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ORIGINAL PAPER

Os acetabuli and femoro-acetabular impingement: aetiology, incidence, treatment, and results

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Abstract

Purpose The purpose of this study was to investigate the pathogenesis, the incidence, and the results of arthroscopic treatment of os acetabuli (OSA) in a group of patients with diagnosis of femoro-acetabular impingement (FAI).

Methods We retrospectively analyzed the full documentation of 294 hips in 273 patients (21 bilateral) operated for FAI through hip arthroscopy. We reviewed all radiographs and arthro-MRI in order to identify the incidence of OSA. All patients with OSA were then assessed with a modified Harris hip score (MHHS) pre-operatively and at the final follow-up.

Results Twenty-one patients (7.7%), 20 (95%) of them were male, were diagnosed with concomitant FAI and os acetabuli. In 21 cases, OSA was excised and FAI was treated with rim trimming, femoral osteoplasty, or both. In one case, a large OSA fragment was fixed with a 4 mm screw avoiding an acetabular uncoverage if excised. The average follow-up was 31 months (range from 6 to 69 months). The MHHS showed an improvement from a pre-operative MHHS of 57.5 (range from 39 to 82) to 95 (range from 73 to 100).

Conclusions Os acetabuli is not uncommon and certainly associated with FAI and male gender. The etiology is probably microtraumatic. The arthroscopic OSA removal or fixation and concomitant FAI treatment showed very good results. Interestingly, these outcomes seem better than FAI treatment alone. Further studies with a wider number of patients and a longer follow-up are needed to confirm these results and understand the real role of OSA in this setting.

Keywords Femoro-acetabular impingement · Os acetabuli · Modified Harris hip score (MHHS)

Introduction

The femoro-acetabular impingement (FAI) is considered by many as the greatest discovery in the hip pathology in recent time.

In 1935, Smith-Petersen reported the first FAI case without recognizing the pathologic entity [1]. FAI, as a self-standing pathology, was described by Ganz as a condition of pathological contact between the acetabular rim and the femur that can derive from both anatomical and functional discrepancies [2]. This abnormal contact is responsible for a progressive joint degeneration.

Different surgical treatments have been proposed for FAI treatment, such as safe surgical hip dislocation, anterior minimally invasive approach, and arthroscopy [3, 4].

The presence of heterotopic calcification at the acetabular rim, os acetabuli (OSA), is a radiographic finding sometimes associated with FAI.

OSA is a bone fragment located at the acetabular rim. In most cases, it is observed at the anterior or anterosuperior edge of the acetabular rim and can be single or composed of more fragments [5].

The aetiology of OSA has been discussed for long time. As early as 1909, Lilienthal had hypothesized that it was a non-fused nucleus of secondary ossification [6, 7].

According to some authors (Perna 1922; de Cuveland and Heuck 1957; Ponsetti 1978), this bone fragment can be observed 6 months after birth and often disappears before the age of 20 years [6, 7].

In 1934, Freedman hypothesized a correlation between the presence of OSA in patients over 20 years old and hormonal disorders [8]. In 1933, Kargus et al. classified it as a non-

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specific osteochondritis, comparable to Perthes's disease for the femoral head [6].

Other authors have suggested that it could be the result of a stress fracture due to acetabular rim overloading in case of dysplasia [6]. Pitto et al. described 23 cases of OSA out of 178 dysplastic hips [9]. The presence of OSA has also been described in cases of rickets (Fromme 1921), osteomyelitis, osteochondritis dissecans, and tuberculosis (Ruehle 1921; Schinz 1922) [7, 9]. Another known cause of peri-acetabular calcification formation is the ossification of the labrum, which therefore goes into differential diagnosis with the OSA [10].

This study aims to speculate on the etiology and evaluate the incidence of OSA in FAI patients and report the clinical results of the subsequent arthroscopic treatment.

Materials and methods

We performed a retrospective study of all the patients that underwent hip arthroscopy for FAI syndrome between January 2012 and December 2017 in our hospital. The patients were 301, 324 hips, due to 23 patients in whom surgery was performed bilaterally. Twenty-eight patients were then excluded for incomplete documentation, if they had undergone a previous surgery and if a labral calcification was recognized, leaving 273 patients, 294 hips (21 bilateral).

All included patients had standardized antero-posterior X-ray of the pelvis, Dunn 45° and cross-leg hip axial views, every patients had also an arthro-MRI.

First, we reviewed all radiographs and arthro-MRI in order to identify the incidence of OSA in our study population. Then, we evaluated the presence of impingement signs. Wiberg's and Sharp's [11] angles were also defined. All hips where then checked with an arthro-MRI for defining OSA relationship with cartilage and labrum and intra-articular-associated pathology. Patients with OSA were also assessed with the modified Harris hip score (MHHS) pre-operatively and at the final follow-up, during April and May 2018 [12].

Surgical technique

Hip arthroscopy was performed with the patient in supine position on a traction table. Antero-lateral and mid-anterior portals were obtained and an interportal capsulotomy was performed. A third accessory portal was used in cases where labral re-fixation was necessary. When we assessed the presence of OSA, we used three types of surgical treatment depending on its position, size, or relationship with labrum and cartilage: direct removal, trimming, or fixation.

- Direct removal: OSA is first released from soft tissue, preserving the cartilage and the labrum, and then directly removed with a grasper.
- Trimming: OSA is trimmed with the help of a bone burr (Fig. 1).
- Fixation: OSA is fixed to the acetabulum with a 4-mm cannulated screw with washer under direct and C-arm control (Fig. 2).

FAI was addressed with acetabular rim trimming, femoral osteoplasty, or both.

The labrum, when possible, was re-fixed with resorbable anchors. Severe cartilage lesions or flaps were regularized and microfractures were performed according to Steadman technique [13].

Results

Twenty-one (7.7%) of the 273 patients included in our study presented a radiopaque formation at the X-rays, compatible with the diagnosis of OSA.

The mean age of the patients was 31 years old (20–44 years). Twenty patients were male (95%) and only one was female. The 21 hips with OSA had an averaged Wiberg's angle of 35.4° (27–40°) and averaged Sharp's angle of 38.9° (34–43°).

The crossover sign, that represent a retroversion or over-coverage of the acetabulum, was found in 12 of the 21 hips (57%).

In the arthro-MRI, it was possible to observe that OSA was closely connected to both articular cartilage and labrum.

During the surgery, the bone fragment was confirmed to be located at the antero-superior edge of the acetabulum, and in all cases, it was mobile at palpation.

In 20 out of 21 cases (95%), OSA was directly removed or trimmed. In only one case, it was fixed with a lag screw to avoid a dangerous reduction of acetabular coverage if excised.

Fig. 1 Preoperative x-ray of a left hip with os acetabuli

Fig. 2 X ray of a right hip before and after os acetabuli fixation

All patients followed a defined postoperative protocol from the first day after surgery: walking with two crutches and progressive weight-bearing. If during the surgery microfractures were needed, the weight-bearing was forbidden for four to six weeks. Hip flexion-extension was allowed immediately with 0–90° range of motion and 3 h a day of continuous passive motion; external rotation was forbidden for four weeks.

The average follow-up was two years and seven months (6–69 months). The MHHS showed an improvement from an average preoperative MHHS of 57.5 (range from 39 to 82) to an average of 95 (range from 73 to 100) at the final follow-up.

The only patient in whom fragment fixation was performed had a preoperative MHHS of 39.6 with referred frequent joint locking and catching. At four years and three months after surgery, he still has a MHHS of 100. During the surgery, he also presented a cartilage lesion of the acetabulum with an unstable flap, of 1 cm^2, that was treated with excision of the flap and microfractures.

Discussion

Several theories have been suggested in order to explain the etiology and the incidence of OSA [10, 14, 15].

In 2006, Martinez performed a retrospective analysis on 495 FAI patients treated through a surgical dislocation in a ten year period. They identified 18 cases (3.6%) with a large mobile fragment of the anterolateral rim of the acetabulum at the level of the CAM overhanging. The bone fragment was attached to the labrum and covered by articular cartilage, excluding the hypothesis of an osteophyte. The line dividing the fragment from the acetabulum had a perpendicular course. The authors described this finding as a result of a stress fracture of the acetabular rim due to a mixed FAI type in active patients [14].

In a retrospective study on arthroscopy results in football players, OSA was the less frequent finding with an incidence of 7% [16]. This is in line with our study where the incidence was 7.7%.

Most studies underline the prevalence of OSA in male patients. Martinez had only three female patients in 15 cases [14]. In our series, we had only one. The male prevalence may reinforce the theory of the CAM concourse in this pathological finding.

Similar to other authors, we believe that the best treatment of a symptomatic OSA is an arthroscopic excision unless the removal of the bone fragment could interfere negatively with acetabular coverage and stability. If this is the case, a fixation is mandatory. In 2009, Epstein and Safran described a case in which the removal of an anterolateral bone fragment in a young 36-year-old man would have led to a Wiberg angle of 18°. Therefore, they performed an internal fixation of the fragment with two cannulated screws. At the end of the procedure, Wiberg angle was 38° [17].

In 2011, Larson published on two FAI patients, both young sportsmen, with a bone fragment on the anterolateral rim that, if removed, would have led to a Wiberg angle of 15° and 18°, respectively. An arthroscopic treatment of the FAI and a fixation with 3.5-mm cannulated screws were performed. At a two year follow-up, the patients reached a MHHS of 97.8 and 100. Radiographically, a complete healing of the fragment was seen in both patients [18]. Similarly, in our case where a fixation was performed, we observed a MHHS of 100.

The results of arthroscopic FAI treatment and OSA excision in this study are extremely good. All patients had an improvement of symptoms. MHHS had an average increase of 37.5 that is much more of the average increase usually obtained in FAI patients without OSA. In a comparable series

of arthroscopically treated FAI patients without OSA, we reported an average post-op MHHS of 80 (48–100) with an increase from preop of only 17.7. Similarly, Clohisy reported an improvement of MHHS from 63.8 to 85.9, 22.1 points, at 2.2-year follow-up in a FAI population with an average age of 34 years [19]. Nielsen found an MHHS improvement from 72.1 to 83.1 [20] and Gupta from 61.29 to 82.02 at a two year follow-up (28.98 months) [21]. Therefore, the presence of an os acetabuli may be a reason for worse preoperative MHHS (57.5 in our series) and, when removed/fixed, a more predictable, better result.

This study is the first study which highlights the clinical importance of os acetabuli in FAI and the results of the arthroscopic combined treatment. Unfortunately, this study has several limitations. First, it is retrospective. We were not able to directly compare these patients to a concomitant control group of patient without OSA. On the other hand, we could compare these results with a series of our previously operated FAI patients of similar age and sex and with literature. Secondly, the number of patients is limited due to the relatively small incidence of this associated pathology.

Conclusion

An os acetabuli is not uncommon in FAI patients. There is a strict relationship with the male sex and a mixed type of impingement with a pronounced CAM lesion. Its origin could be related to a succession of microtraumatic events that lead to a stress fracture of the acetabular rim, especially in active patients.

Although this bone fragment can be removed during arthroscopy, in some instances, its sacrifice could lead to hip instability and a fixation would be preferred.

Arthroscopic treatment demonstrated very good results at two year and seven month follow-up: better than FAI without OSA. Further studies with a wider number of patients and a longer follow-up are needed to confirm these results and understand the real role of OSA in this setting.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

References

1. Smith-Petersen MN (1936) Treatment of malum coxae senilis, old slipped upper femoral epiphysis, intrapelvic protrusion of the acetabulum, and coxa plana by means of acetabuloplasty. JBJS 18(4): 869–880. https://doi.org/10.1007/s11999-008-0670-0
2. Beck M, Kalhor M, Leunig M, Ganz R (2005) Hip morphology influences the pattern of damage to the acetabular cartilage: femoroacetabular impingement as a cause of early osteoarthritis of the hip. J Bone Joint Surg (Br) 87(7):1012–1018. https://doi.org/10.1302/0301-620X.87B7.15203
3. Zaltz I, Kelly BT, Larson CM, Leunig M, Bedi A (2014) Surgical treatment of femoroacetabular impingement: what are the limits of hip arthroscopy? Arthroscopy 30(1):99–110. https://doi.org/10.1016/j.arthro.2013.10.005
4. Griffiths EJ, Khanduja V (2012) Hip arthroscopy: evolution, current practice and future developments. International Orthopaedics (SICOT) 36:1115. https://doi.org/10.1007/s00264-011-1459-4
5. Zini R (2009) Artroscopia dell'anca. Argalia editore Urbino
6. Klaue K, Durnin CW, Ganz R (1991) The acetabular rim syndrome. A clinical presentation of dysplasia of the hip. J Bone Joint Surg (Br) 73:423–429
7. Ponsetti I (1978) Growth and development of the acetabulum in the normal child. J Bone Joint Surg Am 60-A:575–585
8. Freedman E (1934) Os acetabuli. J Bone Joint Surg 31:492–495
9. Pitto RP, Klaue K, Ganz R, Ceppatelli S (1995) Acetabular rim pathology secondary to congenital hip dysplasia in the adult. A radiographic study. Chir Organi Mov 80(4):361–368
10. Ludvigsen TM, Løken S (2011) Hip arthroscopy and os acetabuli: a frequent finding in FAI patients. Arthroscopy 27(10):106–e107
11. Werner CM, Ramseier LE, Ruckstuhl T, Stromberg J, Copeland CE, Turen CH, Rufibch K, Bouaicha S (2012) Normal values of Wiberg's lateral center-edge angle and Lequesne's acetabular index a coxometric update. Skelet Radiol 41(10):1273–1278. https://doi.org/10.1007/s00256-012-1420-7
12. Byrd JW, Jones KS (2000) Prospective analysis of hip arthroscopy with 2-year follow-up. Arthroscopy 16:578–587. https://doi.org/10.1053/jars.2000.7683
13. Steadman JR, Rodkey WG, Rodrigo JJ (2001) Microfracture: surgical technique and rehabilitation to treat chondral defects. Clin Orthop Relat Res 391 Suppl:S362–9
14. Martinez AE, Ganz R, Beck M (2006) Os acetabuli in femoroacetabular impingement: stress fracture or unfused secondary ossification centre of the acetabular rim? Hip International 16(4):281–286
15. Hergan K, Oser W, Moriggl B (2000) Acetabular ossicles: normal variant or disease entity? Eur Radiol 10(4):624–628. https://doi.org/10.1007/s003300050974
16. Singh PJ, O'Donnell JM (2010) The outcome of hip arthroscopy in Australian football league players: a review of 27 hips. Arthroscopy 26(6):743–749. https://doi.org/10.1016/j.arthro.2009.10.010
17. Epstein NJ, Safran MR (2009) Stress fracture of the acetabular rim: arthroscopic reduction and internal fixation A case report. J Bone Joint Surg Am 91(6):1480–1486
18. Larson CM, Stone RM (2011) The rarely encountered rim fracture that contributes to both femoroacetabular impingement and hip stability: a report of 2 cases of arthroscopic partial excision and internal fixation. Arthroscopy 27(7):1018–1022. https://doi.org/10.1016/j.arthro.2011.04.006
19. Clohisy JC, Zebala LP, Nepple JJ, Pashos G (2010) Combined hip arthroscopy and limited open osteochondroplasty for anterior femoroacetabular impingement. J Bone Joint Surg Am 92(8): 1697–1706. https://doi.org/10.2106/JBJS.I.00326
20. Nielsen TG, Miller LL, Lund B, Christiansen SE, Lind M (2014) Outcome of arthroscopic treatment for symptomatic femoroacetabular impingement. BMC Musculoskelet Disord 15: 394. https://doi.org/10.1186/1471-2474-15-394
21. Gupta A, Redmond JM, Stake CE, Dunne KF, Domb BG (2015) Does primary hip arthroscopy result in improved clinical outcomes? 2-year clinical follow-up on a mixed group of 738 consecutive primary hip arthroscopies performed at a high-volume referral center. Am J Sports Med 28. https://doi.org/10.1177/0363546514562563