MPS-FLEX Posterior Stabilized Knees Surgical Technique
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Introduction

Successful total knee arthroplasty depends in part on re-establishment of normal lower extremity alignment, proper implant design and orientation, secure implant fixation, and adequate soft tissue balancing and stability.

MPS-FLEX Posterior Stabilized Knees is posterior fixed components, in order to make patient have a greater activity range. Such as body ability, customs and leisure activities / work activities which need high flexion of patient, this design can be adapted to appropriate a wider range of patients. According to thicken the posterior condyle of MPS-FLEX Posterior Stabilized Knees, the contact area was improved when posterior condyle slides to high flexion angle of 155°. Also consider the articular surface of tibia in the design process, when in high flexion, soft tissue stretching and facing the tightly pulling of front tibia and distal femur, extensor structure will appear high stress. The MPS-FLEX posterior stable knee is helpful in alleviating these stresses by making a larger and deeper anterior incision on the articular surface. The incision can adjust the extensor structure of high flexion. In addition, the cam/Pillar mechanism has been improved in order to provide a higher jump height in the flex process of 120 degree to 155 degree, it in the posterior tibia restrictions subluxation and make mechanical pull back. These design features are adapting to the high flexion activities, and the potential for greater range of activities is increased at the time when proper choose patient selection, surgical techniques and rehabilitation measures. Tools and operation can help surgeons to restore patients with hip, knee and ankle joint axis position, get a straight line, to determine the neutral mechanical axis. These tools can make the osteotomy accurate, and help ensure the components are firmly fixed.
Patient Selection

The MPS-FLEX Posterior Stabilized Knees should be used in patients capable of high flexion, so as to maximize its potential benefits. A common view of orthopedic doctors is that the range of preoperative activities is a good indicator of postoperative range of motion. The following criteria should be carefully considered when determining whether the implant is appropriate for the patient:

1. The patient should be capable of reaching 120 degrees of flexion preoperatively, with a reasonable probability, in the surgeon’s judgement, of achieving a range greater than 130 degree postoperatively.
2. The patient should require and expect high flexion activities. This demand is often reflected by the cultural background. For example, patient often prayed kneeling, cross legged sitting and squat. In addition, some habits and recreational activities, such as gardening, bowling and golf are all requiring high flexion.
3. The patient should have a thigh-calf index of less than 90 degrees.
4. The patient should have stable and functional collateral ligaments.
5. If patient have angular deformity, the angular deformity should less than 20 degrees. It is more difficult to achieve the ligament balance in these patients. Moreover, for patient who is more severe deformity, surgeon should consider the high flexion expectations of patient.
6. The patient should not be obese.
7. Also, it is important to consider the length of patient no high flexion activity time

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 to determine the angle between anatomic axis and mechanical axis. This angle will 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.

Patient Preparation

In order to prepare the limb for MPS-FLEX total knee arthroplasty, adequate muscle relaxation is required. This will help to achieve the patella everted when desired, and to reduce the surplus quadriceps in tension at the maximum level following tourniquet. Alternatively, spinal or epidural anesthesia should produce adequate muscle relaxation.

If desired, apply a proximal thigh tourniquet and inflate it with the knee in hyperflexion to maximize that portion of the quadriceps that is below the level of the tourniquet. This will help reduce the limit of the quadriceps and help the patella everted.

Once the patient is draped and prepped on the operating table, determine the landmarks for the surgical incision with the leg in extension.

Surgical technique introduction

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 and limit the degree of flexion. An elevated joint, for example, can cause tibiofemoral tightness in roll-back and thus restrict flexion.\(^1\)

When using the gap technique, it is possible that the joint line may be moved proximally; especially if there is a preoperative flexion contracture of 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 incision may be made with the leg in extension or flexion depending on surgeon preference. The surgeon can choose a subvastus approach, a midvastus approach, or a par patellar medial arthrotomy. Also, depending on surgeon preference, the patella can be either everted or subluxed.

The length of the incision is dependent on the size of the femoral component needed. Although the goal of a MPS-FLEX technique is to complete the surgery with an approximately 10cm-14cm incision, it may be necessary to extend the incision if visualization is inadequate. If the incision must be extended, it is advisable to extend it gradually and only to the degree necessary.

Using MPS-FLEX recommended a medial parapatellar approach. Place the patient in the supine position, knee slightly buckling, make a slightly oblique parapatellar skin incision, beginning approximately 2cm proximal and medial to the superior pole of the patella, and extend it approximately 10cm to the level of the superior patellar tendon insertion at the center of the tibial tubercle. Be careful to avoid disruption of the tendon insertion. This will facilitate access to the vastus medialis obliquis, and allow a minimal split of the muscle. It will also improve visualization of the lateral aspect of the joint obliquely with the patella everted. The length of the incision should be about 50% above and 50% below the joint line. If the length of the incision is not distributed evenly relative to the joint line, it is preferable that the greater portion be distal.

Divide the subcutaneous tissue to the level of the retinaculum.

Cut the PCL

Cut the PCL will make the balance of collateral ligament simpler. Because MPS-FLEX is a design for posterior cruciate ligament replacement, it is necessary to remove the PCL completely. Any residue PCL will be impact in the cam/pillar mechanism, result in pain and activity limited. Excision PCL will affect the height of the flexion gap. Check the symmetry and balance of flexion and extension gap. Any deviation of the gap must be dealt well.

Soft tissue Release

The objective of this operation is to spread the contact stress evenly to the artificial joint. This requires to establishing an identical, symmetrical of flexion gap and extension gap. Balance of soft
tissue is essential to help ensure stability of implant. The basic principle of ligament release is that the inner concave side of each contact is extended to match with the outer convex side. The purpose is to maintain the consistency, the rectangular shape of the flexion gap and extension gap, rather than diamond shaped. Relaxation steps are as below:

- Open knee joint, according to the specific situation to do a preliminary balance of the soft tissue structure. Remove osteophyta.
- Based on the preoperative planning osteotomy.
- Using gap measuring device to check the flexion and extension gap. Getting the final balance of soft tissue when done for checked the flexion and extension gap after installed provisional. This can prevent soft tissue excessive loosening which lead to ligament loosening after implant.
Surgical Technique
Step One: Resect the Proximal Tibia
Extramedullary Technique

1. Assemble Alignment Guide
   a. As shown in Fig.1, slide the EM/IM Ankle Clamp onto the
dovetail at the bottom of the Distal telescoping Rod. Turn the knob
opposite the dovetail to temporarily hold the clamp in place. The
mediolateral position of the rod can be adjusted by loosening this
knob. When the final position is determined, the knob can be fully
tightened to secure it in place.
   b. As shown in Fig.2, Slide the EM/IM Spike Arm onto the dovetail
at the top of the Spike Arm Telescoping Rod and temporality secure
it by turning the knob at the top of the rod.
   c. As shown in Fig.3, Cut Guide includes left and right two sizes.
Lower the adjustment knob in the middle of the Spike Arm
Telescoping Rod to the bottom of the threaded portion.
Insert the Cut Guide over the threaded portion of the rod above
the adjustment knob and slide it all the way up on the dovetail.
To hold the Cut Guide in place, advance the adjustment knob to
the upper end of its range of travel. This will allow for space
adjustment after the alignment guide assembly has been secured
in position.
d. As shown in Fig.4, Arrows are etched onto both the EM/IM Spike Arm Telescoping Rod and the Distal Telescoping Rod to indicate the correct orientation during assembly. Insert the Spike Arm Telescoping Rod into the Distal Telescoping Rod and pre-tightening. Tibia Extramedullary Positioning Resect Tool has been already assembled (Fig.5).

2. Position Alignment Guide

a. Loosen the knob in the middle of the telescoping rod, adjust the telescoping rod to the approximate length of the tibia and turn the knob on the shaft to temporarily maintain the length. Place the spring arms of the EM/IM Ankle Clamp around the ankle proximal to the malleoli (As shown in Fig. 6) and loosen the knob which opposite side of dovetail that provides mediolateral adjustment at the ankle.
b. As shown in Fig. 7, position the Cut Guide at the proximal tibia. Loosen the knob in the middle of the telescoping rod and adjust the length of the rod until the long spike on the Spike Arm just contacts the tibial plateau. The Cut Guide should be proximal to the tibial tubercle. Center the long spike medially on the bone surface anterior to the tibial spine. This should align the rod with the medial third of the tibial tubercle. Stabilize the Alignment Guide by tapping the Spike Arm until only the long spike engages the tibial plateau. Do not knock the short spike in.

c. As shown in Fig. 8, adjust the slide at the foot of the rod medially so the guide is aligned with the mechanical axis of the tibia. The longitudinal axis of the rod will usually lie just medial to the midpoint of the tibial tubercle and be centered over the intercondylar eminence. The foot of the rod should be positioned about 5mm-10mm medial to the midpoint between the palpable medial and lateral malleoli. The tip should point to the second toe (Fig. 9). When the proper mediolateral position is achieved, knock the short spike in (Fig. 10), tighten the knob to secure the Ankle Clamp to the rod.
3. Set Resection Level

a. Each tip of the Tibial Depth Resection Stylus indicates a different depth. Signs are marked on both side of Stylus, which is ‘2’ and ‘10’. The 2mm tip is used to check the depth from the defective tibial condyle for a minimal cut. The 10mm tip is used to check the depth from the least involved tibial condyle for an anatomic cut.

b. As shown in Fig.11, insert the Tibial Depth Resection Stylus into the top of the Cut Guide, using the hole that corresponds to the defective tibial condyle; ensure the stylus totally into and in the right direction. Usually placed “2” with lateral tibial plateau lows (Fig.12), "10" in the contralateral tibia platform high (Fig.13). In most cases, these two points are in the same plane, which may not be in the same plane when the defect is serious.
c. As shown in Fig. 14, adjust the Cut Guide to the desired depth by adjusting the length of the alignment guide assembly. Then retighten the telescoping rod, and remove Tibial Depth Resection Stylus, insert a fixed nail without head (Impactor) or headless screw into the hole marked “0” on the lateral side of the guide.
d. As shown in Fig. 15, to confirm alignment, insert the Extramedullary Alignment Arch (Alignment Rod) into the Cut Guide and insert the Alignment Rod with Coupler through the arch, passing it distally toward the ankle. The distal end of the rod should point to the second toe.

e. Insert the second Headless Holding Pin into the medial hole marked “0.” Once the tibial resection has been determined, use the Hex-head Holding Pins, or 48mm Headed Screw Pins, or Silver Spring Pins to further stabilize the guide.

f. As shown in Fig. 16, loosen the adjusting knob which at the lower part of Cut Guide, until the knob was released to the bottom. Then loosen the knob on the Distal Telescoping Rod. Use the slide hammer to remove the Spike Arm. To remove Spike Arm Telescoping Rod until the dovetail separation with cut guide. Then open the ankle clamp, remove the entire device, leaving Cut Guide on the tibia only.
4. Resect the Proximal Tibia

Use a .050-inch oscillating saw blade through the slot on the Cut Guide to cut the proximal surface of the tibia flat. Then remove the Cut Guide (Fig. 17).

**Note:** the cut can be made from the mark of cut guide as “-2”, “+2”, “+4” (unit mm) add or reduce.

![Fig. 17](image-url)
Step Two: Resect the Distal Femur

1. Establish Femoral Alignment
   a. In order to position 8MM DIA IM Step Drill, use the Universal Handle to make a hole which was located in the posterior cruciate ligament femoral attachment point forward position 0.5-1cm (Fig.19). The drilling position can also be determined according to the preoperative Template Measurement on the positive side of the film.
   b. As shown in Fig.20, use 8MM DIA IM Step Drill in opening hole drilling along the direction of the medullary cavity, ensure that drilling is parallel to femoral at the positive and side. The step of 8MM DIA IM Drill-With Step will enlarge the entrance hole on the femur to the 12mm. This will reduce intramedullary pressure during placement of subsequent Distal Placement Guide.
      Suction the canal to remove medullary contents. Attract femoral marrow cavity, the biggest possible avoid the occurrence of embolism.
   c. As shown in Fig.21, press the handle button on Valgus intramedullary Alignment Guide, set the panel to the proper valgus angle as determined by preoperative radiographs, then lock this angle by releasing handle button. The adjustment range of valgus angle is 0°to 9°. Check to ensure that the size of LEFT（L）、RIGHT(R)，5°to 7°is the common choice.
   d. As shown in Fig.22, Insert the Fixed Resection Tower into the holes of Distal Femoral Cutting Guide, and move up the Distal outboard rod handle, then lock this two parts.
e. As shown in Fig.23, assemble the 8mm T IM Rod, Valgus Alignment Guide and Fixed Resection Tower. Put Fixed Resection Tower into corresponding hole of Valgus Alignment Guide, set the 8mm T IM Rod into the hole of Valgus Alignment Guide, and lock them by screw button from F Valgus Alignment Guide.

f. Insert the 8mm T IM Rod into femoral marrow cavity. If necessary, use the nail from Valgus Alignment Guide to fix.

NOTE: If the side of distal part of femoral condyle defect severe, valgus intramedullary Alignment Guide may only be attached to other side.

2. Cut the Distal Femur

a. As shown in Fig.25, assemble alignment rod and alignment guide, set assemble alignment into corresponding hole on Distal Femoral Cutting Guide, and make sure that the alignment rod point to center of femoral head.

b. As shown in Fig.26, drill holes through the two standard pin holes marked “0” in the anterior surface of the Distal Femoral Cutting Guide, and place Headless Holding Pins (Puncher) through the holes. It is standard cutting. Additional 2mm adjustments may be made by using the sets of holes marked -2, +2 and +4.
c. If Valgus Alignment Guide be fixed by nails, then use Universal Pin Puller to remove those nails (As shown in Fig.27). Move down Fixed Resection Tower handle, except cutting guide remain at femoral distal, remove all devices (as shown in Fig.28).

d. Use the Tibial resection guide to make sure resection.

e. As shown in Fig.30, place 2 Holding Pins (Puncher) or 48MM Head Screws in the pair of bias holds at the sides of Distal Femoral Cutting Guide, if need more fixation.

f. As shown in Fig.31, cut the distal femur through the cutting slot in the cutting guide by using a 1.27mm oscillating saw blade. Then remove the Distal Femur Cutting Guide.

g. As shown in Fig.32, adjust resect thickness by the holes of Distal Femoral Cutting Guide.
3. Check Extension Gap

As shown in Fig.33, use the Spacer/Alignment Guides to check the extension gaps. With the knee in extension, insert the 10mm Spacer/Alignment Guide between the resected surfaces of the femur and tibia. Insert the Alignment Rod to the guide and check the alignment of the tibial resection. If necessary, insert progressively thicker Spacer/Alignment Guides until the proper soft tissue tension is obtained.

4. Size Femur and Establish External Rotation

a. Size Femur

Remove any osteophytes, put leg in 90° of flexion, as shown in Fig.34, apply front reference of the guide so that the flat surface of the A/P Sizing Guide is flush against the resected surface of the distal femur and the feet of the A/P (Anteroposterior) Sizing Guide are flush against the posterior condyles. The guide be held on the middle of the distal femur and can be fixated by Holding Pins (Impactor). Patients with severe posterior condylar deformity can use condylar wire as reference. Put probe in the lowest or slightly high position of the lateral condyle of the femur, directly read out the size of the femur from the mark on the measuring rod. There are 7 kinds of sizes between A to G, selected trumpet or select the more close to the size from two sizes.

b. Establish External Rotation

According to the preoperative plan, select the appropriate Femoral Measure Guide, this Guide can be provide as 0-3-L, 0-3-R, 5-7-L and 5-7-R four sizes for model of external rotation angle.

As shown in Fig.35, according to the external rotation angle determined preoperatively, put two Headless Holding Pins (Impactor) or headless screws into the hole of model of external rotation angle. Remove the guide.
Step Three: Finish the Femur

1. Complete Femoral A/P

a. As shown in Fig.36, select the correct size of Femoral Finishing Guide as determined by the measurement from the A/P Sizing Guide. Remove any lateral osteophytes that may interfere with guide placement. Place and position the finishing guide onto the distal femur, over the headless pins (Impactor) or headless screws. This determines the A/P position and rotation of the guide placement. Position the finishing guide mediolaterally by sliding it on the headless pins (Impactor) or headless screws.

b. When the position of the Femoral Finishing Guide is set, insert Headed Screw or Hex-head fixation nail (Impactor) into the superior pinhole on the medial and lateral side of the guide (Fig.37). Use Universal Handle to be inserted two fastening nail (Impactor) into the inferior holes on the guide (Fig.38). NOTE: In order to ensure the guide has no slight move, suggest make a predrill before insert Hex-head fixation nail.

c. As shown in Fig.39, use the Resection Guide through the anterior cutting slot of the finishing guide, and check the medial and lateral sides to be sure the cut will not notch the anterior femoral cortex.
d. Remove the headless pins (Impactor) with the Headless Pin Puller.

2. Four in one Resect Femur

As shown in Fig.40, use a 1.27mm narrow oscillating saw blade to cut the femoral profile in the following sequence for optimal stability of the finishing guide.

1) Anterior condyles
2) Posterior condyles
3) Posterior chamfer
4) Anterior chamfers

3. Use the PAT/FEM Drill 6.4MM DIA Bit to drill the post holes (Fig.41)

4. As shown in Fig.42, use the 1.27mm narrow, reciprocating saw blade to cut the base of the trochlear recess.

5. As shown in Fig.43, score the edges in the position of anterior femur mark line.

6. As shown in Fig.44, drill condylar post holes by PAT/FEM Drill 71220102001 (apply to size C-G Femoral Component) or 71220102002 (apply to size A and B Femoral Component), remove the finishing guide to complete the trochlear recess cuts.
7. As shown in Fig. 45, use the Spacer/Alignment Guides to check the flexion and extension gaps. Insert the 10mm Spacer/Alignment Guide to evaluate extension gap, use the 12mm Spacer/Alignment Guide to evaluate flexion gap. Insert the Alignment Rod to the guide and check the alignment of the tibial resection. If necessary, insert progressively thicker Spacer/Alignment Guides until the proper soft tissue tension is obtained.

8. Soft tissue balance treatment, show at the following table.

<table>
<thead>
<tr>
<th>Extension Gap</th>
<th>Tension</th>
<th>Favorable</th>
<th>Loose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion Gap</td>
<td>Tension</td>
<td>Use thinner spacer or resect more tibial platform</td>
<td>Use smaller femur or use thicker spacer</td>
</tr>
<tr>
<td></td>
<td>Favorable</td>
<td>Resect more distal femur</td>
<td>OK</td>
</tr>
<tr>
<td></td>
<td>Loose</td>
<td>Resect more distal femur or use thicker spacer</td>
<td>Resect more distal femur or use thicker spacer</td>
</tr>
</tbody>
</table>

Before osteotomy, suggest make soft tissue balance technique first.

**Step Four: Resect Intercondylar Notch**

1. As shown in Fig.46, position the appropriate size Notch Guide with fixation nail onto the femur so Notch Guide is flush against the resected surfaces both distally and anteriorly.

2. Use hex head holding pin or 48MM Head screw fixed Notch Guide.

3. Use a reciprocating saw to cut the sides and the base of the intercondylar notch. Then remove the Notch Guide.

**Note:** Reciprocating saw should be close to the Notch Guide.
Step Five: Establish Size and Rotation of Tibia

1. As shown in Fig. 47, attach the Locking TIB Tray PROV Handle to the selected Stemmed tibial sizing plates and secure it tightening. Put the plate in place of tibia resect surface. Be sure the position and use fixation nail (Impactor) fixation.

2. The Alignment Rod can be used to aid checking tibia alignment before fixation (Fig. 48)

3. As shown in Fig. 49, place Cemented stem drill guide on Stemmed Tibial Sizing Plate, drilling hole at tibial plate by Tibia Drill- Bone cement with Handle.

   Note: The depth of the drill bit drill into should make the mark line parallel and level with the upper edge of the Cemented stem drill guide.
4. As shown in Fig.50, make sure the determined size of Orthopedics Punch fix into Broach Impactor. Orthopedics Punch can be only assembled at front.

5. As shown in Fig.51, place Keel Impactor into Tibial Sizing Plate/Provisional, knock on the top of Impactor, until the mark line of rod parallel and level with the top edge of sleeve. Use the built-in slide hammer function of the Broach Impactor, take the pile driver out in the vertical direction. Remove the Stemmed tibial sizing plates.

**Note:** Can’t remove orthopedics punch by use hammer to upward knock Keel Impactor.

**Step Six: Prepare the Patella (If necessary)**

1. As shown in Fig.52, use the Patellar Townley Femoral Caliper to measure the thickness and diameter of the patella. **Note:** The thickness of selected implant patella = patella thickness minus 10mm.

2. As shown in Fig.53, apply the Universal Patellar Saw Guide (NGK universal patella saw guide) clamp the patella, use block which be marked “10MM” contract with the patella lateral.
3. Fig. 54, use a pendulum saw or a reciprocating saw blade to remove the inside medial patella which exposed to the outside of Universal Patellar Saw Guide (NGK universal patella saw guide).

4. As shown in Fig. 55, select guide drill which is matched with the patella components, the surface of guide drill with nail close to the side of the medial surface of the patella, ensure that the nail is fully into the medial surface of the patella. Hold the drill guide firmly in place and drill the three peg holes using the PAT/FEM Drill 6.4MM DIA Bit.

**Step Seven: Insert the PROV, Perform a Trial**

1. As shown in Fig. 56, use Femoral Inserter/Extractor clamping selected specifications of LPS-Flex Femoral PROV on both sides of the grooves, then lock install LPS-Flex Femoral PROV to the femur. Use of bone hammers strike Femoral Inserter/Extractor, until the Provisional and the femoral condyle is fully bonded. Loose knob and remove the Femoral Inserter/Extractor.
2. Based on the size of Femoral Provisional and Stemmed tibial sizing plates, select and insert appropriate Article Surface Provisional and install appropriate patella provisional which is match with patella diameter inside of patella (If necessary). Check the balance status of the knee flex and extend, check alignment and the motion range of patella (As shown in Fig.57).

3. After confirmed, remove the provisional components.

Note: The Femoral Intramedullary slaphammer extractor can be used to remove the Femoral Provisional, can’t remove anything by hummer strike directly (As show in Fig.58).

Step Eight: Implant Components

1. Implant Femoral Components
After the cement has been applied, attach the femoral component by Femoral Impactor/Extractor.

2. Implant Tibial Components
As shown in Fig.59, after the cement has been applied, position the tibial component to fully seated by use Tibial impactor.
3. Implant Articular surface Component
As shown in Fig.60, use the Articular Surface Insertion Instrument to attach the high flexion Tibia plate inserting onto the tibial base plate

4. Implant Patella Component
After the cement has been applied, using the Patella Clamp to insert and ensure the patella component in place.

Warning

• Replacement of MPS-FLEX posterior stabilized knees for surgical instruments to MPS-FLEX posterior stabilized knees; users should have the professional qualifications and training of medical personnel; scrap products shall be treated according to the disposal method stipulated by the Ministry of health medical waste.
• Should be opened before cleaning equipment (if applicable); in order to reduce the corrosion and possible cross contamination, reusable devices should be cleaned dry immediately before use and after use; equipment presoaked in PH neutral enzyme solution, PH neutral cleaning agent using the manufacturer's instructions to do manual cleaning, pay special attention to the equipment and internal cavity.
• All instruments should be dried in time after the cleaning was completed.
• All tools must be used in accordance with the operation technique, and shall not be used as other way.
Reference: