 21 points
      d) 23 bipolar lesions: median improvement 23 points
   6. None revised to THA
   7. Six underwent subsequent arthroscopic procedures
   8. Three complications: transient neuropraxia pudendal nerve & LFCN, and mild HO
      - None compromised successful outcome
B. First 200 athletes with minimum one-year follow up (100% follow up)\(^6\)
   1. 159 cam; 31 combined; 10 pincer
   2. 23 professional; 56 intercollegiate; 121 high school or recreational
   3. Average age 29 years (range 11-60)
   4. 148 males; 52 females
      a) Cam type: male/female ratio 2.8:1
      b) Pincer type: male/female ratio 1:1
   5. Secondary damage
      a) 96% acetabular articular damage (75 Grade IV; 101 Grade III; 1 Grade II; 14
         Grade I)
      b) 20% combined femoral damage (13 Grade IV; 27 Grade III)
      c) 89% (178) labral tears
   6. Median improvement 24 points (preop 72; postop 96)
      a) 49 microfractures: median improvement 26 points
      b) 20 bipolar chondral damage: median improvement 16 points
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7. 181 (90%) returned to sport
   a) 95% professional
   b) 85% collegiate
8. Four (2%) underwent repeat arthroscopy
9. One (0.5%) revised to THA
10. Complications
    a) Five transient neurapraxias (all resolved uneventfully)
    b) One mild HO (no treatment; no effect on outcome)
C. Numerous other reports of successful outcomes in arthroscopic treatment of FAI

V. Steps to successful arthroscopic management of FAI
A. Patient selection
   1. FAI amenable to arthroscopic intervention
   2. Reasonable joint preservation
   3. Reasonable patient expectations
B. Patient positioning
   - Important for safety & efficacy of procedure
C. Portal placement
   - Important for assuring access in atraumatic fashion
D. Identify pathology
   - Important to document damage indicative of pathological impingement and thus warranting correction
E. Proper exposure
   1. Fully visualize the abnormal bone before beginning correction
   2. Next to poor patient selection, poor visualization is root of all evil in hip arthroscopy
F. Match the procedure to the pathology
   1. Labral debridement vs. repair/refixation
   2. Acetabuloplasty vs. femoroplasty vs. both
G. Rehabilitation
   - For most, properly structured rehab critical to successful outcome
References


In the last decade femoroacetabular impingement (FAI), defined as a conflict between anterior femoral head-neck junction and anterior acetabular rim, has been proposed as the beginning of early hip osteoarthritis and popularized with more than two hundred papers published in peer-review journals during the last years. This syndrome leads to the development of lesions in the labrum and the adjacent acetabular cartilage that could result in degenerative joint disease.

The treatment of causing elements for this condition (so called femoroacetabular osteochondroplasty- FAO) and resulting chondrolabral injuries can be classified in three different methods (1):

1. Save dislocation with full exposure of the hip,
2. Hip arthroscopy,
3. Arthroscopy assisted anterior mini-open technique .

Mainly anterior mini-open procedure has the advantages of hip arthroscopy avoiding any eventual hip dislocation, trochanter osteotomy, double direct and arthroscopic view, full direct exposure according to different hip positionings (what we call “Hip spaces rule”), and offers same postoperative management and rehabilitation programme when compared to pure arthroscopy (59).

When one understands “hip spaces rule” and upon skills after 8 years we do think this procedure is a strong tool to deal with the most complicated FAI presentations: mixed cases with pronounced anterolateral femoral abutments, coxa retroversa minor, coxa profunda, SCFE sequel.ia or even in not previewed difficulted arthroscopic procedures. Outside from these indications arthroscopic FAO is performed routinely in our institution. Below is explained in detail how to perform the surgical technique (20 – 30,35, 47).

Different advantagtes have to be attributed to this technique, among others:

- Low traction required when compared to pure arthroscopy.
High accuracy in femoroacetabular reshaping in whole planes according to “Hip spaces rule”(47). This allows to treat FAI conditions, which different authors prefer to deal with save dislocation of the hip: coxa profunda, antero-latero-posterior femoral abutments, big labral cysts invading eminentia ileopectineana, SCFE sequel.a, acetabular stress fractures, acetabular and femoral subchondral cysts curettage and autologous filling up, whole labrum allogenic transplantations.

- FAI can be checked easily all the time during whole procedure
- Osteoplasty surface can be sealed with Fibrine spray, as well as microfractured retrolabral chondral lesions.
- Hardware breakage easy to handle
- Other procedures can be simultaneously associated eg. PAO.

TECHNICAL DESCRIPTION

1/ Positioning and approach. The patient is placed in a supine position in an extension table. No traction has to be applied during the approach. The incision begins 1 cm. below and 1 cm. lateral to the anterosuperior iliac spine. It runs 4 to 8 cm distally towards the peroneal head. This incision allows us to prevent further lesion of the posterior branch of lateral femorocutaneous nerve. The fascia is then opened and the fat interval between the sartorius and tensor fascia lata muscles is detected. Detachment of the reflected portion of rectus femoris muscle is performed. A curved blunt Hohmann retractor is introduced over the upper part of the capsule and a straight Hohmann retractor is placed between the iliofemoral muscle and capsule at least at 30° flexion of the hip to avoid the damage of femoral nerve. Capsulotomy is performed from distal to cranial through the interval between iliofemoral ligaments. During capsulotomy special care has to be taken to identify the labrum by pulling up when dissection reaches the acetabulum. A “T” shape capsulotomy is completed, following acetabular rim orientation. At this time, reference sutures are placed in both sides of the capsule and two blunt curved Hohmann retractors are located intrarticular around the femoral neck.

2/ Inspection. Impingement manoeuvre should be clearly tested. Extension is applied for hip distraction. At this point less extension is required when compared to pure arthroscopy. Once the joint is distracted about 10 mms the use of an additional light source attached to Hohmann retractor or the 70° arthroscope by itself is recommended. Acetabular chondral and labral lesions can be inspected in the 6 zones defined by Ilizaliturri et al. On the femoral side, lesions can be directly identified as the cartilage shows inflammatory and prearthritic changes.
3/ Acetabular Osteoplasty and Labral repair. Chondro-labral delamination is repaired through detachment of the labrum and acetabular rim trimming with 5 mms diamond burrs. In extensive ulcerations microfractures are performed according to Steadman’s technique. The labrum is reattached with 3.1 mm resorbable transosseous anchors, when acetabular rim trimming is finished. Once acetabular osteoplasty is performed, extension is released. We do recommend not staying longer than one hour with applied extension to prevent potential neural lesions.

4/ Femoral Osteoplasty. Fluoroscope is used to identify intraoperative landmarks according to the preoperative planning. In cam type, the bone bump is excised with ultra sharp curved osteotomes and round burrs manipulated counter-clockwise to avoid excessive bone penetration. We start the bump resection at the postero-superior head-neck junction with hyperextension-adduction-internal rotation and followed by flexion-abduction and external rotation to reach the posteroinferior head-neck junction and acetabular rim ( “Hip Spaces Rule”). Pulse-lavage is used during all procedure to avoid heterotopic ossification. Final fluoroscope view is recommended after bone resection is completed. Finally, we should test the femoroacetabular clearance and range of motion, especially in flexion and internal rotation.

5/ Closure. A drain can be applied optionally (since five years we have abandoned it; in spite of this a local catheter for local anaesthesia injection every 8 hours is used) and soft tissue planes are reinserted in full extension of the hip to avoid capsular retraction. Special care must be taken to avoid injury to the femorocutaneous nerve branches during superficial closure. In the last 5 years we don’t use.

6/ Postoperative care. Indomethacin protocol is used to prevent heterotopic ossification. Gastroprotective drugs, low molecular weight heparin are also administrated according to our hip surgery protocol. Local catheter is removed one or two days after surgery depending on hospital discharge.
RESULTS
To August 2011 we have performed already more than 620 mini-open femoroacetabular osteochondroplasties in 9 years. In this presentation a cohort of 296 patients operated between 2003 and 2008 (mean follow up 5,2 years, range 2 – 8 years) were included. Data of Merle D’Aubigné and WOMAC scores and UCLA activity level preoperative and at the latest follow up (FU) have been obtained from their clinical records. A Kaplan –Meier survivorship curve has been stablished considering endpoint those patients, who either were lost from FU or those who underwent to hip replacement. Chi-Squared and Wilcoxon test have been used for comparisons between groups according to Tönnis radiological preoperative stage. (SPSS 13 software is used for statistical analysis, a p<0,05 value is considered to be significative). This analysis provided a mean improvement in MDA, WOMAC and UCLA activity level from preoperative values of 15,7 , 59,7 and 7,3 to 17,4 , 93,3 and 8,7 , respectively at the latest FU (p<0,001). Global survivorship was at 8 years 88,8 % (CI 95%). However when survivorship was divided according to radiological degenerative stages: 98,77% was obtained for Tönnis 0, 92,8% for Tönnis 1 and 62,3% in Tönnis 2 (p<0,001, CI 95%).(See Table).

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DISCUSSION AND CONCLUSIONS
Despite arthroscopic approach of FAI may be actually the most popular option, unsuccessful clinical results have been published related to learning curve and incomplete resection of bone deformity. Our study shows that patients with symptomatic femoroacetabular impingement presenting with early changes of hip arthritis (Tonnis 0 or Tonnis 1) may benefit from surgical treatment trough a mini-incision approach, allowing patients to obtain a significant clinical and functional improvement. This procedure has been
performed even in elite sportsmen involved in high level competitions and provides a middle ground between formal surgical dislocation. The later continues to have specific indications in cases were complete access of the acetabular rim pathology has to be treated like marked coxa profunda - protusio, posterior femoro-acetabular impingement and severe cam impingement secondary to SCFE.

We do believe that mini-open anterior approach is a reliable and reproducible technique with direct view of femoral and acetabular side of femoroacetabular impingement structural deformities. Anyway clinical and functional results will depend directly on early diagnosis. According to our experience it should be recommended to this population to undergo to surgical procedure as soon as their clinical symptoms onset ( level of evidence III).

We do agree with other authors, that in mild and regular FAI cases done arthroscopically with mini-open is a safe procedure in the way to 3D-understandying of underlying pathomorphologies and associated lesions and thus an accurated learning curve for FAI arthroscopic management (48). In any case , as previously mentioned, according to our experience there are FAI conditions where other authors advocate for save dislocation, that can be solved through this surgical technique with an immediate and intensive rehabilitation and postoperative management. Moreover we are convinced and suggest, that hip arthroscopists should complete their technical skills with this additional technique.

REFERENCES:


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