

# Cementless metaphyseal reverse shoulder arthroplasty: our preliminary experience

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**Summary.** Reverse shoulder arthroplasty (rTSA) is a largely used procedure with a wide variety of indications. The incidence of this surgery is increased in recent years and the literature expects similar trend for the future. Metaphyseal stem rTSA seems to be a promising solution considering major objectives the preservation of humeral bone stock and ease of revision. In our study we analyzed 19 patients treated with cementless metaphyseal stem rTSA for osteoarthritis (group A) and acute fractures (group B). In group A (7 patients) the average Constant score improved from 21,57 (16-29) to 56,85 (38-72), the average SST improved from 2,29 (1-4) to 9,43 (8-12) and the mean VAS score improved from 14,29 to 4,86. In group B (12 patients) the mean Constant-Murlay score at last follow up was 42,17; the average SST was 7 and average pain score was 8,92. Overall active range-of-motion (ROM) improved significantly. Surgical considerations, clinical (analyzing Constant score and Simple Shoulder Test) and radiological short-term outcomes are encouraging, with low rate of complications. Long term follow-up studies are necessary to confirm our findings and the potential benefits related to these implants. ([www.actabiomedica.it](http://www.actabiomedica.it))

**Key words:** shoulder arthroplasty, reverse shoulder arthroplasty (rTSA), range-of-motion (ROM)

## Introduction

The incidence of reverse shoulder arthroplasty (rTSA) is lower than hip and knee prostheses (1-3) but the number of implants is increased in last years and this trend should continue due to increasing of high demanding patients, better health care capacity and expanding indications (4-6).

In USA 42% of all shoulder arthroplasties were rTSAs in 2011 (7) with a large use in patients <60 years (8, 9).

Several designs, materials and implant characteristics are available and the indications are in particular glenohumeral osteoarthritis with rotator cuff deficiency and severe humeral head-neck fractures in elderly patients (10-15).

On the basis of these considerations and the necessity to treat often young patients that probably will

need also revision surgery, short stem and metaphyseal implant recently emerged (16-22). Short-term studies reported functional and radiological results similar to the gold standard shoulder stemmed implants (16, 23).

The aim of the study is to share our experience and preliminary results with a cementless rTSA with metaphyseal stem in both glenohumeral osteoarthritis and acute fractures.

## Materials and methods

Between May 2016 and June 2018 19 patients underwent rTSA by the senior author (G.S.) utilizing a cementless prosthesis with short metaphyseal stem (Verso®; Innovative Design Orthopaedics, London, UK) and also the stemmed version proposed for the treatment of acute fracture.

Seven patients suffer for glenohumeral arthropathy with deficient rotator cuff (Group A - Fig. 1) and twelve patients had acute displaced fractures of the proximal humerus (Four parts or more according to Neer classification) with rotator cuff dysfunction (Group B - Fig. 3).

In group A there were 2 male and 5 females, the mean age at surgery was 77,33 years (range 65-88 years) and the average follow up was 6,43 months (range 5-9 months)

In group B there were 4 males and 8 females, the mean age at surgery was 79 years (range 68-84 years) and the average follow up was 5 months (range 3-9 months).

#### *Surgical Technique*

The surgery was performed with the patient in "beach chair" position under general anesthesia with interscalene block (blended technique).



**Figure 1.** Preoperative x-rays

In group A patients all the procedures were performed through the anterosuperior approach to the shoulder (Neviaser-MacKenzie approach) while in group B patients though the deltopectoral approach.

In group A patients any remnants of subscapularis or infraspinatus were detached and tagged with stay sutures.

Minimal proximal humeral bone resection was performed and the cancellous bone was used for bone graft impaction technique as purposed by Levy et al (19) and other authors (24).

In group B after individuation and isolation with stay suture of greater and lesser tuberosity parts, the humeral head was remove and used for bone graft impaction technique.

The humeral stemless component was implanted in group A patients while the humeral stemmed component was used in group B patients.



**Figure 2.** Three months follow up x-rays

Good initial press-fit fixation was achieved in all patients.

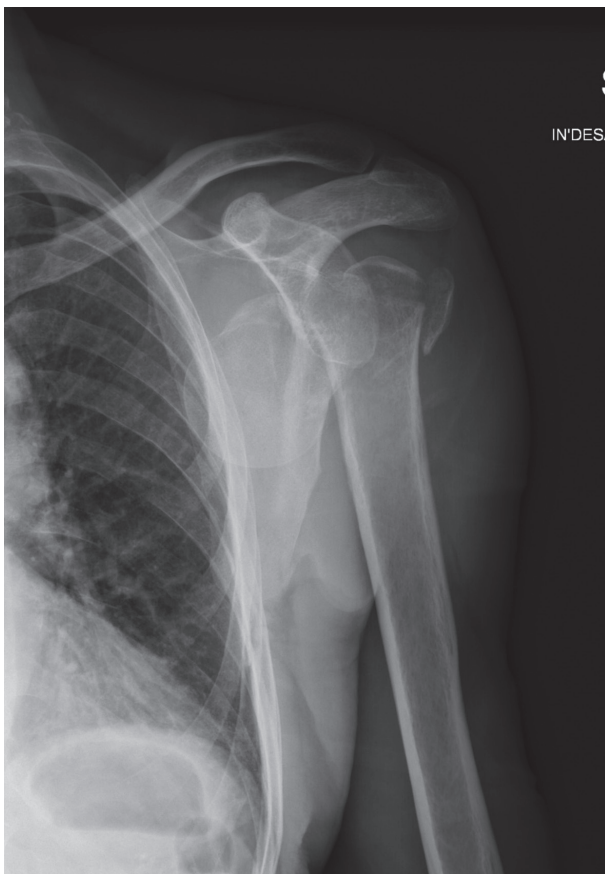
Standard glenoid component was implanted in all patients.

Tuberosities re-attachment was performed using non-absorbable suture (Orthocord® DePuy Sinthes Raynham, Massachusetts, USA) in all cases when possible.

Postoperative rehabilitation included sling immobilization for 2 weeks followed by passive range-of-motion exercises after 2-3 weeks, active range-of-motion exercises after 4-6 weeks and incorporation of strengthening from week 12-20.

#### *Assessment*

Patient evaluation was performed by independent observers pre operatively (only in group A) and at 3,6 and 9 months.



**Figure 3.** Preoperative x-rays

Functional outcome was evaluated with Constant score (pain, activities of daily living, active range of motion and shoulder strength). Range of motion was measured with a goniometer. Active internal rotation was measured as the highest spine level that the patient's thumb could reach. Patients satisfaction was assessed using the Simple Shoulder Test (SST), a functional questionnaire assessing return to work, sport and leisure activities.

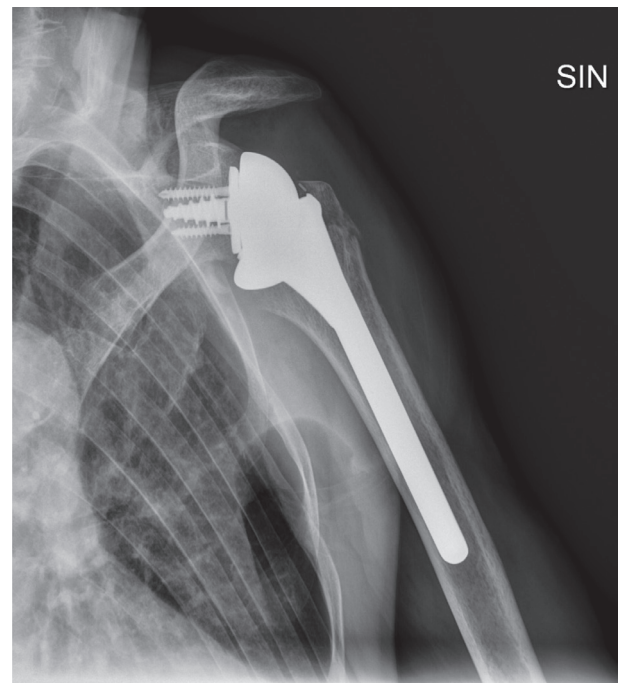
Pain relief was assessed on a 0-15 Visual Analogue Scale (VAS).

Radiograph evaluation was performed analyzing AP and axillary view of the shoulder for any evidence of complication including displacement, migration, subsidence of the implant and appearance of radiolucent lines, osteolysis or sign of stress shielding (Fig. 2, 4).

#### *Statistical methods*

Statistical analysis was performed using Microsoft Excel (2017 version).

In group A patients improvement in Constant score or SST score were calculated for each case by



**Figure 4.** Six months follow up x-rays

comparing the latest observed postoperative value against the corresponding preoperative value and the significance of the difference was tested using the paired t test.

## Results

In group A patients the average Constant score improved from 21,57 (16-29) to 56,86 (38-72), the average SST improved from 2,29 (1-4) to 9,43 (8-12) and the mean VAS score improved from 14,29 to 4,86.

All these gains were statistically significant ( $P < 0.001$ )

Overall active range-of-motion (ROM) improved significantly (Tab. 1).

In group B patients the mean Constant-Murlay score at last follow up was 42,17, the average SST was 7 and average VAS score was 8,92.

Average active range of motion at last follow up is described in table 1.

There were no cases of intraoperative fractures or dislocations in follow-up period.

No findings of subsidence, radiolucent lines around the components and notching at the radiological follow up. No signs of mobilization or position changing over the time of the humeral stem were recognized.

One patient in B group presented axillary nerve palsy after surgery, but it recovery spontaneously within six months.

At the time of the study no patient had undergone to revision surgery.

## Discussion

The decision to perform a study analysing both stemmed and unstemmed version of this prosthesis come from the concept that with Verso the surgeon doesn't have to obtain the cortical press fit with the stem as usually performed with the majority of the available implants (19, 25).

The stemmed version used for the treatment of acute fracture has the same proximal shape of the stemless implant for achieve the primary stability while the

distal part works like a "rudder" in particular in complex fracture patterns. The press fit is with metaphyseal cancellous bone in both groups.

We decided to perform the anterosuperior approach in group A patients while the deltopectoral approach in group B patients. The reason is that we usually use the deltopectoral approach for all the other implants and indications and we believe is easier to enlarge distally in case of peri-implant or intraoperative fractures. Nevertheless we observe that the exposition and preparation of the anatomical structures, in particular the glenoid, is better with the anterosuperior approach, that allows to perform also the open acromion-clavicular decompression and the best suture of the posterior cuff to the humeral bone.

In all cases the glenoid preparation is performed carefully, in particular the round movements of the handy reamer should be as gentle as possible because the pressure exerted on the glenoid bone is very high.

In both groups the humeral preparation is conducted saving much cancellous bone possible. The three tapered thin fins give a theoretical immediate metaphyseal press fit fixation as reported in literature (19, 25). The sensation of stability is not always so secure after the insertion of the last humeral punch, in particular in case of fractures when surgical humeral neck is involved.

In this stage a key role is played by the "bone graft impaction technique" (19, 24) that consists in morselize the cancellous bone of the humeral head and put the small pieces inside the metaphysis between first and last humeral punch insertion and before the humeral shell positioning. Thus in combination with the titanium and hydroxyapatite coating of the definitive humeral component give always a sensation of stability to the surgeon in all cases of our series, and allowed us to avoid the use of cement that could complicate any further revision surgery.

In our opinion the highest difficulty is to move from the concept of achieve cortical press fit to metaphyseal cancellous bone press fit and trust in this philosophy.

Analyzing clinical results all patients had good pain relief and statistical significative improvement of Constant-Murlay and SST scores according to the recent literature (26-28). Considering the ROM the

Table 1.

| ARTROSI  | ETA'       | FOLLOW UP  | CONSTANT PRE  | CONSTANT POST | PAIN PRE    | PAIN POST   | ER PRE      | ER POST    | IR PRE     | IR POST    | ABD PRE    | ABD POST   | FLEX PRE   | FLEX POST  | SST PRE    | SST POST   |
|----------|------------|------------|---------------|---------------|-------------|-------------|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| 1        | 65         | 5          | 17            | 38            | 15          | 10          | 0           | 15         | 10         | 50         | 45         | 110        | 30         | 120        | 1          | 8          |
| 2        | 69         | 6          | 22            | 64            | 12          | 4           | 10          | 30         | 30         | 60         | 60         | 150        | 45         | 150        | 3          | 10         |
| 3        | 88         | 6          | 16            | 44            | 15          | 6           | 5           | 60         | 10         | 70         | 45         | 150        | 45         | 150        | 2          | 8          |
| 4        | 71         | 9          | 29            | 72            | 14          | 0           | 0           | 75         | 25         | 90         | 70         | 180        | 60         | 180        | 4          | 12         |
| 5        | 67         | 7          | 20            | 55            | 15          | 5           | 0           | 60         | 10         | 60         | 45         | 150        | 30         | 150        | 1          | 8          |
| 6        | 79         | 6          | 25            | 67            | 14          | 2           | 5           | 60         | 20         | 70         | 60         | 180        | 45         | 180        | 3          | 10         |
| 7        | 73         | 6          | 22            | 58            | 15          | 7           | 0           | 60         | 20         | 60         | 45         | 130        | 30         | 150        | 2          | 10         |
| MEDIA    | 73,1428571 | 6,42857143 | 21,57142857   | 56,85714286   | 14,2857143  | 4,85714286  | 3,57142857  | 51,4285714 | 17,8571429 | 65,7142857 | 52,8571429 | 150        | 40,7142857 | 154,285714 | 2,28571429 | 9,42857143 |
| SD       | 7,96719464 | 1,27241802 | 4,503966506   | 12,30756639   | 1,11269728  | 3,28778403  | 3,77964473  | 20,9591439 | 8,09173594 | 12,7241802 | 10,3509834 | 25,1661148 | 11,3389342 | 20,7019668 | 1,11269728 | 1,51185789 |
| p value  |            | <0.0001    |               | <0.0001       |             | <0.0001     | 0.0001      |            | <0.0001    |            | <0.0001    |            | <0.0001    |            | <0.0001    |            |
| FRATTURE | ETA'       | FOLLOW UP  | CONSTANT POST | PAIN POST     | ER POST     | IR POST     | ABD POST    | FLEX POST  | SST POST   |            |            |            |            |            |            |            |
| 1        | 82         | 3          | 58            | 7             | 10          | 50          | 130         | 150        | 8          |            |            |            |            |            |            |            |
| 2        | 78         | 3          | 38            | 8             | 20          | 45          | 60          | 120        | 7          |            |            |            |            |            |            |            |
| 3        | 73         | 4          | 44            | 10            | 10          | 30          | 60          | 120        | 7          |            |            |            |            |            |            |            |
| 4        | 84         | 6          | 32            | 10            | 10          | 45          | 90          | 90         | 6          |            |            |            |            |            |            |            |
| 5        | 80         | 6          | 48            | 8             | 10          | 45          | 60          | 150        | 6          |            |            |            |            |            |            |            |
| 6        | 72         | 3          | 39            | 7             | 30          | 30          | 90          | 120        | 7          |            |            |            |            |            |            |            |
| 7        | 76         | 5          | 55            | 5             | 60          | 60          | 120         | 150        | 8          |            |            |            |            |            |            |            |
| 8        | 75         | 4          | 37            | 10            | 10          | 30          | 90          | 90         | 6          |            |            |            |            |            |            |            |
| 9        | 80         | 6          | 49            | 8             | 30          | 45          | 60          | 120        | 8          |            |            |            |            |            |            |            |
| 10       | 77         | 8          | 33            | 12            | 10          | 20          | 45          | 60         | 5          |            |            |            |            |            |            |            |
| 11       | 68         | 9          | 44            | 10            | 20          | 30          | 60          | 90         | 10         |            |            |            |            |            |            |            |
| 12       | 83         | 3          | 29            | 12            | 10          | 30          | 45          | 90         | 6          |            |            |            |            |            |            |            |
| MEDIA    | 77,3333333 | 5          | 42,16666667   | 8,916666667   | 19,16666667 | 38,33333333 | 75,83333333 | 112,5      | 7          |            |            |            |            |            |            |            |
| SD       | 4,81160214 | 2,04494943 | 9,13368723    | 2,108783938   | 15,0504203  | 11,5470054  | 28,028665   | 28,959219  | 1,34839972 |            |            |            |            |            |            |            |



outcomes are encouraging, in particular regarding internal and external rotation. Several studies in literature analysing Grammont-type reverse arthroplasties reported poor values of rotation, our results could be positive influenced by the very low medial profile of polyethylene liner combined with the glenoid sphere offset and 30° of humeral shell retroversion as suggested by the technique (19).

In our opinion also the suture of the tuberosities as much as possible in the original anatomic position, is mandatory for obtaining the best ROM after rTSA surgery for both fracture and osteoarthritis patterns (29).

Radiological outcomes are excellent, without any complication (30), probably related to the short-term follow up (9 months maximum). Not in all cases, in particular in group A (shorter stem), the humeral stem was perfectly aligned with the diaphysis, in 2 cases there were small degrees of varus angulation but without any clinical implication.

In one series conducted with the same implant (Verso prosthesis) glenoid notching was observed in 21,4% of patients (19) lower than those reported in other studies on rTSA in literature (31-36). At the follow up time we didn't observe any case of glenoid notching probably related to the little cohort of patients and follow up duration.

Regarding the case of transitory axillary nerve palsy we hypothesized a strong relationship with high energy trauma. Neurological signs could be underestimated at the admission and the findings at the follow up not related to the surgical procedure. At six months follow up we observe spontaneous recovery of the nerve palsy, with good values of clinical scores and satisfaction.

## Conclusions

Analysing the increase number of implants and the widening of the indications, in particular in younger patients, a cementless short stem reverse arthroplasty could be a precious solution in line with the principles of "tissue sparing surgery". Our preliminary experience has reported positive sensations and encouraging results. More randomized controlled studies about short

stem rTSA are necessary and currently under clinical investigation. In our opinion advantages as easier revision with stemmed implant and periprosthetic fracture involving the metaphysis rather than diaphysis are useful and considerable.

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