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Chinese Expert Consensus on Clinical Diagnosis and Treatment Technique of Osteonecrosis of the Femoral Head (2023)

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Abstract

Osteonecrosis of the femoral head (ONFH) is a common and refractory disease. Although the exact pathophysiological mechanism is not fully understood, it is believed to be closely related to the interruption of intra-bone circulation and eventual bone tissue death. The prevention and treatment of ONFH are always a great challenge for orthopedists. The diagnostic level of ONFH has been continuously improved with the development of imaging techniques such as magnetic resource imaging and the in-depth understanding of the disease in recent years. There are many treatment methods for ONFH, which are generally considered individually and comprehensively according to factors such as the patient's age, osteonecrosis stage, classification, and compliance with joint-sparing treatment. There is currently no unified standard. ONFH staging and classification play an important reference value for doctors to choose treatment options. In recent years, based on the characteristics of ONFH in Chinese people, the academic community has proposed Chinese staging and China-Japan Friendship Hospital classification. The consensus also introduces them together with the international ARCO staging to provide guidance for individualized treatment of ONFH. To further standardize the diagnosis of ONFH and expand the treatment of ONFH, the Association Related to Circulation Osseous of Chinese Microcirculation Society (CSM-ARCO) organized domestic experts in the field of ONFH to jointly formulate the expert consensus, to provide reference for the standardized diagnosis of ONFH and the selection of individualized diagnosis and treatment techniques.

Keywords: Expert consensus, Osteonecrosis of the femoral head, Diagnosis, Treatment technique

Introduction

Osteonecrosis of the femoral head (ONFH) is a common refractory and disabling disease in orthopedics and is one of the common causes of hip pain and dysfunction. ONFH refers to the death of bone tissue and bone marrow components and the subsequent repair process caused by interruption of the intraosseous blood supply to the femoral head due to a variety of reasons. Because of its pathological characteristics, it is also known as "Ischemic necrosis of the femoral head", mainly affecting young patients, often accompanied by progressive collapse of the femoral head and joint destruction, secondary to osteoarthritis of the hip. The pathogenesis of ONFH is still unclear, and it is currently believed to include coagulation dysfunction, abnormalities in lipid metabolism, osteogenesis disorders, and poor vascularization and repair. According to the different etiology, ONFH is divided into two main categories: Traumatic ONFH and non-traumatic ONFH. In China, the prevalence of non-traumatic ONFH is higher in men than in women, and the prevalence in northern residents is higher than that in southern residents. Systemic steroid hormone administration, habitual alcohol intake (or alcoholism), hip trauma (dislocation and/or fracture), abnormal lipid metabolism, decompression sickness, and radiation are common predisposing factors associated with the development of ONFH [1-3].

ONFH has a high disability rate, which seriously affects the work and life of patients, and total hip arthroplasty (THA) is often needed to treat the advanced stage, which brings a heavy burden to patients, families, and society. Due to the presence of complications such as dislocation, aseptic loosening of the prosthesis, infection, and the limitation of the prosthesis' lifespan, patients may need to face multiple total hip revision surgeries. Therefore, ONFH requires early diagnosis and early treatment. Although there are many difficulties in the treatment of ONFH, the early selection of appropriate diagnostic and therapeutic techniques is necessary to slow down the progression of ONFH and delay the timing of THA surgery. At present, there are many diagnostic and therapeutic techniques for ONFH in the

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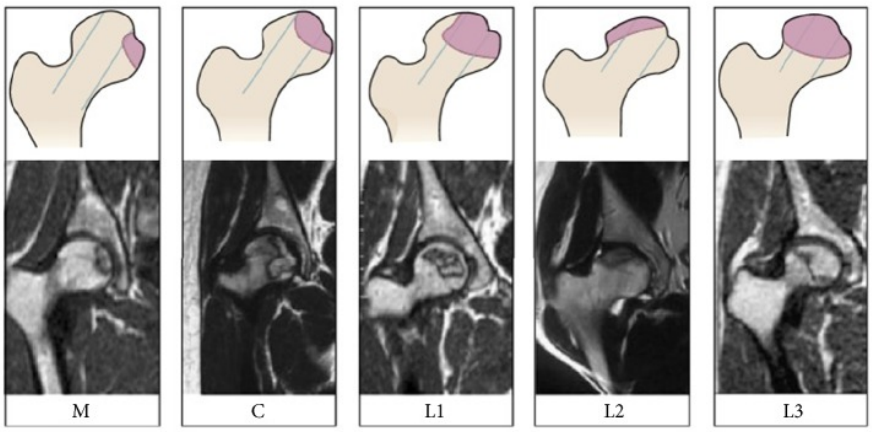

Figure 1: Schematic diagram and magnetic resource imaging images of China-Japan Friendship Hospital classification.

clinic, and due to the different etiologies, staging, and typing, the therapeutic effects vary, and there is a lack of unified expert opinion on the individualized choice of therapeutic regimen. To realize and promote the standardization and scientificization of ONFH diagnostic and treatment techniques, the Association Related to Circulation Osseous of Chinese Microcirculation Society (CSM-ARCO) has organized domestic experts in the field of ONFH, and combined with the progress of research in recent years, jointly formulated the "Expert Consensus on Clinical Diagnostic and Treatment Techniques for ONFH", with a view to provide constructive references for the individualized selection of ONFH diagnostic and treatment techniques.

ONFH Diagnostic Techniques

X-ray:

X-ray is the most basic examination method for the diagnosis of ONFH, although it is not sensitive enough in the diagnosis of early ONFH, it still has a certain role. The appropriate projection must be chosen including the anterior-posterior view of both hip joints and frog position [4-6]. The X-ray film may show curved hypodensity shadow under the articular cartilage, patchy hypodensity, and sclerotic area with or without the collapse of the joint surface, and then the collapse and flattening of the femoral head [5]. Eventually, degenerative arthritis occurs [5]. The X-ray film is a very good method to diagnose ONFH. Articular surface collapse, in turn leads to collapse and flattening of the femoral head and eventually degenerative arthritis [5]. If ONFH is still suspected when no abnormality is seen on radiographs, further diagnosis should be made using other imaging modalities such as magnetic resource imaging (MRI).

Computed tomography (CT) scan:

The role of CT in the diagnosis and guidance of treatment of ONFH is mainly to detect early lesions as far as possible, evaluate whether the bony articular surfaces are collapsed or not, as well as to show the bony structure (sclerosis, capsular degeneration, etc.) in the necrotic area, which can provide a basis for the clinical selection of reasonable treatments and the judgment of the prognosis. The diagnostic value of CT scan for the diagnosis of ONFH in ARCO Stage Ⅰ is limited, but it can show the necrotic foci of Stage Ⅱ and Ⅲ more clearly. CT scanning has limited diagnostic value for ARCO Stage I ONFH, but it can more clearly show the boundary, area, sclerotic band, repair status of the lesion, and subchondral fracture, and the clarity and positivity rate of CT scanning for subchondral fracture is better than that of MRI and X-ray film [6].

Radionuclide computed tomography (ECT)

ECT is more sensitive in detecting early osteonecrosis and can be used to diagnose early ONFH; however, it still lacks specificity and is inferior to MRI in making a definitive diagnosis of osteonecrosis. Literature reports that the sensitivity of detecting bone tissues by the ECT method is 77.7%, specificity is 75%, and accuracy is 76%. Scanning with technetium-labeled methyl diphosphonate (99mTC-MDP) can confirm the diagnosis if there are hot areas (nuclide concentrations) with cold areas, that is, "bagel-like changes" [7]; however, if there are only hot areas, the diagnosis should be differentiated from other hip diseases. This test can be used to screen for early and multifocal osteonecrosis. Single photon emission tomography (SPECT) can increase the sensitivity, but the specificity is still not high [8].

MRI

At present, hip MRI is still recognized as the gold standard for the diagnosis of ONFH. MRI has high specificity (96–99%) and sensitivity (99%) for the diagnosis of early ONFH. Typical MRI images of ONFH are: T1WI band of low signal encircling fat (medium or high signal) or necrotic bone (medium signal), T2WI double line sign, and a high signal band at the edge of the fat-suppressive lesion on T2WI. The T1WI band of low signal has the highest sensitivity and specificity for the diagnosis of ONFH. For T1WI showing a band of low signal and T2WI fat suppression showing bone marrow edema and joint effusion in the neck of the femoral head in addition to the focal area, the lesion should be considered to have progressed to the pre-collapse or collapse stage [9, 10].

Bone tissue biopsy

Histopathological examination is an invasive procedure, and it is recommended that samples be taken at the time of core

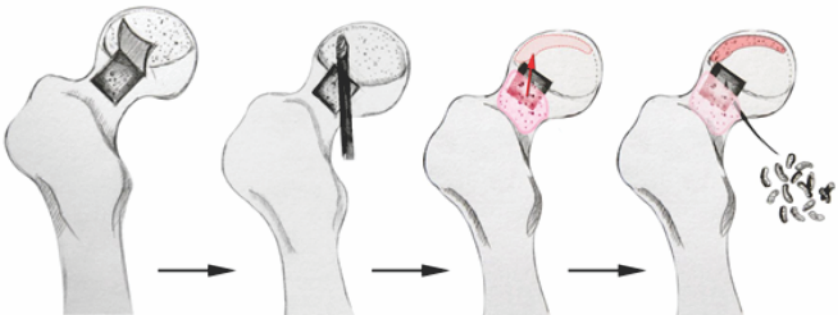

Figure 2: Schematic diagram of impacted bone grafting through femoral head-neck junction fenestration.

Table 1: ARCO staging of the 2019 edition of ONFH

ARCO stage	Image findings	Description
1	X-ray normal MRI abnormal	A band lesion of low signal intensity around the necrotic area is seen on MRI. A cold spot is seen on bone scan. No changes are seen on plain radiographs
2	X-ray abnormal MRI abnormal	Osteosclerosis, focal osteoporosis or cystic changes are seen in the femoral head on plain radiographs or CT scan. Still there is no evidence of subchondral fracture, fracture in the necrotic portion or flattening of the femoral head
3	Subchondral fracture on X-ray or CT	Subchondral fracture, fracture in the necrotic portion and/or flattening of the femoral head is seen on plain radiography or CT scan
3A (early)		Femoral head depression ≤2 mm
3B (late)		Femoral head depression >2 mm
4	X-ray osteoarthritis	Osteoarthritis of the hip joint with joint space narrowing, acetabular changes and destruction are seen on plain radiographs

MRI: Magnetic resonance image, CT: Computed tomography

decompression surgery. The pathomorphology of hemodynamic changes is divided into the early stage of (venous stasis stage), the middle stage (arterial ischemia stage) and the late stage (arterial occlusion stage). When MRI suggests typical femoral head necrosis, biopsy may not be performed.

Differential Diagnosis

Osteoarthritis of the hip joint

When osteoarthritis of the hip joint progresses to the middle or late stage, joint space narrowing and cystic degeneration appear, which is not easy to distinguish from femoral head necrosis. (1) Patients with femoral head necrosis often have obvious triggers; (2) patients with femoral head necrosis show sclerosis and cystic changes on CT, and the cystic changes are mostly far away from the subchondral bone. The cystic changes in arthritis are located in the weight-bearing area corresponding to the subchondral bone. (3) The MRI signal abnormality of osteoarthritic cystic degeneration in hip joint is in the form of a slice rather than a band, and it does not have the "double line sign". In addition, the contour deformation of the femoral head in osteoarthritis of the hip joint is not serious, with gap narrowing as the main feature; while the collapse deformation of the femoral head in osteonecrosis is serious, followed by gap narrowing.

Bone marrow edema syndrome

The etiology is not clear. (1) Bone marrow edema syndrome often develops in a single hip, and less frequently bilaterally; (2) MRI T1WI has no banded low signal, and T2WI fat-suppressed head and neck show uniform high signal, while bone marrow edema of ONFH has banded low signal in T1WI, and fat-suppressed high signal of T2WI is uneven, and necrotic foci often show low signal; (3) it can be dissipated on its own or completely in 3~12 months after the treatment.

Subchondral fracture

It often occurs in elderly osteoporotic patients and is often considered as an incomplete fracture. (1) No obvious history of trauma manifested as sudden hip pain and limited joint movement. (2) MRI shows T1WI and T2WI subchondral low-signal lines and surrounding bone marrow edema, and T2 fat suppression image shows flaky high signal.

Intrafemoral tumor

Chondroblasts are common, MRI shows T2W1 flaky high signal, T1W1 no band low signal, CT scan shows irregular osteolytic destruction.

Pigmented villous nodular synovitis

Unilateral onset, rare hip joint involvement, often misdiagnosed as ONFH in early stage, MRI shows extensive synovial hypertrophy, T1WI is diffuse low signal, X-ray and CT show that the femoral head and acetabular cortical bone are eroded, and the joint space is narrowed.

ONFH Staging and Typing

To assess the severity of ONFH, formulate individualized diagnosis and treatment plans, judge the prognosis, and evaluate the therapeutic efficacy, ONFH needs to be staged. There are many methods for ONFH staging, among which the Ficat-Arlet staging [11], Steinberg staging [12], Association for Research on the Circulation of the Bone (ARCO) staging [13,14], and Chinese staging [10]. They are widely used. Other commonly used staging methods include Japanese Osteonecrosis Research Society staging [15] and China-Japan Friendship Hospital (CJFH) staging [16].

ARCO staging

ARCO staging improves on Ficat-Arlet staging and Steinberg staging by combining radiographs, CT, MRI, and perfusion scanning imaging to determine the location and size of necrotic areas. In 2019, ARCO published a new version of ONFH staging [14]. (Table 1), which simplifies the previous version and is more concise and practical, but we believe that its efficacy for collapse prediction and treatment guidance may be limited.

Chinese staging and CJFH typing

In December 2014, the Joint Surgery Group of the Orthopaedic Science Branch of the Chinese Medical Association organized domestic osteonecrosis research and treatment experts to discuss and formulate the Clinical Diagnostic and Treatment Guidelines for Necrosis of the Femoral Head [10], which put forward the Chinese staging; At the same time, the use of the CJFH staging of ONFH [16] and the Chinese staging was recommended (Fig. 1 and Table 2). CJFH staging is based on the site of ONFH involvement of the three column structures: Type M (medial type), necrotic foci involve the medial column; type C (central type), necrotic foci involve the central column and the medial column; type L1 (sublateral type): Necrotic foci involve the three columns, but some of the lateral columns survive; type L2 (very lateral type), necrotic foci involve the lateral columns and some of the central columns; and type L3 (total L3 [total femoral head type]), where the necrotic zone penetrates the entire cortex of the three columns of the femoral head and the bone marrow. The results of CJFH staging are not affected by anatomical variations and positional movements, and the accuracy of the prediction of ONFH collapse is high,

Table 2: Chinese staging of ONFH

Stage	Clinical findings	Radiographic signs	Pathological changes
I (Pre-clinical, no-collapse)	No.	MRI (+)	Necrosis of bone marrow
According to size of necrotic area[a]		Bone scan (+)	Necrosis of osteocytes
Ia, small <15%		X-ray (−)	
Ib, medium 15–30%		CT (−)	
Ic, large >30%			
II (Early stage, no-collapse)	No or slight pain	MRI (+)	Necrotic area absorbed
According to size of necrotic area[a]		X-ray (±)	Bone repair
IIa, small <15%		CT (+)	
IIb, medium 15–30%			
IIc, large >30%			
III (Medium stage pre-collapse)	Onset of pain	Bone marrow edema[d] (MRI T2WI),	Subchondral fracture or fracture through necrotic bone
According to length of crescent[b]	Slight claudication	subchondral fracture (CT),	
III a, small <15%	Moderate pain	femoral head contour interrupted (plain X-ray film),	
III b, medium 15–30%	Limited internal rotation	crescent sign	
III c, large >30%	Pain in internal rotation		
IV (Middle-late stage, collapse)	Moderate to severe pain	Femoral head collapse with normal joint space (X-ray film)	Femoral head collapse with normal joint space (X-ray film)
According to depth of collapse[c]	Claudication		
IVa, slight <2 mm	Limited internal rotation		
IVb, medium 2–4 mm	Aggravated pain when strenuous internal rotation,		
IVc, severe >4 mm	Limited abduction, and adduction		
V (late-stage, osteoarthritis)	Severe pain	Flattening of femoral head	Cartilage involved[e]
	Severe claudication	Narrow joint space (X-ray film)	Osteoarthritis
	Limited range of motion	Acetabular cystic changes or sclerosis	

[a]Estimation of necrotic area: necrotic area should be estimated in Stages I and II on a mid-coronal section of the femoral head on MRI or CT (small <15%, medium 15–30%, large >30%), the volume of the necrotic area being estimated through the involved layers.

[b]Risk of collapse should be estimated in Stage III according to length of crescent on AP and frog-lateral views. Small <15%, medium 15–30%, large >30%.

[c]Extent of collapse should be estimated in Stage IV according to the depth of articular surface collapse in necrotic area by AP and frog-lateral views X-ray. Slight <2 mm, medium 2–4 mm, severe >4 mm.

[d]When X-ray films show no-collapse, patients with painful hips need to undergo MRI and CT examination. Necrosis has progressed to collapse (Stage III) if bone marrow edema or subchondral fracture has occurred.

[e]When collapse has occurred and patients have experienced pain for more than 6 months, articular cartilage will have clearly degenerated (Stage V).

which is of practical clinical guidance for the selection of treatment options, easy to apply, and highly reproducible.

There are many kinds of staging of ONFH, and each staging has its own advantages and limitations in different times. As China is the country with the highest incidence of osteonecrosis of the hip, Chinese physicians have found the limitations of the original staging in a large number of clinical practices, and the development of the Chinese staging is necessary. The Chinese staging includes the symptoms and signs of each stage with corresponding imaging changes and also includes the functional tests of early osteonecrosis, such as bone scan and MRI, which correspond to each stage of imaging and histologic manifestations, as well as the patient's symptoms and physical examination. Meanwhile, the Chinese staging evaluates the volume of necrosis and the degree of joint involvement, further dividing each stage into corresponding subtypes, which is more operable.

ONFH Treatment Techniques

ONFH treatment techniques include non-surgical and surgical treatment techniques.

Nonsurgical treatment techniques

1. Protective weight-bearing: ONFH leads to a decrease in the mechanical strength of the bone in the femoral head. Reducing the weight bearing of the affected hip can effectively reduce pain, improve function, and may avoid the collapse of the femoral head during the repair of osteonecrosis. For example, the use of crutches to assist walking and the use of a wheelchair for a long period of time is not recommended; at the same time, attention should be paid to avoid confrontational and impact sports. This approach may be considered for ONFH where the lesion is medial to the femoral head and is small in size (<15%). We cannot rely solely on the restriction of weight-bearing to cure ONFH, combining other treatment methods is also necessary. For patients receiving hip-preservation surgery, it is recommended the post-operative use of crutches for 3 months and to gradually discontinue the use according to post-surgical evolution.
2. Medication: Medication can be used alone in the treatment of ONFH or in conjunction with hip preservation surgery. Drugs that inhibit the function of osteoclasts and promote the function of osteoblasts, such as phosphate drugs, as well as anticoagulant, lipid-lowering, vasodilating, promoting fibrinolysis, and other drugs, are often used.
3. Chinese medicine treatment: Chinese medicine treatment emphasizes early diagnosis, combination of disease evidence, and early treatment. For high-risk groups and early ONFH patients, it is recommended to give Chinese medicine treatment such as activating blood circulation and removing blood stasis, tonifying the kidney, and strengthening the bone, which has the effect of promoting necrosis repair and preventing collapse; used in conjunction with hip-preserving surgery, it can improve the effect of hip-preserving surgery. Commonly used medicines include XianlingGuBo and Bone Strengthening Capsule.
4. Shock waves and other non-invasive alternatives: Including extracorporeal shock wave (also known as shock wave), electromagnetic field, hyperbaric oxygen, and so on. As an emerging treatment method in the field of orthopedics, extracorporeal shock wave technology can promote cytokine release, stem cell activation, and

Table 3: Principle of treatment choice for ONFH

Chinese staging and CJFH type of ONFH	Principle of treatment choice
Stage I, II	
M-type	Follow-up, observation, or placebo treatment.
C-type	Extracorporeal shock wave, core decompression or debridement of foci, autologous bone marrow transplantation or bone grafting, medication.
L1 type	Debridement, vascularized or avascularized bone graft, medication. If the patient is aged <5 years, varus osteotomy is recommended.
L2, L3 type	Debridement of foci and strut graft (vascularized or avascularized) or impaction bone grafting. If the patient is aged <5 years and has L2 type, transtrochanteric rotational osteotomy is recommended.
Stage III	
	In patients aged <50 years, joint-preserving surgery is usually indicated, the procedures being the same as for Stage I, II; L2, L3 type, whereas in patients aged more than 50 years with severe pain and joint dysfunction, arthroplasty is indicated.
Stage IVa, IVb	
	In patients aged <40 years, joint-preserving should be attempted, whereas in those aged more than 40 years with severe pain and joint dysfunction, arthroplasty is indicated.
Stage IVc and V	
	In patients with severe pain and joint dysfunction, arthroplasty is indicated.

CJFH: China-Japan Friendship Hospital

angiogenesis in local tissues. High-energy focused shockwave can be used to treat diseases with altered bony structures, such as ONFH and osteogenesis imperfecta [17, 18]. High-energy focused extracorporeal shockwave has obvious efficacy for early ONFH, which can relieve pain symptoms, increase hip mobility, reduce bone marrow edema, and shrink the ONFH area [17, 19], and has the advantages of being non-invasive, safe, and effective. Hyperbaric oxygen technology can rapidly increase the partial pressure of blood oxygen and oxygen content, promote osteogenic repair and neovascularization coupling, improve the local metabolism of the femoral head, and also improve the pain symptoms of patients with ONFH, which can be used as an auxiliary means of ONFH treatment.

Surgical treatment techniques

ONFH progresses rapidly, non-surgical treatment is often ineffective, and surgical treatment is often required, including two major types of repair and reconstruction surgery to preserve the patient's own hip joint and artificial hip arthroplasty.

The main purpose of ONFH hip preservation surgery is to reduce pain, delay the collapse of the femoral head, improve and maintain hip function, and then delay or even avoid hip replacement surgery. The main methods of hip preservation surgery include core decompression, free bone grafting, bone grafting with or without vascularization, and osteotomy. An individualized treatment plan can be formulated according to the staging and typing of ONFH, the patient's age and other factors, and appropriate surgical methods can be selected [20].

Medullary core decompression

Medullary core decompression can reduce venous congestion and intraosseous pressure, increase blood supply to the necrotic area, and contribute to neovascularization, which can delay the collapse process, alleviate pain, and improve hip function; it is often used in conjunction with stem cell transplantation (or concentrated autologous bone marrow single nucleated cell transplantation), which can improve the success rate [21]. The success rate of myeloablative core decompression is closely related to ONFH staging typing, with better outcomes for patients with ARCO Stage I and II, and CJFH typing L1 and C [22, 23, 24]. In addition, it is known that the rate of collapse is lower in asymptomatic ONFH when the necrotic zone is only present in the medial femoral head, and the use of this surgical treatment should be carefully considered [25].

Free bone grafting

Free bone grafting is also commonly used in the treatment of early ONFH, where necrotic tissues are surgically removed and implanted with autogenous bone, allogeneic bone, bone substitute materials, or bioinductive bone matrix, such as BMP-2 [26], to provide structural support for the femoral head with osteoinductive and osteoconductive properties, which helps in osteogenic repair of necrotic foci in the femoral head. Commonly used surgical procedures include femoral head-and-neck openings for necrotic tissue removal and compression osteoimplantation (Fig. 2).

Bone grafting with or without vascularized tibia

Bone grafting with vascularized tibia can give structural support to the femoral head and at the same time can enhance the bone healing ability of the necrotic area by relying on a complete blood supply, The grafted bone sources are mainly autologous, including iliac bone and fibula [27]. However, due to the complexity of the surgery and the susceptibility to donor-recipient site complications, bone grafting with vascularized tibia is more difficult to promote in primary hospitals. Bone grafting without

vascularization is relatively simple, and the more widely used procedures include transfemoral rotor decompression bone grafting, transfemoral head and neck bulb decompression bone grafting, and so on. Bone grafting methods include compression bone grafting and support bone grafting, etc. Bone grafting materials include autogenous cortical and cancellous bone, allogeneic bone, and bone substitution materials.

Osteotomy

The purpose of osteotomy in the treatment of ONFH is to move the necrotic area out of the weight-bearing area of the femoral head to weight-bear with the normal area. Common surgical procedures include rotational osteotomy through the femoral rotor, rotational osteotomy of the acetabulum, rotational osteotomy of the base of the femoral neck through the surgical dislocation approach, and internal or external rotation osteotomy. Osteotomy has better efficacy, but it requires high surgical technique, has more post-operative complications, and may affect the later THA [28], so care should be taken to choose a surgical procedure that does not interfere with the blood supply to the femoral head after osteotomy and does not affect the later arthroplasty. Transfemoral rotary osteotomy was proposed by Sugioka in 1972, which is indicated for patients with Ficat-Alert Stages II B and III with pain, early collapse without joint space narrowing, age <40 years old, and body mass index <24 with femoral head necrosis, and MRI scans that show the femoral head is not involved by necrosis by an area of more than 1/3.In addition, it is also indicated for patients with Perthes's disease, subchondral incomplete fracture of femoral head with collapse, slipped epiphysis of femoral head, early osteoarthritis of hip joint with wear, and tear of weight-bearing area of femoral head.

Choice of treatment techniques

There are many treatment options available for patients with ONFH, but there are no double-blind or single-blind controlled evidence-based medical research protocols to choose from. Non-traumatic ONFH occurs in young and middle-aged people and often involves both hips, with a few patients developing multifocal necrosis (knee, shoulder, etc.). Therefore, the patient's own joints should be saved and preserved whenever possible. The preserved joints should be painless or only mildly uncomfortable, with no deformity and some mobility; if these requirements are not met, arthroplasty should be chosen.

The choice of an ONFH treatment program should be based on the patient's age, osteonecrosis staging, and adherence to the treatment of preserved joints [29].

i. After the patients were admitted to the hospital, they were examined with MRI of both hips, coronal, sagittal, and axial reconstruction CT scans, and orthopantomatic and frog X-rays of both hips to determine the necrotic site, volume, and the presence of bone marrow edema, the presence of subchondral fracture, and the status of self-repairing (limited, destroyed, and reconstructed), and to determine the patient's ARCO staging.

ii. Based on ONFH staging (ARCO staging) and typing (CJFH typing), the principles of treatment selection are shown in Table 3.

iii. Treatment options for asymptomatic ONFH: Before femoral head collapse, the vast majority of patients with ONFH do not present with clinical symptoms, referred to as resting ONFH. The use of MRI for the diagnosis of ONFH has led to the diagnosis of many early-stage (ARCO Stage I) patients, who are often found through census of patients with risk factors for ONFH or, in the case of pre-existing symptomatic ONFH on one side, by examining the contralateral hip joint, it is possible to find asymptomatic injuries. There are different views on whether patients with resting ONFH need immediate treatment. A point of view is that no treatment is needed temporarily, which suggests that some of the lesions of resting ONFH will dissipate on their own; however, most researchers agree with the other view, which suggests that the treatment of resting ONFH should not be standardized, but should be based on the size and location of the necrosis, and should follow the principles of the above selection of treatment for ONF.

Opinions on the treatment of asymptomatic ONFH are somewhat controversial. Steinburg et al. [30] followed up non-traumatic ONFH in 328 hips with University of Pennsylvania Stage I and II for an average of 46 months and found that the number of cases ultimately needing THA was similar regardless of the presence of pain, and therefore prophylaxis should not wait for the onset of pain in particular. Hungerford et al. [31] recommended that the treatment of ONFH with a small area of necrosis (<15%), and lesions located centrally and medially on the femoral head should be observed, while those with 15-30% necrosis and those with necrosis located laterally should undergo early joint preserving surgery, regardless of the presence or absence of hip symptoms. Mont et al. [25] have the same opinion. Our opinion is that the majority of resting ONFH is Stage I or II osteonecrosis, and early surgical intervention in patients at risk of collapse (i.e., those with CJFH staging types C and L1) is significantly more effective than in those who are treated after the onset of hip symptoms. Patients with CJFH staging Type M can be observed and waited for.

Patient management and efficacy assessment

Patient medical records should be established in clinical work, and classified and managed according to etiology, typing, staging, age, necrotic area, and treatment methods, which helps to standardize the treatment of femoral head necrosis. Patients should be followed up regularly after diagnosis, every 3 months in the 1st year after receiving treatment, and every 6 months thereafter, and the treatment effect should be evaluated, including both clinical and imaging assessments.

Clinical evaluation was performed using hip symptomatology (e.g., VAS pain score, etc.) and functional evaluation (e.g., Harris score, RHS hip preservation score, WOMAC score, etc.), which should be categorized and evaluated according to the same stage, similar necrotic area, and the same treatment method. Gait analysis is also recommended.

Imaging evaluation is based on X-rays, including orthopantomogram and frog position X-rays of both hips, which should be observed to see whether there is any change in the shape of the femoral head, whether it is collapsed, whether there is any change in the joint space and whether there is any change in the acetabulum. If necessary, CT and MRI should be performed to observe whether there is femoral head collapse and bone marrow edema. Digital subtraction angiography should be performed to evaluate the blood flow in patients with blood-filled bone grafts.

Look into the future

ONFH is a common refractory disease in orthopedic clinics, and its diagnosis, prevention, and treatment have always been a great challenge for clinical orthopedic surgeons. The Bone Microcirculation Committee of the Chinese Microcirculation Society has organized domestic experts in the field of ONFH to formulate the Expert Consensus on Clinical Diagnosis and Treatment Techniques for Necrosis of the Femoral Head, which takes into account the staging, typing, age, and other individualized factors of necrosis of the femoral head and plays an important guiding significance in regulating the diagnosis and treatment of ONFH, and helps to realize the standardization, scientification, and individual promotion of the diagnosis and treatment techniques of ONFH. Due to the complexity and variability of ONFH, the limitations of various hip-preserving technologies, and the differences in local medical policies, this consensus is only a guiding opinion of experts and is not a mandatory requirement, let alone a legal basis. In clinical practice, local measures can be formulated according to the actual local conditions.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflicts of Interest: Nil.

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