Opening Wedge High Tibial Osteotomy

A Novel Technique for Harvesting Autograft Bone

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ABSTRACT: High tibial osteotomy can provide 10 to 15 years of consistent pain relief and improved function for most patients with unicompartmental knee arthritis. However, some studies have reported less predictable results, with deteriorating survivorship after 10 years of follow-up. Therefore, it is paramount to carefully select patients and to understand that technical errors during surgery often lead to poor outcomes. It is well established that obese patients, as well as undercorrected osteotomies, often lead to early failure, with rapid degeneration of the arthritic compartment. Although many surgical techniques describing high tibial osteotomies have been previously published, most techniques share similar surgical principles. What differentiates our technique from others is the mode of harvesting local autograft bone to fill our osteotomy site. For several years, a specialized harvester has been used to obtain distal femoral cancellous bone. This technique is simple, efficient, reproducible, and safe. This article reviews the novel technique for opening wedge high tibial osteotomies.


INTRODUCTION

Osteotomies involving the knee can be performed in a number of ways, depending on the location and severity of deformity, as well as on the surgeon’s training and experience. For medial knee compartment degenerative disease, the correction is generally performed through a closing lateral wedge or opening medial wedge osteotomy. There are myriad advantages and disadvantages to both.

The main advantages of a closing wedge osteotomy include predictable healing, improved stability with the possibility of earlier weight bearing, and a long track record with proven results. Some drawbacks include increased technical challenge, requirement of a concomitant fibular osteotomy or disruption of the proximal tibia fibular joint, and previous concerns about patella baja.11,14

However, an opening wedge procedure is simpler and does not involve disrupting the fibula or the proximal tibia fibular joint. The surgeon can gradually correct the malalignment, unlike the closing wedge, which requires a more precise calculation of correction. However, the drawbacks include a longer healing time, potentially higher nonunion rates, and loss of reduction.15 For this particular reason, we prefer to use local cancellous autograft bone to ensure rapid and predictable healing of the osteotomy site.

SURGICAL TECHNIQUE

The patient is placed on a radiolucent Jackson table and fluoroscopy is used to evaluate the osteotomy site and limb alignment. We prefer a midline knee incision starting at the proximal pole of the patella. The distal limb of the incision is brought inferior to the tibial tubercle, staying just medial to the crest of the tibia. This allows the surgeon to perform arthroplasty safely in the future, if needed, and does not compromise exposure for the osteotomy. After the skin and subcutaneous tissue are incised,
we elevate a full thickness medial fasciocutaneous flap to preserve the blood supply to the skin.

The pes anserine tendon insertion is identified and a knife is used to incise the distal insertion of the medial collateral ligament just superior to the semitendinosus tendon. The incision runs obliquely thru the medial collateral ligament starting from the tibial crest and follows the superior border of the semitendinosus tendon. One must be careful to stay directly on bone and avoid incising too far posteriorly into the gastrocnemius-soleus musculature. Next, the periosteum is incised longitudinally, just medial to the tibial crest. In this way, a T-shaped periosteal flap can be fashioned using a periosteal elevator to allow room for placement of our hardware (Figure 1). The posterior compartment muscles are identified and carefully elevated subperiosteally with a Cobb elevator off the posterior surface of the tibia. A sponge is then packed between the bone and posterior compartment muscles, and a Hohmann retractor is used to protect the neurovascular bundle from injury (Figure 2).

Next, we use a limited medial subvastus approach, elevating the distal vastus medialis obliquus muscle anteriorly off the intermuscular septum. This step is needed later to harvest the cancellous autograft bone from the distal femur. Unless the preoperative plan calls for a concomitant intra-articular procedure, we stay superficial to our capsule and do not violate the synovium. The C-arm is used to check our proposed osteotomy site, and a smooth pin is drilled thru the tibia to guide the bone cut. We begin with an oscillating saw and complete the osteotomy with an osteotome. We then use a two-prong wedge and a mallet to carefully open our osteotomy site by an amount determined from our preoperative plan (Figure 3). Alternatively, one could use laminar spreaders. We also use

Figure 1. The MCL is partially elevated to allow room for the Puddu plate (Arthrex Inc, Naples, Fla). Note that the MCL fibers closer to the joint line are left undisturbed to prevent postoperative collateral ligament instability. Figure 2. A retractor and sponge are placed to protect the neurovascular structures from inadvertent injury during the osteotomy. Figure 3. The C-arm shows the gradual correction obtained by impacting the double-prong wedge. Note that the bovie cord is being used to aid in judging the correction of the mechanical axis. Figure 4. Placement of the fixation plate.
the C-arm and a bovie cord to ensure the weight bearing axis passes thru the appropriate area of the tibial plateau. When the mechanical axis has been corrected, we secure the osteotomy with a T-shaped Puddu plate (Arthrex Inc, Naples, Fla) (Figure 4). We do not hesitate to place staples laterally as well, if it appears that the lateral cortex has been violated.

To obtain the bone graft, we use a standard OATS harvester (Osteochondral Autologous Transfer System; Arthrex Inc) that can be found on an Osteochondral Autograft set (Arthrex Inc) (Figure 5). A harvester that is 9 mm or 10 mm in diameter is usually more than sufficient. We retract the vastus medialis obliquus, which was elevated earlier, and incise the periosteum just superior to the adductor tubercle. There are often several small blood vessels in this area that may need to be coagulated.

A mallet is used to impact the chisel into the distal femur taking a cylinder of cancellous bone approximately 3 cm in length (Figure 6). It is important to place the OATS harvester adjacent to the adductor tubercle and direct it toward the center of the medullary canal, thus avoiding anterior or posterior cortical perforation (Figure 7). Before the device is backed out of the femur, it should be toggled in a circular motion to ensure the bone plug remains within the harvester and is not left within the femur. Several passes can be made using the same entry hole by slightly changing the direction of impaction. The chisel can be aimed proximally or distally during each successive impaction. In this manner, abundant autograft can usually be obtained from the distal femur. Again, the key is to avoid perforation of the opposite cortex. If there is any doubt as to the direction of the harvester, the C-
arm should be used to ensure safe passage of the device within the metaphysis (Figure 8). The autograft is then packed into the osteotomy site and may be supplemented with allograft bone if desired. The OATS harvester is used to deliver the donor bone directly into the osteotomy site. First, the back end of the OATS harvester handle is detached. This exposes the smooth wire tip that is connected to an internal elevating bone tamp seated within the chisel (Figures 5 and 9). By gently tapping the wire at the opposite end of the chisel with a mallet, the autograft bone is pushed out of the harvesting device and can be delivered into the proximal tibia. In a similar manner, we impact cancellous allograft chips into both the osteotomy site and the donor site using multiple OATS chisels filled with allograft bone (Figures 9 and 10). While the surgeon is obtaining the autograft from the distal femur, the scrub technician or surgical assistant fills the multiple OATS chisels with cancellous allograft. This allows for efficient supplemental packing of the opening wedge, as well as

the donor site, if the surgeon elects to do so during the surgery (Figure 11).

The cortical cap from the first bone plug is usually removed and inserted back into the distal femur. Alternatively, the periosteum alone can be used to cover the donor site if the cortical cap does not fit properly. Finally, we place two drains, one directly posterior to the tibia to decompress the posterior compartment and the other positioned more superficial. The medial collateral ligament is reapproximated with 1-0 nonabsorbable sutures and the rest of the closure is routine. Postoperatively, the knee is placed into a hinged brace and range of motion exercises are started. All of our patients are given warfarin sodium for deep vein thrombosis prophylaxis. Weight bearing often begins 6 to 8 weeks after surgery if signs of healing are evident on follow-up radiographs.

CONCLUSION

The popularity of high tibial osteotomies has declined somewhat in recent years, mainly due to the increase in the number of unicompartmental and total knee replacements performed. Another argument for this decline is the variability discussed in the literature regarding the long-term survivorship of high tibial osteotomies. Some
studies show 80% to 90% survivorship after 10 or more years. However, other studies show less success, with only 50% to 70% survivorship between 5 and 10 years of follow-up.1,3,8,9

Even with these results, high tibial osteotomy is still an important part of an orthopedic surgeon’s armamentarium against degenerative knee arthritis. However, careful patient selection is necessary to ensure a positive outcome. Patients should be young and active, with unicompartmental joint disease. In addition, technical errors have led to early treatment failures. Coventry4 found greater than 90% 10-year survival when the postoperative tibiofemoral valgus was 8° or more versus 63% survival when the valgus was 5° or less.

The technique of high tibial osteotomy is well described in the literature. There are advantages and disadvantages to both opening and closing wedge procedures. The opening wedge osteotomy is technically easier to perform; however, some surgeons avoid using this technique due to concerns over nonunion. For this reason, we prefer to use local cancellous autograft from the distal femur to stimulate bone healing.

We have described an effective, safe modification for obtaining local autograft during opening wedge high tibial osteotomies. The senior author (T.M.) has used the OATS harvester for several years without complications related to its use. Specifically, there have been no fractures or infections related to the use of this technique. The senior author has performed over 100 opening wedge high tibial osteotomies using the OATS harvester with only one nonunion, which was subsequently treated successfully with a repeat bone grafting procedure and internal fixation. Thus, in the senior author’s experience, this procedure has demonstrated greater than a 99% union rate, which compares favorably to the literature.13

We recommend using the OATS harvester for obtaining local cancellous autograft during opening wedge proximal tibial osteotomies. We have found this technique to be very reliable, leading to high union rates without any additional complications.

REFERENCES