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Total shoulder arthroplasty using trabecular metal augments to address glenoid retroversion: the preliminary result of 10 patients with minimum 2-year follow-up

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Background: Options to address glenoid retroversion include eccentric reaming, bone grafting, modifications to component shape, and reverse shoulder arthroplasty. Trabecular metal (TM) augments have been used extensively in the hip and knee to address bone deficiency in arthroplasty as part of a hybrid combination of high-density polyethylene, polymethyl methacrylate, and TM. This study presents the initial results of the use of specifically designed augments in the shoulder to address glenoid retroversion as part of total shoulder arthroplasty (TSA).

Materials: Ten patients (4 women and 6 men; aged 60 to 79 years) with Walch grade B2 or C glenoids have undergone TM glenoid augment insertion as part of a TSA, with a longer than 24-month follow-up. Patients received a 15° or 30° TM wedge to correct excessive glenoid retroversion before the glenoid component was cemented. Outcome analysis was performed preoperatively, at 3, 6, and 12 months, and yearly thereafter.

Results: All patients have been satisfied, and all scores have improved. There have been no complications and no hardware failures or displacement. All glenoid components were implanted to within 10° of neutral glenoid version. Radiographs at 24 months show good incorporation of the TM augment and the glenoid component.

Conclusions: The TM augments have the advantage of immediate secure fixation, no tendency to collapse, and the ability to correct retroversion of 25° or more. This study confirms the successful short-term outcome of wedge-shaped TM augments to correct glenoid retroversion as part of TSA.

Level of evidence: Level IV; Case Series; Treatment Study

Keywords: Anatomic shoulder arthroplasty; glenoid retroversion; trabecular metal wedge; Walch B2 glenoid; tantalum; posterior humeral subluxation

Shoulder arthroplasty has made a major contribution to address patient dysfunction and pain in conditions such as glenohumeral osteoarthritis; however, the issue of glenoid alignment and retroversion, in particular, remains a challenge. Glenoid retroversion due to congenital dysplasia or degenerative wear may be present in a significant

The trial to review outcomes of the implants was endorsed by the Royal Adelaide Hospital Human Research Ethics Committee and conducted under the Australian Government Department of Health TGA (Therapeutic Goods Administration) Authorised Prescriber provisions (Trabecular Metal Glenoid Augment: Authorised Prescriber: 2012/022).

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proportion of shoulders undergoing total shoulder arthroplasty (TSA).[14]

There is increasing evidence that this should be corrected, because eccentric loading of the implanted prosthesis will be increased where there is as little as 4° of retroversion.[3,19,27] The report by Farron et al[3] recommended that unless the retroversion can be corrected, a glenoid implant should not be performed due to the high failure rate. However, it has been well shown that a hemiarthroplasty where the glenoid is in retroversion is highly prone to excessive wear and premature failure, so this in itself does not become an acceptable option.

Matsen et al[17] identified poorer clinical outcomes in shoulders with retroverted or misaligned implants, and more recent work presented by Ho et al[12] provided some of the most compelling clinical support that retroversion is undesirable. They reported a more than 5-times rate of osteolysis around the central peg of cemented glenoid components implanted in 15° or more of retroversion compared with those that were implanted in neutral version.

Correction of glenoid retroversion in shoulder arthroplasty would therefore appear to be an important requirement for a durable TSA. A number of options are available for this, including bone grafting, building up the posterior glenoid by increased cement application, or eccentric reaming of the anterior glenoid to correct the version. Several shaped glenoids are available, but without published long-term clinical outcomes.[26]

Gillespie et al[7] and Nowak et al[18] showed that eccentric reaming can reliably only correct approximately 10° of retroversion, and Ting and Poon[28] showed that the risk of vault perforation is also increased. Reverse shoulder arthroplasty has also been presented as an alternative.[6]

Bone grafting has been regularly used for larger degrees of retroversion but is technically challenging and has a substantial failure rate, with frequent resorption of the graft.[11,25]

To address the problem of glenoid retroversion, we investigated the option of using solutions developed to address bone loss in other joints as part of an arthroplasty procedure. Trabecular metal (TM) augments are now widely used in the hip and the knee with good effect.[2,9,30] Because of the shape and porosity of the augments, bone in-growth has been a consistent outcome, and this provides a stable and durable base for the implanted prosthetic component. Such augmentation devices are not available in the shoulder.

To investigate this approach as a potential option for the shoulder, TM augments designed for the hip and the knee were modified intraoperatively in an off-licence approach to create a shaped wedge to build up the posterior glenoid. This allowed the glenoid component to be implanted in a neutral version. After this limited but successful initial trial, porous tantalum TM augments specific for the shoulder have now been manufactured (Zimmer, Warsaw, IN, USA) and were clinically trialed in this study.

The hypothesis for this ongoing study was that by adequately correcting glenoid retroversion, retaining the subchondral bone plate, and avoiding excessive lateralization of the joint line, the alignment of the shoulder can be addressed to improve longevity of the glenoid component and correct humeral head posterior subluxation.

Although the follow-up period presented here is insufficient to test the hypothesis, this report details the outcomes of the first group of patients to be monitored for more than 2 years postoperatively who have undergone anatomic TSA using a specifically designed TM augment to address glenoid retroversion as part of a hybrid combination of high-density polyethylene (HDPE), polymethyl methacrylate (PMMA), and TM.

Materials and methods

Experimental implant design

This study reports a small case series of patients that have undergone TSA using TM augments to address glenoid retroversion. To design the appropriate shape and form of the corrective wedges, the alignment and dimensions of the glenoids of 60 arthritic shoulders were quantified using 3-dimensional (3D) analysis software (True Life Anatomy, Adelaide, SA, Australia). Because the medial point of the scapula was not routinely available on the 3D models, glenoid version was determined using a 3D vault method, similar to that subsequently described by Scalise et al.[24]

For glenoids with 15° or more of retroversion, a determination was made that wedges of 15° and 30° would allow sufficient options to address virtually all retroversion patterns. For example, a retroversion of 20° could be reduced to 15° with minor eccentric reaming, and one of 25° could be slightly increased to 30° and thus achieve neutral glenoid version with an appropriately shaped wedge.

Because the implants were to be used as part of a hybrid construct of HDPE glenoid component, PMMA cement, and a porous tantalum TM glenoid augment (TMGA), the outer (glenoid component facing) arc of curvature was designed to match the back surface of the pegged glenoid components of the Bigliani-Flatow total shoulder arthroplasty system (Zimmer). The arc of curvature of the outer and inner TMGA faces were the same, but divergent by 15° or 30°. A further analysis of the glenoid size and shape indicated that 2 sizes would be sufficient, with long axes that matched the medium and large glenoid components of the same arthroplasty system. Because the implants were not left or right sided, an inventory of only 4 implants (15° and 30°, medium and large) was thus required.

A further design consideration was to match the superior-to-inferior glenoid component length, but the anterior-to-posterior length was slightly less than the corresponding glenoid component. The location of the holes created in the TMGA to take the glenoid component pegs was such that the posterior or wider portion of the TMGA was flush with the HDPE glenoid component but was slightly shorter on the