Canted liners in modular dual mobility (mDM) implants: a review of current evidence

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Canted liners in mDM implants

Canted seating of the liner, or malseating, occurs when the liner is not correctly engaged with the acetabular shell. Malseated liners may have a higher propensity for micromotion and corrosion, leading to:

- **Osteolysis**
- **Wear**

Spontaneous seating may occur with malseated liners.

- **2007**: First reported incidence of malseating in total hip arthroplasty (THA)
  -16.4% with Trident acetabular system (Stryker Orthopedics, Mahwah, NJ)

- **2016**: Malseating in Modular Dual Mobility (MDM, Stryker Orthopaedics, Mahwah, NJ) first reported

- **2020**: Otto Aufranc Award-winning paper reporting occurrence of liner malseating in MDM and demonstrating potential for fretting corrosion

mDM, modular dual mobility; MDM, Modular Dual Mobility (Stryker Orthopaedics, Mahwah, NJ)
All Trademarks acknowledged.
2020 Otto Aufranc Award: Malseating of modular dual mobility liners

An award from the Hip Society given to the research group at the Hospital for Special Surgery, New York, NY, US who sought to answer two questions:

1. What is the incidence of malseating in mDM constructs in a large volume arthroplasty centre?

2. Is malseating of the mDM liner potentially a risk factor for the development of fretting and corrosion at the modular interface?

mDM, modular dual mobility
What is the incidence of malseating in mDM constructs in a large volume arthroplasty centre?¹

- 17 orthopaedic surgeons (4 high-volume, 13 low-volume)
- Retrospective review of primary THA performed between January 2016 and December 2018 with Trident MDM implants (Stryker Orthopaedics, Mahwah, NJ)
- Radiograph analysis (minimum 6 weeks post-operative)

>1/20 MDM liners were malseated at 6 weeks post-operatively in primary THA

**Incidence of malseated liners in MDM implants**

MDM implants (n=551)

Malseated liners (n=32)

5.8%

Low-volume surgeons

15.9%

(11 of 69)

High-volume surgeons

4.4%

(21 of 482)

Significantly higher incidence of malseating in low-volume surgeons vs high-volume surgeons (p<0.001)

mDM, modular dual mobility; MDM, Modular Dual Mobility (Stryker Orthopaedics, Mahwah, NJ)
Is malseating of the mDM liner potentially a risk factor for fretting and corrosion at the modular interface?¹

Corrosion chamber testing of 6 MDM liners (Stryker Orthopedics, Mahwah, NJ):
- Malseated liners (n=3)
- Well-seated liners (n=3)

Results
Fretting current was significantly lower for well-seated liners at peak compressive loads (p=0.044) compared to canted liners.
Onset of fretting occurred at a lower load in malseated liners:
- Malseated liners – 2,400N
- Well-seated liners – 2,800N

Authors concluded
“These results support the hypothesis that malseated liners may be at risk for fretting corrosion.”

The fretting onset load (2,400N) in the malseated couple was:

- Near to physiological loads measured for a 75kg adult ascending stairs (2,232N)
- Lower than loads observed in a 100kg adult during stance (3,340N)

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“[The 2020 Otto Aufranc Award paper by Romero et al.] will generate discussion, debate, and most importantly further research and development to optimize dual mobility bearings and help our patients in future.”

FS Haddad, Bone Joint J Editorial, June 2020
Occurrence of malseating in mDM systems

Systematic literature review and meta-analysis performed to determine the incidence of liner malseating in mDM systems.

12 studies included

- MDM/Trident (Stryker)
  - 3 studies included
  - 856 hips

- G7 (Biomet)
  - 1 study included
  - 46 hips

Excluded:
- Duplicates (5)
- Commentary/editorial/letter (2)
- In vitro (1)

Incidence of malseating (95% CI) associated with mDM implants

<table>
<thead>
<tr>
<th>Group</th>
<th>Incidence (%)</th>
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<tbody>
<tr>
<td>All (n=902)</td>
<td>2</td>
</tr>
<tr>
<td>Trident/MDM (n=856)</td>
<td>3</td>
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<tr>
<td>G7 (n=47)</td>
<td>0</td>
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</tbody>
</table>

mDM, modular dual mobility; MDM, Modular Dual Mobility (Stryker Orthopaedics, Mahwah, NJ)

*Search performed by S+N on September 17, 2020; search term: (malseat* OR canted) AND ((modular AND dual AND mobility) OR (MDM))
Can OR3O features help to mitigate the risk of malseating?

The alignment peg of the OR3O liner is designed to prevent off-axis liner insertion.

An 18° taper is easier to insert into a multi-bearing acetabular cup than a taper with a more acute angle, and is associated with less malseating. The 18° locking taper of the OR3O liners utilizes the same locking mechanism as the clinically proven R3 Acetabular System.

No adverse events reported (including malseating, dislocation or re-admission) in early clinical data with OR3O in primary and revision THA.
Summary

- Malseated liners may have a higher propensity for micromotion and corrosion leading to increased wear and osteolysis\textsuperscript{1,2}

- 2020 Otto Aufranc Award paper demonstrated an incidence of malseating in mDM implants of 5.8% in a high-volume arthroplasty centre, with \textit{in vitro} results showing that malseated liners may be at risk of fretting corrosion\textsuperscript{1}

- A systematic literature review and meta-analysis found an incidence of 2% of liner malseating in mDM THA systems\textsuperscript{8}

- Clinical consequences of malseating are unknown and further research is warranted\textsuperscript{1,7}

- With its 18° taper and alignment peg, OR3O has unique design features aimed at mitigating the risk of malseating\textsuperscript{9–11}

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References


# Appendix: systematic literature review and meta-analysis studies

<table>
<thead>
<tr>
<th>Reference</th>
<th>Publication Type</th>
<th>Study Type</th>
<th>Implant</th>
<th>Number of THAs</th>
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<tbody>
<tr>
<td>G7 (Biomet)</td>
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