“Material Problems” on the stem side

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Material Problems

Registry

Table HT15 Primary Total Conventional Hip Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Loosening	2975	25.6
Prosthesis Dislocation	2506	21.6
Fracture	2265	19.5
Infection	2055	17.7
Lysis	266	2.3
Pain	219	1.9
Leg Length Discrepancy	169	1.5
Malposition	154	1.3
Instability	125	1.1
Implant Breakage Stem	119	1.0
Metal Related Pathology	118	1.0
Implant Breakage Acetabular Insert	102	0.9
Wear Acetabular Insert	98	0.8
Incorrect Sizing	90	0.8
Implant Breakage Acetabular	76	0.7
Implant Breakage Head	39	0.3
Other	234	2.0
TOTAL	11610	100.0

Note: All procedures using metal/metal prostheses with head size larger than 32mm have been excluded

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Direct material related

“Mechanical” situations facilitating failure

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“Mechanical” situations facilitating failure

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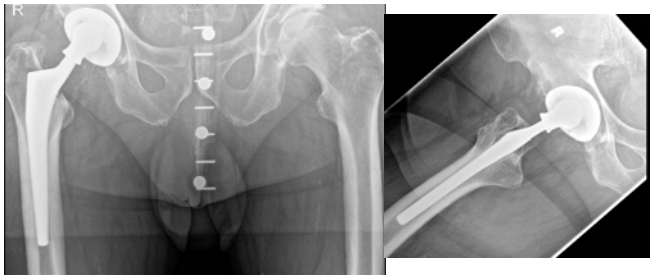
Mechanics

- „Stable stem disease“
- Lever arm

Case 1

Georgi Wassilew, Charite, Berlin

Primary THA: 2006
Pre cup exchange: 2016



Case 1

Georgi Wassilew, Charite, Berlin

Primary THA: 2006
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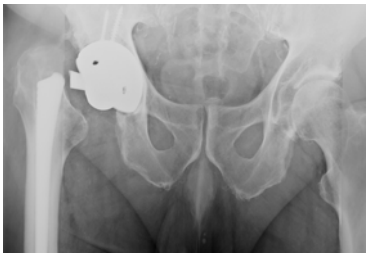
Stem fracture: 2017



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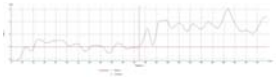
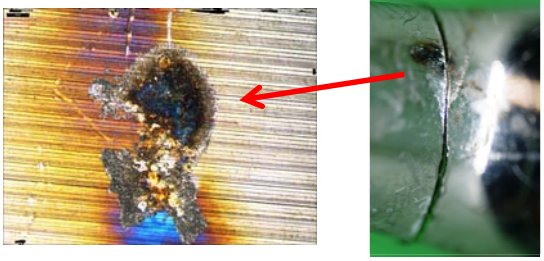




Case 1

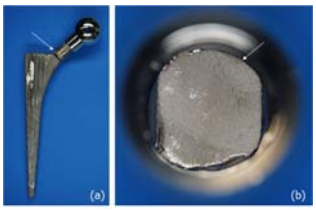
- **High bending load for 10 years (3×XL head)**
- **Weakening of highly loaded area during revision (scratches, spark transition from electro knife)**
- **Notch sensitivity of Ti-Alloys**

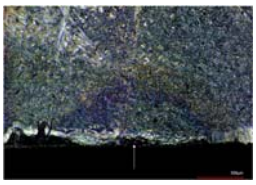
Case 2

Primary 08.10.2006
+8mm head

Case 2

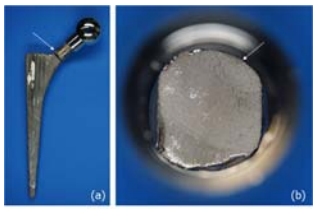
Fracture 15.05.2014

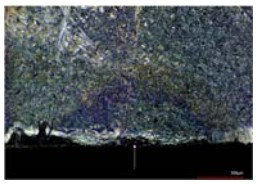




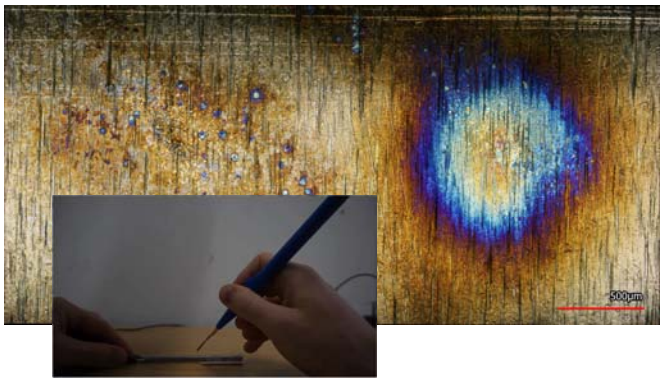
Case 2

….. the combination of a CLS stem and a DePuy head with a neck length of **more than 8 mm** is an unauthorized combination, which is not released by Zimmer (see www.product-compatibility.zimmer.com)...
...





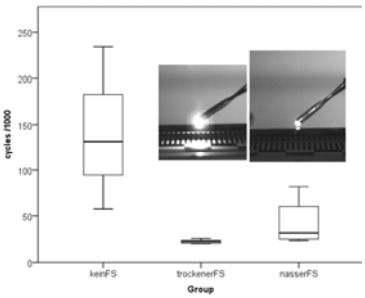
Sparc Transition



Sparc Transition

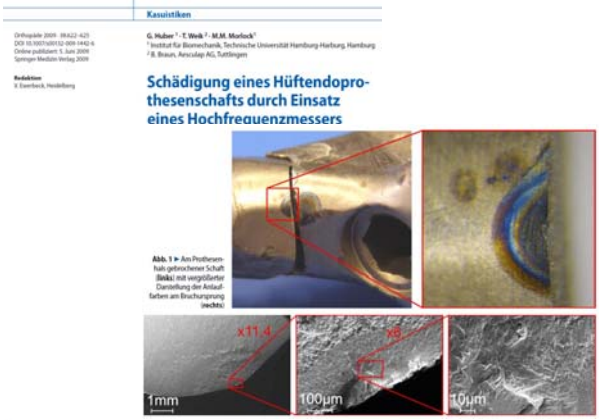
Fatigue testing in cyclic 4 point-bending

- Cyclic bending
- f = 10 Hz
- Maximum bending stress S_B = 1640 MPa
  - FEMA $S_{JoggingHigh100}$ = 694 MPa
  - FEMA $S_{Stumble}$ = 2277 Mpa



Failure for unmodified rods (left), dry contact (middle) and wet contact (right; cyles *1000)

Case 3



Kasuistiken

Schädigung eines Hüftendoprothesenschafts durch Einsatz eines Hochfrequenzmessers

All cases

The Journal of Arthroplasty 32 (2017) 3533–3538

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Basic Science

Electrosurgery Induced Damage to Ti-6Al-4V and CoCrMo Alloy Surfaces in Orthopedic Implants In Vivo and In Vitro

Gregory W. Kubacki, BS [a,b,c], Shiril Sivan, PhD [a,b], Jeremy L. Gilbert, PhD [a,b,c,*]

[a] Department of Biomedical and Chemical Engineering, Syracuse University, Syracuse, New York
[b] Syracuse Biomaterials Institute, Syracuse University, Syracuse, New York
[c] Department of Bioengineering, Clemson University, Charleston, South Carolina

Stable stem "disease"

- Don't touch the stem with an electro knife during revision surgery if you want to keep it
- If you try to take the stem out - you have to finish it…

Stable stem „disease": Mismatch - major

76 y female
16 years in situ
small ø MoM

JBJS Case Connect 2014;4:e25

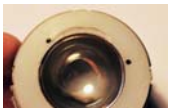
Stable stem „disease": Mismatch - major

76 y female
16 years in situ
small ø MoM
little biological reactions,little Co, Cr wear

Missmatch
14/16 head
with a
12/14 stem taper

Koper M,
JBJS Case Connect 2014;4:e25

Stable stem „disease": Mismatch - major



76 y female
16 years in situ
small ø MoM
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reaction
Co, C
ad
a
2/14 stem taper

Bottoming out due to taper missmatch

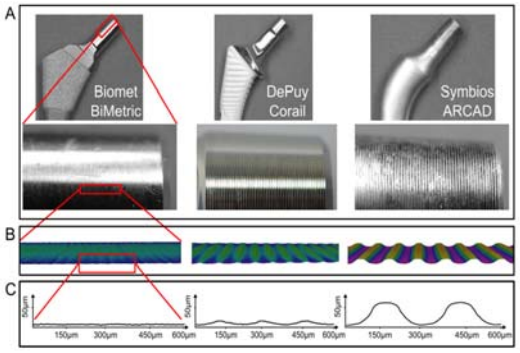
Koper M,
JBJS Case Connect 2014;4:e25

Bottoming out

Courtesy Steve Young

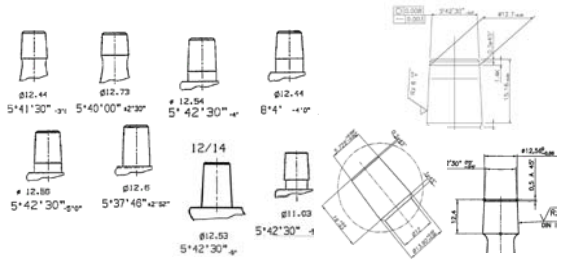
Bottoming out due to taper missmatch

Mismatch - minor



Mismatch - minor

- Prevent major mismatch
- Prevent „minor“ mismatch



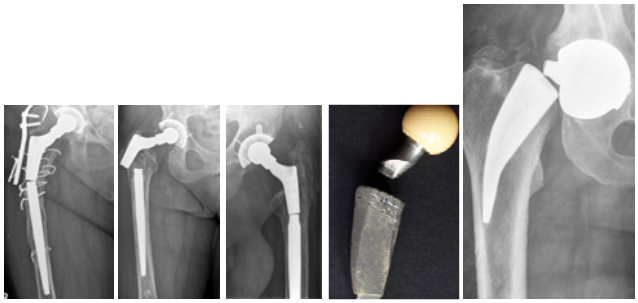
Mismatch - minor

Mechanics

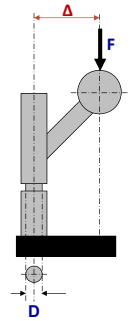
Bending load is dangerous

- Increased by
  - Offset (stem and head)

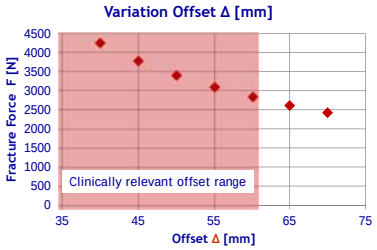
Offset



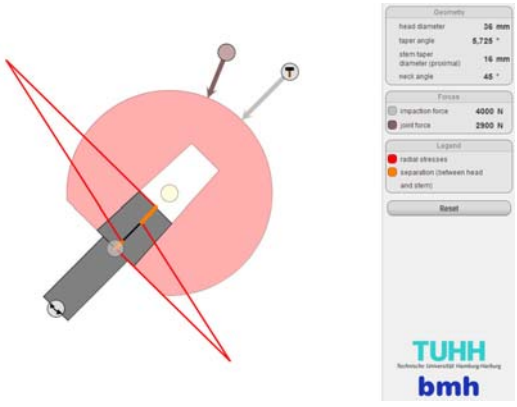
Offset



Assumptions:
- taper-diameter: $D = 12mm$
- Ti6Al4V- tensile strength: $\sigma_{max} = 1000N/mm^2$



Head length



Case 4

Index Surgery 11/2005 head +8.5mm
Cup exchange 03/2014 BioBall 4XL, 32mm
Neck fracture w/o trauma 11/2018

Mechanics

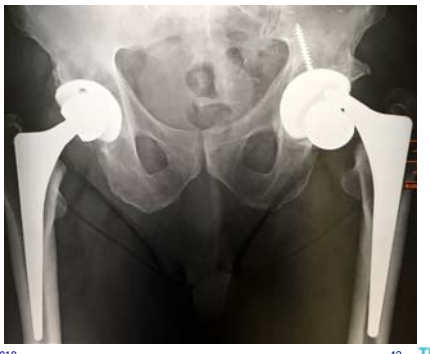
Bending load is dangerous

- Increased by
  - Offset (stem and head)
  - Load (weight and activity)

Case 5

2005/09: uncemented THA (Trilogy 58mm, additional screws; CLS stem, head 36mm Ø, +3.5mm, 12/14 taper)

2019/01:



Case 5

2005/09: uncemented THA (Trilogy 58mm, additional screws; CLS stem, head 36mm Ø, +3.5mm, 12/14 taper)

2019/01:

Case 5

2005/09: uncemented THA (Trilogy 58mm, additional screws; CLS stem, head 36mm Ø, +3.5mm, 12/14 taper)

2019/01:

Material loss
Head: 403mm³

Material loss
■ Taper: 1089mm³ (53%)
■ Neck: 288mm³

Mechanics

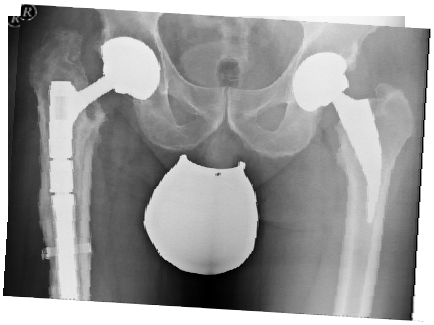
Bending load is dangerous

- Increased by
  - Offset (stem and head)
  - Load (weight and activity)
  - Location of weak spot

Case 6

bmh

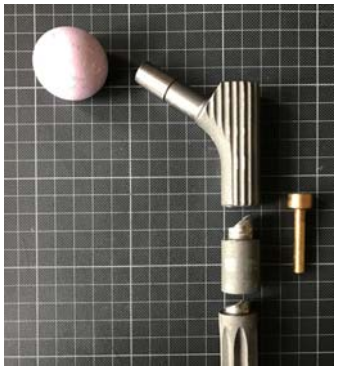
Bruno Schweigert, Gengenbach



Case 6

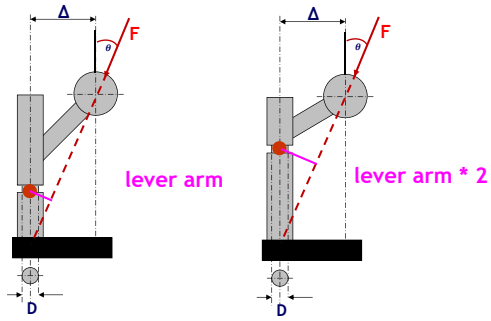
bmh

- Doubble fracture
- Biolox Ø36mm 12/14 XL (+8)
- only+5 approved



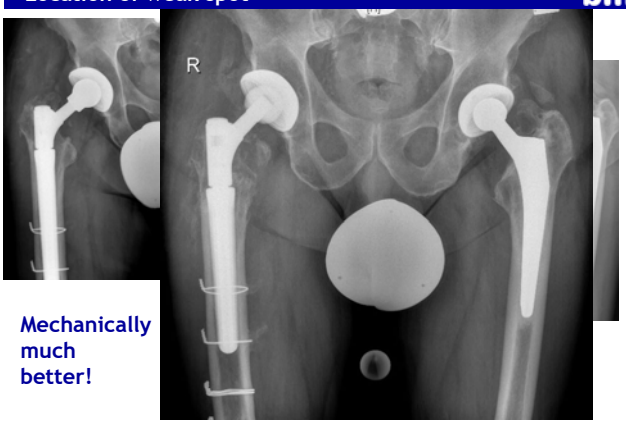
Location of weak spot

bmh



Location of weak spot

bmh



Mechanically much better!

Discussion

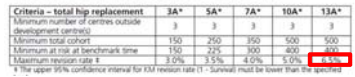
bmh

He crashed twice...

Take Home

bmh

- „Material“ problems in THA have been nearly eliminated



The A* rating
These criteria are summarised for the A* rating in the following tables:

Criteria – total hip replacement	3A*	5A*	7A*	10A*	13A*
Minimum number of centres outside development centre(s)	3	3	3	3	3
Minimum total cohort	150	250	350	500	500
Minimum at risk at benchmark time	150	225	300	400	500
Maximum revision rate ‡	3.0%	3.5%	4.0%	5.0%	5.5%

‡ The upper 95% confidence interval for KM revision rate (1 - Survival) must be lower than the specified

23.04.2019

13A* in THA:
- 15 stems
- 24 cups

Take Home

bmh

- „Material“ problems in THA have been nearly eliminated (registries “control“).
- Today: „Process“ & „System“ problems
- High bending loads in successfull THAs can become critical, especially if implant strength is jeopardized (scratches, notches, sparc transition)
- Critical factor during cup revision (wear of old PEs)
- Watch head length (primary and revision)

Read IfUs….

Thank you for your attention!

bmh

Hamburg Old and New Harbour City 2019