Surgical Technique for the Legacy® Knee LPS-Flex Mobile Bearing Knee

This device is not available for commercial distribution in the U.S.
INTRODUCTION

The Legacy LPS-Flex Mobile Bearing Knee is a posterior stabilized prosthesis designed to accommodate greater range of motion for appropriate patients, such as those who are physically capable or whose cultural customs or recreational/work activities require deep flexion.

The development of the LPS-Flex Mobile Bearing Knee is the result of an analysis of a knee prosthesis as it undergoes deep flexion beyond 120°. For example, the interaction of the posterior condyles on the articular surface was carefully studied. As a result, efforts have been made to optimize the contact area as the posterior condyles roll back to flexion angles up to 155° (Fig. 1). This is addressed by thickening the posterior condyles, thereby extending the radius.

Fig. 1
The tibial articular surface was also considered in the design. In deep flexion, the extensor mechanism experiences a high level of stress as the soft tissues are stretched and pulled tightly against the anterior tibia and distal femur. The LPS-Flex Mobile Bearing Knee is designed to help relieve these stresses through a larger, deeper anterior cutout on the articular surface (Fig. 2). This cutout accommodates the extensor mechanism in deep flexion.

Additionally, the cam/spine mechanism has been modified to provide greater jump height as the knee prosthesis undergoes deep flexion between 120° and 155°. The cam/spine mechanism induces mechanical rollback while inhibiting posterior subluxation of the tibia.

These design features accommodate high-flexion activities and, together with proper patient selection, surgical technique, and rehabilitation, increase the potential for greater range of motion.

The LPS-Flex Mobile Bearing Knee Components can be implanted using any of the NexGen® Knee Instrument Systems. These include:

- Multi-Reference™ 4-in-1 Femoral Instrumentation System
- MICRO-MILL® Instrumentation System—(Milling or 5-in-1 Saw Blade Options)
- Intramedullary Instrumentation System
- Epicondylar Instrumentation System

If the Multi-Reference 4-in-1 Femoral Instrumentation System is used, the posterior referencing technique will help provide a consistent flexion gap. Regardless of the instrumentation system used, the spacer blocks should always be used to check the flexion and extension gaps after the initial femoral and tibial cuts have been made. Also, the V-STAT® Variable Soft Tissue Alignment Tensor can be used with any of the instrument systems except the Intramedullary Instrumentation System to aid in proper flexion/extension gap balancing. When the flexion gap is equal to the extension gap, the Posterior Recut Guide is used to prepare the posterior condyles for the LPS-Flex Femoral Component.
PATIENT SELECTION

The LPS-Flex Mobile Bearing Knee should be used with patients capable of higher flexion to optimize its potential benefits. A common view among potential orthopaedic surgeons is that preoperative range of motion is a good indicator of postoperative range of motion. In determining the appropriateness of this implant for any patient, careful consideration should be given to the following criteria for patient selection.

1. The patient should be capable of reaching $120^\circ$ of flexion preoperatively, with a reasonable probability, in the surgeon’s judgement, of achieving a range greater than $130^\circ$ postoperatively.

2. The patient should have a need and desire to perform deep-flexion activities. This need is often dictated by cultural background where practices such as frequent kneeling for prayer, sitting “cross-legged,” and squatting are common. Also, certain hobbies and recreational activities, such as gardening, bowling, or golfing, may require high-flexion capabilities.

3. The patient should have a thigh-calf index of less than $90^\circ$ (Fig. 3).

4. The patient should have stable and functional collateral ligaments.

5. If the patient has an angular deformity, it should be less than $20^\circ$. Keep in mind that it is more difficult to achieve ligament balance in these patients. And, in patients with severe deformity, consider the patient expectation for achieving high flexion.

6. The patient should not be obese.

It is also important to consider the length of time the patient has not performed high-flexion activities.

PREOPERATIVE CONDITIONING

To help prepare the patient for surgery, it may be helpful for the patient to perform mobility exercises to prepare the ligaments and muscles for the postoperative rehabilitation protocol.

PREOPERATIVE PLANNING

Use the template overlay (available through your Zimmer representative) to help determine the angle between the anatomic axis and the mechanical axis. This angle should be reproduced intraoperatively.

Use the various templates to approximate the appropriate component sizes. The final sizes must be determined intraoperatively; therefore, larger and smaller sizes should be available during surgery.

Select the instrumentation system and technique that will be used to implant the LPS-Flex Mobile Bearing Knee Components. Any of four instrumentation systems and techniques can be used: the Multi-Reference 4-in-1 Femoral Instrumentation System, the MICRO-MILL Instrumentation System with Milling or 5-in-1 Saw Blade Options, the Intramedullary Instrumentation System, or the Epicondylar Instrumentation System. The spacer blocks available with these instrument systems should always be used to check the flexion and extension gaps.

In addition, the V-STAT Variable Soft Tissue Alignment Tensor can be used with any of the instrumentation choices except the Intramedullary Instrumentation System.
SURGICAL TECHNIQUE

Surgical technique is an important factor to consider when attempting to maximize range of motion in total knee arthroplasty (TKA). Close attention must be paid to balancing the flexion and extension gaps, clearing posterior osteophytes, releasing the posterior capsule, and reproducing the joint line.

Although the joint line often changes as a result of a posterior cruciate substituting procedure, it is important that an attempt be made to maintain the joint line when high flexion is a priority. Depending on the degree, altering the joint line can cause patellofemoral issues and limit the degree of flexion. An elevated joint, for example, can cause tibiofemoral tightness in roll-back and thus restrict flexion.

When using the gap technique, it is possible that the joint line may be moved proximally, especially if there is a preoperative flexion contracture or if the selected femoral component is smaller than the A/P dimension of the femur. The alteration of the joint line can be minimized by accurately measuring for the femoral component size and performing a posterior capsulotomy to correct flexion contractures.

INCISION AND EXPOSURE

The medial parapatellar approach is recommended for the LPS-Flex Mobile Bearing Knee. With the patient in the supine position and the knee slightly flexed, make a straight midline incision. Begin the incision medial to the quadriceps tendon and 3cm-5cm above the superior pole of the patella. Extend it distally to below the level of the tibial tubercle (Fig. 4). Then make a medial parapatellar capsular incision.

PCL RESECTION

Removing the PCL will make it easier to balance the collateral ligaments. Because the LPS-Flex Mobile Bearing Knee Prosthesis is a posterior cruciate ligament substituting design, it is necessary to completely resect the PCL. Any residual stump of the PCL may impinge in the cam/spine mechanism causing pain and limited motion. Resection of the PCL may influence the height of the flexion and extension gaps. Check for symmetry and balance of the flexion and extension gaps. Any differences in the gaps must be addressed.
**SOFT TISSUE RELEASES**

The objective of this procedure should be to distribute contact stresses across the artificial joint as symmetrically as possible. This requires the creation of equal and symmetrical flexion and extension gaps.

**Caution: Do not release the popliteal tendon, as this may cause instability.**

**VARUS RELEASE**

To correct most fixed varus deformities (Fig. 5), progressively release the tight medial structures until they reach the length of the lateral supporting structures. The extent of the release can be monitored by inserting laminar spreaders within the femorotibial joint and judging alignment with a plumb line. To facilitate the release, excise osteophytes from the medial femur and tibia. These osteophytes tent the medial capsule and ligamentous structures, and their removal can produce a minimal correction before beginning the soft tissue release. Posteromedial osteophytes may need to be removed after the proximal tibia is resected.

Release the insertion of the semimembranosus muscle from the posteromedial tibia, and concurrently remove posterior osteophytes.

Continue the release distally on the anteromedial surface of the tibia for 8cm-10cm and strip the periosteum medially from the tibia. This should be sufficient for moderate deformities. For more severe deformities, continue subperiosteal stripping posteriorly and distally.

When varus malalignment is present with a flexion contracture, it may be necessary to release or transversely divide the of the posterior capsule.

**VALGUS RELEASE**

Approach the valgus knee (Fig. 6) in a similar fashion to that described for the varus knee; however, to provide better visualization, the bone cuts are usually made before the ligament release.

By comparison with that of a varus release, the principle of a valgus release is to elongate the contracted lateral structures to the length of the medial structures. Though lateral osteophytes may be present and should be removed, they do not bowstring the lateral collateral ligament in the same way as osteophytes on the medial side. This is because the distal insertion of the lateral collateral ligament into the fibular head brings the ligament away from the tibial rim.
For a valgus release, a “piecrust” technique may be preferable. This technique allows lengthening of the lateral side while preserving a continuous soft tissue sleeve, as well as, preserving the popliteus tendon, which ensures stability in flexion.

With the knee in extension and distracted with a laminar spreader, use a 15 blade to transversely cut the arcuate ligament at the joint line. Be careful not to cut or detach the popliteus tendon. Then use the 15 blade to pierce the iliotibial band and the lateral retinaculum in a “piecrust” fashion, both proximally above the joint and distally within the joint. Following the multiple punctures, use a laminar spreader to stretch the lateral side. This should elongate the lateral side and create a rectangular extension space. Use spacer blocks to confirm ligament balance in flexion and extension.

For more severe valgus deformities, strip the lateral femoral condyle of its soft-tissue attachments proximally for about 9cm, and then divide the peristemeum, the iliotibial tract, and the lateral intramuscular septum transversely from inside out. Be sure that any part of the lateral intramuscular septum that remains attached to the distal femur is free to slide.

### Tibial Preparation

Using the selected instrumentation system, and following the appropriate technique for that system, establish the tibial cutting platform and resect the proximal tibia. Some PS surgeons may prefer to cut the tibia with a 3°-5° posterior slope that matches the preoperative slope of the tibia.

### Femoral Preparation

When sizing the femoral component, it is preferable to select the closest size. With the large selection of available femoral component sizes for the LPS-Flex Knee, it is possible to choose a size that is within 2mm of the measured anatomy. However, depending on the situation, selecting the closest size could mean either upsizing or downsizing. Because the LPS-Flex Knee is a posterior stabilized design, surgeons should first consider upsizing. By doing this, they maintain the option to downsizing if the knee is too tight in flexion with the larger size.

Using the selected instrumentation system, and following the appropriate technique for that system, prepare the femur. If a size A or B femoral component is chosen, do not drill the distal femoral post holes at this time. Size A and B femoral components have smaller pegs. The holes should be drilled using the size A/B Femoral Peg Drill and the Posterior Recut Guide.

Using a posterior referencing technique will help ensure an appropriate flexion gap as the technique results in a predictable and consistent resection of the posterior condyles. The resected portion of the medial femoral condyle should be at least 9mm-10mm, while the resected portion of the lateral femoral condyle will be dictated by the degree of femoral component rotation. If an anterior referencing technique is used, be aware of the amount of posterior condylar resection, since the variable cut is now posterior. Avoid resection greater than 10mm from the posterior medial condyle.

It is necessary to externally rotate the femoral component in order to create a symmetrical flexion space. The transepicondylar axis provides a reproducible method of setting femoral rotation.
and allows precise positioning of the femoral component. The anteroposterior axis of the femur provides an additional rotational landmark. While 3° of external rotation of the femoral component may be appropriate for a varus knee, 5° is more appropriate for a valgus deformity of 10°-20°, and 7° may be necessary for a valgus deformity greater than 20° accompanied by patella subluxation. **The critical goal is to create a rectangular and symmetrical flexion gap between the femur and tibia.**

When establishing the mediolateral position of the femoral component, it is recommended to lateralize the component to help improve patellar tracking. Avoid positioning the component where it overhangs the bone as this may restrict flexion.

With the knee in flexion, remove posterior osteophytes with a 3/4-inch curve-on-flat osteotome (Fig. 7). Use a laminar spreader and the Posterior Femoral Retractor to improve exposure (Fig. 8).

**FLEXION/EXTENSION GAPS**

While the basic box cuts are the same for both cruciate retaining and posterior stabilized designs, there are some important differences in the technique, and it is important that those surgeons who have typically followed the cruciate retaining philosophy understand these differences. First, be aware that, when the PCL is removed, there may be a change in the symmetry of the flexion and extension gaps. Therefore, the joint balancing is different with a posterior stabilized prosthesis. In the posterior stabilized technique, the flexion and extension gaps are balanced with spacer blocks and/or tensor devices. Posterior referencing instrumentation systems, like the *Multi-Reference 4-in-1 Instruments*, are designed to help balance the gaps with the initial bone cuts (Fig. 9). With the 4-in-1 Instruments an option exists to resect the distal femur in 3° of flexion to help avoid anterior notching. This option can be helpful when in between femoral sizes.
If the knee is tighter in extension than in flexion, recut the distal femur using the appropriate instrumentation. This will enlarge the extension space. The gaps should then be rechecked with the appropriate Spacer/Alignment Guide to confirm equality.

If the knee is significantly looser in extension than in flexion, two options should be considered:

1) downsize the femoral component, or
2) if the femoral component cannot be downsized, then distally augment the femoral component by increasing the thickness of the cement mantle. This thicker cement mantle should be no greater than 2mm.

Note: If greater augmentation is needed, then modular augmentation should be considered.

If augmentation of 5mm or more is necessary, a stemmed component should be used.

If the knee is tight in both flexion and extension, and will not accommodate a 10mm Spacer/Alignment Guide, recut the proximal tibia.

It is very important that the flexion and extension gaps are equal and balanced before making the posterior femoral recut and, thereby, committing to the LPS-Flex Mobile Bearing Knee.

With the knee flexed 90°, start with the thickest Spacer/Alignment Guide that will easily fit between the posterior femoral condyles and the resected tibia. Use progressively thicker spacers until the proper soft tissue tension is obtained. The resultant flexion space should be balanced and symmetrical. The tibial resection can also be checked at this point by placing the Alignment Rod through the handle of the Spacer/Alignment Guide (Fig 10).

Fig. 10

With the last Spacer/Alignment Guide in place, extend the knee and again check the soft tissue tension and the alignment of the joint using the Alignment Rod through the Spacer/Alignment Guide (Fig. 11). If the tension is equal in both flexion and extension, and alignment is correct, proceed to the next step.

Fig. 11
POSTERIOR CONDYLE RECUT

Insert the Posterior Femoral Retractor to help protect the posterior arteries. Select the Posterior Recut Guide that matches the size of the last cutting guide used for the femur. Position the guide so it is flush with the cut bone surfaces (Fig. 12) and aligned with the trochlear recess. If the femoral post holes have been drilled previously, screw the Recut Guide Modular Pegs into the guide to aid in positioning.

Fig. 12

When positioning the Posterior Recut Guide, ensure that the guide goes on straight to prevent the guide from sitting in flexion. Check to ensure that the Posterior Recut Guide does not impinge on bone or soft tissue either anteriorly or posteriorly.

Cut the posterior condyles through the posterior cutting slot of the recut guide using an oscillating saw with a 0.050-inch/1.27mm blade (Fig. 13).

Fig. 13

This cut will remove a wedge of approximately 2mm from the posterior condyles. If the PS notch cut has not been made, this instrument can also be used as a guide to make the notch cut. Likewise, if post holes have not been drilled, this instrument can be used to drill for the femoral post holes.

Note: For size A or B femoral components, you must use the Posterior Recut Guide to drill the size A/B femoral post holes, using the A/B Femoral Peg Drill (Fig. 14).

Fig. 14

Check to ensure that there is no bone left beyond the feet of the Posterior Recut Guide. The length of the posterior condyle of the recut guide represents the length of the posterior condyles of the femoral implant.

Check the release of the posterior capsule. The capsule should be released to approximately 1cm beyond the posterior edge of the recut guide (Fig. 15). Ensure that all posterior osteophytes are removed. This release of the posterior capsule and excision of the posterior osteophytes will re-establish the posterior capsular recess.

Fig. 15

~1cm
PATELLAR PREPARATION

Note: If the surgeon determines that the condition of the patient’s patella is satisfactory, it is not necessary to resurface the patella. The geometry, depth, and length of the patellar groove on the NexGen Femoral Component accommodate the unresurfaced patella.

Using the desired patella preparation technique, resurface the articular surface of the patella. Be sure to determine the appropriate patella thickness. When drilling the peg holes for the patellar component, position the Patellar Drill Guide so as to medialize the patellar implant. (When the patella is everted, this means placing the guide on the lateral border.)

FINISHING THE TIBIA

Select the proper size Tibial Sizing/Positioning Plate that provides the desired tibial coverage. Be sure that one of the three femoral component sizes designated on the anterior surface of the plate matches the femoral provisional size.

The tibia can be finished before the trial reduction if the implant position will be chosen based on anatomic landmarks. Alternatively, the sizing plate and provisional can be used to perform a trial range of motion to aid in tibial positioning.

OPTIONAL TECHNIQUE:

Position Based on Trial Range of Motion

Insert the proper Femoral Provisional, Tibial Sizing/Positioning Plate, and Articular Surface Provisional. Ensure that soft tissue balance is appropriate.

Insert a Small-head Holding Pin through the anterior hole on the rail of the sizing plate (Fig. 17). This will hold the Articular Surface Provisional in a fixed central position on the sizing plate.

Proceed to Page 11 (2nd column) to complete tibial preparation.

POSITION BASED ON ANATOMIC LANDMARKS

Attach the Mobile Bearing Knee Tibial Holding Clamp to the selected sizing plate by placing the cutout of the clamp over the anterior rail of the plate. Secure it by tightening the thumb screw (Fig. 16).
Flex and extend the knee with the provisionals in place (Fig. 18).

If the Articular Surface Provisional lifts off anteriorly during flexion, check the resected bone surface and remove any bony protrusions. If this lift-off occurs and the resected bone surface is smooth, perform an additional release of the posterior capsule. Flex and extend the knee again with the provisionals in place to determine the location of the plate. Once proper soft tissue balancing is complete, the tibial component tends to seat itself in the position where it best articulates with the femur.

After the location of the plate has been determined, insert the temporary Small-head Holding Pins through the angled holes on the front rail of the sizing plate (Fig. 19).

Remove the Small-head Holding Pin, the Articular Surface Provisional, and the Femoral Provisional. Then insert Short-head Holding Pins through the holes in the top of the Tibial Sizing/Positioning Plate to mark the location of the plate when using the broaching plate in the next step (Fig. 20).

If the Articular Surface Provisional lifts off anteriorly during flexion, check the resected bone surface and remove any bony protrusions. If this lift-off occurs and the resected bone surface is smooth, perform an additional release of the posterior capsule. Flex and extend the knee again with the provisionals in place to determine the location of the plate. Once proper soft tissue balancing is complete, the tibial component tends to seat itself in the position where it best articulates with the femur.

After the location of the plate has been determined, insert the temporary Small-head Holding Pins through the angled holes on the front rail of the sizing plate (Fig. 19).

Remove any pins and the Tibial Sizing/Positioning Plate. Place the same size Fluted Stem Tibial Broach Plate onto the tibial surface. Use the holes created by the Small-head Holding Pins that secured the Tibial Sizing/Positioning Plate to determine the proper location of the Fluted Stem Tibial Broach Plate. Secure the plate with Short-head Holding Pins through the existing holes.
Assemble the proper size Fluted Stem Tibial Broach to the Broach Impactor (Fig. 22).

The broach can be assembled only from the front. Seat the impactor on the broach plate and impact the broach to the proper depth indicated by the etched groove on the shaft aligning with the impactor handle. The broach has a built-in stop so it cannot be overimpacted (Fig. 23).

Remove the impactor assembly using the built-in slaphammer, then remove the Fluted Stem Broach Plate. Use the correct size tibial plate provisional to ensure proper fit before implanting the final components.

TRIAL REDUCTION

Place the Femoral Provisional, the Tibial Plate Provisional, the Articular Surface Provisional, and the Patellar Provisional (if needed) onto the prepared bone surfaces.

With all the provisional components in place, perform a complete range of motion. Observe patellar tracking and tilt. If necessary, perform a lateral retinacular release.
IMPLANTATION

After the implants have been chosen, make one last check to ensure that the femoral, tibial, and articulart surface components match. The femoral letter must match one of the letters on the articular surface carton. The tibial plate number must match one of the three numbers indicated on the articular surface carton as indicated by the interchangeability chart (Fig. 24).

If desired, a Straight or Offset Stem Extension can be used with the Precoat Fluted Stem Mobile Tibial Base Plate. The locking mechanism between the mobile tibial implant and the stem extension implant is a combination of a Morse-type taper and a set screw. Remove the stem extension locking screw from the stem extension and discard. The stem extension locking screw is not used with the mobile tibial component.

Check to ensure that the set screw has not migrated into the mobile tibial stem base taper prior to inserting the stem extension. Insert the stem extension into the stem-base of the mobile tibial component. When using the Offset Stem Extension, line up the stem location number with the etched line on the posterior stem base housing. The stem extension should be “snug” in the tibial component stem base. If toggle exists, back out the set screw one half turn. When a snug fit is achieved, wrap the mobile tibial component in a cloth and place it on a surgical cart. While protecting the stem extension, strike it solidly one time with a two-pound mallet.

**LPS-FLEX MOBILE INTERCHANGEABILITY KEY**

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Note: Hitting the stem more than once may loosen the taper connection.

After seating the Morse-type taper, tighten the set screw located on the posterior aspect of the mobile tibial base plate stem (Fig. 25) using a standard 3.5mm hex screwdriver.

Note: If, in the surgeon's opinion, a stem is not needed, then the set screw should be removed before implanting the tibial base plate.

Insert the appropriate size femoral and tibial components. Then insert the appropriate tibial articular surface onto the plate.
Techniques for 17mm and 20mm Articular Surface Assembly

A secondary locking screw is required for the 17mm- and 20mm-thick articular surface components (Fig. 26). Either of two assembly techniques can be used.

Intraoperative Technique:
Implant the tibial base plate and wait for the bone cement to completely cure. Then insert the articular surface onto the trunnion of the base plate. Place the secondary locking screw (packaged with the articular surface) through the hole in the articular surface.

Select the Tibial Plate Wrench which has the tibial plate size that matches the implant size to be assembled. Place the end of the wrench over the tibial plate. Ensure that the wrench is in line with the base of the tibial plate. Attach the Deflection Beam Torque Wrench to the 4.5mm Hex Driver Bit. Apply 95 in.-lbs. of torque with the wrench.

Do not over or under torque.

Optional Back-Table Technique:
The tibial plate may be placed onto the holding fixture, which is an integral part of the instrument case. Assemble the articular surface onto the trunnion of the tibial plate. Insert the secondary locking screw through the hole in the articular surface.

Attach the Deflection Beam Assembly Wrench to the 4.5mm Hex Driver Bit. Apply 95 in.-lbs. of torque with the wrench.

Do not over or under torque.
REHABILITATION PROTOCOL

An equally important factor in gaining or maintaining high flexion after successful total knee arthroplasty is early and/or aggressive rehabilitation of the patient. Many of the standard rehabilitation protocols used in western-style hospitals today are aimed at restoring knee motion and function between 90° and 110°, which is sufficient for the TKA patient to get into or out of a chair or a car. Those patients undergoing TKA who are able and willing to flex and wish to maintain preoperative flexibility may be better off with earlier and/or relatively more aggressive rehabilitation exercises.


CLOSURE

Close the capsule and perform a “drop and dangle” test to predict the range of motion for the patient (Fig. 27).

Position the knee in full extension to continue closing the layers (Fig. 28).

Fig. 27

Fig. 28