A Technique Utilizing GraftNet to Fill Graft Donor Sites in Bone-Patellar-Bone Anterior Cruciate Ligament Reconstruction

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Abstract: Anterior knee pain and patella fracture are 2 potential complications of bone-patellar-bone autograft anterior cruciate ligament reconstruction. Techniques have been developed to minimize the risk of these complications, including filling the defects with autologous bone fragments and augmenting with biologic agents. We have developed a technique that uses a graft collection device to collect the autologous bone graft generated during surgery. This graft augments the larger bone graft derived from the bone plugs. This autologous augmentation provides a complete biologic strategy to potentially reduce the risk of anterior knee pain and potential patella fracture.

Bone-patella-bone is the gold standard of anterior cruciate ligament (ACL) reconstruction. Donor site morbidity, however, is 1 disadvantage of this technique that has led to the use of other techniques for ACL reconstruction. Although the risk of patella fracture is low, the rate of anterior knee pain has been reported to be as high as 34%. The risk of patella fracture and anterior knee pain has been related to patellar and tibial defects. Various studies have demonstrated that filling these defects after the reconstruction decreases anterior knee pain. The bone debris generated while reaming the femoral and tibial tunnels, chips collected during the notchplasty, cancellous bone curetted from the proximal tibia, and fragments from sizing the bone blocks can be used to fill the defects and provide structural support. Biologic agents containing growth factors have also been added to the bone graft to promote healing. Autologous fluids such as platelet-rich plasma (PRP) have anti-inflammatory properties and an ability to stimulate healing that, in theory, could decrease knee pain and help fill the defects.

The use of autogenous bone grafting is important because it provides osteoconductive, as well as presumed osteogenic, factors. Previous studies have shown that reaming the tibial and femoral tunnels generates the largest amount of bone graft, but retrieving the graft from the joint efficiently has proven difficult. We describe a technique using the GraftNet device (Arthrex Inc, Naples, FL) to easily and efficiently collect the tunnel reamings and notchplasty bone to augment the larger fragments from the bone blocks. Our technique helps to completely fill the defect while improving biology.

Technique

After standard bone-patella-bone harvest, the bone blocks are appropriately sized using a saw and a rongeur. The bone removed from the bone blocks is reserved in a sterile specimen cup. There are 3 opportunities for the collection of autologous bone using the GraftNet device. A Frazier suction catheter, collection device, and suction tubing are assembled (Fig 1A and B). We used a 14-Fr suction tip to ensure that the bone would not clog the tip. If removing the bone at the same time as reaming, then Frazier tip suction is inserted adjacent to the reamer via the anteromedial portal. The GraftNet apparatus captures the reamings while reaming the femoral tunnel (Fig 1C) (Video 1). The reamer is removed, but the Frazier tip remains in the knee to remove any excess
bone graft. The suction tip and GraftNet apparatus are then removed from the joint. The alternative is to finish reaming the femoral tunnel, remove the reamer from the anteromedial portal, and then immediately replace it with the suction tip to collect the reamings via the anteromedial portal. Using the arthroscopic viewing screen, we confirmed that we had collected all of the reamings that had been removed from the joint.

The GraftNet apparatus is disconnected from the suction and taken to the sterile back table. The stem is easily removed from the chamber, and the bone graft is placed into a sterile specimen cup. The reamings from the femoral tunnel generate approximately 3 mL of autologous bone graft (Fig 2, Video 1). If notchplasty is performed before femoral reaming, the GraftNet device...
can be used to collect the bone through the burr by connecting the device directly to the burr.

The GraftNet device is then reconnected to the suction tubing and Frazier tip. During antegrade tibial tunnel drilling, the suction tip with the connected GraftNet device is placed at the tibial aperture via the anteromedial portal to collect the efflux of bone reamings. Collection of all of the reamings is once again confirmed using the arthroscopic viewing screen. The GraftNet device is then again disconnected and taken to the sterile back table. The device is disassembled like previously, and the bone graft is emptied into the same sterile specimen cup as the tibial reamings. Once all of the bone has been collected, a variety of biologic augmentation can be used to improve the handling, texture, and biology of the graft. These include bone marrow concentrate, PRP, autologous conditioned plasma, and whole venous blood taken from the patients. In this case, we added 3 mL of whole venous blood to each specimen cup and mixed the blood with the reamings (Video 1). This provides for an easily molded graft that is structurally and biologically robust (Fig 3).

Once the patella tendon has been closed in a side-to-side fashion using simple, interrupted sutures, the patellar defect can be grafted. During grafting, the patellar and tibial defects are first filled with the bone graft obtained from sizing the patellar and tibial bone blocks (Fig 4A). The patellar defect is grafted first. A retractor is placed proximal to the patellar defect to expose the defect. The larger fragments of bone obtained during the sizing of the graft are placed into the patellar defect. Using large pick-ups, the GraftNet-collected bone is used to completely fill the defect (Fig 4B). We do not attempt to close patellar tendon over the patellar defect. While still retracting to expose the proximal patellar defect, the overlying paratenon is closed using size 0 Vicryl suture in a running fashion (Fig 4C). Once the graft site has been covered and the paratenon has been closed to the point of the tibia, the tibial defect is filled the same way as the patellar defect. Oftentimes the paratenon is inadequate to cover the graft in the tibial defect. In these circumstances, a flap of periosteum is sutured to adjacent fat or subcutaneous

**Fig 4.** Right side. Patient is supine. The lateral side is to the left. The medial side is to the right. (A) The large fragments of bone graft collected while sizing the femoral and tibial bone blocks are placed into the patellar and tibial defects. The proximal portion of the incision adjacent to the patellar defect is on the left, and the distal portion of the incision adjacent to the tibia defect is on the right. (B) Large pick-ups are then used to place the reamings on top of the large pieces of bone graft. The filled defect is marked with an asterisk. (C) The paratenon is then closed over the defects to help contain the bone graft material. Here, the paratenon is closed over the patellar defect while the tibial defect has yet to be filled.

| Table 1. Pearls and Pitfalls of the GraftNet Device |
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| **Pearls** |
| Leave the retractor exposing the patellar defect in place until the graft site is completely closed by the paratenon. |
| Inserting the suction tip while reaming the femoral tunnel improves visualization. |
| Adding a biologic adjuvant significantly improves the handling of the graft material. |
| **Pitfalls** |
| Over-stuffing the patella defect may cause the suture to tear through the paratenon in an attempt to stretch it over the graft. |
| The graft will not remain in the patellar defect if the paratenon is not completely closed over graft. |
tissue to cover the graft. The subcutaneous tissues and skin are then closed in the desired fashion (Table 1).

Discussion

Previous studies have proven that filling the patellar and tibial defect decreases anterior knee pain in ACL reconstruction.\(^1\)\(^,\)\(^3\)\(^,\)\(^5\) The GraftNet device technique described here provides an efficient means of preserving high-quality, autologous bone from reaming the femoral and tibial tunnels, as well as notch-plasty. The graft augments the larger bone fragments obtained from sizing the bone blocks. This method provides structural support and osteogenic factors to promote healing. Additional biologic factors can also be added to aid in healing because the device removes the moisture from the bone particulate. The GraftNet device typically extracts more graft than is needed to fill the defects (Table 2).

Limitations do exist with this technique. The cost of the device may be prohibitive for some locations. If the defect is “overstuffed,” then the paratenon may be damaged while trying to close it over the graft site. Additionally, adding biologic agents such as PRP may be an additional cost.

Table 2. Advantages and disadvantages of the GraftNet device

| Advantages                                      | Disadvantages                           |
|------------------------------------------------|-----------------------------------------|
| More bone collected for grafting               | Potentially higher costs                |
| Potentially improved healing via autologous factors | Difficult without intact paratenon     |

The broad applications of the GraftNet device have not all been explored, but this technique has proven to be effective in our experience. Further study of the device is of interest, including with use for cartilage, soft tissue, and additional bone applications.

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