



Zimmer® Segmental System

Distal Femoral
Surgical Technique



Zimmer Segmental System Surgical Technique

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Introduction

The *Zimmer*® Segmental System is designed to address patients with significant bone loss often found in oncology, trauma, and/or multiple revision. The system components provide broad operative options for surgeons addressing patients presenting with these conditions.

The system includes distal femoral components, a one-piece hinge post, tibial articular surfaces, segments, straight and bowed stems, stem collars, with either *Trabecular Metal*™ Material or a smooth titanium surface and a proximal femoral component. The one-piece Segmental Hinge Post, which is packaged with the corresponding size Segmental Articular Surface, ensures a minimum 40mm jump-height of the post for all sizes of Segmental Articular Surface. The system also includes specific instruments designed to facilitate the surgical procedure.

The *Zimmer* Segmental System enables complementary intersystem assembly with some specific components of the *Zimmer NexGen*® Complete Knee Solution RH Knee and the Modular Options for Severe Bone Loss and Trauma (*MOST Options*®) System. The Segmental Distal Femoral Component features the same condylar-loading geometry as the *Zimmer NexGen* RH Knee, but will also allow both medial and lateral access to the hinge pin locking assembly.

This surgical technique is divided into sections that provide detailed descriptions of each step in a specific procedure (See Table of Contents). The main body of each procedure describes the steps that are specific to the *Zimmer* Segmental System. When implanting components from the *NexGen* RH Knee or the *MOST Options* System, some steps are the same as those detailed in the specific surgical techniques for those systems. For these steps, the surgeon is referred to the appropriate technique. The *NexGen* RH Knee Technique is part number 97-5880-002-00, while the *MOST Options* System technique is 97-5010-002-00.

Patient Counseling Information

Due to the serious health issues normally seen with segmental implant recipients, complications and/or failure of total knee prostheses are more likely to occur. This is especially true of patients with concomitant diseases, unrealistic functional expectations, heavy patients, physically active patients, and/or with patients that fail to follow through with the required rehabilitation program. Physical activity or trauma can result in loosening, wear, and/or fracture of the device. Additionally, the impact of total health status or treatment regime, (chemotherapy, radiation, etc.) may affect the stability and overall success of the implant. The patient must be instructed about all postoperative restrictions, particularly those related to occupational and sports activities and about the possibility that the implant or its components may wear out, fail, or need to be replaced. The implant may not last the rest of the patient's life, or any particular length of time. Because prosthetic implants are not as strong, reliable, or durable as natural, healthy tissues/bones, all such devices may need to be replaced at some point.

Compatibility

Some implants and provisional components from the Segmental Knee System are compatible with the *Zimmer NexGen RH Knee* and/or the *Zimmer MOST Options System*, and vice versa. However, some specific implants and provisional components are not to be used across systems. Do not use components from other knee systems (and vice versa) unless explicitly labeled for such use.

Using the Correct Polyethylene Insert

The Segmental System includes a Segmental Polyethylene Insert for use with the Segmental Distal Femur, while the *NexGen RH Knee* includes a Polyethylene Insert with Cement Shield for use when the one-piece Segmental Hinge Post is used with the *NexGen RH Knee Distal Femoral Component* (Fig. 1). This *NexGen Polyethylene Insert with Cement Shield* is packaged in the *NexGen RH Knee Cement Shield Hinge Servicing Kit*. The Segmental Polyethylene Insert is packaged individually for use with the Segmental Distal Femoral Component. It is very important to distinguish between these two polyethylene inserts.

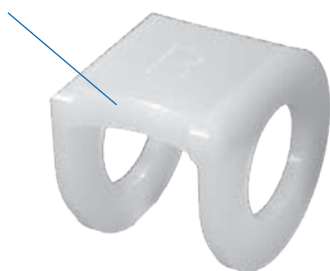
When implanting a *NexGen RH Knee Femoral Component*, do not allow excess cement to contact the hinge components. Because of the proximity of cement to the hinge components, the polyethylene insert used with the *NexGen RH Knee Femoral Component* is designed with a cement shield to help protect the hinge components from cement intrusion. Be sure to use the appropriate polyethylene insert component. The Segmental Polyethylene Insert does not include the cement shield geometry on the component, and has a different wall thickness than the *NexGen RH Knee Polyethylene Insert with Cement Shield*.

Using the Correct Hinge Post Provisional

Whenever a Segmental Articular Surface is used, the one-piece Segmental Hinge Post must be used. The same Segmental Hinge Post (packaged with the Segmental Articular Surface) is used with both the Segmental Distal Femoral Component and the *NexGen RH Knee Distal Femoral Component*; however, each is mated to a different polyethylene insert. The differences resulting from the polyethylene inserts have already been taken into account in the design of the Hinge Post Provisionals.

The Segmental Hinge Post Provisionals (sizes B and C) are used with the Segmental Distal Femoral Components, while the Segmental/RH Knee Hinge Post Provisionals (sizes B, C, D, E, and F) are used with the *NexGen RH Knee Distal Femoral Components*. These two types of hinge post provisionals are not designed to be interchanged between the distal femoral component provisionals of the two systems because the difference in the polyethylene insert thickness is incorporated into the designs. They are easy to distinguish from one another in that the Segmental Hinge Post Provisionals have a gold color on their superior end, whereas the Segmental/RH Knee Hinge Post Provisionals do not.

Groove on Segmental Polyethylene Insert

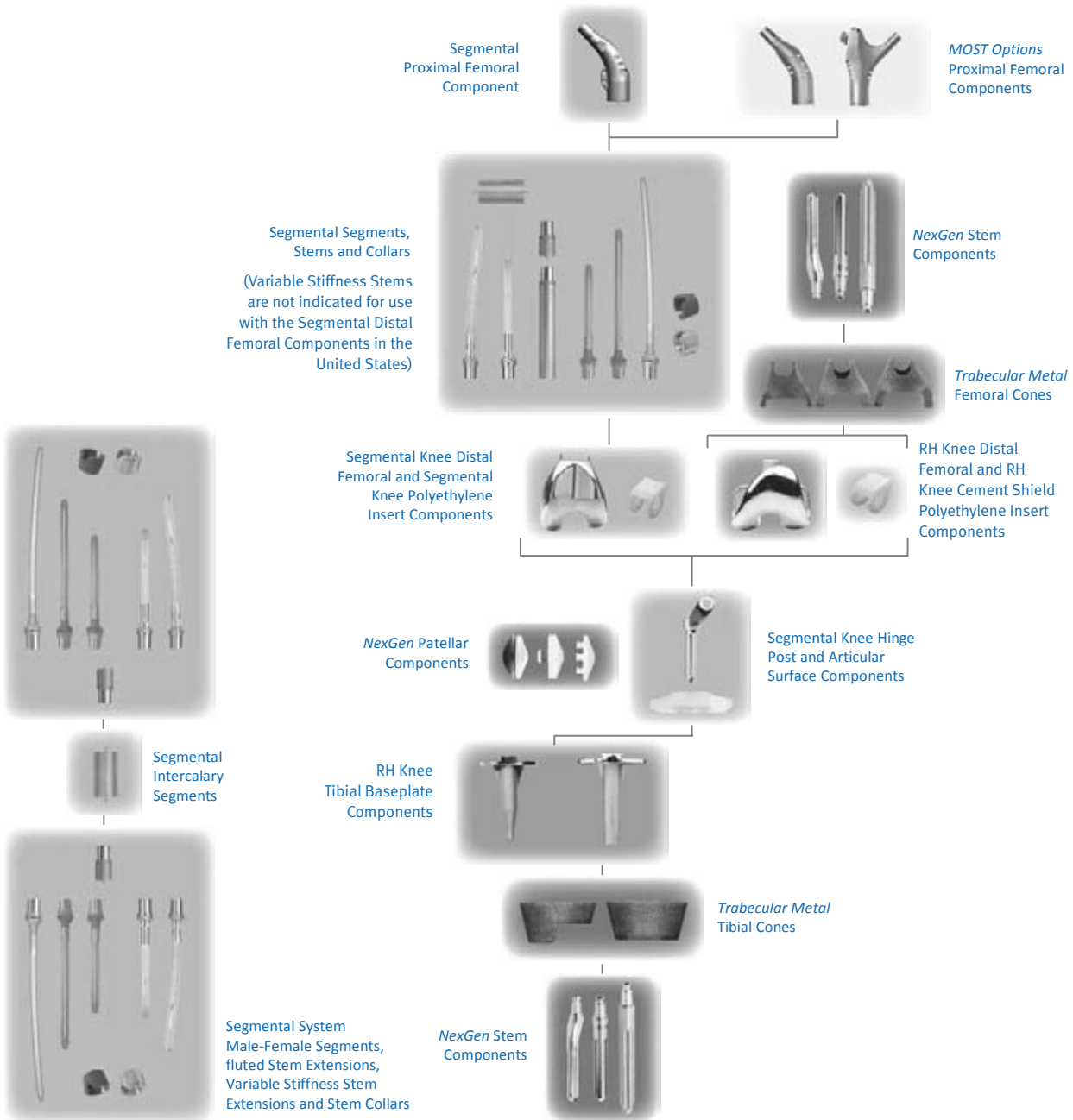


No groove on *NexGen RH Knee Polyethylene Insert with Cement Shield* for RH Knee



Fig. 1 Segmental Polyethylene Insert and *NexGen Polyethylene Insert with Cement Shield*

Segmental System Scope/Compatibility Chart



	MOST Options System
	NexGen Knee
	Segmental System
	RH Knee

Zimmer Segmental System Stem Options

Variable Stiffness Stems

Note: The Variable Stiffness Stems are not indicated for use with the Distal Femur in the U.S.

Note: The Variable Stiffness Stems are indicated for uncemented use only.

The *Zimmer* Segmental System Variable Stiffness Stems are available in both 130mm straight and 190mm bowed geometries in 9-19mm diameters. The stems are manufactured from cobalt-chromium-molybdenum alloy.

The goal of the design was to establish a secure initial press fit while providing a gradual proximal-to-distal decrease in stem stiffness along the length of the stem. This gradation of stem stiffness is accomplished via a transition from a solid shank proximally to four troughs, and then to four slots that split the stem tip into four closely configured prongs.

The intramedullary length of the stem extension contains splines, providing a diametric press fit of up to 0.5mm. The base of the stem extension is precoated with polymethyl methacrylate (PMMA) to enhance fixation of the cemented collars. Anteversion pockets at the base of the male taper fit with the anti-rotation tabs of mating components and allow for controllable anteversion adjustment in 20° increments.

Zimmer Segmental System Fluted Stems

The *Zimmer* Segmental System Fluted Stems are intended to allow surgeons the option of cemented fixation of the stem to the host bone. Available in 130mm straight, 190mm straight and 250mm bowed in 9-19mm diameters the stems are manufactured from cobalt-chromium-molybdenum alloy. The base of each stem is precoated with polymethyl methacrylate (PMMA) to enhance fixation of the cemented collars. Anteversion pockets at the base of the male taper fit with the anti-rotation tabs of mating components and allow for controllable anteversion adjustment in 20° increments.

Distal Femur Replacement Using the Segmental Distal Femoral Component

As part of preoperative planning, determine whether the hinge post will be locked to the femoral component before or after it is inserted through the Segmental Articular Surface. If locked before insertion through the articular surface, be sure that enough distraction across the joint space will be possible.

Note: The hinge post provisional used for trial reduction is available in one length which may be shorter than the final Segmental Hinge Post that will be implanted. The main purpose of the hinge post provisional is to bring the tibia into alignment with the mechanical axis directly under the femur. The Segmental Hinge Post plays a similar role; however, its length also accounts for the thickness of the Segmental Articular Surface and provides 40mm of jump height to resist subluxation. Do not lock the hinge post to the femoral component before it is inserted through the articular surface if there is concern over distracting the joint beyond that used during trial reduction.

Technique Tip: Consider marking Femoral Rotation outside of the resection area prior to resection for later reference.

Technique Tip: To ensure proper leg length, consider marking both the tibia and femur outside of the resection area. Measure and record the distance between the two lines for later reference during trialing.

Fig. 2 Distal Femoral Resection with Stems, Collars, and Segments

Note: Each large taper connection adds 2mm to the total length.

Step One Prepare the Femur

After exposing the distal femur and proximal tibia, extend the leg in a reproducible position (typically full extension).

Distal Femoral Resection

Measuring from the articular surface of the distal femur, use a marker, osteotome, or electrocautery to make a horizontal line marking the proposed

resection level based on preoperative planning and the implant configuration (Fig. 2).

Note: Each large taper connection adds approximately 2mm to the total length.

Resect the distal femur at or slightly distal (0.5mm-1.0mm) to the marked resection level. Resecting the femur slightly below the mark will account for slightly oblique cuts and help accommodate femoral resection planing.

Distal Femoral Resection with Stems, Collars, and Segments

Distal Femur	Stem/Collar	Segments	Total Length
Size B 58mm**	30mm	None	90mm
		30mm	122mm
		35mm	127mm
		40mm	132mm
		45mm	137mm
		60mm	152mm
		35+30mm	159mm
		40+30mm	164mm
		40+35mm	169mm
		80mm	172mm
		40+45mm	179mm
		60+30mm	184mm
		60+35mm	189mm
		100mm	192mm
		60+45mm	199mm
		80+30mm	204mm
		80+35mm	209mm
		120mm	212mm
		80+45mm	219mm
		100+30mm	224mm
		100+35mm	229mm
		140mm	232mm
		100+45mm	239mm
		120+30mm	244mm
		120+35mm	249mm
		160mm	252mm
		120+45mm	259mm
		140+30mm	264mm
		140+35mm	269mm
		180mm	272mm
		140+45mm	279mm
		30 + 160mm	284mm
200mm	292mm		
30 + 180mm	304mm		
220mm	312mm		
30 + 200mm	324mm		

**Size C Segmental Distal Femoral is 60mm tall. Resect an additional 2mm beyond the total length of resection listed in the table above for the Size C.

Ream the Femoral Canal

Ream the femoral canal until the reamer contacts cortical bone in the isthmus. For a straight stem, use the straight reamers from the *VerSys*[®] Hip System. For a bowed stem, flexible reamers from the *Pressure Sentinel*[®] Intramedullary Reaming System are recommended: use the *Pressure Sentinel* Reamer Expanded Hip Set (00-2228-000-03) or the *ZMR*[®] Flexible Reamer Set (00-9975-000-11). If preferred, the flexible reamers can also be used for a straight Variable Stiffness Stem to allow for point contact in the canal. The intramedullary lengths of the stems are listed in the chart below (Fig. 3a). Ream to a depth greater than the intramedullary length to allow proper seating of the stem collar on the cortical bone and placement of a cement restrictor if using a fluted stem.

Stem Type	Straight	Bowed
Fluted	130mm, 190mm	250mm
Variable Stiffness	130mm	190mm

Fig. 3a Stem Length

Note: The diameters indicated for the **Segmental Variable Stiffness Stems** represent the actual outer diameters of the stems, which include the height of the splines. The diameter of the reamed hole should be 0.5mm smaller than the labeled stem size to provide for apposition of the distal splines with the femoral canal (Fig. 3b).

Note: When using a bowed variable stiffness stem it may be necessary to ream the intramedullary canal to a diameter equal to or slightly greater than the diameter of the stem to accommodate any difference between the bow of the stem prosthesis and the anatomy of the patient.

Note: The diameters indicated for the **Segmental Fluted Stems** represent the actual outer diameters of the stem. Therefore, the diameter of the definitive stem should be 2mm smaller than that of the largest reamer used to ream the canal to allow for an adequate cement mantle (Fig. 3b).

Stem Size	Minimum Ream Diameter (Fluted)	Minimum Ream Diameter (Variable Stiffness)
9mm	11mm	8.5mm
10mm	12mm	9.5mm
11mm	13mm	10.5mm
12mm	14mm	11.5mm
13mm	15mm	12.5mm
14mm	16mm	13.5mm
15mm	17mm	14.5mm
16mm	18mm	15.5mm
17mm	19mm	16.5mm
18mm	20mm	17.5mm
19mm	21mm	18.5mm

Fig. 3b Recommended reamer diameters

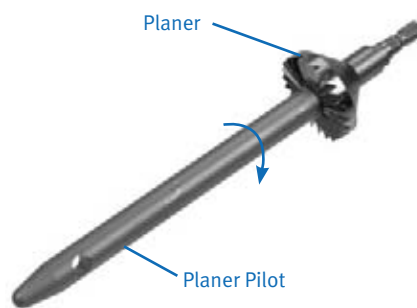


Fig. 4 Threading the Planer Pilot onto the Planer

Plane the Femoral Bone

Thread the appropriately sized Segmental Planer Pilot (130mm long) for the stem diameter selected onto the *MOST Options* Femoral/Tibial Planer (Fig. 4). If the anatomy requires the use of a shorter planer pilot, use the 75mm length Segmental Planer Pilots. A Planer Pilot 1-2mm smaller than the stem diameter chosen can be used to facilitate insertion into a curved medullary canal (Fig. 5). Attach the assembly to a power driver with a Zimmer adapter. Then plane the resected distal femur until the cortical bone is smooth and flat.

To aid in removing the Planer Pilot from the Planer, insert the pin on the Segmental Collar Provisional Sizer through the cross-hole and, while securing the noncutting end of the planer, turn the shank counterclockwise.

Stem Size	Planer Pilot Diameter (Fluted)	Planer Pilot Diameter (Variable Stiffness)
9mm	9mm	8mm
10mm	10mm	9mm
11mm	11mm	10mm
12mm	12mm	11mm
13mm	13mm	12mm
14mm	14mm	13mm
15mm	15mm	14mm
16mm	16mm	15mm
17mm	17mm	16mm
18mm	18mm	17mm

Fig. 5 Recommended Planer Pilot diameters

Counterbore the Femoral Canal (Variable Stiffness Stems Only)

The full diameter of a Variable Stiffness Stem proximal to the splines will be 0.5mm greater than the reamed diameter of the femoral canal. Counterboring this proximal portion is required for proper insertion of the stem in the intramedullary canal.

Thread the appropriate size Counterbore Reamer Tip into the Counterbore Stop Plate (Fig. 6). Then insert the assembly into a power driver. Insert the pin on the Segmental Collar Provisional Sizer through the cross-hole of the Counterbore Reamer Tip and turn the collar to tightly secure it to the Counterbore Stop Plate (Fig. 7).

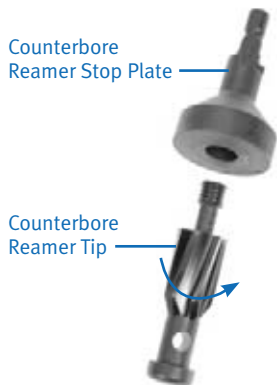


Fig. 6 Counterbore Reamer Tip and Counterbore Reamer Stop Plate

Insert the assembly into the reamed canal and counterbore the proximal canal (Fig. 8). The Counterbore Stop Plate will serve as a stop when the appropriate depth is achieved. **Do not over ream or elongate the hole.**

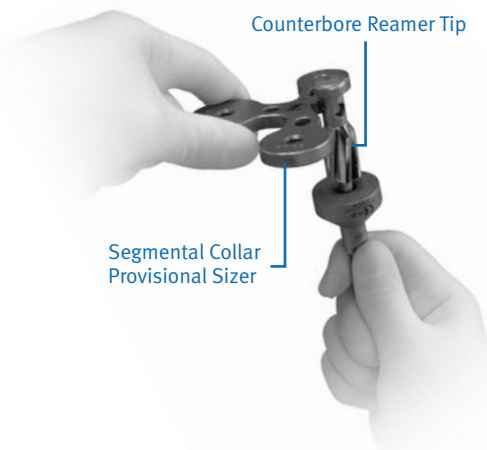


Fig. 7 Counterbore Reamer Tip and Counterbore Reamer Stop Plate Assembly



Fig. 8 Counterbore the Intramedullary Canal

Step Two Prepare the Tibia

For the steps required to prepare the tibia for use with the *NexGen* RH Knee, refer to the *Zimmer NexGen* RH Knee Primary/Revision Surgical Technique (97-5880-002-00).

Step Three Prepare the Patella

If the patella will be resurfaced, refer to the steps required to prepare the patella, in the *Zimmer NexGen* RH Knee Primary/Revision Surgical Technique (97-5880-002-00). Other surgical techniques that may be helpful are those for the *Zimmer* Patella Reamer, the *Augmentation* Patella, and the *Trabecular Metal* Primary Patella.

Step Four Assemble Provisional Components and Perform Trial Reduction

Stem Extension Provisional Assembly
Use the Segmental Collar Provisional Sizer to select the collar size that provides the best coverage of the bone surface. If using a nonporous collar, only the 30mm diameter collar is available. As an option, the collar sizer may be threaded onto the selected Planer Pilot to facilitate collar selection. Select the appropriate stem provisional (Fig. 9). Confirm that the stem and stem collar sizes are compatible (Fig. 10). Then thread the Segmental Collar Provisional onto the selected Segmental Stem Provisional (Fig. 11).

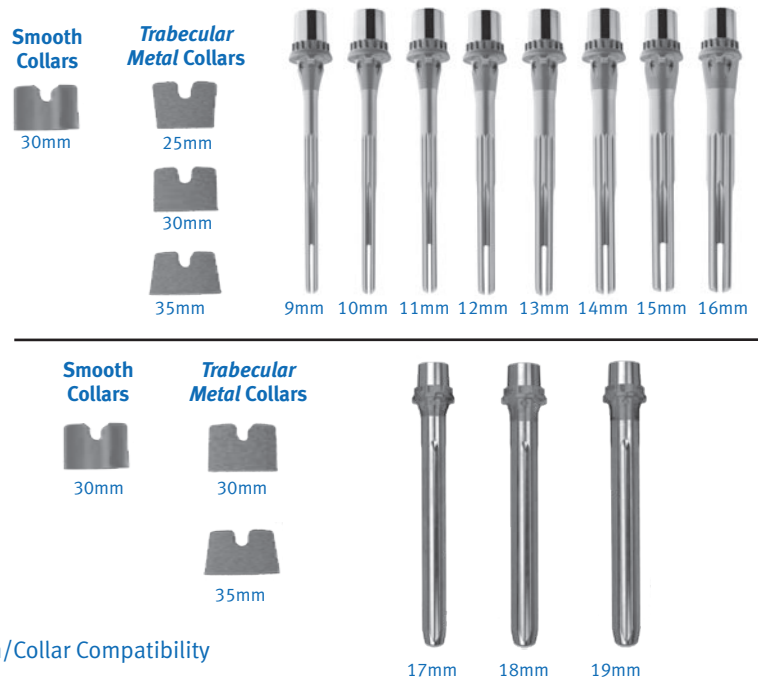
Technique Tip: Check the fit of the Stem Extension Provisional Assembly by inserting it into the reamed canal. For a bowed canal, it may be necessary to perform additional reaming, possibly causing the next smaller stem size to be utilized.

Note: The diameters of the Segmental Stem Provisionals represent the actual diameters of the stems, i.e. a 14mm stem provisional has a nominal 14mm outer diameter.

Note: The same Segmental Straight Stem Provisionals (130mm) are used for both the 130mm Segmental Fluted Straight Stem and the 130mm Variable Stiffness Straight Stem, although, when trialing, a diameter 1mm less than the stem to be implanted is recommended for the Segmental Variable Stiffness stems.

Stem Size	Provisional Stem Diameter (Fluted)	Provisional Stem Diameter (Variable Stiffness)
9mm	9mm	8mm
10mm	10mm	9mm
11mm	11mm	10mm
12mm	12mm	11mm
13mm	13mm	12mm
14mm	14mm	13mm
15mm	15mm	14mm
16mm	16mm	15mm
17mm	17mm	16mm
18mm	18mm	17mm
19mm	19mm	18mm

Fig. 9 Recommended stem provisional diameters



Stem/Collar Compatibility

Note: The bowed stems (not depicted) also have the same compatibility with the collars.

Stem Diameter	Smooth Collar (Item #)	Trabecular Metal Collar (Item #)	Stem I/M Length (Stem Type)
9-16mm	<ul style="list-style-type: none"> • 30mm for 9-16mm stems (00-5852-042-09) 	<ul style="list-style-type: none"> • 25mm for 9-16mm stems (00-5852-040-25) • 30mm for 9-16mm stems (00-5852-040-30) • 35mm for 9-16mm stems (00-5852-040-35) 	<ul style="list-style-type: none"> • 130mm Straight (Fluted and Variable Stiffness) • 190mm Straight (Fluted) • 190mm Bowed (Variable Stiffness) • 250mm Bowed (Fluted)*
17-19mm	<ul style="list-style-type: none"> • 30mm for 17-19mm stems (00-5852-042-17) 	<ul style="list-style-type: none"> • 30mm for 17-19mm stems (00-5852-041-30) • 35mm for 17-19mm stems (00-5852-041-35) 	<ul style="list-style-type: none"> • 130mm Straight (Fluted and Variable Stiffness) • 190mm Straight (Fluted) • 190mm Bowed (Variable Stiffness) • 250mm Bowed (Fluted)

* 250mm Bowed Stems are not available in 9-11mm diameters

Fig. 10 Stem Collar Compatibility Table

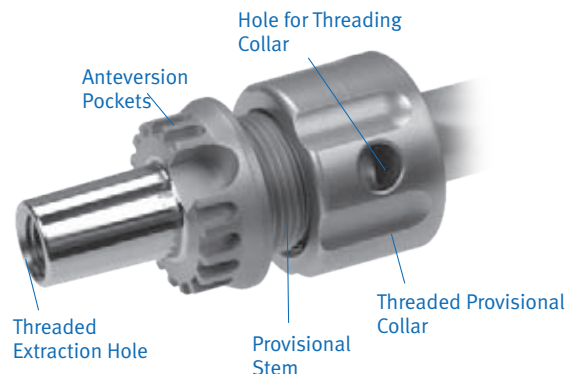


Fig. 11 Threading the collar provisional onto the stem provisional.

Femoral Provisional Assembly and Insertion

After verifying that all sizes are correct, assemble the provisional femoral components. The components can be assembled either on the back table or *in vivo*. For back-table assembly, place the Segmental Distal Femoral Provisional into the Segmental Condyle Impactor. If using a segment provisional, place the male taper into the female taper of the distal femoral provisional. Using the appropriate Segmental Implant/Provisional Male or Female Impactor and the Universal Impactor Handle, impact the segment provisional onto the distal femur. Next attach the stem provisional to the segment provisional or femoral provisional using the appropriate impactor. Ensure that all tabs on the provisional components are properly engaged in the corresponding pockets. Use gauze to protect the stem tip and impact with a mallet.

Alternatively, the femoral provisionals may be assembled sequentially *in vivo*. If necessary, the Universal Impactor Handle can be threaded into the base of the Segmental Condyle Impactor (Fig. 12).

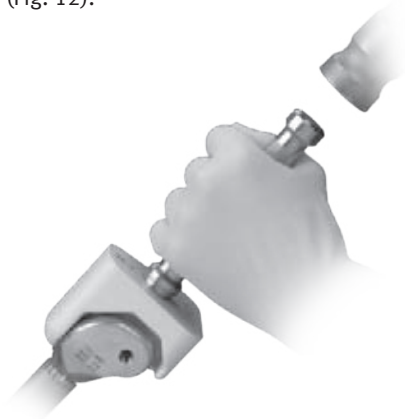


Fig. 12 Universal Impactor Handle threaded into the base of the Segmental Condyle Impactor being used to impact the provisionals *in vivo*.

Insert the femoral provisional assembly into the femoral canal and evaluate the fit. If necessary to achieve full seating, use the Segmental Condyle Impactor, the Universal Impactor Handle, and a mallet to lightly impact the distal end of the Segmental Distal Femoral Provisional (Fig. 12). Evaluate the fit of the stem collar on the bone surface to determine if the stem is fully seated. Assess the orientation of the distal femoral provisional and determine whether a rotation adjustment will be necessary. If desired, the femoral component can be slightly externally rotated based on the anterior femur and linea aspera to facilitate patellar tracking.

If a bowed stem is being used, mark the femoral bone in line with the alignment slot on the mediolateral side of the Segmental Bowed Stem Provisional to provide a locator for proper orientation of the implant (Fig. 13).

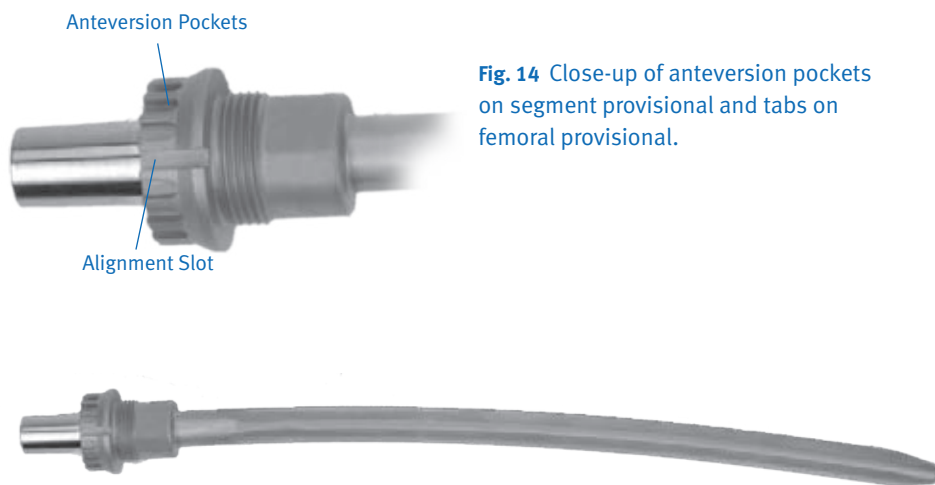


Fig. 13 Slot Properly Aligned

Femoral Version Adjustment

If a rotation adjustment is necessary, use the Segmental Taper Separator to disassemble the provisional taper. The anteversion pockets and tabs on the provisional components allow the component rotation to be adjusted in a controllable manner in 20-degree increments (Fig. 14).

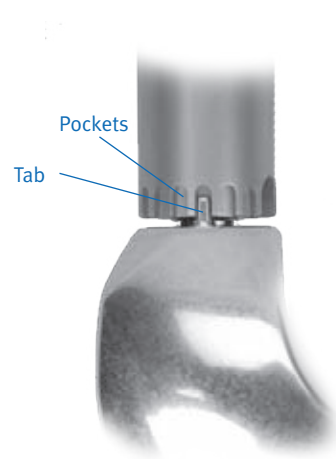


Fig. 14 Close-up of anteversion pockets on segment provisional and tabs on femoral provisional.

Using the Segmental Taper Separator

Before employing the Segmental Taper Separator, make sure that the inside wedging portion of the instrument is fully retracted and centered within its housing. To orient the instrument correctly, insert the tabs of the separator into the anteversion pockets with the flat of the separator toward the anatomical joint as etched on the instrument (Fig. 15). Slowly turn the handle clockwise until the tapers are disengaged, taking care not to pinch fingers against the rotating impactor cap. If necessary, lightly tap the impactor cap on the instrument to facilitate taper disassembly.

Note: To protect the taper integrity of the femoral provisional components, use only the Segmental Taper Separator with the turning handle when disassembling the femoral provisional construct.

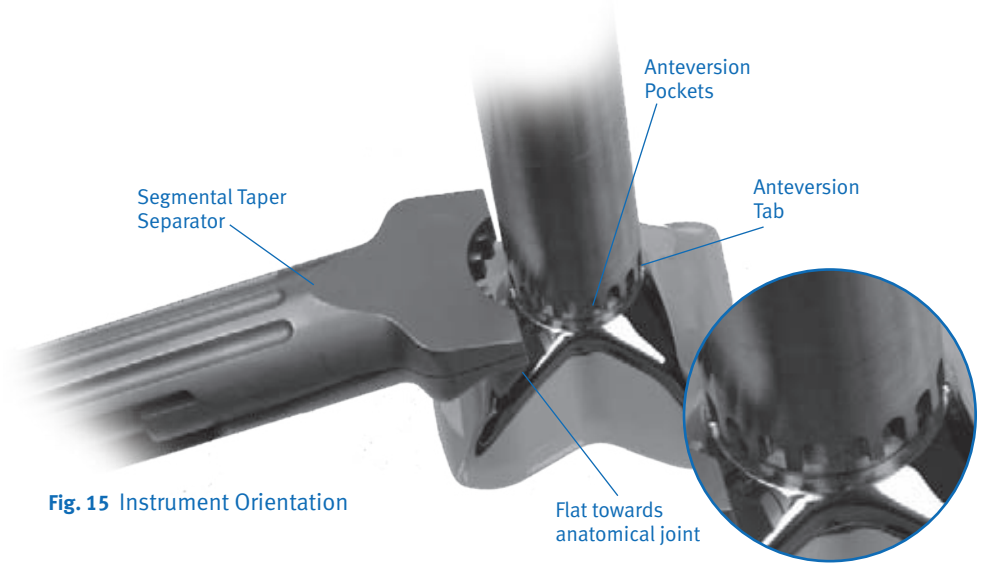


Fig. 15 Instrument Orientation

Tibial Provisional Assembly and Insertion

Assemble the *NexGen* RH Knee Tibial Provisional Components and *NexGen* Stem Extension Provisional, if applicable. Use the provisionals from the RH Knee Articular Surface Provisional Instrument Set (Kit# 5979-04). Remember that the size on the femoral provisional must exactly match the size of the articular surface provisional. The size on the tibial provisional must be appropriate for the size of the femoral provisional and tibial articular surface provisional (Fig. 16).

Note: When using a large tibia component paired with a small femoral component, some portion of the tibia base plate will be visible under the articulating surface. This is normal.

Interchangeability Chart 1
Segmental Knee System
(using an RH Knee tibial component)

		Segmental Femoral Size	
		B	C
RH Knee Tibial Size	1	B/123456	C/123456
	2	B/123456	C/123456
	3	B/123456	C/123456
	4	B/123456	C/123456
	5	B/123456	C/123456
	6	B/123456	C/123456

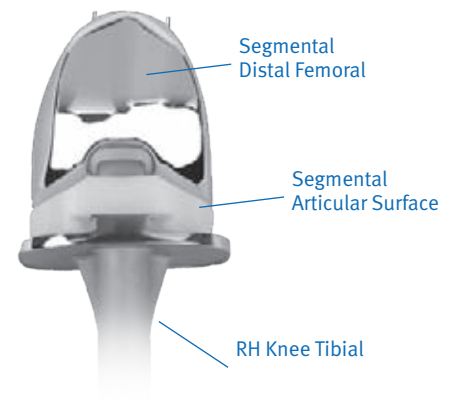


Fig. 16 Interchangeability Chart

Insert the tibial provisional construct into the tibial canal, and then insert the appropriate size articular surface provisional. Place the knee through a full range of motion to evaluate soft tissue tension and knee stability. A thicker articular surface provisional should be used if necessary to correctly balance the knee.

Note: The Segmental Distal Femoral Component and the RH Knee Tibial Components are linked, forcing the tibia to be in alignment directly under the femur (on the mechanical axis) by virtue of the one-piece hinge post that links the femoral and tibial components.

Trial Reduction

When assessing hyperextension during trial reduction, use only the Segmental Hinge Post Provisionals, which have gold color on their superior ends, with the Segmental Distal Femoral Provisional. This is important because these hinge post provisionals incorporate the thickness of the Segmental Polyethylene Insert into the design. Using a one-piece hinge post provisional, without the gold color on its end, will not provide an accurate assessment of hyperextension during trial reduction.

The Segmental Hinge Post Provisional can be attached to the distal femoral provisional first, and then inserted through the articular surface provisional and tibial provisional. However, if there is concern about overstressing nerves and vascular structures, insert the Segmental Hinge Post Provisional into the articular surface provisional and tibial provisional before attaching it to the femoral provisional.

The hinge post provisional must match the femoral provisional size. Use the Segmental Hinge Pin Aligner to align the hole in the hinge post provisional with those on each side of the femoral provisional. Then, while maintaining the position, remove the aligner, and insert the Segmental Distal Femoral Bolt Provisional using the 4.5mm Hex Driver to secure the bolt into the femoral provisional.

Note: If the joint is being distracted to insert the hinge post provisional into the tibial component, be aware that the length of the hinge post implant may be longer than the provisional, which will require additional distraction to insert the hinge post into the tibial component upon final implantation.

When using distraction, assembly is facilitated if the knee is in approximately 90° of flexion and the tibia is free to be moved mediolaterally for centering under the femur. If the Segmental Hinge Post Provisional will not line up with the hole in the articular surface provisional, it will be necessary to reposition the tibia under the femur. The femoral provisional rotation should also be evaluated and adjusted, if necessary. Leg holders should not be used during the assembly process.

Insert the appropriate patellar provisional if patellar resurfacing is being performed. Conduct a complete evaluation of range of motion. Evaluate the patellar tracking, and palpate the posterior soft tissues to ensure that there is not excessive tension. To avoid causing damage to nerve and vascular structures, do not pull too hard on the leg. Assess the rotation of the limb and, if necessary, adjust the rotation of the components. Then perform any necessary soft tissue releases.

Provisional Disassembly

Remove the patellar provisional, if used, Segmental Distal Femoral Bolt Provisional, Segmental Hinge Post Provisional, and articular surface provisional. Manually attempt to remove the femoral provisional, segment provisional, if used, and the stem provisional. If these components cannot be removed manually, use the Segmental Taper Separator to loosen the taper between the stem and the femoral provisional or segment provisional, if used. Thread the Provisional Slaphammer Adaptor (Fig. 17) onto the slaphammer and thread it into the stem provisional. Impact the slaphammer to remove the stem provisional. Then remove the tibial base plate provisional and associated extension provisional, if used.



Provisional Slaphammer Adapter (two grooves) Implant Slaphammer Adapter (one groove)

Fig. 17 Slaphammer groove diagram

Step Five Assemble Implants

Note: Remove any debris from tapers prior to assembly of tapered components.

Note: If implanting the Variable Stiffness Stem/Collar/Segment/Distal Femur assembly separately, DO NOT impact the segment or stem to the distal femur at this time. Please proceed to the next section “Stem Extension Assembly.”

Distal Femoral Assembly

Before assembling the final components, verify the accuracy of the implants selected and the compatibility of all component sizes (Page 4 Compatibility Chart & Fig. 16). Assemble the femoral and tibial components as described in the provisional assembly step before mixing the cement. If segments will be used, rest the distal condyles of the femoral component on the Segmental Condyle Impactor (Fig. 18). Align the anteversion tabs, and then use the Segmental Implant/Provisional Male or Female Impactor, the Universal Impactor Handle, and a mallet to solidly impact the segment into the femoral component.

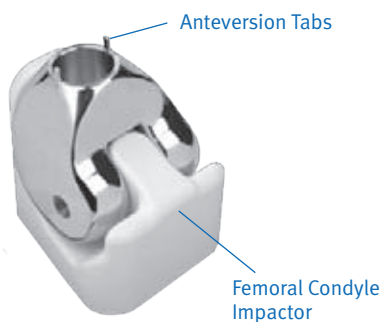


Fig. 18 Locating the Distal Femoral Component on the Femoral Condyle Impactor

Note: Avoid notching, scratching, or directly striking the implants during assembly

With the femoral component resting on the Segmental Condyle Impactor on the back table, ensure that all anteversion tabs are properly aligned. For a Fluted stem, protect the end of the stem with gauze during impaction. Then use a mallet to solidly impact the stem into the femoral component or segment.

When impacting the Variable Stiffness Stem into the distal femoral component or segment, the Variable Stiffness Stem Impaction Sleeve must be used to avoid damaging the prongs on the Variable Stiffness Stem tip.

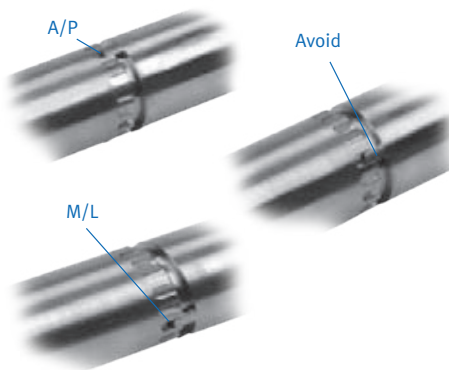


Fig. 19 Anteversion Tab Positioning

Slide the Variable Stiffness Stem Impaction Sleeve over the stem until the notches on the sleeve capture the collar alignment tabs on the stem base. Use a two-pound mallet to solidly strike the impaction head of the sleeve. This will impact the stem into the femoral component or segment. Use cementing technique described for Fluted stems (Fig. 20) to cement the collar to the Variable Stiffness Stem.

Note: Impacting the taper more than once may loosen the taper connection.

Note: Do not strike the tip of the Variable Stiffness Stem with any instrument, as this may damage the prongs created by the slots.

Note: The segment anteversion tabs must be positioned in either the direct A/P or M/L direction. This will facilitate access for the Segmental Taper Separator (Fig. 19).

Stem Extension Assembly

All Segmental Stems must be used with collars, and all collars must be cemented to the stems. Refer to Fig. 10 for an overview of stem and collar combinations. Be sure to verify compatibility of the collar with the stem size being used on the product label before the implant packages are opened.

Technique Tip: Consider using two mixes of bone cement. The first can be used to cement the collar to the stem. Once the cement has set, the stem/collar assembly can be inserted as a unit. The second mix can be used to cement the stem/collar assembly (if using a Fluted Stem), tibial component, and patellar component.

Technique Tip: If using a Fluted (cemented) stem, before cementing the collar, insert the stem implant into the intramedullary canal to confirm that the stem will fully seat. Clean off the stem prior to cementing the collar.

For a Fluted stem, apply cement in the doughy state to the base/taper end of the stem. Then slide the stem collar over the stem and advance it to the shank area where cement was applied. Clean off excess cement as the collar is advanced. Care should be taken to prevent cement from contacting the taper, the anteversion adjustment pockets, and the external surfaces of *Trabecular Metal* Material. Collars must be assembled to the stem with the pockets toward the anatomical joint and engaged into the tabs on the stem (Fig. 20). Allow the cement to fully harden before inserting into the Distal Femoral Component.

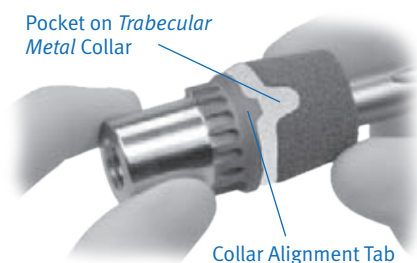


Fig. 20 Collar Assembly Detail

Proximal Tibial Assembly

To assemble the tibial component, refer to the *Zimmer NexGen RH Knee Primary/Revision Surgical Technique* (97-5880-002-00).

Step Six Insert Implants

Implanting the Fluted Stem/ Collar/Segment/Distal Femur as a Single Unit

Before final implantation, verify that properly sized components (Segmental Polyethylene Insert, Segmental Hinge Pin, Segmental Hinge Post, Segmental Articular Surface, Segmental Stem, and Segmental Segments) have been used in the assemblies, as determined when using provisionals.

After cementing the collar onto the stem, and if desired, use a plastic cement restrictor to permit the cement to be manually pressurized. A *Bigliani/Flatow*[®] Pressurizer Sponge (item # 00-4301-035-01) may be used to prevent cement from extruding out of the femoral canal and onto the face of the *Trabecular Metal* Collar that contacts that planed surface of the femoral cortex. If using this technique, after the cement that attaches the collar to the stem has cured, slide the sponge onto the stem until it contacts the base of the *Trabecular Metal* Collar. Inject cement into the intramedullary canal. Apply cement to the shank of the stem to ensure adequate cement coverage at the implant/bone interface. Attach the Universal Impactor Handle to the Segmental Condyle Impactor. Use this impactor and a mallet to tap the implant until fully seated, cleaning off excess cement as the femoral implant assembly is inserted and being careful to keep cement off of the external surfaces of the smooth or *Trabecular Metal* Collars, the entire surface of the tapers, and the crevices of the anteverision adjustment pockets. If using the *Bigliani/Flatow* Pressurizer Sponge, remove the sponge just prior to the collar sitting flush with the prepared cortex and prior to the cement curing. Fully seat the stem, taking care not to leave any foam material in the

wound or on the *Trabecular Metal* Material's surface.

Do not implant the pressurizer sponge.

Note: Cement must be added to the base of the Smooth Collar where it contacts the bone.

Other Components

To implant the tibial component, refer to the *NexGen RH Knee Primary/Revision Surgical Technique* (97-5880-002-00). To implant the patellar component, refer to "Step Three: Prepare the Patella." The articular surface provisional may be inserted and the knee placed in extension while the cement is setting to maintain compression on the components.

Segmental Polyethylene Insert / Hinge Post Orientation

The size of the Segmental Polyethylene Insert must match the femoral size selected. Attach the Segmental Polyethylene Insert to the Segmental Hinge Post by spreading the sides of the polyethylene insert out slightly and pressing it over the hinge post until it snaps into place. The holes in the polyethylene insert must match the bosses on the hinge pin bushing to assure proper orientation (Fig. 21). If attached backwards, the Segmental Polyethylene Insert and Segmental Hinge Post will not fit easily within the Segmental Distal Femoral Component without interference.

Once the cement has set, remove the articular surface provisional, if used. Insert the final Segmental Articular Surface. The Segmental Articular Surface is packaged with a mating hinge post that ensures a 40mm jump height. Do not use a hinge post from another articular surface size.

Warning: Do not use Segmental System components (such as the one-piece Segmental Hinge Post) with NexGen RH Knee articular surfaces. They were not designed to be compatible.

If the joint can be distracted sufficiently, attach the hinge post assembly (with Segmental Polyethylene Insert snapped on) to the Segmental Distal Femoral Component. Follow the steps below to lock the hinge post to the femoral component. Then insert the hinge post into the tibial component.

If there is concern about overstretching nerves and vascular structures, insert the hinge post assembly (with Segmental Polyethylene Insert snapped on) into the tibial component before attaching it to the femoral component. Then follow the steps below to lock the hinge post to the femoral component.

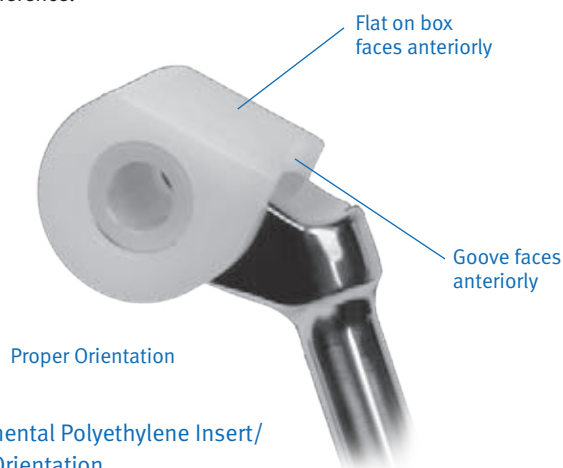


Fig. 21 Segmental Polyethylene Insert/
Hinge Post Orientation

Implanting the Variable Stiffness Stem/Collar/Segment/Distal Femur as Single Unit

After cementing the collar onto the stem (see previous section “Stem Extension Assembly” for details), insert the construct into the femoral canal and use the Segmental Condyle Impactor with the Universal Impactor Handle attached and a mallet to tap the implant until fully seated.

Note: Cement must be added to the base of the Smooth Collar where it contacts bone.

As the stem advances into the canal, use the vertical mark on the bone to assess the rotational alignment. If the stem fits too tightly in the bone, consider removing the stem and passing the last reamer used through the canal several more times. This can help to increase the hole diameter slightly, which will permit the stem to be more easily impacted into the bone.

Implanting the Variable Stiffness Stem/ Collar Assembly and the Segment/Distal Femur Assembly Separately

After cementing the collar onto the stem, insert the stem/collar assembly into the femoral canal and use the Segmental Implant/Provisional Male Taper Impactor (assembled to the Universal Impactor Handle) and a mallet to tap the stem implant until fully seated. **Note: Cement must be added to the base of the Smooth Collar where it contacts bone.** As the stem advances into the canal, use the vertical mark on the bone to assess the rotational alignment. If the stem fits too tightly in the bone, consider removing the stem and passing the last reamer used through the canal several more times. This can help to increase the hole diameter slightly, which will permit the stem to be more easily impacted into the bone.

Note: Remove any debris from tapers prior to assembly of tapered components.

If using a segment, assemble it to the Distal Femur using the Segmental Condyle Impactor. Impact the assembly together with the Segmental Implant/Provisional Female Taper Impactor assembled to the Universal Impactor Handle. Use a mallet to firmly tap the tapers to the seated position.

Place the Distal femoral assembly onto the stem taper, and use the Segmental Condyle Impactor (with Universal Handle) and a mallet to tap the two assemblies together until fully seated.

Other Components

To implant the tibial component, refer to the *NexGen* RH Knee Primary/Revision Surgical Technique (97-5880-002-00).

To implant the patellar component, refer to “Step Three: Prepare the Patella.”

The articular surface provisional may be inserted and the knee placed in extension while the cement is setting to maintain compression on the components.

Segmental Polyethylene Insert / Hinge Post Orientation

The size of the Segmental Polyethylene Insert must match the femoral size selected. Attach the Segmental Polyethylene Insert to the Segmental Hinge Post by spreading the sides of the polyethylene insert out slightly and pressing it over the hinge post until it snaps into place. The holes in the polyethylene insert must match the bosses on the hinge pin bushing to assure proper orientation (Fig. 21). If attached backwards, the Segmental Polyethylene Insert and Segmental Hinge Post will not fit easily within the Segmental Distal Femoral Component without interference.

Insert the final Segmental Articular Surface. The Segmental Articular Surface is packaged with a mating Hinge post that ensures a 40mm jump height. Do not use a hinge post from another articular surface size.

Warning: Do not use Segmental System components (such as the one-piece Segmental Hinge Post) with *NexGen* RH Knee articular surfaces. They were not designed to be compatible.

If the joint can be distracted sufficiently, attach the hinge post assembly (with Segmental Polyethylene Insert snapped on) to the Segmental Distal Femoral Component. Follow the steps below to lock the hinge post to the femoral component. Then insert the hinge post into the tibial component.

If there is concern about overstressing nerves and vascular structures, insert the hinge post assembly (with Segmental Polyethylene Insert snapped on) into the tibial component before attaching it to the femoral component. Then follow the steps below to lock the hinge post to the femoral component.

Locking the Hinge Post to the Femoral Component

Use the Segmental Hinge Pin Aligner to align the hole in the hinge post with the holes of the femoral implant. Then remove the aligner. Use the 4.5mm Hex Driver to insert and thread the Segmental Hinge Pin through the hole of the femoral implant (Fig. 22). Make sure that the pin crosses through the hole in the hinge post bushing. The hinge pin may be inserted either medially or laterally into the femoral component. Use the RH Knee Torque Wrench with the blue handle and 4.5mm Hex Driver to tighten the hinge pin to 130in-lbs. While torquing, watch the stylus on the wrench until it reaches the 130 line, then stop (Fig. 23). Insert the Segmental Hinge Pin Set Screw on the same side as the hinge pin (Fig. 22) and use the RH Knee Torque Wrench with the blue handle and 4.5mm Hex Driver to torque the set screw to 130in-lbs. While torquing, watch the stylus on the wrench until it reaches the 130 line, then stop (Fig. 23).

Caution: Do not torque the hinge-pin or set screw beyond 130in-lbs or damage to the hex-drive or driver will occur.

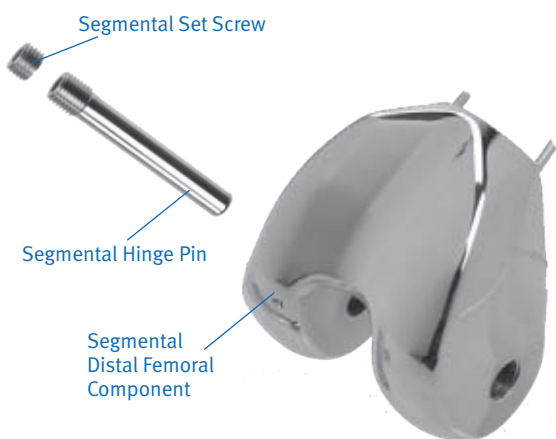


Fig. 22 Femoral Assembly



Fig. 23 Torque Reading Detail

Disassembly

If disassembly is necessary during surgery, the Segmental Taper Separator is designed to enable separation of the junctions between segments, stems, and femoral implants without damaging the tapers. Refer to “Using the Segmental Taper Separator” under “Femoral Version Adjustment” in Step Four for instructions related to the Segmental Taper Separator. Alternatively, the Segmental Wedge Taper Separator may be used as a back-up to disassemble the tapers on the implants.

For stem removal, thread the Implant Slaphammer Adaptor (Fig. 24) onto the slaphammer and thread it into the stem. Impact the slaphammer to remove the stem.

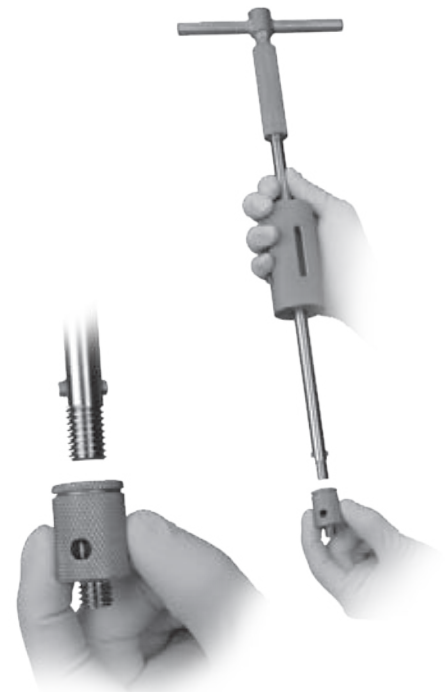


Fig. 24 Slaphammer Adapter alignment when threading onto the slaphammer

Closure

Before closing, thoroughly cleanse the surgical site of bone chips, bone cement, and any other debris. Foreign particles at the articular interface may cause excessive wear.

Segmental Hinge Servicing Kit: A Segmental Hinge Servicing Kit (see Fig. 25) is available if a component is dropped or damaged during surgery. This kit is also used during revisions of the Segmental hinge. In addition, the Segmental Polyethylene Insert is also available as a separate package from the kit.

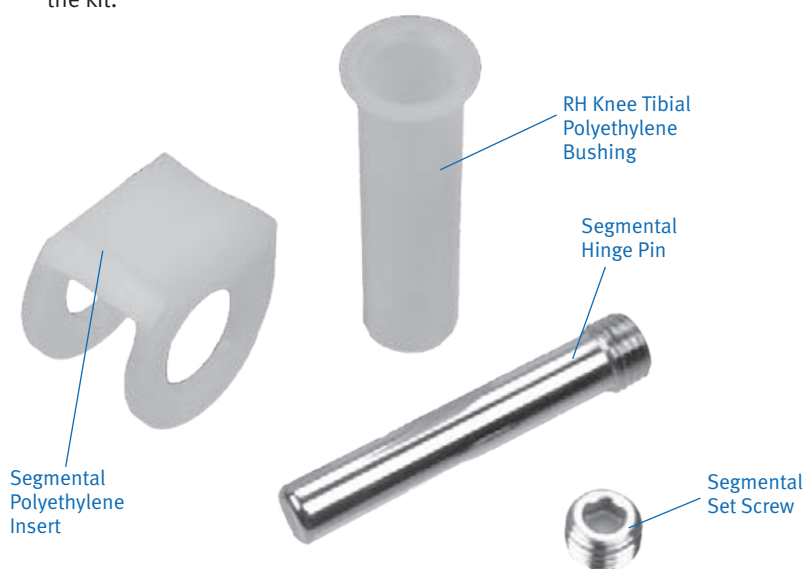


Fig. 25 Segmental Hinge Servicing Kit Components

Using the Segmental Hinge Post with the NexGen RH Knee

If using the Segmental Hinge Post with the NexGen RH Knee System for a primary or a complete revision arthroplasty, prepare the tibia, femur, and patella as indicated in Steps 1-10 of the *Zimmer NexGen Primary/Revision RH Knee Surgical Technique* (97-5880-002-00). Then continue with the following four steps.

If replacing the tibial articular surface and hinge post with a Segmental Articular Surface and Segmental Hinge Post in a patient with an existing NexGen RH Knee, remove the previous modular hinge component and articular surface. Refer to the *Zimmer NexGen Primary/Revision RH Knee Surgical Technique* (97-5880-002-00), Appendix G. Use the RH Knee Articular Surface Provisionals, Rotating-Hinge Knee Segmental Hinge Post Provisionals, and Segmental/RH Knee Hinge Pin Aligner for trial range-of-motion evaluations. Then proceed to “Step Four – Assemble Segmental Hinge Post” (page 25) in this technique, and use the *in vivo* assembly technique.

As part of the preoperative planning, determine whether back-table (distractive) assembly or *in vivo*

assembly of the Segmental Hinge Post to the NexGen RH Knee Distal Femoral Component and NexGen RH Knee Tibial Component will be performed. In back-table assembly, the Segmental Hinge Post is cross-pinned to the NexGen RH Knee Distal Femoral Component before insertion into the patient. The distal femoral implant assembly (with Segmental Hinge Post) is inserted onto the chamfered distal femoral bone, and the cylindrical portion of the hinge post is inserted through the articular surface and into the tibia once enough distraction across the joint space is achieved. This technique is detailed in “Back-table (distractive) Assembly Technique” under “Step Four - Assemble Segmental Hinge Post” (page 27).

For *in vivo* assembly, the Segmental Hinge Post is cross-pinned to the NexGen RH Knee Distal Femoral Component through the medial trephine hole in the femoral bone. *In vivo* assembly is detailed in “*In vivo* Assembly Technique” under “Step Four – Assemble Segmental Hinge” (page 26).

Note: If needed please reference the Segmental System scope compatibility chart on page 4 for system cross-compatibilities.

Step One Prepare the Femur for the Segmental Hinge Post

Use the Segmental /RH Knee Drill Guide Body that is the same size as the femoral component being implanted. Slide the Segmental Trephine Guide Bushing into the slot of the drill guide body such that the drill guide body will facilitate drilling of the medial side of the femur (Fig. 26). Thread the Universal Impactor Handle into the hole on the distal face of the Segmental/RH Knee Drill Guide Body and tighten to secure the guide bushing to the drill guide body. This instrument is intended for use with a primary procedure only. Utilize the NexGen RH Knee Hinge Pin Servicing Kit (Kit # 00-5979-005-00) for revisions, as described in Appendix G of the *NexGen Primary/Revision RH Knee Surgical Technique* (97-5880-002-00).

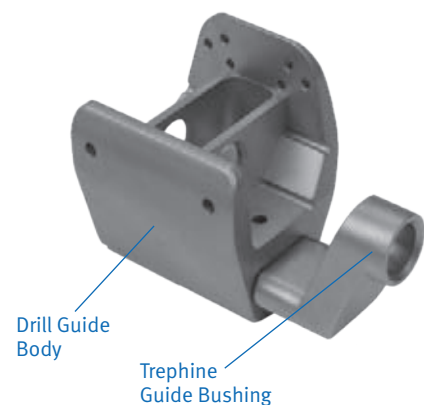


Fig. 26 Locating the Segmental Trephine Guide Bushing

NexGen Distal Femoral Augments and Posterior Femoral Augments are available for use with the *NexGen* RH Knee. Distal augments are available in 5mm, 10mm, 15mm, and 20mm sizes, and posterior augments are available in 5mm and 10mm sizes. *NexGen* Anterior Femoral Augments are not available for use with the *NexGen* RH Knee.



If the *NexGen* Distal Femoral Augments are being used on the lateral side of the femur, the distal augment provisionals must be attached to the underside of the drill guide body. If the augments are being used on the medial side of the femur, the distal augment provisionals should not be attached to the underside of the drill guide body as this could block the Trepine when drilling the access hole. In this case, it is important to confirm that the Trepine Drill Guide Body is flush against the distal and anterior chamfer cuts on the lateral side to ensure that the access hole will be drilled in the correct location (Fig. 27).

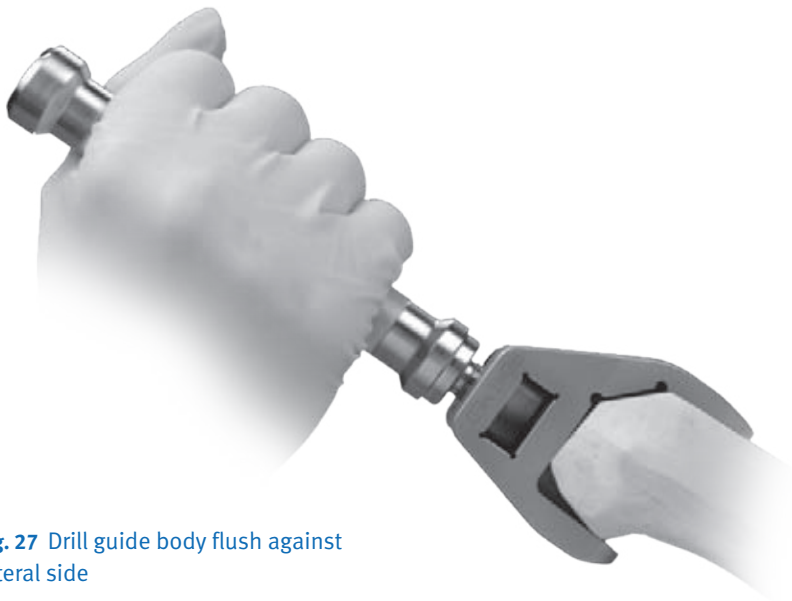


Fig. 27 Drill guide body flush against lateral side

Insert the drill guide assembly onto the prepared distal femur, and impact lightly with a mallet until it is flush with the resected distal surface.

Attach the Trepine to a drill/driver. Then use the Trepine to drill an access hole through the guide bushing and into the medial side of the femur. The Trepine has a built-in stop to limit the depth of drilling (Fig. 28).

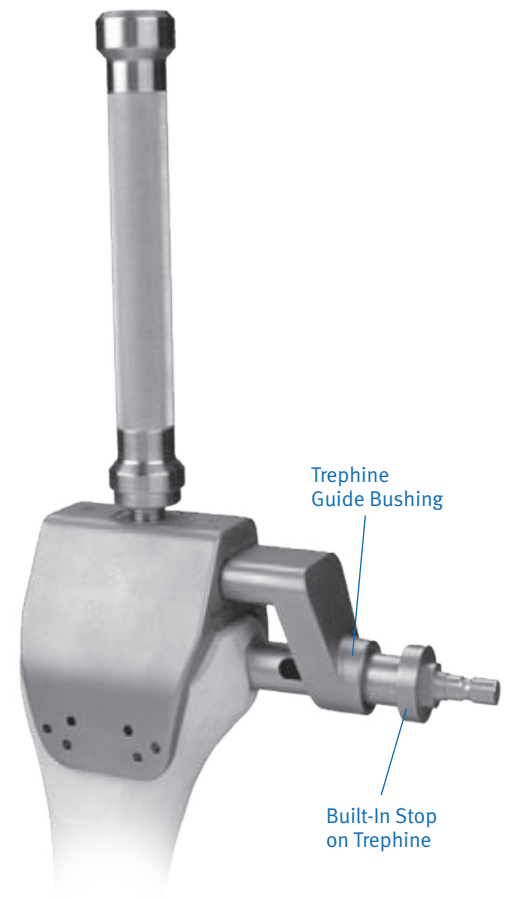


Fig. 28 Trepine Guide Assembly

Step Two Assemble Provisional Components and Perform Trial Reduction

If augmentation is required, attach the appropriate *NexGen* Posterior Femoral Augment Provisionals to the Femoral Provisional/Cutting Guide (Fig. 29) on the lateral side. Then attach the *NexGen* Distal Femoral Augment Provisionals on the lateral side, if necessary. The augment provisionals simply snap into place.

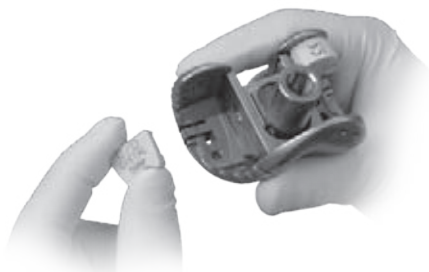


Fig. 29 Locating the Posterior Femoral Augments

Note: Do not attach Distal Femoral Augment Provisionals to the medial side of the Femoral Provisional/Cutting Guide as this may block access for cross-pinning with the Segmental/RH Knee Hinge Pin Aligner.

Technique Tip: The 10, 15 and 20mm *NexGen* Distal Femoral Augments will block access to the *NexGen* RH Knee hinge pin at revision if placed on the medial side. Use of cement in place of the augment bolt is recommended to affix an augment of these sizes when used on the medial side to expedite removal at revision.

Assemble the Stem Extension Provisional to the Femoral Provisional/Cutting Guide (Fig. 30). If an offset stem extension will be used, fully thread the Offset Stem Locknut onto the appropriate size Offset Stem Provisional and tighten the locknut against the Stem Extension Bushing to lock the orientation. Slide the appropriate size Segmental/RH Knee Modular Box Provisional onto the RH Knee Femoral Provisional/Cutting Guide and push the clip until it snaps into place (Fig. 31).



Fig. 30 Stem Provisional Assembly

Insert the femoral provisional assembly onto the bone and impact if necessary to fully seat the provisional on the bone. The hole in the medial side of the box provisional should align with the access hole drilled into the medial side of the femur. If the hole is not aligned, the access hole should be re-drilled or additional bone removed with a burr until the hole is aligned.

Insert the correct size RH Knee Tibial Provisional with the selected Tibial Augment Provisionals and Stem Extension Provisional, if applicable. *NexGen* Tibial Augment Provisionals are available in full blocks (RH Knee-specific — 10mm), blocks (5mm, 10mm, 15mm, and 20mm), 16-degree half wedges, 26-degree half wedges, and 22-degree third wedges.

Note: The 7-degree tibial wedges (full-angled wedges) will not work with the *NexGen* RH Knee or the Segmental Knee.

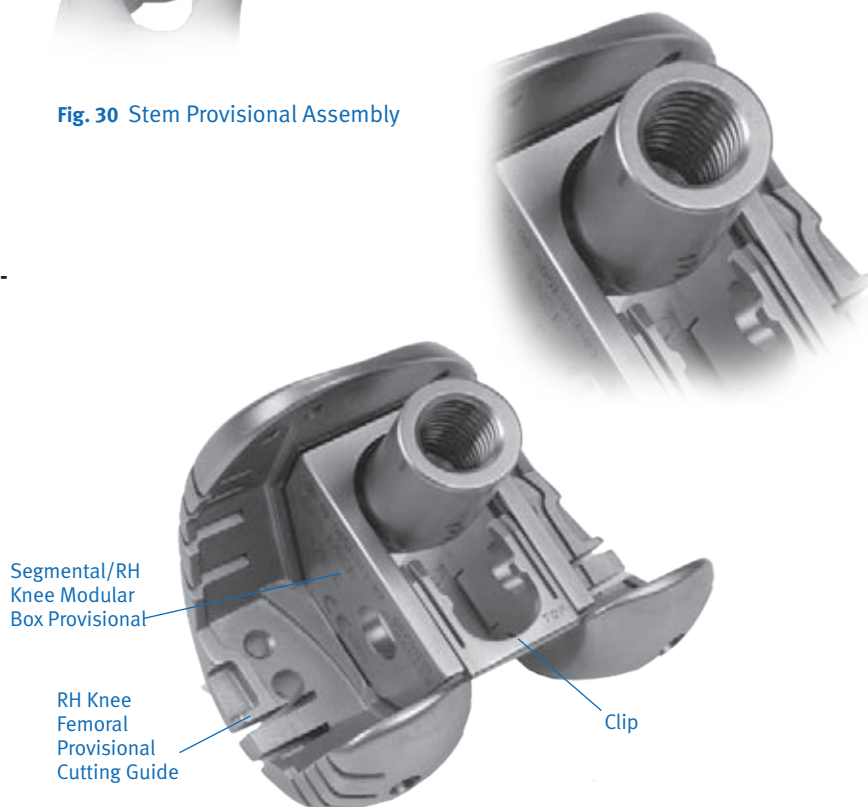


Fig. 31 Cutting Guide Assembly

Use the *NexGen* RH Knee Articular Surface Provisionals from the *NexGen* RH Knee Articular Surface Provisional Instrument Set (Kit # 00-5979-004-00) and insert the appropriate size provisional. The size of the articular surface provisional must match the size of the femoral provisional, and the size of the tibial provisional must be compatible with the size on the femoral provisional. Refer to the sizing chart (Fig. 32).

Interchangeability Chart 2
Segmental Knee System
(using RH Knee femoral and tibial components)

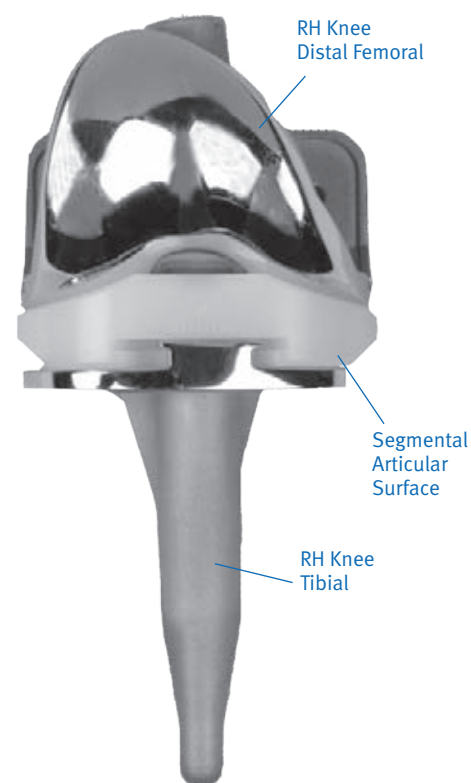
		RH Knee Femoral Size				
		B	C	D	E	F
RH Knee Tibial Size	1	B/123456	C/123456	D/123456		
	2	B/123456	C/123456	D/123456	E/23456	
	3	B/123456	C/123456	D/123456	E/23456	F/3456
	4	B/123456	C/123456	D/123456	E/23456	F/3456
	5	B/123456	C/123456	D/123456	E/23456	F/3456
	6	B/123456	C/123456	D/123456	E/23456	F/3456

Fig. 32 Interchangeability Chart

Flex the knee through the full range of motion to evaluate soft tissue tension and knee stability. A thicker articular surface provisional should be used if necessary to correctly balance the knee.

Note: The RH Knee is a linked design that will force the tibia to be in alignment directly under the femur (on the mechanical axis) by virtue of the hinge post that links the femoral and tibial components.

When assessing hyperextension during trial reduction, use only the one-piece Segmental/RH Knee Hinge Post Provisionals, which do not have gold color on their superior ends, with the *NexGen* RH Knee Femoral Provisional Cutting Guide. This is important because these hinge post provisionals incorporate the thickness of the *NexGen* Polyethylene Insert with Cement Shield into the design. Using a one-piece hinge post provisional with a gold color on its end will not provide an accurate assessment of hyperextension during trial reduction.



Select the appropriate Segmental/RH Knee Hinge Post Provisional, and insert it through the post hole in the tibial provisional assembly. Then insert the proximal end of the hinge post provisional into the box provisional so the hole aligns with the medial hole in the box provisional. Insert the Segmental/RH Knee Hinge Pin Aligner through the access hole drilled on the medial side of the femur, and through the holes in the insert provisional and hinge post provisional.

If after inserting the hinge post provisional into the tibial provisional assembly, the proximal end will not line up with the box provisional, it will be necessary to reposition the tibia under the femur. Assembly is facilitated if the knee is at approximately 90° of flexion, and the tibia is free to be moved mediolaterally to be centered under the femur. Movement of the knee from 90° of flexion to full extension may also facilitate assembly of the components. Use of leg-holders during the assembly process is not recommended.

Note: The provisional hinge post used for trial reduction is available in only one length, which may be shorter than the final hinge post implanted. The main purpose of the provisional hinge post is to bring the tibia into alignment with the mechanical axis directly under the femur. The Segmental/RH Knee Hinge Post Provisional plays a similar role; however, its length also accounts for the thickness of the Segmental Articular Surface and provides 40mm of jump height to resist subluxation. Do not proceed with back-table assembly if there is concern over distracting the joint beyond that used in trial reduction.

Perform any necessary soft tissue releases.

Patellar Tracking

Evaluate the tracking of the Patellar Provisional against the Femoral Provisional/Cutting Guide.

The patella must track centrally. Simulate closure of the capsule with either a single suture or by attaching a towel clip. If additional pressure is needed to hold the patella reduced, or if the patella tends to sublux or tilt laterally, perform a lateral retinacular release by a preferred technique. Be careful not to create any defect in the skin. Extend the release until the patella tracks satisfactorily. If a lateral retinacular release fails to correct patellar tracking, re-assess the rotation of the femoral and tibial components. Also check the orientation of the tibial tubercle.

Remove all provisional components.

Step Three

Assemble and Insert Implants

Preparation of the Femoral Component

The following sequence can be followed exactly in preparation for the *in vivo* assembly technique used in Step 4. Back-table assembly notes have been added where applicable. Check all component sizes to ensure that the distal femoral, articular surface, and hinge post components match (Fig. 32). Check that the size selected for the tibial component is compatible with the size of the distal femoral component.

The modular hinge post assembly that is pre-attached to and packaged with the RH Knee Femoral Component must be removed. Use the Hinge Pin Polyethylene Plug Removal Tool to remove the hinge pin plug. Then use the 4.5mm Hex Driver and LCKK Torque Wrench (black handle) to remove the hinge pin. When the hinge pin is removed, the hinge post and polyethylene insert can be removed and discarded. Next, re-insert the hinge pin and manually tighten. This will protect the thread in the femoral component during the cementing process.

Distractive Assembly Note: It will not be necessary to re-insert the original hinge pin (from the modular hinge post assembly) back into the femoral component because cementing will occur after the final hinge pin (from the NexGen RH Knee Cement Shield Service Kit) has already been assembled to the implant.

Cementing the Implants

If implanting a NexGen Stem Extension, refer to Appendix F in the *Zimmer NexGen RH Knee Primary/Revision Surgical Technique* (97-5880-002-00).

Assemble the femoral and tibial components as indicated in the *Zimmer NexGen RH Knee Primary/Revision Surgical Technique* (97-5880-002-00). Insert the tibial base plate component first, and then implant the femoral component. If using the back-table assembly technique, implant only the tibial base plate component. Do not yet attach the posterior femoral augments and distal femoral augments on the medial side. Ensure that the medial side remains clear (Fig. 33) when applying cement and impacting the component. If needed, medial augments must be cemented in place after implanting the femoral component and assembling the hinge post mechanism as described in “Step Four – Assemble Segmental Hinge Post.” Use of cement in place of an augment bolt is recommended when assembling medial augments to expedite removal at revision. After the cement has cured, use the 4.5mm Hex Driver through the medial access hole to remove the hinge pin. Then discard the hinge pin. A fresh pin is included in the *NexGen RH Knee Cement Shield Service Kit* described in Step 4.

The articular surface provisional may be inserted and the knee placed in extension while the cement is setting to maintain compression on the components. Be careful to protect the articular surface from cement when implanting the distal femoral components.



Fig. 33 Medial side of implant during cementing

Step Four Assemble Segmental Hinge Post

Before attaching the Segmental Hinge Post, verify that the appropriate size *NexGen* RH Knee Cement Shield Service Kit (Fig. 34) is used. At least two *NexGen* RH Knee Cement Shield Hinge Servicing Kits must be available in the operating room in case a component is dropped or otherwise rendered non-sterile. This kit is not the same as the *NexGen* RH Knee Hinge Servicing Kit or the Segmental Knee Hinge Servicing Kit.

Warning: Do not use the Segmental Polyethylene Insert with the *NexGen* RH Knee Distal Femoral Component. Only the items shown in Fig. 34 are to be used with the Segmental Hinge Post when it is being implanted with a *NexGen* RH Knee Distal Femoral Component.

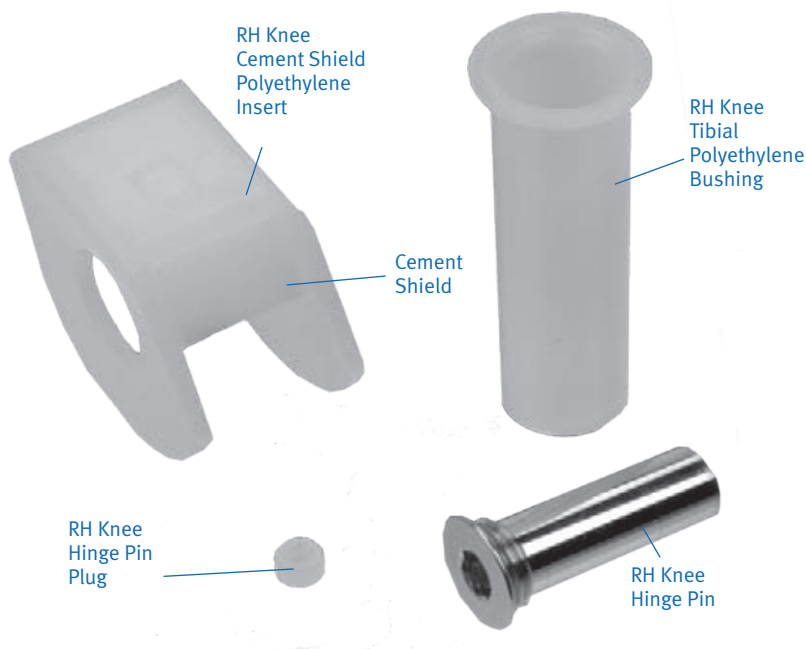


Fig. 34 *NexGen* RH Knee Cement Shield Hinge Servicing Kit

Also verify the appropriate size Segmental Articular Surface. It should be the same size as that used in the trial reduction. Check the compatibility of the tibial articular surface with the femoral and tibial base plate components (Fig. 32) before opening the implants.

Use only the Segmental Hinge Post packaged with the Segmental Articular Surface. Its length accounts for the thickness of the Segmental Articular Surface and includes an additional 40mm of jump height to resist subluxation. In addition, there is a Hinge Pin Bushing pre-assembled to the hinge post that prevents the polyethylene insert from being assembled backwards. This bushing should never be replaced with one from the modular *NexGen* RH Knee Hinge Post.

Attach the proper size RH Knee Polyethylene Insert with Shield to the Segmental Hinge Post by spreading out the sides of the insert slightly and pressing it over the hinge post so the holes in the insert engage the bosses of the Segmental Hinge Pin Bushing. The holes in the polyethylene insert must match the bosses on the hinge pin bushing to ensure proper orientation (Fig. 35).

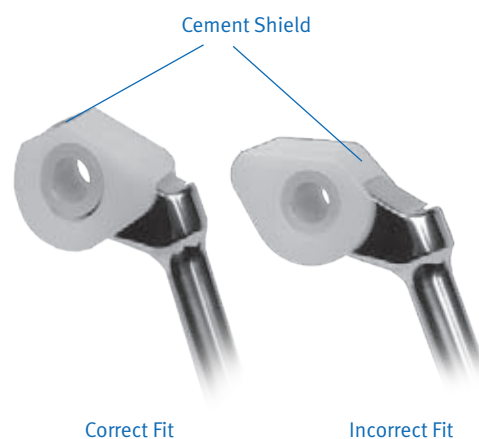


Fig. 35 Detail of Hinge Post Fit with *NexGen* Polyethylene Insert with Cement Shield

Note: If the polyethylene insert with shield is assembled backwards onto the hinge post, the insert will not sit flush against the lateral side of the hinge post due to a “no-fit” condition with the hinge pin bushing. This will cause the hinge post/polyethylene insert assembly to not fit without interference within the intercondylar notch of the *NexGen* RH Knee Distal Femoral Component upon assembly. Therefore, if the hinge post/polyethylene insert assembly does not fit easily within the intercondylar notch, pull the assembly out, spread the sides of the polyethylene insert to remove it from the hinge post, reverse the polyethylene insert orientation, and re-attach it. The polyethylene insert should then be flush against the lateral sides of the hinge post.

In vivo Assembly Technique

For *in vivo* assembly, the hinge post is attached to the femoral component after the femoral component, Segmental Articular Surface and the tibial component have been implanted. The cylindrical portion of the hinge post is first inserted through the Segmental Articular Surface and into the implanted tibial component. Then the proximal portion of the hinge post is attached to the implanted femoral component.

Attach the new hinge pin from the *NexGen* RH Knee Cement Shield Servicing Kit to the 4.5mm Expandable Extractor (Fig. 36). Do not use the hinge pin that was in place during the cementing process. The 4.5mm Expandable Extractor can be used to hold the hinge pin during insertion. Do not use this instrument to torque the hinge pin after it is fully inserted.

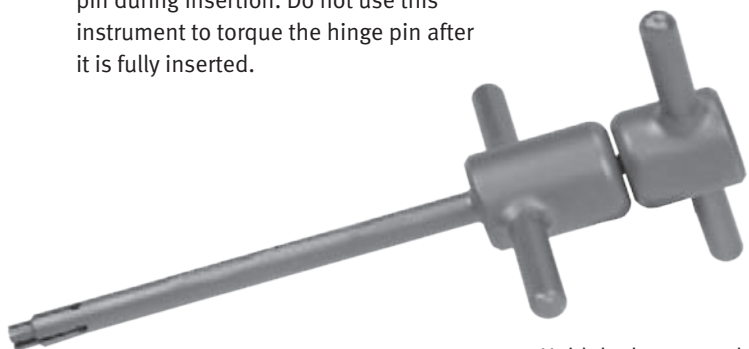


Fig. 36 Expandable Extractor

Insert the proximal end of the hinge post/polyethylene insert assembly into the intercondylar notch of the distal femur. Anteroposterior rotation of the hinge post/polyethylene insert assembly, in addition to moving the knee from 90° of flexion into extension, may facilitate seating of the assembly into the intercondylar notch. Align the holes to accept the hinge pin by first confirming alignment visually through the medial access hole, then insert the Segmental/RH Knee Hinge Pin Aligner through the hole. If desired, confirm that the aligner has engaged the hole on the opposite side of the intercondylar notch by pulling distally on the hinge post by hand.



Fig. 37 LCCK Torque Wrench

If medial augments are required, pack cement into the medial pockets of the distal femoral component, and onto the resected distal and posterior medial femoral condyle. Insert the medial augments from the side, and fill any gaps with additional cement.

Note: If femoral augments are being used on the medial side of the *NexGen* RH Knee Distal Femoral Component, the augments will need to be removed to remove the hinge pin in a future revision.

Hold the knee steady, and remove the Segmental/RH Knee Hinge Pin Aligner. Then insert and thread the new hinge pin (attached to the 4.5mm Expandable Extractor) through the medial access hole into the aligned holes of the femoral component and hinge post. Make sure that the hinge pin passes through the hinge pin bushing of the hinge post. If desired, confirm that the hinge pin has engaged the hole on the opposite side of the intercondylar notch by pulling distally on the hinge post by hand. Use the LCCK Torque Wrench (black handle) and 4.5mm Hex Driver to torque the hinge pin to 95in-lbs (Fig. 37). Then cover the hex with bone wax through the medial access hole.

Back-table (distractive) Assembly Technique

In back-table assembly, the hinge post is attached to the femoral component on the back table before the femoral component is implanted. The distal femoral implant assembly (with hinge post) is inserted into the femoral medullary canal as a complete construct. Then, after sufficient distraction has been achieved across the joint space, the cylindrical portion of the hinge post is inserted through the articular surface and into the tibia.

Back-table assembly requires that the Segmental Hinge Post, RH Knee Polyethylene Insert with Shield, RH Knee Hinge Pin, and RH Knee Distal Femoral Components be assembled on a padded, sterile surface on the back table.

Place the distal femoral component on the padded surgical table. Insert the Segmental Hinge Post/Polyethylene Insert with Shield assembly into the distal femoral component. Align the holes in the components by inserting the Segmental/RH Knee Hinge Pin Aligner through the medial hole of the femoral component and through the hole in the hinge post assembly. Then remove the hinge pin aligner and insert the hinge pin. Confirm that the hinge pin has engaged the hole on the opposite side of the intercondylar notch visually or by pulling distally on the hinge post by hand. Use the LCCK Torque Wrench (black handle) and 4.5mm Hex Driver to torque the hinge pin to 95in-lbs. Then cover the hex with bone wax or press the Hinge Pin Plug from the *NexGen* RH Knee Cement Shield Hinge Servicing Kit into place with a finger-tip or blunt tool to protect the hex of the hinge pin during cementing.

Insert the proper size Segmental Articular Surface (packaged with the Segmental

Hinge Post) onto the implanted *NexGen* RH Knee Tibial Component.

Apply cement to the fixation surfaces of the distal femoral component, and to the stem extension. Insert the stem extension into the medullary canal and begin to advance the femoral component toward the prepared distal femur. As the attached hinge post approaches the tibial component, distract the joint and simultaneously engage the cylindrical portion of the hinge post into the tibial component while continuing to advance the femoral construct until it is flush against the resected femoral bone (Fig. 38).

Note: Be careful to protect the articular surface from cement when implanting the distal femoral/hinge post assembly.



Fig. 38 Post Insertion Diagram

Total Femur Replacement

For total femur replacement, the *Zimmer Segmental System* is compatible with the *Zimmer NexGen RH Knee*. Certain components of the *Zimmer MOST Options System* are also compatible. (See compatibility chart on page 4.)

Implant Configuration

In the event that a total femur is required, the procedures for a proximal femur replacement and distal femur replacement are essentially combined. The suggested procedures are performed after a routine approach has been performed for opening and exposing the acetabulum, femur, and proximal tibia. It is critical that leg length be checked and noted before any bone resection. Care should be taken during the reconstruction to avoid stretch injury to the neurovascular structures.

Note: if needed please reference again the Segmental System scope compatibility chart on p.4 for system cross-compatibilities.

Determine the implant configuration based on the bone replacement requirements (Fig. 39).

Proximal Femur	Distal Femoral	Male-Male Segments	Male-Female Segments	Total Length
80mm	Size B 58mm**	80mm	-	222mm
		90mm	-	232mm
		80mm	30mm	254mm
		80mm	35mm	259mm
		90mm	30mm	264mm
		90mm	35mm	269mm
		90mm	40mm	274mm
		90mm	45mm	279mm
		80mm	60mm	284mm
		80mm	30 + 35mm	291mm
		90mm	60mm	294mm
		90mm	30 + 35mm	301mm
		80mm	80mm	304mm
		90mm	30 + 40mm	306mm
		80mm	40 + 45mm	311mm
		90mm	80mm	314mm
		90mm	40 + 45mm	321mm
		80mm	100mm	324mm
		80mm	60 + 45mm	331mm
		90mm	100mm	334mm
		90mm	60 + 45mm	341mm
		200mm	-	342mm
		80mm	120mm	344mm
		90mm	80 + 35mm	351mm
		90mm	120mm	354mm
		90mm	80 + 45mm	361mm
		80mm	100 + 40mm	366mm
		80mm	100 + 45mm	371mm
		200mm	30mm	374mm
		90mm	100 + 60mm	376mm
		200mm	35mm	379mm
		200mm	40mm	384mm
		200mm	45mm	389mm
		90mm	100 + 60mm	396mm
		80mm	140 + 35mm	401mm
		200mm	60mm	404mm
		80mm	140 + 45mm	411mm
		90mm	180mm	414mm
		90mm	140 + 45mm	421mm
		200mm	80mm	424mm
200mm	40 + 45mm	431mm		
90mm	200mm	434mm		
90mm	160 + 45mm	441mm		
200mm	100mm	446mm		
200mm	60 + 45mm	451mm		
90mm	220mm	454mm		
90mm	180 + 45mm	461mm		
200mm	120mm	464mm		
200mm	80 + 45mm	471mm		
90mm	200 + 40mm	476mm		
90mm	200 + 45mm	481mm		
200mm	140mm	484mm		
200mm	100 + 45mm	491mm		
90mm	200 + 60mm	496mm		
90mm	220 + 45mm	501mm		
200mm	160mm	504mm		
200mm	120 + 45mm	511mm		
90mm	220 + 60mm	516mm		
200mm	140 + 35mm	521mm		
200mm	180mm	524mm		

Fig. 39 Total femur with segments table

Note: Each large taper connection adds 2 mm to the total length.

**Size C Segmental Distal Femoral is 60mm tall. Resect an additional 2mm beyond the total length of resection listed in the table above for the Size C.

Total Femur Replacement (continued)

Proximal Femoral Options

The *Zimmer* Segmental System Proximal Femur has 38mm of offset and suture holes on both the medial and lateral aspect of the prosthesis. This component, or the *MOST Options* Basic Proximal Femur, is used for attachment of soft tissue when the trochanteric bone cannot be salvaged. Refer to the *Zimmer* Segmental System Proximal Femoral Replacement and Intercalary Segments Surgical Technique (97-5850-007-00) for more details.

A variety of components from the *Zimmer* Segmental System are compatible with the proximal femoral components from the *MOST Options* System (refer to compatibility chart on page 4 for more information). As such, when trochanteric bone can be salvaged, use of the *MOST Options* System Proximal Femur with Tissue Attachments may be considered.

Optimal candidates for this method of fixation are those in whom a resection can be performed without removing more than 1cm of native abductor tendon. Sacrificing more than this amount may leave the abductor mechanism with insufficient tendon for fixation using the pronged washers.

Restriction of postoperative rehabilitation activity and/or bracing should be individualized for each case to prevent dislocation.

When a *MOST Options* System Femoral Component is used with a Segmental Femoral/Tibial Segment, anteversion adjustments can be made in 20-degree increments to enhance proximal joint stability using the anteversion adjustment features between the Segmental Distal Femoral Component and the Segmental Femoral/Tibial Segments.

The Segmental System Proximal Femur can be anteverted in 20-degree increments without needing to use an additional Segmental Male-Female Segment.

Distal Femur

To replace the distal femur, refer to “Distal Femur Replacement Using the Segmental Distal Femoral Component” on page 6 of this surgical technique.

Proximal Tibia

To replace the proximal tibia component from the RH Knee, refer to the *Zimmer NexGen* RH Knee Primary/Revision Surgical Technique (97-5880-002-00).

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