■ HIP

# The 15° face-changing acetabular component for treatment of osteoarthritis secondary to developmental dysplasia of the hip


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**We report the use of a 15° face-changing cementless acetabular component in patients undergoing total hip replacement for osteoarthritis secondary to developmental dysplasia of the hip. The rationale behind its design and the surgical technique used for its implantation are described. It is distinctly different from a standard cementless hemispherical component as it is designed to position the bearing surface at the optimal angle of inclination, that is, < 45°, while maximising the cover of the component by host bone.**


Osteoarthritis (OA) resulting from developmental dysplasia of the hip (DDH) is one of the most technically difficult conditions to treat by total hip replacement (THR).[1] The severity of DDH ranges from a shallow acetabulum to complete dislocation with a 'high-riding hip'.[2] Several techniques of acetabular reconstruction have been reported,[3-9] with the aim of improving bony cover and support for a cemented or cementless acetabular component.

The medium to long-term results of THR with a cemented acetabular component under these circumstances range from satisfactory to poor.[2,10-18] The results with cementless components have been inconsistent.[19-23] The absence of satisfactory acetabular bone stock and poor positioning of the component have resulted in aseptic loosening and osteolysis due to polyethylene wear, particularly with first-generation cementless components, thereby compromising the results. It has been suggested that hard-on-hard bearing surfaces such as ceramic-on-ceramic (CoC) may reduce wear-related problems and improve long-term outcomes.[24]

Irrespective of the bearing surface, accurate alignment of the acetabular component is critical.[25-27] The best position for the acetabular component in the patient with DDH is medial and inferior: a low inclination angle < 45° is recommended.[28-31]

By modifying the design of a standard hemispherical cementless acetabular component to that of a 15° face-changing (15°FC) component, the liner can be inclined to the optimal position of < 45° without compromising the cover of shell in 'dysplastic' and 'low dislocation' cases of DDH, as described by Hartofilakidis et al.[2] We report the design rationale and surgical technique for the 15°FC cementless component in THR for patients with DDH.

## Patients and Methods

The indication to use the Exceed Advanced Bearing Technology (ABT) 15°FC cup (Biomet UK Ltd, Bridgend, United Kingdom) was OA secondary to 'dysplasia' or 'low dislocation' DDH,[2] as assessed on anteroposterior (AP) pelvic radiographs. Dysplasia is defined by a centre–edge (CE) angle[32] < 20°, a femoral head extrusion index (FHEI)[33] > 25% and a Sharp angle[34] < 42°.

The Exceed ABT 15°FC cup is a CoC-bearing acetabular component with a solid hemispherical titanium alloy cementless shell and a 15° superior lip. The shell allows for supplementary screw fixation, having five clustered removable titanium alloy screw-hole blanking plugs. The convex outer surface is covered with a closed-porous plasma spray cover (with optional hydroxyapatite coating) to encourage osseo-integration. The superior lip is uncoated, as this area does not come into contact with host bone. The inner surface of the shell has a Morse taper for the hard-bearing liner and is designed to orientate the liner at an angle of 15° to the rim of the shell but parallel to the rim of the superior lip. The liner may be made of either Biolox Delta ceramic or cobalt–chrome.

This significant modification of the standard hemispherical component allows a more anatomical reconstruction of the centre of rotation of the hip. The surgeon can place the cup at the appropriate steeper angle of inclination (50° to 60°) to achieve maximum contact with host


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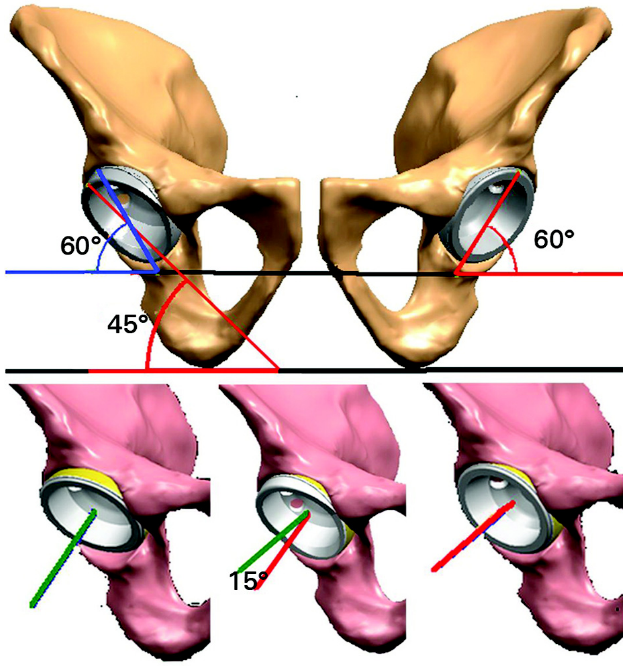


Fig. 1

Top left: diagram showing the 15° face-changing cup in the optimal position, with a cover angle with the liner of 60° (in blue), and a face-changing angle with the liner of 45° (in red). Top right: diagram showing a 'standard' component incorrectly positioned at a high inclined angle of 60° to obtain full contact with host bone. Bottom row: diagrams showing optimal liner alignment of the uncovered closed standard component (left), the 15° face-changing component in closed position (middle), and a standard component in a high inclined position (right).

bone without compromising its cover in 'dysplastic' and 'low dislocation' cases, while keeping the inclination of the bearing surface at < 45° (Fig. 1). In cases of 'low dislocation' the 15°FC component can be used when pre-operative templating shows that the acetabular component can be implanted with adequate bone cover without the need for an augment or bulk graft.

**Surgical technique.** At pre-operative templating, the component is placed just lateral to the lateral edge of the teardrop on the inter-teardrop line with the face of the cup at approximately 40° to this line. In most cases the porous-coated part of the component is completely covered by host bone, which spans the teardrop and the defective superolateral margin of the acetabulum, while the superior 15° lip remains uncovered.

If necessary, the component can be placed up to 5 mm more proximally to maximise contact with the host bone. It can still be used if the porous-coated part is not in full contact with the host bone, but may not be appropriate in patients with complete dislocation or a high-riding hip.

Preparation of the acetabulum involves the use of standard hemispherical reamers to remove any remaining cartilage and subchondral bone. In order to place the component in its optimal position, the standard directional reaming technique is modified so that the face of the reamer is parallel to the face of the dysplastic acetabulum in approximately 50° to 60° of abduction or inclination and anteversion of 15° to 20°. Typically, when completed, the rim of the final reamer is flush with the rim of the acetabulum.

The shell is introduced in the same axis as the reamer. This places the liner in the optimal position of 45° abduction (with an inclination 15° less than that of the hemispherical shell and introducer). In this position, the porous-coated surface is fully covered by bone (Fig. 2). Orientation is facilitated by an etched mark in the centre of the 15° superior lip, which is aligned in the 12 o'clock position. In most cases the 15° superior lip remains uncovered. It is important to seat the inferior lip of the component within the rim of the reamed acetabulum to avoid impingement with the neck of the femoral component (Fig. 1).

The 15°FC component is press-fitted after under-reaming the acetabulum by 2 mm. However, there is the option of supplementary screw fixation when a stable fit cannot be achieved, or when part of the porous-coated shell extends beyond the margin of the acetabulum. Care is needed when introducing the ceramic liner to ensure that its edge is flush with the edge of the superior lip of the shell.

**Example.** Figure 3 shows the use of the component. The point of transition between the porous-coated surface and the 15° lip is obvious as a small step, and a line connecting this point to the inferior edge of the component corresponds to the face of its porous-coated portion. We defined the angle formed between this line and the inter-teardrop line as the angle of component cover (C angle). A line drawn from the lateral edge of the component through the centre of rotation represents the face of the liner. We defined the angle formed between this line and the inter-teardrop line as the face-changing (FCh) angle, which is always 15° less than the C angle on a true AP radiograph. The centre of rotation is measured with reference to the teardrop and contralateral hip as described by Sharp.[34] In the short term no significant complications have occurred in our cases, except for a transient sciatic nerve neurapraxia that occurred in a patient with a low dislocation who underwent a degree of planned leg lengthening; the neurapraxia resolved within three months of surgery.

## Discussion

Patients who need a THR for the sequelae of DDH pose particular problems. In order to achieve stable primary fixation maximum cover of the acetabular component with host bone is required.[9,12,18-20]

The Exceed ABT 15°FC cementless acetabular shell and ceramic bearing achieves these goals while addressing many other potential mechanisms of failure.[2,12,16-18,25-30] Its unique design means that the shell can be implanted reliably at an inclination angle of 50° to 60° while the bearing surface is inclined at an angle of < 45°, thus restoring the

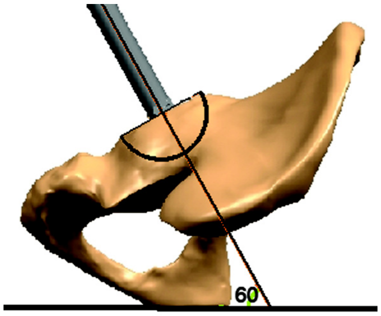


Fig. 2a

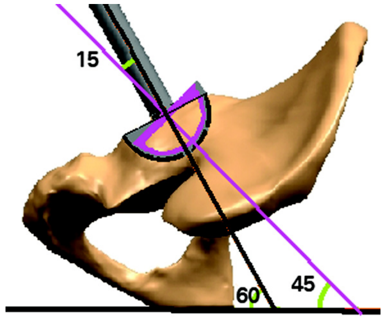


Fig. 2b

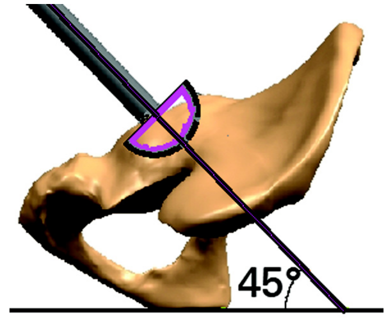


FIg. 2c

Figures 2a and 2b – diagrams showing the implantation of the 15° face-changing component, with a) the reamer inserted parallel to the face of the dysplastic acetabulum in 50° to 60° of abduction, b) achievement of optimal position with introducer in 60° of abduction. The superior lip (grey) is uncovered by 15°; the inferior lip (grey and black) is sited within the rim of the acetabulum to avoid impingement. Figure 2c – diagram showing a standard component positioned in 45° of abduction. The acetabular rim is uncovered by 15°.

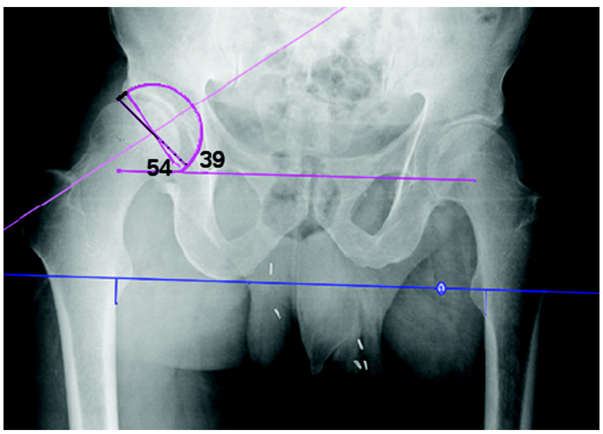


Fig. 3a

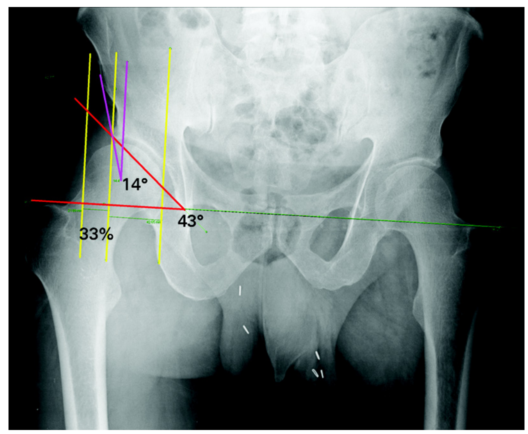


Fig. 3b

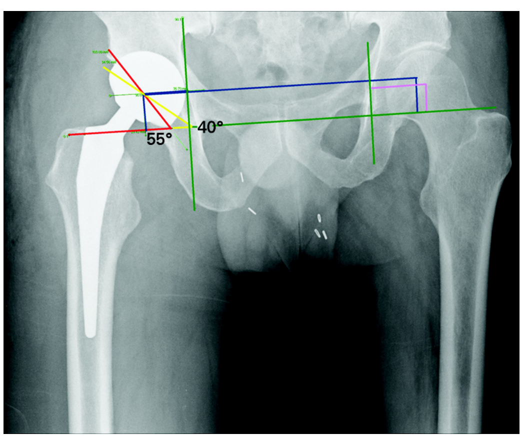


Fig. 3c

Figures 3a and 3b – pre-operative anteroposterior (AP) radiographs of a case of dysplasia. a) Templated position of the acetabular component. Pink line denotes the inter-teardrop line. Horizontal blue line identifies the leg-length discrepancy. Vertical blue line further focuses leg-length discrepancy by identifying the inferior border of the lesser trochanter, and b) showing a centre-edge angle[32] of 14° (in pink), a Sharp angle[34] of 43° (in red) and a femoral head extrusion index[33] of 33% (in yellow). Figure 3c – post-operative AP radiograph of a 15° face-changing component, with the porous surface of the acetabular component at an angle of 55° (in red), resulting in an abduction angle of the ceramic liner of 40° (in yellow). Centre of rotation and offset of the hip restored. Blue line denotes the reconstructed centre of rotation. Pink denotes the anatomical centre of rotation.

centre of rotation in patients with dysplasia or 'low dislocation' DDH.

Our experience with this component suggests that it is a better choice for young, active patients and of value when undertaking a complex replacement of the dysplastic hip. Further clinical evaluation of our patients with the 15°FC component will be reported.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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