WHY CUSTOM TOTAL HIP REPLACEMENT?

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... is one of the most successful and efficient treatments.

TOTAL HIP REPLACEMENT

BUT ...

Discrepancy between expectancy and result!

Swedish National Hip Arthroplasty Register 2014.
TRY AND AVOID

Bad publicity or …
1. Wear
2. Aseptic loosening
3. Dislocation
4. Leg length discrepancy
5. Chronic pain
6. …
WHY PLANIFY?

Femoral morphology is very variable
- from one patient to the other
- depending on age

= BIOMECHANICS

CEMENTED STEM

Position of stem = center of rotation

Adjusted in cement mantle

Small size

Big size

Antetorsion

= “poorman’s custom”  BG Weber
Metaphyseal filling (fit-and-fill) of stem determines the position of center of rotation.

Depends on femoral morphology

Small size

Big size

Schizas CG et al. 1996.
2-D ANATOMY

CANAL FLARE INDEX


Intramedullary

ML Flare Index = \( \frac{A_{ML}}{B_{ML}} \)

- **Stovepipe**
  - Canal Shape
  - ML Flare Index < 3
  - Incidence: 11%

- **Normal**
  - Canal Shape
  - ML Flare Index > 3 & < 4.7

- **Champagne-Fluted**
  - Canal Shape
  - ML Flare Index
  - Incidence: 8%
Medial and anterior canal flare indices


<table>
<thead>
<tr>
<th>Sagittal Frontal</th>
<th>Stovepipe &lt; 2</th>
<th>Normal 2.0 – 3.0</th>
<th>Champagne flute &gt; 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stovepipe &lt; 3</td>
<td>17.5 %</td>
<td>8.5 %</td>
<td>0 %</td>
</tr>
<tr>
<td>Normal 3.0 – 4.5</td>
<td>19 %</td>
<td><strong>30 %</strong></td>
<td>8 %</td>
</tr>
<tr>
<td>Champagne flute &gt; 4.5</td>
<td>4 %</td>
<td>7 %</td>
<td>6 %</td>
</tr>
</tbody>
</table>
Angle between axis of femoral neck and posterior bicondylar plane (knee).

Values in adults (CT)  
1° OA  $24.7° \pm 8.7°$  
(- $20°$ to $50°$)  
Dysplasia  $28° \pm 17°$  
(- $26°$ to $86°$)

ANTETORSION

Robertson, CORR 1996  
Sugano, JBJS-Br 1998  
Argenson, JBJS-Br 2005  
Husmann, J Arthroplasty 1997  
Baumann, CORR 1994
Femoral torsion = HELITORSION

<table>
<thead>
<tr>
<th>Neck</th>
<th>Head</th>
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</thead>
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<tr>
<td>9°</td>
<td>1°</td>
</tr>
<tr>
<td>7°</td>
<td>10°</td>
</tr>
<tr>
<td>18°</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>10</td>
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<tr>
<td>32°</td>
<td></td>
</tr>
<tr>
<td>-10</td>
<td></td>
</tr>
<tr>
<td>-20</td>
<td></td>
</tr>
</tbody>
</table>

Husmann, J Arthroplasty 1997
Wettstein, NP
1° osteoarthritis

Highly individual progression of torsion with large variations.

Similar values in
- R. polyarthritis
- SCFE
- Osteonecrosis

Wettstein M et al. Helitorsion: CT-scan study. NP.
HELITORSION

Same pattern of individual variations, but …

significantly higher HT with DDH or CDH.

Wettstein M et al. Helitorsion: CT-scan study. NP.
A single metaphyseal axis does not exist.

The proximal femur is a cylinder with progressive torsion changing from one patient to the other!

Wettstein M et al. Helitorsion: CT-scan study. NP.
Discrepancy ± 5° between HT and ideal AT 15°

- **Primary OA**: 56% (45%) ≤ 5°, 44% (>5°)
- **Rpolyarthritis**: 50% (45%) ≤ 5°, 50% (>5°)
- **Dysplasia**: 80% (5%) ≤ 5°, 20% (>5°)
- **Necrosis**: 55% (45%) ≤ 5°, 55% (>5°)
- **Epiphysiolsysis**: 50% (45%) ≤ 5°, 50% (>5°)
- **CDH**: 95% (5%) ≤ 5°, 5% (>5°)

Wettstein M et al. Helitorsion: CT-scan study. NP.
WHICH STEM IS THE BEST?
In case of discrepancy between HT and AT:
It is possible to use a standard rectangular or anatomic stem …

… but if you adapt the stem size to the canal shape you compromise the stability and have in-toeing gait.
In case of discrepancy between HT and AT:
It is possible to use a standard rectangular stem …

… but if you undersize the stem to correct AT, you compromise the fixation of the implant (edge loading).

In case of discrepancy between HT and AT:
It is possible to use a modular stem …

… but the degree of correction is limited.
CUSTOM FEMORAL STEM

The only way of making no compromise with:

- a perfect intramedullary fitting
- a perfect orientation of the femoral neck
INDICATIONS CUSTOM STEM

Distorsion of anatomy (trauma, osteotomy, …)

Dysplasia!

Young and active patient

Any patient you can not reconstruct perfectly in 3D with a standard stem
**RESULTS**

<table>
<thead>
<tr>
<th>Type of fixation</th>
<th>Author</th>
<th>Number of patients</th>
<th>Number of hips</th>
<th>Mean follow-up (years)</th>
<th>Mean age and range (years)</th>
<th>Mean Harris Hip Score and range (points)</th>
<th>Thigh pain (%)</th>
<th>Dislocation (%)</th>
<th>Aseptic Femoral Loosening (%)</th>
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<tr>
<td>Cemented</td>
<td>Harris</td>
<td>- 65</td>
<td>6.6</td>
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<td></td>
<td>Malchau</td>
<td>- 2588</td>
<td>9</td>
<td>55</td>
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<td></td>
<td>Smith</td>
<td>40 47 18</td>
<td>50</td>
<td>87 (54-100)</td>
<td>- 8.5</td>
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<td>Cementless</td>
<td>Bourne</td>
<td>94 101</td>
<td>5</td>
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<td>Capello</td>
<td>133 152</td>
<td>6.4</td>
<td>39 (16-49)</td>
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<tr>
<td></td>
<td>Heckin</td>
<td>91 100</td>
<td>6</td>
<td>58 (22-81)</td>
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<td></td>
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<td>Schramm</td>
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<td>51 (20-77)</td>
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<td>Zeng</td>
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<td>Resurfacing</td>
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<td>Bert</td>
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<td>OUR SERIES</td>
<td>Wettstein et al.</td>
<td>57 62</td>
<td>7.9</td>
<td>57 (35-64)</td>
<td>99 (84-100)</td>
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</tbody>
</table>

Excellent survival, decreased dislocation, excellent function.

Argenson et al. CORR, 1999.
Wettstein et al. CORR, 2005.
Flecher et al. RCO, 2006.
Anatomy of the proximal femur is very variable!

You can not match every anatomy with one stem design.

Custom stems are « the Top »: perfect adaptation and reconstruction of individual anatomy.
CONCLUSION

Anatomy and THR are not 2D,

so plan in 3D to find the best stem for your patient!
THANK YOU!

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