Title: Suture debris from high-tensile sutures contributes significantly to particle-induced tissue response in shoulder arthroplasty.

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Abstract

Background and hypothesis: Polyethylene wear debris has long been known to be important for the development of osteolysis and aseptic loosening in total joint replacements. Evaluation of shoulder hemiarthroplasty (HA) specimens from the largest repository of shoulder arthroplasty and associated tissue retrievals provided a unique opportunity to study the histopathologic response when a polyethylene-bearing surface was absent. We hypothesized that HAs would exhibit no significant inflammatory periprosthetic tissue response due to the absence of significant numbers of wear particles from the articulation.

Methods: We analyzed 13 shoulder HAs. The explants were examined for damage to the bearing surface and taper damage using a stereo-microscope. The periprosthetic tissues were examined histologically for wear debris and cellular biological response. Fourier Transform Infrared Spectroscopic imaging (FTIR-I) and scanning electron microscopy (SEM) with energy dispersive x-ray spectroscopy (EDS) were used to characterize debris, if present, within tissue samples.

Results: The average patient age at the time of implantation was 57.2 ± 7.3 years and the patient cohort was predominantly female (n = 10, 76.9%). The average time in-situ was 34.1 ± 29.4 months. The metal-bearing surface damage was mostly mild with an average score of 1.5±0.7. The same was true for taper damage on both humeral stem and head tapers with average scores of 1.7±0.5 and 1.7±0.9, respectively. The histopathological analysis revealed the considerable presence of metal debris in 11 (84.6%), cement debris in 4 (30.8%), and suture debris in 11 (84.6%) cases. SEM/EDS revealed titanium alloy debris to be the most dominant type of metal particle present, while FTIR-I scans suggested polyester to be the most commonly occurring type of suture debris. Particles were mostly found within and around macrophages. The mean macrophage score was 3.1 ± 0.8 and the mean foreign-body giant cell (FBGC) score was 2.3±1.1. There was, on average, no significant lymphocyte or neutrophil presence, except for a single septic case.

Discussion and Conclusion: Surprisingly, this surgically retrieved shoulder HA cohort exhibited a considerable macrophage and FBGC response within the periprosthetic environment. Interestingly, given the low amount of damage to metallic surfaces and the absence of a polyethylene bearing, the tissue response does not appear to be driven by wear particles from the metal-bearing surface or taper junction, but rather from suture and, to a much lesser degree, cement and metal debris. Overall, these findings highlight the potential impact that high-tensile suture

material, frequently used in high quantities around shoulder arthroplasty, may have on the periprosthetic environment and identify these materials as a potential driver of osteolysis.

Level of Evidence: Basic Science Study

Keywords: suture debris; shoulder; arthroplasty; hemiarthroplasty; failed; macrophage; wear debris; osteolysis