Technical Note

Bone Graft Procurement for Patellar Defect Grafting in Anterior Cruciate Ligament Reconstruction

James D. Ferrari, M.D., and Bernard R. Bach, Jr., M.D.

Summary: Bone grafting of the patellar defect from harvest of the central third bone–patellar tendon–bone autograft in anterior cruciate ligament (ACL) reconstruction has been advocated by some authors to decrease the risk of patellar fracture from the existing stress riser as well as decrease postoperative donor site pain. We present a method of harvesting bone reamings during ACL reconstruction that is simple, efficient, and maximizes the amount of bone that can be collected. **Key Words:** Patellar bone grafting—ACL reconstruction—Bone–patellar tendon–bone autograft.

The treatment of the anterior cruciate ligament (ACL)-deficient knee using autogenous central third patellar bone-tendon-bone (BTB) substitution is a common method for ACL reconstruction. Its excellent biomechanical properties, easy surgical access, and the ability to achieve immediate rigid bone-to-bone fixation with eventual healing are several of the reasons for its appeal.[1] Patellar fracture, an uncommon but significant problem, and graft donor site pain are two complications cited as reasons for using alternative graft sources.[2-7] Primary bone grafting of the patellar defect is advocated by some authors as a means of both decreasing the stress riser and potential risk of patellar fracture and minimizing patellar donor site pain.[8-10]

During the course of ACL reconstruction, bone can be collected from various sources. Reamings collected during drilling of the tibial tunnel provide the most bone volume, with femoral tunnel reamings also providing a significant amount. These can be collected in a cup or flushed out onto gauze. Notchplasty chips can be removed of articular cartilage and grafted also. Should more bone be desired, cancellous bone can be curetted from the proximal tibia through the tibial tubercle graft defect. Ideally bone reamings from the tibial and femoral tunnels are maximally collected during the procedure for use in grafting the patellar and tibial tubercle defects. The purpose of this article is to present our technique for harvesting bone reamings during the course of ACL reconstruction that maximizes bone collection.

TECHNIQUE

We currently use an endoscopic technique utilizing the central third BTB autograft. The graft is harvested as the initial step in the operation if examination under anaesthesia with Lachman, anterior drawer, and pivot shift testing unequivocably reveals ACL insufficiency. The graft is harvested with the knee flexed and the surgeon sitting. An 8- to 10-cm incision is made 5 to 10 mm medial to the midline, extending from the distal third of the patella to 2 to 3 cm distal to the tibial tubercle. Sharp dissection is carried down through the deep retinacular layer, which is reflected medially and laterally. A small incision is then made in the peri-

From the Department of Orthopaedic Surgery, Section of Sports Medicine, Rush Medical College, Chicago, Illinois, U.S.A.

Address correspondence and reprint requests to Bernard R. Bach, Jr., M.D., Rush-Presbyterian-St. Luke's Medical Center, 1725 W. Harrison St, Suite 1063, Chicago, IL 60612, U.S.A.

0749-8063/98/1405-1880$3.00/0

tenon, which is then extended longitudinally with scissors to expose the patellar tendon and its origin and insertion. The tendon's width is then measured, and the center of the tendon is determined. A No. 10 blade is then used to incise one edge of the graft, paying careful attention to remain parallel to the tendon fibers. The soft tissue overlying the patella and tibial tubercle is incised as well. The second edge of the graft is then taken, with the goal of harvesting a tendon width of 10 mm with a patellar bone plug 10 mm in width and 22 to 25 mm in length and a tibial bone plug 10 mm in width and 25 mm in length. An oscillating saw with a No. 238 saw blade is then used to make bone cuts of 5 to 6 mm in depth, fashioning the patellar plug as a trapezoid on profile and the tibial plug as an equilateral triangle on profile. In general, the patellar plug is then fashioned to fit a 10-mm diameter bone tunnel and the tibial plug to easily slide through an 11-mm bone tunnel. During bone plug contouring, excess bone removed is saved for future bone grafting.

The arthroscopic portion of the procedure is then begun. The initial aspect of the notchplasty is started with a quarter-inch curved osteotome. Approximately 3 to 5 mm of cartilage and bone is removed along the lateral aspect of the intercondylar notch, and the osteochondral fragments are then removed with a grasper. An assistant then removes the articular cartilage and the bone is saved for grafting. The notchplasty is then completed with the arthroscopic motorized burr.

An ACL tibial tunnel aiming device is then used to place a guide pin in the center of the anatomic footprint of the ACL. A cannulated bone reaming collector is placed over the 11-mm cannulated reamer (Linvatec, Largo, FL) and is pushed flush against the proximal tibial bone surface (Fig 1). Owens Gauze nonadherent surgical dressing (American Cyanamid, Wayne, NJ) is placed below the reamer as well. Reaming is begun, and when the guide pin begins to rotate just prior to the reamer entering the joint, the inflow pump is turned off. The reamer then penetrates the joint and is then removed. Careful attention is paid to keeping the bone reamings collector flush against the bone until the reamer is fully removed from the tibial tunnel. The reamer and its collector are then removed from the drill and brought to the back table and the bone is then removed from the collector (Fig 2). The pump is turned back on and excess reaming are caught with the Owens Gauze, which has been kept just distal to the tibial tunnel. The Owens Gauze allows for easy and complete removal of the bone it has caught, whereas it is generally difficult to remove bone particles from standard surgical sponzes or ''lap'' pads. The femoral tunnel is drilled dry and the 10-mm reamer is removed. The Owens Gauze is once again placed below the tibial tunnel and the pump is turned back on with the reamings caught by the gauze. A large amount of bone graft is easily obtained (Fig 3). The graft is then appropriately placed within its tunnels and secured with Kurosaka interference screws. The graft defect is then closed with the knee flexed using 3 to 4 interrupted simple sutures of No. 1 Vicryl (Ethicon, Somerville, NJ). Bone graft is then placed in the patellar defect. We are routinely able to fill our patellar defects with the bone we harvest and have bone left to place in the tibial defect as well. The peritenon is then closed over the patella and its tendon, securing the bone graft

FIGURE 1. Bone harvester is placed over the cannulated reamer and flush against the tibial cortex. Owens Gauze is placed below the reamer to catch any other bone particles that may escape the harvester.

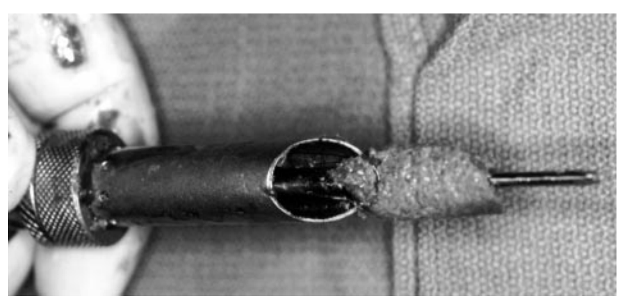

FIGURE 2. Reamer and guide pin are protruding through the bone harvester with a core of cancellous bone that was collected.

FIGURE 3. Total amount of bone collected in the harvester.

in place. Closure is completed with interrupted subcutaneous 2-0 Vicryl sutures and a running subcuticular 3-0 Prolene suture (Ethicon).

DISCUSSION

Patella fracture after ACL reconstruction is an extremely uncommon complication of harvesting the BTB graft. Carangelo et al.[5] reported on eight postoperative patella fractures out of 1,497 ACL reconstructions with BTB autograft (0.53%). Four of these cases had been bone-grafted and four had not. Bear et al.[2] reviewed 8 of 2,300 reconstructions for an incidence of 0.35%. Christen and Jakob[6] identified 9 cases of 490 reconstructions for a 1.8% incidence. Whether bone grafting is efficacious in preventing patella fracture is a question not likely to be answered, as performing a randomized, prospective study with enough power to be significant would require an extremely large number of patients. Nevertheless, we feel that every effort should be made to bone graft the patellar defect to minimize the stress riser. In the experience of the senior author (B.R.B.) with 693 ACL reconstructions using BTB autograft and bone grafting the defect, no patella fractures have occurred. Furthermore, no cases of heterotopic ossification, which has been proposed as a reason not to bone graft, have been identified.[3]

Bone grafting of the patellar defect has also been advocated to decrease donor site pain. Martin et al.[9] prospectively evaluated 15 patients who had defects grafted and 19 who did not. Grafted patients had no local pain, whereas 21% of nongrafted patients had pain at the patellar defect. Differences were noted up to 2 years postoperatively. Grafted patients had higher and more consistent patellofemoral pain scores and earlier radiographic evidence of defect healing as well. Differences were most marked at early follow-up. By filling the bony defect, no bone-soft tissue step-off is present, and no soft tissue can roll over the edge of the bone defect, which may be a source of pain. Finally, should revision ACL reconstruction be necessary in the future, the reconstituted patellar bone stock may allow reharvesting of the central third patellar tendon.

CONCLUSION

It is recommended that the patellar defect created in harvesting the bone–patellar tendon–bone autograft for ACL reconstruction be bone-grafted at the time of closure to both decrease the stress riser and potentially diminish the risk of postoperative patella fracture as well as minimize donor site pain and morbidity. A simple and effective means of bone graft harvesting which maximizes bone collection during reaming of the tibial and femoral tunnels is presented.

REFERENCES

1. Noyes FR, Butler DL, Grood ES, et al. Biomechanical analysis of human ligament grafts used in knee ligament repairs and reconstructions. *J Bone Joint Surg Am* 1984;66:344-352.
2. Bear BJ, Cohen SC, Bowen M, et al. Patella fracture after anterior cruciate ligament reconstruction using bone patella bone autogenous grafts. *Orthop Trans* 1996;20:9 (abstr).
3. Berg EE. Management of patella fractures associated with central third bone-patella tendon-bone autograft ACL reconstructions. *Arthroscopy* 1996;12:756-759.
4. Bonatus TJ, Alexander AH. Patellar fracture and avulsion of the patellar ligament complicating arthroscopic ACL reconstruction. *Orthop Rev* 1991;2:23-27.
5. Carangelo RJ, Caputo AE, Langeland RH, et al. Postoperative patella fractures after autogenous patellar tendon harvesting for anterior cruciate ligament reconstruction. *Orthop Trans* 1995; 19:24 (abstr).
6. Christen B, Jakob R. Fractures associated with patellar ligament grafts in cruciate ligament surgery. *J Bone Joint Surg Br* 1992;74:617-619.
7. McCarroll JR. Fracture of the patella during a golf swing following reconstruction of the anterior cruciate ligament. *Am J Sports Med* 1983;11:26-27.
8. Daluga D, Johnson C, Bach BR Jr. Primary bone grafting following graft procurement for anterior cruciate ligament insufficiency. *Arthroscopy* 1990;6:205-208.
9. Martin RP, Galloway MT, Daigneault JP, et al. Patellofemoral pain following ACL reconstruction: Bone grafting the patellar defect. *Orthop Trans* 1996;20:9 (abstr).
10. Roberts TS, Drez D Jr, Parker W. Prevention of late patellar fracture in ACL deficient knees reconstructed with bone-patellar tendon-bone autografts. *Am J Knee Surg* 1989;2:83-86.