Polyethylene Wear: An Under-Recognized Cause of Failed Shoulder Arthroplasty

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INTRODUCTION: Particle-induced osteolytic and chronic inflammatory effects of polyethylene (PE) wear are a source of failure after both anatomic total shoulder arthroplasty (ATSA) and reverse total shoulder arthroplasty (RTSA). Historically, PE wear has rarely been reported as a cause of revision in the setting of prior shoulder arthroplasty, unlike hip and knee counterparts. The goal of this study was to analyze and present the clinical, radiographic, and intra-operative findings in a consecutive series of patients who presented after shoulder arthroplasty with evidence of PE wear.

METHODS: This was a retrospective review of prospectively collected data on a consecutive series of patients who presented with evidence of polyethylene wear between 2018 and 2024 to the senior author within a high-volume tertiary referral shoulder arthroplasty practice. Patient demographics and historical data regarding index surgery, implants utilized, and manufacturing information were collected. Upon presentation after index arthroplasty, patient chief complaints, radiographic features, and clinical examinations were reviewed and analyzed. In patients that underwent revision arthroplasty, the intraoperative findings and wear patterns were reviewed.

RESULTS: A total of 43 patients were included in this study with 22 having undergone prior ATSA and 21 having undergone prior RTSA. The most common indications for index arthroplasty were primary osteoarthritis for those with ATSA (86%, n=19) and rotator cuff arthropathy in those with prior RTSA (86%, n=18). The average time after index surgery to first presentation with new onset symptoms of PE wear was 12.1 ± 4.8 years after ATSA and 8.3 ± 3.4 years after RTSA. The most common chief complaint was new onset pain for 77% of patients with prior ATSA. The most common chief complaint was new onset instability in 57% of patients with prior RTSA. The most encountered ATSA glenoid components were all-poly, pegged, onlay designs with radial mismatch comprised of conventional non-crosslinked PE. The most encountered RTSA humeral liners were inlay designs with conventional non-crosslinked PE. All 43 patients had radiographic evidence of humeral bone loss with 100% (n=43) showing osteolysis in the medial calcar region. 65% of patients (n=28) demonstrated medial cortical reactive sclerosis. 95% of patients (n=41) demonstrated glenoid osteolysis. Lazarus grade 1 and 2 was most common in the ATSA group (28%, n=5 for both). Baseplate backside osteolysis was present in 90% of patients with prior RTSA with inferior osteolysis akin to Sirveaux grade 1 being the most common (61%, n=11). An average glenoid PE clear space of 1.48mm was found after prior ATSA. Eccentricity of the RTSA articulation was seen in 43% of those (n=9) after prior RTSA. 28 patients in total underwent revision, with 14 in each group. At revision, all patients underwent aggressive soft tissue debridement and synovectomy. All patients had evidence of PE wear-induced, yellow-stained synovium with particulate debris and wear of the PE component. 3 humeral components (21%) were grossly loose in the ATSA group, with 0 in the RTSA group. 8 glenoid components (57%) were loose in the ATSA group, with 2 baseplates loose (14%) in the RTSA group. 43% of patients (n=6) with prior ATSA were converted to RTSA, with 43% (n=6) requiring conversion to hemiarthroplasty due to massive glenoid bone loss. 14% (n=2) were managed with humeral head exchange alone. 86% of patients (n=12) with prior RTSA underwent PE liner exchange with or without glenosphere exchange. 1 patient was revised to a hemiarthroplasty, and 1 patient was revised to a custom constrained implant.

DISCUSSION AND CONCLUSION: As shoulder arthroplasty volume increases and prosthesis survivorship improves, PE wear will become more prevalent. Surgeons should be aware of the clinical, radiographic, and intra-operative findings of PE wear in patients who have undergone prior shoulder arthroplasty, especially those with conventional, non-crosslinked PE implants. New onset pain and weakness after a symptom-free holiday (years) are common after prior ATSA. New onset instability and pain after a symptom-free holiday (years) are common after prior RTSA. 100% of patients with PE wear present with humeral osteolysis, often with cortical reactive sclerosis, that may be mistakenly attributed to stress shielding. Radiographs consistently demonstrate a narrowed glenoid clear space, humeral and glenoid bone loss, and eccentricity. Revision arthroplasty poses unique challenges, such as a copious chronic inflammatory response with rubbery tissue transformation, destructive osteolysis, and potential for metallosis. Surgical management should include an aggressive synovectomy and soft tissue debridement of the wear particles to relieve pain and arrest the destructive chronic inflammatory process. Further studies regarding implant design, materials, technique, patient parameters, and outcomes after revision are crucial for understanding this emerging phenomenon after shoulder arthroplasty.

Figure 1. A) AP radiograph in an 80-year-old male after RTSA 11 years prior who presented with pain and new onset instability. Radiographs demonstrate eccentric positioning of components with humeral and glenoid osteolysis. B) Intraoperative photo demonstrating severe inferior PE wear and metallosis of the soft tissues.



Fyre 2. A) AP and axillary radiographs from a 64-year-old female 7.4 years after primary ATSA demonstrating demonstrating entral PE wear with metal-on-metal articulation and humenal and glenoid osteolysis. B) Intraoperative point demonstrating entral PE ware with metal-on-metal articulation and humenal and glenoid osteolysis. B) Intraoperative points with a cavity, copious fibrin deposition, and histiccytes with enguled metal debris consistent with chronic inflammatory researce of the metal copion of the position, and histiccytes with enguled metal debris consistent with chronic inflammatory researce of the metal copion of the position of the position and histiccytes with enguled metal debris consistent with chronic inflammatory researce of the position with ensures in staining and polarized light for PE ampliture.