Hip replacement in femoral head osteonecrosis: current concepts

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Summary

Osteonecrosis of the femoral head is a destructive disease that usually affects young adults with high functional demands and can have devastating effects on hip joint. The treatment depends on extent and location of the necrosis lesion and on patient's factors, that suggest disease progression, collapse probability and also implants survival. Non-idiopathic osteonecrosis patients had the worst outcome. There is not a gold standard treatment and frequently it is necessary a multidisciplinary approach. Preservation procedures of the femoral head are the first choice and can be attempted in younger patients without head collapse. Replacement procedure remains the main treatment after failure of preserving procedures and in the late-stage ONFH, involving collapse of the femoral head and degenerative changes to the acetabulum. Resurfacing procedure still has good results but the patient selection is a critical factor. Total hip arthroplasties had historically poor results in patients with osteonecrosis. More recently, reports have shown excellent results, but implant longevity and following revisions are still outstanding problems.

KEY WORDS: femur head necrosis; osteonecrosis; arthroplasty; replacement; hip.

Introduction

The etiology of Avascular Necrosis of the Femoral Head (ONFH) is multifactorial unclear and partly unknown but this pathologic entity is the final common pathway of traumatic or non-traumatic factors that compromise and at last interrupt the particular circulation of the femoral head. Many risk factors have been identified, but none of them is a certain cause. The estimated frequency of the most frequent risk factors for ONFH in the United States is: alcohol (20-40%), corticosteroid therapy (35-40%), and idiopathic (20-40%) (1). It is estimated that 20,000 to 30,000 new patients are diagnosed with osteonecrosis annually accounting for approximately 10% of the 250,000 Total Hip Arthroplasties (THA) done annually in the United States (2). The vascular impairment leads to the death of marrow and osteocytes and, in the late stages, to the bony structure alteration and the collapse of the necrotic segment with consequent degenerative joint alteration. It may go clinically unrecognized and can lead to progressive hip pain until total loss of function. Spontaneous regression is rare, with the vast majority of untreated patients progressing to THA and a collapse rate of 67% in asymptomatic patients and 85% of symptomatic hips (3). Treatment options include pharmacologic agents, biophysical treatments, and surgical treatments. These last ones can be divided into Femoral Head Sparing Procedures (FHSP) preferred in pre-collapse stages and femoral Head Replacement Procedures (FHRP) preferred in post-collapse symptomatic stages. It's difficult to identify the limits of the saving procedures and determine the best treatment.

Patient assessment and classification

Many Authors suggested a treatment based on patient age, symptoms, stage, comorbidities, but there is not an uniform treatment algorithm yet. It's difficult to identify optimal treatment protocols due to the lack of level 1 evidence in literature.

Several systems have been developed to stage and classify ONFH providing information on prognosis, treatment decision, and outcome comparison. However, it's difficult to compare and analyze the data from different centers leaking a universally accepted classification. 16 major classification systems were identified. Only 4 account for greater than 85.4% of the reported studies: the Ficat Classification is the most frequently used system (63%), followed by the University of Pennsylvania system (20%), the Association Research Circulation Osseous (ARCO) system (12%), and the Japanese Orthopaedic Association system (5%) (4).

The extent of the necrosis and the location of the lesion are generally considered the principal factors in determining the risk of collapse (5). Most of the classification systems consider one or both factors. Lesion size has a relationship to outcome, small lesions have a low rate of progression, whereas larger ones have worst prognosis. In 1974 Kerboul et al. (6) proposed a method to estimate the extent of the necrosis by adding the two angles of the arc of the surface involved, measured in antero-posterior and lateral radiographs. Even if it can be a predictor of femoral head collapse, especially in lesions larger than 200°, this method may not be accurate to evaluate the true three-dimensional size of the lesion. Koo (7) and after Ha (8) developed a measuring method using MRI scan and demonstrated that it's reliable to assess the future collapse in hips with femoral head osteonecrosis. They sum angles of arc of the femoral surface involved by necrosis on a midcoronal and a mid-

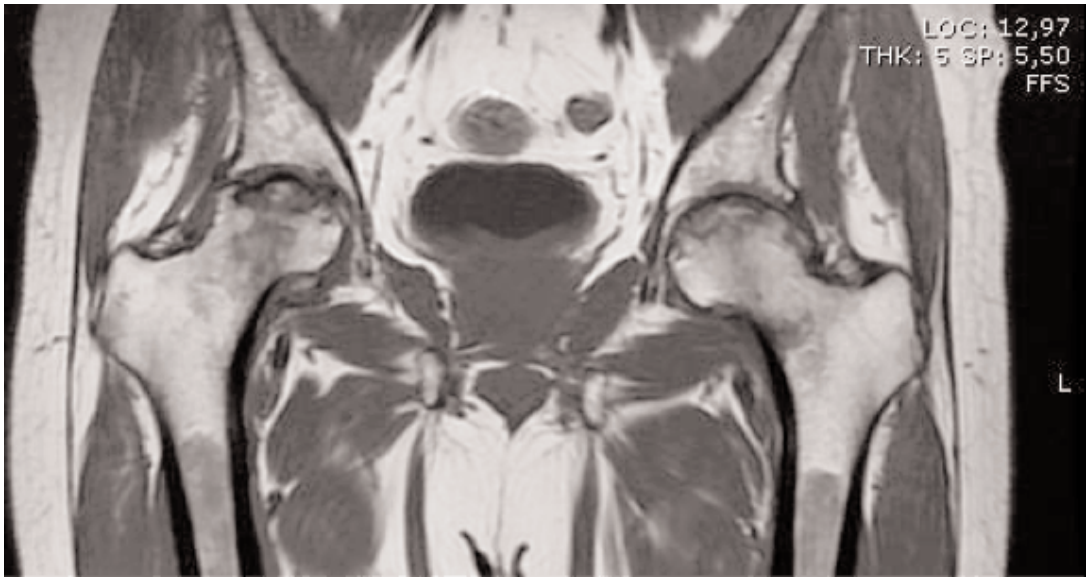

Figure 1 - Coronal MRI scan highlights bilateral necrosis areas.

sagittal magnetic resonance image. The lesion location is another important prognostic factor: weight-bearing portion and lateral side have a higher prevalence of collapse (9) (Figure 1).

Etiology also has a prognostic role. Three groups can be identified: patients with idiopathic osteonecrosis and no apparent risk factors, patients with local etiologic factors (trauma or surgery of the hip, infection), and patients with systemic risk factors (such as hypercortisonism, hyperlipidemia, dysbaric phenomena, autoimmune diseases, smoking, alcoholism, clotting disturbances, coagulopathies and hemoglobinopathies, metabolic diseases, organ transplantation) (Figure 2). Genetic factors may also play a significant role (10). Nonidiopathic osteonecrosis patients had the worst outcome (11). Patients with sickle cell disease have a high likelihood of progressing to head collapse. Moreover, they have a poor clinical and radiographic response after core decompression. The use of THA has increased in popularity and now is the mainstay of the treatment for advanced disease. The primary indication for THA in sickle cell disease is a persistent and intractable pain of the hip in a patient who has failed non-operative management (12).

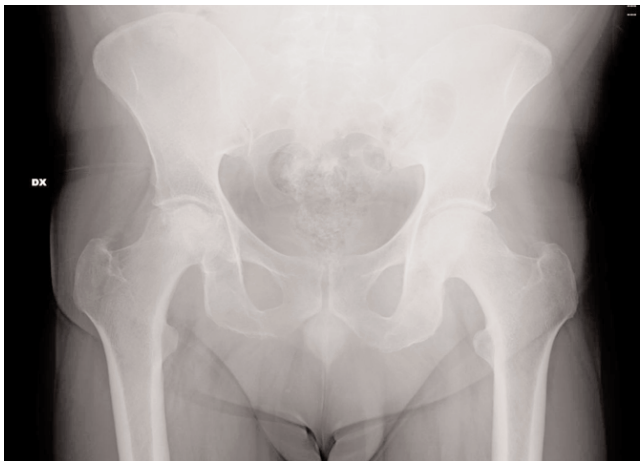

Figure 2 - A 39-year-old man with bilateral femoral head osteonecrosis and non-Hodgkin lymphoma in chemotherapy treatment.

Femoral head replacement procedures

The early diagnosis is crucial for an optimal treatment of osteonecrosis and its success is related to the stage at which the care started. The early stages may be managed surgically, with core decompression with or without autologous bone grafting, while hip arthroplasty is the mainstay of treatment for advanced stages (i.e. stage V-VI of Pennsylvania system or stage IV of Ficat classification) in patients who have intractable pain. The indications for hip arthroplasty are: failure of femoral head procedures, femoral head collapse or joint degenerative changes (13, 14), considering patient-specific factors (age, symptoms, prognostic factors). The operative procedures designed to save the femoral head don't prevent the progression of disease in hips that have already collapsed and they are associated with high failure rates (15).

FHRP includes resurfacing procedure, hemiarthoplasty and total hip arthroplasty.

Bipolar arthroplasty is no more an acceptable treatment option. Young patients, high incidence of migration, gluteal and groin pain, increased rate of loosening and polyethylene wear are the major reasons. The revision rate ranging from 13.9 to 27.6% have been reported after more than 5 years (13, 16). However, Dudani et al. recently reported a good outcome and mid-term survival in young patients using bipolar hip arthroplasty with tight fitting cup and acetabular reaming (17).

The purported advantages of hemi- and total-resurfacing arthroplasty, compared to standard hip arthroplasty, include higher bone stock conservation, lower dislocation rates, more range-of-motion, normal gait pattern, increased activity levels, and easier revision. Possible disadvantages are increased difficulty to perform the procedure, increased acetabular bone stock loss, femoral neck fractures, and the release of metal ions (18). Current indications for resurfacing are: patients with high functional demand, good bone quality especially of the neck, no anatomical deformities, and avas-

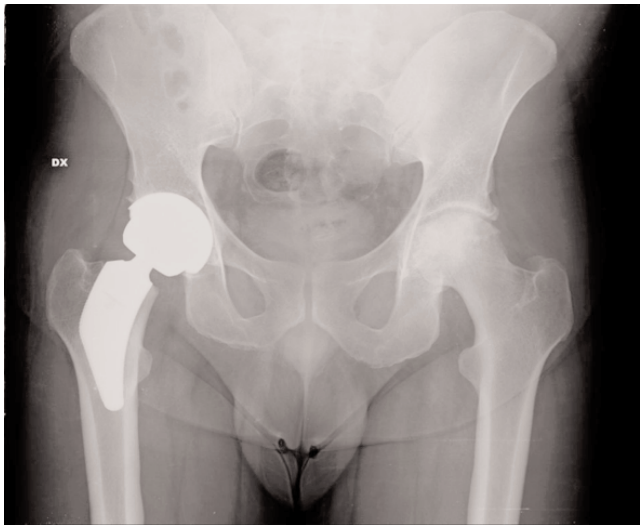

Figure 3 - Total hip replacement.

cular osteonecrosis in Ficat III or IV stage osteonecrosis involving less than 50% of the femoral head (13, 19). Concerning the age, the general recommendation is to avoid hip resurfacing in men older than 65 and in women older than 55, depending on the patient activity and bone quality. Female gender is considered a relative contraindication. Most surgeons would not implant a MoM hip in fertile women. There is a consensus not to perform hip resurfacing in case of a femoral head size smaller than 46 mm and in patients with renal insufficiency or with a known metal allergy (20). Blood supply to the femoral head is much better preserved during an anterolateral approach, that might be a useful prognostic factor (21). Hip resurfacing has a good implant survival of 96.2%, at a maximum follow-up of 11 years, and an excellent post-operative function (22), but the patient selection is a critical factor that will govern the outcomes. The results after resurfacing in osteonecrosis are comparable to patients treated for coxarthrosis (23).

Focal anatomic-resurfacing implant (HemiCAP®) is generally used for limited osteochondral lesions. Bilge et al. (24) have recently utilized this technique as an alternative option of joint-preserving surgery of the hip. Prerequisites are small lesion extension and good quality of subchondral bone.

Total hip replacement is indicated once the femoral head has collapsed and the hip joint is degenerated. In that cases, younger patients need a long lasting implant that can be revised easily. Surgeon has to think further than the first implant. In literature there is no evidence of superiority of: specific implant design, use of particular bearing surface combination or cementation rather than cementless implant (14, 23, 25) (Figure 3).

Initially, several studies showed poor results of THA in osteonecrosis treatment with a high failure rate (2, 26, 27). These are due to relative young patients, long life expectancy, inferior bone quality with different tissue response. Nowadays, outcomes are improved thanks to better implant, bearings, component design, improved materials and cementing technique. Patients with ONFH have similar failure rates after THA than the general population. There was a significant decrease in revision rates between patients operated upon before 1990 *versus* those in 1990 or later, with rates of 17% and 3%, respectively (28). However, some risk factors are associated with higher or lower revision rates. Patients with sickle cell disease, renal failure and/or transplant and Gaucher disease have significantly higher revision rates when compared to the overall population of patients treated with primary THA for osteonecrosis. Whereas patients with idiopathic ONFH, systemic lupus erythematosus and heart transplant have lower revision rates (29, 30). It's possible that the shorter follow-up time of heart transplant patients and the lower activity level are responsible for the lower failure rates. Renal transplant patients are typically treated with higher doses of corticosteroids, and this might have a greater adverse impact on bone metabolism, contributing to the higher failure rates seen for this group (28). Many studies have also shown that the outcomes of primary THR are not affected by previous hip joint preserving procedures (2, 31-33).

Conclusion

ONFH is a destructive disease that usually affects young adults with high functional demands and can have devastating effects on hip joint. The treatment depends on lesion and patient's features. The main prognostic factors are the extent and location of the necrosis. Patient's factors (age, etiology) suggest disease progression, collapse probability and also implants survival. There is not a gold standard treatment and frequently it is necessary a multidisciplinary approach. Preservation procedures of the femoral head are the first choice and can be attempted in younger patients without head collapse. Replacement procedure remains the gold standard treatment after failure of preserving procedures and in the late-stage ONFH, involving collapse of the femoral head and degenerative changes to the acetabulum. Resurfacing procedure still has good results but the patient selection is a critical factor. Total hip arthroplasties had historically poor results in patients with osteonecrosis. More recently, reports have shown excellent results, but implant longevity and following revisions are still outstanding problems.

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