



**JISRF Joint Implant Surgery  
& Research Foundation**

*Dedicated to the Advancement of Total Joint Arthroplasty • Since 1971*

## **Taper Issues in Total Hip Arthroplasty (THA)**

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**JISRF**

# Disclosures

## Timothy McTighe, \*Declan Brazil

- Held Shares in CDD, LLC, Omnilife Science, J&J, Zimmer**
- Received Royalties from: CDD, LLC, Omnilife Science, GOT**
- Done consulting work for: Omnilife Science**
- Received institutional support from 1971: +30 companies.**
- Equity Position: \*Signature Orthopaedics**

# Tapers Junctions in THA Devices

## Demand for Tapers (Modularity)



SIR JOHN CHARNLEY  
(1911-1982)

## Type I - Head / Neck Modularity

# Tapers Junctions in THA Devices

## Demand for Tapers (Modularity)



**Type II - Stem / Neck Modularity**

# Type I Modularity (Tapers)

## Market Trends

- Impingement
- Ceramic heads
- Large heads



## Design Changes

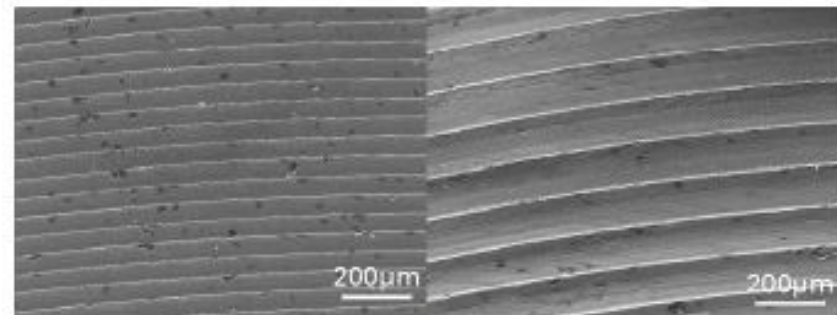
- Altered Neck
- Altered Taper

# Altered Taper

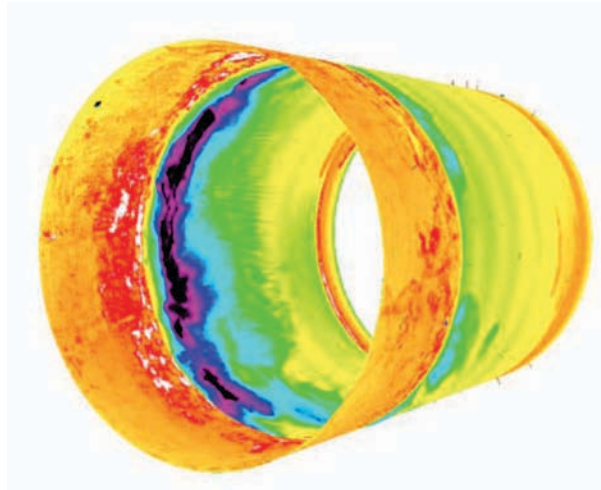
Reduced Taper Length



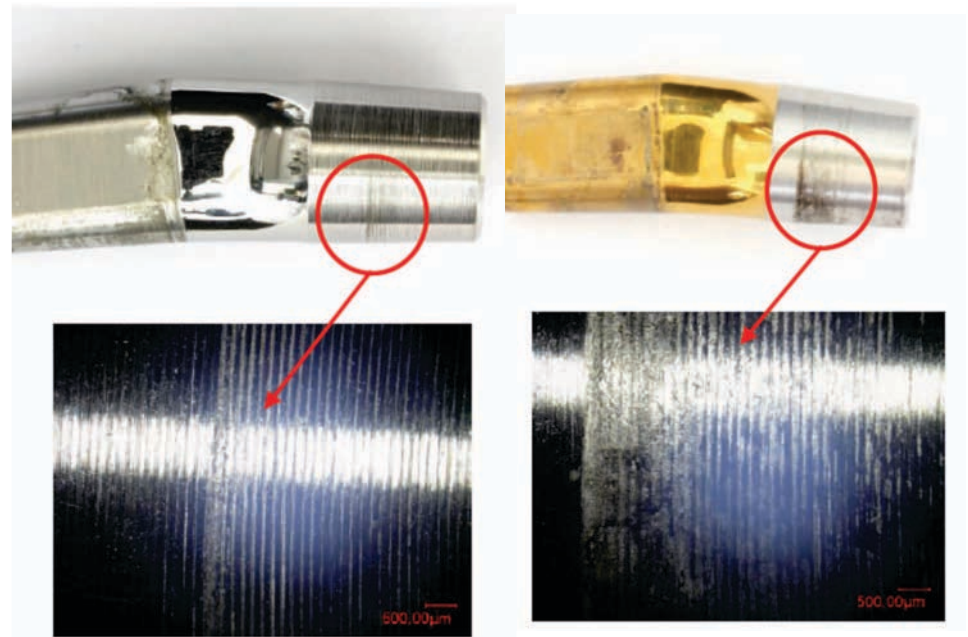
Altered Surface finish



# Altered Taper



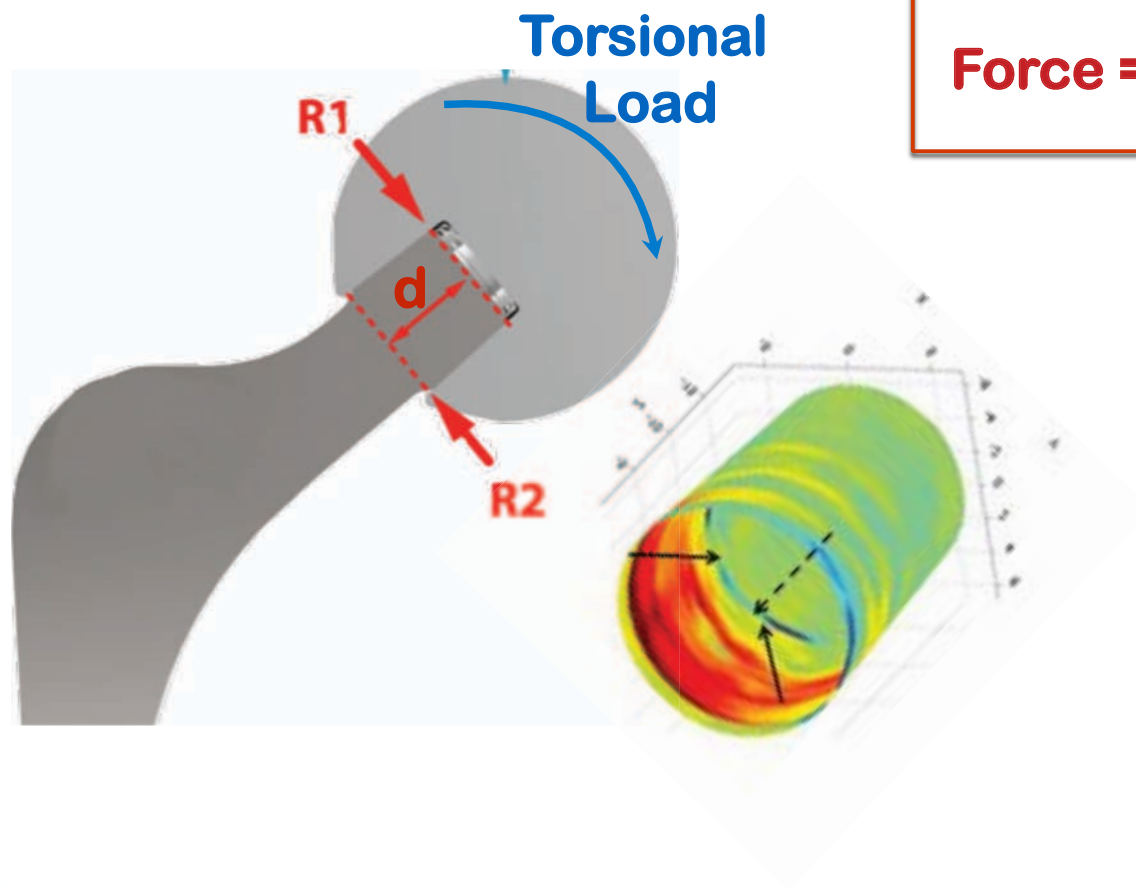
**Retrieval Analysis**



**In-vitro Analysis**

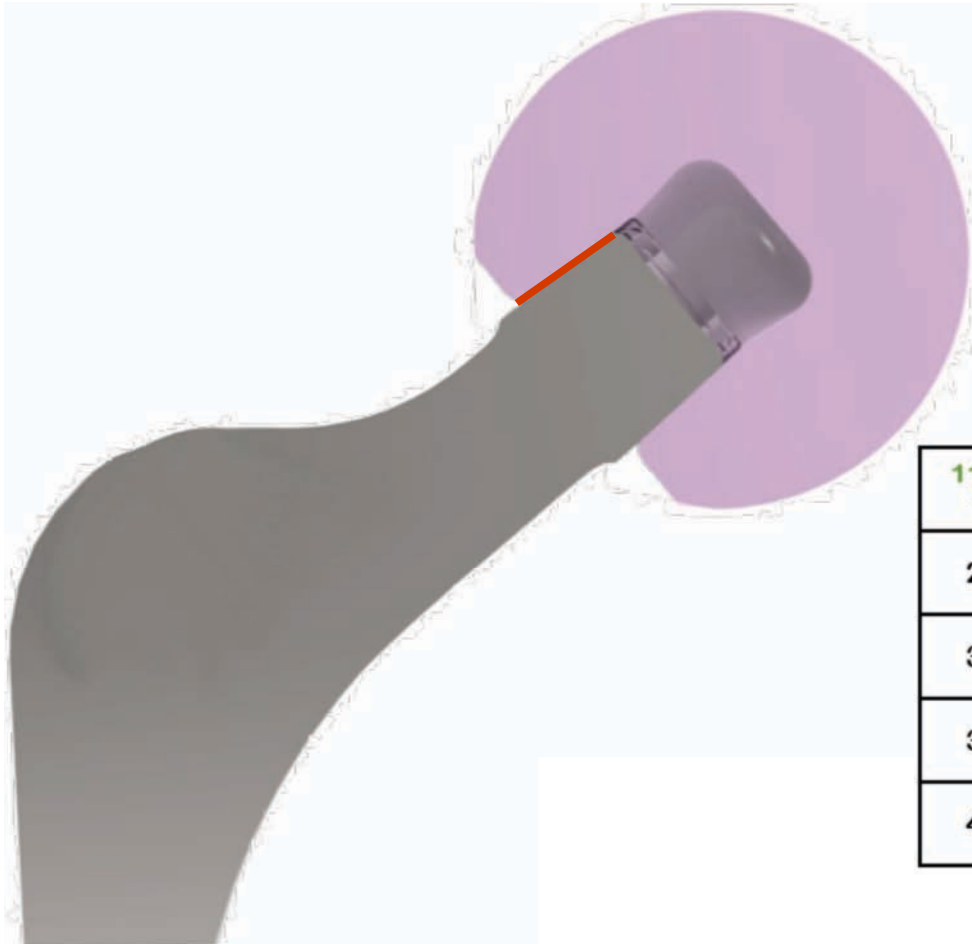
10 million cycles - 5.3kN

# Altered Taper



$$\text{Force} = \frac{\text{Torsional Load}}{\text{Distance (d)}}$$

# Increasing the Demand on Tapers

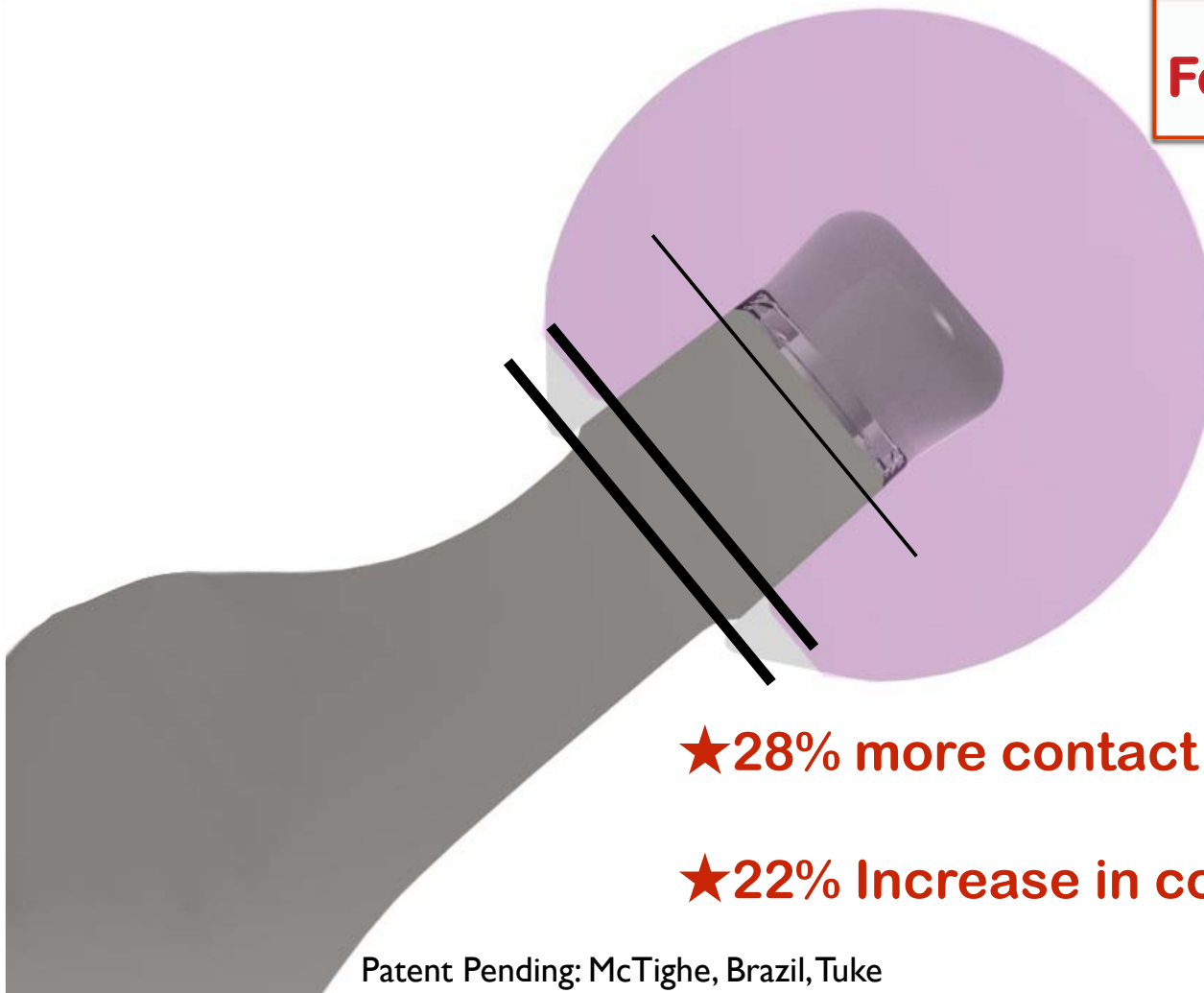


- ★ Large Head Diameter
- ★ High offsets
- ★ Increased Torsional loads
- ★ Reduced Taper contact (d)

11mm of 12/14	Contact length - Offset (S)	Contact length - Offset (M)	Contact length - Offset (L)	Contact length - Offset (XL)
28mm	10.5mm	10.5mm	10.3mm	
32mm	10.5mm	10.5mm	10.5mm	8.8mm
36mm	10.5mm	10.5mm	10.5mm	9.2mm
40mm	10.5mm	10.5mm	10.5mm	9mm

# Advanced Taper Solution

$$\text{Force} = \frac{\text{Torsional Load}}{\text{Distance (d)}}$$



★28% more contact area (36mm XL)

★22% Increase in contact force

Patent Pending: McTighe, Brazil, Tuke

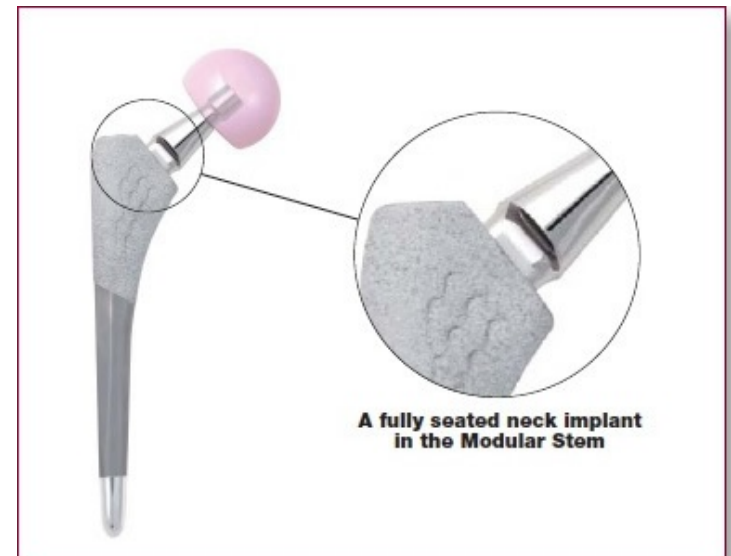
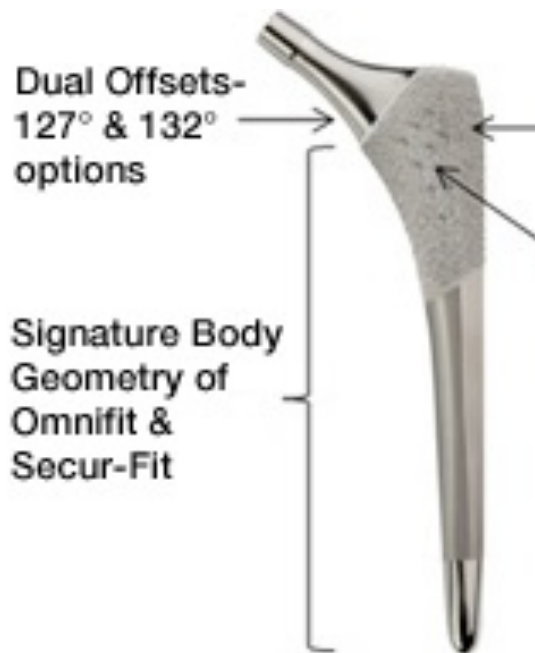
# Downside of Advanced Taper



	11mm 12/14 Taper	12.9mm 12/14 Taper	Loss
Flexion/Extension	199	192	7
Abduction/Adduction	133	130	3
Internal/External	210	205	5

# Tapers Junctions in THA Devices

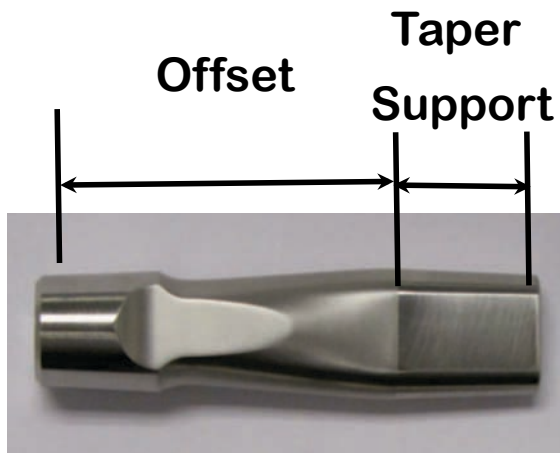
## Demand for Tapers (Modularity)



Market went from “Taper Mad” to “**Taper Bad**”

# Not all Tapers are created Equally

	Taper Support	Offset	% Increase head centre length
TSI	17	27.5	
Wright Medical	15	42	55%
Stryker	13	42	53%



Patent Pending: McTighe, Brazil

# Beyond Compliance

## ISO7206-6 Setup

5340N - 10 million Cycles

Measured Abrasive wear



Fig. 1: Specimen tested – group 1.



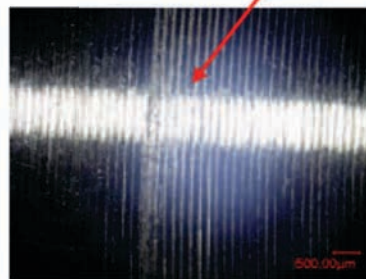
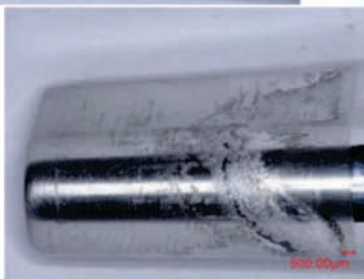
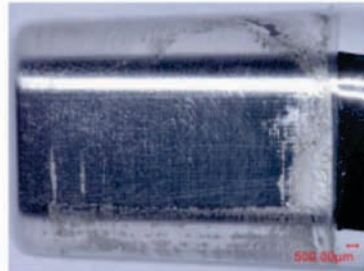
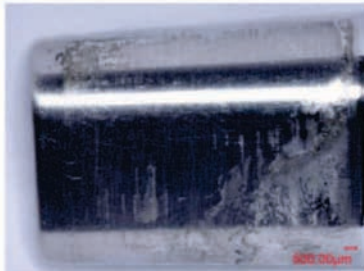
**Test Series 1 - Uncoated**



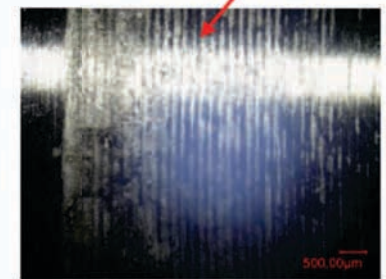
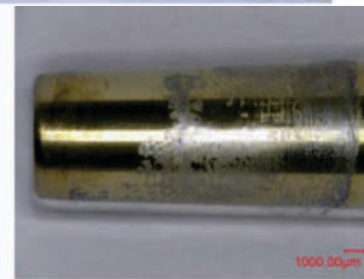
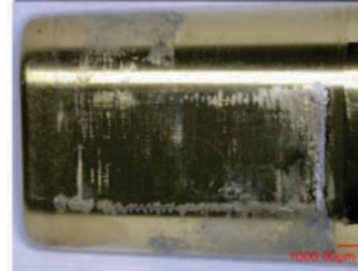
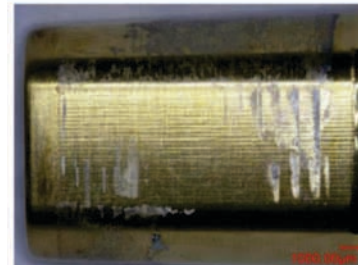
**Test Series 2 - Nitrided Neck**

# Beyond Compliance

Mean 61mg wear



Mean 1.2 mg wear



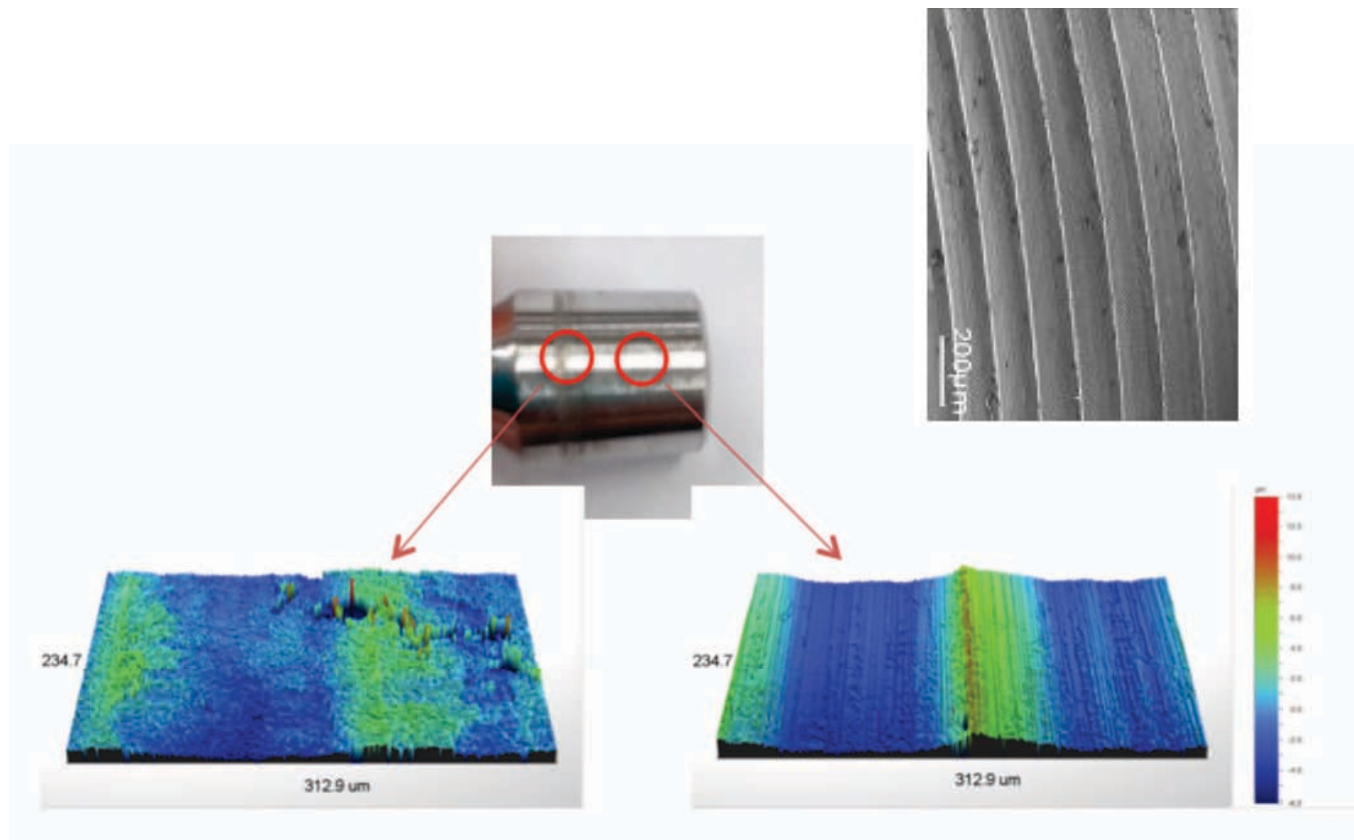
2,825 Implanted 98.6%  
Survivorship

Tab. 12: Mean dynamic current values [ $\mu\text{A}$ ] for test specimen tested – post-fatigue.

Test group	Cycles					
	0	30	360	1000	1800	3600
1	$4.87 \pm 2.07$	$2.14 \pm 1.15$	$1.16 \pm 0.27$	$0.98 \pm 0.05$	$0.90 \pm 0.28$	$0.86 \pm 0.51$
2	$3.55 \pm 4.33$	$1.50 \pm 1.16$	$1.41 \pm 0.73$	$0.61 \pm 0.07$	$0.54 \pm 0.20$	$0.63 \pm 0.20$

ASTM F1875

# Trunnion Wear



# Development Pathway

**Run Complete Nitrided Neck**

**Establish Monoblock Baseline Acceptance Vale**

**Compare Modular to baseline**

**Nitride Inside of Stem taper**

**Incrementally Control Clinical Validation**

# Summary

**Load  
Reduction**

**Load  
Reduction**

**Wear  
Reduction**

**Load  
Reduction**