Professional article **UDC: 616.718.4-007.2-0.53.81**
doi:10.5633/amm.2015.0310

FEMOROACETABULAR IMPINGEMENT AS A RESULT OF MORPHOLOGICAL CHANGES OF THE PROXIMAL PART OF THE FEMUR

Marko Mladenović[1,2], Ivan Micić[1,2], Desimir Mladenović[1,2], Predrag Stojiljković[1], Saša Milenković[1,2], Zoran Anđelković[3]

The proximal part of femur can have morphological changes of osteochondral type, in the form of bone hill–cam type, which can cause femoroacetabular impingement.

The aim of this paper is to point out the morphological changes of the head and neck of femur that can affect the development of degenerative arthrosis of the hip joint in young people.

We report a young female patient with severe clinical signs of femoroacetabular impingement. The removal of the bone deformation of the femur neck in the form of bone hill was done. With this removal we have optimized the joint space and eliminated the painful collision of the femur neck and acetabulum.

Morphological changes of the proximal femur cause early hip arthrosis. They can be found in young people and they should be timely detected and treated surgically. *Acta Medica Medianae 2015;54(3):59-63.*

***Key words**: proximal part of femur, CAM, FAI, surgery*

Clinic of Orthopaedic Surgery and Traumatology, Clinical Centre Niš, Niš, Serbia[1]
University of Niš, Faculty of Medicine, Niš, Serbia[2]
Department of Orthopedic Trauma, Hospital in Leskovac, Leskovac, Serbia[3]

Contact: Marko Mladenović
Dragiše Cvetkovića 21 /1 18 000 Niš
Email: mladenovicdmarko@gmail.com

Introduction

It is of an essential importance to quantify the properties of the proximal femur since it is the part of the hip joint and an integral locomotor component. The head-neck ratio as well as the ratio of proximal diaphysis and femoral neck has been the subject of research and disagreement in the literature since the 19th century.

A well-known parameter for defining the relationship between the diaphysis and femoral neck is a round – diaphyseal angle or neck – shaft angle, which is between 125º to 135°. For the purpose of better and easier understanding of proximal femur changes, several measures have been established to evaluate the relationship between the femoral head and neck, such as: alpha angle (1) and two alpha angle (2) – they determine the concavity of the anterior joint between the femoral head and neck, there are also the offset parameters for defining the translational displacement of the femoral head in relation to the femur neck – the most commonly used is the front offset index (normal value 1±2) and it represents the ratio of the upper and lower offset (3).

There is a possibility of variation in the positioning of the head and neck calotte, which is usually the result of a trauma or congenital diseases - Perthes' disease, epiphysiolysis or other dysplasias (4). With changes like these on the hip, more complex biomechanical displacements of the hip joint elements occur, as well as the development of early arthrosis. The development of femoroacetabular collision occurs (femoroacetabular impingement – FAI) i.e. a painful contact between the morphologically altered femur and the anterior upper edge of the acetabulum. FAI is not a disease per se, but a pathomechanical process which leads to hip joint deterioration (5, 6). This kind of FAI is cam–hill type. There are characteristic morphological changes on the proximal femur in the form of osteochondral bone abnormality of femur head and neck junction, which reduces the space between the front upper edge of the acetabulum and anterolateral femur head and neck junction.

The collision represents a dynamic overload of vulnerable acetabulum sections. Cam-type impingement is caused by the aberrant non-spherical femoral head and voluminous thickening of the femoral neck at the junction with the head, that is,

the bone hill violates the concavity of head-neck juncture converting it into a flat or convex structure. Abnormal shear forces are transferred to the antero-superior part of the acetabulum in the extreme range of flexion and internal rotation. These abnormal shear forces result in cascade chondrolabral degeneration of the acetabulum, and also lead to degeneration of cartilage of the non-spherical part of the femoral head. Cam-type impingement explains why is non-spherical femoral head associated with the growing incidence of osteoarthritis and is now identified as pre-osteoarthritic pathomorphology. Patients with cam–type FAI show intraoperative variety of damage levels within the acetabulum, however, the maximum of sheer force is in flexion and internal rotation, which is why the place of the most extensive damage is antero-superior quadrant of the acetabulum (7).

The aim of this paper is to point out the morphological changes of the head and neck of the femur that may affect the development of early hip joint arthrosis and the possibility of surgical treatment.

Case report

The patient M.S. aged 23, reported pain in her right hip and limping while walking. A clinical examination detected limited hip movements: 80º of flexion, internal rotation of 15º, 40º external rotation, abduction 40°, adduction 10º. Impingement test (6) was positive in the range of flexion of the hip joint from 40º to 80º. Clinical findings graded by the Western Ontario and McMaster Osteoarthritis Index Univesities (WOMAC) were 76 (8).

The alpha angle on the anteroposterior (AP) radiograph images of the hips on the right hip was 56°, and on the healthy, left hip 46º (normal value <51°). Two alpha angle on the right hip was 112º and 83º on the left (normal value <83°). On lateral Dunn - Rippstein - Mueller image, the right hip alpha angle was 72º and 41º on the healthy hip (normal value <46°). In this position, two alpha

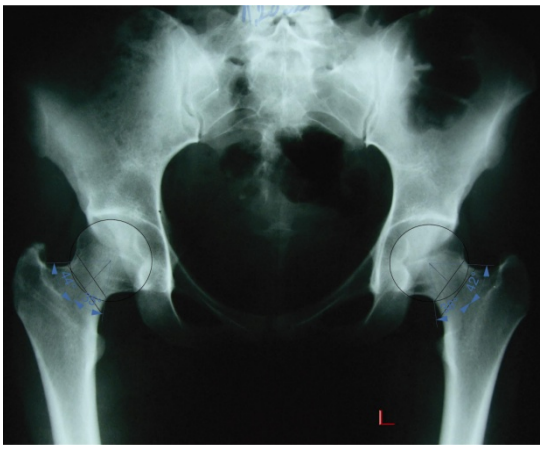
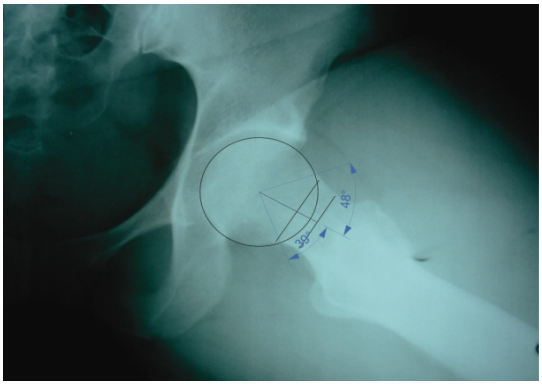

a

Figure 1. a, b Alpha angle on radiographs in AP and Dunn 90 positions


b

angle on the right hip was 98º, and on the left hip was 74º (normal value <73°). On the AP radiographs of the hips, front offset index on the right hip was 1.13 and on the healthy hip was 1.01.

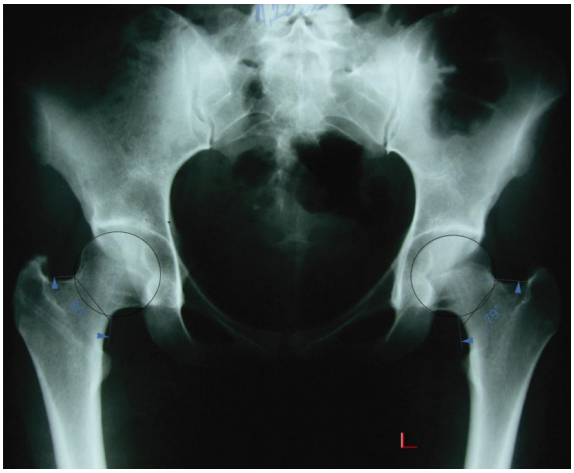
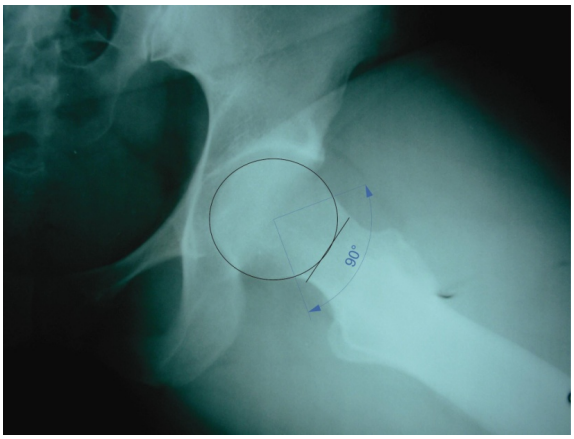

a

Figure 2. a, b Two alpha angle on radiographs in AP and Dunn 90 positions


b

With radiological images the existence of a hilly thickening of femur neck was detected. (Figure 1a, b and 2a, b).

The method of treatment included surgery - trochanter "flip" osteotomy, i.e. longitudinal osteotomy of the trochanter (9, 10). With a spinal anesthesia in lateral position, the patient underwent a lateral approach to the hip joint with osteotomy of the greater trochanter. After the preparation of

muscles and exploration of the capsule, ''Z'' capsulotomy and dislocation of the hip joint were performed. After that, morphological abnormality of the head and neck of femur was verified – a hill-shaped deformation (CAM) which had caused the destruction of the labrum and acetabular cartilage. Afterwards, osteotomy bone upgrades to 30% of the neck thickness were performed (11) as well as the repositioning of the hip joint. Then, the capsule reinsertion was done and trochanter fixation with two screws (Figure 3).

Six months after the surgery, limping on the right leg and pain in inguinal and trochanteric region disappeared. The movements of the hip were: 95º of flexion, internal rotation of 25º, and other movements within the normal range, and WOMAC score was 96.

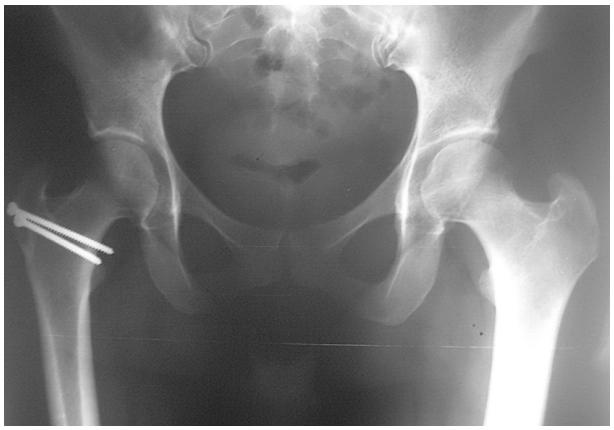


Figure 3. Radiological image of the operated hip with FAI

On the AP image alpha angle was 52º, two alpha angle was 87°, and the front offset index was 1.02. On lateral Dunn - Rippstein - Mueller image alpha angle was 49º and two alpha angle was 78º, indicating a significant improvement. The place of trochanteric osteotomy was healed, femur head was free of bone cysts and with no signs of the development of avascular necrosis.

Discussion

As the interest in the problem of femoroacetabular impingement grows, the number of published papers on etiology, clinical and radiological researches as well as surgical treatment also grows. So, in 2004, 10 papers were published, in 2007, there were 44 published papers, and this number continues to grow today (12). This paper represents an initiative to devote more attention to this disease in our country in the future.

The proximal femur part may have variations and modifications i.e. abnormalities at the neck and head junction as far as both hill type and head sliding type are concerned; it is the so-called silent epiphysiolysis, which appears asymptomatic at an early age. This kind of slippage occurs in the sagittal plane and therefore does not register on the AP hip image. The femur head and neck contour in radiographic image may be designated as indicators of the origin of femoroacetabular impigement (1). The non-spherical femoral head, visible in AP radiographic image, is described as a "pistol grip" (grip of a pistol) (13). This change has for years been associated with the development of idiopathic osteoarthritis of the hip (14). Epiphysiolysis of the femur was designated as the reason for the emergence of "pistol grip" deformity, i.e. the secondary arthrosis of the hip (13, 15, 16).

These changes are an etiological factor for the development of secondary osteoarthritis of the hip, especially among young people. Protruding part of the neck slides under the anterior acetabulum and puts pressure on the labrum which possesses the proprioceptive and nociceptive nerve fibrils and emits a sharp pain. Labrum represents a "sensible" shock absorber of the hip and thus simulates knee meniscus (17). In chronic forms of FAI there is a damage to the cartilage and labrum in front of the upper quadrant of the acetabulum, in the region of 10 to 17 hours - according to the system of clock dials, and this gives rise to degenerative arthrosis of the hip. First occurs the spreading of labrum and cartilage junction, then tearing and crushing of the labrum as well as its separation from the edge of acetabulum, followed by the damage to the subchondral bone, eventually leading to cartilage defect and disappearance – the process of osteoarthritis of the hip joint occurs (4, 5).

The treatment of these morphological changes is in the form of surgical resection of the bone hill and the part of femoral neck. The surgical technique involves an anterior dislocation of the hip, which protects the blood vessels of the neck and femoral head, and provides the opportunity to display intra-articular changes (9, 18). This procedure prevents the occurrence of early aseptic necrosis of the femoral head.

The extent of neck dissection is up to 30% of its diameter (11). The improvement of clinical signs and function of the hip joint after FAI treatment was confirmed by other authors as well (7, 19, 20). Our clinical results in the presented patient are approximately the same as in the above mentioned authors, with an improvement in WOMAC score of 96, which manifests in the absence of the hip joint pain, limping and full motion range of the hip.

Conclusion

Morphological modifications of the proximal femur part are present and should be searched for in everyday orthopedic practice. They should be treated surgically with the aim of preventing the early hip joint osteoarthrosis in young persons, which prevents the insertion of hip endoprosthesis implant.

References

1. Notzli HP, Wyss TF, Stoecklin CH, Schmid MR, Treiber K, Hodler J. The contour of the femoral head - neck junction as a predictor for the risk of anterior impingement. J Bone Joint Surg Br 2002; 84: 556-560. [CrossRef] [PubMed]
2. Anđelković Z, Mladenović D. Merenje osteohondralnog spoja glave i vrata femura kod bolesnika sa femoro acetabularnim impingement-om određivanjem ugla dva alfa na lateralnim i anteroposteriornim radiografskim snimcima kuka.Vojnosanit Pregl 2013; 70: 259-266.
3. Ito K,Minka MAII,Leuning M,Werlen S,Ganz R. Femoro-acetabular impingement and the cam-effect: A MRI-based quantitative anatomical study of the femoral head neck offset. J Bone Joint Surg Br 2001; 83: 171-176. [CrossRef] [PubMed]
4. Wagner S, Hofstetter W, Chiquet M et al. Early osteoarthritic changes of human femoral head cartilage subsebsequent to femoro - acetabular impigement. Osteoarthritis cartilage 2003; 11: 508-518. [CrossRef] [PubMed]
5. Beck M, Kalhor M, Leuning M, Ganz R. Hip morhology influences the pattern of damage to the acetabular cartilage: femoro - acetabular impingement as a cause of early osteoarthritis of the hip. J Bone Joint Surg Br 2005; 87: 1012-1018. [CrossRef] [PubMed]
6. Ganz R, Parvizi J, Beck M, Leunig M, Notzli H, Siebenrock KA. Femoroacetabular impingement:a cause for osteoerthritis of the hip.Clin Orthop Relat Res 2003; 413: 112-120. [PubMed]
7. Espinosa N, Rothenfluh DA, Beck M, Ganz R, Launig M. Treatment of femoro - acetabular impingement: preliminary results of labral refixation. J Bone Joint Surg Am 2006; 88: 925-935. [CrossRef] [PubMed]
8. Bellamy N, Buchanan WW, GoldsmithCH, Campbell J, Stitt JW. Validation study of WOMAC: a health status instrument for measuring clinically - important patient - relevant outgomes following total hip or knee arthroplasty in osteoarthritis. J Ortop Rheumatol 1988; 1: 95-108.
9. Ganz R, Gill TJ, Gautier E, Ganz K, Krugel K, Berlemann U.Surgical dislocation of the adult hip. A technique with full access to the femoral head acetabulum a without the risk of avascular necrosis.J Bone Joint Surg Br 2001; 83: 1119- 1124. [CrossRef] [PubMed]
10. Gautier E, Ganz K, Krugel N, Gill T, Ganz R. Anatomy of the medial femoral circumflex artery and its surgical imlications. J Bone Joint Surg Br 2000; 82: 679-683. [CrossRef] [PubMed]
11. Mardones MR, Gonzales C, Chen Q, Zobitz M, Kaufman KR. Surgical treatment of femoroacetabular impingement: evaluation of the effect of the size of the resection. J Bone Joint Surg Am 2005; 87: 273-278. [CrossRef] [PubMed]
12. Leunig M, Beaule P, Ganz R. The concept of Femoroacetabular Impingement. Current Status and Future Perspectives. Clin Orthop Relat Res 2009; 467: 616-622. [CrossRef] [PubMed]
13. Stulberg SD, Cordell LD, Harris WH, et al. Unrecognized childhood hip dasease:a major cause of idiopathic osteoarthritis of the hip. The hip. Proceedings of the third open scientific meeting of the hipsociety. St. Louis: C.V. Mosby; 1975: 2112-228.
14. Harris WH. Etiology of osteoarthritis of the hip. Clin Orthop Relat Res 1986; 213: 20-33. [CrossRef] [PubMed]
15. Murray RO. The etiology of primary osteoarthritis of the hip. Br J Radiol 1965;38: 810-824. [CrossRef] [PubMed]
16. Solomon L. Patterns of osteoarthritis of the hip. J Bone Joint Surg Br 1976; 52: 176-183. [PubMed]
17. Kim YT, Azuma H. The nerve endiks of the acetabular labrum. Clin Orthop 1995; 320:176-181. [PubMed]
18. Lavigne M, Parvizi J, Beck M, Siebenrock KA, Ganz R, Leunig M. Anterior femoroacetabular impingement: Part I. Techniques of joint preserving surgery. Clin Orthop Relat Res 2004; 418: 61–66. [CrossRef] [PubMed]
19. Peters CL, Erickson JA. Treatment of femoro - acetabular impingement with surgical dislocation and debridement in young adults. J Bone Joint Surg Am 2006; 88: 1735-1741. [CrossRef] [PubMed]
20. Beck M, Leuning M, Parvizi J, Boutier V, Wyss D, Ganz R. Anterior femoro - acetabular impigement: Part II.Midterm results of surgical treatment. Clin Orthop Relat Res 2004; 418: 67-73. [CrossRef] [PubMed]

FEMORO-ACETABULARNI SUDAR KAO POSLEDICA MORFOLOŠKIH PROMENA PROKSIMALNOG DELA FEMURA

Marko Mladenović[1,2], Ivan Micić[1,2], Desimir Mladenović[1,2], Predrag Stojiljković[1], Saša Milenković[1,2], Zoran Anđelković[3]

Ortopedsko-traumatološka klinika, Klinički centar Niš, Srbija[1]
Univerzitet u Nišu, Medicinski fakultet, Niš, Srbija[2]
Odeljenje za ortopediju i traumatologiju, Bolnica u Leskovcu, Srbija[3]

Kontakt: Marko Mladenović,
Dragiše Cvetkovića 21/1
18000 Niš, Srbija
mail: mladenovicdmarko@gmail.com

Proksimalni deo femura može imati morfološke promene osteohondralnog tipa u vidu koštanog brežuljka – CAM tip, koje uzrokuju femoroacetabularni impingement.

Cilj rada bio je da se ukaže na morfološke promene vrata i glave femura koje mogu uticati na razvoj artroze zgloba kuka kod mladih.

Prikazujemo mladu bolesnicu sa izraženim kliničkim znacima femoro-acetabularnog impingementa. Urađeno je uklanjanje koštane deformacije vrata femura koja je imala formu koštanog brežuljka. Njegovim uklanjanjem optimizovan je zglobni prostor i uklonjen bolni sudar vrata femura i acetabuluma.

Morfološke promene proksimalnog okrajka femura izazivaju ranu artrozu kuka, sreću se kod mladih i treba ih na vreme otkriti i hirurški lečiti. *Acta Medica Medianae 2015; 54(3):59-63.*

***Ključne reči**: proksimalni okrajak femura, CAM, FAI, operacija*