Technical Note

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Full-wedge metallic reconstruction of glenoid bone deficiency in reverse shoulder arthroplasty

Video online

The online version of this article (https://doi.org/10.1007/s11678-020-00587-9) contains the video: "Full-wedge metallic reconstruction of glenoid bone deficiency in reverse shoulder arthroplasty". You will find the video at the end of the article as "Supplementary material." Video by courtesy of D. Endell and A. Grob, Department of Shoulder and Elbow Surgery, Schulthess Clinic Zurich, Switzerland; J.-P. Imiolczyk and P. Moroder, Center for Musculoskeletal Surgery, Charité-Universitätsmedizin Berlin; M. Scheibel, Department of Shoulder and Elbow Surgery, Schulthess Clinic Zurich, Switzerland, and the Department of Shoulder and Elbow Surgery, Center for Musculoskeletal Surgery, Charité-Universitätsmedizin Berlin, Germany; all rights reserved 2020.

Background

Glenoid bone loss creates a challenge in choosing the right operative technique for successful defect correction in reverse shoulder arthroplasty. Currently the following treatment options are available [1–3]: When excessive reaming reaches its limits and cannot be reliably used to treat larger defects or extensive medialization, allogenic and autologous bone graft augmentations can be a valid alternative. Another option is metallic wedge augmentation (**Fig. 1**; [3, 4]).

There are multiple reasons for glenoid bone loss: Cuff tear arthropathy with superior migration of the humeral head can result in asymmetric glenoid wear, described by Sirveaux et al. as type E2 and E3 [5]. Additionally, primary glenohumeral osteoarthritis can result in posterior wear of the glenoid. Addressing glenoid bone deficiency is essential in type B2 and B3 glenoids according to Walch, due to the biconcave destruction of the articular surface with medialization and retroversion of over 20° [6]. Walch type C glenoids exhibit primary dysplastic deformities of the glenoid with retroversion of more than 25°.

Planning software (e.g., Blueprint™, Wright Medical Group, Memphis, TN, USA) using thin-layered computed tomography (CT) with additional three-dimensional (3D) reconstruction of the glenoid can help simulate the fit of the implant preoperatively. Higher amounts of eccentric wear can be corrected using a full-wedge (15°) metallic augmented baseplate. Preoperative planning is essential in order to understand the ideal implant position and size and also to prevent excessive medialization while reaming.

Operative technique

The patient is placed in conventional beach-chair position. After marking all bony landmarks, a standard deltopectoral approach is used, with retraction of the deltoid muscle laterally and the pectoralis major and the conjoined tendon medially. The subdeltoid mobilization and resection of its bursa follows in order to achieve sufficient lateralization of the deltoid muscle. The tendon of the subscapularis muscle is detached close to its insertion and armed using FiberWire® sutures (Arthrex, Naples, FL, USA) in an adapted Mason–Allen technique. After careful dislocation of the humerus and tenotomy of the long head of the biceps tendon, the resection of the humeral head is performed in preparation for the humeral stem component (e.g., Aequalis™ Ascend Flex™ or Aequalis™ Reversed II, Wright Medical Group, Arlington, TN, USA). After impaction of the metaphysis, a protection device is placed. Using retractors, the humerus is pushed posteriorly to allow for sufficient glenoid exposure. Under protection of the axillary nerve, residual labral tissue is excised (**Fig. 2a**), and the capsule is released superiorly, posteriorly, and inferiorly. Initially, the size and slope of the paleo- and neoglenoid, using full-wedge templates, have to be assessed (**Fig. 2b**). The template is used to estimate the size and alignment of the wedge implant. Ideally, intraoperative measures match the preoperatively planned 3D-CT simulation. After placing the central guiding pin (**Fig. 2c**), the asymmetric reamer is now used cautiously (**Fig. 2d**). Under constant supervision the reaming is completed (**Fig. 2e**) until full alignment of the asymmetric reamer onto the glenoid surface is achieved. Excessive reaming and glenoid fractures ought to be prevented.

A drill bit is used over the central guiding pin to create the cylindrical seat for the post of the baseplate (**Fig. 2f**). Sub-

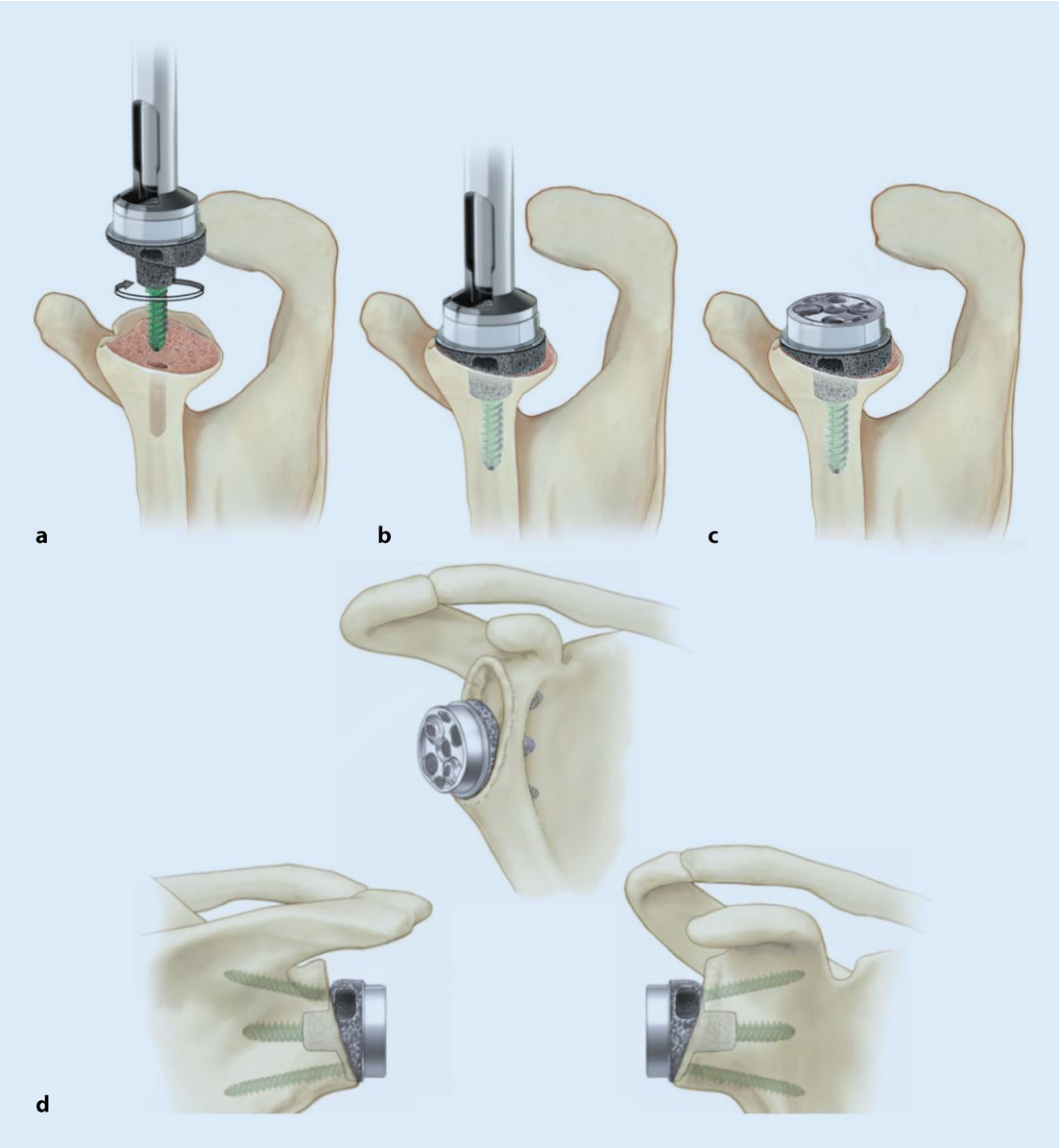

Fig. 1 ◀ Sequence of an implantation of a full-wedge metallic augmented baseplate

sequently, the pilot hole for the central screw is over-drilled and its length measured. An optional tap may be used and is recommended for central screws with a wider diameter in order to prevent fractures around the screw. The full-wedge baseplate (Aequalis™ Perform™ Reversed, Wright Medical Group) is now assembled. Multiple 1.6-mm holes are drilled into the glenoid for better bony integration of the implant. Now the wedge baseplate is set in place (**Fig. 2g**). Special attention is needed when placing the central screw to prevent rotation and false alignment of the wedge onto the glenoid (**Fig. 1a–c**). Further stabilization is achieved by using up to four fixation screws, which can either be used as compression or locking screws (**Fig. 2h**). In the thick portion of the full-wedge augmentation, the choice is limited to a compression screw due to the implant design. In order to achieve optimal stabilization of the additional offset created by the wedge augmentation, the peripheral screws ideally are longer than the central one (**Fig. 2i**).

Before setting the glenosphere on top of the baseplate, a dead space reduction is achieved using a gentamicin-soaked sponge. With an impactor, the monobloc assembly of the baseplate and glenosphere is achieved and secured with a locking screw. Implantation of the humeral component follows after verifying its rotation stability and examining impingement and notching. Following a sufficient lavage, the subscapularis is reattached and wound closure is performed after placing a redon drainage.

The shoulder is immobilized postoperatively in a sling in internal rotation during the first week for pain control. Early mobilization is allowed in the patient's field of vision. In the first 2 weeks only passive movements in limited internal and external rotation are allowed, increasing the range of motion from the third week on. Starting with the fifth week postoperatively, active mobilization is planned.

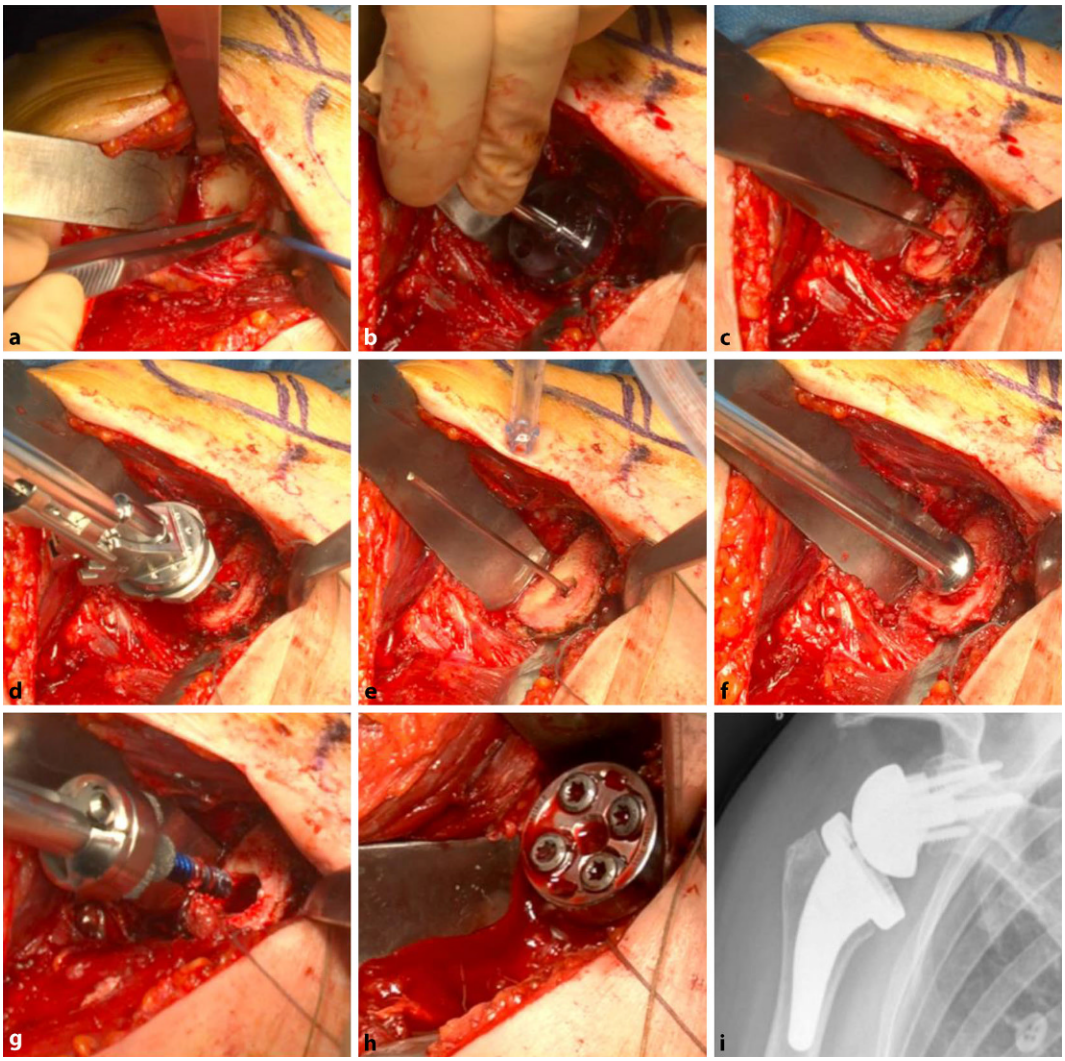

Fig. 2 ◀ Step-by-step illustration of glenoid preparation and implantation of a full-wedge metallic augmented baseplate in a cuff tear arthropathy with irreparable cuff tear and posterosuperior glenoid wear. For more detailed information on the figure parts, please see the text

Discussion

The technique presented using an implant-controlled full-wedge augmentation is a viable therapeutic option in reverse shoulder arthroplasty for asymmetric glenoid bone loss. This technique can provide a safe and stable setting of the glenosphere and baseplate onto asymmetrically deformed glenoids preventing medialization. The main objective is to correct the preoperative glenohumeral decentration to ensure the alignment and support of the baseplate. Glenoid component loosening, excessive inlay wear, and instability ought to be prevented.

Lower rates of scapular notching have been documented [7]. Metallic wedge augmentations show an advantage compared with biological augments as they avoid the possibility of graft resorption and secondary loss of fixation.

Take-home message The use of metallic full-wedge augmented implants in reverse shoulder arthroplasty is a useful reconstruction technique for patients with excessive glenoid bone deficiency. Prospective clinical trials are needed to evaluate the clinical, radiological, and biological results.

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Compliance with ethical guidelines

Conflict of interest. D. Endell, J.-P. Imiolczyk, A. Grob, and P. Moroder declare that they have no competing interests. M. Scheibel is a consultant for Wright Medical Group, Memphis, USA.

For this article no studies with human participants or animals were performed by any of the authors. All studies performed were in accordance with the ethical standards indicated in each case.

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