PROCEDURE 11

Osteochondral Autograft Transplantation

Timothy Leroux, Maximilian Meyer, Adam B. Yanke and Brian Cole

INDICATIONS

- Smaller (<2 cm^2) symptomatic localized, full-thickness, unipolar chondral lesions of the femoral condyle, trochlea or patella
- Symptoms include swelling, catching, and pain.
- Optimal lesion size less than 2 cm^2, but can be utilized in lesions up to 4 cm^2.
- Patients under 50.
- Higher physical demand.

Examination/Imaging

- History: should include a thorough review of all previous injuries, operative reports, and arthroscopic photos and videos.
- Standard radiographic imaging: weight-bearing anteroposterior, nonweight-bearing lateral, Merchant's view, 45° flexion posteroanterior view to better assess joint space narrowing, long cassette view standing films to assess malalignment.
- Magnetic resonance imaging (MRI): assesses the size and extent of the chondral lesion and evaluates for additional abnormalities (i.e., ligament or meniscus deficiency) (Fig. 11.1A and B).
- Comorbidities must be defined and corrected concomitantly or prior to autograft implantation.

POSITIONING

- The patient can be positioned in the supine position, or the limb may be placed in a standard leg holder. Our preference is to drop the foot of the bed, flex the knee, and place the extremity in a leg holder. This allows the surgeon to have more flexibility in accessing lesions on the posterior aspect of the femoral condyle.

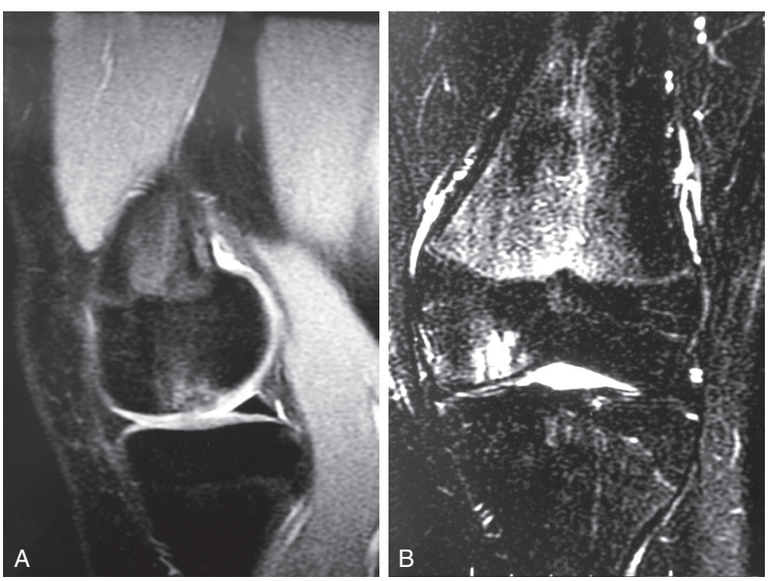


FIG. 11.1 Preoperative MRI shows cartilage defect on the medial femoral condyle and pronounced underlying subchondral edema.

CONTROVERSIES

- Inflammatory arthritis
- Morbid obesity
- Medical problems that may interfere with autograft incorporation

TREATMENT OPTIONS

Nonoperative Treatment Options

- Nonsteroidal anti-inflammatory drugs
- Cortisone injections
- Viscosupplementation
- Unloader braces
- Assistive devices (canes, walkers)
- Activity modification
- Weight loss

Operative Treatment Options

- Consider osteotomy in all patients with malalignment.
- Lesions less than 2 cm^2
  - For low-physical-demand patients or low-level symptoms: débridement, microfracture.
  - For high-physical-demand patients or high-level symptoms: débridement, microfracture, osteochondral autograft.
  - If the above fail: osteochondral allograft, autologous chondrocyte implantation.

EXAMINATION PEARLS

- The implantation incision may go through the patellar tendon. In that case, care must be taken to split the patellar tendon in line with its fibers and minimize trauma during the implantation.

10011-MILLER-9780323462921

u0135 • A tourniquet is applied but is generally not used. If a small incision is made to harvest or implant the autograft plug, the tourniquet is used but deflated prior to closure to achieve hemostasis.

s0025 PORTALS/EXPOSURE

u0145 • The procedure is generally started arthroscopically as the surgeon may decide to continue arthroscopically or perform the transfer through a small incision(s). Performing the transfer through a mini-open approach is more accurate and more reliably allows harvesting and implanting perpendicular to the articular surface.

u0150 • Standard arthroscopic anteromedial and anterolateral portals are established first. Using a spinal needle to achieve a perpendicular approach to the lesion, a small accessory portal is created once the lesion is identified. Another portal is created laterally adjacent to the proximal aspect of the patella to harvest the autologous plug.

u0155 • If an open approach is chosen, two 3-cm incisions are made for harvest and implantation. A spinal needle can still be used to create the appropriate trajectory of the instruments and to select the best and smallest incisions possible.

u0160 • Plug harvest is optimally performed open, and implantation can often be performed arthroscopically.

u0165 • The harvest incision is made along the superolateral border of the patella, where a small arthrotomy is created (Fig. 11.2). Two retractors are placed to expose the superolateral trochlea proximal to the sulcus terminalis.

u0170 • Advantages of the lateral trochlea as a donor site:

u0175 • Subjected to relatively low contact forces

u0180 • Convex surface mimicking recipient site

u0185 • Simplified access through a limited incision

u0190 • Other sources of donor plugs:

u0195 • Superomedial trochlea and superolateral notch (cannot obtain plugs larger than 6 mm)

u0200 • Opposite knee

s0030 PROCEDURE

s0035 Step 1: Diagnostic Arthroscopy

u0205 • After establishing the standard arthroscopic portals, a systematic evaluation of all compartments of the knee is performed. Any loose bodies should be removed.

u0210 • The lesion is exposed, and, if necessary, a small portion of the fat pad may be excised to facilitate visualization.

u0215 • The lesion is probed to check for diffuse arthritic changes surrounding the lesion. A sizing device or probe is used to determine lesion size (Fig. 11.3).

f0015

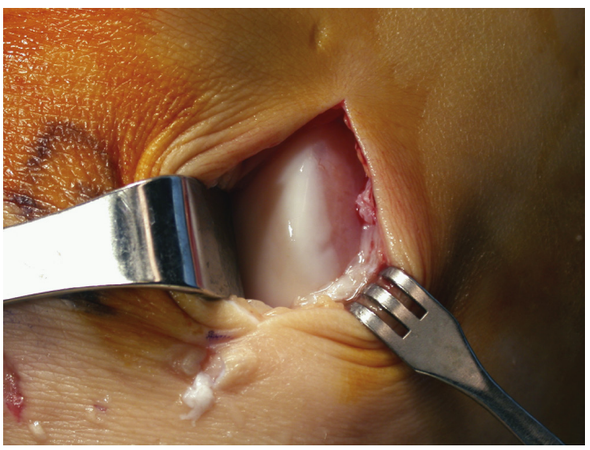


FIG. 11.2 Opening incision for graft harvest, made along the superolateral border of the patella.

f0020

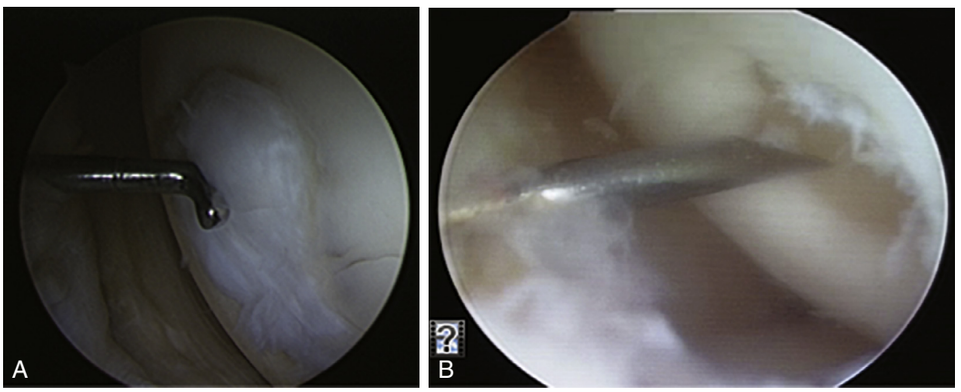


FIG. 11.3 Measurement of defect area (A) and depth (B).

f0025

FIG. 11.4 Arthrex osteochondral autograft transport system (OATS) kit.

u0220 • A number of companies distribute instrument sets for autologous plug transfers. We prefer the Osteochondral Autograft Implantation System (OATS) instruments distributed by Arthrex, Inc. (Naples, FL).

u0225 • The size of the lesion is measured using one of the color-coded sizers/tamps available in the OATS tray (Fig. 11.4). Six different sizers are available (5–10 mm) (Fig. 11.5).

s0040 ## Step 2: Harvesting The Donor Plug

u0245 • Using a perpendicular angle with the lateral trochlea, the assembled tube extractor of the appropriate size is driven with a mallet into the subchondral bone to a depth of 10 mm to 15 mm (Fig. 11.6A).

u0250 • The harvester is axially loaded and turned 90° clockwise (Fig. 11.6B), then counterclockwise. The harvester is then removed. Inspection should be made to verify that the donor plug is intact inside the harvester tube.

s0045 ## Step 3: Preparing the Recipient Site

u0265 • The recipient harvester is placed at 90° to the recipient lesion. The harvester is rotated until the size markings are visible.

u0270 • A mallet is used to drive the harvester into the recipient site up to about 2 mm less than the depth previously achieved by the donor harvester (Fig. 11.7). Using the same rotational maneuvers, the recipient plug is removed.

u0275 • An alignment stick is used to measure the depth of the recipient socket.

u0280 • The recipient socket is inspected to make sure it is clean of any bony debris (Fig. 11.8A and B).

b0025

STEP 1 PEARLS

- It is very important to avoid rotation or levering of the harvesting tube during initial impaction.
- Once the desired depth is met, if difficulty is encountered in removing the donor plug, the harvester can be gently levered proximally, distally, and side to side to break the plug from its cancellous bony bed.
- If the plug still is not captured in the harvesting tube, a small thin osteotome can be used along the side of the condyle to transect the junction of the plug and host, freeing the osteochondral plug.

b0030

STEP 2 PEARLS

- Knee flexion has to be maintained constant during the preparation of the recipient site.
- Watching the laser lines on the recipient harvesting tube as it is impacted assures that the tube remains perpendicular during the impaction process.

f0030

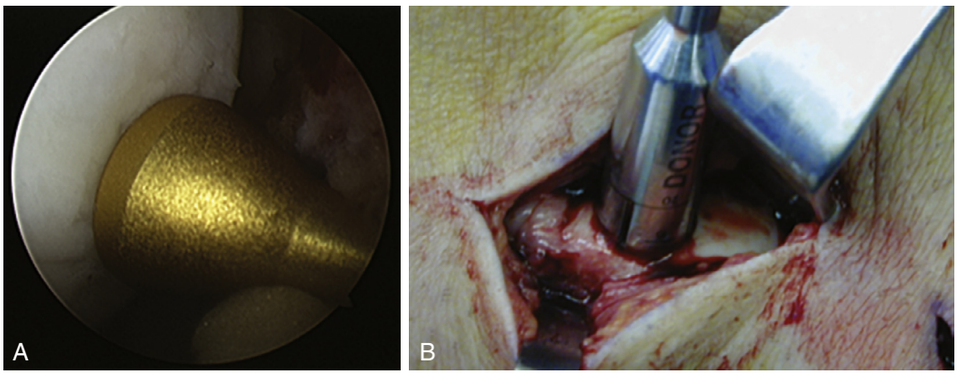
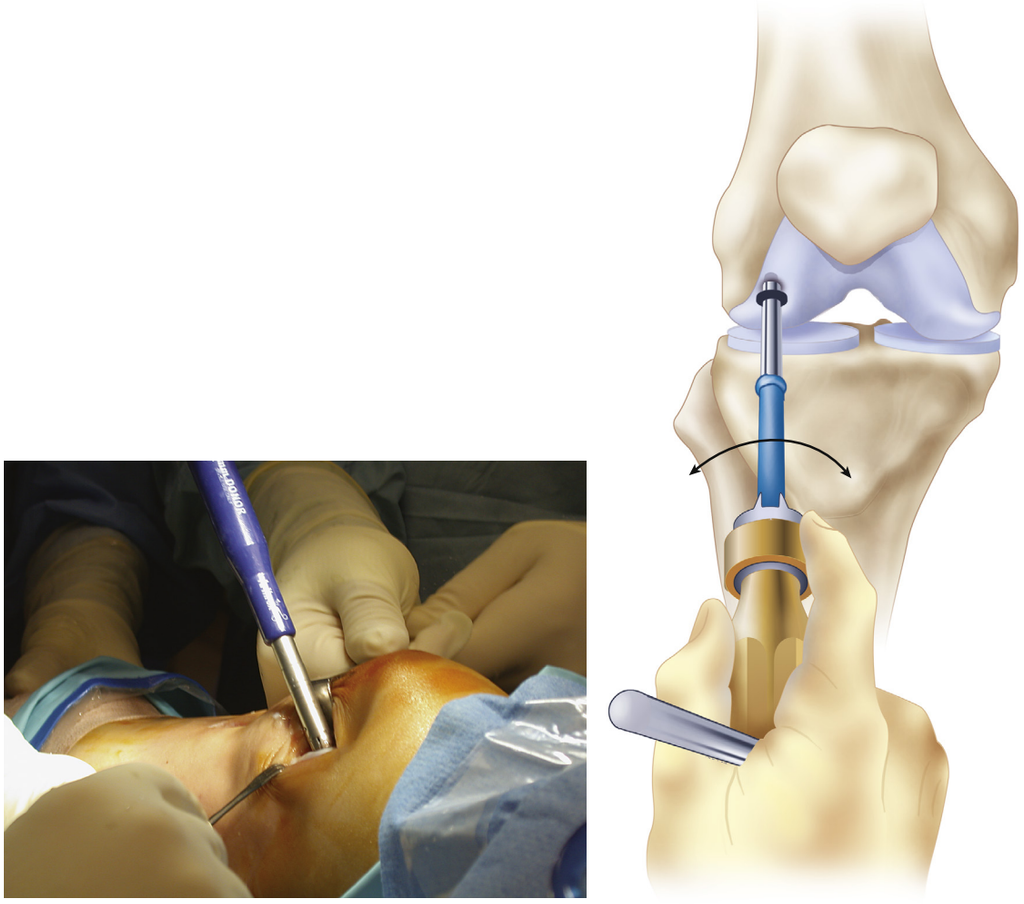


FIG. 11.5 Matching harvest size (A) to defect area (B).

f0035



[AU6]

FIG. 11.6 Harvest of osteochondral core (A). Note that the harvester is rotated 90 degrees clockwise and then 90 degrees counterclockwise to liberate the donor plug (B).

s0050 ## Step 4: Placing the Donor Plug

u0285 • The donor harvester is placed inside the recipient socket and the donor graft is gently extruded. The collard pin of the harvester is advanced until the pin is flush with the pin calibrator. This places the graft 1 mm outside of the socket.

u0290 • A tamp that is 1 mm larger in diameter than the plug is used to gently advance the plug further (Fig. 11.9A and B) until it is fully seated (Fig. 11.10A and B).

f0040

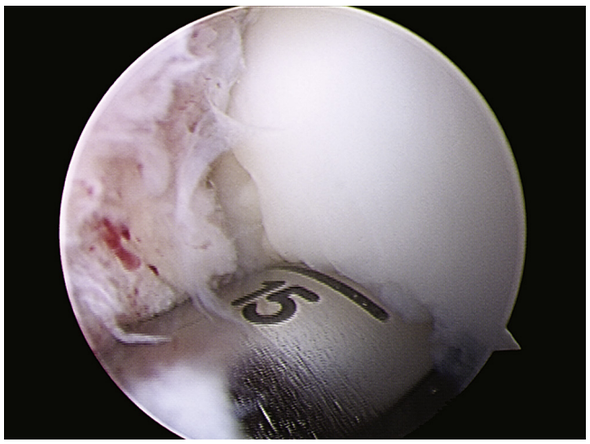


FIG. 11.7 Preparation of the recipient site using harvester device.

f0045

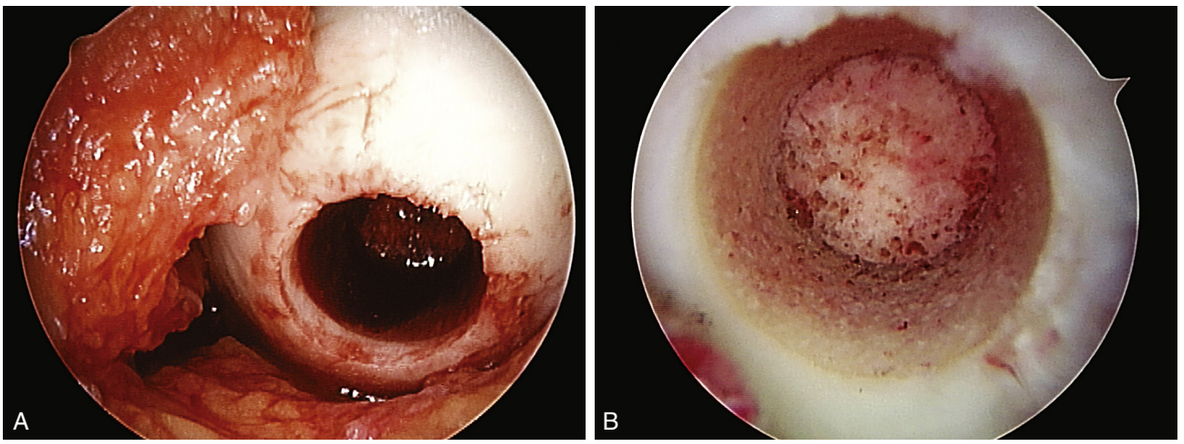


FIG. 11.8 Recipient socket after preparation (A) and removal of residual bony material (B).

u0295 • If multiple plugs are needed, it is important to complete each transfer before creating a subsequent recipient socket (Fig. 11.11).

u0300 • The knee is cycled to make sure the graft is stable.

s0055 ## Step 5: Closure

u0305 • If an open procedure is chosen, the tourniquet is deflated, and hemostasis is achieved.

u0310 • Arthrotomy incisions are closed in layers. No drains are necessary.

u0315 • A knee brace locked in full extension is applied and is taken off only for physical therapy.

s0060 ## Postoperative Care and Expected Outcomes

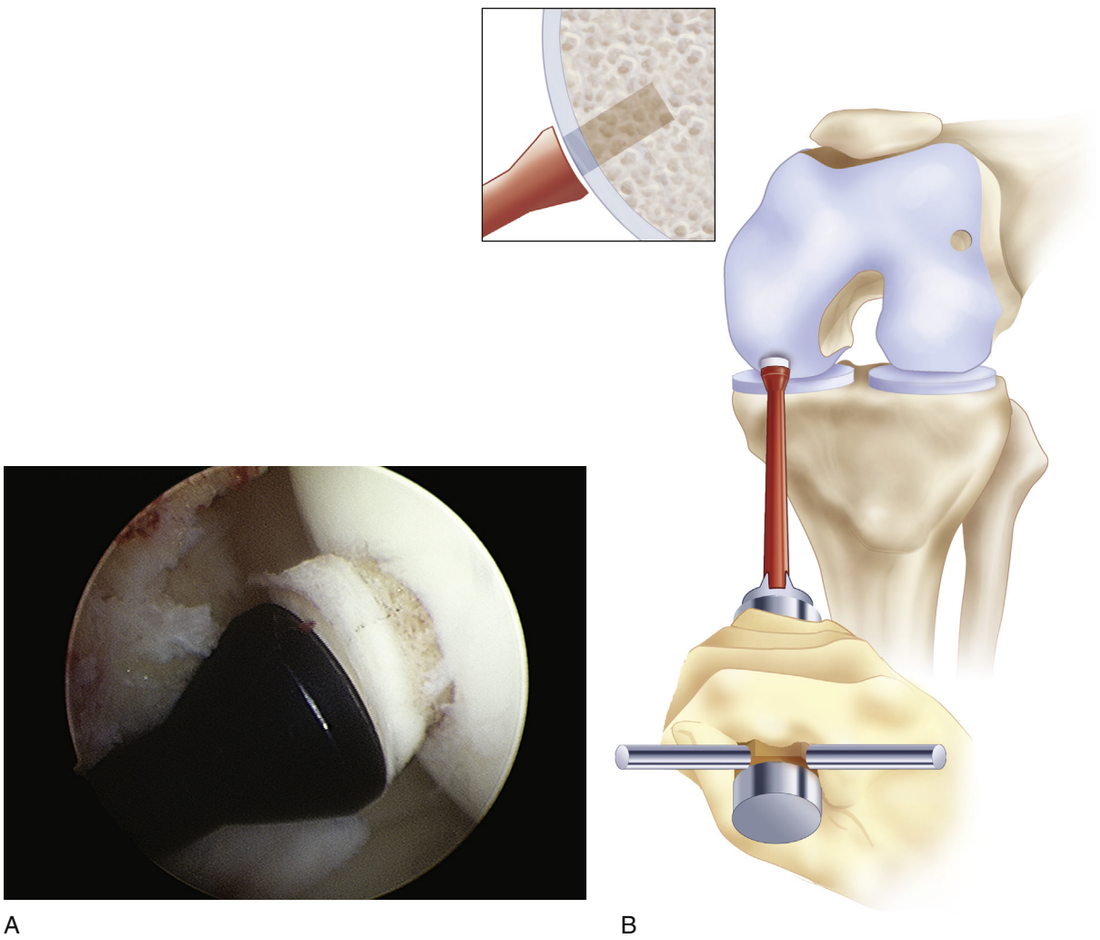
u0320 • Phase I (0–6 weeks)

u0325 • Patients are usually made partially weight bearing with crutches. In cases of contained and well-fixed defects, relatively early advances in weight bearing may begin in the first 2 weeks.

u0330 • The brace is locked in full extension for 1 week and then unlocked and maintained in place during ambulation for the next 3 weeks.

u0335 • Brace use is discontinued when the patient can perform a straight leg raise without any extension lag.

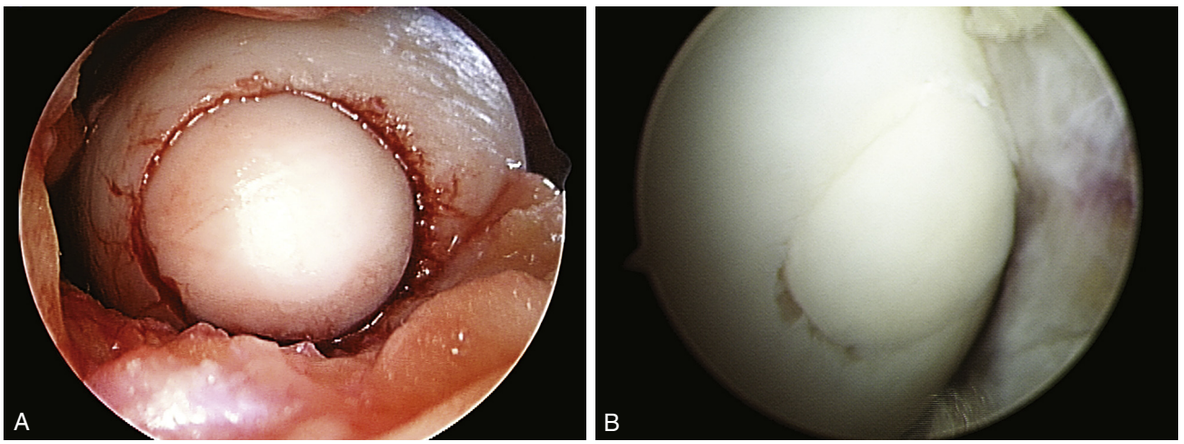
u0340 • Continuous passive motion is started immediately. Patients are asked to use it for about 6 hours each day for the first 6 weeks. Gradual increases in flexion angle as tolerated are allowed immediately.



f0050

[AU7]

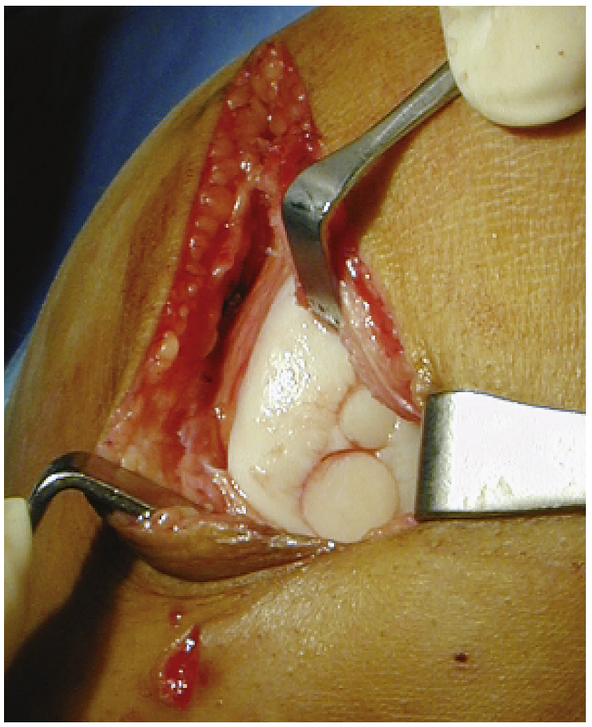
FIG. 11.9 Gentle advancement of osteochondral plug into recipient site using a tamp that is 1 mm larger than the core itself.



f0055

[AU8]

FIG. 11.10 Arthroscopic images of completed osteochondral autograft transfer into the femoral condyle.



f0060

FIG. 11.11 Larger defects may require multiple osteochondral autografts, also known as a "snowman graft". Note the importance of finalizing the initial transfer before proceeding onto subsequent graft harvest.

u0345 - Physical therapy works mainly on passive and active-assisted range of motion. A stationary bike is also used.

u0350 • Phase II (6–8 weeks)

u0355 - Patients are progressed to full weight bearing.

u0360 - The brace is discontinued.

u0365 - Flexion of 130° should be achieved by 8 weeks.

u0370 - Physical therapy begins gait training and closed-chain quadriceps strengthening.

u0375 • Phase III (8–12 weeks)

u0380 - Full, painless range of motion should be achieved.

u0385 - Physical therapy is continued with advanced activities.

u0390 - Return to sports is delayed until the patient has objective evidence of autograft incorporation (4–6 months).

POTENTIAL COMPLICATIONS

b0035

- Hemarthrosis
- Donor site morbidity
- Graft fracture
- Infections
- Arthrofibrosis
- Graft failure

s0065 EVIDENCE

Astur DC, Arliani GG, Binz M, Austur N, Kaleka CC, Amaro JT, Pochini A, Cohen M: Autologous osteochondral transplantation for treating patellar chondral injuries: evaluation, treatment, and outcomes of a two-year follow-up study, J Bone Joint Surg Am 96:816–823, 2014.

The authors prospectively followed 33 patients receiving autologous osteochondral transplantation for symptomatic, full-thickness chondral defects in the patella. At 2-year follow-up, all patients showed significant improvements in Lysholm, Kujala, Fulkerson, and Short Form-36 scores. All follow-up magnetic resonance imaging showed full bone-plug integration into the patella.

Hangody L, Fules P: Autologous osteochondral mosaicplasty for the treatment of full-thickness defects of weight-bearing joints: 10 years of experimental and clinical experience, J Bone Joint Surg Am 85:25–32, 2003.

The authors reported their 10-year results in treating patients with osteochondral autografts. Good to excellent results were reported in 92% of patients with femoral condyle lesions, 87% with tibial lesions, and 79% with patellar or trochlear lesions.

Horas U, Pelinkovic D, Herr G, Aigner T, Schnettler R: Autologous chondrocyte implantation and osteochondral cylinder transplantation in cartilage repair of the knee joint, J Bone Joint Surg Am 85:185–192, 2003.

The authors reported the results of a randomized controlled trial comparing 40 patients treated with autologous chondrocyte implantation (ACI) to 40 patients treated with osteochondral autografts. At a minimum of 2-years' follow-up, both groups had significant improvements, but the Lysholm scores of the ACI group lagged behind the osteochondral autograft group. The osteochondral autograft group showed consistent hyaline cartilage, whereas the ACI group showed mainly fibrocartilage.

Jakob RP, Franz T, Gautier E, Mainil-Varlet P: Autologous osteochondral grafting in the knee: indications, results, and reflections, Clin Orthop 401:170–184, 2002.
The authors treated 52 patients with osteochondral autografts, with an average follow-up of 37 months. At the latest follow-up, improved knee function was observed in 92% of the patients. The treatment results were limited by the size of the lesion and the number of plugs implanted.

Koh JL, Wirsing K, Lautenschlager E, Zhang LO: The effect of graft height mismatch on contact pressure following osteochondral grafting, Am J Sports Med 32:317–320, 2004.
A biomechanical study used swine knees to investigate the effect of graft height mismatch on contact pressures following osteochondral grafting. After defect creation, the contact pressures were elevated by 20%. A flush graft plug reduced the pressure to normal. A proud plug (0.5 mm) increased the contact pressures by 40%. A countersunk graft increased the contact pressures by 10%.

Krych AJ, Harnly HW, Rodeo SA, Williams III RJ: Activity levels are higher after osteochondral autograft transfer mosaicplasty than after microfracture for articular cartilage defects of the knee: a retrospective comparative study, J Bone Joint Surg Am 94:971–978, 2012.
The authors conducted a retrospective study comparing 48 patients receiving osteochondral autograft transplantation mosaicplasty to 48 patients receiving microfracture for full-thickness cartilage defects of the femoral condyle or trochlea. While both treatment groups reported significant improvements in patient reported outcome scores (SF-36, Knee Outcome Survey, IKDC), the osteochondral autograft group reported significantly higher Marx Activity Rating Scale scores at 2-year, 3-year, and 5-year follow-up, suggesting that patients receiving autografts maintain a superior level of athletic activity compared with those treated with microfracture.

Lynch TS, Patel RM, Benedick A, Amin NH, Jones MH, Miniaci A: Systematic review of autogenous osteochondral transplant outcomes, Arthroscopy 31:746–754, 2015.
The authors conducted a systematic review of all randomized trials and cohort studies on osteochondral autograft transplantation between 1950 and 2013 and found nine studies matching inclusion criteria. They concluded that osteochondral autograft transplantation improves clinical outcomes when compared with preoperative conditions and may allow return to sport as early as 6 months after the procedure. Furthermore, osteochondral autografting is more appropriate for lesions that are smaller than 2 cm.

Marcacci M, Kon E, Delcogliano M, Filardo G, Busacca M, Zaffagnini S: Arthroscopic autologous osteochondral grafting for cartilage defects of the knee: prospective study results at a minimum 7-year follow-up, Am J Sports Med 35:2014–2021, 2007.
The authors prospectively evaluated 30 patients undergoing osteochondral autograft for focal articular cartilage defects of the knee that were less than 2.5 cm. Patients reported significant improvements in IKDC and Tegner scores at 7-year follow-up, and MRI showed good graft integration into the host bone in over 60% of cases.