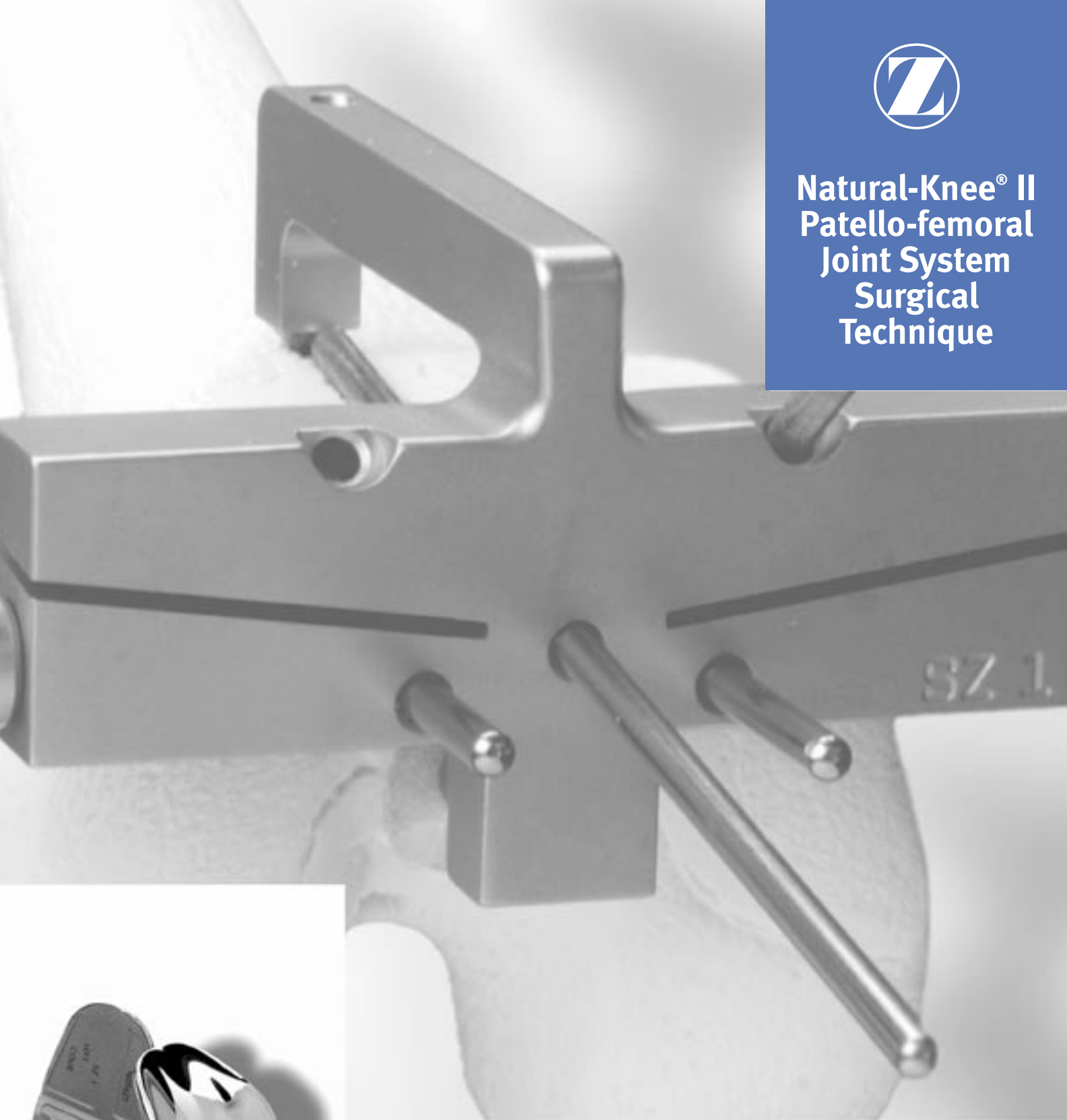




Natural-Knee® II Patello-femoral Joint System Surgical Technique



A conservative option for younger patients

Surgical Technique

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Introduction

Patello-femoral joint arthroplasty (PFA) has been shown to be an effective treatment for osteoarthritis that is isolated to the anterior compartment of the knee joint. By limiting the reconstruction to the patello-femoral joint, and retaining the soft tissues that contribute to normal knee motion, the procedure can result in the preservation of healthy bone stock and optimized knee kinematics. It provides a conservative option for younger patients who may otherwise be considered for total knee arthroplasty (TKA). The PFA procedure can be converted to a TKA procedure intraoperatively if the exposure reveals unexpected involvement of the tibiofemoral joint. Also, if necessary, a PFA can be easily revised to a TKA.



Combined with the surgeon's judgment and appropriate use of the device, this guide offers a comprehensive technique that discusses the procedure for patient selection, component selection, bone preparation, trial reduction, and component implantation.

Rationale

Since 1986 the *Natural-Knee*® System has been used to successfully treat more than 450,000 patients. Long-term clinical results have confirmed that the design considerations of the *Natural-Knee* System have resulted in improved motion and stability, as well as normal alignment and stable fixation of the implant. The *Natural-Knee* II Patello-femoral Joint System incorporates the same proven design elements as the *Natural-Knee* II Primary System and applies them to isolated patello-femoral joint disease.

Device Design

The patello-femoral joint system incorporates a number of design elements that facilitate implantation and contribute to a desirable outcome. The trochlear component has a deepened patellar groove that is designed to allow smooth articulation of the patella through the full range of motion while minimizing the load on the patellar component.

The implant is bone sparing, requiring minimal removal of subchondral bone due to the design of the four-faceted fixation surface. Bone removal is different for each facet. This provides the deep trochlear groove while allowing the surgeon to remove a minimal amount of bone. Moreover, the femoral preparation does not damage the bone stock used for primary total knee arthroplasty.

Well-fixed and stable implant/cement and cement/bone interfaces contribute significantly to the long-term success of PFA. The cobalt-chromium alloy component is designed to achieve secure cemented fixation. The cement interface surfaces on the implant are grit blasted to enhance the implant/cement interface, and the implant is further secured with pegs to increase stabilization.

When the prosthesis is appropriately sized and properly implanted, the edges of the component are flush with the adjacent articular cartilage to ensure a smooth transition with surrounding bone. This helps avoid soft tissue impingement and irritation during joint motion.

The trochlear implant is compatible with the unresurfaced patella. If the surgeon chooses to resurface the patella, the trochlear component can be used with a standard *Natural-Knee* Patellar Component.



Instrument Design

Designed to allow for a reproducible technique, the instrumentation for the *Natural-Knee* II Patello-femoral Joint System combines the flexibility of freehand alignment with the precision of instrumented bone cuts. Femoral bone resections are referenced off of proximal and distal points of the center facet on the back of the implant to help ensure a smooth transition to the natural anatomy.



The instrumentation for the patello-femoral joint system is extramedullary so there is no need to violate the medullary canal. This is intended to help minimize blood loss and facilitate recovery.

A reference base is established by the placement of the first instrument. This initial instrument not only provides a guide for the anterior resections, but also allows the placement of locating pins for subsequent instruments. This is intended to reduce the likelihood of error propagation from one cut to another.

Measured patellar resection combined with medialization of the component reduces the need for lateral retinacular releases, as well as prevents the surgeon from exceeding the original patellar thickness.

Additionally, the instrumentation is smaller, allowing the surgeon to operate without everting the patella. This may also reduce postoperative pain, and may lower the potential for subsequent patellar dislocations.

Patient Selection

Patello-femoral joint arthroplasty is appropriate as an alternative to total joint arthroplasty for those patients who may benefit from a procedure that requires less bone removal. Patients experiencing severe anterior pain and significant functional limitations from isolated patello-femoral osteoarthritis, history of patella dislocation or fracture, failed previous surgery (tibial tubercle elevation, arthroscopy, lateral release, etc.) with persistent pain, deformity, or dysfunction are candidates as long as there is no evidence of disease in the tibiofemoral joint.

Careful physical examination and radiographic assessment should be done and, if necessary, arthroscopic evaluation. There should be clear evidence of patello-femoral joint damage, narrowing or loss of joint space, sclerosis, and peripheral osteophytes. Typically, patients will exhibit retropatellar knee pain during loaded flexion, as well as pain when undergoing patellar inhibition testing. Patello-femoral crepitus is also routinely observed.

Patello-femoral joint arthroplasty should be considered only when all other possible causes of anterior knee pain have been ruled out, including pes anserinus bursitis, patellar tendinitis, prepatellar bursitis, and pain referred from the hip or back. Furthermore, the procedure should be considered only after at least six months of nonoperative treatment has failed, including weight reduction, physical therapy, and drug therapy. Patients who have not had relief from other surgical interventions are also candidates. These include lateral retinacular releases and arthroscopic options such as debridement and chondroplasty.

It is important that the meniscus and the ligament structures are intact, and that the knee still has good range of motion. Patellar instability, maltracking, or malalignment should be corrected before patello-femoral arthroplasty.

Contraindications include, but are not limited to patella baja, neuroma, arthrofibrosis, and stiff knee. As with any joint arthroplasty, this procedure should be limited to patients who are willing to modify their activity levels and thereby minimize stress that could contribute to implant wear.

Radiographic Evaluation

Isolated patello-femoral joint disease is not usually visible on standard weight-bearing anteroposterior and midflexion posteroanterior and lateral radiographs. However, these views are necessary to rule out tibiofemoral joint involvement. Axial radiographs will allow evaluation of patellar seating, but may not reveal a narrowed joint space or the extent of osteophytes. The most common radiographic clues are subchondral sclerosis and flattening of the facets on the articulating surfaces of the patella and femur.

Abbreviated Surgical Technique



1. Prepare patella



2. Establish size and position of trochlear implant



3. Resect anterior facets



4. Mark distal boundaries of implant



5. Resect chamfer facets



6. Perform trial reduction



7. Implant components

Surgical Procedure

Introduction

In combination with the design of the implant, the surgical procedure is designed to restore the anatomic level of the trochlear groove. Patello-femoral joint stability is achieved, making lateral release less frequent and, when required, less extensive. In addition, increased patello-femoral compressive forces are avoided by maintaining the patello-femoral joint line.

Patellar options are offered in four sizes including a 10mm-thick all-polyethylene patella that can be countersunk,¹ or a 7mm-thick all-polyethylene patella. The 7mm-thick all-polyethylene patella is available for thinner (less than 20mm) patellas but should not be countersunk. Patellar component fixation is augmented by three peripheral pegs.

By minimizing soft tissue disruption, the surgeon can minimize some of the factors that impede patient recovery. This may result in shorter hospital stays and facilitate rehabilitation. The technique accomplishes this in a number of ways. For example, the entire surgical exposure is distal to the vastus medialis making it unnecessary to divide the muscle. This helps minimize postoperative pain and may reduce the time required for the resumption of the activities of daily living. Also, in most cases, there is no need to evert the patella.

Note: Bone resorption and connective tissue formation occur when bone is surgically traumatized and heated to above 47 degrees centigrade for longer than one minute. To control thermal injury, cool the saw blade by constant irrigation when making bone cuts.²

Note: To ensure that all resected surfaces are perfectly flat, use a Miller Guide to sight all bone cuts.

Note: It is recommended that 1/2-inch wide or narrower (.039-inch thick) saw blades be used for accurate and consistent results. Sharp saw blades will decrease both operating time as well as injury to the bone. If desired, adjustments to cuts can be made with the UniSpacer™ Femoral and Tibial Rasps.

Patient Positioning

Prepare the extremity in the same manner as for total knee arthroplasty. Use a standard leg holder to accommodate intraoperative flexion and extension. A leg-holding device may be helpful with a less invasive approach.

Surgical Approach

With the knee flexed, make a straight, anterior, midline skin incision beginning approximately 1cm-2cm proximal to the superior pole of the patella and extending to the level of the joint line (Fig. 1). This incision helps avoid the use of skin retractors, especially in obese patients, and provides excellent visibility. An inverted L-shaped incision to perform a subvastus approach can be very helpful.



Fig 1

Incise the capsule medially, being careful to avoid the medial meniscus. Everting the patella is typically not necessary, and a lateral release is not required. If possible, preserve the fat pad to help facilitate the blood supply.

Before proceeding, carefully inspect the entire joint to ensure that the tibiofemoral compartments are free of disease.

Excise any osteophytes from the borders of the intercondylar notch. Then palpate the notch to ensure that the arch is smooth and to ensure adequate space for the cruciate ligaments.

Minimally incise the anterior synovium of the supra patella pouch and elevate the flaps just enough to expose the anterior femoral cortex.

1 Evanich C, Tkach T, von Glinski S, Camargo M, Hofmann A. 6- to 10-year experience using countersunk metal-backed patellas. *J Arthroplasty*. Vol. 12 No.2 (149-154) 1997.

2 Krause, W.R., et al., Temperature Elevations in Orthopaedic Cutting Operations. *Journal of Biomechanics*. 1982; Vol. 15 No.4, pp. 267-275.

Step One Preparing the Patella

Prepare the patella by placing the leg in full extension and stabilizing the patella with two inverted towel clips, or by using a rake retractor to keep the patella everted. Incise soft tissue around the patella down to the insertion of the quadriceps and patellar tendons using an electrocautery knife. Before making any bone cuts, determine the maximum thickness of the patella using a caliper (Fig. 2).



Fig. 2

Using a 1/8in drill, drill the highest portion of the medial facet perpendicular to the articular surface approximately 12mm deep (Fig. 3).



Fig. 3

This acts as a guide for proper medialization of the patella.³ Next, use the patella osteotomy guide with the stylus set for the desired amount of resection (usually 7mm). If the patella is very worn, resect less bone. At least 10mm of bony patella should be retained.

Apply the guide medially and laterally with the jaws at the osteochondral juncture and the handles of the jig oriented toward the foot. The jaws should be parallel to the dorsal surface of the patella. Position the stylus over the most prominent point on the patella. If the 10mm component is countersunk, position the stylus for 7mm of resection. Make the cut with a 1in saw blade (Fig. 4).



Fig. 4

Using the sizing template (Fig. 5), select the maximum-sized patella that does not overhang (sizes 0 to 3). Eccentric placement of the patella 3-4mm toward the medial facet allows for better tracking. Use the 1/8in drill hole as a reference for proper medialization.

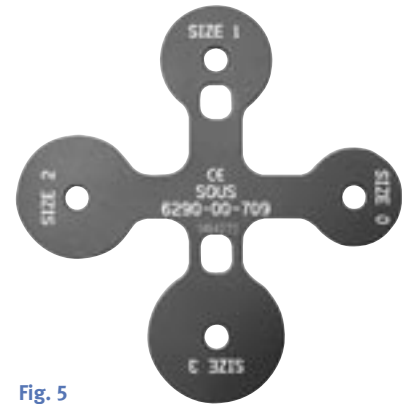


Fig. 5

Place the patellar clamp with the appropriately-sized patella bushing over the cut surface of the patella and center it slightly toward the medial facet and over the 1/8in drill hole (Fig. 6).



Fig. 6

3. Hofmann AA, Tkach TK, Evanich CJ, Camargo MP, Zhang Y. Patellar component medialization in total knee arthroplasty. *J Arthroplasty*. 1997 Feb; 12(2): 155-60.

Prepare the surface by applying gentle pressure with the matching size cutter (Fig. 7) for 5-10 seconds at a time until the desired thickness is achieved.



Fig. 7

Place the caliper through the inferior hole of the patella clamp and over the patella bushing (Fig. 8).



Fig. 8

If the 10mm metal-backed component is selected, it should be recessed 2-3mm. It is contraindicated to countersink the 7mm all-poly patella.

Example: If the patellar thickness is 25mm, the thickness will be 18mm after resection. The final thickness of the countersunk area should be 15mm for use with a 10mm-thick patella component. With the clamp still in place, insert the drill guide into the patella bushing. If a metal-backed patella is selected, drill the three smaller holes for the patella pegs with a 5/16 x 1/8in drill bit and successively fill them with 3/16 x 1/8in smooth pins (Fig. 9).

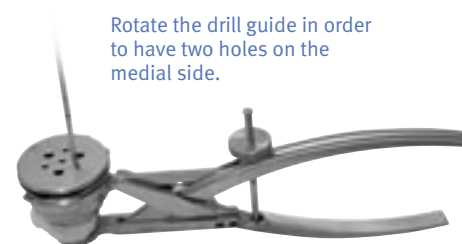


Fig. 9

Each hole must be drilled and filled before proceeding to the next hole to ensure an equal distance between holes. If the all-poly patellar component is selected, use the all-poly patella stop drill to drill the three larger holes. The peg holes are in the same location on all of the patellar sizes.

Separate patella trials are available for 7mm and 10mm all-poly patellae, as well as 10mm metal-backed patellae.

Step Two Establishing the Size and Position of the Trochlear Implant

Determine the appropriate implant size by holding the Patello-femoral Joint Provisional/Drill Guides up to the distal/anterior femoral bone. If the ideal mediolateral size appears to be between two sizes, choose the larger size.

Position the selected size Provisional/Drill Guide so it is in line with the trochlea, using Whiteside's line as a reference (Fig. 10). Use a scalpel, marker, or methylene blue to outline the provisional component. Then confirm that the size is appropriate by determining the bone-to-implant transition points.



Fig 10

Make a reference mark at the distal end of the provisional component (Fig. 11). From the most proximal edge of the central facet of the provisional component, draw a line with electrocautery along the mechanical axis of the femur, extending about 10mm proximally (Fig. 12).



Fig 11



Fig 12

The trochlear component should achieve optimal coverage of the anterior cortex and trochlea mediolaterally without affecting the tibiofemoral articulations; however, do not allow the distal/posterior edge of the implant to overhang the intercondylar notch. The edge should be 3mm to 5mm anterior to the roof of the notch (Fig. 13).

Remove the provisional component.

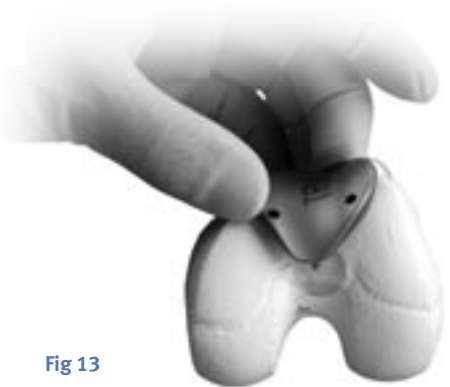


Fig 13

Step Three
Resecting the Anterior Facets

Thread a handle onto one or both sides of the selected size Anterior Cut Guide, and apply the guide to the bone. The spikes on the guide correspond to the proximal and distal edges of the implant. The placement of the spikes determines where the implant will be flush with the bone (Figs. 14 & 15).

First, place the distal spike at the previously marked distal point, which should be approximately centered on the trochlear groove, and tap it into the bone (Fig. 16). While holding the distal spike in place, pivot the guide on the distal spike until the anterior spike is on the previously marked proximal line (Fig. 17). Then tap the anterior spike into the anterior femoral cortex (Fig. 18).



Fig 14

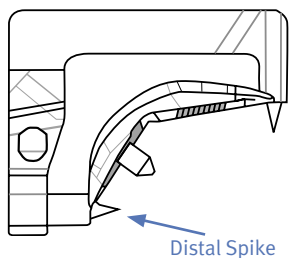
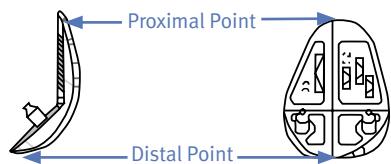


Fig 15



Fig 16

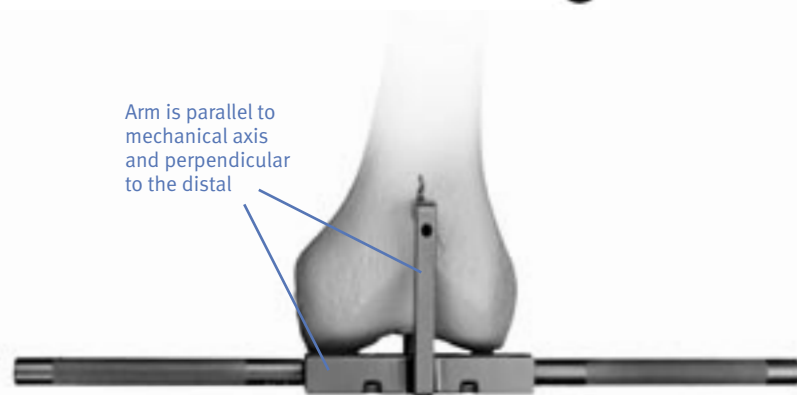


Fig 17



Fig 18

The posterior face of the guide should be parallel to the epicondylar axis (Fig. 19). To stabilize the guide, drill 1/8-inch holes through the two most posterior drill holes on each side of the distal face of the guide. Insert 1/8-inch by 3-inch smooth pins through these holes.

If desired, use the Miller Guide to check the bone resection.

Drill a 1/8-inch hole through the center hole on the distal face of the guide until the drill bit contacts the proximal spike. Insert a 1/8-inch by 5-inch smooth pin (Fig. 20). This pin serves as a fence between the two anterior cuts.

Use a 1/2-inch oscillating saw blade (.039-inch thick) through the slots in the guide to make the two anterior cuts (Fig. 21). Remove the 1/8-inch by 5-inch smooth pin from the center hole.

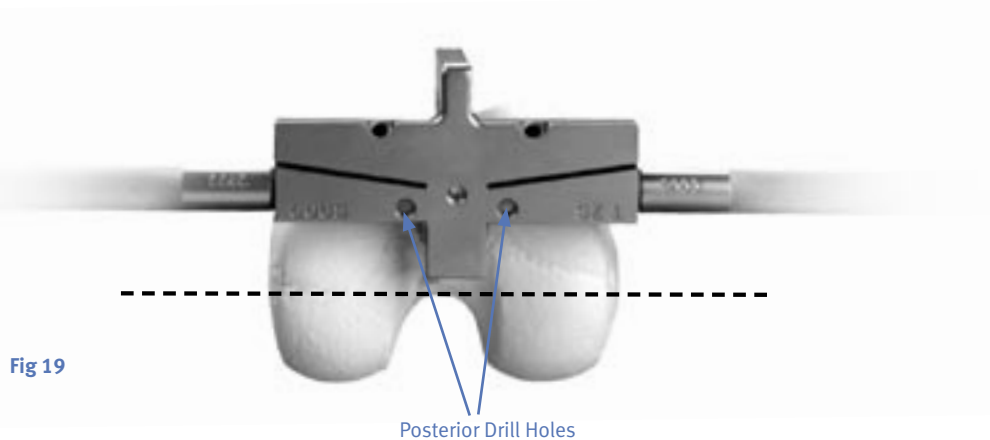


Fig 19

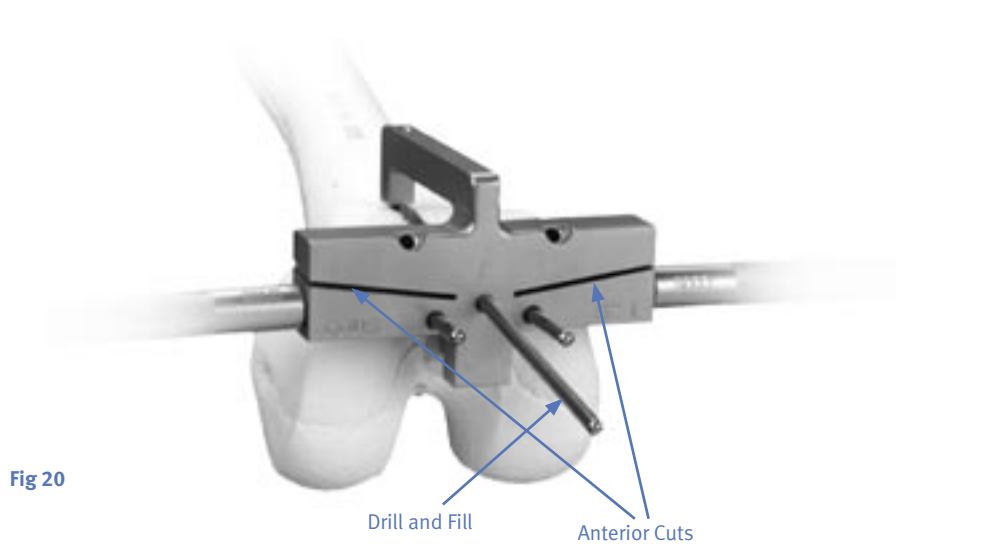


Fig 20



Fig 21



Fig 22

Use a 1/8-inch drill bit to drill the two distal angled holes on the distal face of the guide to a depth of approximately 25mm (Fig. 22). Then, using the same drill bit, drill the anterior angled hole at the proximal end of the arm of the guide (Fig. 23). To locate these holes for later reference, mark them with methylene blue (Fig. 24).

Remove the two smooth holding pins, and remove the Anterior Cut Guide. After removing the bone fragments, smooth the resected bone surfaces with a power rasp.



Fig 23

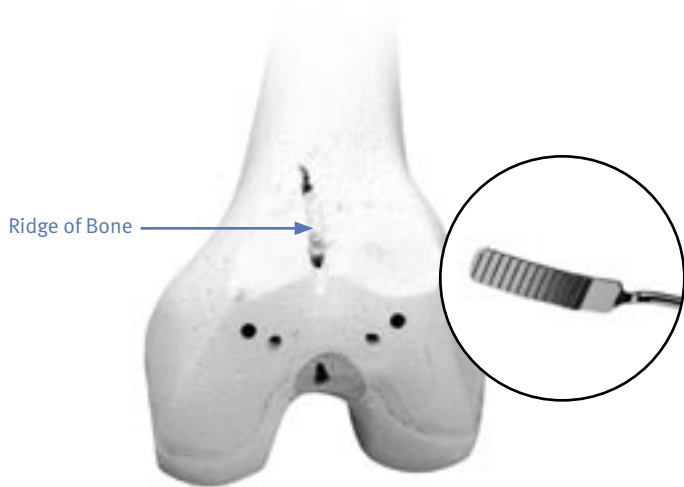


Fig 24

Step Four Marking the Distal Boundaries of the Implant

Place two 1/8-inch by 3-inch pins through the previously drilled distal angled holes (Fig. 25). These pins serve as rails for the Chamfer Punch (Fig. 26). Select the appropriate size right or left Chamfer Punch and apply it to the bone over the pins. Use a mallet to impact the Chamfer Punch until it seats. This marks the outer boundaries of the implant/bone transition distally (Fig. 27). Then remove the Chamfer Punch and pins (Fig. 28).



Fig 26



Fig 25



Fig 27

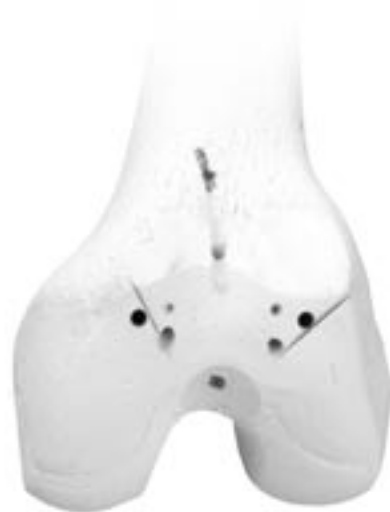


Fig 28

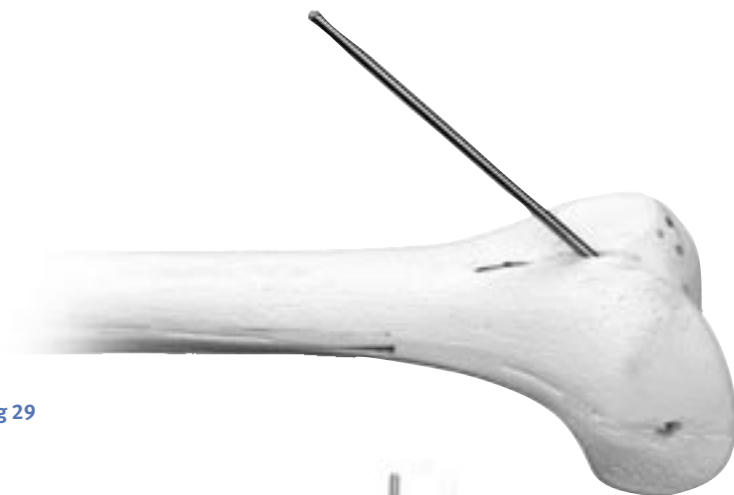


Fig 29



Fig 30

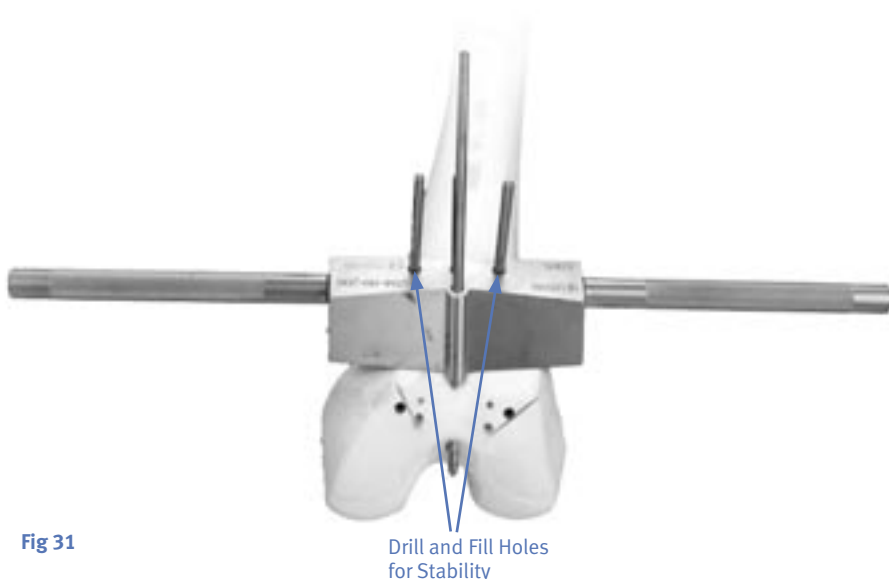


Fig 31

Step Five Resecting the Chamfer Facets

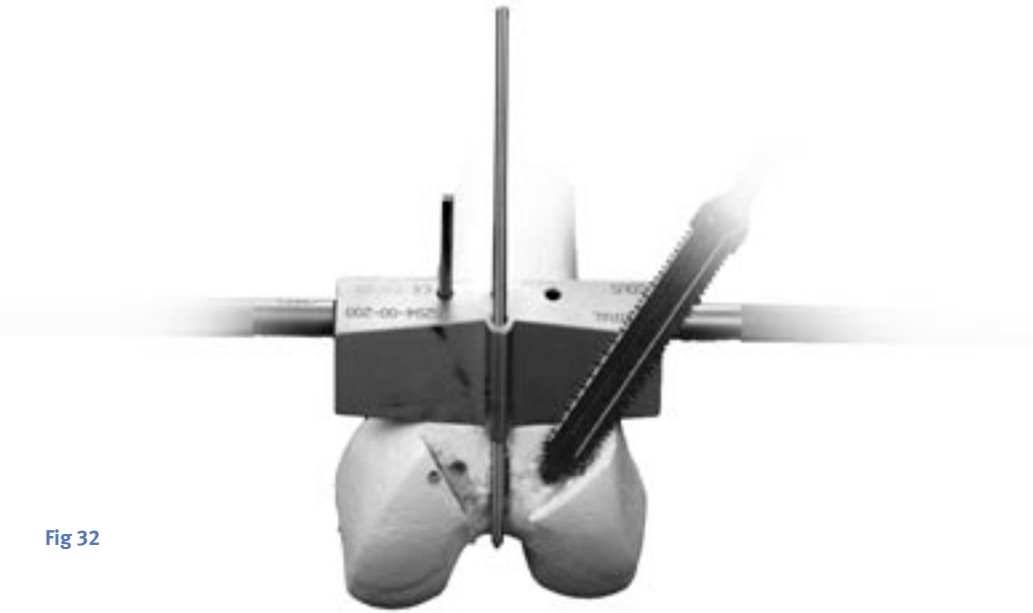
Insert a 1/8-inch by 3-inch pin into the previously drilled anterior angled hole (Fig. 29). Place the proximal middle hole of the Neutral Chamfer Cut Guide over this pin so the guide rests flush on the two facets of the cut anterior cortex (Fig. 30).

Use a 1/8-inch drill bit to drill the anterior holes on each side of the guide. Then insert 1/8-inch smooth pins to help stabilize the guide.

Use a 1/8-inch drill bit to drill the most distal anterior hole, and insert a 1/8-inch pin, 3 inches or 5 inches in length. This pin serves as a fence between the two chamfer cuts (Fig. 31).

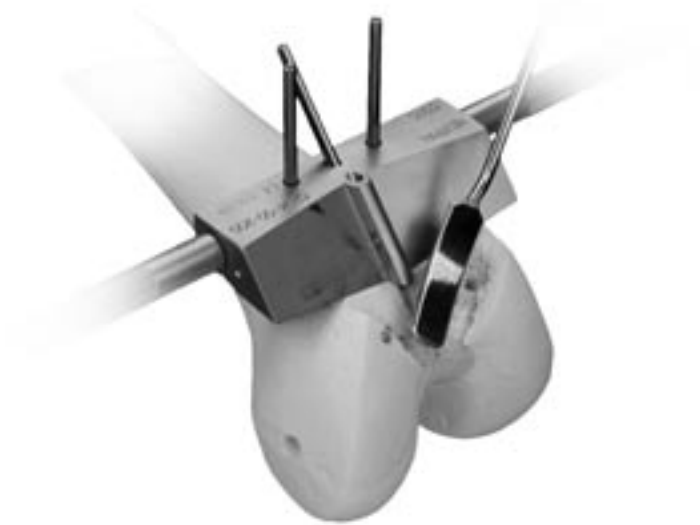
Remove the anterior pin on one side of the guide and use a saw blade to make the chamfer cut along the angled face of the Neutral Chamfer Cut Guide, being careful not to cut beyond the boundaries that were previously marked by the Chamfer Punch (Fig. 32). Then replace the anterior pin. Remove the anterior pin on the other side of the guide, and make the chamfer cut on that side. If preferred, these cuts can also be made using a 1/4-inch osteotome.

Fig 32



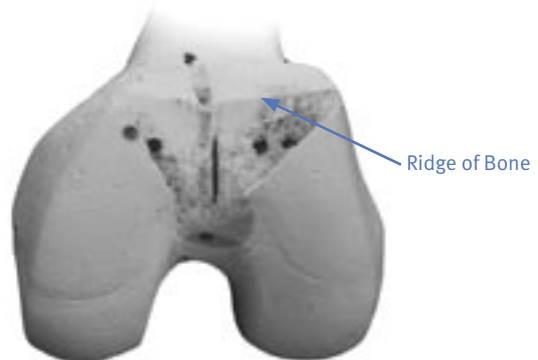
Use a file, rongeur, or power rasp to remove the slight ridge of bone that remains between the two chamfer cuts (Fig. 33).

Fig 33



If a ridge of bone remains between the anterior and chamfer cuts, use a file to remove it. If necessary, use a rongeur to clean up any remaining bone cuts, especially in the distal corner (Fig. 34).

Fig 34



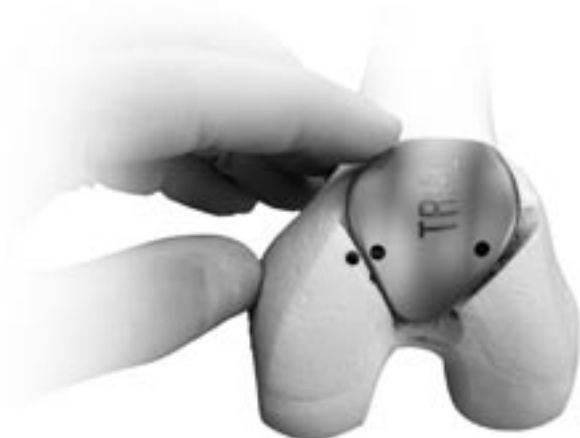


Fig 35

Step Six Performing a Trial Reduction

Place the appropriate size Trochlear Provisional/Drill Guide onto the bone. Check the fit of the provisional component and be sure that a smooth transition exists between the implant and bone distally (Fig. 35).



Fig 36

If the implant does not fit flush with all resected surfaces, use a file or power rasp to shape the surfaces as needed (Fig. 36).

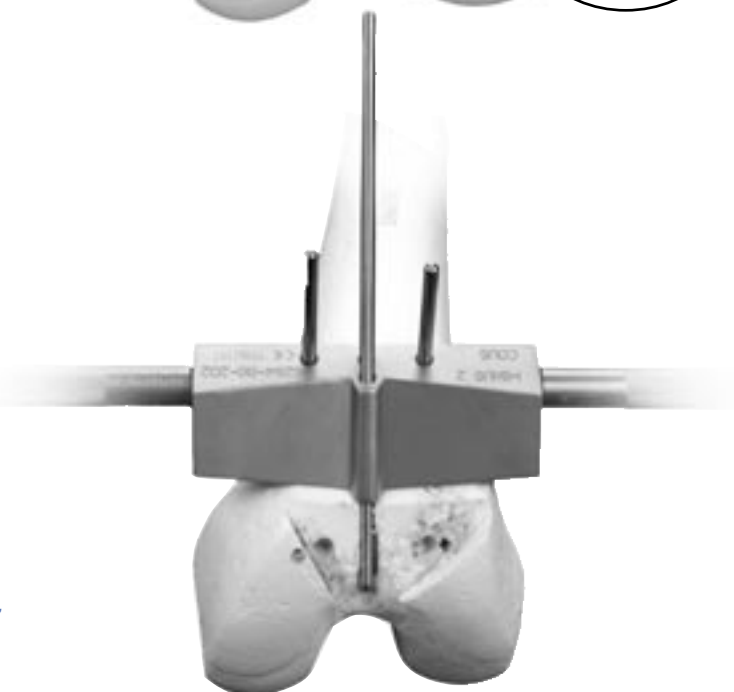


Fig 37

If insufficient bone was resected distally, allowing the distal/posterior edge of the implant to overhang the intercondylar notch, the Minus 1 or Minus 2 Chamfer Block can be used to inset the implant an additional 1mm or 2mm in depth respectively (Fig. 37). Place a pin back into the previously drilled anterior angled hole. Then place the Minus 1 or Minus 2 Chamfer Block over the pin and onto the resected bone surface. Secure the block with 1/8-inch smooth pins, and make the additional cut. If preferred, use a power rasp for a deeper cut.

When the provisional component position is acceptable, use a 1/8-inch drill bit to create the holes for the implant pegs. Drill through the holes in the Trochlear Provisional/Drill Guide to a depth of at least 10mm, or to the first mark on the calibrated drill (Fig. 38).



Fig 38

Remove the Trochlear Provisional/Drill Guide and insert the corresponding size Trochlear Provisional with Pegs. Use the Impactor to drive the provisional component until it seats flush against the bone (Fig. 39).

Insert the Patellar Provisional, perform a trial reduction, and put the knee through a full range of motion. Assess patellar tracking using the “rule of no thumb.” Measure the Q-angle with the knee extended. If patellar tilt or mild subluxation occur, a lateral retinacular release may be necessary. If the Q-angle exceeds 20 degrees, a medial tibial tubercle transfer may be necessary. If the patellar component impinges on the trochlear component, slightly adjust the trochlear cuts to alter the component position.

Fig 39



Remove the Patellar Provisional, but leave the Trochlear Provisional with Pegs in place.

Step Seven Implanting the Components

Patella

Use the patellar clamp in combination with the patellar inserter to insert the patella. Use the mallet to lightly tap the inserter to ensure complete seating of the component.

Place the leg through a range of motion to observe patellar tracking. Perform a lateral release if the patella tends to track laterally. Using the outside-in technique, flex the knee to facilitate any release that is needed. If possible, save the lateral superior geniculate artery and keep the synovium intact.

Trochlear Component

Remove the Trochlear Provisional with Pegs by prying it off with an osteotome. Bevel the edges of the anterior cut to help avoid tissue scaring and disruption. Apply cement to the implant and drive it in until it is fully seated, with a cement mantle thickness of approximately 2mm (Fig. 40).

Closure

Release the tourniquet and obtain hemostasis before closure. Insert a *Hemovac*® Wound Drainage Device and close the wound in layers using a nonabsorbable suture such as number 0 braided polyester.

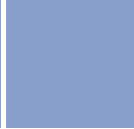
Postoperative Care

Postoperative management of patients after patello-femoral joint arthroplasty depends on the patient profile and surgeon judgement. The use of a continuous passive motion machine may be helpful immediately after surgery. The patient should be encouraged to bear weight as tolerated, with support for at least 3-6 weeks postoperatively. Physical therapy is advised for about 4 weeks with the primary goals of restoring motion control and quadriceps mechanism strength.



Fig 40







Please refer to package insert for complete product information, including product information, including contraindications, warnings, precautions, and adverse effects.

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