THE DUAL MOBILITY CONCEPT: 30 YEARS OF EXCELLENT CLINICAL RESULTS

Prosthetic articulating systems with two distinct articulating surfaces, so called Dual Mobility systems, were conceived with the aim of:
- Decrease wear.
- Better replicate the physiological Range of Motion.
- Increase Hip stability.
- Decrease shear stresses.

This concept had been first proposed by Prof. Gilles Bousquet in 1976. The basic idea is to couple two concepts: decrease wear according to the low friction concept of Charnley and achieve an intrinsic stability of the articulation utilizing a femoral head of bigger size, more similar to patient's anatomy as advocated by McKee-Farrar. The Bousquet concept consist of two interfaces articulating a metallic head (usually of diameter 22.2mm or 28mm) with a UHMWPE liner, the latter also articulating with a polished inner surface of the metallic acetabular shell. Hence the system is basically composed of a press-fit acetabular shell realizing two distinct concentric articulations:
- The femoral head within the polyethylene liner (small articulation).
- The liner within the metal shell (great articulation).

The UHMWPE Liner represents, according to the different sizes, approximately 5/8 of a sphere and it is invariably designed with a retentive mechanism for the femoral head. Stress reduction has been observed and documented over the years and at least three publications of Aubriot et al. [1] Farizon et al. [2] and Lecercq et al. [3] have been dealing with this issue. Altogether more than 380 patients have been followed up for a period of more than 10 years. Results were excellent with an implant's survival curve exceeding 95%. Even in those cases where a mobilization of the implant led to revision, this was never in association with loss of bone stock suggesting an optimal distribution of stresses. Several other authors have been addressing the issue of implant stability, early dislocation in relation to a double mobility or bi-articular cup. [4, 5, 6, 7]

Early dislocation remains the main complication after total hip replacement surgery, and its origin is most often multifactorial including surgical mistakes, errors in orientation or lateralisation of the implants, length of the limb, muscular insufficiency, lever effect, neurological disturbances etc. In the above mentioned literature review, patients with recidivant dislocation or at high risk of dislocation have been satisfactorily treated with this kind of implant. In terms of safety, Lecercq et al. [8] complain of only 1 dislocation on 1100 implants over a period of more than 10 years.

REFERENCES


Versafitcup® Design Rationale

- The Versafitcup® elliptical press-fit cup geometry with equatorial macrostructure and surface effect provides a gradual load transfer avoiding peaks and ensuring excellent primary stability. Secondary cup fixation is provided by a dual coating of 100µm plasma spray Titanium and 90µm of Hydroxylapatite.
- The equatorial macrostructures shows circular retaining splines which increase the contact between the implant and the bone to 30 to 40%, promoting excellent bone ongrowth.
- An upper edge in the shape of a 5° bill provides an additional cover for the articulating liner.
- Solid high nitrogen stainless steel cup, interior mirror polishing, without screw holes. Mechanical stable fixation for precise cup impaction.

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Versafitcup®

V E R S A F I T C U P
A N E W  G E N E R A T I O N
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No risk of metal ions release.

A NEW GENERATION

VERSAFITCUP®

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CONCEPT

The Versafitcup® Double Mobility is based on the original Dual Mobility design developed by Prof. Bousquet and the Medical School of St. Etienne, France back in 1976. With more than 30 years of successful clinical history this concept is widely used in Europe and in particular in France, where it represents about 25% of the primary hip cup market. With the introduction of the Highcross® Double Mobility Liner, the Versafitcup® can be considered as a valid alternative to hard/hard big head articulation. While reducing drastically the wear rate, the supplementary advantages are to avoid the risk of liner fractures and squeaking observed with Ceramic-on-Ceramic bearings and to avoid the risk of metal ions release observed with Metal-on-Metal.

WHY CHOOSE A DOUBLE MOBILITY CUP?

- Better than standard fixed liner cups:
  - Low wear rate thanks to the Dual Mobility and Third Articulation.
  - Low dislocation rate thanks to increased head diameter.
  - Increased Range of Motion (ROM) thanks to increased head/neck ratio.

- Better than Metal-on-Metal:
  - No risk of metal ions release.

- Better than Ceramic-on-Ceramic:
  - No risk of liners fracture.
  - No squeaking.

| 1 | Articulation Liner/Shell | Dual Mobility |
| 2 | Articulation Head/Liner |
| 3 | Articulation Neck/Liner | Third Articulation |

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LOW WEAR RATE

The question of a potential UHMWPE wear increase due to the double articulation has been raised, and clinical follow up of more than 30 years on similar systems has been reassuring. Additionally the dynamic mechanism of action is becoming more understood.

The Dual Mobility and Third Articulation concepts are responsible for the low wear rate of the Versafitcup® Double Mobility:

Head/Liner Articulation (80% of the time)

A1 is always smaller than A2 and under physiological loading conditions, A1 is the first to be mobilized up to contact of stem neck with UHMWPE liner rim.

Liner/Shell Articulation (20% of the time)

Only when the stem neck enters into contact with the internal rim of the liner, A2 starts to move. The rim of the liner is chamfered to articulate with polished neck (Third Articulation concept). This happens with activities requiring high ROM such as climbing stairs.

Thanks to this concept, the wear rate of the Versafitcup® is lower compared with standard fixed UHMWPE liner coupled with metal head as shown in the graph below.

By using a Ceramic head instead of a Cobalt Chrome head, the wear rate further decreases by approximately 50%. It is important to always couple the Versafitcup Double Mobility with Medacta® femoral stems which have a highly polished neck and a short taper design.

Gravimetric Wear

Test on Versafitcup® Double Mobility size 64 mm, CoCr 28 mm head, 5 Million Cycles with 3400 N according to ISO 14242-1. Other data are an extrapolation from literature[9] and the above mentioned test.

VERSAFITCUP® HIGHCROSS® DOUBLE MOBILITY LINER

The Versafitcup® Double Mobility design provides a low wear rate. The usage of Highcross®, cross-linked polyethylene by Medacta, guarantees a further drastic reduction of wear production, thanks to the enhanced properties. In fact, by using Highcross®, the wear rate further decreases more than fifteen times in comparison to a conventional UHMWPE double mobility liner.[10]

This means that the Double Mobility Highcross® Liner has wear characteristics comparable to Metal-on-Metal and Ceramic-on-Ceramic bearing combinations.

VERSALINE® HIGHCROSS® DOUBLE MOBILITY LINER

Highcross® by Medacta® is characterised by:

- Irradiation at 100 kGy.
- Stabilisation temperature of 150°C.
- Controlled cooling rate in order to optimise mechanical properties.
- Final sterilisation with ethylene oxide.

Such innovative production characteristics yield a high quality material with enhanced properties.

THE ALTERNATIVE TO METAL-ON-METAL AND CERAMIC-ON-CERAMIC

- It has been demonstrated that for Metal-on-Metal bearing, the prosthesis components positioning is very critical and a bad positioning can lead to early failures due to excessive metal debris.[11,12]

Also in the case of Ceramic-on-Ceramic bearing, the implants positioning is really critical, in fact a malpositioning can augment the risk of liner fracture or squeaking.[13]

The Versafitcup® Double Mobility eliminates all these issues, adding the best protection against dislocation, which is the most common cause of Total Hip Arthroplasty revision, according to a recent market survey.[14]
When the Versafitcup® Double Mobility is implanted, the liner diameter provides the hip joint stability, not the head diameter.

**Versafitcup® Double Mobility**

Diameter responsible for hip stability is the Liner Diameter (38mm, 40mm, 42mm,…), due to the retentive mechanism for the femoral head.

In the Versafitcup® product range, the minimal diameter of the liner is 38mm for the 46mm cup and increases with 2mm steps up to 56mm for the 64mm cup. (Liners can be coupled with 28mm head for acetabular shells from sizes 48mm to 64mm; 22mm head coupling available for shell sizes 46mm and 48mm).

<table>
<thead>
<tr>
<th>Acetabular Shell Ø (mm)</th>
<th>46</th>
<th>48</th>
<th>50</th>
<th>52</th>
<th>54</th>
<th>56</th>
<th>58</th>
<th>60</th>
<th>62</th>
<th>64</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liner Ø (mm)</td>
<td>38</td>
<td>40</td>
<td>42</td>
<td>44</td>
<td>46</td>
<td>48</td>
<td>50</td>
<td>52</td>
<td>54</td>
<td>56</td>
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</table>

Thanks to that concept, the clinical results reported in the literature on similar product systems show extremely low dislocation rates as low as 0.1% with over 1000 patients enrolled [4,5,7].

**Increased Range of Motion (ROM)**

In the following table the ROM of the Versafitcup® Double Mobility is compared with a standard fixed liner cup size 64mm with different head sizes (28mm, 32mm, 36mm).

<table>
<thead>
<tr>
<th>ISO 21635</th>
<th>Versafitcup® Double Mobility</th>
<th>Standard Fixed Liner Cup Head Ø 28mm</th>
<th>Standard Fixed Liner Cup Head Ø 32mm</th>
<th>Standard Fixed Liner Cup Head Ø 36mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abduction/Adduction</td>
<td>140°</td>
<td>125°</td>
<td>132°</td>
<td>137°</td>
</tr>
<tr>
<td>Flexion/Extension</td>
<td>141°</td>
<td>125°</td>
<td>132°</td>
<td>137°</td>
</tr>
<tr>
<td>Internal/External Rotation</td>
<td>216°</td>
<td>163°</td>
<td>172°</td>
<td>180°</td>
</tr>
</tbody>
</table>

Thanks to the Dual Mobility concept, the Versafitcup® has a Head/Neck ratio close to 3.25 for the smallest size growing up to 4.80 for the biggest size: that explains the increased Range of Motion of the Versafitcup® Double Mobility.

**Versafitcup® offers a preoperative or intraoperative choice between a double mobility liner or a fixed liner.**

- The fixed liner is mechanically locked to the cup intraoperatively.
- Locking is ensured by a double clipping system, secured by a patented retaining groove.
- The UHMWPE thickness of the liner is always greater than 5mm, even for the smaller sizes.

The double mobility liner is also available in combination with a cemented cup: the Versacem.

Versacem is an elliptic cemented cup made of stainless steel, with grooves for an optimal cement distribution.

It is suitable for specific cases, where the dislocation prevention is crucial, but it is not possible to implant a cementless cup or a UHMWPE cemented cup.

**Versafitcup® Instrumentation**

The Versafitcup® instrumentation is composed by a general tray for reaming and a specific instrumentation for double mobility.

**Versacem Instrumentation**

The Versacem shares the same instrumentation of the Versafitcup®, adding a special holding handle to position the shell during cementation.

**Fixed Liner**

- The fixed liner is mechanically locked to the cup.
- Its design allows for an easy removal of the cement during the revision procedure.
- The liner is fixed with a retaining groove.