Evaluating Taper Junction Fretting and Corrosion in Reverse Total Shoulder Arthroplasty

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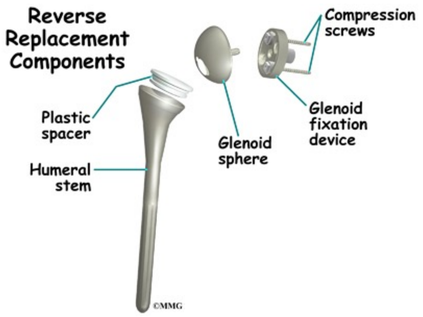
Introduction

- Taper junction fretting and corrosion (F&C) has been identified in total hip arthroplasty (THA) as an implant failure mode
- Similar findings appreciated in anatomic total shoulder arthroplasty (ATSA)
- Limited data series currently present in literature on reverse total shoulder arthroplasty F&C



https://midwestbonejoint.com/shoulder/reverse-shoulder-arthroplasty

Hypothesis

The authors expect to find the presence of fretting and corrosion on reverse total shoulder arthroplasty implants.

Aims & Objective

Specific Aim 1: Gather information from our implant retrieval database regarding glenosphere head size, taper geometry, and interaction

Specific Aim 2: Analyze surgical and patient factors that may contribute to poor patient outcomes.

Specific Aim 3: Determine the presence and extent of fretting and corrosion on specific implant components

Specific Aim 4: Perform a subgroup analysis between implant characteristics to better understand risk factors for fretting and corrosion

Methods

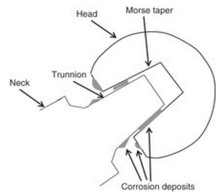
1. Beaumont implant retrieval database (22,867 explants from 2000-2018) → Final count 58 RTSA explants split into six cohorts (Bolt-reinforced v. Unbolted v. Large v. Small v. Male v. Female)
   a. Inclusion criteria → Complete chart review, complete set of components, ability to dis-impact
2. Medical Records Review, Radiographic Analysis, & Statistical Analysis
3. Fretting and Corrosion Damage using Modified Goldberg-Cusick Grading (Below)

Fretting[20]	Corrosion[20]
Mechanical wear and tear	Electrochemical reaction

Tribocorrosion → material degradation due to fretting and corrosion compromising the implant
Trunnionosis → adverse biological tissue reaction in host

Table 1. Modified Goldberg-Cusick[20] score for visual assessment of taper junction in retrieved RTSA implants

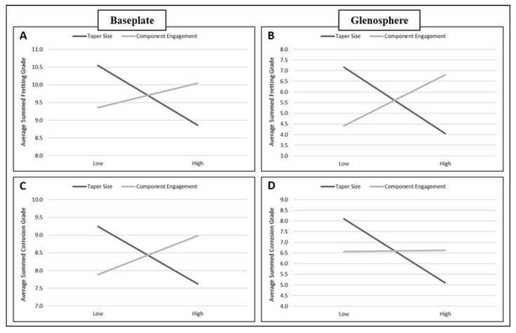
Damage	Score	Fretting Criteria	Corrosion Criteria
None	1	Fretting on 0% of the surface	<10% visible corrosion observed
Mild	2	Fretting on <25% of the surface	<30% of the taper surface discolored/dull
Moderate	3	Fretting on 25-50% of the surface	>30% of the taper surface discolored/dull or <10% of taper surface containing black debris, pits or etch marks
Severe	4	Fretting on the majority (>50%) of the surface	>10% of taper surface containing black debris, pits or etch marks



https://www.cambridge.org/core/books/introduction-to-surface-engineering

Results

- Baseplates showed greater moderate-to-severe fretting (43%) and corrosion (27%) damage than matched glenospheres (fretting, 9%; corrosion, 13%).
- Humeral stems showed greater moderate-to-severe fretting (28%) and corrosion (30%) of implants than matched humeral trays/spacers (fretting, 14%; corrosion, 17%).
- Unbolted glenospeheres had significantly greater corrosion grades compared to bolted tapered implants (p≤0.001).
- Small-tapered glenospheres (low) and baseplates had significantly greater F&C grades compared to large-tapered (high) implants (glenospheres, p≤0.001; baseplates, p=0.031).



- F&C grades on glenospheres with trunnions (component engagement; male; high) were significantly greater than glenospheres with bores (component engagement; female; low) (both p≤0.001)

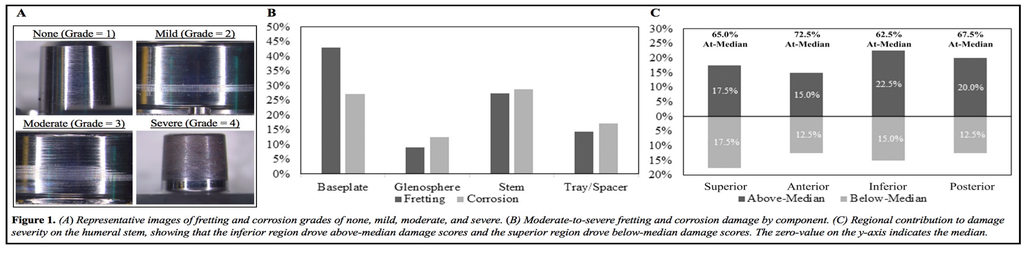


Figure 1. *(A) Representative images of fretting and corrosion grades of none, mild, moderate, and severe. (B) Moderate-to-severe fretting and corrosion damage by component. (C) Regional contribution to damage severity on the humeral stem, showing that the inferior region drove above-median damage scores and the superior region drove below-median damage scores. The zero-value on the y-axis indicates the median.*

Conclusions

- F&C damage predominantly occurred on the taper surface of the baseplate (vs. glenosphere) as well as on the humeral stem (vs. tray/spacer).
- Large-tapered implants showed less F&C damage.
- Bolted glenospheres showed less corrosion than unbolted glenospheres.
- Designs with bores (female), rather than trunnions (male), showed less F&C damage.

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