

OSTEONECROSIS OF THE FEMORAL HEAD

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- Progressive disease
- Affects patients in the **third** through fifth decades of life
- 20,000 new cases each year in the United States
- 12% of all total hip arthroplasties

Risk factors

- Idiopathic
- Trauma
- Corticosteroid use
- Alcohol abuse
- Smoking
- Hemoglobinopathies (e.g., sickle cell anemia)
- Coagulation disorders
- Myeloproliferative disorders (Gaucher disease, leukemia)
- Hyperbaric decompression
- Hyperlipidemias
- Chronic kidney disease
- Autoimmune diseases
- Human immunodeficiency virus infection

Classification

TABLE 6.1

Ficat and Arlet Classification of Osteonecrosis of the Femoral Head

STAGE	SYMPTOMS	RADIOGRAPHY	BONE SCAN	PATHOLOGIC FINDINGS	BIOPSY
0	None	Normal	Decreased uptake?		
1	None/mild	Normal	Cold spot on femoral head	Infarction of weight-bearing portion of femoral head	Abundant dead marrow cells, osteoblasts, osteogenic cells
2	Mild	Density change in femoral head Sclerosis or cysts, normal joint line, normal head contour	Increased uptake	Spontaneous repair of infarcted area	New bone deposited between necrotic trabeculae
3	Mild to moderate	Flattening (crescent sign) Loss of sphericity, collapse	Increased uptake	Subchondral fracture, collapse, compaction, and fragmentation of necrotic segment	Dead bone trabeculae and marrow cells on both sides of fracture line
4	Moderate to severe	Joint space narrowing, acetabular changes	Increased uptake	Osteoarthritic changes	Degenerative changes in acetabular cartilage

Classification

TABLE 6.2

Additional Classifications for Osteonecrosis

STAGE	STEINBERG ET AL.	ARCOS
0	Normal or nondiagnostic radiographic, bone scan, and MRI findings	Bone biopsy results consistent with osteonecrosis; other test results normal
I	Normal radiographic findings, abnormal bone scan and/or MRI findings A: Mild: <15% of head affected B: Moderate: 15%–30% affected C: Severe: >30% affected	Positive findings on bone scan, MRI, or both IA: <15% head involvement (MRI) IB: 15%–30% involvement IC: >30% involvement
II	Lucent and sclerotic changes in the femoral head A: Mild: <15% B: Moderate: 15%–30% C: Severe: >30%	Mottled appearance of femoral head, osteosclerosis, cyst formation, and osteopenia on radiographs; no signs of collapse of femoral head on radiograph or CT; positive findings on bone scan and MRI; no changes in acetabulum A: Mild: <15% B: Moderate: 15%–30% C: Severe: >30%
III	Subchondral collapse (crescent sign) without flattening A: Mild: <15% of articular surface B: Moderate: 15%–30% C: Severe: >30%	Presence of crescent sign lesions classified on basis of appearance on anteroposterior and lateral radiographs A: <15% crescent or <2-mm depression B: 15%–30% crescent sign or 2- to 4-mm depression C: >30% crescent sign or >4-mm depression
IV	Flattening of the femoral head A: Mild: <15% of surface or <2-mm depression B: Moderate: 15%–30% of surface or 2- to 4-mm depression C: Severe: >30% of surface or >4-mm depression	Articular surface flattened; joint space narrowing; change in acetabulum with evidence of osteosclerosis, cyst formation, and marginal osteophytes
V	Joint narrowing and/or acetabular changes A: Mild: Average of femoral head involvement as in stage IV and estimated acetabular involvement B: Moderate involvement C: Severe involvement	
VI	Advanced degenerative changes	

Classification

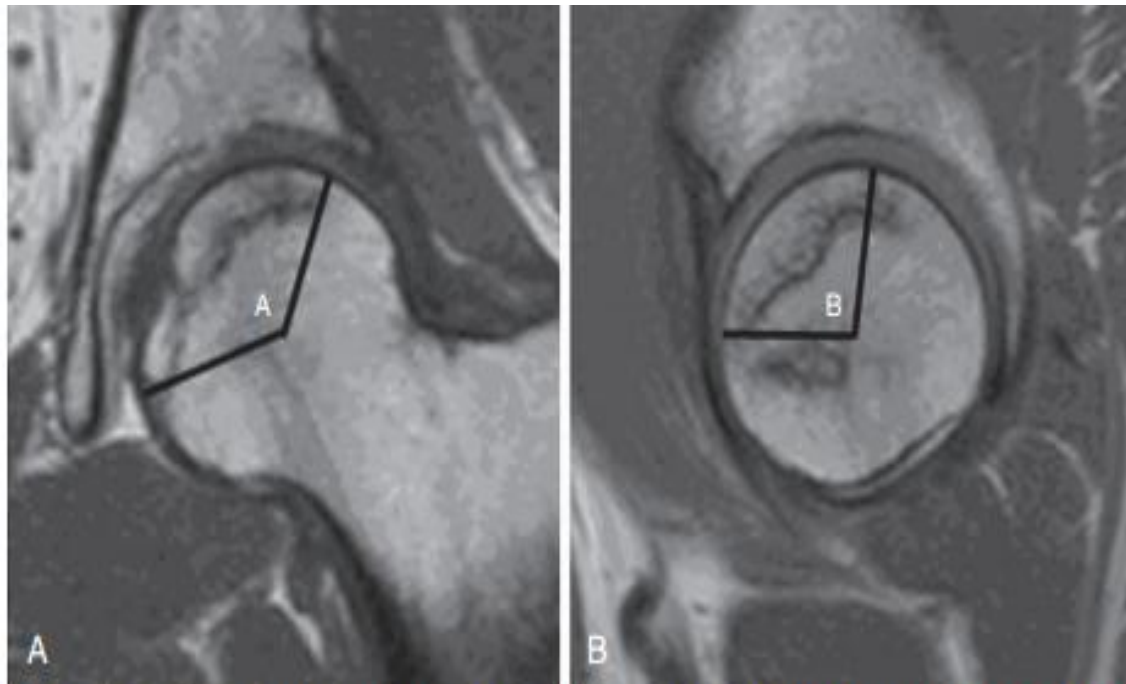


FIGURE 6.52 Calculation of the combined necrotic angle from magnetic resonance imaging scans. **A**, Angle of necrotic area in the midcoronal image. **B**, Angle of necrotic area in the midsagittal image. The combined necrotic angle = $A + B$. (From Ha, YC, Jung WH, Kim JR, et al: Prediction of collapse in femoral head osteonecrosis: a modified Kerboul method with use of magnetic resonance images, *J Bone Joint Surg* 88 (suppl 3):35, 2006.)

Diagnosis

- Asymptomatic early
- Hip, groin, or gluteal pain
- Groin pain is characteristic of hip pathology
- C sign
- May include catching or popping sensation
- Trendelenburg gait often noted

- Radiography:
anteroposterior and frog-leg lateral
pathognomonic crescent sign(best seen on frog-leg
lateral views)
- MRI :
modality of choice
Specificity of 98% and sensitivity of 97% in
differentiating AVN from non-AVN disease of femoral
head



- *Double-line sign:*

Seen on T2-weighted

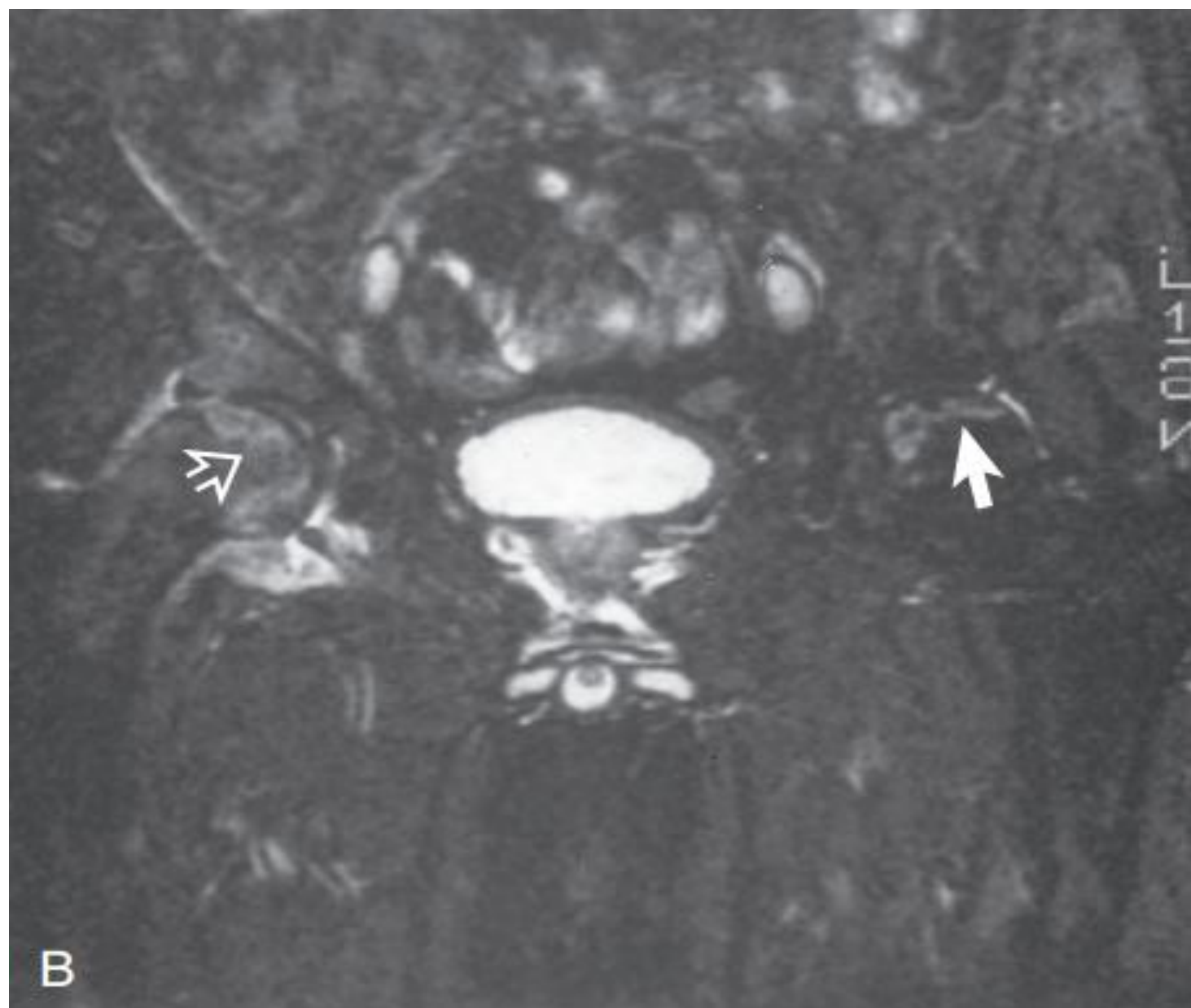
Inner border of high signal intensity (hyperemic granulation tissue)

Parallel, low-signal-intensity periphery (sclerosis)

Can be observed in **up to 80%** of lesions

Specific and pathognomonic

AVN can be present in the absence of the double-line sign



- Femoral head and neck edema may be mistaken for transient osteoporosis of the hip
- May have associated joint effusion
- Differentiation between transient osteoporosis and osteonecrosis :

bone marrow edema of transient osteoporosis extending into the intertrochanteric region of the femur with no demarcation of a proximal necrotic segment

- Technetium-99m Bone scanning:
decreased in the very early stage of disease and is
variable or increased at a stage when symptoms
occur

TREATMENT

- Asymptomatic osteonecrosis; lesion was less than 30% of the area of the femoral head; remain asymptomatic in most patients (95%) for more than 5 years;
- As lesion size increased, however, the percentage of painful osteonecrosis increased
- No femoral heads with a combined necrotic angle of **less than 190 degrees** went on to collapse
- All the femoral heads with a combined necrotic angle of **more than 240 degrees** collapsed

- Extremely **poor prognosis**, with a rate of femoral head collapse of greater than 85% at 2 years in **symptomatic patients**
- No treatment method has proved to be completely effective in arresting the disease process
- Conservative treatment, such as crutch ambulation or bed rest, generally is ineffective (Symptomatic patients who may benefit from a femoral head preserving technique)

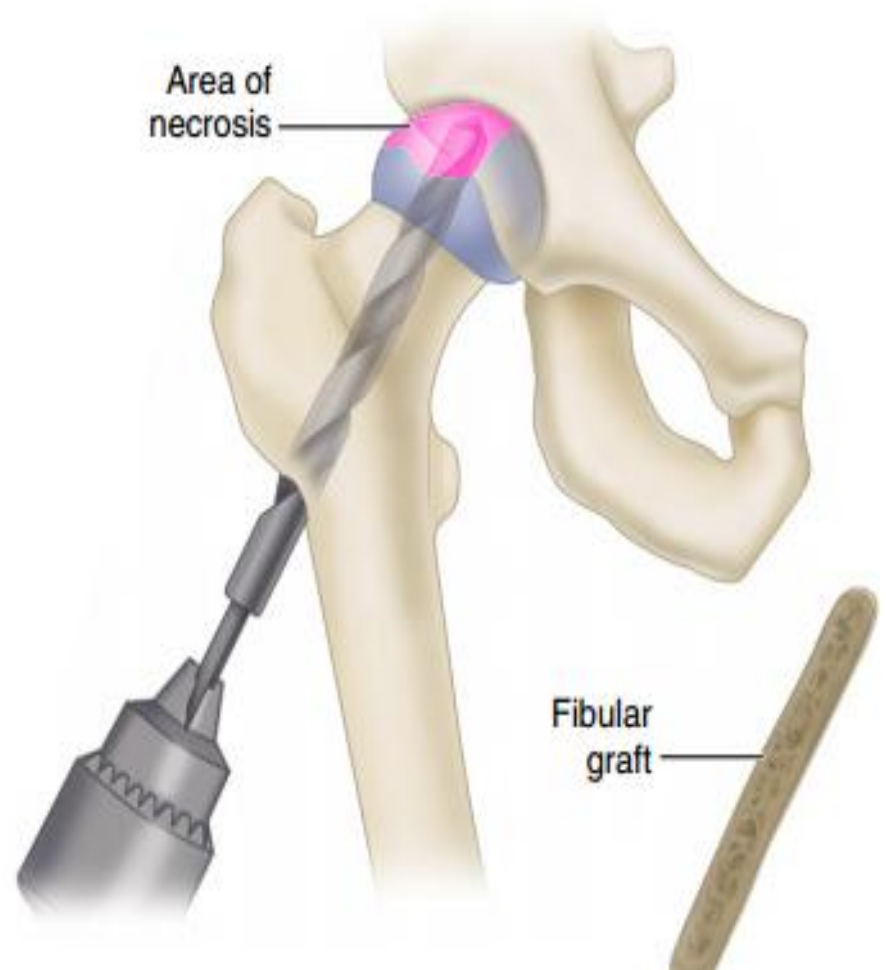
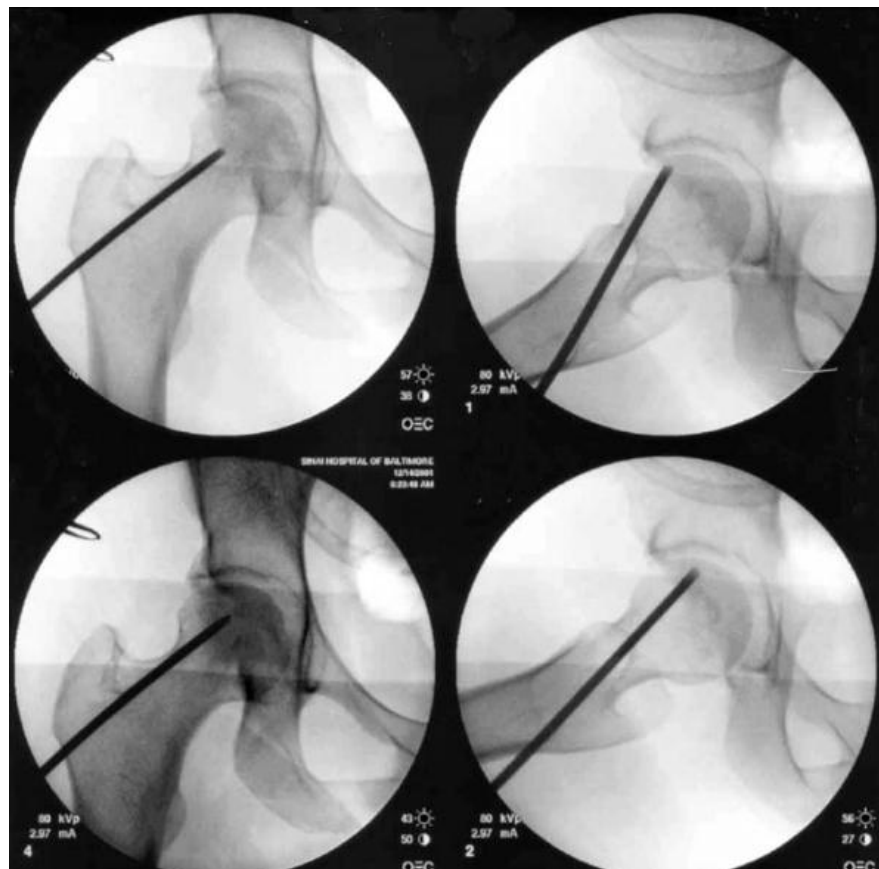
NONOPERATIVE TREATMENT

- Bisphosphonates
- Statins ;early stages;reduce intraosseous adipose deposition and may decrease vascular congestion
- Hyperbaric oxygen
- Extracorporeal shock wave therapy

Operative treatment

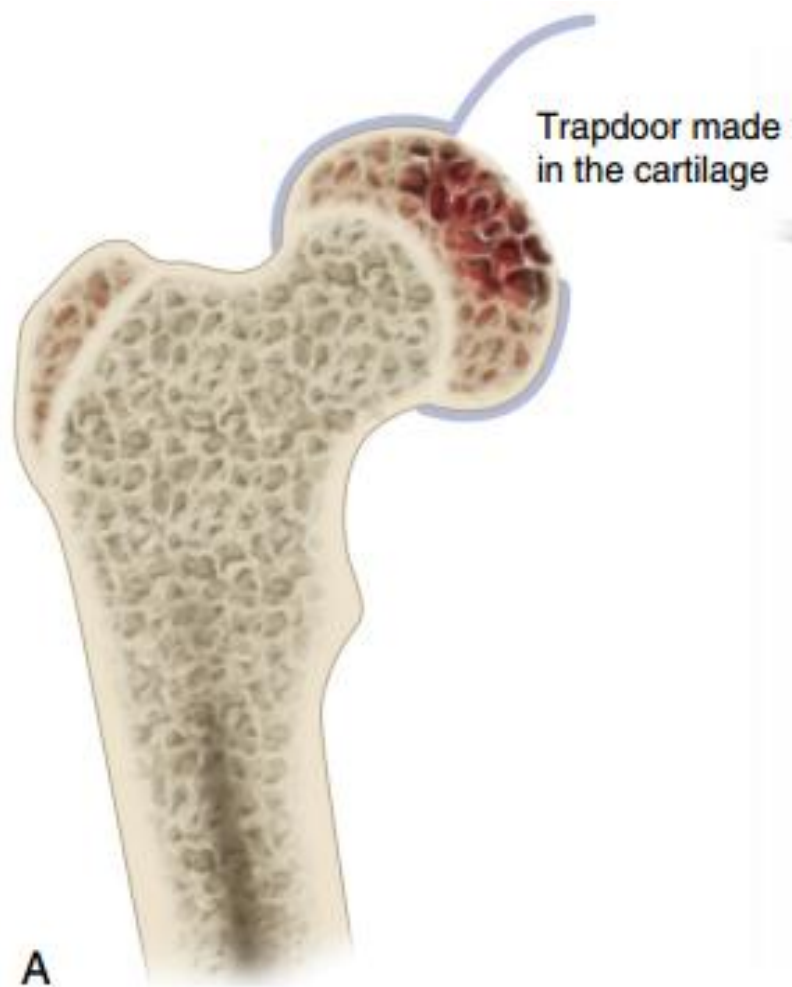
- **CORE DECOMPRESSION:**

- ✓ the earlier the stage of the disease, the better the results
- ✓ best results reported in Ficat stage I
- ✓ Ficat stages I and IIA, Small central lesions in young, nonobese patients who are not taking steroids
- ✓ **More than 30%** of patients, even with early-stage disease, will likely require THA within 4 to 5 years of core decompression surgery



BONE GRAFTING

- 50% to 80% Successful results
- Cortical bone, cancellous bone, vascularized bone graft, and debridement of necrotic bone from the femoral head
- Accurate placement of the graft within the lesion and under subchondral bone is essential
- “standard core track technique”, “trapdoor” technique, or a “light bulb” technique

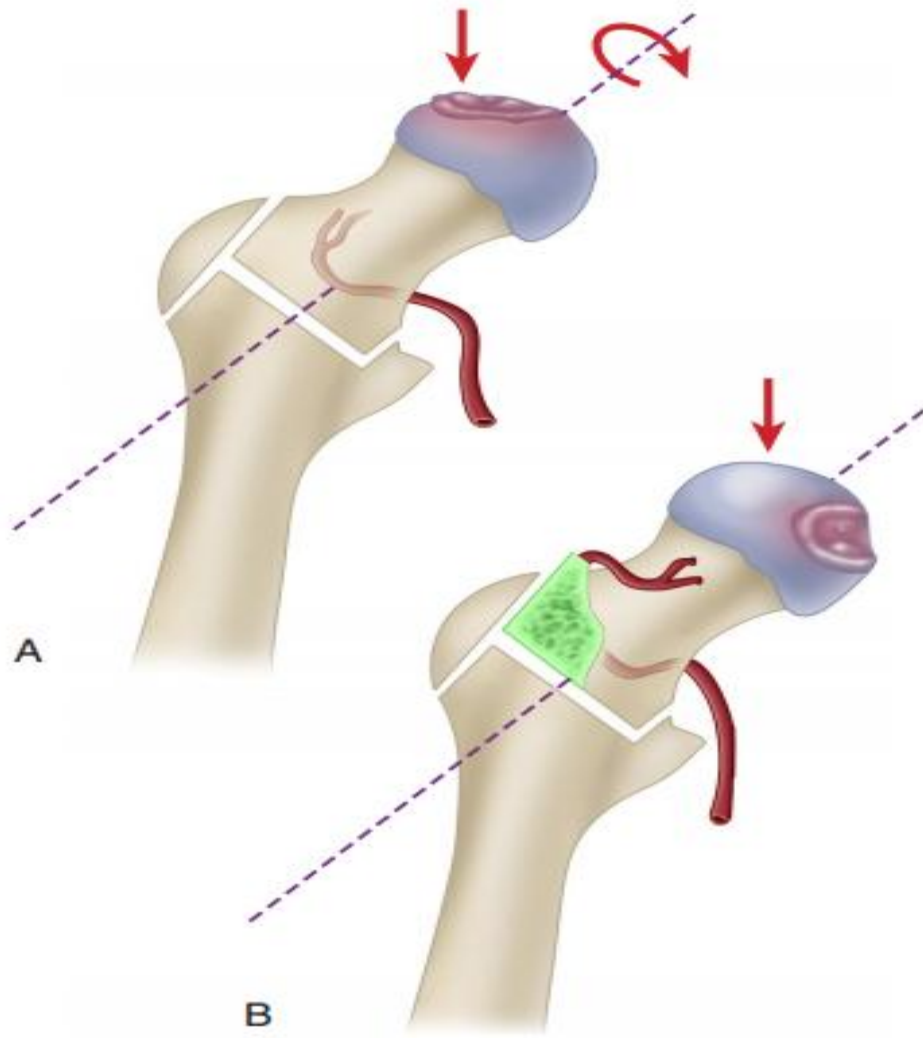


VASCULARIZED FIBULAR GRAFTING

- Most reports have shown good results in 80% to 91% of patients
- Younger than 50 years without collapse of the femoral head
- Concurrent steroid use is not a contraindication for this procedure
- Controversial for patients with asymptomatic early-stage osteonecrosis

PROXIMAL FEMORAL OSTEOTOMY

- Small-sized or medium-sized lesions (<30% femoral head involvement) in young patients
- Patients with **idiopathic** or **posttraumatic** osteonecrosis did better than patients with alcohol-induced or steroid-induced necrosis



ARTHROPLASTY

- osteonecrosis involves more than 30% of the head, the success rates of the aforementioned techniques tend to diminish

Ten-year results of mesenchymal stromal cell transplantation augmented with vascularised bone grafts for advanced osteonecrosis of the femoral head

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Abstract

Background: A prospective, open-label clinical trial, in which transplantation of cultured autologous bone marrow-derived multipotent mesenchymal stromal cells in combination with vascularised bone grafts for the treatment of post-collapse extensive osteonecrosis of the femoral head in ten patients, was conducted previously. The aim of this study was to assess the 10-year clinical and radiographic results of that study.

Methods: Patients were evaluated for radiographic progression of osteonecrosis of the femoral head using anteroposterior radiographs at 10 years postoperatively. Clinical score and hip function, including the timed up and go test, were also estimated.

Results: Osteoarthritic changes in the affected hip were found in five of the ten patients, two of whom had undergone total hip arthroplasty at 7 and 9 years postoperatively. Five of the six cases (83.3%) in which pre-operative femoral head collapse was less than 3 mm, had no further collapse. On the other hand, all four cases in which pre-operative femoral head collapse was ≥ 3 mm, showed osteoarthritic changes within 10 years. The average clinical score significantly improved postoperatively and was maintained at 10 years.

Conclusions: Considering that eight of 10 post-collapse cases could avoid total hip arthroplasty conversion with good clinical results for 10 years and five of 6 post-collapse cases (collapse < 3 mm) could avoid further collapse and osteoarthritic changes for 10 years, mesenchymal stromal cell transplantation in combination with vascularised bone grafts could be an effective treatment for post-collapse osteonecrosis of the femoral head.