Review

Capsula Eburnea

SURGERY FOR FEMOROACETABULAR IMPINGEMENT IN EARLY DEGENERATIVE STAGE

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SUMMARY

Femoroacetabular impingement (FAI) is a recently defined condition that affects mainly young adults, often athletes, and represents one of the most common causes of osteoarthritis of the hip. An early diagnosis is especially important to successfully treat this condition; in fact, if the hip joint is not yet compromised on initial diagnosis, it is possible to improve the prognosis of the patient thanks to conservative surgical treatment.

Introduction

Femoroacetabular impingement (FAI) results from a series of congenital or acquired pathologies of the hip. Its primary pathogenic element is an abnormal contact between the two articular components of the hip (the acetabulum and the proximal femoral epiphysis). FAI presents with distinct radiological and clinical characteristics. In the past, these were often considered to be caused by a degenerative arthritic process. In reality, FAI itself is one of the most frequent causes of hip osteoarthritis [1]. Young adult males, often athletes, are the main category of patients affected by this condition due to the high frequency of repetitive motions associated with FAI performed by such individuals.

Classification

Three forms of femoroacetabular impingement have been defined:

- *CAM impingement (femoral):* caused by an abnormal femoral head/neck relationship (Head/Neck Offset), with the femoral neck coming into premature contact with the acetabular rim in flexion, usually due to the presence of a bone deformation (bump) in the anterior or anterolateral surface of the head.
- *PINCER Impingement (acetabular):* resulting from acetabular overcoverage causing premature contact with the femoral head.
- *CAM-PINCER Impingement (mixed):* concomitant presence of the two types of impingement described above [2, 3, 4].

Diagnosis

FAI diagnosis is based on patient history (young, active patients, with previous hip problems and/or those who have needed to undergo hip surgery in the past) and clinical examination (showing reduced flexion and internal rotation of the hip) [5], as well as on the findings of three clinical tests:

- *Provocative test for CAM impingement:* hip flexion and internal rotation in a supine position [6].
- *Provocative test for PINCER impingement:* hip extension and external rotation in a prone position.
- *FABER test:* hip flexion, abduction and external rotation in a supine position [2].

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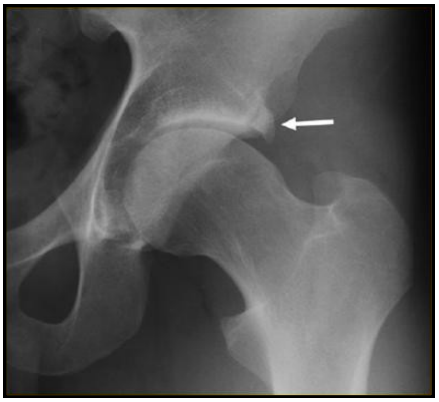
Figure 1: "Pistol grip deformity": flattening of the normal concavity of the lateral profile of the femoral neck (a patognomic radiologic sign of Cam type impingement).

Figure 2: Impact of the femoral head-neck junction against the acetabular rim due to abnormalities of the edge of the acetabulum (Pincer type FAI).



The diagnosis is further confirmed by the following methods:

- *X-rays with an anteroposterior view of the pelvis and a lateral view of the hip:* these allow the detection of eventual deformities of the femoral head (figure 1), or acetabular overcoverage (figure 2) [1, 5].
- *CT scan:* useful to evaluate the alignment of the femoral head in relation to the acetabulum and eventual osseous deformities [7, 8].
- *MRI and MRI Arthrogram:* these enable the assessment of the intra-articular condition, detection of labrum and cartilage lesions, as well as subchondral cysts [9, 10, 11, 12, 13].

A direct visual examination of the intra-articular structures is certainly the gold standard for diagnosing FAI-related cartilage or labrum lesions; therefore *diagnostic arthroscopy*, despite being an invasive method, can be considered in athletes with hip pain that significantly compromises performance and could even end their career; however, the high precision level reached by diagnostic imaging has decidedly diminished the role of this approach in diagnostic use [5].

Treatment

A combination of physiotherapy and anti-inflammatory therapy is still the first treatment option to consider, although their efficacy remains debatable. Physiotherapy should be focused on avoiding activities that take the hip through extreme or full ranges of motion in order to avoid conflict (but in this case sporting actions will be restricted), seeking to reach a correct muscle balance, and in some cases even modifying specific sport-related technical movement patterns.

The femoroacetabular impingement syndrome does not respond well to conservative and rehabilitative treatment. Stretching exercises with hip flexion and abduction, often recommended and implemented to increase the range of hip movement in other conditions, are contraindicated in patients with FAI since they can worsen the symptoms. Nevertheless, positive results are achievable, though only in highly motivated patients willing to carry out specific exercises and cease any physical activity that could compromise their recovery.

Choosing the most opportune moment for surgery is still a controversial topic; a delayed surgical correction of the underlying deformation causing femoroacetabular impingement can lead to such a degree of progression that the patient may be unable to regain the desired level of athletic performance [5].

The choice of treatment method is strongly influenced by the level of joint degeneration upon diagnosis.

When advanced cartilage lesions, joint space narrowing, proximal subluxation of the femoral head, etc. are detected along with impingement symptoms, and conservative surgery cannot offer possibility of improvement, prosthetic surgery is the only remaining solution.

If the condition is identified at an early stage, conservative surgical treatment can be attempted to eliminate the causes of the conflict and restore the proper anat-

Figure 3: Open surgery for Cam impingement: bone bump before resection.

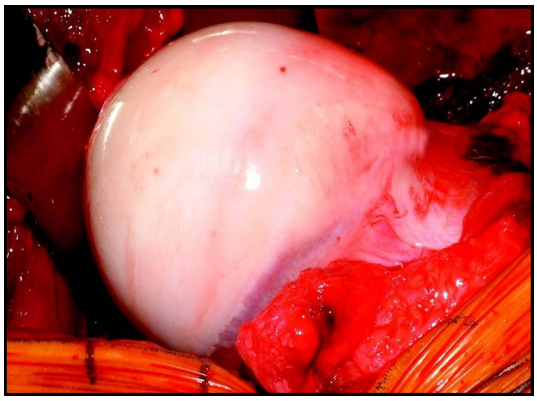


Figure 4: Intra-articular phase of FAI arthroscopy.

omy of the joint. Surgical treatment aims to:

- Recreate a correct femoral head/neck offset, with the removal of the osseous bump at the neck.
- Eliminate the localized or generalized acetabular overcoverage.
- Repair any associated labral lesions and treat, as far as possible, other joint injuries detected.

There are three different surgical approaches for treating FAI:

Open surgery

Ganz et al. were the first to devise a technique with open surgical femur dislocation to treat this type of condition. It involves performing a trochanteric osteotomy though a lateral access with the patient in a lateral decubitus position, seeking to protect the vascularity of the femoral head (figure 3). The femoral head is dislocated from the acetabulum, and it is then possible to proceed with the resection of the abnormality causing the impingement, reshaping of the femoral neck, or acetabular rim trimming. Thanks to this approach, in fact, the anterior acetabular overcoverage can be removed, while preserving the labrum that is initially taken down from the rim, repaired if necessary, and successively reattached to the rim. For acetabular retroversion (Pincer form FAI), the only non-prosthetic surgical option is the Bernese Periacetabular Osteotomy, where the acetabulum is rotated and secured to the pelvis with screws. This approach was developed by Ganz years before the discovery of FAI, and originally used to treat hip dysplasia [7]. This surgical technique produces good or excellent medium-term results in 70-80% of patients [14, 15, 16, 17], but requires a long recovery period; tone recovery in the muscles detached during the surgery can also be difficult, and surgical complications are not negligible. These include heterotopic ossification, sciatic nerve neuropraxia and avascular necrosis of the femoral head. Therefore, periacetabular osteotomy is rarely used in high-level athletes, and considered necessary only for patients with advanced lesions which cannot be treated arthroscopically, or those with complex anatomical abnormalities often associated with the Pincer form FAI [3].

Arthroscopy

Hip arthroscopy is a rapidly evolving orthopedic field. The number of treatable conditions is increasing due to improvements in diagnostic techniques and surgical approaches involving this minimally invasive procedure. The preferred surgical treatment method for FAI in athletes is arthroscopy. Such patients are usually diagnosed at an early stage of the disease, due to the wider knowledge of this condition in the athletic community, as well as the higher frequency of medical check-ups in these subjects, who necessitate a shorter post-operative recovery period. Additionally, the Cam type is more prevalent in athletes, and can be treated with arthroscopy in the majority of cases unlike the Pincer form. Hip arthroscopy allows the decompression of the femoral head-neck junction to restore its correct anatomic concavity, by resection of the excess anterior margin of the acetabulum to a depth of approximately 5-7 mm and a width of approximately 8-12 mm. Small (<3 mm) Pincer type lesions can be treated by osteoplasty of the head-neck junction, while for the larger ones, acetabular rim trimming with labral refixation is required [18]. Arthro-

scopy allows labral repair by reattaching a detached, but still viable labrum with suture anchors, or the removal of any degenerative portions of the tissue; moreover, this method can also be used to assess chondral lesions and to perform chondral shaving or microfracture [5]. Dedicated surgical instruments are needed for both accessing the joint as well as the actual surgical procedure. For example, two different scopes (with 30° and 70° lens angles) are needed to obtain a clear view of the joint. A traction device, an image intensifier and a good quality arthroscopy pump are fundamental. The arthroscopic treatment of femoroacetabular impingement is carried out with the patient in lateral decubitus position and supine position, and consists of two distinct phases: the intra-articular phase and the extra-articular phase. During the intra-articular phase, with the hip placed in traction, two or three ports are used to view and access the intra-articular structures (figure 4), and the typical joint lesions frequently associated with FAI are treated. It is also possible to carry out labral takedown, resection of the excess anterior acetabular margin to reduce retroversion, and refixation of the labrum.The extra-articular surgical phase involves releasing the traction and positioning the hip in various flexion angles. This allows the surgeon to have a good view of the anterior part of the femoral neck and the head-neck junction, where the Cam-type impingement occurs. It is therefore possible to perform an impingement test in direct view by flexion and internal rotation of the hip. The surgery then proceeds with shaping (partial resection) of the femoral head-neck junction, followed by a second intraoperative flexion test to verify the end result. After the initial stage of the arthroscopy, performed with the patient in a lateral position, the subject is moved to a supine position, facilitating the extra-articular phase with hip flexion. A capsulotomy can also be useful to make it easier to maneuver the instruments within the narrow spaces available. It is not always possible to perform or complete FAI arthroscopy due to particular circumstances, such as failure to employ traction, or an excessive surgery duration causing the surgeon to desist from continuing with the procedure [1]. At the end of surgery, regardless of the method used (open or arthroscopy), a dynamic exam consisting of flexion, abduction and internal rotation, is fundamental to ensure that the causes of the conflict have been successfully eliminated. Arthroscopy, when performed by an experienced surgeon, is less invasive, faster (2-3 hours in surgery) and has a lower morbidity rate than open surgery; the risk of neuropraxia or vascular damage can be contained by limiting the time in traction to a maximum of two hours [19]. Due to the minimally invasive nature of arthroscopy, the recovery is less painful and thus more rapid: full recovery of joint function typically requires four to six weeks. Return to high-level athletic activity can also be achieved earlier than following an open surgery, and medium-term results obtained are comparable, if not better, with arthroscopy [20, 21].

Combined surgical approach: arthroscopy and open surgery

Some orthopedic surgeons use a combination of arthroscopy and open surgery to treat femoroacetabular impingement. This approach consists of an arthroscopic phase, during which articular lesions are treated, and an open surgery phase, during which neck osteoplasty is performed via a small anterior incision. Anterior acetabular resection without hip dislocation or distraction results more complex [1].

Conclusions

Femoroacetabular impingement syndrome is a recently defined condition that has become increasingly studied and well-known over the past few years. The prospect of FAI should be considered in the differential diagnosis of any groin pain, especially in athletes who habitually perform sporting actions involving internal rotation of the hip in flexion and under load. Results of a thorough analysis of the patient history and physical examination including impingement and FABER tests can be indicative of this condition, but imaging techniques, in particular the MRI arthrogram, are crucial to confirm the diagnosis as well as to identify eventual FAI -related lesions, especially labrum and cartilage injuries. It is imperative to be able to consider, recognize and diagnose all aspects of FAI. If caught in time, this condition should be treated with conservative surgical techniques, although these are inefficient in subjects with excessive joint degeneration. The tangible results obtained with the latest surgical techniques

are still being evaluated, although the early follow-up results have been encouraging. Open surgery seems increasingly replaceable with arthroscopy when requisites are similar; thus a more efficient and less invasive treatment protocol is now achievable. Arthroscopy is the treatment of choice for FAI, especially in athletes, since it is more likely to guarantee a successful return to competitive sports in addition to offering a faster recovery time and a lower surgical morbidity rate.

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