Technical Note

The Arthroscopic Implantation of Autologous Chondrocytes for the Treatment of Full-Thickness Cartilage Defects of the Knee Joint

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Abstract: Autologous chondrocyte implantation is an established option for the treatment of full-thickness cartilage defects of the knee. Open implantation has a high morbidity. On a resorbable polymer fleece, autologous chondrocytes can be implanted arthroscopically. Transosseous anchoring assures high initial stability of the implant. Tibial defects can be addressed. The arthroscopic technique for the implantation of autologous chondrocytes eliminates a substantial amount of the side effects known to occur after open autologous chondrocyte implantation procedures. Key Words: Autologous chondrocyte implantation—Arthroscopy—Cartilage—Knee—Chondrocytes

Since the report of Brittberg et al. in 1994 introducing the clinical application of autologous chondrocytes for the treatment of cartilage defects, more than 5,000 cases are documented and results are presented in various publications. The clinical outcomes in short-term to midterm studies seem to be promising, especially for patients with a failed previous cartilage procedure. A major disadvantage of the technique is the morbidity of the implantation when performed as an open procedure. More than 26% of the procedure-related side effects are contributed to the arthrotomy; predominantly in the form of fibroarthrosis. Adhesions, decreased range of motion, postoperative pain, and impressive scars can be minimized by using an arthroscopic approach. The original technique described by Brittberg was characterized by the instillation of a chondrocyte suspension under a periosteal flap into a “bioactive chamber.” Refined ways of cell proceeding now allow the culture and expansion of chondrocytes on 3-dimensional resorbable scaffolds to standardize cell distribution and improve operative handling. Various constructs have been tested in animal models. Our technique is based on a 2-mm thick polymer fleece loaded with $5 \times 10^6$ autologous chondrocytes in a fibrin gel. Standard sizes are $2 \times 1$ cm and $3 \times 2$ cm. The constructs are delivered on time for implantation on femoral condyles and tibial plateau.

TECHNIQUE

The setup is standardized with the possibility of flexing the knee intra-operatively. A ventrolateral portal is used. The instrument portal ventromedially is equipped with an 8-mm water-stop canula. The defect site is carefully debrided to a rectangular shape down to the subchondral bone plate with a curette or a sharp spoon (Fig 1). A stable shoulder surrounding the defect is mandatory. For the anterior segment of the lesion a selection of anterior-posterior spoons is nec-
necessary. The size of the defect is determined using a scaled needle that can be inserted percutaneously in all necessary angles. The construct is then cut accordingly. For femoral lesions, all 4 corners of the defect are drilled with a guidewire in an inside-out technique (Fig 2). An additional portal might be appropriate. Using a resorbable thread (2-0), the scaffold is armed on the corners (Fig 3). One 3-fold knot approximately 1 cm from the edge secures the sling. An additional knot approximately 2 cm out moors the sling, which serves as a pulley. The pulley slings are now pulled into the joint by the guidewire and through the femoral bone. This is when the construct penetrates the joint, rolled up through the canula. Firm action on the pulleys guides the knots into the drill holes. The scaffold is now securely anchored. The pulley slings are cut close to their dermal exit and removed. Tibial defects are prepared as described above. The anchoring holes are created with a modified anterior cruciate ligament drill guide in an outside-in technique. Single resorbable threads are knotted to the corners of the construct leaving 1 long end that is the guided into the joint and through the holes using a suture retriever. A short incision might be helpful to ease the tibial introduction of the retriever. Coordinated tension on all 4 threads will pull the scaffold through the canula as described. Caution has to be executed to avoid twisting of the threads. Different color threads might be beneficial. Finally the threads are tied over the bony bridges 2 by 2. The joint is then mobilized to control the secure positioning of the scaffold (Fig 4). Irrigation, drainage, and suturing of the portals terminates the operation. Early continuous passive motion and reduced
weight bearing on crutches are essential for the rehabilitation program.

**DISCUSSION**

The arthroscopic technique for the implantation of autologous chondrocytes eliminates a substantial amount of the side effects known to occur after open autologous chondrocyte implantation procedures. According to the nature of minimally invasive surgery, the postoperative rehabilitation is faster due to reduced pain and muscular deficits (e.g., patellar tracking). Extensive animal studies on rabbits and horses have shown ingrowth and resorption of the scaffold as well as the promotion of hyaline cartilage regeneration.6,7 The intraosseal fixation of the scaffold was repeatedly tested for pull-out strength in cadaveric knees. Arthroscopic autologous chondrocyte implantation highlights the biologic character of the method and opens new horizons for the treatment of cartilage defects.

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**REFERENCES**