Preoperative Deformity Patterns in Patients Undergoing Custom Reverse Shoulder Arthroplasty

Peter George Boufadel, Aghdas Movassaghi, Benjamin Robert Wesorick, Mohamad Fares, Lana M Smith, Eddie Y Lo, Joseph A Abboud, Vani Janaki Sabesan

INTRODUCTION:
Severe glenoid deformity remains one of the most technically complex challenges in reverse shoulder arthroplasty (RSA). As RSA indications expand and revision procedures become more common, surgeons are increasingly encountering cases with extensive retroversion, inclination, and vault bone loss- conditions previously considered unreconstructable. These deformities often exceed the correction capabilities of off-the-shelf implants, limiting baseplate fixation, coverage and long-term stability. Custom implants offer a promising alternative by enabling patient specific fixation strategies and optimizing glenosphere positioning. However, despite their growing adoption, limited data exists on the specific deformity patterns that prompt the use of custom designs. This study aims to characterize three-dimensional deformity profiles of patients selected for custom RSA and assess how these patterns vary based on prior surgical intervention.
METHODS:
A retrospective review was conducted on 455 patients who underwent CT-based planning for a custom glenoid baseplate between May 2023 and December 2024. Preoperative deformities were evaluated using 3D imaging and standard anatomical coordinate systems to quantify glenoid version, inclination, vault reconstruction volume, and offset depth. Cases were classified according to a deformity-based zoning system that stratifies glenoids based on native glenoid version and inclination into anatomical zones including superior, posterior, anterior, massive posterior, and minimal planar deformity (MPD). This system enables detailed assessment of deformity severity, distribution, and its correlation with surgical history and vault reconstruction demands.
RESULTS:
The preliminary analysis included 214 patients (mean age 68.4 ± 9.5 years; 60.3% female). The cohort exhibited significant deformities, with a mean glenoid inclination of 18.5° ± 12.1°, and mean volumetric bone loss of 7,337 ± 6,390 mm^3. Notably, 82% (176/214) of cases fell into deformity zones that exceeded the correction limits of standard augment geometries primarily in superior, posterior, or massive posterior patterns. In contrast, 33% (71/214) exhibited minimal planar deformity (MPD). Prior surgical history was strongly associated with deformity patterns and reconstruction requirements. Single-stage revision of reverse shoulder arthroplasty and two-stage revision with a cement spacer exhibited the highest vault reconstruction volumes (10,171 mm^3 and 7,503 mm^3), despite exhibiting less mean retroversion (25.4° ± 14.0°, p = 0.019) compared to all revision subgroups. Single-stage revision of anatomic TSA or hemiarthroplasty had relatively moderate bone loss and neutral version/inclination.
DISCUSSION AND CONCLUSION:
CT based planning for custom RSA reveals a high prevalence of complex glenoid deformities, predominantly with superior, posterior, or massive posterior bone loss. Revision cases, particularly those involving prior RSA or two stage revision with cement spacer are associated with great vault bone loss, while primary RSA cases exhibit more severe angular deformity. Given that the majority of deformity zones fall outside the correctional range of standard augment geometries, this study emphasizes the need for custom implant solutions and advanced individualized planning for cases that surpass the reconstructive limits of standard implant options.

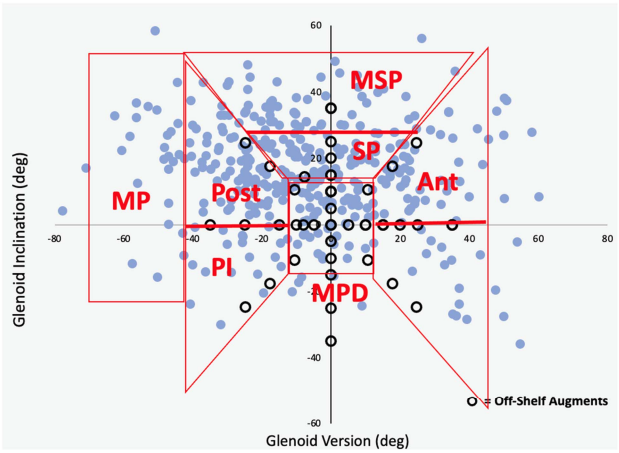

Figure 1. Glenoid version and inclination of patients undergoing custom revision RSA, stratified into anatomical deformity zones based on native angular measurements. SP = superior inclination; Post = posterior; Ant = anterior; Inf = inferior; MP = massive posterior; MPD = minimal planar deformity