MARATHON™

CROSS-LINKED POLYETHYLENE

Cemented Cup

Surgical Technique

never stop moving®

DePuy

companies of Johnson & Johnson

Contents

Introduction
Evolution of DePuy Cemented Cups

For almost 50 years, Ultra High Molecular Weight Polyethylene (UHMWPe) has been used as an acetabular bearing material bearing material that shows excellent clinical results.[1-2]

In 1962 Charnley implanted his stem for the first time in combination with a UHMWPe acetabular component. Since then UHMWPe has been the primary polymer used for 'soft' bearing surfaces by implant manufacturers.

In 1977 the pressure injection flange was introduced to improve acetabular fixation and the early pressurisation of the bone cement. The incidence of radiolucent lines at the cement-bone interface is significantly reduced in early radiographs when using a flanged cup, and the advantage is maintained in the long-term results.[3]

In 1994 the UHMWPe used was upgraded to ENDURON™ polyethylene, a more consistent form of the material. "The Swedish Arthroplasty Register details survival rates at up to 96.1% for ELITE™ cups at 10 years.[5]

1962 **1977** **1994**

1972 **1982**

In 1972 a long posterior wall was added to the cup to improve head stability by reducing the likelihood of posterior dislocation of the femoral head in adduction, flexion and internal rotation.

In 1982 the flange was modified to an OGEE™ design and the improved results over a non-flanged cup in subsequent years are recorded in the literature:

Carlsson et al showed an increase in the 7 year survival rate from 80% to 96% (using radiographic loosening as a determinant).[4]

Cross-Linked Polyethylene (XLPE)

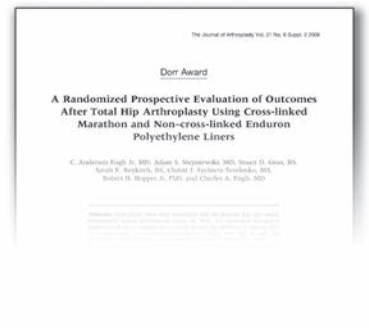

Development of an Extremely Wear-Resistant Ultra High Molecular Weight Polyethylene for Total Hip Replacements

Engh et al reported a 95% reduction in the linear wear rate of MARATHON XLPE compared to ENDURON polyethylene at mean follow up of 5.7 years in 2006.[7] In 2007 Horne and Devane showed a 77% reduction in volumetric wear of MARATHON XLPE compared to ENDURON after 4 years (13.7mm³/y for Marathon and 60.24mm³/y for Enduron).[8]

1998

The introduction of MARATHON Cross-Linked Polyethylene in 1998 was an evolutionary rather than a revolutionary advance in the adaptation of UHMWPe as an advanced bearing surface. The level of irradiation (50 kGy) is only marginally higher than has already been used widely and successfully as a sterilising procedure, but the reduction in volumetric wear rates in-vitro, seen by the developer of the MARATHON material Dr Harry McKellop (pictured), are 86% compared to standard UHMWPE's.[6]

2006


Dorr Award

A Randomized Prospective Evaluation of Outcomes After Total Hip Arthroplasty Using Cross-linked Marathon and Non-cross-linked Enduron Polyethylene Liners

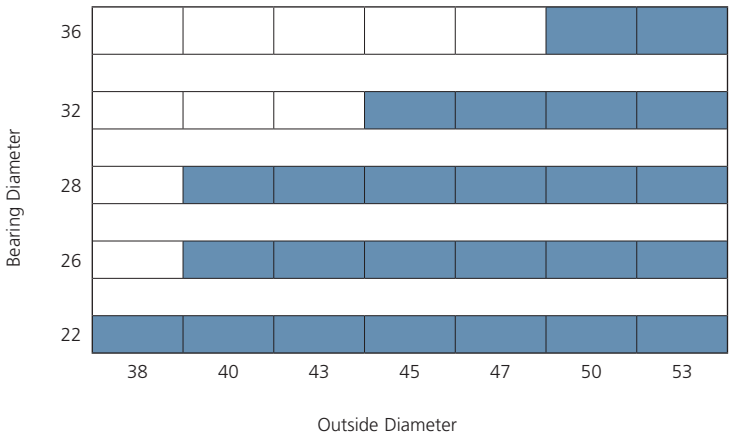
2008

In 2008 the use of MARATHON Cross Linked Polyethylene has been extended to include cemented cups, having successfully been used for 10 years as a modular liner in the DURALOC™ and PINNACLE® acetabular systems.[9] The design of the MARATHON XLPE Cemented Cup is identical to the established CHARNLEY®/ELITE cups with regard to the backside geometry and cement interface.

With the application of this clinically established, bearing material from DePuy, the MARATHON XLPE Cemented Cup may enable surgeons to improve upon the long-term results of an already successful operation by implanting a material that as a modular liner has been shown to has a substantially reduced two-dimensional wear rate of 0.05mm/year compared with conventional polyethylene at 0.26mm/year ($p<0.001$).[10] Clinically, using revision for wear-related complications as an endpoint, Engh reported that survivorship at 10-years was 100% for MARATHON liners and 94.7 ± 4.6% for non-cross-linked polyethylene ($p=0.003$).[9]

MARATHON XLPE Cemented Cup

MARATHON XLPE Cemented Cup Size Range (mm)



Size Range

The introduction of MARATHON Cross-linked polyethylene as a high performance PE bearing for cemented cup manufacture has allowed the existing size range to be extended to include a new 36 mm bearing diameter combined with a 45 mm outside diameter (please refer to the table opposite for the full size range).

An area of concern is the rate of wear at the bearing surface and the need to mimimise the amount of polyethylene wear debris produced (related to head size) that can lead to osteolysis and eventual loosening. MARATHON Cross-Linked Polyethylene has exhibited significantly more resistance to wear[6-11] and therefore the use of a 36 mm head can now be more readily considered by the clinician in balancing the patient needs for maximising stability balanced with expected wear based on age and activity level.

A minimum design thickness of more than 5 mm at the pole and 7 mm at the rim has been maintained for the 36 mm bore liners.

Surgical Technique
Templating and Pre-Operative Planning

Pre-operative planning is intended to assess patient suitability to receive the MARATHON XLPE Cemented Cup and may save time in theatre by helping predict the final implant size.

X-ray templates have been provided for each of the available sizes of implant in various magnifications. Digital X-ray templates are also available if required (Figure 1).

The landmarks for acetabular component positioning are the medial wall of the acetabulum (radiographic tear drop) and the superolateral rim of the acetabulum (Figure 2).

It is important to note that the template is a guide only. The final implant size and position will be determined intraoperatively.

The X-ray templates include the following information

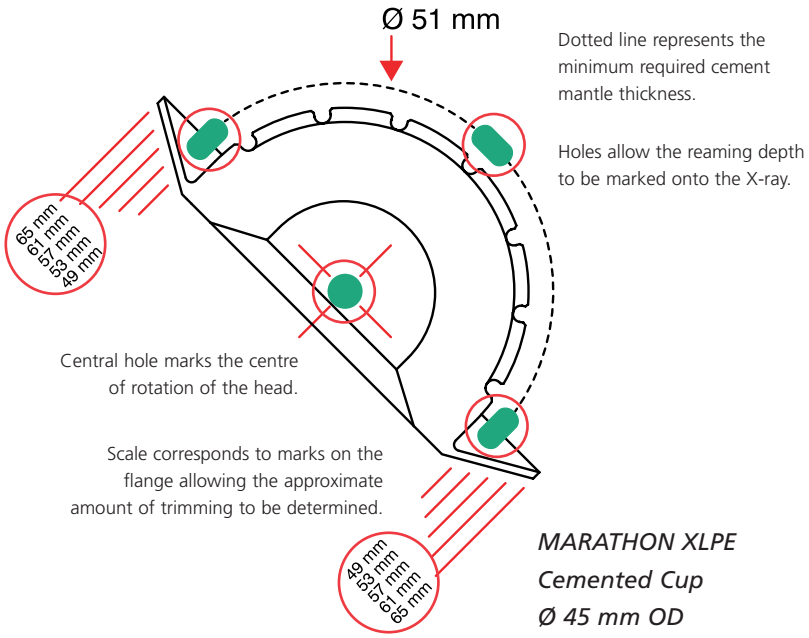
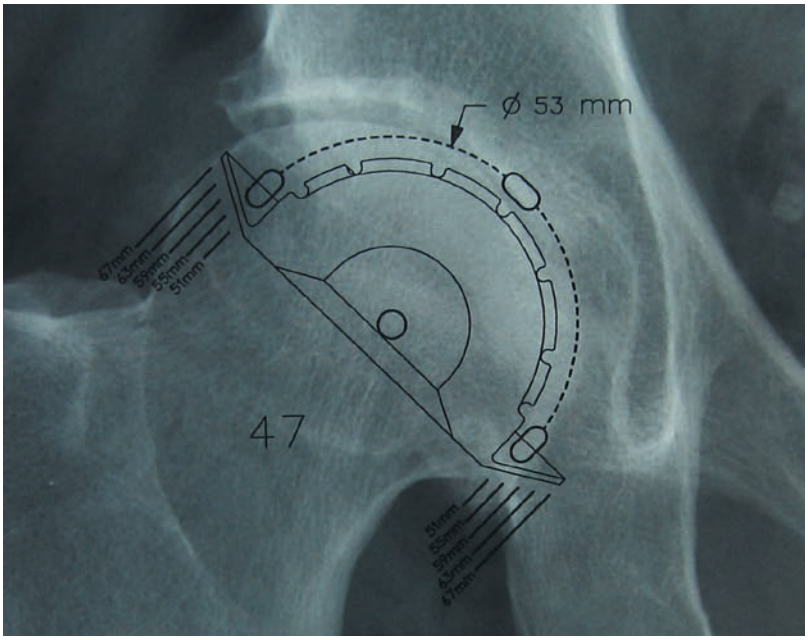


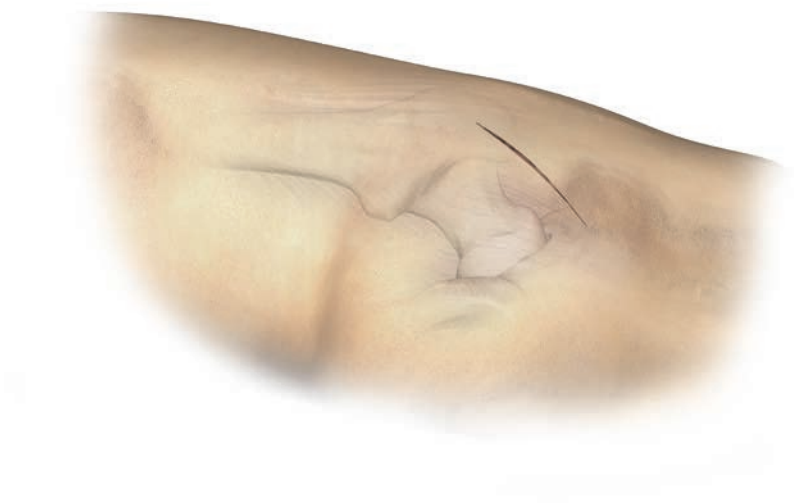
Figure 1



MARATHON XLPE
Cemented Cup
Ø 47 mm OD

Figure 2

Approach to the Acetabulum



Use the approach with which you are most familiar to achieve the best surgical results. The MARATHON XLPE Cemented Cup Instrumentation is designed to accommodate all surgical approaches.

Regardless of the surgical approach used, it is vital that a full 360 degree view of the acetabulum be achieved prior to beginning its preparation. The entire acetabular rim and transverse acetabular ligament should be identifiable.

If the view is restricted it may be necessary to increase the incision length.

Reaming

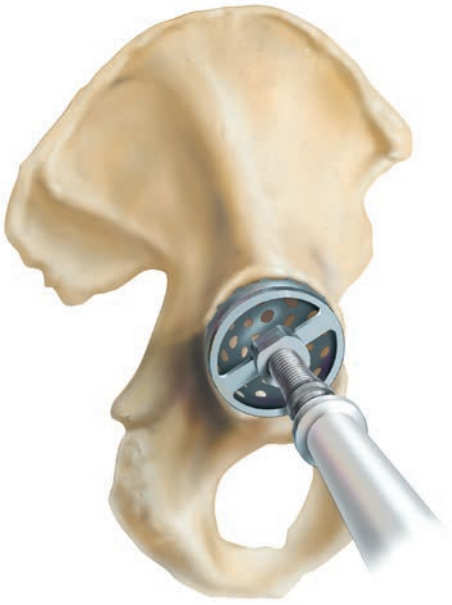


Figure 3

Remove the labrum and any osteophytes from the acetabular rim. The acetabulum should be reamed to achieve the optimum bone surface for fixation of the MARATHON XLPE Cemented Cup. The focus during reaming should be on removing all sclerotic bone, cartilage and soft tissue from the acetabulum in order to facilitate cement interdigitation. The cement will completely fill the prepared acetabulum so that a spherical cavity is not required.

Initially identify the true floor of the acetabulum as this will define the maximum depth to which reaming should progress.

Start reaming close to the transverse acetabular ligament as this will compensate for the drift superiorly that can occur (Figure 3).

The size of reamer should then be increased incrementally and used to expand the cavity, taking care not to progress further medially.

Spherical reaming should continue until good quality bone is exposed anteriorly and posteriorly, at which point further up-sizing of the reamer should stop. The reamer may be progressed superiorly so that good bone is exposed over the entire acetabulum.

The final cavity will be slightly oval in shape (narrowest in the anterior/posterior direction), as defined by the quality of the underlying bone (Figure 4).

It is important that the medial, anterior and posterior walls of the acetabulum are not over reamed, as this risks damaging surrounding soft tissue and destabilising the implant.

The final implant size to be used will be 6 mm less than the final reamer size for a minimum cement mantel thickness of 3 mm. e.g. a final reamer size of 49 mm would indicate a size 43 implant. The final reamer size also gives an indication of the size to which the flange needs to be trimmed to ensure complete cement coverage and optimum pressurisation (although caution should be taken if the cavity is significantly oval in shape).

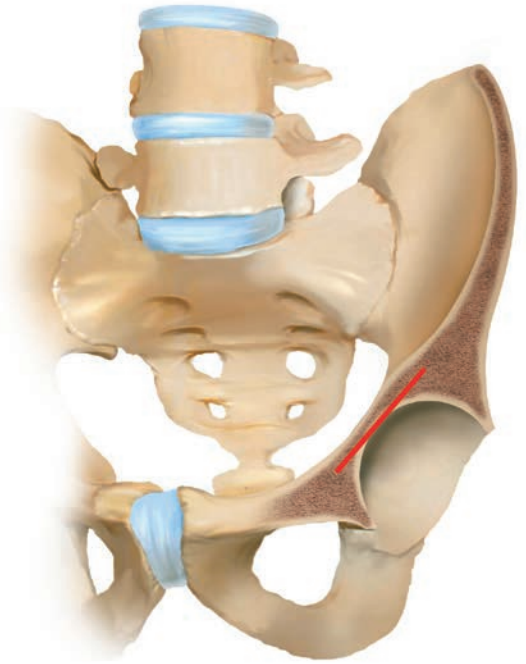


Figure 4

Cup Positioning

Peer reviewed publications highlight the importance of acetabular component positioning in relation to short and long term outcomes during total hip arthroplasty for all types of bearing materials.[12-16]

Cup positioning should be varied to optimise fixation, range of motion, dislocation resistance and to minimise the likelihood of subluxation, impingement and edge loading. This may be assessed during pre-operative planning, acetabular preparation and cup trialling. Sub-optimal component positioning may lead to edge loading, dislocation, increased wear, and polyethylene fracture.[12-16]

The target cup inclination (as measured on radiographs) should be 45° taking into account local soft tissue and anatomic landmarks. The target cup anteversion (as measured on radiographs) should be 15 – 20° taking into account local soft tissue and anatomic landmarks.

An instrument is provided to assist with cup positioning; however, cup orientation in the patient depends on patient position. The handle does not allow for variation in patient position with respect to the operating table and it should be noted that patient orientation can vary throughout the procedure.

Trial

A trial cup exists for each definitive implant size. The trial should be attached to the introducer instrument (introducers are available for each of the head diameters) providing an opportunity to trial the final implant position in addition to checking the size. Trials are compatible with all sizes of introducer with mating features marked accordingly.

The correct size of trial should sit within the acetabular cavity with 3-4 mm of clear space all around it.

The introducer instrument provides a guide to allow correct orientation of the implant. When the shaft of the instrument is aligned with the axis described by the patient's anterior superior iliac spines and the instrument handle is pointing towards the patient's head, the implant will be introduced at 45 degrees inclination and 0 degrees anterversion (Figure 5).

In order to achieve the correct degree of anteversion the instrument should be rotated about the long axis of the instrument shaft by the desired amount (Figure 6), allowing for the patient's position.

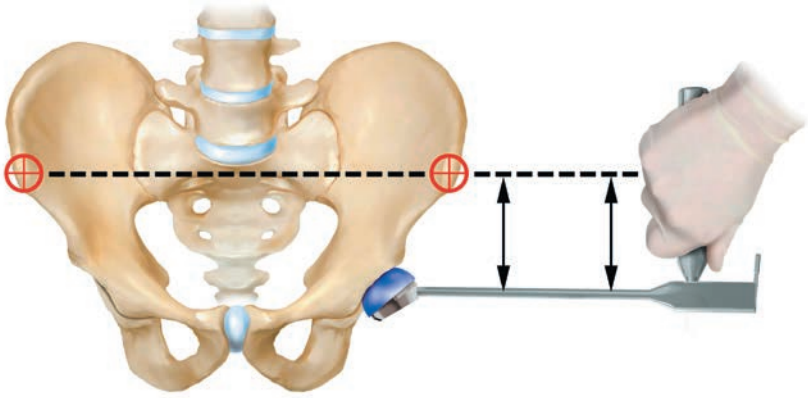


Figure 5

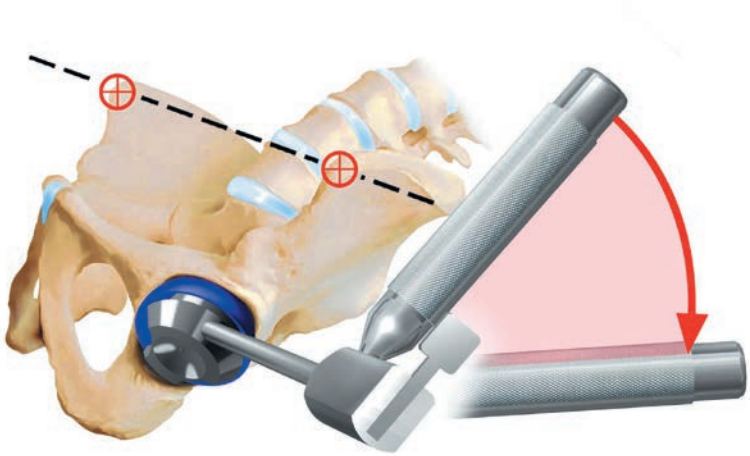


Figure 6

Prepare Acetabulum

Once the acetabulum has been reamed to size, further preparation is required to ensure cement penetration into the bone is maximised.

Using the supplied end stop drill, holes should be distributed around the illium, ischium and pubis (walls of the acetabulum, Figure 7). At this stage any cysts in the acetabulum can be packed with bone graft from acetabular reamings. No holes should be made in the medial wall (acetabular floor) due to the risk of breaching the pelvis. Care should be taken if drilling anteriorly as there is a risk of vascular damage.

The acetabulum should then be cleaned of all bone debris and any remaining soft tissue using a Charnley Ring Curette.

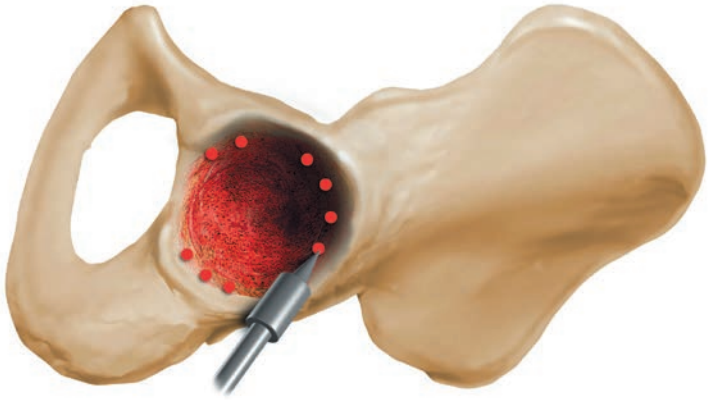


Figure 7

Assemble X-ray Marker Wire

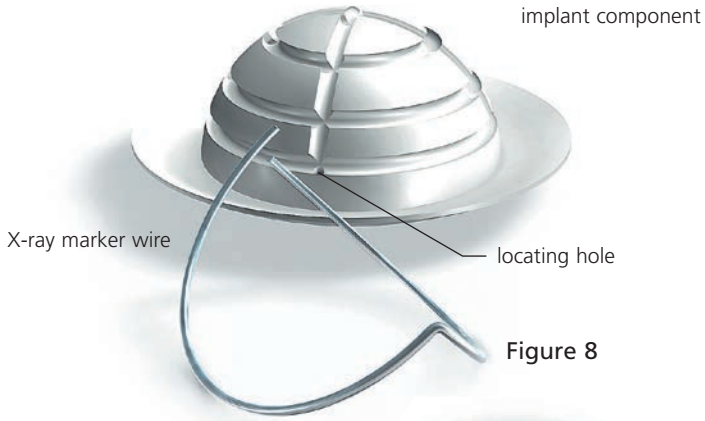


Figure 8

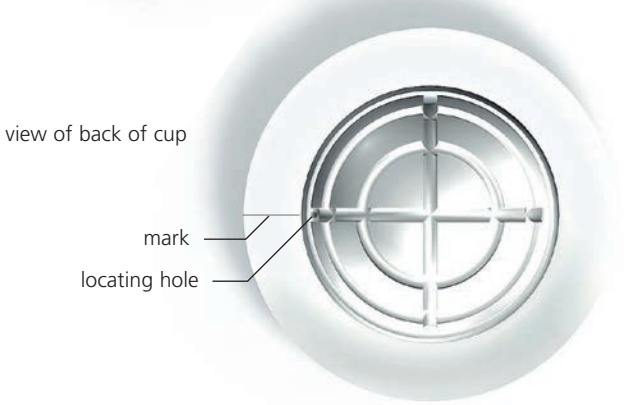


Figure 9

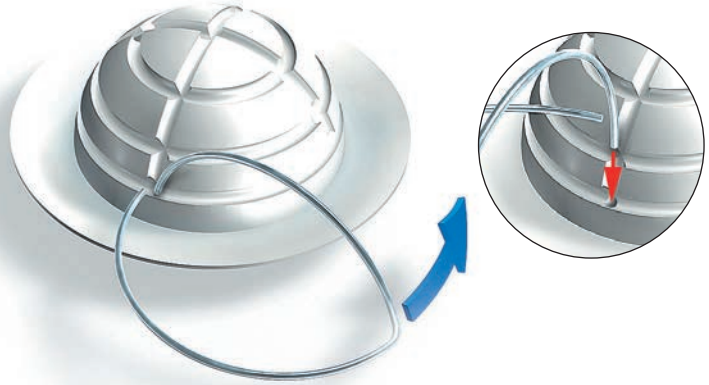


Figure 10

Figure 11

The MARATHON XLPE Cemented Cup X-ray marker wire is supplied as a separate component that should be assembled to the implant component prior to implantation. The marker wire provides useful postoperative information regarding cup inclination, anteversion and retroversion, and its use should be considered standard (Figure 8).

The wire must be correctly orientated to give the proper appearance on the X-ray. In order to assemble the wire to the device, open the sterile pack as normal and remove the implant component and the X-ray marker wire. Holding the implant with the dome of the cup upwards, insert the longest end of the wire into the locating hole, identified by the alignment mark (Figure 9), visible through the flange on the implant and then rotate the wire (Figure 10) so that it snaps into place on the implant grooves (Figure 11). The locating hole prevents the marker wire from being wrongly-assembled.

Prepare Implant

Assemble the implant onto the appropriate size of introducer instrument. The implant has laser marking to identify when it is correctly assembled for the side of the operated hip (Figure 12). When correctly assembled, the exposed side marker "L" or "R" should be the same as the side of the operated hip (Figure 13).

Before trimming the flange it may be useful to offer the implant up to the acetabulum to check the size.

The flange should be trimmed to size (using the supplied scissors), away from the acetabulum. Markings on the flange relate back to the reamer diameters and markings on the X-ray template to provide a guide to the amount of trimming required.

Trimming the flange should be done carefully in order to avoid debris falling into the joint space. Trimming the flange can be made easier by holding the implant on the introducer upside down in one hand, with the handle securely held (Figure 14).

It is advisable to be conservative when trimming the flange to avoid undersizing the flange.

Figure 12

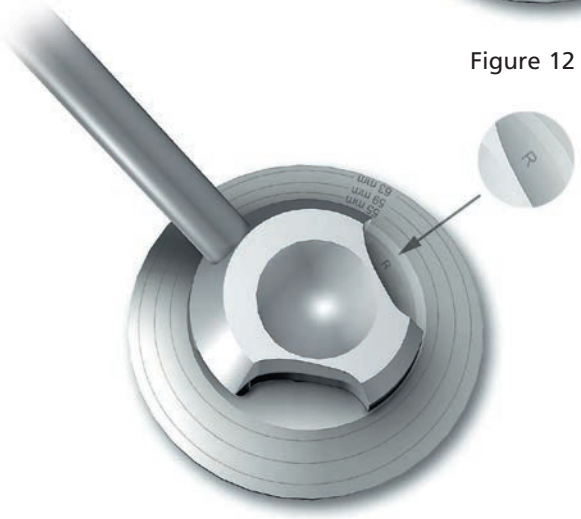


Figure 13

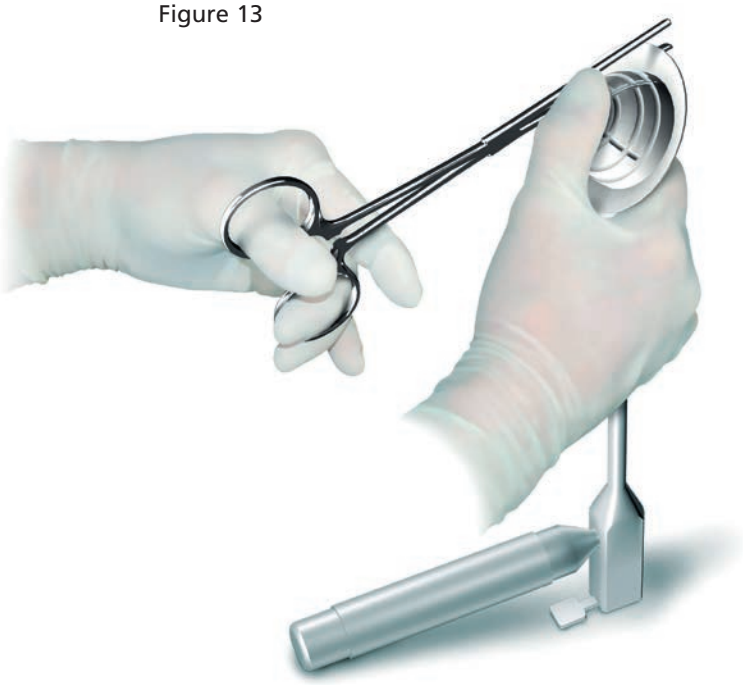


Figure 14

Final Bone Preparation

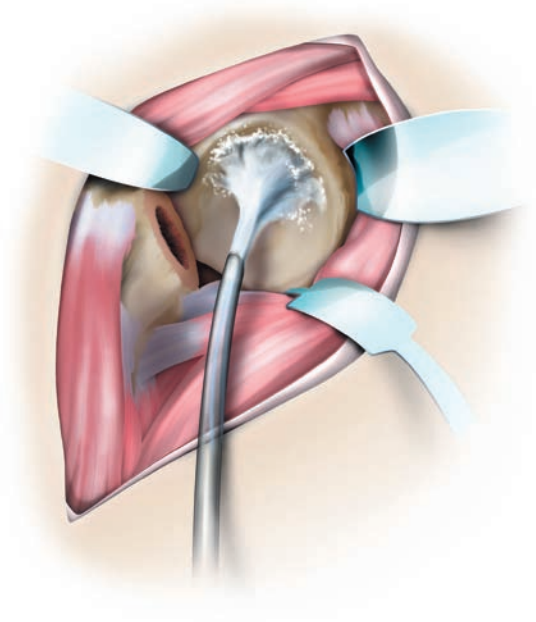


Figure 15

Use pulse or continuous lavage within the acetabulum to remove fat and debris from the cancellous bone interface. Employ suction and dry swabs to clean and dry the bone surface (Figure 15).

When the acetabular surface is dry and the bone surface is open, pack the socket with swabs. These will prevent blood clots adhering to the bone and leave the surface ready for cement introduction.

Introduce Cement and Pressurise

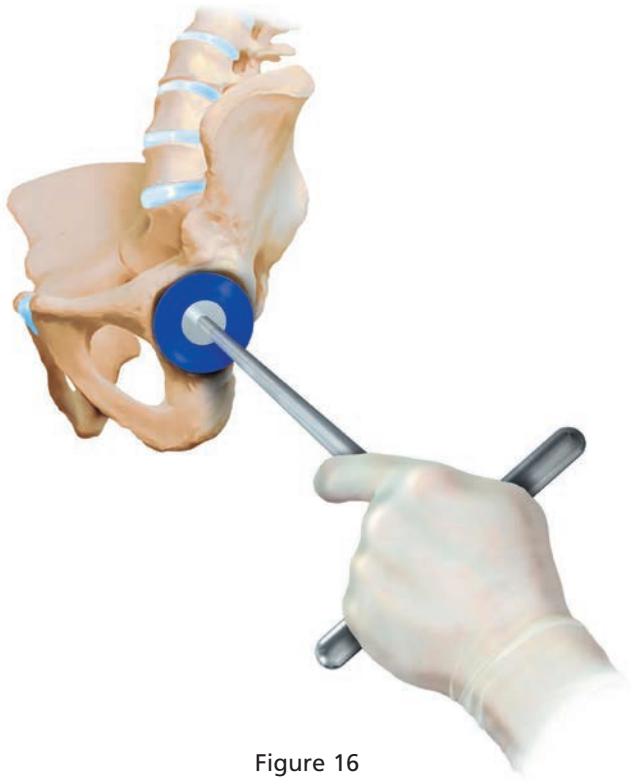


Figure 16

A clean pair of gloves should be worn during cementing to avoid contamination of the cement during handling. A 20g or 40g mix (according to acetabular size) of high viscosity cement should be prepared according to the manufacturer's instructions. Suitable cements include the fast setting DePuy CMW 2 and DePuy CMW 2G gentamicin bone cements or SMARTSET® HV and SMARTSET GHV gentamicin bone cements that have a longer working time. A quantity of cement should be introduced into the dry acetabulum and pressurised using the pressuriser (slightly larger than the final reamer used) and T-handle.

Only if absolutely necessary should surgical gloves be lightly wetted with sterile water or normal saline during this process to prevent cement from sticking to the gloves. Excessive moisture must be avoided as it may reduce the strength of the cement. During pressurisation, the force should be applied superiorly to maximise interdigitation into the predrilled holes (Figure 16).

Introduce Implant

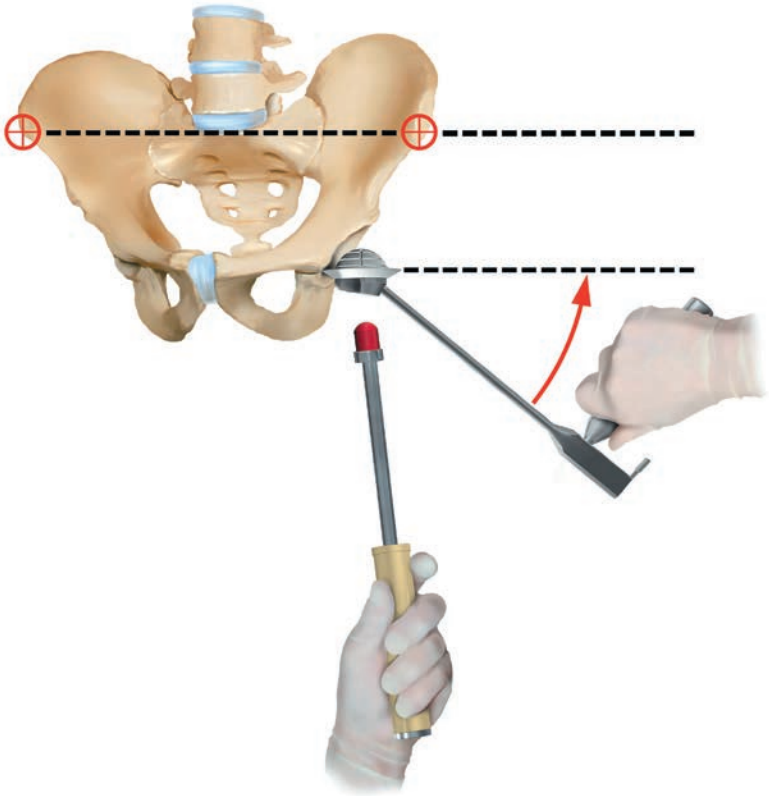


Figure 17

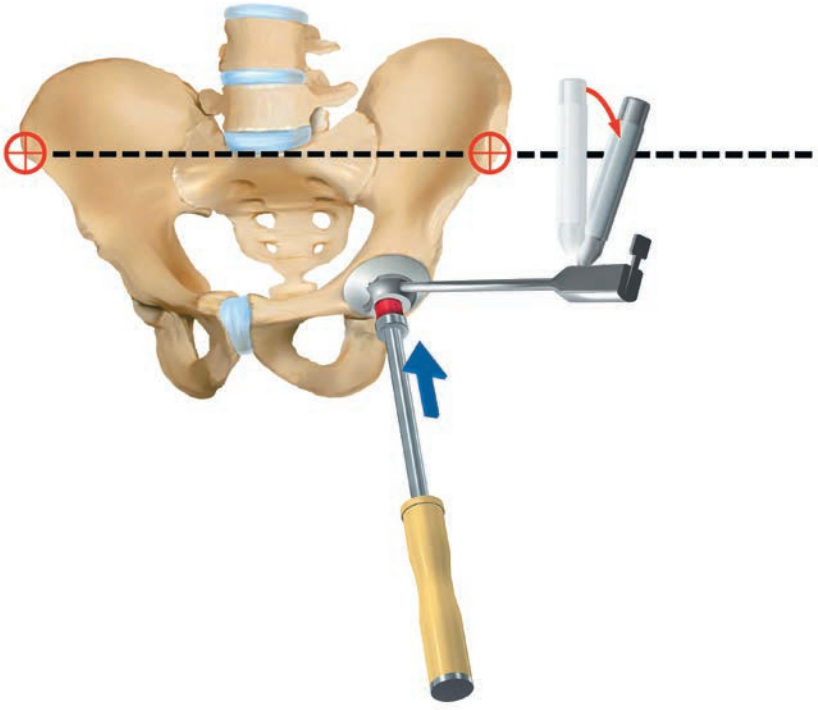


Figure 18

Introduce Implant continued

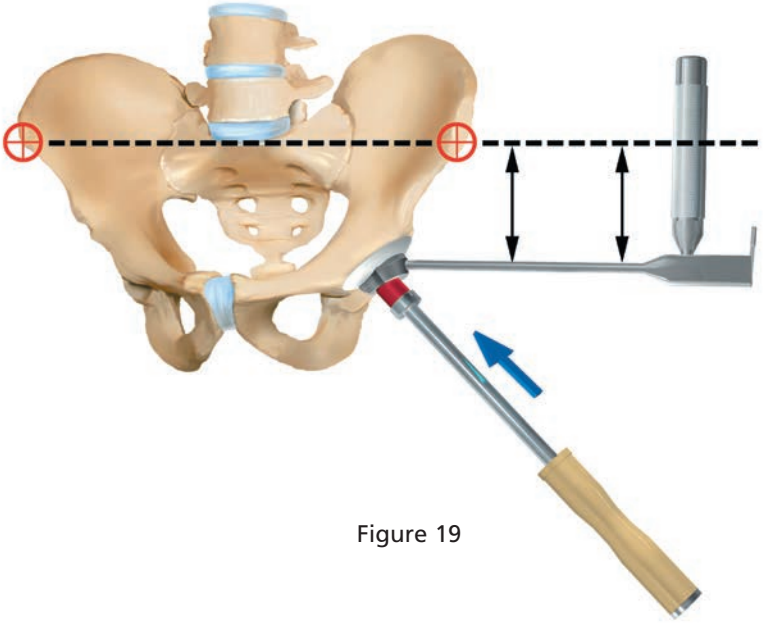


Figure 19

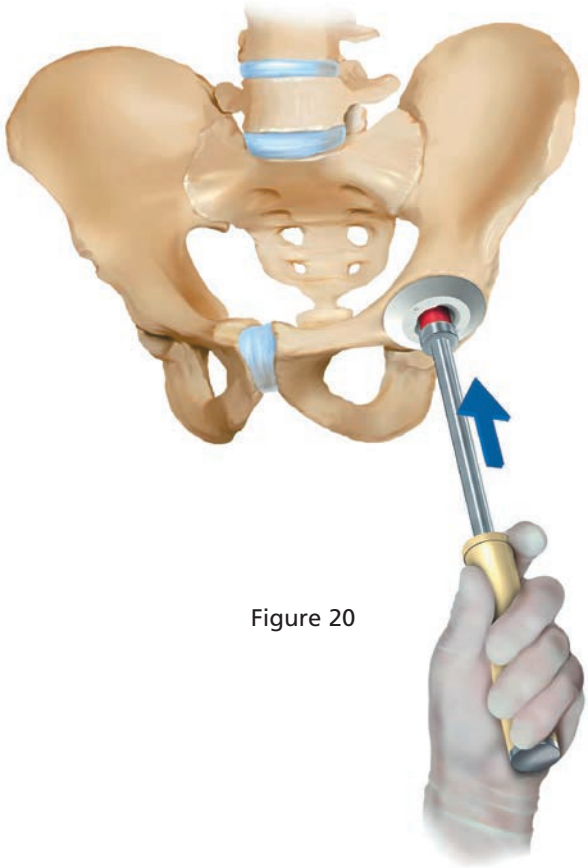


Figure 20

The time of introduction of the implant is at the discretion of the surgeon and will vary according to the cement used and the ambient conditions. The surface of the cement should be dull as opposed to shiny and it should not stick excessively to the surgeon's gloves. If the cement has cured to the point where it will no longer stick to itself then it is too late to introduce the implant.

Start by pushing the leading edge of the implant into the acetabulum to close off the acetabular notch inferiorly first (Figure 17).

During introduction of the implant, the introducer should be used to control alignment of the implant, in the same way as described for trial alignment, while force is applied via the pusher instrument (Figure 18).

Keeping the flange edge in contact with the bone, use the pusher instrument to "close" the implant across the acetabulum (Figure 19).

When correctly positioned, the shaft of the introducer should align to the anterior superior iliac spines, with the handle at the desired anteversion angle to the axis of the trunk and the implant flange in contact with the acetabular rim (Figure 20). Throughout the positioning of the implant excess cement will be expelled from around the flange. This should be completely removed.

Once the implant is positioned, use the trigger to remove the introducer and then re-apply the pusher to the implant bore. Moderate force should then be applied to the pusher until the cement has fully cured. This final pressurisation step is only intended to prevent extrusion of the cement out of the bone by blood pressure. Excessive force at this stage could cause the flange to bottom out and should be avoided.

Ordering Information

MARATHON XLPE Cemented Cup Implant Codes

Cat. No.	Description
9655-12-238	MARATHON XLPE Cement Cup 22 x 38 mm
9655-12-240	MARATHON XLPE Cement Cup 22 x 40 mm
9655-12-243	MARATHON XLPE Cement Cup 22 x 43 mm
9655-12-245	MARATHON XLPE Cement Cup 22 x 45 mm
9655-12-247	MARATHON XLPE Cement Cup 22 x 47 mm
9655-12-250	MARATHON XLPE Cement Cup 22 x 50 mm
9655-12-253	MARATHON XLPE Cement Cup 22 x 53 mm
9655-12-640	MARATHON XLPE Cement Cup 26 x 40 mm
9655-12-643	MARATHON XLPE Cement Cup 26 x 43 mm
9655-12-645	MARATHON XLPE Cement Cup 26 x 45 mm
9655-12-647	MARATHON XLPE Cement Cup 26 x 47 mm
9655-12-650	MARATHON XLPE Cement Cup 26 x 50 mm
9655-12-653	MARATHON XLPE Cement Cup 26 x 53 mm
9655-12-840	MARATHON XLPE Cement Cup 28 x 40 mm
9655-12-843	MARATHON XLPE Cement Cup 28 x 43 mm
9655-12-845	MARATHON XLPE Cement Cup 28 x 45 mm
9655-12-847	MARATHON XLPE Cement Cup 28 x 47 mm
9655-12-850	MARATHON XLPE Cement Cup 28 x 50 mm
9655-12-853	MARATHON XLPE Cement Cup 28 x 53 mm
9655-13-245	MARATHON XLPE Cement Cup 32 x 45 mm
9655-13-247	MARATHON XLPE Cement Cup 32 x 47 mm
9655-13-250	MARATHON XLPE Cement Cup 32 x 50 mm
9655-13-253	MARATHON XLPE Cement Cup 32 x 53 mm
9655-13-650	MARATHON XLPE Cement Cup 36 x 50 mm
9655-13-653	MARATHON XLPE Cement Cup 36 x 53 mm

DePuy Bone Cement

Cat. No.	Description
3095020	SMARTSET GHV Gentamicin 20g
3095040	SMARTSET GHV Gentamicin 40g
3025020	DePuy CMW 2 Gentamicin 20g
3025040	DePuy CMW 2 Gentamicin 40g
3092020	SMARTSET HV 20g
3092040	SMARTSET HV 40g
3322020	DePuy CMW 2 20g
3322040	DePuy CMW 2 40g

Ordering Information

Cemented Cup Instruments

Cat. No.	Description
2440-00-501	Quickset Acetabular Grater, Case Complete (Case, Tray, Lid)
2440-00-510	Quickset Acetabular Grater, Grater Handle
2440-00-511	Quickset Acetabular Grater, Tissue Protector
2440-00-536	Grater Head 36 mm
2440-00-537	Grater Head 37 mm
2440-00-538	Grater Head 38 mm
2440-00-539	Grater Head 39 mm
2440-00-540	Grater Head 40 mm
2440-00-541	Grater Head 41 mm
2440-00-542	Grater Head 42 mm
2440-00-543	Grater Head 43 mm
2440-00-544	Grater Head 44 mm
2440-00-545	Grater Head 45 mm
2440-00-546	Grater Head 46 mm
2440-00-547	Grater Head 47 mm
2440-00-548	Grater Head 48 mm
2440-00-549	Grater Head 49 mm
2440-00-550	Grater Head 50 mm
2440-00-551	Grater Head 51 mm
2440-00-552	Grater Head 52 mm
2440-00-553	Grater Head 53 mm
2440-00-554	Grater Head 54 mm
2440-00-555	Grater Head 55 mm
2440-00-556	Grater Head 56 mm
2440-00-557	Grater Head 57 mm
2440-00-558	Grater Head 58 mm
2440-00-559	Grater Head 59 mm
2440-00-560	Grater Head 60 mm
9626-29-000	Acetabular Prep Drill
3206045	Acetabular Pressuriser 5 x 45 mm
3206052	Acetabular Pressuriser 5 x 52 mm
3206055	Acetabular Pressuriser 5 x 55 mm
3206060	Acetabular Pressuriser 5 x 60 mm
3206065	Acetabular Pressuriser 5 x 65 mm

Cat. No.	Description
9626-30-000	Cup Introducer 22.225 mm
9626-28-000	Cup Introducer 26/28 mm
9626-36-000	Cup Introducer 32 mm
9626-00-036	Cup Introducer 36 mm
9626-38-001	Cup Trial 38 mm
9626-00-000	Cup Trial 40 mm
9626-01-000	Cup Trial 43 mm
9626-45-000	Cup Trial 45 mm
9626-02-000	Cup Trial 47 mm
9626-50-000	Cup Trial 50 mm
9626-53-000	Cup Trial 53 mm
2015-25-000	Pressuriser Handle Long
9628-00-000	Cemented Acetabular Instrument Tray
9628-02-001	Cemented Acetabular Templates
Either	
2015-24-000	Cup Pusher Handle (imperial thread)
9601-18-000	Cup Pusher Head 22.225 mm (imperial thread)
2129-22-000	Cup Pusher Head 26 mm (imperial thread)
2129-20-000	Cup Pusher Head 28 mm (imperial thread)
2129-12-000	Cup Pusher Head 32 mm (imperial thread)*
Or	
9626-07-000	Cup Pusher Handle (metric thread) supplied with 22.225, 26, 28 mm** Pusher Heads
2129-36-000	Cup Pusher Head 36 mm (metric thread)

** Please note that the Cup Pusher Head 32 mm (imperial thread) can be used with both 32 and 36 bearing diameter cups.*

*** Please note that the Cup Pusher Head 28 mm (metric thread) can be used with both 32 and 36 bearing diameter cups.*

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