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Supplement

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Os acetabuli—a new arthroscopic treatment option for the acetabular rim fracture

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ABSTRACT

Os acetabuli (Os) or acetabular rimfractures are often seen in femoroacetabular impingement patients and can result in groin pain. When seen in symptomatic patients, the question is whether to remove them or to fixate the loose fragment to the acetabular rim. This depends on acetabular coverage and the extent of the Os. If removal of the Os might lead to hip dysplasia and instability, fixation of the Os should be the goal. This technical article describes the author's technique in fixating the Os with a suture-bridge technique.

INTRODUCTION

Os acetabuli (Os), also known as acetabular rim stress fractures, are often associated with femoroacetabular impingement (FAI). One of the theories on these bony abnormalities seen in young adults is that an Os may be the result of repetitive overload of the acetabular rim in patients with FAI and that this leads to a stress fracture or non-union of the rim during adolescence and, subsequently, to a bony detachment of part of the acetabular rim [1, 2].

Usually, these fragments may be removed to correct the hip morphology, unless the bony fragment constitutes a large part of the acetabular rim and therefore adds to joint congruency. Hip coverage is considered normal, when the Wiberg Centre Edge angle (CE-angle) is >25° on an antero–posterior pelvic radiograph and dysplastic coverage when it is <20°, and borderline dysplastic, when it ranges between 20° and 25° [3, 4]. Not only the CE-angle is of importance in these cases, but also acetabular anteversion or retroversion should be taken into account. Here, computed tomography scans (CT-scans) are helpful in measuring the anterior or posterior coverage [5]. Anda *et al.* [6] published reference values for some of the acetabular angles; namely the anterior-sector (AASA), the posterior-sector (PASA) and the acetabular anteversion angle (AcAV). Reference values for the CE angle, the acetabular index angle, AASA, PASA and the AcAV have been published by Tallroth *et al.* [5]. Normal AASA-angles are considered to be between 61.2° (±7.2) and 67° (±13) as described in various studies [5–7].

If bony resection of a large Os seems to compromise coverage, it should, in such cases, be carefully planned to avoid diminishing the femoral coverage post-operatively. Diminishing coverage might lead to increased risk of iatrogenic subluxation or dislocation, or even rapid development of osteoarthritis [1, 8]. In these cases, it is important to fix the Os *in situ* in order to preserve hip coverage and stability and often only a partial resection of the Os in combination with internal fixation is a possible solution and is described in this article.

Previously, open reduction and internal fixation has been recommended, but with the recent advances in arthroscopic techniques, there have been several reports on arthroscopic reduction and internal fixation with metal screws with good outcome in small case series [9–14].

PATIENT MATERIAL

In this article, we present three patients with large Os and the arthroscopic treatment they received. All patients were young males (20, 21 and 21 years) playing either soccer or team handball at a high level. The three patients were referred to our department because conservative treatment had failed. They had all stopped their professional soccer and handball careers due to hip and groin pain.

Patient #1 had bilateral Os, but only symptoms from the right hip, where the Os measured 14.7×16.3 mm (see Fig. 1A and B). CE-angle including the Os was 38°, and excluding the Os, the CE-angle was 16°.

Patient #2 also had bilateral Os, but only the left hip was symptomatic. He had a large Os in the left hip measuring 12×14.4 mm. combined with a low spine or pincer medial on the rim (see Fig. 1D and E). The Os was more medial on the rim and here the AASA including Os was 60°, and excluding the Os, the AASA-angle was 27°.

Patient #3 had a symptomatic Os in the left hip, very similar to patient #2, and also placed medially on the rim with an AASA-angle including Os of 74.3°, and excluding the Os, the AASA-angle was 52.1° (Fig. 1G and H).

TECHNIQUE

Preoperative imaging studies

Once the patient has been diagnosed with an Os on a standing antero–posterior radiograph of the pelvis, the CE-angle should be measured with and without the os acetabulum. In addition, a CT-scan is recommended in order to measure AASA-angles and CT-scans are also useful in identifying the position of the Os within the acetabular rim. A CT 3D-reconstruction gives good visualization of Os and is useful in the preoperative planning.

Surgery

Previous reports on arthroscopic treatment of unstable Os involved metal screw fixations of the Os after debriding the fibrous layer between the Os and the acetabulum [9–11, 13, 14]. We describe a technical modification of the arthroscopic technique using a suture-bridge technique, instead of metal screws. With this technique, we are also treating the labral lesion and cartilage while addressing the Os that splits the acetabular roof. So far, this surgical technique has been performed in three patients with a combined-type FAI (cam and pincer). At the time of writing, we have 1-year follow-up with post-op CT-scans on all three patients (see Fig. 1). We describe the technique and short-term results in this article.

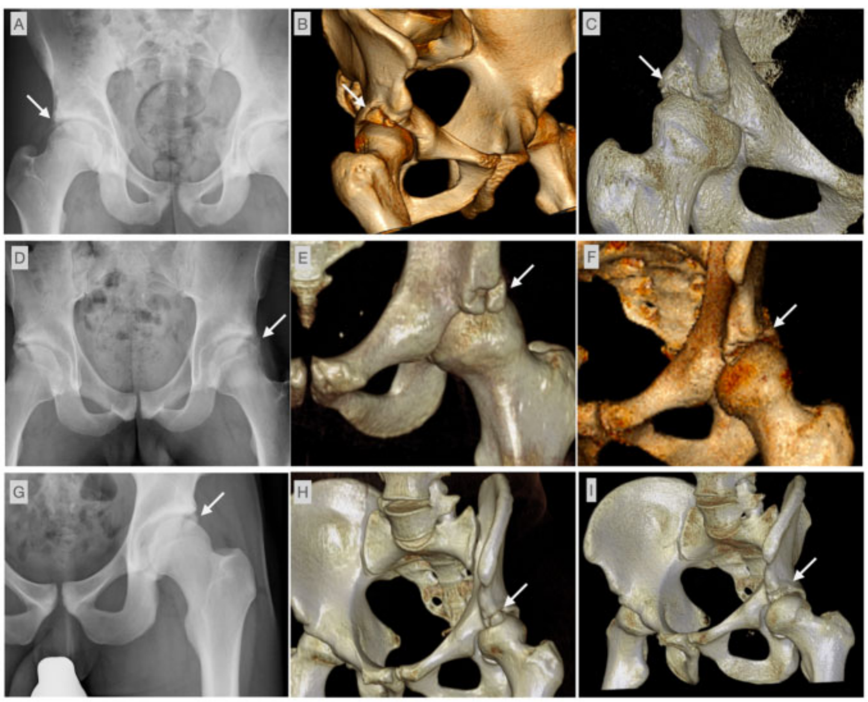

Fig. 1. Preoperative and post-operative imaging studies. (**A**) Patient #1, right hip. Preoperative radiographs showing the Os (arrow). (**B**) Preoperative CT-scan 3D-reconstruction oblique view. The arrow indicates the Os, which is in two parts. (**C**) Post-operative CT-scan 3D. One year after partial excision and fixation. Oblique view. Arrow indicates healed Os. (**D**) Patient #2, left hip. Preoperative radiographs showing the Os (arrow). (**E**) Preoperative 3D CT-scan, oblique view. The arrow indicates the Os and pincer medially to the Os. (**F**) Post-operative CT-scan 3D recon. one year after partial excision and fixation. Oblique view. Arrow indicates healed Os. (**G**) Patient #3, left hip. Preoperative radiographs showing the Os (arrow). (**H**) Preoperative 3D CT-scan, oblique view. The arrow indicates the Os. (**I**) Post-operative CT-scan 3D. One year after partial excision and fixation. Oblique view. Arrow indicates healed Os.

Patient positioning and portal placement

The hip arthroscopy is performed through anterolateral and mid-anterior portals with the patient supine on a specialist traction table. The hip is in 10° of flexion, maximal internal rotation and neutral abduction. An anterolateral portal is used to gain access to the central compartment under fluoroscopy guidance and the mid-anterior portal is then established using direct arthroscopic vision.

Capsulotomy and addressing the intra-articular pathology

After access is obtained, an interportal capsulotomy is performed and a diagnostic arthroscopy is performed using a 70° arthroscope in order to evaluate any concomitant pathology. The labral tear is assessed regarding its location and size and the cartilage is evaluated as well. In all three cases, the cartilage showed Grade 3 damage along the rim with delamination and all patients had concomitant labral tears along the rim. In all three patients, the Os was unstable and could be moved slightly with a probe. Utilizing the so-called upper-deck view, the soft tissue in the perilabral recess was debrided using a radiofrequency wand and a shaver, exposing the acetabular rim and the Os [15, 16]. We then perform the osteochondroplasty of the acetabular rim with a partial Os excision using a 5.5 mm oval burr (Smith & Nephew, Andover, MA) (see Fig. 2A and B). During this part of the procedure, it is helpful to evaluate the depth of the resection using fluoroscopy, but also to evaluate the rim and labrum in order to avoid over-resection of the rim and the Os and thus creating undercoverage.

Internal fixation and labral repair

After completion of the acetabular impingement procedure, we go on to fix the remaining fragment of the Os. First, we drill a series of small holes through the remaining Os with a curved drill guide for the SutureFix Ultra® 1.7 mm anchor (Smith & Nephew, Andover, MA), thus creating passage for bony ingrowth and stimulate possible healing (see Fig. 2C and D). Six to eight drillholes were drilled in each case through the fragment and then two SutureFix Ultra® 1.7 mm anchors were placed at each end of the Os, into the acetabular rim. The sutures from both anchors are separated through an 11×8.5 mm plastic canula placed in an accessory portal. One suture from each anchor is then tied with a non-slip knot at the end and the knot is passed down onto the rim and the Os, compressing against the fragment. The two remaining sutures are then tied down using a standard sliding knot with a knot pusher and compressing the Os fragment at the other end (Fig. 2F). Afterwards the labral tear is sutured with Speedlock Hip® 3.0 mm knotless PEEK-anchors (Smith & Nephew, Andover, MA) (see Fig. 2G). The cartilage fraying damage was then debrided using a radiofrequency wand.

Traction was reduced, and the hip flexed to about 45°. The cam is identified, and an osteochondroplasty was performed around the head-neck junction with a 5.5 mm Titanium Bonecutter® (Smith & Nephew, Andover, MA). After complete resection of the deformities, the hip was brought through a dynamic range of motion and impingement was assessed on arthroscopic visualization and fluoroscopy. At the end of the procedure, the capsule was closed with 2×#2Vicryl knots in the anterior part of the capsule and in the lateral part of the capsulotomy.

Post-operative rehabilitation

Post-operatively, the patients were allowed full weightbearing as tolerated with crutches for about 2 weeks and started cycling the day after surgery on a stationary bike. They

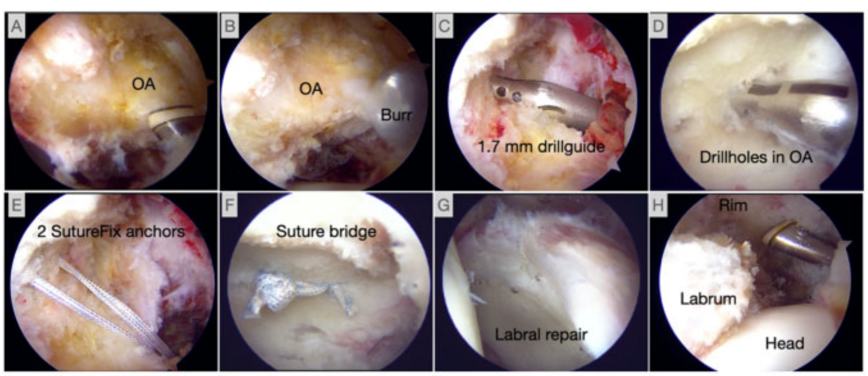

Fig. 2. Intraoperative arthroscopic images of the suture-bridge technique. The arthroscope is in the mid-anterior portal, with drilling and excision performed through the anterolateral portal. (**A** and **B**) Chondroplasty and fragment excision. (**C** and **D**) Os fragment after partial resection and drilling of the fragment. (**E** and **F**) Placing two SutureFix anchors and tying them down to form suture bridge. (**G**) The articular cartilage of the Os intact and continuous with the rest of the cartilage after repair. (**H**) Final result (Os).

Table I. HAGOS sub scores, ADL, sport and physical activity

Patient	*Pre-ADL*	*One-YADL*	*Difference*	*Pre-sport*	*OneY-sport*	*Difference*	*Pre-PA*	*One-YPA*	*Difference*
#1	50	75	25	34	59	25	0	0	0
#2	60	95	35	28	88	60	13	75	62
#3	90	95	5	50	94	44	25	100	75

Minimal clinical important difference (MCID) for ADL=11.7 points, sport =11.2 points and PA=11.8 points [from Danish Hip Arthroscopy Registry (DHAR) Annual Report].

underwent physiotherapist advised rehabilitation with a graduated exercise programme over the next 3–6 months and were allowed to return to sports at 5–6 months.

The post-operative period of all three patients progressed uneventfully, and they returned to playing soccer and team handball before the 1-year follow-up and at a high level. All patients still reported minor problems with some stiffness and minor aches after activity, but they were overall very satisfied with the outcome and had significant improvements in their Copenhagen Hip and Groin Outcomes Score (ADL, Sports and Physical Activity) scores at 1-year follow-up (see Table I). Post-op CT-scans at 1-year follow-up showed that the Os fragments had healed to the acetabulum with solid bony bridges and that only minor gaps at the edges were visible on the CT-scans (see Fig. 1).

DISCUSSION

Over the past 10–15 years, the advances in arthroscopic hip surgery have led to increased knowledge and awareness of problems related to femoroacetabular impingement syndrome (FAIS). Today, it is widely accepted that FAI develops from abnormal contact between the proximal femur and acetabular rim, and this may lead to a variety of lesions of the surrounding soft-tissue structures such as the cartilage and labrum [1, 17, 18]. The formation of Os in young adults is nowadays believed to be the result of repeating shearing forces on the acetabular rim which may lead to a stress fracture, especially in very active individuals.

The prevalence of Os is estimated to be between 3.6% and 6.4% in the FAI population. The presence of FAI and an unstable Os in a symptomatic patient hip is something orthopaedic surgeons should recognize as a potential precursor to significant articular cartilage damage [14, 19, 20]. In these cases, surgical treatment should address the cause, meaning resecting, debriding and/or fix the acetabular fragment and also treat the underlying FAI [12–14]. Among others, Pérez Carro *et al.* and Cuéllar *et al.* [11, 20] have reported that arthroscopic FAI management has shown good results, and that it might be the best approach for Os treatment. Giordano *et al.* [21] reported on the excision of the Os in 20 out of 21 patients and compared them with 21 FAIS patients and found no differences in outcome between the two groups. There were no refixations in their groups.

Although an Os can be completely excised, if not important for joint stability, there are cases in which full excision would lead to hip instability. In our cases, patient #1 had acetabular over-coverage with a CE-angle of Wiberg of 54° and a Tönnis angle of 6° and total removal of the Os would have led to a CE-angle of Wiberg of 24°. Patient #2 had acetabular over-coverage with a CE-angle of Wiberg of 53° and a Tönnis angle of 11° and total removal of the Os would have led to a CE-angle of Wiberg of 23°. But more importantly, with an AASA-angle including Os of 60°, and excluding the Os, the AASA-angle would have ended up in only 27°, which might have led to anterior instability. Patient #3 had an AASA-angle of 74.3° including the Os and excluding the Os, the AASA-angle was 52.1° and a resection might lead to post-operative instability.

So far, only few reports have been made in the literature regarding Os osteosynthesis. The first case was reported by Epstein [13] and they performed the fixation with two 4.5-mm cannulated screws. Others have reported on fixation with one or two screws [12, 14]. Also, two Spanish groups have reported on their modifications of these techniques and all reported good results without any complications [11, 20].

We present a technical modification to the above-mentioned techniques regarding treatment of unstable rim fractures. It is well established that labral reattachment has a crucial role in the hip function and subsequent outcome. It is therefore important that the placement of metal screws adjacent to the labrum do not interfere with labral fixation and anchor placement. With our suggested technique, the anchors can be placed close to the subchondral bone and thereby lead to a better labral fixation maintaining the labral suction seal. The small all-suture anchors do not hinder further placement of additional all-suture anchors or PEEK-anchors in close proximity. It is simple to execute because it resembles anchor placement in labral reattachment and utilizes simple knots for fixation. Moreover, it is less time-consuming, which is always a favourable point when performing hip arthroscopy, where traction time can be a challenge.

The good short-term results obtained in our cases with the suture-bridge technique leads us to believe that this technical note should be taken into consideration, when performing this procedure. The approach in these three cases with arthroscopic drilling across the non-union site with a curved 1.7 mm drill guide wire to stimulate bony ingrowth and percutaneous suture-bridge fixation to compress the non-union site without removing the fibrous tissue was performed because the articular cartilage was entirely intact. The suture-bridge technique is a promising technique to address the problem of a rim fracture and concomitant labral lesion as it allows good fixation of both the Os fragment and labrum while reducing the likelihood of damaging the fixed fragment. This technique offers a good alternative to the standard method of metal screw fixation in presence of a rim fracture.

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CONFLICT OF INTEREST STATEMENT

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REFERENCES

1. Klaue K, Durnin CW, Ganz R. The acetabular rim syndrome. A clinical presentation of dysplasia of the hip. *J Bone Joint Surg Br* 1991; **73**: 423–9.
2. Martinez AE, Li SM, Ganz R *et al.* Os acetabuli in femoro-acetabular impingement: stress fracture or unfused secondary ossification centre of the acetabular rim? *Hip Int* 2006; **16**: 281–6.
3. Wiberg G. Studies on dysplastic acetabula and congenital subluxation of the hip joint with special reference to the complication of osteo-arthritis. *JAMA* 1940; **115**: 81.
4. Tönnis D, Dietrich. Development of the hip joint. In: *Congenital Dysplasia and Dislocation of the Hip in Children and Adults*. Berlin, Heidelberg: Springer, 1987, 13–22.
5. Tallroth K, Lepistö J. Computed tomography measurement of acetabular dimensions: normal values for correction of dysplasia. *Acta Orthop* 2006; **77**: 598–602.
6. Anda S, Svenningsen S, Dale LG *et al.* The acetabular sector angle of the adult hip determined by computed tomography. *Acta Radiol Diagn* 1986; **27**: 443–7.
7. Mechlenburg I, Stilling M, Rømer L *et al.* Reference values and variation of acetabular angles measured by computed tomography in 170 asymptomatic hips. *Acta Radiol* 2019; **60**: 895–901.
8. Cuéllar A, Ruiz-Ibán MA, Marín-Peña O *et al.* Rapid development of osteoarthritis following arthroscopic resection of an "os acetabuli" in a mildly dysplastic hip—a case report. *Acta Orthop* 2015; **86**: 396–8.
9. Pascual-Garrido C, Schrock JB, Mitchell JJ *et al.* Arthroscopic fixation of Os acetabuli Technique: when to resect and when to fix. *Arthrosc Tech* 2016; **5**: e1155–60.
10. Torres-Eguía R, Más Martínez J, Sanz-Reig J. Arthroscopic reduction and internal fixation of a rim fracture. *Arthrosc Tech* 2017; **6**: e2155–60.
11. Cuéllar A, Albillos X, Cuéllar A *et al.* Screw fixation of Os acetabuli: an arthroscopic technique. *Arthrosc Tech* 2017; **6**: e801–6.
12. Rafols C, Monckeberg JE, Numair J. Unusual bilateral rim fracture in femoroacetabular impingement. *Case Rep Orthop* 2015; **2015**: 210827.
13. Epstein NJ, Safran MR. Stress fracture of the acetabular rim: arthroscopic reduction and internal fixation. *J Bone Joint Surg Am* 2009; **91**: 1480–6.
14. Larson CM, Stone RM. 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* 2011; **27**: 1018–22.
15. Ortiz-Declet V, Mu B, Chen AW *et al.* The "Bird's Eye" and "Upper Deck" views in hip arthroscopy: powerful arthroscopic perspectives for acetabuloplasty. *Arthrosc Tech* 2018; **7**: e13–6.
16. Ortiz-Declet V, Mu BH, Yuen LC *et al.* The 'upper deck view' improves visualization during acetabuloplasty without chondrolabral detachment. *J Hip Preserv Surg* 2019; **6**: 183–8.
17. Ganz R, Leunig M, Leunig-Ganz K *et al.* The etiology of osteoarthritis of the hip: an integrated mechanical concept. *Clin Orthop Relat Res* 2008; **466**: 264–72.
18. Beck M, Kalhor M, Leunig M *et al.* 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* 2005; **87**: 1012–8.
19. Larson CM. Arthroscopic management of pincer-type impingement. *Sports Med Arthrosc Rev* 2010; **18**: 100–7.
20. Pérez Carro L, Sa Rodrigues A, Ortiz Castillo A *et al.* Suture-on-screw technique for Os acetabuli fixation and labral repair. *Arthrosc Tech* 2017; **6**: e107–12.
21. Giordano BD, Suarez-Ahedo C, Gui C *et al.* Clinical outcomes of patients with symptomatic acetabular rim fractures after arthroscopic FAI treatment. *J Hip Preserv Surg* 2018; **5**: 66–72.