Original article

“Femoroacetabular impingement”. Legg-Calve-Perthes disease: From childhood to adulthood

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Abstract

Objectives: The objective of this study was to investigate cases of femoroacetabular impingement (FAI) and analyze the risk factors for a painful hip at skeletal maturity after Perthes disease. We hypothesized that FAI occurs as a sequela of Perthes disease and that coxa plana and triple osteotomy of the pelvis (TOP) may be risk factors.

Methods: Ninety-five hips were included from 1981 to 2011, 56 of which were operated on with TOP (53) or shelf acetabuloplasty (3). The results were evaluated at a mean 13 years of follow-up (range, 2–23 years) with Oxford score and hip radiograph analysis including the Stulberg grade, coxometry, and presence of a femoral bump. FAI was characterized by positional hip pain with preserved joint space and aspherical/nonspherical femoral head.

Results: The Oxford score was optimal (12) in 79 hips (75%) and 20 or above in nine hips (9.5%). Seventeen hips were rated Stulberg I (18%), 36 Stulberg II (38%), 27 Stulberg III (28%), and 15 Stulberg IV or V (16%). The average acetabular angle was 10° (range, –4 to 25°), VCE 41.5° (range, 18–80°), and VCA 38.5° (range, 13–70°). A femoral bump was noted in 31 hips (33%). Five cases of FAI were managed operatively with at least pain relief. Hip pain at the latest follow-up correlated with coxa plana (P = 0.0003) and femoral bump (P = 0.0007). No significant correlation was found with a history of hip surgery or coxometry parameters.

Conclusion: Perthes hips bear risk for later FAI. Risk factors include coxa plana and femoral bump. In case of TOP, it is advocated to avoid excessive tilt, which may cause FAI.

Level of evidence: IV.

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1. Introduction

Legg-Calve-Perthes disease (LCPD) is defined as remodeling of the proximal femoral epiphysis during growth after idiopathic ischemia. At stake is the onset of hip osteoarthritis, occurring more or less rapidly depending on the sphericity and congruency of the femoral head. The therapeutic strategy consists in identifying the risk factors (beginning treatment after 8 years of age, the amount of necrosis, and the extrusion of the femoral head) and proposing an intervention to the patient that would aim at guiding the remodeling and preventing its deformity. Several solutions have been suggested depending on the cases and preferences: Salter osteotomy, triple osteotomy of the pelvis (TOP), shelf acetabuloplasty, and femoral varus or valgus osteotomy. The radiographic result is measured at skeletal maturity using the Stulberg classification in five stages: 1 for a normal hip, 2 for a large but spherical femoral head, 3 for an oval head, 4 for congruent coxa plana, and 5 for incongruent coxa plana. The prognosis is classically poor for the last stage [1]. Hip pain is possible before the hip osteoarthritis stage and impingement was identified in the 1980s by Grossbard [2] and later Catterall [3], with sometimes associated labral lesions. In 1993, for the first time Snow et al. reported pain in internal rotation in adolescents, related to impingement between the anterior part of the femoral head and the acetabular labrum [4]. Currently, cam-type femoroacetabular impingement involving anterolateral offset of the femoral head is recognized as well as a pinching component involving acetabular retroversion, sometimes consecutive to osteotomy of the pelvis [5]. The objective of this study was to...
scrutinize the proven cases and search for the risk factors after TOP. We hypothesized that impingement is one of the sequelae of this disease, most particularly in cases of coxa plana and surgical TOP treatment.

2. Materials and methods

We studied 95 hips in 19 females and 73 males (three bilateral forms) who presented femoroacetabular impingement (FAI) diagnosed between 1981 and 2011 in the Pediatric Orthopaedic Departments of the Toulouse and Strasbourg University Hospitals. The hips were classified using the Herring classification as follows: A = 31, B = 39, C = 25, and according to the Catterall classification: I = 14, II = 18, III = 29, IV = 34. The initial treatment consisted in simple non-weightbearing measures until signs of fragmentation appeared. The indication for surgery was then determined by the presence of the commonly recognized risk factors cited above. Fifty-six were operated on with either a Pol-le-Coeur TOP (53) or shelf acetabuloplasty (3). The patients were reassessed at skeletal maturity with a mean follow-up of 13 years (range, 2–23 years) from the diagnosis or at the time of surgery for those undergoing surgery. The follow-up assessment included an Oxford score [6] and an AP and lateral radiographic analysis of the hip with the Stulberg grade, the acetabular angle (AA), lateral center edge (CE), and anterior center edge (ACE) angles, and the presence of a femoral bump. Impingement was defined by positional hip pain reproduced at the clinical examination associated with preserved joint space and an aspherical femoral head. Depending on the center, treatment of the impingement consisted in resection of the anterolateral offset part of the head by arthroscopy or arthroscopy.

3. Statistical analysis

Statistical analysis was performed using SAS software (version 9.2). The quantitative variables were described by the mean and the range and the qualitative variables by percentages and totals. The normal distribution of the quantitative variables was tested using the Shapiro-Wilks test. The hips were classified into two groups according to the Oxford score: painless hips defined as Oxford score = 12 and painful hips defined as Oxford score < 12. The quantitative and qualitative variables were compared between the two groups using the Student t-test (or the Mann-Whitney U-test for non-normally distributed data) and the Chi² test (or the Fisher exact test for small groups), respectively. P < 0.05 was considered statistically significant.

4. Results

The Oxford score was optimal (12) for 79 hips (75%) and greater than or equal to 20 for nine hips (9.5%). Seventeen hips were classified as Stulberg I (18%), 36 as Stulberg II (38%), 27 as Stulberg III (28%), and 15 as Stulberg IV or V (16%); the latter two groups were grouped for the statistical analysis because only one hip was classified as type V. The mean AA angle was 10° (range, −4 to 25°), the CE angle was 41.5° (range, 18–80°), and the ACE angle was 38.5° (range, 13–70°). A femoral bump was observed for 31 hips (33%). Five proven femoroacetabular impingements (5% of the hips) warranted surgical treatment, which in all cases at least improved the pain symptoms.

Hip pain at the follow-up as defined by the Oxford score greater than 12 was correlated with the presence of coxa plana (P = 0.0003)
and a femoral bump (P=0.007). No significant correlation was found with surgical treatment or the coxometry parameters.

5. Discussion

Although retrospective, this study is one of the rare studies to investigate FAI in LCPD, with a relatively large number of subjects. Concerning the long-term natural history of this disease, in 2012 Larson et al. reported the results of a prospective multicenter study investigating 66 patients treated conservatively at a mean 20 years of follow-up [7]. Thirty-one presented anterior clinical impingement, 18 lateral impingements, and 14 posterior impingements, with the possibility of accumulating these impingements. The presence of clinical impingement was correlated with Herring and Stulberg stages. The clinical notion is essential because femoroacetabular impingement is a dynamic pathology whose diagnosis can never be made based on imaging only. A recent radiographic study using steroedography found, in more than half of a totally asymptomatic population of adolescents and young adults, at least two signs suggesting impingement [8].

LCPD includes acquired retroversion of the acetabulum, as shown by Sankar et al. on a series of 53 hips: retroversion was present in one hip (1.8%) at diagnosis and in five hips for the 16 followed up until skeletal maturity (31%), with a positive correlation with Herring grade [9]. The anatomical modifications predisposing to FAI can also be iatrogenic. In 2010, Wenger et al. reported results at 3 years of follow-up in a series of 40 hips having undergone TOP with the CE angle increased a mean 17° [10]. They had to perform surgical revision in two patients for pincer-type impingement at the beginning of their experience before they realized the harmful effect of excessive tilt. Even if a remodeling effect exists after TOP on the CE, AA, and Sharp angles, it is recommended not to “cover” the femoral head [11]. In this study, we found no influence of a history of TOP or coxometry parameters on the progression to painful hip at follow-up. This may be related to the group being too small or surgery having been performed by experienced senior surgeons.

Several treatments have been proposed in FAI after LCPD. Cheilectomy of the hip was recommended in the 1980s [12,13]. Although the results were initially satisfactory in terms of pain and mobility, progression at 25 years of follow-up showed deterioration toward hip osteoarthritis [14]. Actually, this was not strictly speaking treatment for impingement but rather severe forms of LCPD in young patients (9–11 years of age), sometimes at the fragmentation stage. Resection of the offset of the femoral head in cam-type impingement in adolescents or young adults has in our experience provided satisfactory results (Fig. 1 and Video supplement). Recently, Novais reported on this technique and the results of the Ganz method applied to the treatment of FAI in LCPD. With anterior dislocation and major surgery, it allows “à la carte” surgery with the choice of cheilectomy of the femoral head, labrum repair, neck-lengthening osteotomy, lowering of the great trochanter, and intertrochanteric osteotomy [15]. A literature review found 138 patients aged from 14 to 21 years who have undergone this procedure. Nine percent also had a periacetabular osteotomy at the same time. Between 3 and 8 years of follow-up, the author found 6% complications and 16% failures defined by the persistence of pain, 10% of which underwent revision for arthroplasty. Arthroscopic treatment of the impingement in this specific indication is possible even if no series has reported results to date [16]. It nevertheless seems more laborious given the involvement of the femoral head itself and the relatively large volume of the resection.

6. Conclusion

LCPD at the sequela stage is a source of FAI, with several possible origins. The risk factors include coxa plana and the presence of a femoral bump. Signs of impingement should be sought with questioning at the clinical examination in at-risk patients. In cases with TOP, it is important to avoid excessive tilt, which may induce impingement because the remodeling is modest. Treatment of FAI in LCPD is specific. Simple resection of the anterolateral offset of the femoral head is relatively simple and only minimally invasive, and seems to give satisfactory results even if this needs to be confirmed.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

Appendix A. Supplementary data

Supplementary data (Videos 1 and 2) associated with this article can be found, in the online version, at doi:10.1016/j.otsr.2014.03.029.

References