Osseoscopy: Direct Visualization to Assist Core Decompression and Debridement of Necrotic Bone Defects

William C. Geisert, M.D., Aaron M. Perdue, M.D., and Kagan Ozer, M.D.

Abstract: Free vascularized fibular grafting after core decompression and debridement of necrotic lesions is an effective surgical treatment of avascular necrosis of the femoral head. A technical challenge encountered in performing this procedure is ensuring adequate debridement of necrotic parts while preserving healthy bone. A previously described method accomplishes this indirectly using radioactive contrast media and fluoroscopy, increasing the risk of radiation exposure.

We propose a surgical technique using standard arthroscopic equipment to visualize inside the femoral head, facilitating precise and accurate debridement without additional radiation exposure.

Nontraumatic avascular necrosis of the femoral head is a source of significant morbidity in young, otherwise healthy patients.1-3 In the early stages of the disease, core decompression alone has been shown to slow progression.3,4,5 In later stages, core decompression with free vascularized fibular grafting to the femoral head has proved to be a promising surgical salvage option.6-10 In this procedure, a cavity to accommodate a vascularized fibular graft is created extending from the proximal aspect of the lateral femoral cortex to the area of osteonecrosis in the femoral head.11 Debridement of necrotic bone is performed from the interior of the femoral head before graft placement. Adequate debridement of the sclerotic nonviable bone is crucial for revascularization of the femoral head. In this report we propose a surgical technique used at our institution to allow direct visualization of the interior of the femoral head to assist with characterization and debridement of necrotic lesions. We use standard arthroscopic equipment with no added risk of radiation exposure.

Surgical Technique

The complete surgical technique for free vascularized fibular grafting for osteonecrosis of the femoral head has been previously described by Aldridge et al.11 and is beyond the scope of this article. This is largely the approach that we follow when performing the procedure. The part regarding visualization of the necrotic

Fig 1. Standard setup in operating room. The patient is placed in the lateral decubitus position on the table. The operating table allows passage of the C-arm underneath to perform core decompression of the femoral head. Once core decompression has been performed, the arthroscopy tower is placed on the opposite side of the table to allow direct visualization.
femoral head lesion as performed by the senior author (K.O.) is described in this report.

**Patient Positioning**

The patient is placed in the lateral decubitus position on an operating table that enables a portable radiography machine to move around beneath it. The lateral position allows 2 teams to work simultaneously on the hip and the leg for fibula harvesting. The patient’s sacral ala and pubic symphysis should be supported by 2 separate peg boards. The lower extremity is prepared from the iliac crest to the foot. A povidone-iodine–impregnated drape is applied before incision (Fig 1).

**Approach to Hip**

The operation begins with an anterolateral approach to the hip. An apex-anterior curvilinear skin incision is made over the lateral hip, centered over the greater trochanter, measuring approximately 10 to 15 cm with one-third of the incision superior to the tip of the greater trochanter and the remaining two-thirds below it.11 The tensor fascia lata is incised to allow access to the greater trochanter. For the preparation of the donor

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**Fig 2.** Radiographs taken from the same patient placed in the lateral decubitus position on the operating table. (A) On the anteroposterior view, a pin entry site is chosen at a level just proximal to the anterior border of the lesser trochanter. The pin is advanced in a proximal and medial direction toward the area of the necrotic lesion (arrows) in the femoral head. (B) A lateral image is obtained to verify that the guide pin is centered in the femoral neck and the pin is advanced into the lesion. (C) Once entry is made, a cavity to receive the graft is fashioned. Reaming is continued over the guidewire to the level of the lesion. The image shows a 10-mm reamer placed through the guidewire, reaming through the necrotic area of the bone (arrows). (D) The cavity is reamed to a diameter sufficient to receive the fibular graft while care is taken to ensure that the cortex of the femoral neck is not breached. An 18-mm reamer within the canal is shown. Throughout this procedure, the patient is placed in the lateral decubitus position with the C-arm arching over the patient, obtaining anteroposterior and lateral (frog-leg) views of the affected hip.
vessels, the vastus lateralis is reflected proximally 5 cm from the linea aspera. Then the vastus intermedius is completely detached. The lateral circumflex artery and vein are exposed deep to this plane. Once the donor vessels are prepared for anastomosis, attention is turned to the core decompression.

Core Decompression

A C-arm fluoroscopy system is draped in a position perpendicular to the long axis of the table to allow anteroposterior and frog-leg lateral views of the proximal femur. Under fluoroscopic guidance, a 3-mm guide pin is placed 2 cm distal to the vastus ridge and advanced along the center of the femoral neck toward the necrotic bone (Fig 2). Passage of the pin is confirmed on anteroposterior and lateral planes to ensure its central location along the femoral neck (Fig 2A and B). The pin should be directed at the necrotic bone. Once this has been confirmed, sequential reaming is performed through the guide pin starting with a 10-mm reamer (DePuy Synthes, Warsaw, IN) to up to 21 mm (Fig 2C and D). In the end, the reamed cavity should be large enough to receive the fibular graft. Reaming is performed under live fluoroscopic guidance to avoid penetrating the femoral head. The final diameter of the femoral canal is typically 17 to 21 mm. Any reamed fragments are saved for use as bone graft.

Osseoscopy

To ensure the adequacy of necrotic bone removal, we proceed with direct visualization of the femoral head. A standard arthroscopy setup is used, including a 30° arthroscope and an inflow-outflow cannula (Fig 3A). First, the femoral canal is irrigated on the continuous-flow setting, allowing outflow for open drainage. This clears any osseous bleeding and loose bone pieces. After 2 minutes of open irrigation, the outflow is blocked to provide better visualization and minimize fluid loss by wrapping a standard surgical sponge around the inflow-outflow cannula at a level matching the level of the lateral femoral cortex with the arthroscope fully inserted into the cavity. Passage of the pin is confirmed on anteroposterior and lateral planes to ensure its central location along the femoral neck (Fig 2A and B). The pin should be directed at the necrotic bone. Once this has been confirmed, sequential reaming is performed through the guide pin starting with a 10-mm reamer (DePuy Synthes, Warsaw, IN) to up to 21 mm (Fig 2C and D). In the end, the reamed cavity should be large enough to receive the fibular graft. Reaming is performed under live fluoroscopic guidance to avoid penetrating the femoral head. The final diameter of the femoral canal is typically 17 to 21 mm. Any reamed fragments are saved for use as bone graft.
By use of the camera, the boundaries of the lesion are identified and debridement of necrotic bone continues using curved bone curettes with long stems (Video 1).

If the canal diameter is smaller than 18 mm, operating the camera at the same time with the curette may not be possible. To achieve visualization, we switch to a dry arthroscopy technique. The cavity is irrigated and suctioned dry by use of a standard Yankauer suction tip. The camera (without inflow-outflow cannula) and curette are quickly introduced into the cavity. The demarcation between bleeding and avascular bone is apparent and used to selectively debride only the avascular areas. Because there is no counter-pressure to prevent active bleeding, the clear view is soon obstructed, which requires repeating these steps several times as needed to allow for complete and accurate debridement under direct visualization.

**Grafting and Closure**

Once all the necrotic bone is debrided, the defects are filled with autograft bone obtained during cavity...
The technique is indicated in symptomatic patients aged <50 years with osteonecrosis of the femoral head, distal femur, or humeral head requiring core decompression, as well as removal of osteonecrotic bone fragments.

Pitfalls
When the procedure is used with hip decompression, a strict non-weight-bearing protocol should be closely followed after the operation because premature weight bearing on the affected side may result in femoral head collapse or fracture.

Table 1. Indications and Pitfalls of Surgical Technique

<table>
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<th>Pitfalls</th>
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<td>When the procedure is used with hip decompression, a strict non-weight-bearing protocol should be closely followed after the operation because premature weight bearing on the affected side may result in femoral head collapse or fracture.</td>
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Table 2. Advantages and Limitations of Osseoscopy of Femoral Head

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<td>The technique allows direct, 3-dimensional visualization of the necrotic bone defect. The technique allows confirmation of complete removal of the necrotic bone defect. There is no need to use water-soluble radiographic contrast material, minimizing radiation exposure to the patient and surgeon. There is no risk of an allergic reaction to radioactive material. Use of the technique is appropriate for other parts of the body including the humerus, femoral head, and distal femur.</td>
<td>The technique requires arthroscopic instrumentation and trained staff to set up. The camera and curette may not work together if the reamed canal is &lt;18 mm in diameter. More time is required to set up the system compared with contrast media-assisted radiography.</td>
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Postoperative Care
All patients receive 1 aspirin per day for 2 weeks. Weight bearing is not allowed for 6 weeks. Only partial weight bearing is allowed between 6 weeks and 3 months until healing is observed on radiographs. In the meantime, active and passive knee, ankle, and toe motions are encouraged.

Discussion
Core decompression followed by free vascularized fibular grafting for treatment of osteonecrosis of the femoral head is a technically challenging procedure. One of the crucial steps is ensuring adequate decompression and debridement of necrotic bone while preserving as much healthy bone as possible in the femoral head. Aldridge et al. recommended using contrast creation and reaming to create a solid base for the fibular graft. The previously harvested vascularized fibular graft is inserted into the cavity, and the anastomosis is carried out. The vascularized graft is assessed for flow, and the anastomoses are examined for any leaks. The fascia of the vastus lateralis and tensor fascia lata are closed with nonabsorbable suture in an interrupted fashion. The soft tissues are approximated and the skin closed after placement of a negative suction drain.

References
5. Stulberg BN, Davis AW, Bauer TW, Levine M, Easley K. Osteonecrosis of the femoral head. A prospective...


