



Nevada Hip & Knee  
Center Of Excellence  
& Research Institute



# Ceramic-on-Ceramic THA: The Good with the Bad

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## Bearing Surface Choices

### Head

- Metal
- Ceramic
  - Zirconia
  - BioloX Forte
  - BioloX Delta

### Cup

- Polyethylene
  - Standard
  - Highly cross-linked
- Metal
- BioloX Forte
- BioloX Delta



# Ceramic-on-Ceramic (CoC)

## ▪ Early examples

- 1969 – France (Boutin)
- 1974 – CeramTec (Germany)
- 1983-- Mittelmeier (Autophor) –U.S. (Smith & Nephew)

– Failures due to:

- › Lack of fixation
- › Neck impingement

– However, minimal wear



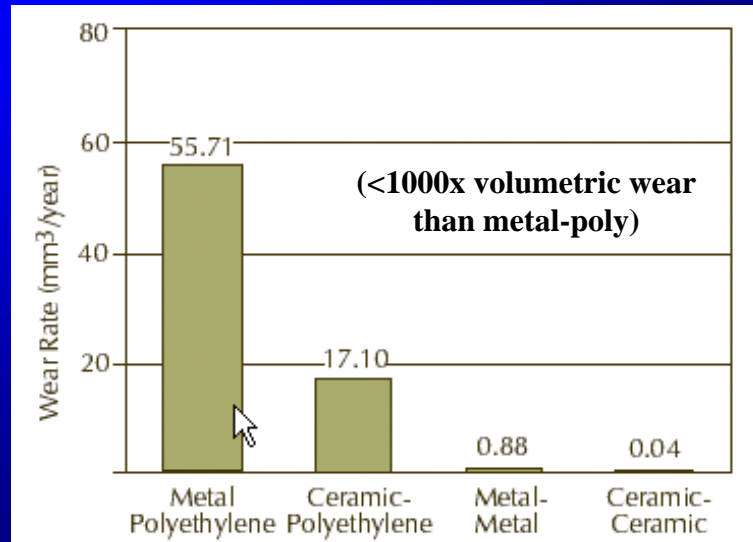
# Ceramic-Ceramic Wear Rates

## ▪ Retrievals have shown very low wear

- >1000x less wear than conventional polyethylene
- Very favorable tribological properties
  - Smooth surface
  - Wettable
  - Hard surface



## Volumetric Wear Rates



## CoC in the USA

- 2 companies received FDA approval

Feb 3, 2003

- Wright Medical
- Stryker Orthopedics



- Encore approval December 1, 2003
- Several other companies followed
- All ceramics produced by CeramTec

# Concerns about Ceramics

- **Ceramic wear**
- **Ceramic Fracture**
- **Inability to re-use trunnion**
- **Lack of head/liner options**
- **Latest concern: Squeaking**

January 9, 2008

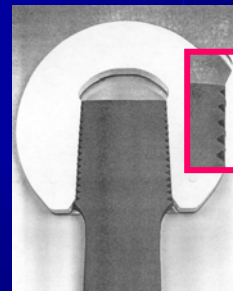
Ceramic-Ceramic

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# Ceramic Fracture: Risk Factors

- **Poor manufacturing techniques with older components**
- **Trauma**
- **Small head diameter**
- **Short necks**
- **Damaged trunnion or cup taper**



January 9, 2008

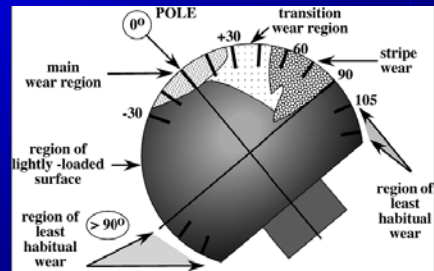
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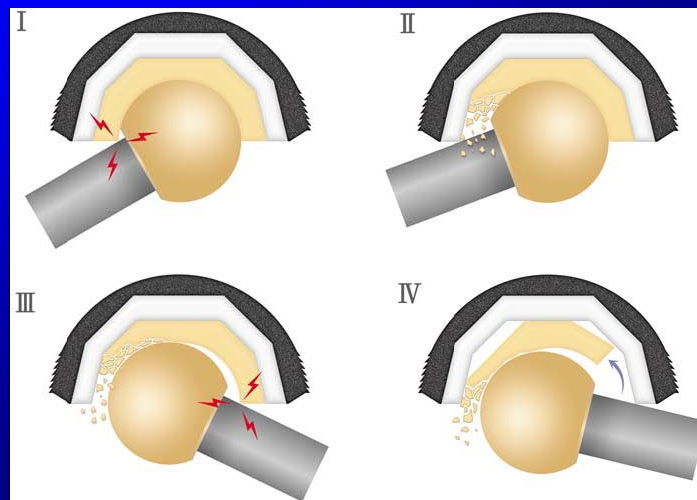
## Ceramic Fracture: Risk Factors

- Cup Malposition (incorrect anteversion or vertical cup)
  - Microseparation/stripe wear

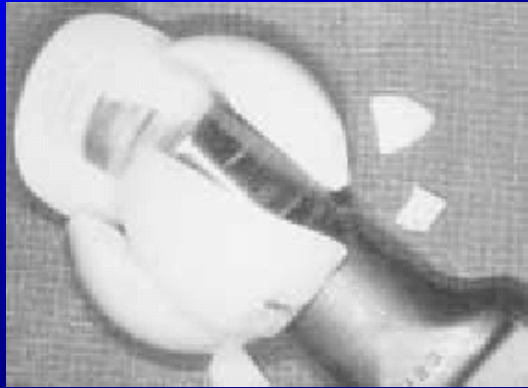


- Sandwich type liner designs

## Sandwich Design Failure Mechanisms (Park, JBJS-A, 2006)



**Risk of fracture:  $\cong 1/10,000$**   
**(11 studies: 2000-2003)**  
**(Tateiwa, Am J Orthop, 2008)**



## **New Problem: Squeaking**

- **Significant squeaking in some ceramic on ceramic THA's became apparent shortly after FDA approval of Stryker and Wright Medical hips in 2003**



## Proposed Causes

- **Impingement**
- **Ligament laxity / microseparation / stripe wear**
- **Inadequate lubrication**
- **Particulate metal debris**
- **New “beta” titanium alloy (TMFZ)**



## 1 Common Denominator

**Almost all studies with large numbers of squeaky ceramic hips are Stryker Trident cups mated with Stryker Accolade Stems**



## Stryker Trident cup

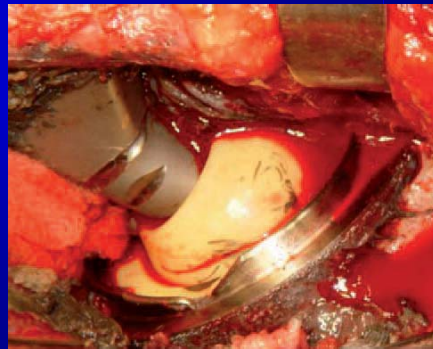
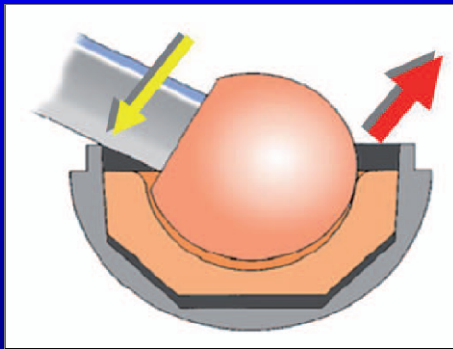


- Ceramic encased in metal shell which extends past ceramic face



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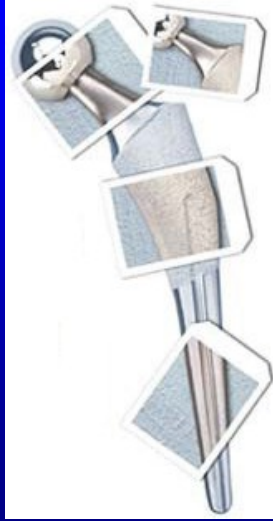
## Overhanging rim increases risk for impingement



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# Stryker Accolade Stem

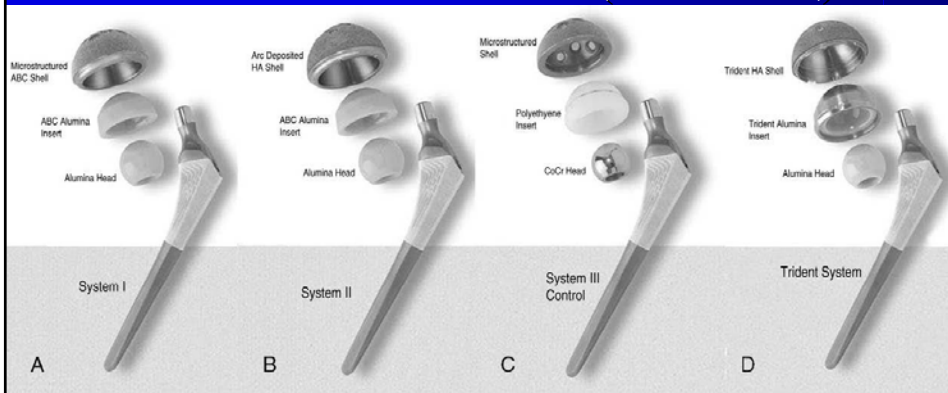


- **TMZF beta titanium allow (25% greater flexibility than Ti-6Al-4V)**
  - Titanium
  - Molybdenum
  - Zirconium
  - Iron
- **HA Coated**

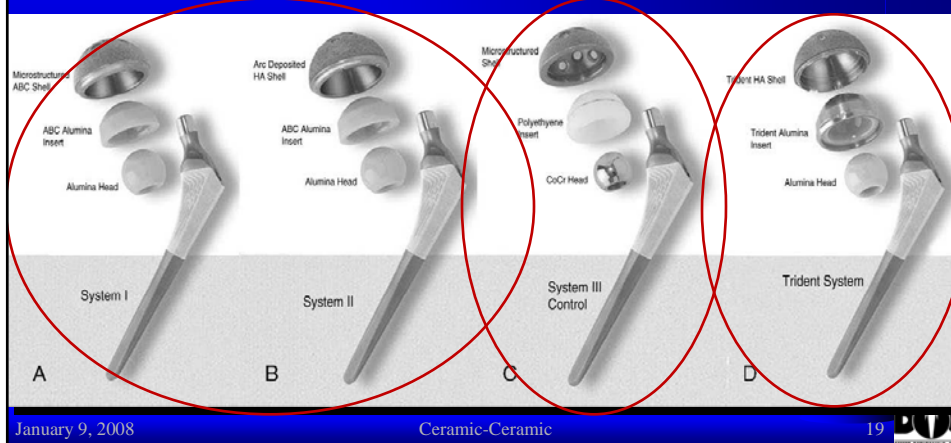


# Stryker CoC IDE Study

- **4 study arms:**
  - 380 CoC vs 95 controls
  - All used Omnifit stem (Ti-6Al-4V)



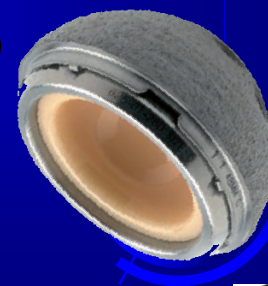
- 1<sup>st</sup> & 2<sup>nd</sup> arms used ABC cup (194)
- 3<sup>rd</sup> arm used metal on poly control
- 4<sup>th</sup> arm used Trident cup (186)



## Stryker IDE Study

- Only 0.8% incidence of transient squeaking after 8 year F/U

(Capello, J Arth, 2008)



## Murphy, CCJR, Orlando, FL, 12/08

- **1100 CoC THA's with flush mounted ceramic liners-1 squeaker**
- **Of the Trident cups, only those mated with Accolade stem squeaked!**

## Squeaky Trident Cups

Table

Squeak Prevalence by Implant Couple<sup>a</sup>

Implant Couple	Squeak Prevalence (%)
Trident cup with Omnifit stem	
Walter et al <sup>5</sup>	0.54
Capello et al <sup>16</sup>	0.75
Manley <sup>17</sup>	0.46
Trident cup with Accolade stem	
Restrepo et al <sup>18</sup>	2.70
Jarrett et al <sup>1</sup>	11.00
Christensen & Jacobs <sup>7</sup>	7.70

<sup>a</sup>All implants manufactured by Stryker, Mahwah, New Jersey.

## **My Results**

- **314 CoC hips performed 1999-2006**
- **5 brands of hips implanted**
- **276 Contacted telephonically for questions re: squeaking**
- **Cup positions compared radiographically**



## **Brands Implanted**

- **156 Encore Keramos**
- **67 Plus MPF**
- **50 Stryker Trident (all with Accolade stems)**
- **34 Wright Medical Lineage**
- **7 Smith & Nephew Reflection**



## Demographics

- **Total Hips: 314**
- **Total Patients: 270**
- **Males : Females =146 : 124**
- **Left : Right = 158 : 156**
- **Bilaterals: 44**
- **Mean Age: 47.2±8.3**
- **Mean BMI: 28.1±6.9**



## Diagnoses

- **DJD-190**
- **AVN-44**
- **DDH-21**
- **Post Traumatic-16**
- **RA-15**
- **Perthes-14**
- **Other-14**



## Results

- Mean F/U: 52 months (24-110)
- 20 (7.2%) hips with ANY reported squeaking
  - 15/45 Stryker (33.3%)
  - 1/29 Wright Medical (3.4%)
  - 3/143 Encore (2.1%)
  - 1/52 Plus (1.4%)
- Mean onset to squeaking: 16±13 months

## Squeaking Frequency

	Stryker	Encore	Plus	Wright
Daily	3	0	0	0
4-5/week	2	0	0	0
1-2/week	1	2	1	0
Rare	8	1	0	0
NA	1	0	0	1
TOTAL	15	3	1	1

## Squeaking Intensity

	Stryker	Encore	Plus	Wright
Creates Social Problem	2	0	0	0
Always Perceptible	5	0	0	0
Occ Perceptible to Others	5	1	1	0
Perceptible Only to Patient	2	2	0	0
NA	1	0	0	1
<b>TOTAL</b>	<b>15</b>	<b>3</b>	<b>1</b>	<b>1</b>

## Problem Squeaking

Frequency >1/wk			Perceptible to Others		
Stryker	6	13.3%	Stryker	12	26.7%
Encore	2	1.4%	Encore	1	0.7%
Plus	1	1.9%	Plus	1	1.9%

# Squeakers vs Non-Squeakers

- **No difference in:**
  - **Demographics**
  - **Cup size or position**
  - **Head size**
  - **Stem Offset**
  - **Neck length**



# Conclusion

- **Something related to elevated rim ceramic inlay (Trident) and TMFZ beta titanium alloy (Accolade) leads to an unusually high incidence of squeaking**





## Summary

- **Ceramic on Ceramic THA is a reliable, durable articulation provided certain precautions are followed:**
- **Avoid cup malposition: vertical placement or inaccurate version**
- **Avoid use in overly lax soft tissues**
- **Avoid small heads, short necks**
- **Avoid elevated rim liners (Stryker Trident cups) with TMFZ stems (Stryker Accolade) to avoid squeaking**

## Thank-You



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