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Research article

Surgical hip dislocation and varus derotation osteotomy for extra-articular cause of femoroacetabular impingement: a single case report

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ABSTRACT

Femoral retroversion is an extra-articular cause of cam-type femoroacetabular impingement (FAI) via early engagement with anterior rim. Valgus hip also causes extra-articular FAI by decreasing the range of motion. We present a case of valgus hip accompanied by femoral retroversion, which was refractory to prior arthroscopic femoroplasty. As a reasonable strategy, we have performed extra-articular correction via femoral subtrochanteric varus derotation osteotomy as well as intra-articular decompression by surgical hip dislocation. Femoral varus derotation osteotomy with surgical hip dislocation is a rational and appropriate solution in patients with extra-articular FAI, which is refractory to arthroscopic FAI surgery. Extra-articular causes of FAI should be suspected in every refractory case.

INTRODUCTION

External torsional deformity of femur may generate proximal femoral retroversion (external torsion above or at lesser trochanter) or retrotorsion (external torsion below lesser trochanter). Femoral retroversion is known to exacerbate or contribute to hip impingement by early engagement with anterior rim [1, 2]. Femora were categorized as coxa vara (>120°), physiological (≥120 to <130°) and coxa valga (≥130°) [3]. Valgus hip with high ante-torsion causes pain via posterior extra-articular femoroacetabular impingement (FAI) [4]. We present a case of valgus hip accompanied by femoral retroversion with atypical and somewhat contrasting features. As a reasonable approach, we performed extra-articular correction by femoral subtrochanteric varus derotation osteotomy as well as intra-articular decompression via surgical hip dislocation.

CASE REPORT

A 37-year-old man presented with right hip pain and limitation of motion. He reported that he underwent fixation for linear and undisplaced intertrochanteric fractures 3 years ago, with uneventful solid bony union. He reported pain around the right hip prior to injury. He exhibited positive anterior impingement sign and out-toeing gait involving his right leg while walking. A simple roentgenogram revealed valgus hip with decreased medial offset and aspheric lesion around the lateral head–neck junction area and over-coverage of acetabulum. The caput-collum-diaphyseal (CCD) angle was 145° and the lateral center-edge angle (LCEA) was 42° (Fig. 1). Arthroscopic resection of the cam deformity was performed and the 3D computed tomogram (3D CT) revealed decompression of the head–neck area post-operatively (Fig. 2). Nonetheless, the patient complained of persistent pain, and continued to manifest out-toeing gait with thigh abduction (Fig. 3). The modified Harris hip score (MHHS) was 59, and the University of California at Los Angeles (UCLA) activity score was 4. The flexion in neutral rotation was 90°. Internal rotations involving hip extension as well as hip flexion were significantly limited (internal rotation at 90/20° flexion, 15/25°; external rotation at 90/20° flexion,

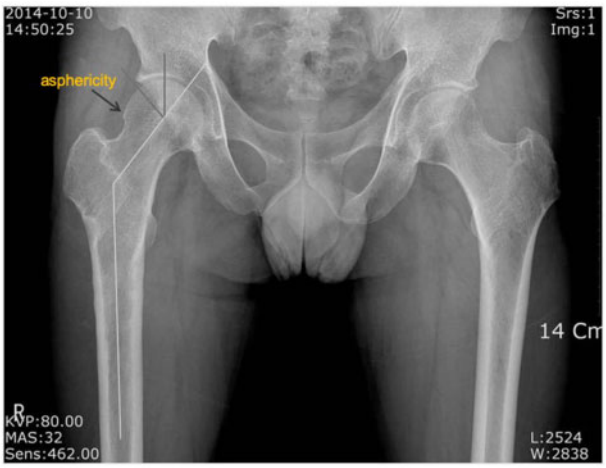

Fig. 1. The CCD angle was 145°, the LCEA was 42° and asphericity was present on X-ray image.

Fig. 2. The 3D CT view of femur head–neck area after arthroscopic surgery.

35/65°). The CT image showed femoral retroversion of right femur. The distal femoral transepicondylar axis was externally rotated compared with the right femoral neck axis (10°) and there was external torsion at and above lesser trochanter in orthogonal 3D CT view (Fig. 4A–D). Valgus hip (CCD angle of 145°) also contributed to decreased internal rotation by decreasing the lateral femoral offset. The persistent hip pain and limited rotation was attributed to the residual intra-articular FAI and extra-articular impingement caused by femoral retroversion and

Fig. 3. The patient continued to walk with toes out and thigh abducted despite arthroscopic surgery.

high CCD angle. We presumptively diagnosed extra-articular component of FAI in addition to intra-articular impingement, and corrected the extra-articular defect via open surgery. Intra-articularly, surgical hip dislocation was used to perform labral takedown, acetabular rim resection and reattachment as well as cam decompression. These procedures have been considered inadequate because of extra-articular FAI. Therefore, varus and derotational femoral osteotomy was planned simultaneously. CCD angle was altered from pre-operative 145° to post-operative 130°. The pre-operative 10° of retroversion was modified to anteversion post-operatively. We used a 5.0-mm pediatric proximal femoral osteotomy locking compression plate (5.0 LCP pediatric hip plate 120°, DepuySynthes, USA) as the fixation material. This plate carries three neck screws proximally and combi-holes for locking or cortex screws distally. The degree of varization was calibrated in the pre-operative roentgenogram and that of derotation was measured by two parallel K-wires in the saw bone model (Fig. 5A). All the procedures including trochanteric

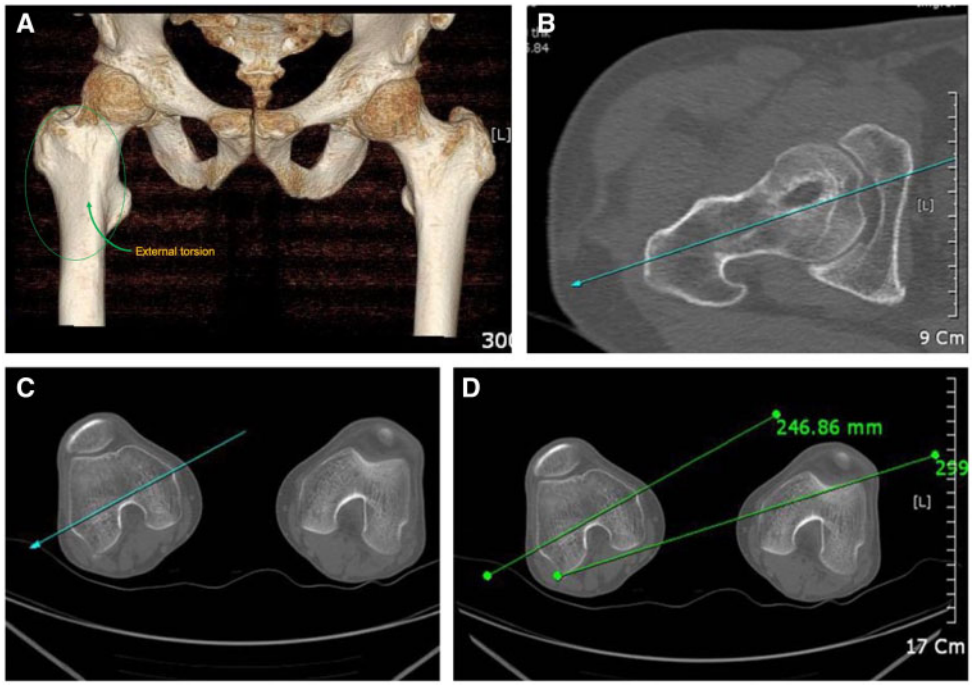

Fig. 4. (**A**) The orthogonal 3D CT view of femur neck and trochanter showed the external torsional deformity. (**B**) Right femur neck axis. (**C**) Right distal femur trans-epicondylar axis. (**D**) The right distal femoral transepicondylar axis was externally rotated by 10° compared with the right femur neck axis, which meant femoral retroversion.

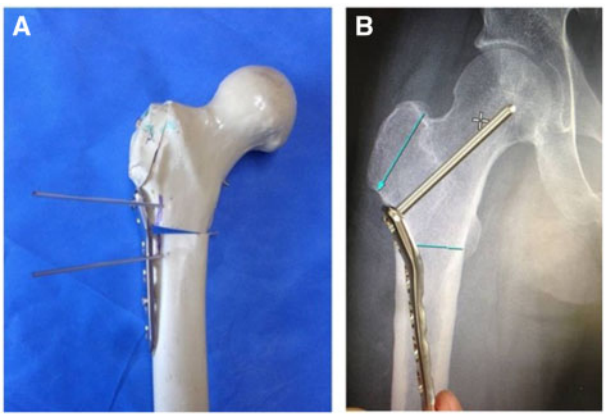

Fig. 5. (**A**) Two parallel K-wires inserted above and below the osteotomy site were used to measure varization and derotation after osteotomy. (**B**) The paths of two neck screws were guided by preemptive insertion of K-wires in lateral as well as anteroposterior fluoroscopic film.

osteotomy and proximal femoral osteotomy with varization and derotation were simulated in the saw bone model.

Surgical technique

The patient was placed in a lateral decubitus position. A straight incision was performed over the greater trochanter area and extended distally as well as proximally. After the incision of fascia and trochanteric bursa, the vastus lateralis was elevated at the trochanteric ridge. The two K-wires for neck screws on the lateral film were inserted in parallel, and linearly in the anteroposterior film under fluoroscopic guidance (Fig. 5B). The gluteus medius and minimus were elevated and retracted superficial to the piriformis at a safe distance of 5 mm anterior to trochanteric overhang to protect medial femoral circumflex artery. Pre-drilling on the greater trochanter was performed before osteotomy. After careful digastric trochanteric osteotomy, the trochanteric fragment was retracted anteriorly. After removing the remnant gluteus minimus, the capsule was exposed and a Z-shaped capsulotomy was performed while taking care not to injure the retinacular vessel. The extra-articular impingement was confirmed by viewing the contact between anteromedial cortex of the inferior portion along the intertrochanteric line and the anterior acetabular rim along with iliopectineal eminence area within the physiologic ROM (Fig. 6A). The femoral head was then dislocated while the leg was flexed and externally rotated. Previous femoroplasty area was identified (Fig. 6B). Acetabular chondral lesion was visible at the chondrolabral junction of 12 o'clock position and the labrum was not torn (Fig. 7A). A small rim defect and rent at chondrolabral junction were noticed at the 2 o'clock position (Fig. 7B). Acetabular

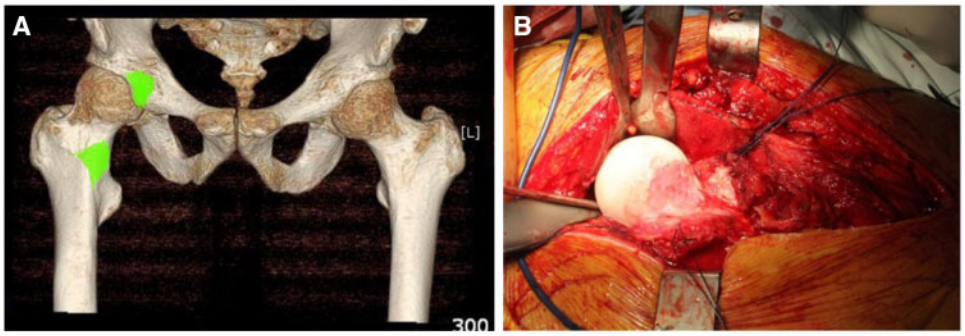

Fig. 6. (**A**) The extra-articular impingement was confirmed by viewing the contact between the inferior intertrochanteric line area and the iliopectineal area with internal rotation in both 90 and 20° flex. (**B**) The previous femoroplasty area was identified by surgical hip dislocation.

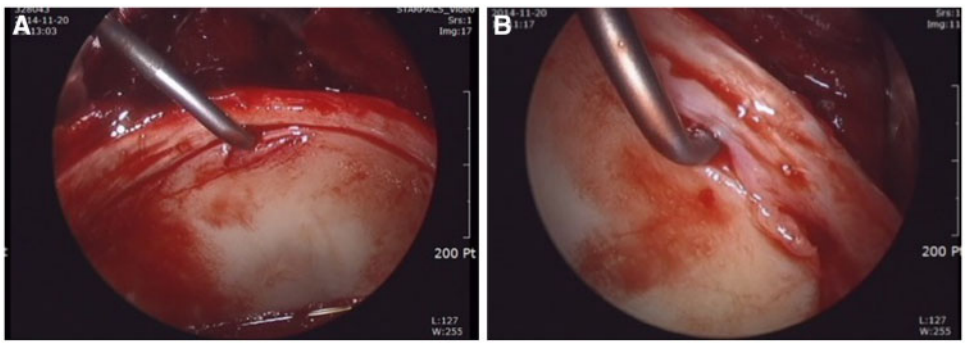

Fig. 7. (**A**) Acetabular chondral lesion at the chondrolabral junction of 12 o'clock position. (**B**) A small rim defect and labral rent at the chondrolabral junction of 2 o'clock position.

labral takedown, bone trimming, and labral refixation were performed at 12 o'clock positions, measuring ~1 inch in length (Fig. 8A). The rim resection is indicated for a case with large LCEA (>40°). After the acetabular procedure, femoral osteochondroplasty was performed. After intra-articular procedure, the femoral head was reduced into acetabulum again. Vastus lateralis was elevated and subtrochanteric osteotomy site was defined with plate attached temporarily. The entry and direction of two parallel neck screws were pre-drilled in parallelly on the lateral film and linearly in the anteroposterior film calibrated pre-operatively (Fig. 5B). Two parallel K-wires were inserted into the femoral shaft anterior to the plate proximal and distal to the defined femoral osteotomy site, respectively. A single neck screw with the plate attached was inserted until the distal portion reached the lateral femoral cortex leaving the proximal portion away from the lateral cortex. Incomplete osteotomy was intended to control the opening and rotation by preserving the medial cortico-cancellous bone as a hinge. The plate was rotated posteriorly to facilitate osteotomy. Incomplete femoral osteotomy was performed cautiously to preserve the medial cortico-cancellous hinge with the oscillating saw while the thigh was abducted and the knee was flexed. The final insertion of this neck screw was performed with the plate parallel to femur. Simultaneous varization and derotation were performed gently as much as measured pre-operatively by rotation and divergence of the distal K-wire with the distal thigh adducted slightly and the leg rotated internally by the assistant (Fig. 8B). The proximal part of osteotomy was beveled for removal of the bone after varization. Subsequently, a single plate screw was inserted into the femur swiftly for immediate fixation of the osteotomy site. The second neck screw and the other three plate screws were inserted for further fixation, and the calcar neck screw was inserted finally. The gluteus-greater trochanter-vastus lateralis sleeve was relocated and the osteotomized greater trochanter was fixed with three large cortical screws (Fig. 8C).

Pre- and post-operative X-ray images were compared. The CCD angle was changed to 131°, the medial offset was increased and the LCEA decreased from 42 to 28°

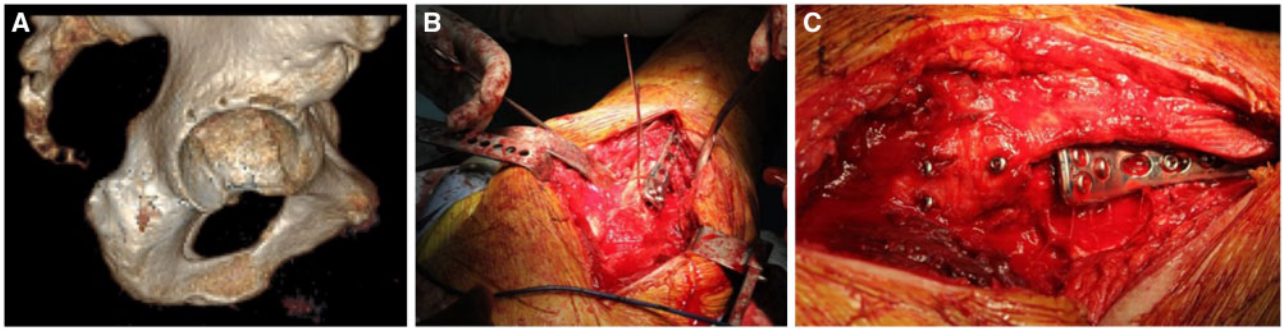

Fig. 8. (**A**) Acetabular labral takedown, rim resection and labral refixation with two anchors. (**B**) *In vivo* lateral opening and derotation by divergence and rotation of the K-wires and subsequent fixation of neck and plate screw. (**C**) After the final fixation of the calcar neck and the other plate screws, the osteotomized digastric greater trochanter was relocated and fixed with three large screws.

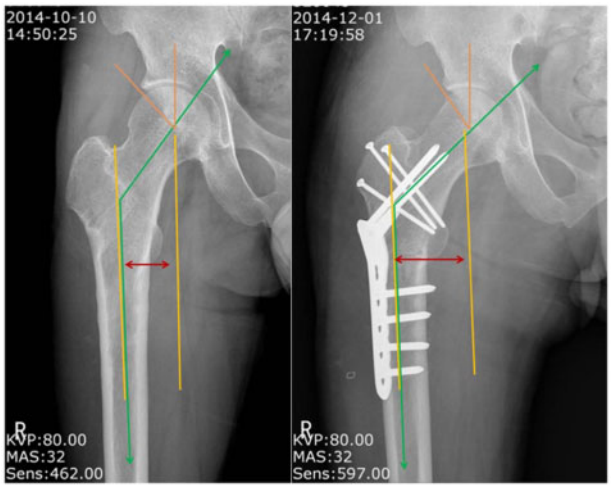

Fig. 9. The CCD angle was changed to 131° and the LCEA decreased to 28°.

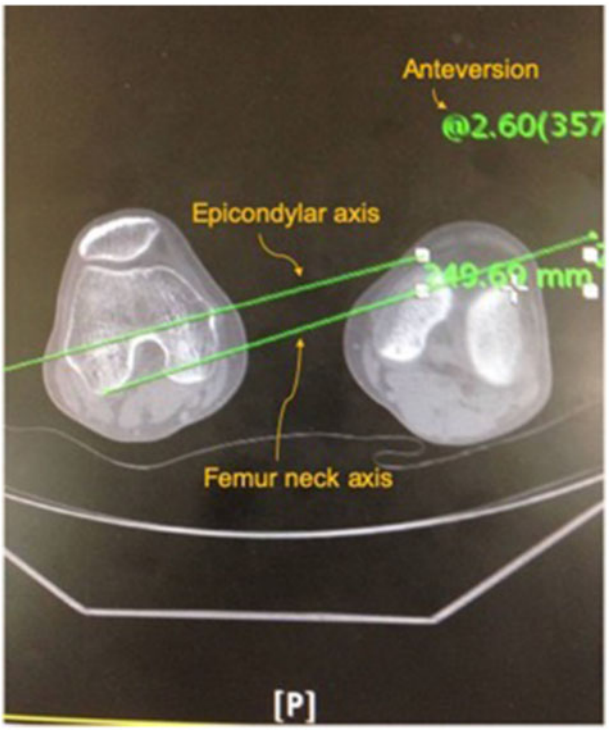

Fig. 10. The post-operative right femur neck anteversion was 2.6°.

(Fig. 9). The femoral neck axis was anterverted compared with the distal femoral epicondylar axis in CT (2.6° anteversion; Fig. 10). Two years post-operatively, a solid bone union of osteotomy site was observed, and the fixative for osteotomy was removed (Fig. 11). The patient walked well without crutches. Clinically, the MHHS was 85 and UCLA activity score was 7. The internal rotation of hip improved (internal rotation at 90/20° flexion, 30/25°; external rotation at 90/20° flexion, 45/65°). The foot progression angle was normalized.

DISCUSSION

Femoral anteversion, which is increased in infants and younger children, is reduced spontaneously with growth to normal adulthood by the age of 8 years. If the version is reduced excessively or negatively, the hip may cause pain and lead to osteoarthritis [5]. Retroversion of proximal femur may have increased the mean peak joint pressure and possibly triggered FAI in patients without any definitive abnormality of femoral head–neck area [6]. Thus, femur retroversion may be regarded as the third cause of FAI other than cam or pincer FAI [7]. Retroverted femur may engage the rim sooner resulting in significant pain and loss of internal rotation with daily activities [1]. The reduced femoral anteversion may be treated via either open or arthroscopic method. Huber *et al.* [7] reported clinical results involving treatment of reduced femoral anteversion via subtrochanteric rotational femoral

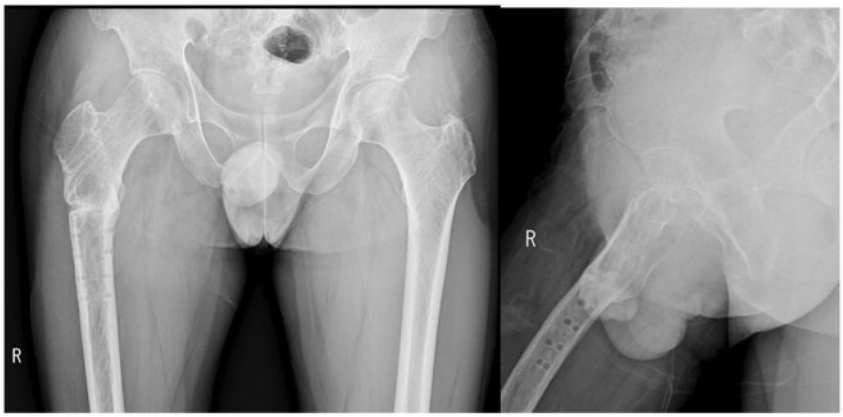

Fig. 11. Solid bony union on 2-year post-operative X-ray films.

osteotomy. Surgical hip dislocation may be combined with subtrochanteric osteotomy for the treatment of complex hip pathologies [2]. Matsuda *et al.* [8] reported a case of cam FAI resulting from bilateral femoral retroversion following closed intramedullary derotational osteotomy and hip arthroscopy.

Coxa valga has been associated with acetabular dysplasia and neuromuscular disorders but may also occur as an isolated entity [4]. This patient sustained linear, undisplaced intertrochanteric fracture 3 years ago before admission, suggesting that the proximal femur deformity may be secondary to injury. However, the fracture was faintly linear as shown in the pre-operative roentgenogram and fixated *in situ*, to prevent deformation of femoral head and neck to coxa valga with retroversion because of trauma. The etiology of this case appeared to be idiopathic. In coxa valga, decreased medial offset may theoretically contribute to decreased range of hip motion, specifically adduction and internal rotation, which may be caused by extra-articular FAI [4]. Coxa valga associated with increased antetorsion has been reported to increase the risk of posterior predominantly extra-articular FAI and also lead to anterior subluxation [4]. Coxa valga can be combined with excessive femoral antetorsion or retrotrosion and may be treated with femoral derotation osteotomy [4, 8]. Siebenrock *et al.* [4] reported that valgus hips with increased anteversion showed an extra-articular impingement pattern different from that of normal and idiopathic FAI hips, suggesting that the logical surgical treatment was a varus and derotation osteotomy of the proximal femur. Coxa valga with retroversion is an infrequent combination, but can occur as a sequela of femur neck fracture (valgus impaction). If coxa valga is accompanied by retroversion and extra-articular impingement is presumptively diagnosed based upon history, physical examination and radiographic studies, varus and derotation are also logical treatment options according to Siebenrock *et al.* If coxa valga associated with femoral retroversion is accompanied by acetabular over-coverage, the treatment is more complicated. In this case, it is reasonable to perform an intra-articular procedure as well as femoral osteotomy. Surgical hip dislocation is an appropriate intra-articular strategy enabling circumferential view of acetabulum and femoral head.

We report a case of mixed type FAI accompanied by valgus hip with femoral retroversion, which was preceded by arthroscopic femoroplasty and successfully treated via surgical hip dislocation and varus and derotational femoral osteotomy. Acetabular osteoplasty including rim trimming may not be a prerequisite in arthroscopic FAI surgery as long as the labrum is conserved and the acetabular cartilage was not severely damaged, and impingement-free functional motion was obtained by cam decompression [9]. Therefore, no arthroscopic rim trimming or refixation was performed because of adequate cam decompression. However, the *in vitro* femoro-acetabular clearance during the first surgery appeared to be inadequate in walking simulation studies. Therefore, it is highly recommended to identify any femoral rotational abnormality and measure the CCD angle for valgus or varus hips in every case of FAI. These abnormalities, even a few degrees, may have a profound effect on femoroacetabular clearance. These abnormalities are often elusive in the initial FAI studies that we need to do a CT scan of the whole femur and evaluate the patient's gait pattern comprehensively.

CONCLUSION

Femoral varus derotation osteotomy with surgical hip dislocation is a rational and appropriate solution in patients with extra-articular causes of FAI, which are refractory to arthroscopic FAI surgery. It is strongly advisable to identify

any extra-articular causes of FAI in every case of FAI operation.

CONFLICT OF INTEREST STATEMENT

None declared.

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