Early migration pattern of Vanguard® CR tibial component evaluated by two different radiostereometric analysis systems

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Introduction

Two RSA systems, UmRSA and RSAcoreModel-based RSA (MB-RSA), are widely used to evaluate early migration of artificial joint implants. We previously reported the precision and the interclass correlation coefficient of these two different RSA systems for the evaluation of femoral stem migration of total hip arthroplasty.

We report on the 1 year micromotion of tibial implants of total knee arthroplasty (Vanguard CR, Biomet) using the two RSA system and compare the results.

Patients and methods

- 21 total knee replacements with cemented Vanguard CR.
- Marker placement: In the polyethylene and in the tibial bone.
- Cage: Umea43 (Um RSA biomedical).
- Exclusion criteria: Condition number ≥ 150, Mean Error ≥ 0.35,
- Difference between model and contour ≥ 0.1.
- Calculation: Micromotion between double examinations (zero motion), at 3 months and at 1 year.

Results

1: Quality of the examinations

<table>
<thead>
<tr>
<th>Number of examinations</th>
<th>Total</th>
<th>Not available*</th>
<th>Used markers, CN and ME</th>
<th>Marker number</th>
<th>CN</th>
<th>ME</th>
</tr>
</thead>
<tbody>
<tr>
<td>UmRSA 233</td>
<td>53 (22.7%)</td>
<td></td>
<td>UmRSA Poly</td>
<td>4.7</td>
<td>60.1</td>
<td>0.0053</td>
</tr>
<tr>
<td>MB-RSA (poly) 235</td>
<td>45 (19.3%)</td>
<td></td>
<td>Tibia</td>
<td>7.1</td>
<td>44.3</td>
<td>0.1902</td>
</tr>
<tr>
<td>MB-RSA (model) 235</td>
<td>37 (15.9%)</td>
<td></td>
<td>MB-RSA Poly</td>
<td>4.5</td>
<td>21.3</td>
<td>0.0083</td>
</tr>
</tbody>
</table>

* Excluded or not possible to calculate.

2: Calculation of zero-motion (precision)

<table>
<thead>
<tr>
<th>Used markers, CN and ME</th>
<th>Rot X</th>
<th>Rot Y</th>
<th>Rot Z</th>
<th>Trl X</th>
<th>Trl Y</th>
<th>Trl Z</th>
<th>N =</th>
</tr>
</thead>
<tbody>
<tr>
<td>UmRSA poly vs. bone 5D</td>
<td>0.0080</td>
<td>0.0065</td>
<td>0.0025</td>
<td>0.0239</td>
<td>0.0031</td>
<td>0.0097</td>
<td>53</td>
</tr>
<tr>
<td>MB-RSA poly vs. bone 5D</td>
<td>0.1990</td>
<td>0.1020</td>
<td>0.0851</td>
<td>0.0821</td>
<td>0.0393</td>
<td>0.0947</td>
<td>53</td>
</tr>
<tr>
<td>MB-RSA model vs. bone 5D</td>
<td>0.4938</td>
<td>0.2091</td>
<td>0.1913</td>
<td>0.1875</td>
<td>0.0688</td>
<td>0.2029</td>
<td>53</td>
</tr>
</tbody>
</table>

3: Time change

4: Correlation at 12 months

Discussion

- With uninplan cage, many markers were not identified in some patients.
- Condition numbers were calculated higher in UmRSA than MB-RSA, resulting in a higher exclusion rate of examinations in UmRSA.
- In MB-RSA, poly segments and models showed good correlation.
- Poly segments in UmRSA and MB-RSA showed moderate correlation.
- The difference between UmRSA and MB-RSA might be because of the impaired identification of poly markers with a uniplanar cage.

Conclusion

- Tibial component of Vanguard CR were generally stable up to 1 year.
- All the 4 modes of RSA had sufficient precision for Z rotation, y translation and x rotation.

Polyethylene marker placement

At least 8 markers were placed in each polyethylene.
2 at the anterior, 2 at the posterior, 2 at the medial and 2 at the lateral part of the poly.