ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 11| Issue: 2| February 2025|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2025: 8.691 || ISI Value: 1.188

OSTEONECROSIS OF FEMORAL HEAD SCOPING REVIEW

Andre Sebastian Valenzuela Torres[1], Andrea Carolina Espinoza Fernández[2], Priscila Lorena Morales Castillo[3], María Pauleth Valarezo Muñoz[4], Fernando Sebastián Pérez Páez[5], Marcos Antonio Sánchez Macías[6], Arianna Liceth Mero Zambrano[7], José Andrés Trelles Guarnizo[8], John Carlos Chona Serrano[9], Bryam Esteban Coello García[10]

[1]General Practitioner at "Hospital De Especialidades Eugenio Espejo", Faculty of Medical Sciences, Universidad De Las Américas. Ecuador ORCID https://orcid.org/0009-0004-6723-9646
[2]General Practitioner at "Universidad Técnica de Machala", faculty of Medical Sciences, Universidad Católica de Cuenca . Ecuador ORCID https://orcid.org/0000-0001-6642-6256
[3]General Practitioner in Independent Practice, Faculty of Medical Sciences, Escuela Superior Politécnica de Chimborazo . Ecuador ORCID https://orcid.org/0009-0003-3039-571X
[4]Master in Occupational Health and Safety at "Centro de Salud tipo C Velasco Ibarra -Distrito de Salud 07D02", Faculty of Medical Sciences, Universidad de Guayaquil / Universidad de Especialidades Espíritu Santo. Ecuador ORCID https://orcid.org/0009-0009-6561-5421
[5]General practitioner in independent practice, faculty of Medical Sciences, Universidad de las Américas. Ecuador ORCID https://orcid.org/0009-0009-6442-7680
[6]General Practitioner at "Hospital General Guasmo Sur", faculty of Medical Sciences, Universidad Católica de Santiago de Guayaquil. Ecuador ORCID https://orcid.org/0009-0009-3317-6866
[7]General Practitioner at "CS Honorato Vásquez", faculty of Medical Sciences, Universidad Central del Ecuador. Santa Ana-Manabí-Ecuador ORCID https://orcid.org/0000-0002-0691-0975
[8]General Practitioner in independent practice, faculty of Medical Sciences, Universidad Técnica Particular de Loja. Ecuador ORCID https://orcid.org/0000-0001-6767-6847
[9]General Practitioner at "Hospital Regional Valle de Tenza", faculty of Medical Sciences, Fundación universitária Sanitas. Colombia ORCID https://orcid.org/0009-0000-0289-6064
[10]Postgraduate Doctor in Orthopedics and Traumatology at Faculdade de Ciências Médicas Minas Gerais. Belo Horizonte - Brasil. ORCID https://orcid.org/0000-0003-2497-0274
Corresponding Author: *Bryam Esteban Coello García* ***Address****: Rua Teresópolis 183. Belo Horizonte. Minas Gerais. Brasil.* ***Postal Code****: 31130050*

Article DOI: https://doi.org/10.36713/epra20136
DOI No: 10.36713/epra20136

SUMMARY

Introduction: *Osteonecrosis of the femoral head is a progressive and debilitating pathology with several causative factors. Around 1830, Jean Cruveilhier, a French anatomist and pathologist, described femoral head necrosis as a late complication of hip trauma. He suggested that the cause of necrosis was vascular injury. This condition was known as avascular necrosis, ischemic necrosis or aseptic necrosis of the femoral head.*
Objective: *to detail important information related to the epidemiology, pathogenesis, diagnosis, classification and treatment of osteonecrosis of the femoral head.*
Methodology: *a total of 32 articles were analyzed in this review, including review and original articles, as well as clinical cases, of which 22 bibliographies were used because the other articles were not relevant to this study. The sources of information were PubMed, Google Scholar and Cochrane; the terms used to search for information in Spanish, Portuguese and English were: osteonecrosis femoral head, avascular necrosis, ischemic necrosis, hip trauma.*
Results: *Osteonecrosis of the femoral head (ONFH) mainly affects young adults between 20 and 40 years of age, with an estimated incidence of 20,000 to 30,000 cases per year in the United States. Its pathogenesis is related to altered blood flow to the bone, which*

ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 11| Issue: 2| February 2025|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2025: 8.691 || ISI Value: 1.188

generates an imbalance between bone formation and resorption, resulting in a structurally weak area. Early diagnosis can be complicated, as the disease is often asymptomatic in its early stages, with MRI being the most effective tool for early identification. Treatment varies according to the stage of the disease and ranges from pharmacological options to surgical interventions such as central decompression, bone grafting and arthroplasty, the latter being the only definitive cure. However, hip arthroplasty is not a permanent solution, and young patients may need revision later in life, highlighting the importance of close follow-up.
Conclusions: *Osteonecrosis of the femoral head affects mainly young adults and is caused by compromised blood flow to the bone, resulting in an imbalance between bone formation and resorption. Although early diagnosis can be complicated, MRI is key to detecting early signs. Although pharmacological treatments have been tried, their efficacy has not been consistently demonstrated, and surgical options, such as hip arthroplasty, are the only definitive cure, although not permanent, which implies the need for close follow-up, especially in young patients who may require future surgeries.*
KEY WORDS*: Osteonecrosis, Femur, Necrosis, Avascular.*

INTRODUCTION

Around 1830, Jean Cruveilhier, a French anatomist and pathologist, described necrosis of the femoral head as a late complication of hip trauma. He suggested that the cause of necrosis was vascular injury. This condition was known as avascular necrosis, ischemic necrosis or aseptic necrosis of the femoral head. In 1992, the Nomenclature and Staging Committee of the Association for Research on Bone Circulation (ARCO) decided to adopt the term "osteonecrosis" as a uniform designation for necrotic lesions of the femoral head.

Osteonecrosis of the femoral head is a progressive and debilitating pathology with several causative factors, such as trauma, steroid use and excessive alcohol consumption. Diagnosis and classification are made by means of imaging studies, such as magnetic resonance imaging at any stage, and plain radiography in more advanced cases. At the moment the only definitive treatment is total hip arthroplasty, however, there are various approaches, such as dysphosphonates and central decompression, to slow the progression of the disease(1-3).

METHODOLOGY

A total of 32 articles were analyzed in this review, including review and original articles, as well as clinical cases, of which 22 bibliographies were used because the other articles were not relevant to this study. The sources of information were PubMed, Google Scholar and Cochrane; the terms used to search for information in Spanish, Portuguese and English were: osteonecrosis femoral head, avascular necrosis, ischemic necrosis, hip trauma.

The choice of bibliography exposes elements related to femoral head osteonecrosis, epidemiology, pathogenesis, diagnosis, classification, treatment.

DEVELOPMENT

Epidemiology

The incidence of osteonecrosis in the United States has been estimated to range from 20,000 to 30,000 cases annually, primarily affecting young adults between the ages of 20 and 40 years. A recent study revealed that although the number of hip arthroplasties performed due to osteonecrosis increased between 2001 and 2010 (from 54.2 per 100,000 hospital admissions to 60.6 per 100,000 hospital admissions), the percentage of these surgeries related to osteonecrosis decreased from 9.7% to 8.3%. This is probably due to the rapid growth of osteoarthritis, which also requires hip arthroplasties(4,5).

Pathogenesis

In terms of pathogenesis, osteonecrosis occurs due to damage to blood flow or oxygen supply to the bone, although the clinical manifestation results more from the repair process than from initial ischemia. In osteonecrosis, bone generation by osteoblasts fails to balance with bone resorption by osteoclasts. This imbalance in remodeling fails to adequately replace necrotic bone, leaving a structurally weakened area of bone tissue.

ONFH has a multifactorial cause, encompassing genetic factors and exposure to various risk conditions, such as trauma, glucocorticoids, alcohol, hyperlipidemia, systemic lupus erythematosus, sickle cell disease, decompression sickness, acute lymphoblastic leukemia, organ transplantation, and HIV. In addition, osteonecrosis of atraumatic and idiopathic origin has been observed. The size and location of necrosis are the main predictors of femoral head collapse and should therefore be the determining factors in the management of patients with ONFH. The extent of necrosis is established during the first ischemic episode, and lesion size remains constant over time. Small lesions do not progress, even without treatment, and do not require intervention.

Diagnosis

The initial stages of osteonecrosis of the femoral head are usually asymptomatic, although in several cases it may present with pain radiating to the hip or groin and limitation in the range of motion of the joint on physical examination. The diagnosis of osteonecrosis is based primarily on imaging studies, although clinical examination and medical history are essential to obtain information about the context and possible cause. Plain radiography is a suitable initial tool to identify cases of osteonecrosis, with advantages such as low cost, wide availability and sufficient sensitivity for intermediate and advanced stages of the disease. Frontal and lateral "frog-leg" views are suggested for accuracy. In the early stages of disease, radiography may not be sufficient to detect subtle or early changes. Magnetic resonance imaging (MRI) is the gold standard technique for diagnosing osteonecrosis because of its high sensitivity for identifying early signs. Adjunctive imaging, such as diffusion-weighted MRI and gadolinium perfusion MRI, can further enhance the diagnostic capability of MRI. Perfusion MRI is useful in differentiating between

ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 11| Issue: 2| February 2025|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2025: 8.691 || ISI Value: 1.188

radiographically and symptomatically similar conditions, such as bone marrow edema and subchondral insufficiency fractures. In pediatric individuals with developmental dysplasia of the hip, perfusion MRI has been effective in identifying those at increased risk for osteonecrosis following closed reduction or herringbone casting. In addition, whole-body bone scintigraphy represents an option for individuals at risk for multifocal osteonecrosis, such as those receiving systemic corticosteroids or immunosuppressants(2,6-8).

Differential Diagnosis

- Bone Marrow Edema Syndrome.
- Neoplasm.
- Subchondral Insufficiency Fracture.

Classification

The most commonly used classification system for osteonecrosis of the femoral head is that of Ficat and Arlet, which classifies affected individuals with osteonecrosis into stages 0 to 4, according to the appearance observed on plain radiography.

Table 1. Ficat and Arlet classification system.

Stage	Features
0	Normal radiographs (silent hip)
I	Inconspicious abnormality orminor osteopenia changes
II	Sclerotic or cystic lesions
	II a. Focal radiological changes
	II b. Crescent sign without flattening of the femoral head
III	Flattening of the femoral head or femoral head collapse, joint space normal
IV	Femoral head collapse and osteoarthritis of the hip (joint spacecollapse, acetabular changes)

Source: Guo P, Gao F, Wang Y, Zhang Z, Sun W, Jiang B, et al. The use of anticoagulants for prevention and treatment of osteonecrosis of the femoral head(9).

Although the Ficat and Arlet classification is simple to apply from a practical approach, it does not accurately reflect the actual degree of femoral head involvement at each stage. For this reason, some authors suggest quantitative classifications. Currently, three classification systems are also commonly used: the Steinberg classification, the Japanese Investigation Committee (JIC) classification and the modified Kerboul classification(10,11).

Treatment

So far, several drugs, including enoxaparin, statins, bisphosphonates, iloprost and acetylsalicylic acid, have been tested with the aim of slowing or reversing the progression of the disease. However, none have been shown to be effective according to high-level evidence, and most of them are associated with adverse effects. Drugs have been a key component in the treatment of osteonecrosis, although their efficacy has recently been called into question. Bisphosphonates, which are a frequent choice for pharmacological treatment, act by inhibiting osteoclast activity. However, studies on the use of bisphosphonates have reported mixed results(12-15).

Central Decompression (CD) with Bone Marrow Aspirate Concentration (BMAC).

Central decompression (CD) has been employed in the early (pre-collapse) stages of osteonecrosis of the femoral head (ONFH), under the assumption that it prevents femoral head collapse and, ideally, slows disease progression. However, the results of CD have been variable and its effectiveness has been questioned. Recently, BMAC injection has been combined with traditional DC to improve outcomes. DC is performed in osteonecrosis of the femoral head with the aim of decreasing intraosseous pressure and promoting increased blood flow as well as bone formation. Ficat, in his early descriptions of osteonecrosis and the DC procedure, noted an increase in intramedullary pressures, which are released by DC, helping to relieve pain and restore blood flow if the lesion is treated in its early stages(16,17).

Vascularized and Non-Vascularized Bone Grafting

Non-vascularized bone grafting consists of placing bone graft material to provide structural support with the purpose of decreasing intraosseous pressure and preventing collapse in the early stages of osteonecrosis. On the other hand, vascularized bone grafting (VBG) aims to provide increased blood supply. This graft is performed by placing a non-vascularized cortical allograft from the ileum, tibia or fibula, or a vascularized graft

ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 11| Issue: 2| February 2025|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2025: 8.691 || ISI Value: 1.188

from the iliac crest, fibula or greater trochanter, in a central space created for the procedure or during a central decompression (CD). Non-vascularized bone grafting has shown moderate success, especially in smaller lesions, with a success rate ranging from 55% to 87%, according to studies with follow-up of 2 to 9 years(18,19).

Osteotomies

Several osteotomies of the proximal femur have been performed in order to preserve hips affected by osteonecrosis. These procedures relocate the necrotic portion of the weight-bearing dome to a non-load bearing area. The goal of osteotomy is to slow the progression of osteonecrosis by reducing the weight bearing on the necrotic or pre-necrotic areas to prevent collapse.

Resurfacing Arthroplasty

Total resurfacing and hemi-resurfacing arthroplasties were once considered as options for preserving bone in total hip arthroplasty in young patients with ONFH. However, hemi-resurfacing has been discontinued, and total resurfacing is infrequently performed due to complications associated with metal-to-metal bearing and the risk of periprosthetic femoral neck fracture(20,21).

Total joint arthroplasty

Hip arthroplasty is currently the only definitive option for treating osteonecrosis; however, the potential disadvantages must be carefully evaluated. Total hip arthroplasties do not offer a permanent solution and, although they may be useful in the early stages for older patients by reducing cumulative procedures, most patients with osteonecrosis are relatively young. In these cases, if the joint is replaced at the time of diagnosis, the patient is likely to require a new arthroplasty or revision in the future. Of note, a study of patients with osteonecrosis who required hip arthroplasty revealed that 46.6% of patients would subsequently require contralateral hip arthroplasty, especially if the contralateral hip showed radiographic signs of osteonecrosis at the time of the first procedure, highlighting the importance of consistent follow-up(2,22).

CONCLUSIONS

Osteonecrosis of the femoral head affects mainly young adults and is caused by compromised blood flow to the bone, resulting in an imbalance between bone formation and resorption. Although early diagnosis can be complicated, MRI is key to detecting early signs. Although pharmacological treatments have been tried, their efficacy has not been consistently demonstrated, and surgical options, such as hip arthroplasty, are the only definitive cure, although not permanent, implying the need for close follow-up, especially in young patients who may require future surgeries.

BIBLIOGRAPHY

1. *Dubois EL. Avascular (Aseptic) Bone Necrosis Associated with Systemic Lupus Erythematosus. JAMA. 1960 Oct 22;174(8):966.*
2. *George G, Lane JM. Osteonecrosis of the Femoral Head. JAAOS Glob Res Rev [Internet]. 2022 May [cited 2025 Feb 5];6(5). Available from: https://journals.lww.com/10.5435/JAAOSGlobal-D-21-00176*
3. *Hines JT, Jo WL, Cui Q, Mont MA, Koo KH, Cheng EY, et al. Osteonecrosis of the Femoral Head: an Updated Review of ARCO on Pathogenesis, Staging and Treatment. J Korean Med Sci. 2021;36(24):e177.*
4. *Mayers W, Schwartz B, Schwartz A, Moretti V, Goldstein W, Shah R. National trends and in hospital outcomes for total hip arthroplasty in avascular necrosis in the United States. Int Orthop. 2016 Sep;40(9):1787–92.*
5. *Desforges JF, Mankin HJ. Nontraumatic Necrosis of Bone (Osteonecrosis). N Engl J Med. 1992 May 28;326(22):1473–9.*
6. *Gornitzky AL, Georgiadis AG, Seeley MA, Horn DB, Sankar WN. Does Perfusion MRI After Closed Reduction of Developmental Dysplasia of the Hip Reduce the Incidence of Avascular Necrosis? Clin Orthop. 2016 May;474(5):1153–65.*
7. *Choi HR, Steinberg ME, Y. Cheng E. Osteonecrosis of the femoral head: diagnosis and classification systems. Curr Rev Musculoskelet Med. 2015 Sep;8(3):210–20.*
8. *Manenti G. The role of imaging in diagnosis and management of femoral head avascular necrosis. Clin Cases Miner Bone Metab [Internet]. 2015 [cited 2025 Feb 6]; Available from: http://www.ccmbm.com/common/php/portiere.php?ID=a076d5f59993f8ac0608586f82b86351*
9. *Guo P, Gao F, Wang Y, Zhang Z, Sun W, Jiang B, et al. The use of anticoagulants for prevention and treatment of osteonecrosis of the femoral head: A systematic review. Medicine (Baltimore). 2017 Apr;96(16):e6646.*
10. *Jawad MU, Haleem AA, Scully SP. In Brief: Ficat Classification: Avascular Necrosis of the Femoral Head. Clin Orthop. 2012 Sep;470(9):2636–9.*
11. *Steinberg DR, Steinberg ME. The University of Pennsylvania Classification of Osteonecrosis. In: Koo KH, Mont MA, Jones LC, editors. Osteonecrosis [Internet]. Berlin, Heidelberg: Springer Berlin Heidelberg; 2014 [cited 2025 Feb 6]. p. 201–6. Available from: https://link.springer.com/10.1007/978-3-642-35767-1_25*
12. *Ajmal M, Matas AJ, Kuskowski M, Cheng EY. Does Statin Usage Reduce the Risk of Corticosteroid-Related Osteonecrosis in Renal Transplant Population? Orthop Clin North Am. 2009 Apr;40(2):235–9.*
13. *Mont MA, Cherian JJ, Sierra RJ, Jones LC, Lieberman JR. Nontraumatic Osteonecrosis of the Femoral Head: Where Do We Stand Today?: A Ten-Year Update. J Bone Jt Surg. 2015 Oct 7;97(19):1604–27.*
14. *Lee YJ, Cui Q, Koo KH. Is There a Role of Pharmacological Treatments in the Prevention or Treatment of Osteonecrosis of the Femoral Head?: A Systematic Review. J Bone Metab. 2019;26(1):13.*
15. *Pritchett JW. Statin Therapy Decreases the Risk of Osteonecrosis in Patients Receiving Steroids: Clin Orthop. 2001 May;386:173–8.*
16. *Yoon BH, Lee YK, Kim KC, Ha YC, Koo KH. No differences in the efficacy among various core decompression modalities and non-operative treatment: a network meta-analysis. Int Orthop. 2018 Dec;42(12):2737–43.*

17. *Ficat R. Idiopathic bone necrosis of the femoral head. Early diagnosis and treatment. J Bone Joint Surg Br. 1985 Jan;67-B(1):3–9.*
18. *Pierce TP, Elmallah RK, Jauregui JJ, Poola S, Mont MA, Delanois RE. A current review of non-vascularized bone grafting in osteonecrosis of the femoral head. Curr Rev Musculoskelet Med. 2015 Sep;8(3):240–5.*
19. *Millikan PD, Karas V, Wellman SS. Treatment of osteonecrosis of the femoral head with vascularized bone grafting. Curr Rev Musculoskelet Med. 2015 Sep;8(3):252–9.*
20. *Zustin J, Sauter G, Morlock MM, Rüther W, Amling M. Association of Osteonecrosis and Failure of Hip Resurfacing Arthroplasty. Clin Orthop. 2010 Mar;468(3):756–61.*
21. *De Smet KA, Van Der Straeten C, Van Orsouw M, Doubi R, Backers K, Grammatopoulos G. Revisions of Metal-on-Metal Hip Resurfacing: Lessons Learned and Improved Outcome. Orthop Clin North Am. 2011 Apr;42(2):259–69.*
22. *Goker B, Block JA. Risk of contralateral avascular necrosis (AVN) after total hip arthroplasty (THA) for non-traumatic AVN. Rheumatol Int. 2006 Jan;26(3):215–9.*

Conflict of Interest Statement
The authors report no conflicts of interest.

Funding
The authors report no funding by any organization or company.