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Case report

Stemless hemiarthroplasty failure: a challenging revision using reverse total shoulder arthroplasty. Case report and literature review

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Abstract. Stemless shoulder prosthesis are used in shoulder arthropathy treatments because of metaphyseal fixation minimizes humeral bone removal, avoids intraoperative and postoperative humeral fracture complications and usually decreases morbidity associated with revision operations. However it's very important to plan carefully the revision because it could be a high demanding procedure. We report the case of 46 years-old woman with a painful stemless hemiarthroplasty that we revised into a reverse total shoulder arthroplasty. Moreover we describe the possible reasons of this failure and we describe a literature update. (www.actabiomedica.it)

Key words: Stemless, reverse total shoulder arthroplasty, rotator cuff tear, superior subluxation

Introduction

Stemless shoulder prosthesis are, in the latter years, more and more used in shoulder arthropathy treatments because of the advantages they seem to have in terms of bone stock, less intra-operative and post operative complications (periprostetic fractures, loosening around the stem) and positive clinical outcome similar to the standard stem implants (1).

Anyway, rotator cuff rupture represent 19% of complications in total anatomical shoulder arthroplasty and it is the second cause of implant' failure, the first is bound to glenoid failures. In fact humeral component malposition, cuff disease and glenoid-related problems are the most common causes for revision surgery (2). In anatomic stemless prosthesis one of the most important target is to reconstruct the rotation center of the joint, especially in post traumatic cases (3).

Components size and their positioning are important in order to reconstruct a correct neck shaft angle (4) and guarantee a successful clinical results. Stemless implant are usually considered easier to revision than stemmed once. However it's very important to plan carefully the revision because it could be high demanding procedure.

We report the case of 46 years-old woman, who came to our attention for a painful shoulder. She was treated 10 years before for an anatomic neck fracture with a stemless hemiarthroplasty, and we revisioned it into a reverse total shoulder arthroplasty because of glenoid degeneration, superior subluxation and massive rotator cuff lesion which caused important functional limitation and severe pain.

Case Report

In January 2019, a 46 years old woman came to our department for severe right shoulder pain without relief from drugs and conservative therapies. 10 years before she was treated with a stemless hemiarthroplasty for an anatomic neck humeral fracture in another hospital. Unfortunately she lost all the prior documentation and the x-rays of the fracture.

She was a right-handed manual worker in good general conditions.

She had suffered from a progressive shoulder pain, expecially in the night, with functional limitations, expecially in abduction, for 4-5 years without any referred trauma.

She had no relief from physical therapy.

The physical examination shown a surgical scar with no signs of infection or inflammation, a painful 0-60° ROM in abduction, conserved extra rotation, Jobe test positive, Palm up test negative, Yocum test positive, Bear Hug test negative.

She had 1 year old x-rays and a recent scintigraphy with sign of loosening (**Fig. 1**).

We completed the diagnostics with blood test with ESV and CRP, new x-rays, US and CT scan. (**Fig. 2**).

The results of the blood test were normal. The US shown a complete tear with retraction of the sovraspinatus and tendinosis of subscapular.

We decided for revision surgery with a reverse short stem prosthesis (Tornier Aequalis Ascend Flex), but with the foresight of having a standard stem or a long stem prosthesis in case of any complications

Figure 1. pre-operative x-ray.

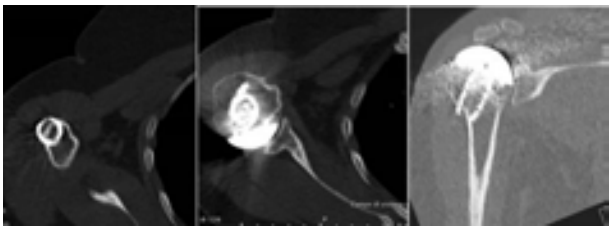

Figure 2. pre-operative CT.

In April 2019 we made the revision surgery: through a delto-pectoral approach we found fibrotic tissue next to the articular plane of the right shoulder, we found the subscapular tendon previously operated with a metallic anchor without tears, a complete lesion with the impossibility to indentify the sovraspinatus tendon, a partial tear of the infraspinatus tendon, absence of the CLBB (**Fig. 3** a-e).

We detached the subscapular tendon finding out a lot of fibrotic periglenoid tissue, we easily removed the stemless cap and we tried to remove the metaphyseal taproot which appeared oversized and invaded the lateral cortical.

It was impossible to remove it with the specific screwdriver, even with a little weakening of the lateral cortical; so we performed a trans tuberosity osteotomy throughout the long tendon biceps sulcus which allowed the taproot removal at the expense of a bone stock loss around the little tuberosity region.

We accomplished a periglenoid toilette and we implanted a 36 mm metalbacked glenoid with a 10 degree inferior tilt, stabilized with two 32 mm screws.

Because of the osteotomy we decided for a Tornier uncemented standard stem instead of a short stem. We reinserted the subscapular tendon through metadiaphysar holes and the tuberosities with vertical and circumferencial osteosutures.

The arm was immobilized in a brace that the patient could remove to do simple movements and it was completely removed after 25 days to begin physical therapy.

Result

The follow up was undertaken at 1-3-6-12 months postoperatively with clinical and x ray evaluations. No signs of loosening were found at the final X-ray.

Figure 3a. implant intraoperative image.

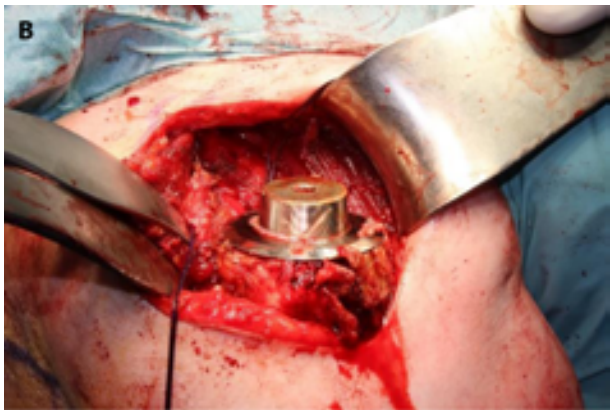

Figure 3b. stemless cap removed.

Figure 3c. Metaphyseal taproot which appeared oversized and invaded the lateral cortical.

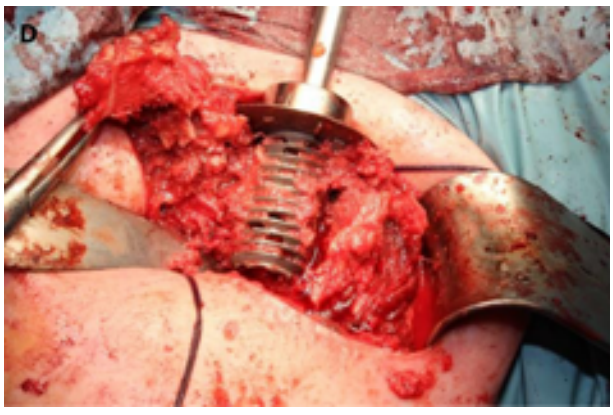

Figure 3d. trans tuberosity osteotomy.

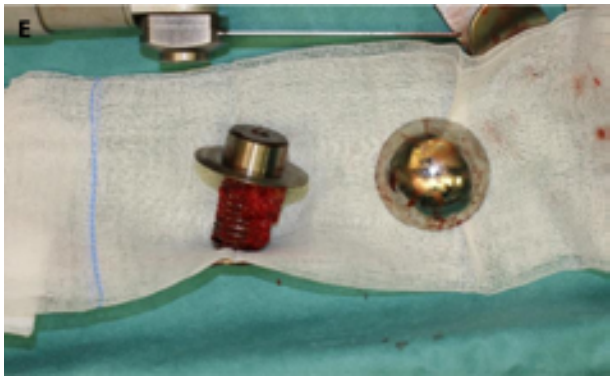

Figure 3e. prosthesis completely removed.

At the last clinical evaluation (1 year after surgery), the Constant score improved to 92 points and the American Shoulder and Elbow Surgeons score improved to 88 points. Pain was remarkably relieved. The patient resumed work and was able to accomplish daily life activities. She achieved almost full range of motion with a residual limitation in extrarotation (**Fig. 4** a-c).

Discussion

The purpose of a stemless hemi arthroplasty is to restore the patient's individual anatomy and the lateral offset of the proximal humerus while preserving the bone stock of the humeral head with less intra and post operative complications.

Figure 4a. 1 year follow up: clinical evaluation.

Figure 4b. 1 year follow up: clinical evaluation.

Figure 4c. 1 year follow up: clinical evaluation.

In fact the incidence of intraoperative humeral fractures in stemless total shoulder arthroplasty is 1.5 %, and the incidence of postoperative periprosthetic humeral fractures is between 1.6 and 2.3 % (5).

Stemless shoulder prostheses, originally introduced in 2004 with the Biomet TESS Total Evolutive Shoulder System (TESS) (Biomet, Warsaw, Indiana) implant (6), have had a greatest widespread in the last decade as they allow bone preservation, decreased stress shielding, humeral head placement independent from orthopedic axis, shorter operative time with less complication and potential easier removal at revision (7-8).

According to Issa et al. the contraindications for anatomical stemless TSA are acute proximal humerus fracture, inadequate metaphyseal bone stock, and rotator cuff insufficiency (9).

In 2005 Arthrex introduced Eclipse stemless shoulder arthroplasty system. Of the implants currently on the market, this implant is the only threaded implant that has screw in implantation as opposed to impaction implantation with lower intraoperative risk of fractures (10).

There are a number of short term cohorts that have shown low complication rates and outcomes similar to previous generations of stemmed humeral components, but longer term and better designed studies are needed for short stems and stemless components to become the standard of care (11).

Habermayer et al (12) evaluated, at mean follow up of 5 years, 78 patients using the Eclipse implant. He achieved good functional results in patients with osteoarthritis and post-traumatic arthritis and he observed no difference in function and pain relief in patients comparing hemiarthroplasty with total shoulder arthroplasty. The overall complication rate was 12.8% with a revision rate of 9%. Rotator cuff tears with loss of active range of motion occurred in 7.7% of patients but no one was revisioned for loosening.

Recently Liu et al. (13) performed a systematic review reporting a Stemless TSA overall complication rate of 8.3% and a revision rate of 5.6% that are comparable to those reported for stemmed TSA.

The most common reasons for revision were rotator cuff failure (1.8%), glenoid failure (0.8%), and glenoid loosening (0.8%).

Stemless hemi-shoulder prostheses are considered a valid treatment option in selected patients because of the limited survival of the glenoid component in TSA after long-term follow-up (14).

However Geervlier et al (15) in their study report that glenoid erosion in hemiarthroplasty is one of the major reasons for revision to total or reverse shoulder arthroplasty, although acording to literature, radiological glenoid deterioration is not correlated with pain or deterioration of clinical results. For this reason, in a young patient with a non-arthritic glenoid, emiarthoplasty allows glenoid bone stock preservation with certain advantages in case of revision.

Other possible cause of revision described in stemless arthroplasty is overstuffing. This could be due to inaccurate sizing or positioning of a prosthetic humeral head that can lead to overstuffing the joint. Overstuffing then implies poor outcomes resulting from glenoid erosion or rotator cuff tearing, and in the case of a glenoid component, wear and loosening (16).

Our patient had been treated 10 years earlier in another hospital, with implantation of a stemless prosthesis for an anatomical neck fracture of her right humerus. The surgeon probably chose a stemless implant thanks to the metaphyseal area sparing.

Malpositioning of the prosthetic head may cause impingement to the coracoacromial arch and rotator cuff damage.

However, analyzing this case, the position of the implant was not optimal and the neck-shaft angle obtained was far from the values described in the literature. However rotation centre was correct and therefore the sizing too (**Fig. 5**).

Iannotti et al. (4) measured a total of 2058 cadaveric humeri to define the normal distribution of neck-shaft angles and found an average of 134.7° (range, 115° to 148°). Our patient had a 164° neck-shaft angle, therefore a valgus position resulting in joint imbalance and progressive degeneration of the rotator cuff, with consequent gradual upward migration and glenoid degeneration. Indeed the patient was treated without glenoid prosthesis because she was young and at the radiological exams she didn't show primary ostheoarthrosis and they wanted prevent glenoid loosening. In fact as we said, one of the major cause of revision in stemless TSA is the glenoid

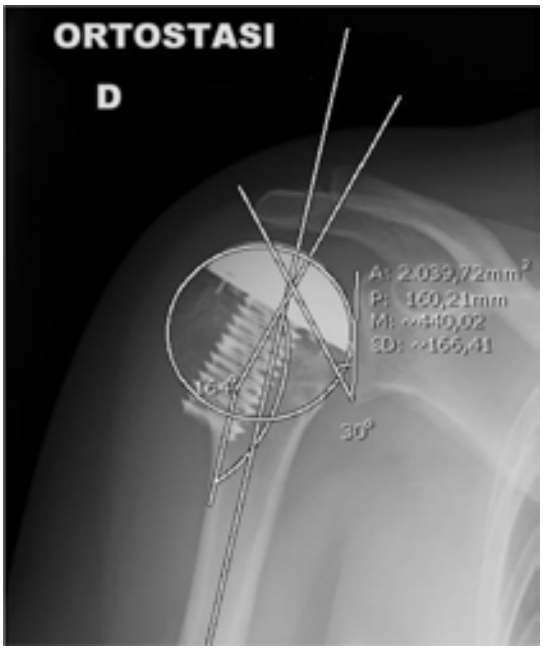

Figure 5 pre-operative implant evaluation.

loosening, caused by eccentric loading, the so- called "rocking-horse" phenomenon. Another parameter to be calculated is 'Critical Shoulder Angle'.

The CSA equals the angle between glenoid and lateral border of the acromion. This angle Based on the study by Moor et al. (17) were classified into three grades: grade I CSA <30°, grade II CSA 30–35°, and grade III CSA >35°. They said that CSA <30° is associated with gleno-humeral OA and a CSA >35° as rotator cuff tear. Our patient had Critical shoulder angle of 30°.

However Young and Walch (18) found that the survivorship of anatomic total shoulder replacements, estimate as shoulders free of secondary rotator cuff dysfunction, was 100% at five years, 84% at ten years, 45% at fifteen years and probably was not simply related to preoperative rotator cuff ruptures, which are relatively uncommon in patients with primary osteoarthritis, but likely due as a natural progression of the rotator cuff degeneration, observed with long-term follow-up of TSA.

Anyway in our case the patient was only 46 years old which means a degenerative cause could be hardly accepted. A post traumatic lesion, associated to a malposition in valgus could better explain this failure within 5 years from the surgery.

However revision shoulder arthroplasty can be a challenging and technically hight demanding even in case of stemless prosthesis if well osteointegrated.

Our patient had surgery with a stemless ECLIPSE ARTHREX which offers epiphyseal and metaphyseal anchoring and is inserted over a compression screw for primary stability of the implant . This is a three pieces system which included a humeral head and a two-piece humeral implant composed of a threated central cage unit inserted over a collar. This central part was in our case oversized conditioning a breakthrough of the lateral cortical of the humerus and leading to a more invasive explant because we needed to perform a longitudinal transuberosity osteotomy in order to remove the implant.

Before surgery we made a planning, and our first choice for the revision would have been a short stem, but during surgery we realized that it wouldn't have been possible due to osteotomy. Therefore considering the young age, we turned to a non cemented standard stem (Tornier Aequalis Reversed Fx) which allowed us to a tuberosity reconstruction. The non cemented techinque was dictated for a possible future further revision. The glenoid component used was a standard one and it was positioned at the inferior border of the glenoid to avoid scapular notching. (**Fig. 6**).

We did not report any major problems in execution since the patient had a hemiarthroplasty.

The subscapular and infraspinatus insertions were preserved respectively on the lesser and grater tuberosity and they were reconstructed using non-absorbable osteosutures fixed to diaphyseal holes. At 1 year follow-up both had maintained their position and size without resorption (**Fig. 7**).

There is only one last note we have to remark and is about the limitation of extrarotation (0-10°).

Nevertheless this data partially agree with the concept of RSA reported in literature.

Infact, the shift of the centre of rotation medially and inferiorly , recruits more fiber of the deltoid during abduction and flexion but simultaneously shorten the external rotation moment arm of the teres minor and posterior sub-region of the deltoid thereby reducing external rotation capacity (19).

In conclusion the potential easier removal claim by stemless implant is not always as expected and it

Figure 6 post op x-ray.

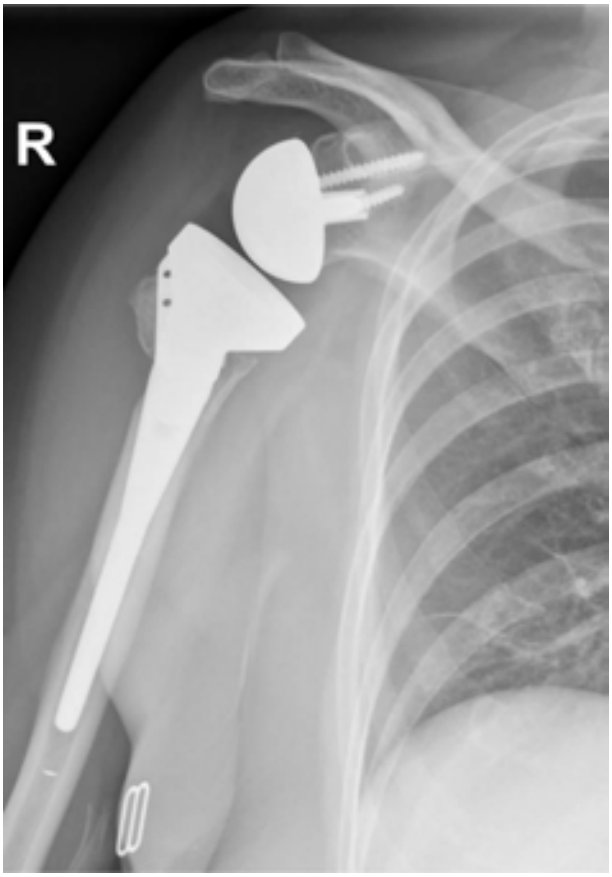

Figure 7 1 years follow up X-RAY.

could be very challenging and often not accomplish by a short stem revision.

Our personal choice of using a non cemented total reverse shoulder arthroplasty with a standard stem and a standard glenoid component, provided us with optimal radiological and clinical outcome in agreement with the functional requirements of a patient in working age.

References

1. Hawi N, Magosch P, Tauber M, Lichtenberg S, Habermeyer P. Nine year outcome after anatomic stemless shoulder prosthesis: clinical and radiologic results. J Shoulder Elbow Surg 2017;26: 1609-1615. doi:10.1016/j.jse.2017.02.017
2. Cil A, Veillette CJH, Sanchez-Sotelo J, Sperling JW, Schleck CD, Cofield RH. Survivorship of the humeral component in shoulder arthroplasty. J Shoulder Elbow Surg 2010; 19:143-50. doi:10.1016/j.jse.2009.04.011
3. Kadun B, Hassany H, Wadsten M, Sayed-Noor A, Sjödén G. Geometrical analysis of stemless shoulder arthroplasty: a radiological study of seventy TESS total shoulder prostheses. Int Orthop 2016;40:751-8. doi:10.1007/s00264-015-2935-z
4. Jeong J, Bryan J, Iannotti JP. Effect of a variable prosthetic neck-shaft angle and the surgical technique on replication of normal humeral anatomy. J Bone joint Surg Am 2009;91:1932-41. doi:10.2106/jbjs.h.00729
5. Churchill RS, Athwal G. Stemless shoulder arthroplasty—current results and designs. Curr Rev Musculoskelet Med (2016) 9:10–16. doi 10.1007/s12178-016-9320-4
6. Huguet D, DeClercq G, Rio B, Teissier J, Zipoli B. Results of a new stemless shoulder prosthesis: radiologic proof of maintained fixation and stability after a minimum of three years' follow-up. J Shoulder Elb Surg. 2010;19(6):847–52. Doi:10.1016/j.jse.2009.12.009
7. Geurts GF, van Riet RP, Jansen N, Declercq G. Placement of the stemless humeral component in the Total Evolutive Shoulder System (TESS). Tech Hand Up Extrem Surg 2010;14:214-7. doi: 10.1097/BTH.0b013e3181e397c5
8. Petriccioli D, Bertone C, Marchi G. Stemless shoulder arthroplasty: a literature review. *Joints*. 2015;3(1):38-41. Published 2015 Jun 8
9. Issa Z, Rasmussen JV, Petersen JK, Schantz K , Brorson S. Patient-reported outcome after stemmed versus stemless total shoulder arthroplasty for glenohumeral osteoarthritis: a patient-blinded randomized clinical trial. Trials. 2019 Jul 12;20(1):427. Doi: 10.1186/s13063-019-3535-9
10. Churchill RS. Stemless shoulder arthroplasty: current status. J Shoulder Elbow Surg. 2014 Sep;23(9):1409-14. doi: 10.1016/j.jse.2014.05.005
11. Mariotti U, Motta P, Stucchi A., Ponti di Sant'Angelo F. Stemmed versus stemless total shoulder arthroplasty:a preliminary report and short-term results. Musculoskelet Surg 2014 98:195–200. DOI 10.1007/s12306-014-0312-5
12. Habermeyer P, Lichtenberg S, Tauber M, Magosch P. Midterm results of stemless shoulder arthroplasty: a prospective study. J Shoulder Elbow Surg. 2015 Sep;24(9):1463-72. Doi.10.1016/j.jse.2015.02.023
13. Liu E, Kord D, Horner N, Leroux T, Alolabi B, Khan M. Stemless anatomic total shoulder arthroplasty:a systematic review and meta-analysis. J shoulder elbow 2020 Mar 24;S1058-2746(20)30012-4. doi: 10.1016/j.jse.2019.12.022.
14. Sperling JW, Cofield RH, Rowland CM. Minimum fifteen-year follow-up of Neer hemiarthroplasty and total shoulder arthroplasty in patients aged fifty years or younger. J Shoulder Elbow Surg. 2004 Nov-Dec;13(6):604-13. Doi: 10.1016/j.jse.2004.03.013
15. Geervliet P, Van den Bekerom P.J, Spruyt P, M Curvers M, Van Noort A, C P J Visser.n Outcome and revision rate of uncemented glenohumeral resurfacing (C.A.P.) after 5–8 years. Arch Orthop Trauma Surg (2017) 137:771–778. Doi: 10.1007/s00402-017-2688-9
16. Geervliet P, Willems J, Sierevelt I, Visser CPJ , Van Noort A. Overstuffing in resurfacing hemiarthroplasty is a potential risk for failure. Journal of Orthopaedic Surgery and Research (2019) 14:474. doi 10.1186/s13018-019-1522-1
17. Moor BK, Bouaicha S, Rothenfluh DA, Sukthankar A, Gerber C. Is there an association between the individual anatomy of the scapula and thedevelopment of rotator cuff tears or osteoarthritis of the glenohumeral joint? A radiological study of the critical shoulder angle. Bone Joint J. 2013;95(7):935. doi :10.1302/0301-620X.95B7.31028
18. Young A, Walch G, Pape G, Gohlke F, Favard L. Secondary Rotator Cuff Dysfunction Following Total Shoulder Arthroplasty for Primary Glenohumeral Osteoarthritis: Results of a Multicenter Study with More Than Five Years of Follow-up. J Bone Joint Surg Am. 2012;94:685-93. Doi 10.2106/JBJS.J.00727
19. Ackland DC, Patel M, Knox D. Prosthesis design and placement in reverse total shoulder arthroplasty. J Orthop Surg Res. 2015 Jul 2;10:101. doi: 10.1186

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