Reverse Total Shoulder Arthroplasty with Custom Humeral Prosthesis for Complex Humeral Deformity in Post-Polio Syndrome

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This video demonstrates reverse total shoulder arthroplasty using a patient-specific CT-based 3D-printed humeral prosthesis in a 73-year-old man with post-polio syndrome with proximal humerus dysplasia. The patient presented with longstanding pain progressing to functional limitation interfering with his employment in manual labor, persistent despite maximal conservative treatment. Imaging demonstrated severe glenohumeral arthritis, anterior glenoid erosion, dysplastic proximal humerus intramedullary canal with deficient bone stock. Physical exam showed crepitus, restricted motion including forward flexion and abduction limited to 60° with external rotation limited to 20°. Neurovascular status was normal with intact motor function and negative preoperative EMG study.

An anatomic total shoulder arthroplasty was considered, however the rotator cuff integrity was questionable due to rotator cuff muscle atrophy on imaging. A standard reverse shoulder arthroplasty was considered, however the dysplastic angulated proximal humerus metadiaphysis would likely result in varus malposition of standard stemless or short stem prostheses. To address this, a CT-based template was used to create a 3D-printed patient-specific custom humerus implant bypassing the metadiaphysis and osteotomy guide, compatible with standard glenoid baseplate and glenosphere.

Intraoperative challenges included rigid contracture complicating exposure and dislocation as well as distorted anatomy requiring careful protection of neurovascular structures with custom cutting guide. A standard deltopectoral approach was utilized with successful seating of implants and stable full range of motion. Open biceps tenodesis and transosseous suture tape subscapularis repair were performed.

The patient recovered without complications and was adherent to postoperative lifting restrictions and rehabilitation protocol throughout recovery. At 3-month follow-up the patient reported minimal pain, with forward flexion to 150°, and stable well-fixed implants on postoperative films.

The majority of clinical data in the literature regarding patient-specific instrumentation and CT-based custom implant designs in reverse shoulder arthroplasty relates to custom glenoid component design.[1] The utility of patient specific instrumentation in standard reverse shoulder arthroplasty is unclear.[2] However the use of custom 3D-printed endoprosthetic components has demonstrated successful outcomes in addressing complex deformity reconstruction in critical traumatic bone defects and limb salvage.[3,4] Similar approaches as applied in this case have demonstrated good results in the reconstruction of varus malunion of the proximal humerus.[5] One important consideration in this case is that patients with neuromuscular compromise must be evaluated for and counseled regarding specific complications, such as muscular weakness in post-polio syndrome significantly increasing the risk of instability with standard methods.[6,7]

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