PROCEDURE 15

Avascular Necrosis and Core Decompression

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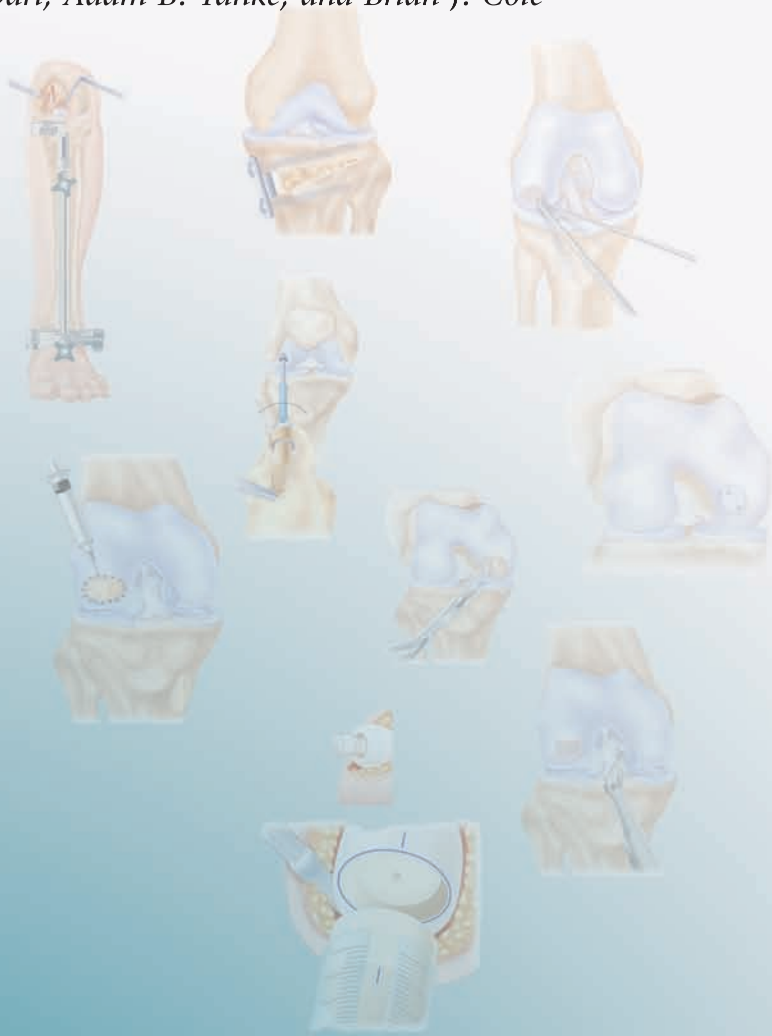

Indications

- *Core decompression* is indicated for symptomatic stages I, II, and III avascular necrosis (AVN) that has failed conservative treatment. Notably, these first three stages have no evidence of subchondral bone collapse.
  - Stage I: normal radiographs, abnormal bone scan and abnormal magnetic resonance imaging (MRI)
  - Stage II: subtle flattening of the femoral condyle
  - Stage III: necrotic, radiolucent area in the subchondral bone bordered by a sclerotic halo
- *Osteoarticular autograft or allograft* with or without an osteotomy is indicated for contained symptomatic stage IV AVN. This stage exists after a collapse in the subchondral bone has occurred and there has been a failure to respond to earlier intervention.
  - Stage IV: thickening of the sclerotic halo, subchondral bone collapse, and cartilage flap formation.
- *Arthroplasty* is generally used for advanced disease (stage V).
  - Stage V: overt degenerative changes with joint space narrowing and osteophyte formation.

Treatment Options

- Treatment options are based on a number of factors and assume failure of nonoperative treatment.
- Initial surgical treatment might include arthroscopy and débridement independent of the AVN classification in an effort to débride loose bodies and plan for definitive reconstruction.

CLASSIFICATION

- Spontaneous osteonecrosis
  - Core decompression is typically less successful in this entity.
  - May respond to osteochondral grafting, osteotomy, and arthroplasty.

Examination/Imaging

- History
  - Rarely will patients provide a history of trauma.
  - Patients often complain of progressively worsening pain in the involved compartment that is often worse at night.
  - Mechanical symptoms may be present with articular cartilage delamination and fragmentation.
- While most AVN cases are idiopathic, know risk factors include alcohol abuse, chronic steroid use, and spontaneous occurrence after arthroscopy.
- Physical examination
  - The patient usually exhibits tenderness over the affected condyle during palpation.
  - Effusions are more common when the articular surface is violated.
  - Range of motion is generally preserved.

Treatment Options—cont'd

- Secondary osteonecrosis
  - Core decompression is typically more successful in this entity.
  - May respond to osteochondral grafting and arthroplasty; often less responsive to osteotomy.

LESION SIZE

- The larger the lesion, the less likely it will respond to core decompression.

LESION LOCATION

- If the disease involves more than one condyle, it is less likely to respond to osteotomy, as is often seen with secondary osteonecrosis.

LESION STAGE

- Stages I and II: Nonoperative treatment options, including nonsteroidal anti-inflammatories, physical therapy, unloader bracing, and a period of protected weight bearing with assistive devices (cane, walker), may prove beneficial in symptom reduction and subsequent revascularization.

- Plain radiographs
  - Weight-bearing anteroposterior, flexion weight-bearing posteroanterior, and lateral radiographs can be helpful, especially in stage III or greater involvement.
  - Radiographs may demonstrate subchondral lucencies, sclerotic lines, bony fragmentation, joint space narrowing, and loose bodies in advanced cases.
- Bone scan
  - Early in the disease, the blood flow phase shows hyperemia and delayed images demonstrate focally intense uptake.
  - While helpful in the early diagnosis of AVN, up to one third of individuals with AVN have initially negative bone scans.
- MRI
  - While not as sensitive as a bone scan for detecting early AVN, MRI is very useful in assessing the extent of the disease and the presence of bone collapse.
  - T_1-weighted images show decreased signal intensity in the bone marrow (Fig. 1A and 1B).
  - T_2-weighted images demonstrate decreased signal corresponding to the lesion surrounded by high-signal edema (Fig. 2A and 2B).

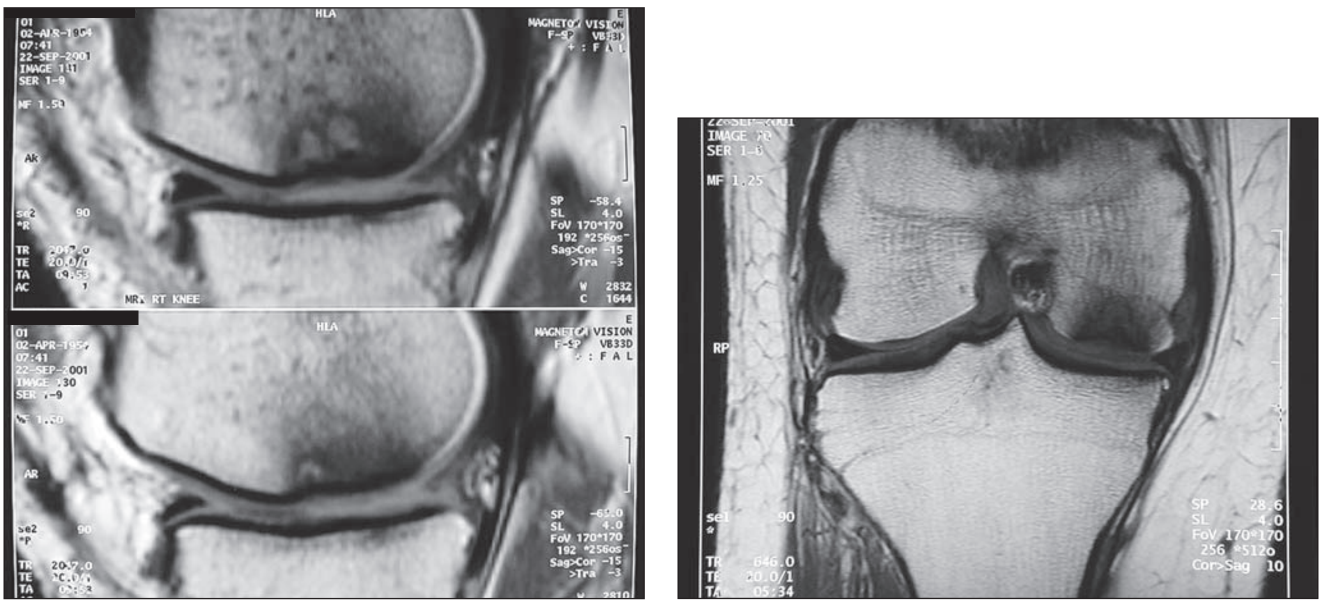

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FIGURE 1

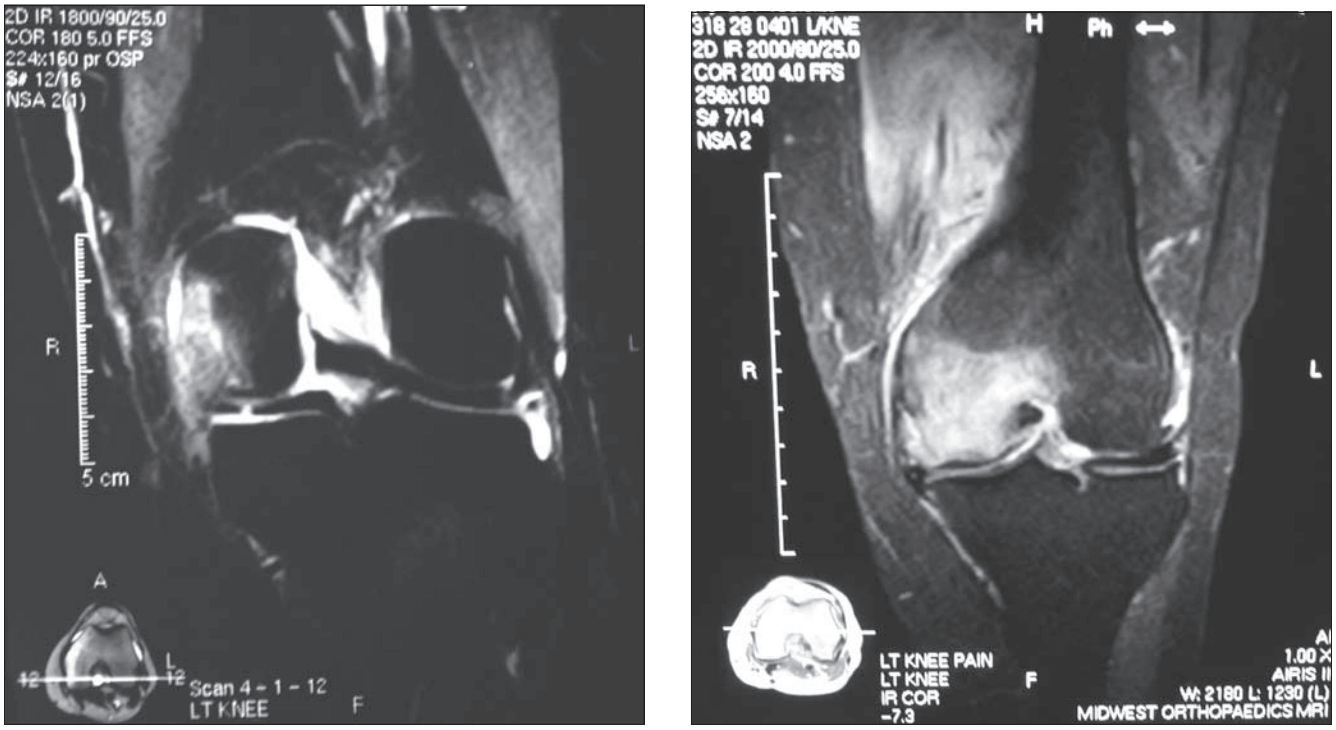

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FIGURE 2

Treatment Options—cont'd

- Stages III and beyond: Operative treatment is guided by the severity (stage) of the disease and the symptoms experienced by the patient and includes:
  - Arthroscopy, débridement, and core decompression
  - Osteoarticular grafting (see Procedures 11 and 13)
  - High tibial osteotomy (see Procedure 16)
  - Arthroplasty (unicompartment or total) (see Procedure 17)

Instrumentation

- Standard arthroscopy instruments
- Arthroscopic graspers
- Arthroscopic shaver
- Anterior cruciate ligament (ACL) protractor-type adjustable angle guide
- 2-mm guidewires
- 4.5-mm cannulated reamers

Positioning

- The patient undergoing core decompression can be placed in the supine position or in a flexed knee position using a standard leg holder. We prefer the latter because it allows knee hyperflexion and improved access for posterior lesions. It also leaves room to accommodate a C-arm or portable fluoroscan.
- A radiolucent table will facilitate fluoroscopic access in the supine position.
- A lateral post is used to stabilize the leg in a valgus position when core decompression is performed in the supine position.

Portals/Exposure

- Standard arthroscopic anteromedial and anterolateral portals are initially established.
- Accessory portals are created as necessary, including small incisions to facilitate the core decompression.

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Procedure

Step 1: Arthroscopy

- A systematic diagnostic arthroscopy is performed.
- Loose bodies and unstable cartilage edges are addressed using a grasper or a shaver (Fig. 3).
- The area that corresponds to the AVN location on MRI is localized, and a probe is used to assess the quality of the articular cartilage (Fig. 4A and 4B).

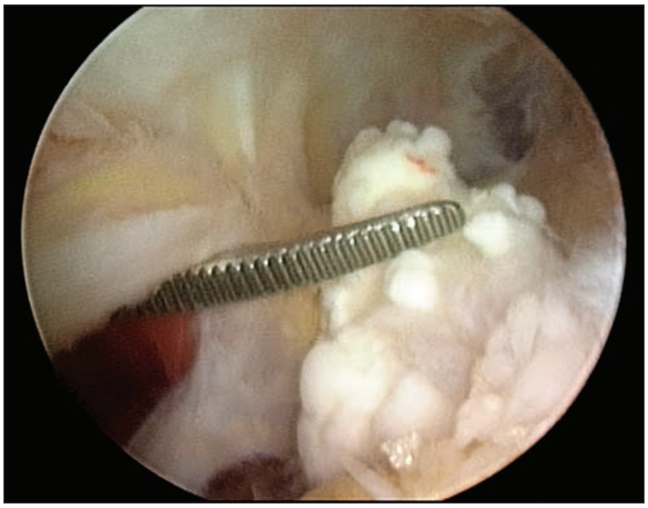

FIGURE 3

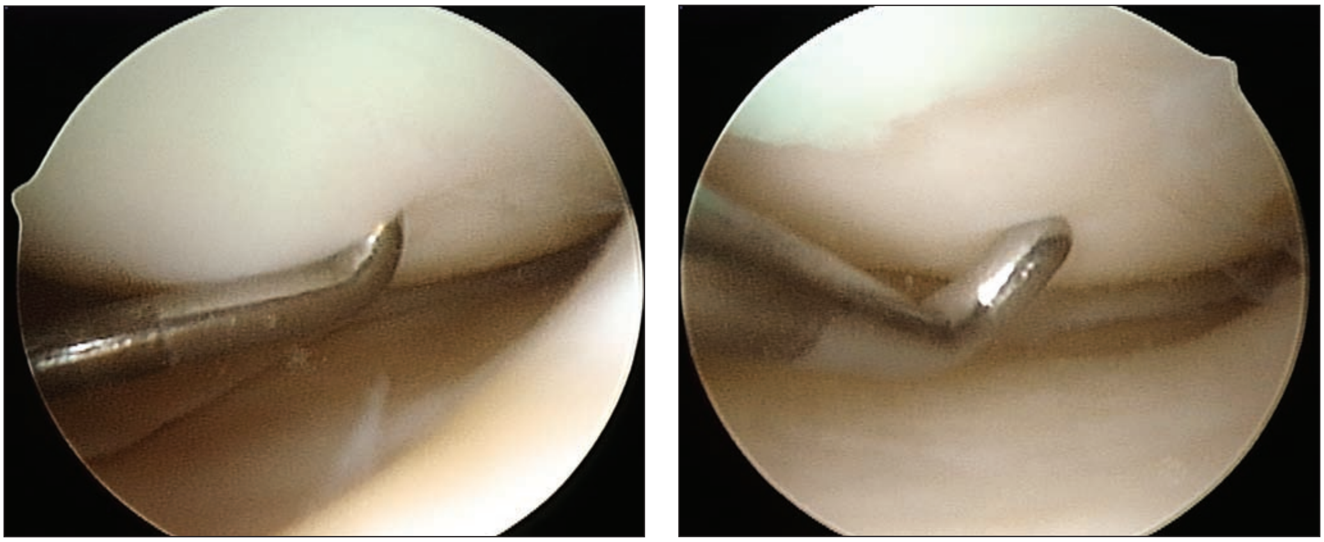

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FIGURE 4

- If the cartilage is loose and frayed, a combination of a shaver and a basket are used to débride it back to a stable rim (Fig. 5A–C). In some cases, a curette or elevator may be needed to debulk the volume of necrotic bone (Fig. 6).
- The subchondral bone can be microfractured in an effort to promote fibrocartilage formation (Fig. 7).

Step 2: Retrograde Drilling in the Femur

- This step is used if the cartilage is intact, including a relative absence of intra-articular findings during arthroscopy.
- The drilling is performed by placing the ACL drill guide sleeve percutaneously against the ipsilateral

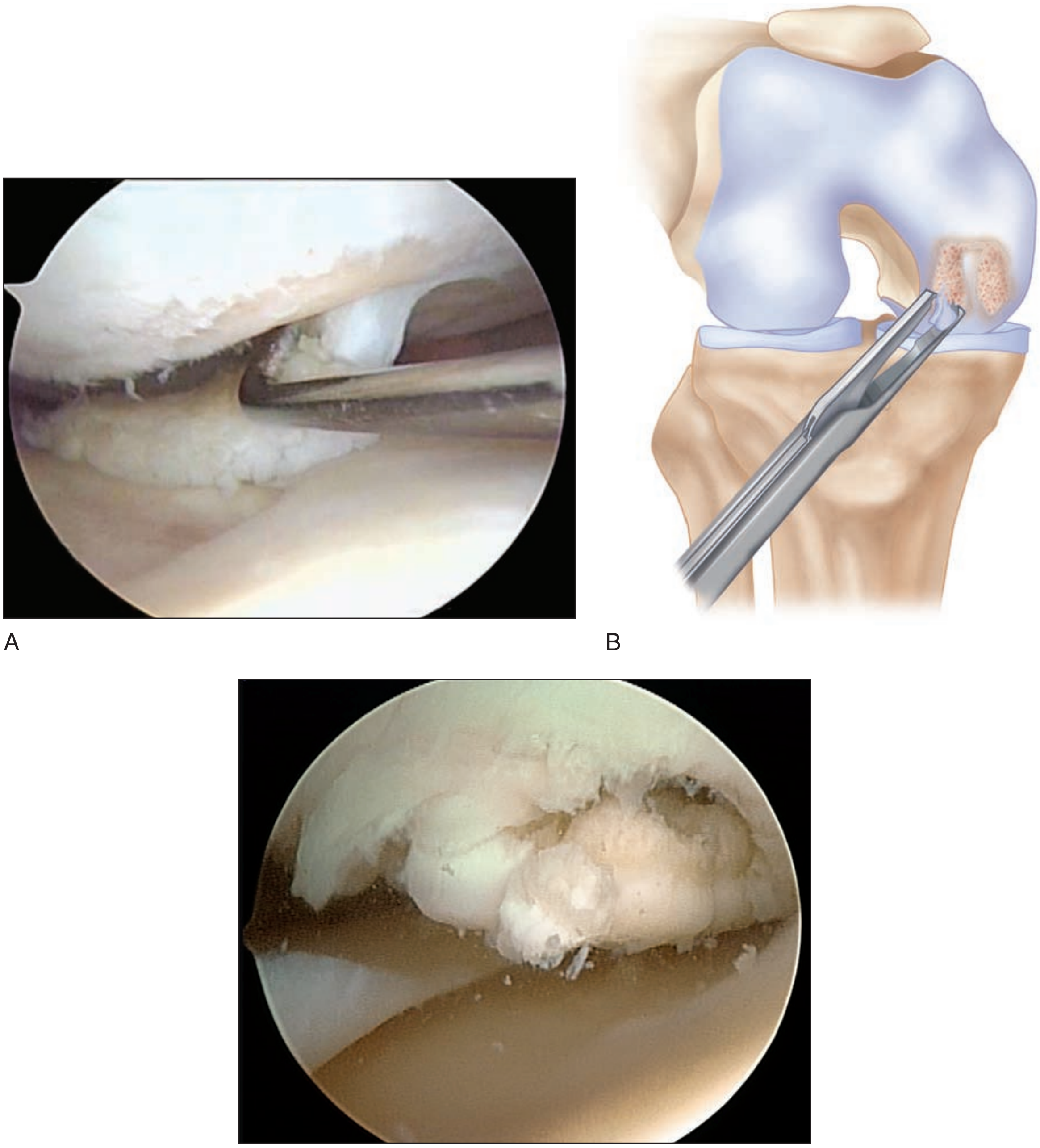

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FIGURE 5 C

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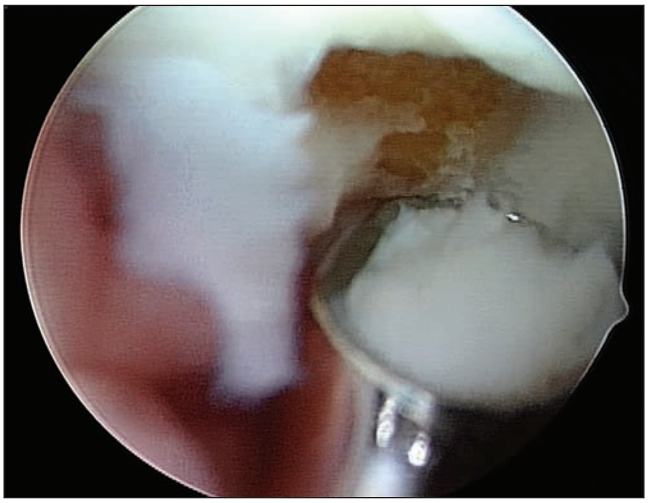

FIGURE 6

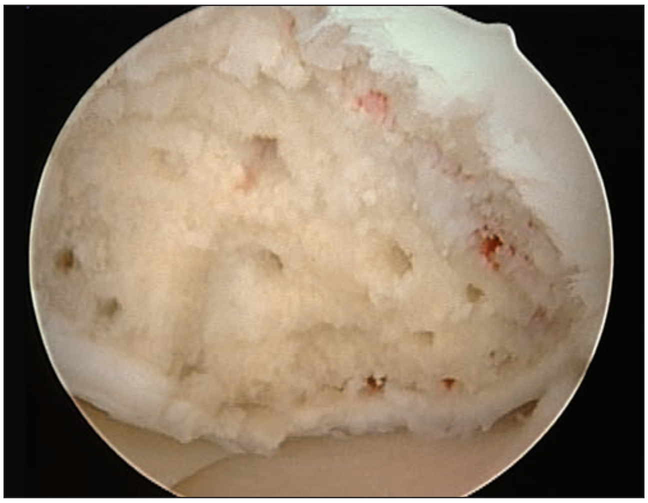

FIGURE 7

epicondyle and triangulating with the pointed guide arm placed through an appropriate portal using the preoperative imaging studies.

- Using fluoroscopy:
  - The ACL drill guide sleeve is advanced percutaneously through a small stab incision to the epicondyle. The 2-mm guidewire is placed through the guide sleeve against the epicondyle. The lesion is targeted with the marking hook placed through the ipsilateral portal, with the tip placed over the affected cartilage.
  - Under fluoroscopic guidance, the wire is advanced to the AVN zone, stopping 2–3 mm short of the articular surface.
  - The ACL drill guide sleeve is removed, leaving the pin in position.

- A 4.5-mm cannulated reamer is advanced over the guidewire in multiple passes to achieve the desired core decompression.
- The reamer is removed along with the guidewire, and the steps are repeated to target a different area.

Step 3: Closure

- Portal sites and percutaneous incisions are closed in a standard fashion.
- Sterile and compressive dressings are applied to the affected lower extremity.

Postoperative Care and Expected Outcomes

- Patients can generally be discharged home the same day.
- Depending on the extent of drilling and involved lesion, patients are allowed either touch-down weight bearing or partial weight bearing with crutches for 4–6 weeks.
- Initial physical therapy consists of passive and active range-of-motion exercises and gentle isometric quadriceps contractions.
- At 6 weeks, patients are advanced to full weight bearing and therapy is progressed to include closed-chain quadriceps exercises.
- Patients are restricted to low-impact activities for about 12 months.

Potential Complications of Core Decompression

- Penetration of the posterior cortex and potential violation of the neurovascular structures
- Inability to localize the lesion
- Soft tissue and skin burn from a percutaneous wire penetration

Evidence

Akgun I, Kesmezacar H, Ogut T, Kebudi A, Kanberoglu K. Arthroscopic microfracture treatment for osteonecrosis of the knee. Arthroscopy. 2005;21:834-43.

Forty-one patients with spontaneous or secondary AVN were treated with arthroscopic microfracture. The spontaneous AVN patients were followed for an average of 27 months. Their average defect size was 162 mm^2. The patients improved their Lysholm scores from 57 to 90, and their mean Modified Cincinnati Scale activity score improved from 6 to 13.5. The secondary AVN patients were followed for an average of 37 months. Their average defect size was 362 mm^2. Their Lysholm scores improved from 41 to 75, and their activity score improved from 2.7 to 11.7.

Flynn JM, Springfield DS, Mankin HJ. Osteoarticular allografts to treat distal femoral osteonecrosis. Clin Orthop. 1994;303:38-43.

Seventeen knees in patients under 50 years of age with large defects of the distal femur were treated with osteoarticular allografts. The patients were followed for an average of 4.2 years; 70% of the patients classified their results as good or excellent.

Forst J, Forst R, Heller KD, Adam G. Spontaneous osteonecrosis of the femoral condyle: causal treatment by early core decompression. Arch Orthop Trauma Surg. 1998;117:18-22.

Sixteen patients with stage I spontaneous osteonecrosis were treated with extra-articular drilling of the affected condyle. All 16 patients had relief of pain after surgery. Healing was seen at an average of 35.8 months after surgery. The authors recommended this procedure for all symptomatic stage I disease.

Koshino T. The treatment of spontaneous osteonecrosis of the knee by high tibial osteotomy with and without bone-grafting or drilling of the lesion. J Bone Joint Surg Am. 1982;64:47-58.

High tibial osteotomy was performed on 37 knees with AVN. Drilling or bone grafting was performed on 23 of the osteotomy patients. Patients were followed for between 2 and 8 years. Pain and walking were improved in 35 patients. Patients whose alignment was corrected had better knee scores. Radiographically, more improvement was seen in patients who had an osteotomy in addition to the drilling.

Marmor L. Unicompartmental arthroplasty for osteonecrosis of the knee joint. Clin Orthop. 1993;294:247-53.

Thirty-four patients with osteonecrosis of the medial femoral condyle were treated with a unicompartmental arthroplasty. The patients were followed for an average of 5.5 years. Good to excellent results were achieved by 89% of patients. Two patients developed AVN in the lateral compartment, and one patient continued to have pain medially.

Mont MA, Baumgarten KM, Fifai A, Bluemke DA, Jones LC, Hungerford DS. Atraumatic osteonecrosis of the knee. J Bone Joint Surg Am. 2000:82:1279-90.

A total of 136 patients with atraumatic osteonecrosis were followed after receiving different modalities of treatment. Of the 41 patients treated nonoperatively, only 20% had a successful outcome without additional surgery at a mean follow-up of 8 years. Of the 91 knees treated with core decompression, 79% had good to excellent results at a mean follow-up of 7 years. Repeat core decompression or arthroscopic débridement in 25 patients who failed their initial core decompression demonstrated 60% good to excellent results. Total knee arthroplasty performed on 48 knees had 71% good to excellent results at a mean of 9 years.

Wang CJ. Treatment of focal articular cartilage lesions of the knee with autogenous osteochondral grafts: a 2- to 4-year follow-up study. Arch Orthop Trauma Surg. 2002;122:169-72.

A retrospective review of 16 knees with focal articular defects treated with osteochondral autografts. The results were not affected by the diagnosis (osteochondritis dissecans, AVN, trauma). Good to excellent results were achieved by 80% of the patients. The improvement was time dependent and took up to 4 months to appear.

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