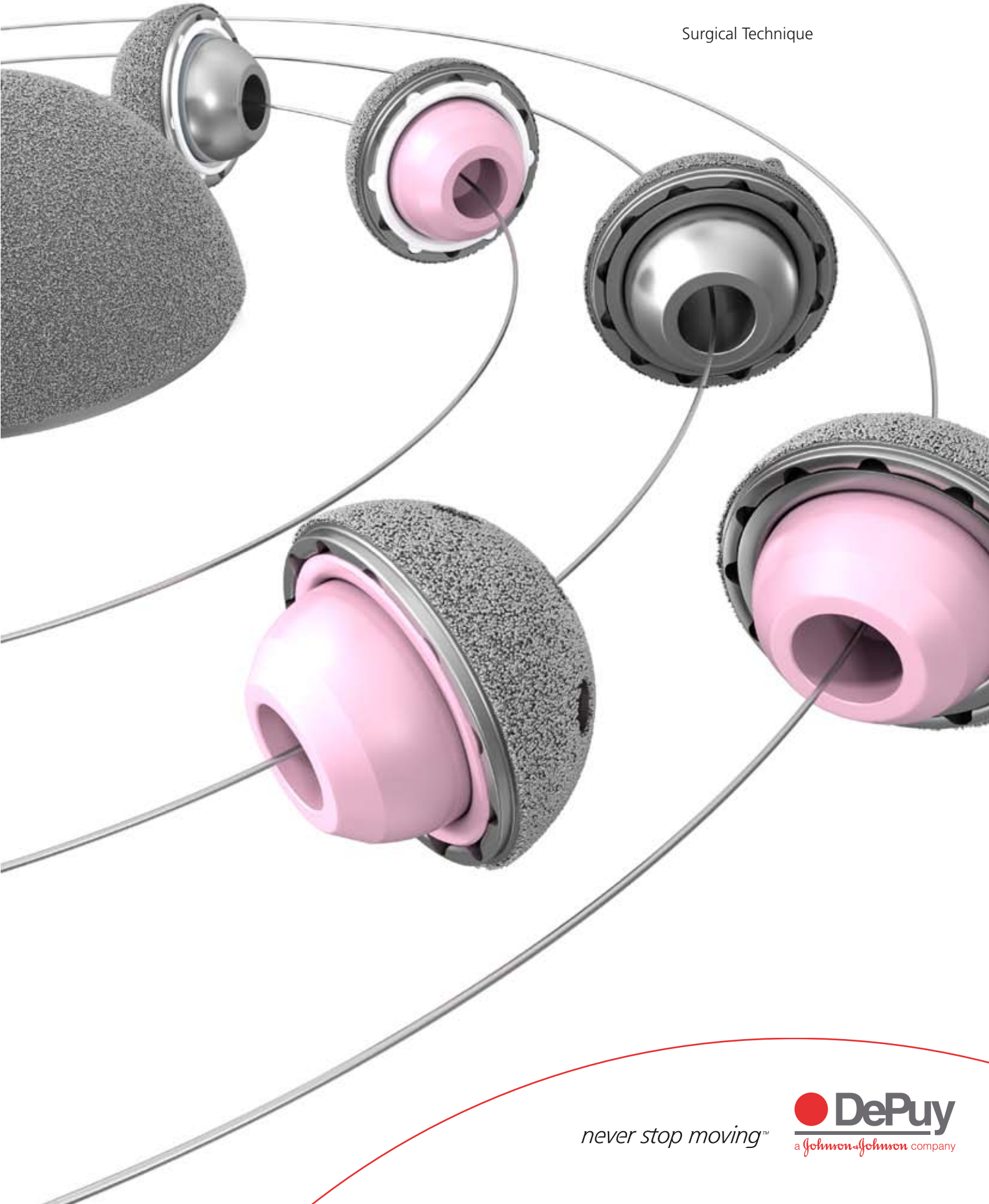
PINNACLE™
ACETABULAR CUP SYSTEM

Surgical Technique



never stop moving™

DePuy
a Johnson&Johnson company

9 Weeks post-op, 18 Holes, 360˚ of Freedom – Back in the game!

Gerald Murray received a Pinnacle™ Ceramic-on-Metal High Performance Bearing combination with a Corail® HA-coated stem.

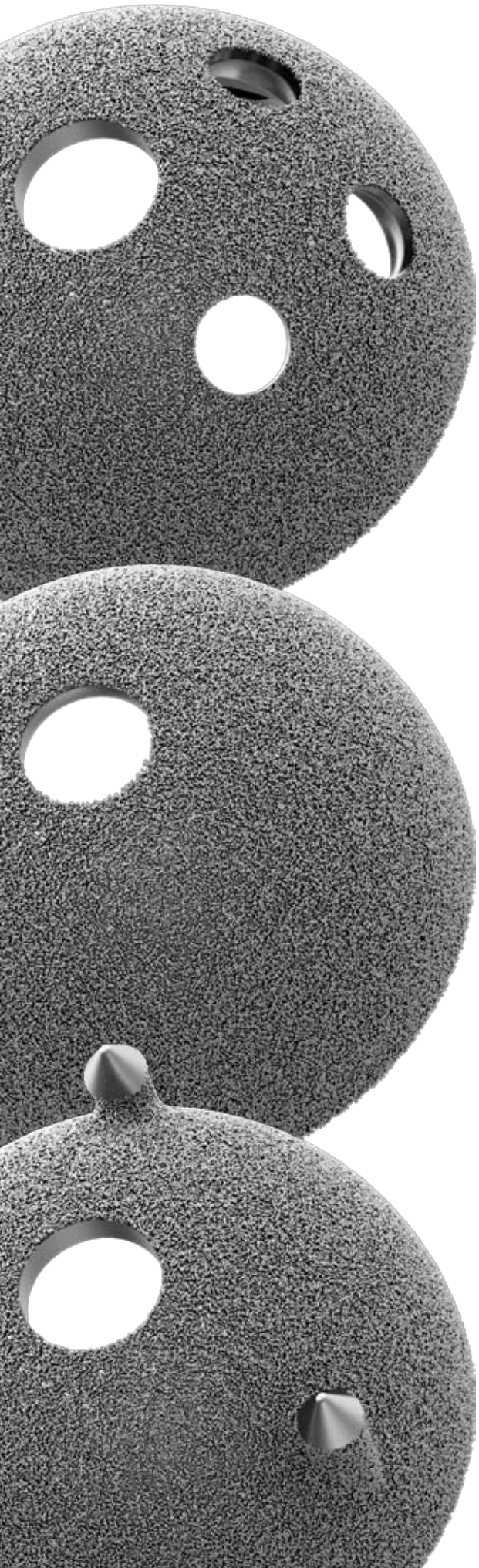
Contents

Introduction

Hip reconstruction has become a successful answer for degenerative hip disease in a more demanding patient population. In addition, hip replacement provides mobility and pain relief to the younger patient with hip dysplasia or post–traumatic arthritis. Experience with total hip arthroplasty has resulted in a more comprehensive understanding of hip anatomy and biomechanics and advances in surgical technique. These advances have allowed the development of more efficient instrumentation and increasingly sophisticated implant designs that enhance clinical outcomes.

The Pinnacle™ Acetabular Cup System Primary Surgical Technique has been developed in consultation with an experienced surgeon design team and provides the surgeon with general guidance when implanting the Pinnacle™ Acetabular Cup System.

Design Philosophy



Pre–Operative Planning

Pre–operative planning is essential for optimal prosthetic reconstruction of the hip joint. The Pinnacle™ Acetabular Cup System Templates enhance pre–operative planning by providing all cup profiles with the neutral and lateralised head centres identified.

Instrumentation

Executing the pre–operative plan requires exact surgical technique and precise surgical instrumentation. The Quickset™ Grater and Screw Instrumentation Systems, combined with the Pinnacle™ Acetabular Cup System Insertion and Trialing Instrumentation, are designed to function in concert for maximum efficiency and precision.

Fixation

Without initial and long–term component fixation, a surgeon's efforts to restore joint function are lost. With the Pinnacle™ Acetabular Cup System, fixation is achieved through 180˚ of either Porocoat® Porous Coating or DuoFix™ Hydroxyapatite (HA) on Porocoat® Porous Coating. Unchanged in structure since its 1977 introduction, Porocoat® Porous Coating has established a clinical success record of more than 30 years.[1,2,3] DuoFix™ HA Coating has been in use for over 8 years.[4]

Restoration of Joint Biomechanics

Proper restoration of joint biomechanics positively impacts clinical outcomes, reduces wear and enhances function. Biomechanical restoration involves both the acetabular and femoral sides of hip joint reconstruction. The Pinnacle™ Acetabular Cup System Trials, Implants and Insert alternatives, allow the surgeon maximum flexibility to work with virtually any DePuy femoral component and facilitate biomechanical restoration.

Modularity

Adding enhanced modularity, the Pinnacle™ Acetabular Cup System incorporates the unique Variable Interface Prosthesis (VIP) taper which supports optimum performance for both ceramic and metal inserts, without compromising the dome loading that is critical to polyethylene inserts.

Wear Reduction

The Pinnacle™ Acetabular Cup System's microstability, congruency at the polyethylene insert/cup interface and bearing surface alternatives were developed to minimise wear.

Design Philosophy

Marathon™ Cross–Linked Polyethylene Inserts

The Pinnacle™ Acetabular Cup System combines optimal cup/ polyethylene insert congruency to help minimise micromotion. With the clinically proven wear resistance of Marathon™ Cross–Linked Polyethylene[5], larger head diameters can be used to improve functional range of motion and reduce the risk of dislocation, while maintaining adequate thickness of the polyethylene insert.[5,6]

Ultamet™ Metal–on–Metal

The Pinnacle™ Acetabular Cup System's Ultamet™ Metal–on–Metal Insert is manufactured from forged high–carbon wrought alloy. Precision controlled manufacturing of the bearing surfaces results in specially engineered articular surface clearances. Sophisticated manufacturing and advanced grinding and polishing techniques enable Ultamet™ Metal–on–Metal Inserts to achieve a very low surface roughness. All of these factors help contribute to exceptionally low wear rates.[7,8,9]

Ceramax™ Ceramic–on–Ceramic

The ceramic material offered with the Pinnacle™ Acetabular Cup System is Ceramax™ Ceramic, Biolox® *delta* a composite material with a unique combination of toughness and structural integrity. Through an exhaustive process of assessment and testing, Ceramax™ Ceramic has been developed to incorporate the best characteristics of ceramics as implant materials. The outcome is a material with the wear behaviour and excellent biocompatibility, but improved mechanical properties when compared to alumina, and the state-of-the-art performance of Ceramic–on–Ceramic joints.[10,11]

Pinnacle™ Ceramic–on–Metal

The ceramic-on-metal bearing combination brings a new option for the surgeon within the DePuy high performance bearing range. The use of differential hardness bearings has been common in many different industries, as a solution for optimised wear performance. DePuy has embraced this technology by extensively testing the combination of their Ceramax™ ceramic head and their Ultamet™ metal liner. The results show improved wear performance and reduced metal ion release[12,13]. Design flexibility allows for Ceramic–on–Metal bearings up to a head diameter of 44 mm for enhanced stability and to prevent dislocation. Ceramic-on-Metal bearings combine the extremely low wear of ceramic and toughness of metal, for active and demanding patients.

CoMmon Sense

CoMmon Sense – The logical next step in High Performance Bearing Technology

Templating and Pre–Operative Planning

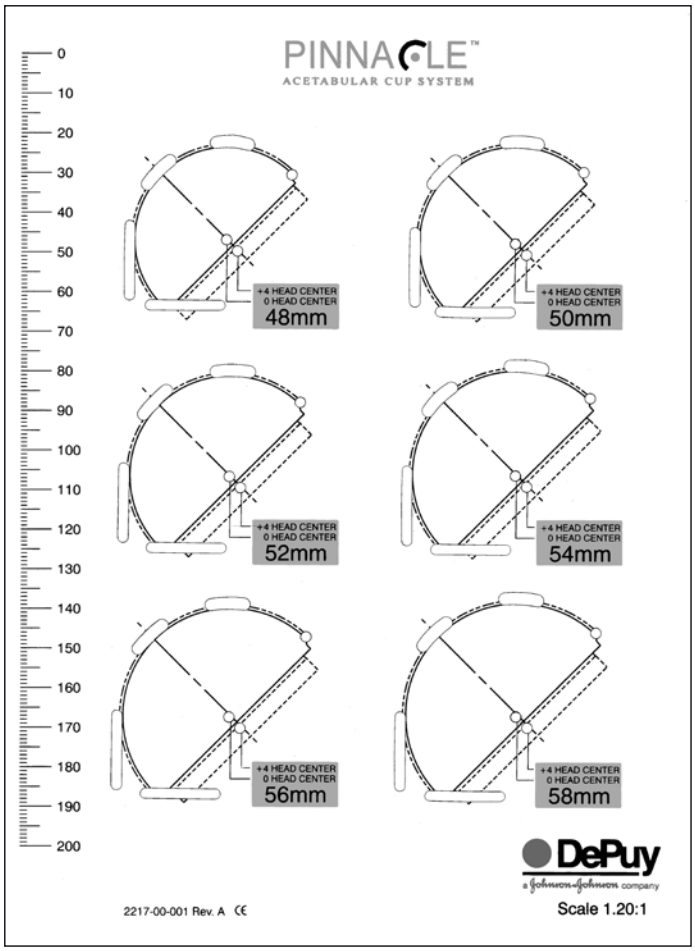


Figure 1a
Pinnacle™ Acetabular Cup System Template
(Cat No. 2217-00-001)

The primary goal of total hip arthroplasty is the anatomic reconstruction of the hip joint, resulting in favourable prosthetic joint load and function. Mechanically, the goals are to create a stable articulation with optimised range of motion, restored biomechanics for muscular efficiency and equalised limb lengths.

Meeting these goals begins with a thorough analysis of the hip with comparison to the contralateral side in anterior/posterior (A/P) and lateral projections. The desired magnification for all imaging should be 20%, which corresponds to the templates provided for the Pinnacle™ Acetabular Cup System (Figure 1a). Magnification markers taped to the patient's leg at the level of the trochanter will assist in determining actual magnification.

For the A/P projection, place both extremities in 15˚ of internal rotation to position the head and neck parallel to the coronal plane.
Centre the beam on the symphysis pubis and ensure the proximal femoral shaft is included in the radiograph.

Templating and Pre–Operative Planning

The radiographs should clearly demonstrate the acetabular configuration and the endosteal and periosteal contours of the femoral head, neck and proximal femur (Figure 1b).

Frequently, the affected hip is fixed in external rotation, which leads one to underestimate the amount of offset present. In this situation it may be helpful to template the normal hip. Take into consideration any anatomical anomaly, dysplasia, previous fracture or leg length discrepancy.

The Pinnacle™ Acetabular Cup System Templates are oriented at 45˚ and allow measurement of any hip that can be accommodated by the Pinnacle™ Acetabular Cup System Primary components (38 – 66 mm) as well as the Pinnacle™ Acetabular Cup System Revision components (54-80 mm).

Using the A/P radiograph, position the template 40˚– 45° to the inter–teardrop or interischial line so that the inferomedial aspect of the cup abuts the teardrop and the superior–lateral cup is not excessively uncovered (Figure 1c).

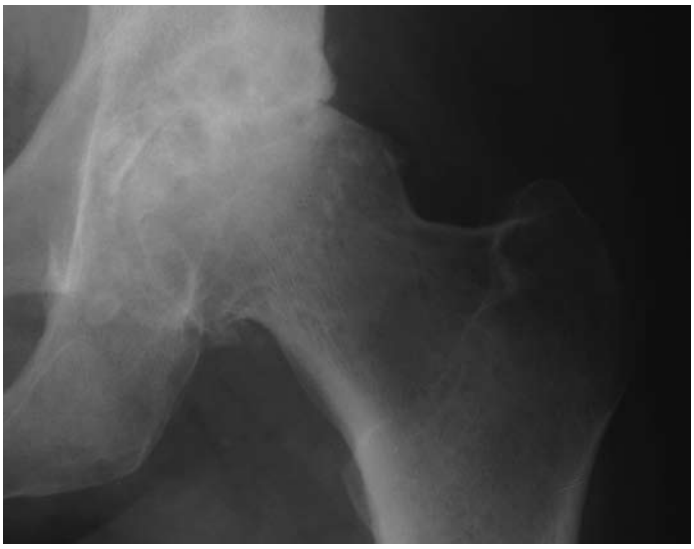


Figure 1b
Acetabulum with good lateral coverage

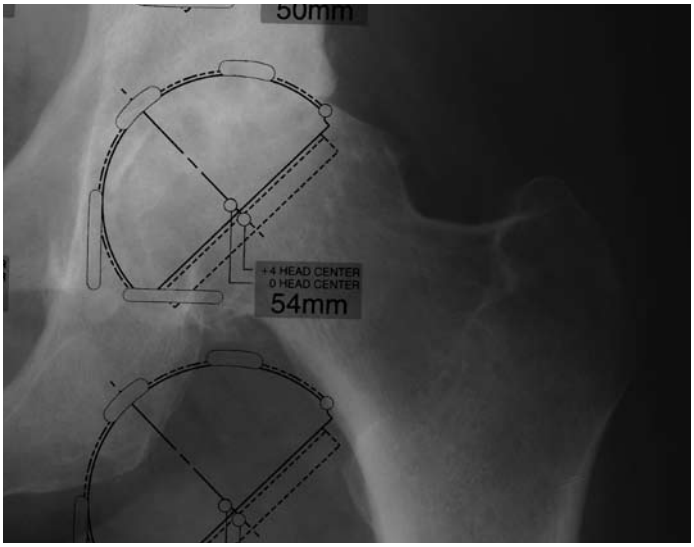


Figure 1c
Properly positioned acetabular template

Acetabular Reaming

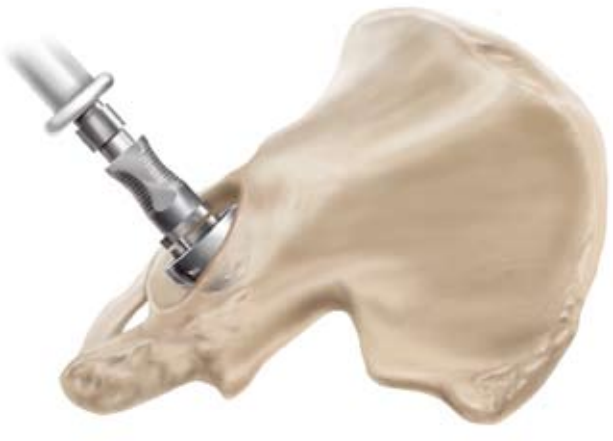


Figure 2
Acetabular reaming

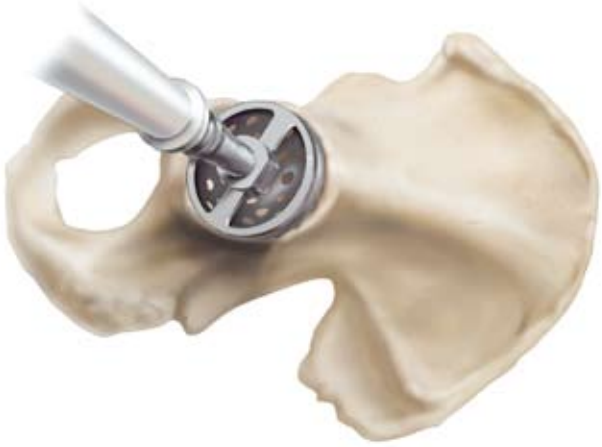


Figure 3
Acetabular reaming

The goal of acetabular reaming is to restore the centre of the original acetabulum. Initially employ a grater 6 – 8 mm smaller than the anticipated acetabular component size to deepen the acetabulum to the level determined by pre–operative templating (Figures 2 and 3). Subsequent reaming should proceed in 1 – 2 mm increments. Centre the reamers in the acetabulum until the deepened socket becomes a true hemisphere. Use a curette to free all cysts of fibrous tissue. Pack any defects densely with cancellous bone.

It is important to understand that all Pinnacle™ Acetabular Cup System Instrumentation is marked with true dimensions. The graters, cup trials and actual Pinnacle™ Acetabular Cups are all 180˚ (Figure 4).

Under–reaming of the acetabulum is dependent on bone quality and the size of the acetabular component. A 1 mm under–ream is usually sufficient in smaller sockets, while a larger socket may require 1 – 2 mm under–ream. Likewise, soft bone will more readily accommodate a greater press–fit of the acetabular component than sclerotic bone.

In some patients, line-to-line reaming may be sufficient to achieve stability.

Where the acetablum is reamed often determines where the cup will seat, it is important to ream where the final cup is to be positioned. As such a part of the reamer head will be visible on the superolateral rim when reaming (Figure 3).

A 54 mm Quickset™ Grater reams a 54 mm cavity

A 54 mm trial cup is 54 mm in diameter

A 54 mm Pinnacle™ Acetabular Cup is 54 mm in diameter as measured over the Porocoat® Porous Coating

Figure 4

Acetabular Cup Trialing and Positioning

Determining the Abduction Angle

The pre–operative A/P X–Ray can help determine the ideal abduction angle (Figure 5) and be helpful in determining how much of the acetabular component should be left uncovered to provide the proper implant abduction angle (Figure 7).

The landmarks for acetabular component positioning are the medial wall of the acetabulum (the radiographic tear drop) and the lateral-superior rim of the acetabulum.

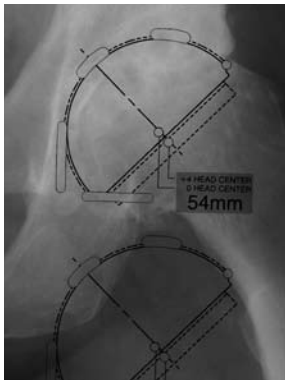


Figure 5
Pre–operative determination of abduction angle

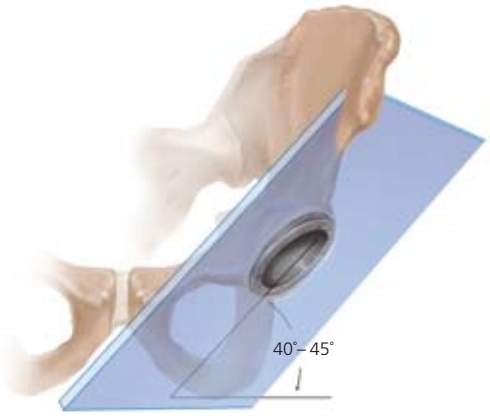


Figure 6
Cup abduction is typically 40°– 45°

Determining Proper Anteversion

The most reliable method for determining proper anteversion is the use of the bony landmark or the transverse acetabular ligament[14]. Other methods are subject to error through a change in patient position during the procedure. Defining the bony landmarks of the ischium and pubis during exposure greatly facilitates proper acetabular component position.

The plane created by the pubis and the ischium can serve as a guide for proper acetabular cup orientation. The cup should be slightly more anteverted than the pubis/ischial plane. This relationship should remain constant regardless of the depth of reaming (Figure 8).

Cup trials in 1 mm incremental sizes are available to assess cup fit and orientation. Contingent on the quality of the prepared bone, select the acetabular trial equal to or 1 mm larger in diameter than the final grater size. The size of the cup trial is as marked on the trial cup (54 mm measures 54 mm). Peripheral rim ridges on the cup trial enhance the stability of the trial cup through trial reduction. Even insert trials fit both even and smaller odd cup trials. For example, a 54 mm polyethylene insert trial fits both the 54 mm and the 53 mm cup trials. Using cup and insert trials in conjunction with the femoral component trials aids in ensuring optimum position of the components.

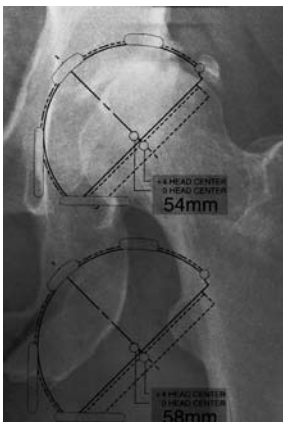


Figure 7
Pre–operative assessment of coverage of the acetabulum

Figure 8
Cup anteversion is typically 15°– 20°

Acetabular Cup Trialing and Positioning

Current studies have highlighted that correct acetabular component positioning is a key element to success with all types of bearings used in hip replacement surgery. As well as subluxation, impingement, fixation and range of motion; optimum femoral head coverage and mechanical loading of the bearing must also be considered when positioning the acetabular component. Incorrect acetabular component positioning can lead to edge loading and undesireable effects across all bearings, such as dislocation, increased wear, ceramic squeaking, elevated metal ion release and polyethylene fractures.[15,16,17,18,19,20,21,22]

Correct Positioning

Inclination 40°– 45°, Anteversion 15°– 20°*, radiographic view

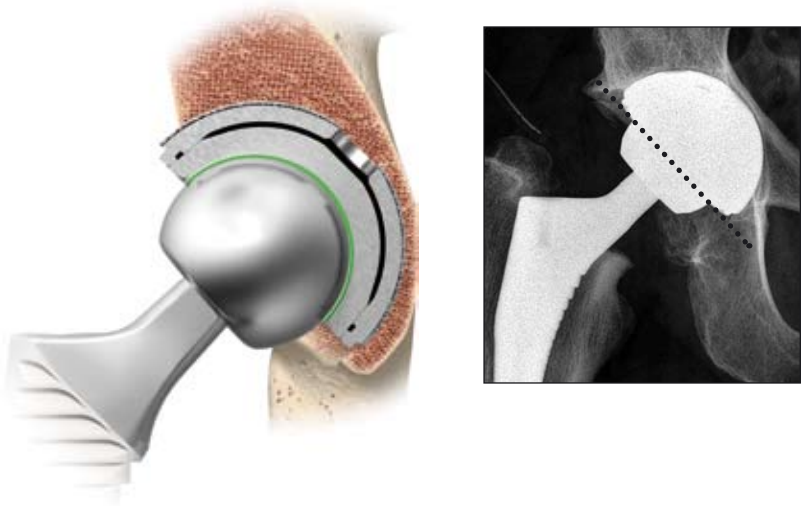


Figure 9

Cups which are placed in the optimum inclination of 40°– 45° and an anteversion of 15°– 20°, give the correct cup alignment, allowing for correct loading of the bearing, which provides a significant reduction in wear during both the bedding-in and steady-state phase.[2,3]

No negative implications have been identified when leaving Porocoat® exposed superolaterally. It often ensures that the correct inclination has been achieved.

Incorrect Positioning

Inclination >45°, Anteversion >20°*, radiographic view

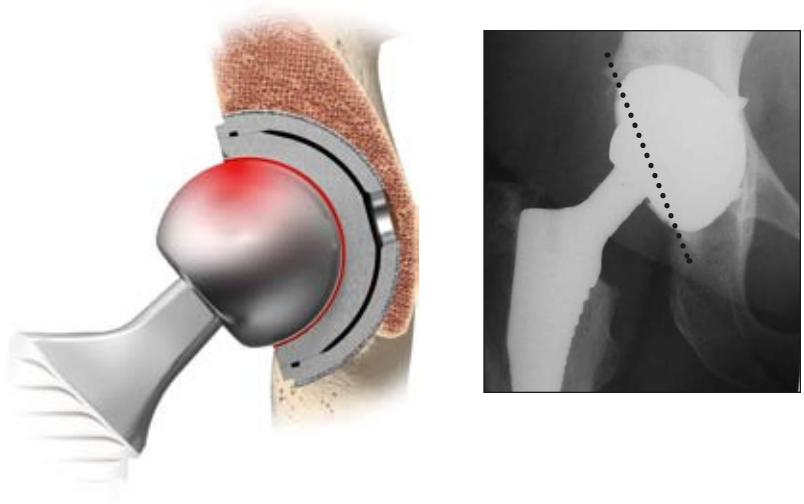


Figure 10

An inclination angle above 45° and an anteversion angle above 20° can result in dislocation, impingement, a reduced range of motion and edge loading. Edge loading can potentially lead to increased wear rates and adverse effects.

It has been highlighted in several studies that a greater abduction angle for metal-on-metal bearings can generate higher wear rates, which can in turn create increased metal ions and debris within the joint. Although it should be noted that metal ion levels cannot be directly related to wear.[2,3]

* assuming 10° - 15° of femoral anteversion

** assuming femoral anteversion is no more than 10°

For more detail regarding acetabular cup positioning please refer to the brochure "The Importance of Correct Acetabular Component Positioning" (Cat. No. 9066-00-001)

Acetabular Cup Trialing and Positioning

Place the cup trial in an anatomic orientation with an abduction angle of 40˚– 45˚ to the transverse plane (refer to Figure 6) and 15˚– 20˚ of anteversion.

Appropriate trial cup orientation can be verified with the external alignment guide system in addition to bony landmarks.

The Pinnacle™ alignment guide system may be used to indicate an acceptable level of acetabular cup inclination and version. Once assembled, the inserter handle should be raised until the vertical bar is perpendicular to the plane of the operating table. With the patient in the lateral decubitus position and the version guide parallel to the floor (Figure 11) the cup will be in the amount of abduction selected on the handle. Available options are 35˚ and 45˚.

The inserter handle should then be rotated until the horizontal bar is in line with the patient's longitudinal axis (Figure 12).

The version guide is marked with 30˚, which provides an indication of operative anterversion. Operative anteversion differs from radiographic anteversion due to the projection of angles on a radiograph, therefore the 30˚ marking equates to a radiographic anteversion of 20˚ as measured on postoperative radiographs.

Care should be taken to ensure that the pelvis is not tilted and that the patient has not moved as this will affect the accuracy of the alignment guide.

Confirm complete cup trial seating by sighting through the holes and cutouts in the acetabular cup trial. The screw hole pattern in the trial cup replicates the Pinnacle™ Sector Cup Implant screw hole pattern to assist with screw targeting.

Do not use the cup trial to prepare screw holes. Prepare screw holes only through the final implant.

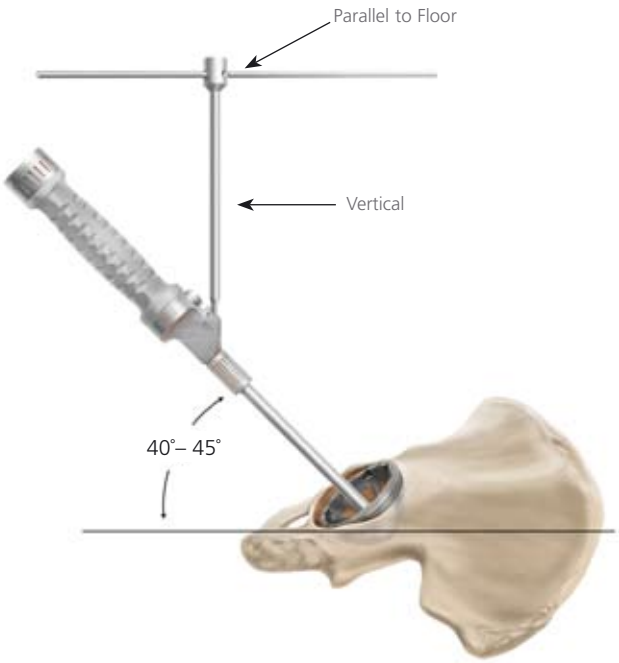


Figure 11

Hold the version guide parallel to the floor and select the abduction angle

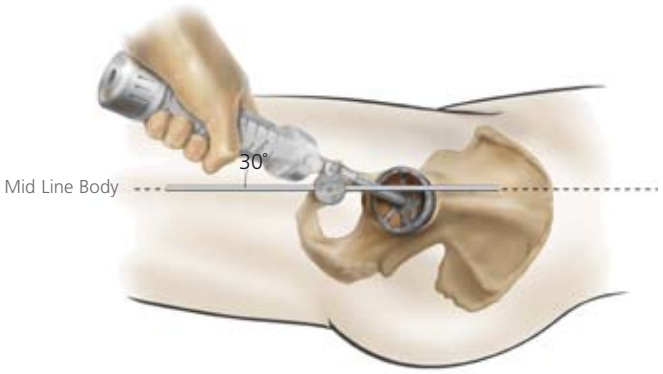


Figure 12

Position the extended arm of the version guide on the long body axis to determine anteversion (30˚ anteversion angle on the alignment guide relate to 20˚ of anteversion radiographically)

Acetabular Cup Trialing and Positioning

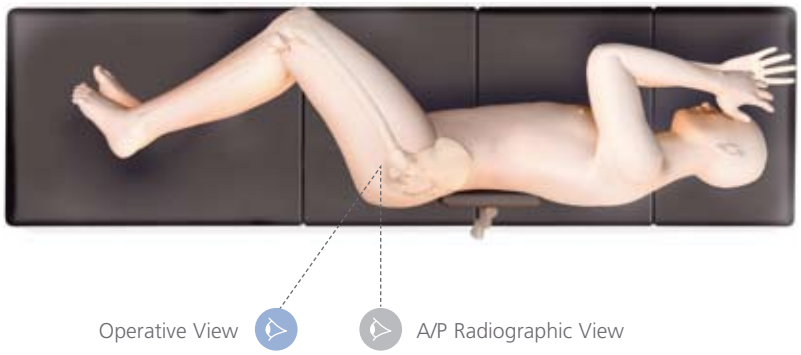


Figure 13a

Incorrect Positioning

Inclination >45°, Anteversion >20°*

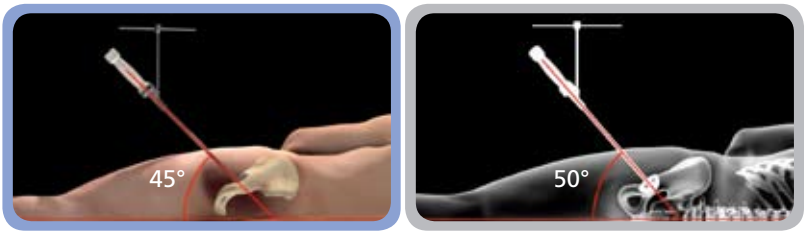


Figure 13b

Correct Positioning

Inclination 40°– 45°, Anteversion 15°– 20°*

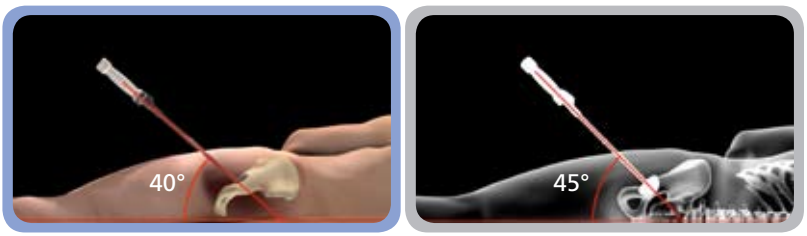


Figure 13c

Operative Inclination	Operative Anteversion	Radiographic Inclination	Radiographic Anteversion
30	30	34	26
45	30	49	21
60	30	63	15
45	15	46	11
45	30	49	21
45	45	55	31

In most cases a patient will move from their original position during a procedure, which often means the pelvis is tilted when positioning the acetabular component. This can cause malpositioning when using alignment guides. As such bony landmarks should also be considered when positioning the acetabular component. The information from the alignment guide should then be balanced with the information provided from the bony landmarks in order to achieve the desired position.

A common cause of malpositioning is the difference between operative angles and radiographic angles. This is due to the projection of angles seen from different views (Figure 13a). For example 45˚ of inclination and 30˚ of anteversion achieved in the operative environment will provide a steeper inclination angle of 50˚ when displayed on an A/P radiograph (Figure 13b).

Note: 40˚-45˚ inclination and 15˚-20˚ anterversion relates to radiographic angles. Please see the table below which explains the differences between the two views and the effect on angles.

In most cases to achieve an inclination angle of 45˚ on an A/P radiograph the angle of the alignment guide should be reduced by 5˚, which will provide a 40˚ inclination angle in the operative setting (Figure 13c).

Implanting a Pinnacle™ Primary Acetabular Cup

The natural acetabulum is inclined at an average angle of 50° – 55°. Therefore when a replacement acetabular component implanted at the correct position, some Porocoat® coating will be visible To achieve the desired cup position of 40° – 45° inclination and 15° – 20° of anteversion, we recommend that 4-6mm of Porocoat® coating should be left exposed (Figure 15). However, the amount of Porocoat® coating to be left visible is dependant on the angle of the patients acetabulum and the size of the component used.

Cup Insertion

Each Pinnacle™ Primary Acetabular Cup Style is implanted using the same basic surgical technique; however, some cup styles have technique–specific tips that help facilitate implantation. This technique demonstrates the insertion of a Pinnacle™ 100 Series (No–Hole) Cup. Before implanting the real prosthesis, take the hip through a full range of motion and stability assessment with all trial components in position. Securely thread the permanent acetabular cup prosthesis onto the acetabular cup positioner (Figure 14). Use the Pinnacle™ external alignment guide, with optional positions of 35˚ and 45˚ of abduction, to assist in component orientation and to achieve required inclination (refer to Figure 11).

Anteversion is typically set at 15˚– 20˚. Establish this orientation through visual confirmation that the acetabular component is directed fully into the acetabulum. The external alignment guide should be used in conjunction with appropriate bony landmarks and the position of the acetabular trial to determine the best position for the acetabular component (refer to Figure 12). After confirming alignment (Figure 15), impact the prosthesis into position. Given the nature of a hemispherical acetabular component, rim contact will occur before dome seating occurs. This may require additional impaction to ensure seating. Confirm seating by sighting through the apical hole or, if present, screw holes. An apical hole eliminator may be inserted with a standard hex head screwdriver following cup impaction. Following final component seating, if adjustments to the cup orientation are necessary, thread the impactor handle back into the apical hole to adjust the cup position. **Avoid using a punch in the taper region to adjust cup position.**

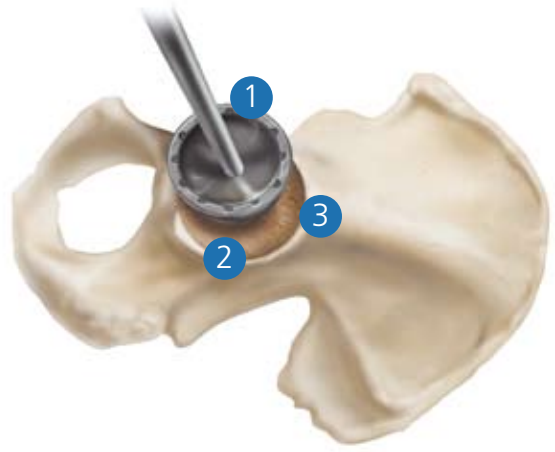


Figure 14
Securely thread the acetabular cup onto the acetabular cup positioner

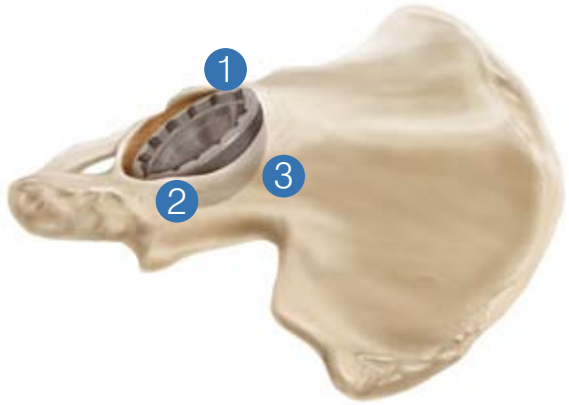


Figure 15
Confirm acetabular cup alignment

1. **Anterior notch**
   Check for psoas tendon impingement with large diameter heads.
2. **Posterior**
   Check toe-off impingement.
3. **Supero-lateral rim**
   Porocoat® / reamer visible

Acetabular Trial Inserts for Polyethylene Liners

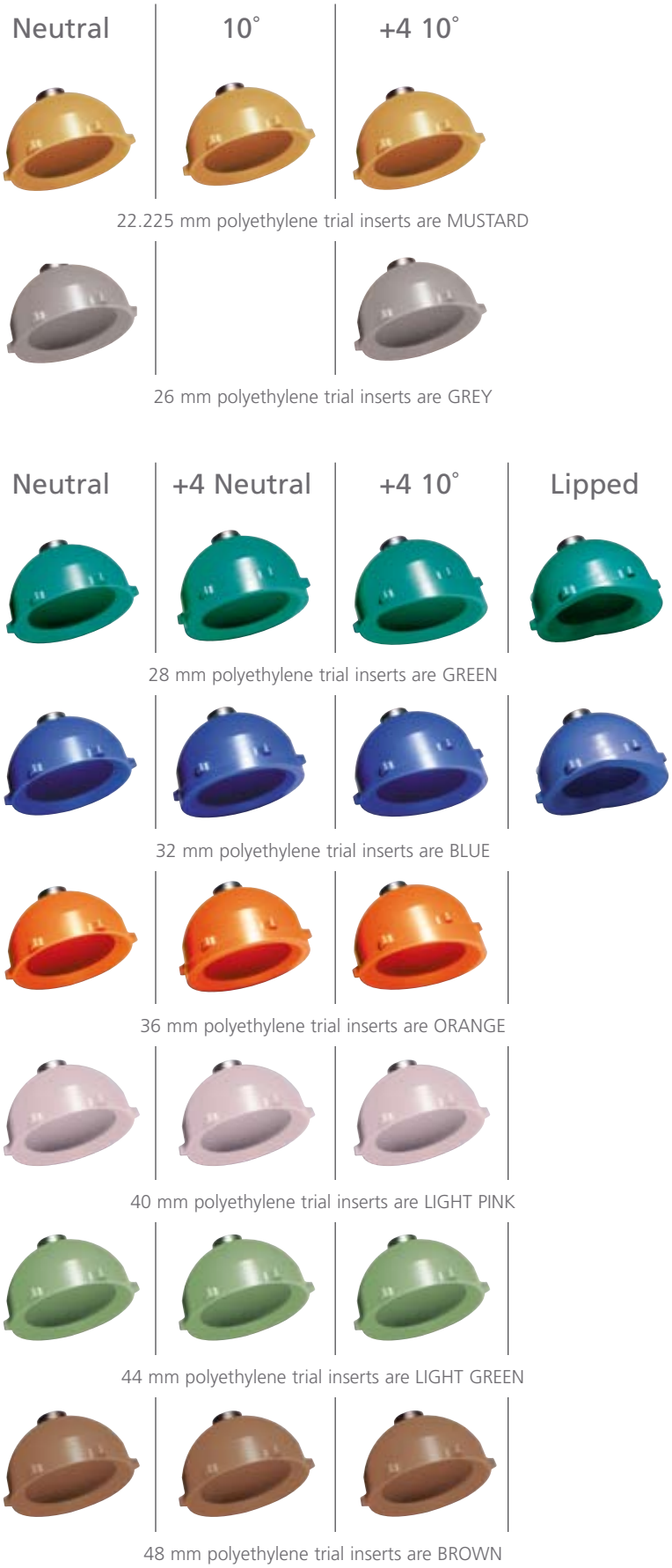


Figure 16
Insert trial colour guide

Following positioning and seating of the acetabular cup trial, place an insert trial into the trial cup. Secure the insert trial to the cup trial through the apical hole screw using a standard hex head screwdriver. There are alternative insert configurations for polyethylene inserts. Dedicated trials for alternative bearings exist that help ensure the correct restoration of biomechanics (Figure 16).

With the femoral component trials in position, assess stability and range of motion. Couple the insert trial with the cup trial in the desired position. For insert alternatives other than neutral, there is an orientation reference etch mark on the insert trial and insert implant.

Alternative Bearings - Acetabular Trial Inserts

When implanting an alternative bearing the trial reduction needs to be done with dedicated trial liners (Figure 17).

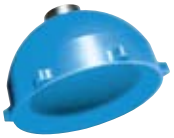
Please note that alternative bearing trials have a built in offset of +2 mm.

Neutral

28 mm alternative bearing trial inserts are YELLOW

32 mm alternative bearing trial inserts are PINK

36 mm alternative bearing trial inserts are PURPLE



40 mm alternative bearing trial inserts are AQUA

44 mm alternative bearing trial inserts are RED

Figure 17
Insert trial colour guide

Polyethylene Insert Configurations

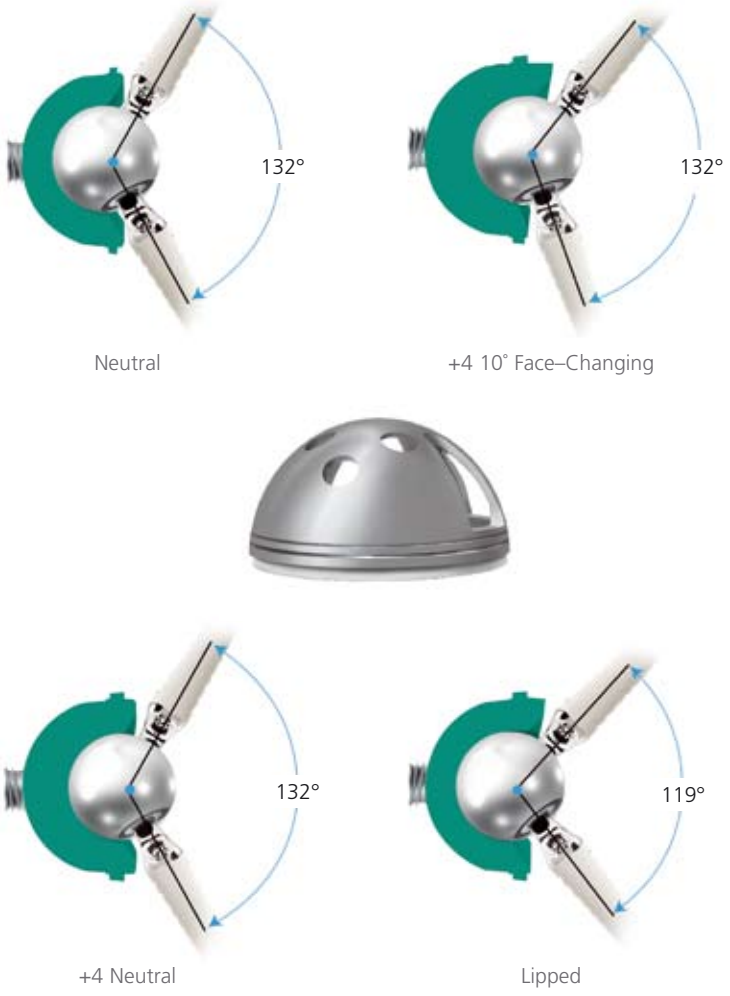


Figure 18
Insert alternatives – 28 mm Inner Diameter (ID)
with DePuy AMT 12/14 Taper Stem
(Range of Motion (ROM) calculated as AP sweep angle)

In the Pinnacle™ Acetabular Cup System, a variety of polyethylene insert designs are available. Each design has specific benefits. It is important for the surgeon to understand the geometry of the various insert alternatives and their impact on joint biomechanics and range of motion (Figure 18).

Neutral Insert

The neutral insert provides 180° of head coverage. The wide face chamfer is optimised for range of motion. The range of motion measured is 132° with a DePuy AMT 12/14 Taper Stem and a 28 mm +5 head. The femoral head's centre of rotation is concentric with the outer diameter of the cup.

+4 Neutral Insert

Like the neutral insert, the +4 mm neutral insert provides 180° of head coverage. The wide face chamfer is optimised for range of motion. The range of motion measured is 132° with a DePuy AMT 12/14 Taper Stem and a 28 mm +5 head. This insert provides a 4 mm lateralisation of the femoral head's centre of rotation. This 4 mm offset both increases soft tissue tensioning and provides 4 mm of increased polyethylene thickness in the cup's dome region. This lateralised insert can be used as an alternative to a longer neck and may enable the surgeon to avoid using a skirted head. **A +4 mm lateralised insert will result in about 3 mm of leg length and about 3 mm of offset if the cup is inserted at a 45° abduction angle.**

+4 10° Face–Changing Insert

Like the other inserts, the +4 10° insert provides 180° of head coverage and the wide chamfer is optimised for range of motion. The range of motion measured is 132° with a DePuy AMT 12/14 Taper Stem and a 28 mm +5 head. This insert lateralises the femoral head 4 mm and a 10° face change alters inclination/version dependent upon placement of the insert.

Lipped Insert

This insert provides 180° of head coverage, plus a 4 mm vertical wall to enhance stability. The range of motion is measured at 119° maximum, with a DePuy AMT 12/14 Taper Stem and a 28 mm +5 head. The lip on this insert can provide additional stability; however, the impact on range of motion and early impingement must be understood.

Polyethylene Insert Configurations

The required ranges of angular movement between the acetabular and femoral components in a total hip joint replacement are specified in ISO 21535:2007(E).[23]

The ROM data presented in the below table derive from a computer analysis using 3-dimensional digital models of the actual components. The analysis was carried out on the combinations of Pinnacle™ and Corail® hip systems, including cups, inserts, femoral heads and femoral components.

The acetabular component model was oriented into an initial position which is considered a neutral position for a physiologically oriented acetabular cup component in terms of abduction and version. From the neutral position the femoral stem was rotated until the neck of the stem made contact with the rim of the acetabular cup.

The range of motion (ROM) data of physiologically positioned acetabular and femoral components differs from commonly discussed sweep angles and describes maximum achievable movement in flexion and extension, and abduction and adduction (Figure 19). However, these are theoretical numbers and clinical results may be reduced due to skeletal impingement or the presence of soft tissues.

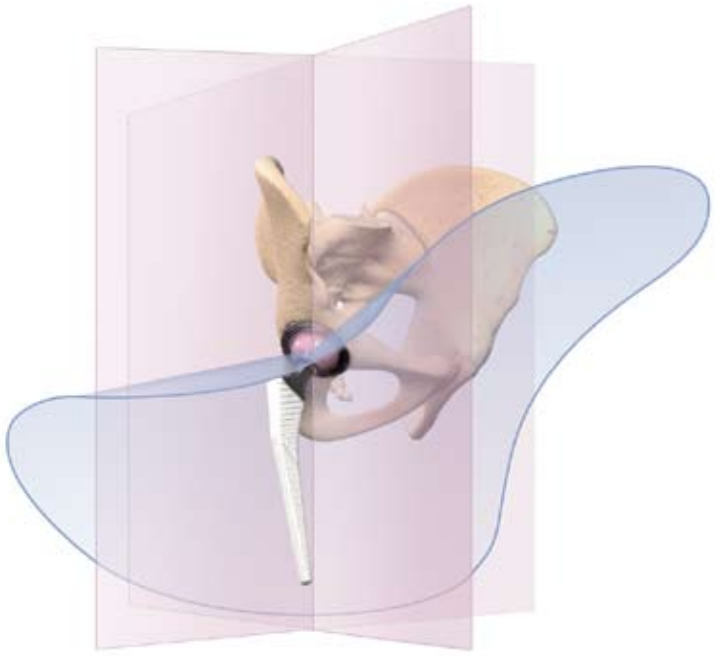


Figure 19

The angles achieved in each direction about each axis are shown in the following table:

Insert		Neutral		+4 Neutral		+4 10˚ Face		Lipped	
		Flexion / Extension	Abduction / Adduction	Flexion / Extension	Abduction / Adduction	Flexion / Extension	Abduction / Adduction	Flexion / Extension	Abduction / Adduction
PE	28 mm	166˚	119˚	167˚	121˚	165˚	115˚	143˚	105˚
PE	32 mm	177˚	127˚	177˚	127˚	172˚	121˚	151˚	113˚
PE	36 mm	177˚	127˚	180˚	128˚	174˚	122˚	N/A	N/A
PE	40 mm*	N/A	N/A	177˚	127˚	173˚	121˚	N/A	N/A
PE	44 mm*	N/A	N/A	174˚	126˚	170˚	120˚	N/A	N/A
PE	48 mm*	N/A	N/A	171˚	124˚	165˚	112˚	N/A	N/A
METAL	28 mm	184˚	131˚	N/A	N/A	N/A	N/A	N/A	N/A
METAL	36 mm	194˚	139˚	N/A	N/A	N/A	N/A	N/A	N/A
METAL	40 mm	195˚	146˚	N/A	N/A	N/A	N/A	N/A	N/A
METAL	44 mm	206˚	147˚	N/A	N/A	N/A	N/A	N/A	N/A
CERAMIC	28 mm	171˚	123˚	N/A	N/A	N/A	N/A	N/A	N/A
CERAMIC	32 mm	187˚	133˚	N/A	N/A	N/A	N/A	N/A	N/A
CERAMIC	36 mm	196˚	139˚	N/A	N/A	N/A	N/A	N/A	N/A

Range of Motion (ROM) tested with a Corail® 12/14 Taper Stem in accordance with ISO 21535:2007 (E) standard for a physiologically positioned cup and stem.
* Marathon™ liners in sizes 40, 44 and 48 mm ID are part of the ES³™ system and are manufactured with a Charnley bore

Implanting the Acetabular Cup with Screw Fixation

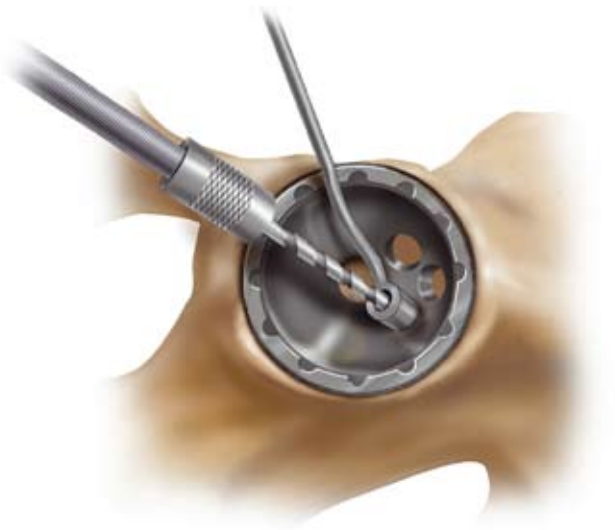


Figure 20
Drill Guide

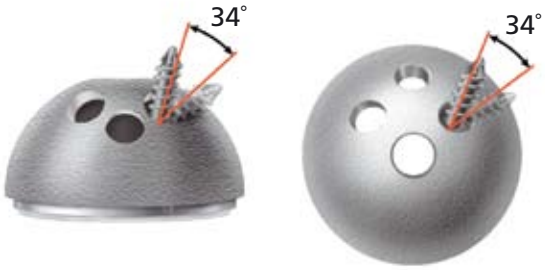


Figure 21
Screw angulation

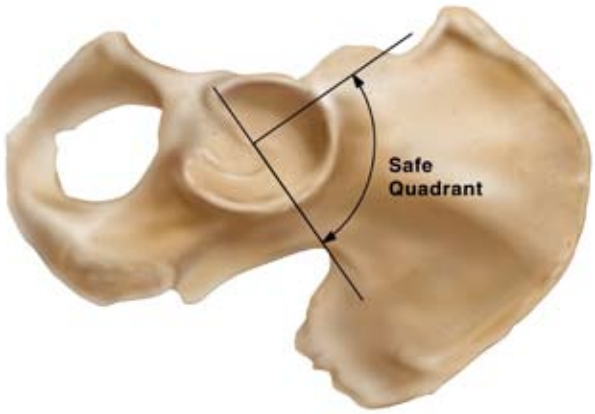


Figure 22
Screw hole selection

Screw Insertion

The Pinnacle™ Sector Cup has three screw holes and is designed for insertion with screws. Quickset™ Acetabular Screw Instruments are recommended for screw insertion. Two medial hole alternatives are placed to enable screw placement up the posterior column in either the right or left hip. The single lateral screw provides additional access to the ilium.

The drill bit is controlled by the drill guide as it passes through selected holes into the acetabulum (Figure 20). The screw angle may vary by as much as 34˚ (Figure 21). The effective lengths of the four drill bits available are for 25, 35, 45 and 70 mm. By seating the drill bit completely into the guide, holes corresponding to the effective length of the drill bit will be created.

Select holes where the prosthesis is to be anchored with cancellous screws so that the screws lie within a safe quadrant. The safe quadrant is defined by two lines from the anterior–inferior iliac spine through the centre of the acetabulum and posterior by a line from the sciatic notch to the centre of the acetabulum (Figure 22).

Implanting the Acetabular Cup with Screw Fixation

Verify hole depth using the Quickset™ Depth Gauge. Alternating colours on the depth gauge represent 10 mm increments (Figure 23).

Insert 6.5 mm Pinnacle™ Acetabular Cup System Cancellous Bone Screws using a hex head screwdriver (Figures 24 and 25).

The 6.5 mm self–tapping screws have four–point cutting flutes with a blunt tip to reduce the risk of neurovascular injury (Figure 26).

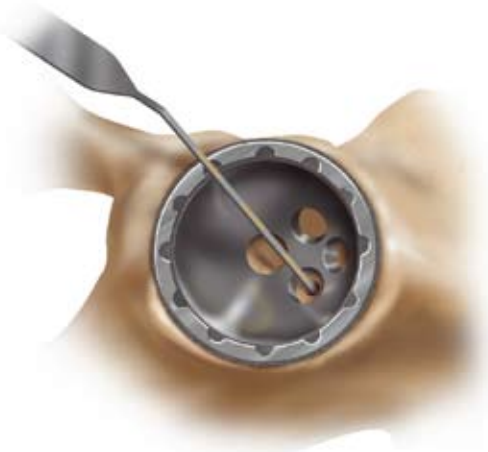


Figure 23
Depth Gauge

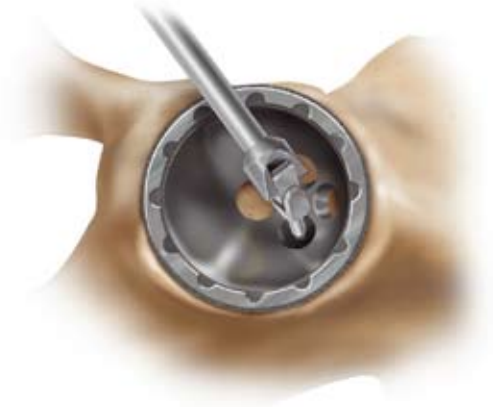


Figure 24
Screw insertion

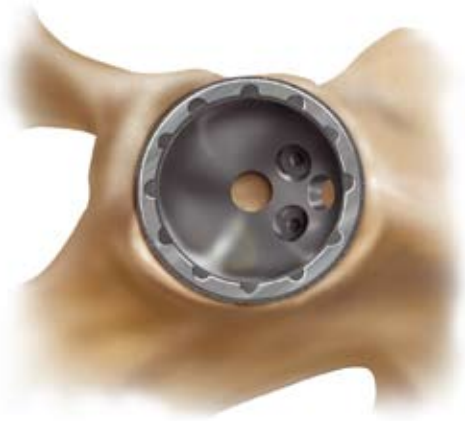


Figure 25
Screw insertion

Figure 26
Screw tip

Implanting the Acetabular Cup with Spikes

Figure 27

Prior to cup impaction, spikes and rim engage simultaneously when the cup is centred and aligned

Spike orientation

Spike length

Figure 28

Pinnacle™ 300 Series Cup Insertion

Spike placement along the radius of the Pinnacle™ 300 Series Cup is the same as the clinically established Duraloc® 300 Series Acetabular Cup (Figures 27 and 28). The spikes are coated for additional fixation but have been reduced in length by 1.5 mm compared to the Duraloc® Acetabular Cup. This reduction in spike length does not alter fixation but ensures that the spike contacts bone on insertion at the same point that the cup contacts the rim of the prepared acetabulum. This gives the surgeon greater control when inserting the Pinnacle™ 300 Series Cup and ensures the cup bottoms out in the dome of the acetabulum.

The recommended acetabular reaming technique for the Pinnacle™ 300 Acetabular Cup is either 1 mm under or line–to–line dependent on bone quality. It is important that the cup is well centred in the prepared acetabular cavity in the predetermined alignment indicated by the trial before being impacted.

Polyethylene Insert Insertion and Impaction

Following insertion of the final acetabular cup and femoral component, the trial inserts can be used in the cup to confirm insert selection and evaluate joint stability and range of motion (refer to Figure 16 on page 14).

Prior to inserting the final acetabular insert, thoroughly irrigate and clean the cup. **It is important to check the cup/insert locking groove is free from debris.** Remove all soft tissue from the face of the cup so as not to impede insert seating (Figure 29). An apical hole eliminator may be used prior to insert insertion.

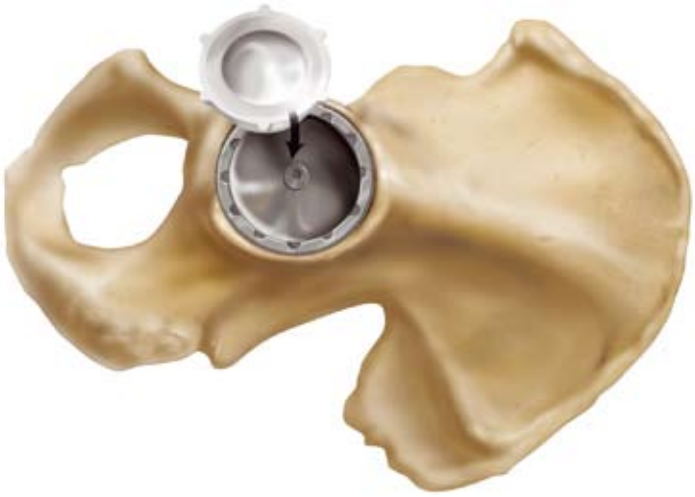


Figure 29
Insert placement

Polyethylene Insert Insertion and Impaction

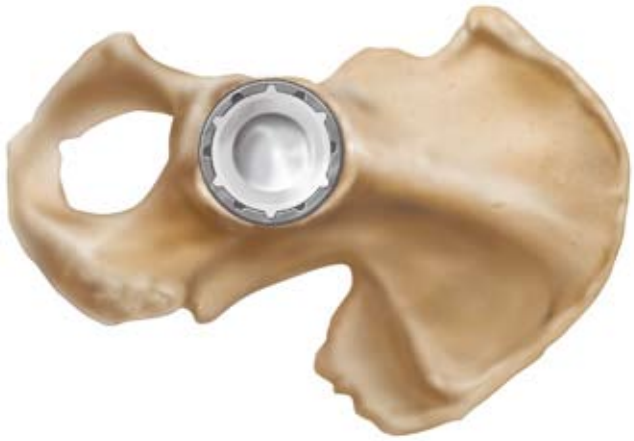


Figure 30
Align the insert anti–rotation tabs with cup scallops

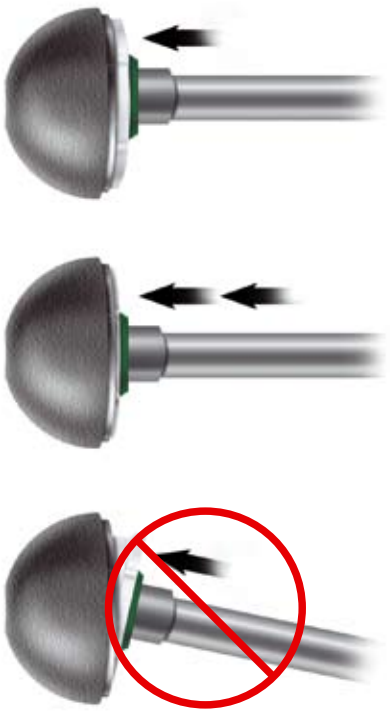


Figure 31
Insert impaction

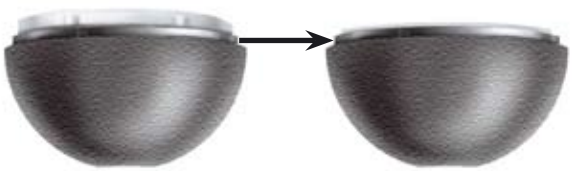


Figure 32
Insert seating height of a neutral liner

Align the insert anti–rotational device (ARD) tabs with the ARD scallops on the cup (Figure 30). There are six ARD tabs on the inserts and 12 ARD scallops in the cup. This allows the insert to be rotated in 30˚ increments.

Seat the insert using the ID insert impactor that corresponds to the selected implant. Because the locking mechanism is tapered, it is important to impact the insert directly into the cup with multiple medium blows (Figure 31).

Impacting the insert in a tilted position may prevent complete seating. **Seating of the insert is visually confirmed when the insert ARDs are flush with the face of the acetabular cup;** however, the insert face will remain proud in relation to the cup face by approximately 1 mm (Figure 32).

Polyethylene Insert Extraction

A polyethylene insert extractor is available to aid in polyethylene insert extraction and to help ensure the Pinnacle™ Acetabular Shell is not damaged during polyethylene insert extraction (Figure 33).

Open the extractor jaws and extend the ARD pin from the extractor tip. Place the ARD pin into an empty ARD and tightly close the jaws of the extractor (Figure 34). The teeth of the extractor should dig into the inner diameter of the polyethylene.

Once the ARD tip and teeth are secure on the polyethylene, advance the extraction knob clockwise until the polyethylene is removed (Figures 35 and 36).

It is important to note that an extracted polyethylene insert cannot be reused.

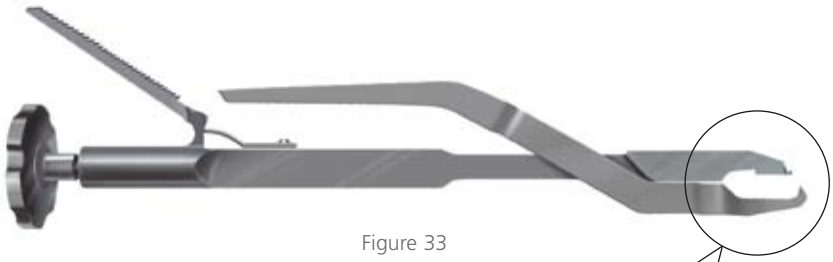


Figure 33
Polyethylene Insert Extractor

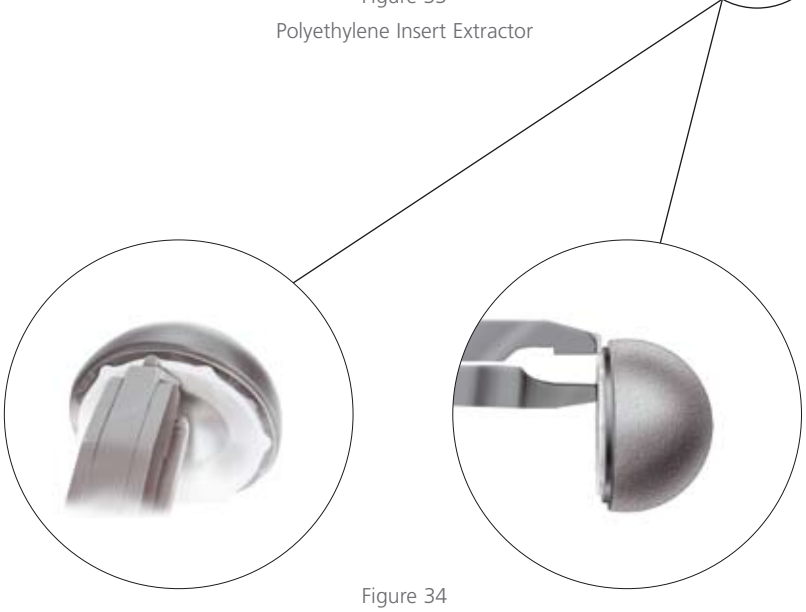


Figure 34
Extractor placement

Figure 35
Rotation of Extraction Knob

Figure 36
Polyethylene insert removal

Alternative Bearing Insert

Ceramax™ - Ultamet™ Insertion Technique

28 mm Alternative Bearing Trial - YELLOW

32 mm Alternative Bearing Trial - PINK

36 mm Alternative Bearing Trial - PURPLE

40 mm Alternative Bearing Trial - AQUA

44 mm Alternative Bearing Trial - RED

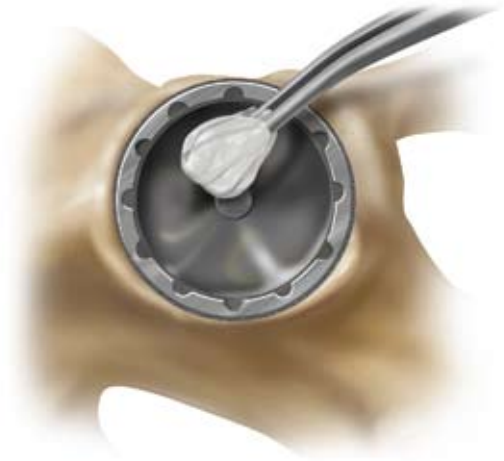


Figure 37
Ensure all taper mating surfaces are clean and free of debris

Figure 38
Alternative Bearing Gripper

To ensure optimal component placement when using alternative bearing inserts, trialing is critical. Dedicated trials for inserts help ensure the correct restoration of biomechanics.

If correct joint biomechanics, free of mechanical impingement, cannot be obtained with the alternative bearing trials, perform a trial reduction using the Pinnacle™ polyethylene insert trials. Then use the Pinnacle™ polyethylene insert that results in joint stability.

Before placing a Ceramax™ or an Ultamet™ insert into the Pinnacle™ shell, ensure all mating surfaces are clean and free of debris (Figure 37). Handle the Ceramax™ or Ultamet™ insert carefully to avoid damage that could compromise the mechanical integrity of the insert taper locking mechanism.

Use of the Pinnacle™ AB Gripper (Figure 38) instrumentation is recommended for insertion of metal inserts and is mandatory for ceramic inserts.

The surgical technique must be followed when inserting the ceramic insert into the acetabular shell to ensure correct alignment of the insert into the shell prior to impaction. Failure to do so could contribute to rim chipping during insertion or post-operative fracture.

Alternative Bearing Gripper – Insertion Technique

Assemble the appropriate size gripper to the inserter shaft aligning the slot of the gripper with the pin of the shaft (Figure 39).

Thread the appropriate size tip to the shaft (Figure 40). Make sure that the gripper is positioned such that it is touching the tip once it has been fully threaded (Figure 41).

Figure 39

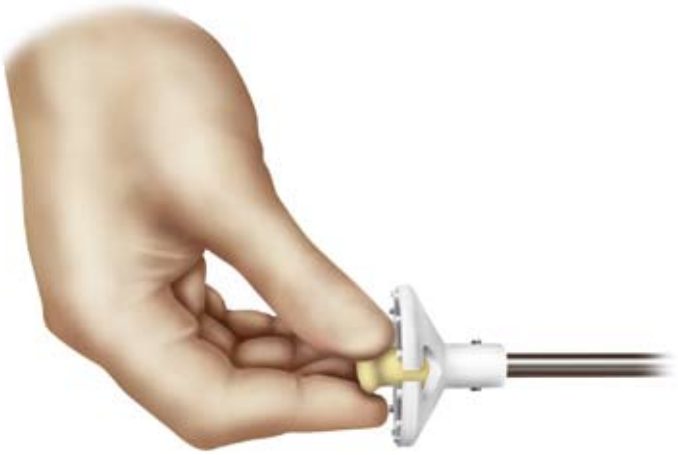


Figure 40

Figure 41

Alternative Bearing Gripper – Insertion Technique

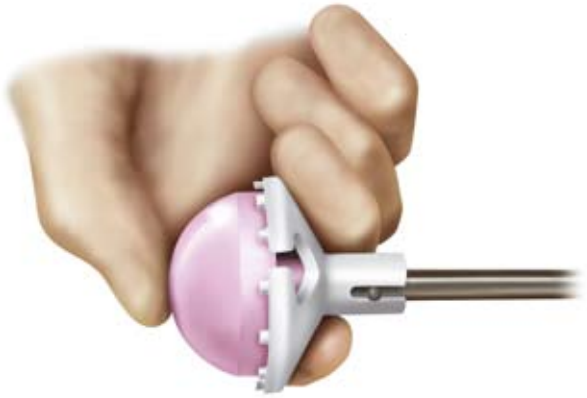


Figure 42

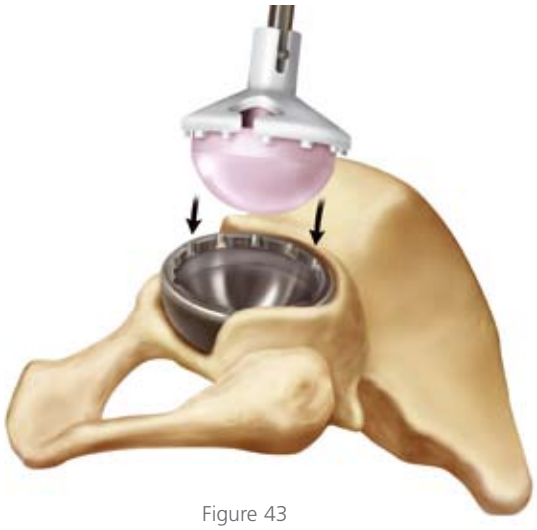


Figure 43

Figure 44

Press–fit the insert on the gripper component. Verify that the insert is fully seated to ensure proper alignment (Figure 42).

Cautiously advance the insert into the incision and align the face of the gripper to the face of the cup.

Proper alignment is achieved when the instrument will no longer rotate due to the locking features between the gripper, cup and insert (Figures 43 and 44).

Alternative Bearing Gripper – Insertion Technique

Press firmly on handle to introduce the insert into the cup (Figure 45). **Do not attempt to fully engage the taper locking mechanism by striking the end of the Alternate Bearing Gripper Inserter.**

Carefully remove instrument by pulling back the plastic gripper flange whilst pushing down gently on the gripper handle (Figure 46).

Palpate the insert to confirm proper taper alignment and seating in the shell (Figure 47).

Figure 45

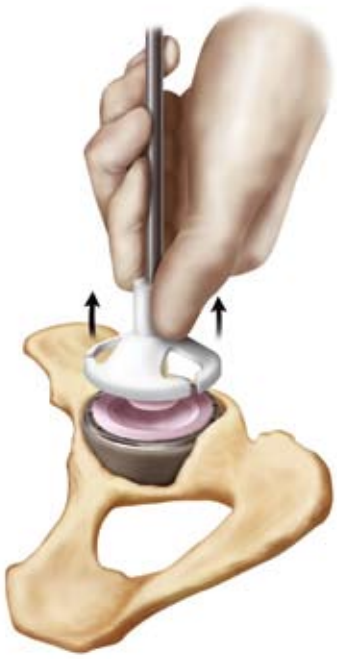


Figure 46

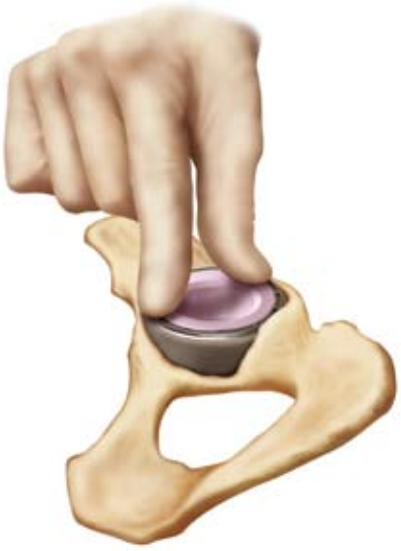


Figure 47

Alternative Bearing Gripper – Insertion Technique

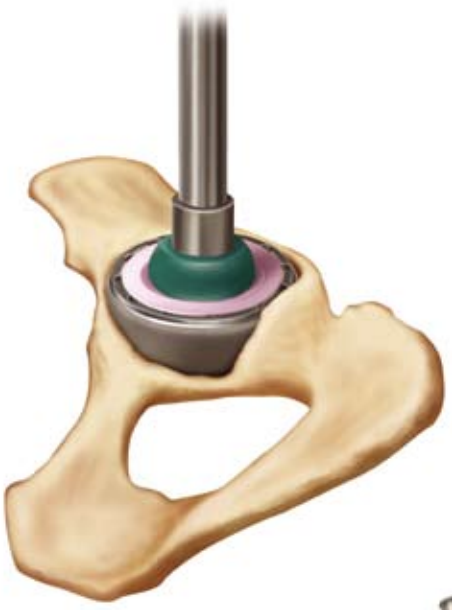


Figure 48

Figure 49

Use an impactor with appropriate impactor tip for final seating of the insert (Figure 48). Final seating requires two to four moderate blows (Figure 49).

The nature of hard–on–hard bearings requires precise placement of femoral and acetabular components. It is important to optimise component placement to avoid mechanical impingement. To ensure optimal component placement when using alternative bearings, trialing is critical. Dedicated trials for alternative bearings help ensure the correct representation of biomechanics.

Note: if any other bearing surface has been impacted into the shell, a Ceramax™ insert cannot be used. Ceramax™ inserts should only be used in new Pinnacle™ acetabular shells with an "as manufactured" taper.

Ceramax™ and Ultamet™ Insert Extraction

If it is necessary to remove an Ultamet™ or Ceramax™ insert from a Pinnacle™ cup, thread the extractor handle onto the appropriate size alternative bearing (AB) extractor (Figure 50). Each cup size has a specific extractor, e.g., 48 mm cup uses a 48 mm extractor.

Note: AB extractors are available for shells starting at 44 mm OD up to 66 mm OD.

The AB extractor can be used with 28,32,36,40 & 44 mm ID

Place the three tips of the AB extractor into any three scallops on the face of the Pinnacle™ shell (Figure 51).

Push down the attached lever with thumb pressure to engage the suction cup against the inner face of the Ultamet™ or Ceramax™ insert (Figure 52).

To remove the Ultamet™ or Ceramax™ insert from the shell, impact the extraction handle lightly one to two times with a metal mallet. The resulting vibration will release the taper lock between the Ultamet™ or Ceramax™ insert and the Pinnacle™ shell. The insert is then lifted out of the shell by the suction cup mechanism (Figure 53).

Figure 50
Alternative Bearing Extractor

Figure 51
Placement of Alternative Bearing Extractor

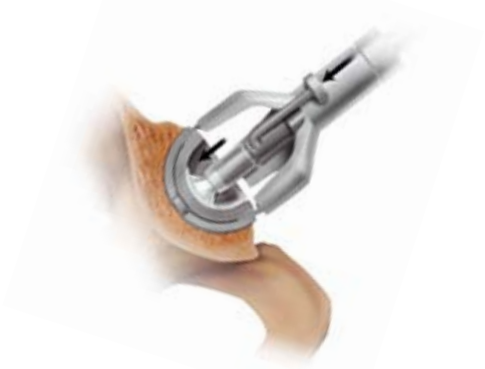


Figure 52
Engage the suction cup by pushing down on the lever

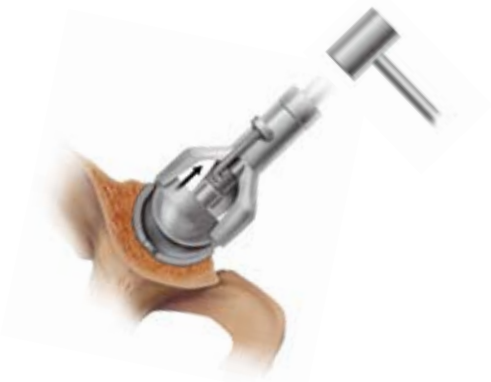


Figure 53
Impact the extractor handle lightly and lift the insert

Closure

Closure is based on the surgeon's preference and the individual case. If the capsule is retained it is closed separately. The gluteus minimus and gluteus medius can be closed separately or as a single unit.

At least one stitch is passed through bone. Tension is relieved during the repair with slight internal rotation.

The repair should be tested throughout the hip range of motion.

Ordering Information

Instruments

2217-50-048	Pinnacle™ Impactor Adaptor
2217-00-002	Pinnacle™ Primary Template
2217-00-020	Pinnacle™ Alternative Bearing Suction Cup Inserter
2217-50-001	Pinnacle™ Polyethylene Liner Extractor
2217-50-004	Impactor Tip 22.225 mm
2217-50-005	Impactor Tip 26 mm
2217-50-006	Impactor Tip 28 mm
2217-50-007	Impactor Tip 32 mm
2217-50-008	Impactor Tip 36 mm
2217-50-060	Pinnacle™ Impactor Tip 40 mm
2217-50-061	Pinnacle™ Impactor Tip 44 mm
2217-50-062	Pinnacle™ Impactor Tip 48 mm
2217-50-041	Pinnacle™ Straight Cup Impactor
2217-50-044	Pinnacle™ Version Guide
2217-50-050	Pinnacle™ Trial Liner Base
2217-50-051	Pinnacle™ Trial Liner Lid
2217-60-015	Primary Case Complete (Case, Tray, Lid)
9599-10-000	Replacement Suction Cup
2015-24-000	Pinnacle™ Poly Impactor Handle

2217-50-053	Pinnacle™ Alternative Bearing Extractor Case Complete (Case, Tray, Lid)
2217-00-044	Pinnacle™ Alternative Bearing Extractor Body 44
2217-00-046	Pinnacle™ Alternative Bearing Extractor Body 46
2217-00-048	Pinnacle™ Alternative Bearing Extractor Body 48
2217-00-050	Pinnacle™ Alternative Bearing Extractor Body 50
2217-00-052	Pinnacle™ Alternative Bearing Extractor Body 52
2217-00-054	Pinnacle™ Alternative Bearing Extractor Body 54
2217-00-056	Pinnacle™ Alternative Bearing Extractor Body 56
2217-00-058	Pinnacle™ Alternative Bearing Extractor Body 58
2217-00-060	Pinnacle™ Alternative Bearing Extractor Body 60
2217-00-062	Pinnacle™ Alternative Bearing Extractor Body 62
2217-00-064	Pinnacle™ Alternative Bearing Extractor Body 64
2217-00-066	Pinnacle™ Alternative Bearing Extractor Body 66
2218-90-001	Pinnacle™ 28 mm TIP
2218-90-007	Pinnacle™ 32 mm TIP
2218-90-002	Pinnacle™ 36 mm TIP
2218-90-004	Pinnacle™ 40 mm TIP
2218-90-005	Pinnacle™ 44 mm TIP
2217-60-020	Pinnacle™ AB Inserter Case
2218-90-003	AB Curved Handle Assembly
2218-90-044	Pinnacle™ 44 mm Gripper
2218-90-046	Pinnacle™ 46 mm Gripper
2218-90-048	Pinnacle™ 48 mm Gripper
2218-90-050	Pinnacle™ 50 mm Gripper
2218-90-052	Pinnacle™ 52 mm Gripper
2218-90-054	Pinnacle™ 54 mm Gripper
2218-90-056	Pinnacle™ 56 mm Gripper
2218-90-058	Pinnacle™ 58 mm Gripper
2218-90-060	Pinnacle™ 60 mm Gripper
2218-90-062	Pinnacle™ 62 mm Gripper
2218-90-064	Pinnacle™ 64 mm Gripper
2218-90-066	Pinnacle™ 66 mm Gripper
2217-50-048	Pinnacle™ Bantam Adapter

Ordering Information

2274-54500	Quickset™ Drill Guide 3.8 mm Diameter
2274-64000	Quickset™ Screw Case Complete
2015-28000	Screw Holding Forcep
2111-13000	Hex Screwdriver Cardan Joint
2274-36000	DLC Depth Gauge
2346-01000	Apex Hole Elim TPD Hex Driver
2364-12000	3.8 mm Drill Guide
2366-83000	45 Deg Angle Drill
2366-84000	3.8 mm Drill Bit 25 mm
2366-85000	3.8 mm Drill Bit 50 mm
2244-14000	Poly Extractor Screwdriver
2217-00-020	Pinnacle™ Insert Inserter
2244-10-000	Acetabular Alignment Guide
2015-28-000	Screw Holding Forcep
2274-02-000	DLC Ratchet Screwdriver Handle
2274-04-000	DLC Hex Screwdriver Shaft Rigid
2274-06-000	DLC Hex Screwdriver Shaft Flex
2274-08-000	DLC Hex Screwdriver Shaft Cardan
2274-12-000	DLC Drill Bit 3.8dia 40 mm
2274-13-000	DLC Drill Bit 3.8dia 70 mm
2274-20-000	DLC Flex Drill Shaft
2274-22-000	DLC Rigid Drill Shaft
2274-32-000	T-Handle
2274-36-000	Duraloc® Depth Gauge
2364-12-000	3.8 mm Drill Guide
2366-83-000	45 Deg Angle Drill
2366-84-000	Drill Bit 3.8 Dia 25 mm Length
2366-85-000	Drill Bit 3.8 Dia 50 mm Length
9399-99-326	Depth Gauge 4.5 mm - 6.5 mm

For more detailed information on Pinnacle™ implants and related trial instruments please refer to the Pinnacle™ Primary System Overview (Cat. No. 9080-20-000) and the Pinnacle™ Revision System Overview (Cat. No. 9080-20-001)

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DePuy International Ltd
St Anthony's Road
Leeds LS11 8DT
England
Tel: +44 (0)113 387 7800
Fax: +44 (0)113 387 7890

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