Summary
Fresh osteochondral allografting is a reconstructive technique with a long clinical history. In fresh allografting, diseased or damaged articular cartilage is replaced with living mature hyaline cartilage from a suitable donor. The bony portion of the allograft serves as an attachment vehicle or to reconstruct associated osseous defects. Fresh allografts can be used for a wide spectrum of pathology, ranging from focal chondral lesions to posttraumatic arthrosis. The surgical technique involves fashioning the allograft to fit into a prepared recipient site. Outcomes of fresh allografting for focal femoral condyle lesions are 75–90% successful while results in salvage situations range from 50–75% successful at follow-up intervals from 2 to 15 years. Many unique clinical issues associated with fresh osteochondral allografting require further investigation, but clinical success supports the use of fresh allografts as a cartilage repair technique.

Key Words: Allograft; cartilage injury; cartilage repair; cartilage transplant; osteochondral allograft.

HISTORICAL BACKGROUND
Initial experimentation with fresh joint transplantation started with Erich Lexer in the early 1900s (1); however, in the modern era, fresh small-fragment osteochondral allografting for the treatment of articular cartilage injury and disease began in the 1970s. This clinical experience, along with basic scientific investigation, has provided an understanding of the rationale and support for the use of fresh osteochondral allografts.

Currently, fresh osteochondral allografts are utilized to treat a broad spectrum of articular cartilage pathology, from focal chondral defects (2,3) to joints with established osteoarthrosis (4). Most commonly, allografts have successfully treated osteochondritis dissecans (OCD) lesions (5), osteonecrosis (6), and posttraumatic cartilage defects of the knee (7,8). Allografts also have been successfully utilized in the treatment of osteochondral lesions of the ankle and hip joints (9–11).

RATIONALE
The fundamental concept governing fresh osteochondral allografting is the transplantation of architecturally mature hyaline cartilage with living chondrocytes. It is the notion that these living chondrocytes survive transplantation and are thus capable of supporting the cartilage matrix indefinitely following implantation into the host knee. Hyaline cartilage possesses characteristics that make it attractive for transplantation. It is an avascular tissue and therefore does not require a blood supply, meeting its metabolic needs through diffusion.
from synovial fluid. It is an aneural structure as well and does not require innervation for function. Third, articular cartilage is relatively immunoprivileged (12) as the chondrocytes are embedded within the articular cartilage matrix and are relatively protected from host immune surveillance.

The second component of the osteochondral allograft is the osseous portion. The bony portion of the fresh osteochondral allograft is dead (void of cells) and functions as a support for the living articular cartilage layer and as a vehicle that facilitates attachment and fixation of the graft to the host. The osseous portion of the graft is quite different from the hyaline portion because it is a vascularized tissue, and cells are not thought to survive transplantation; rather, the osseous structure functions as a scaffold for healing to the host by creeping substitution (similar to other types of bone graft). Generally, the osseous portion of the graft should be limited to a few millimeters; however, depending on the clinical situation, the allograft may contain more extensive amounts of bone, as might be required to restore injured or absent subchondral tissue. Large osteochondral lesions such as those associated with OCD, osteonecrosis, or posttraumatic reconstruction may require the transplantation of a large bony component.

In light of the aforementioned concepts, it is helpful to consider a fresh osteochondral allograft as a composite graft of both bone and cartilage, with a living mature hyaline cartilage portion and a nonliving subchondral bone portion. It is also helpful to understand the allografting procedure in the context of a tissue or organ transplantation. The graft essentially is transplanted as an intact structural and functional unit replacing a diseased or absent component in the recipient joint. The transplantation of mature hyaline cartilage obviates the need to rely on techniques, which are central to other restorative procedures, that induce cells to form cartilage tissue; however, the allograft has its own set of clinic issues, including the following:

1. Complexities of acquisition, processing, and storage of the donor tissue.
2. Safety concerns with respect to disease transmission from donor tissue to host.
3. Immunological behavior of the allograft.
4. The allograft–host bone interaction.

DONOR TISSUE

Graft Acquisition

The cornerstone of an allografting procedure is the availability of fresh osteochondral tissue. It is important to note that currently, in fresh osteochondral allografting, the small-fragment allografts are not human lymphocyte antigen- (HLA) or blood type-matched and are utilized fresh rather than frozen or processed, such as is used in other bulk allografting or tumor-reconstructive procedures. The rationale for fresh tissue use in this application is predicated on the concept of maximizing the quality of the articular cartilage in the graft. This is in distinction to cases of large osseous reconstructions, for which restoration of the osseous defect is the primary goal and for which frozen tissue may be more appropriate.

Despite numerous efforts at cryopreservation and other freezing protocols that might maintain chondrocyte viability, it has been demonstrated that the cryopreservation freezing process kills chondrocytes (13), and that this effectively eliminates more than 95% of viable chondrocytes in the articular cartilage portion of osteochondral grafts. Furthermore, clinical experience has shown that the articular matrix in transplanted frozen allografts deteriorates over time; this phenomenon presumably occurs because there are no cells