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# Reverse shoulder arthroplasty for deltoid-deficient shoulder following latissimus dorsi flap transfer. Case report

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ABSTRACT

*INTRODUCTION:* The usual indication for reverse shoulder arthroplasty is glenohumeral arthritis with inadequate rotator cuff and intact deltoid muscle. We report here a case of reverse shoulder arthroplasty using a lattisimus dorsi flap in a patient with deltoid-deficient shoulder following a gunshot injury.

*PRESENTATION OF THE CASE:* The patient was an otherwise healthy 51-year-old male with a history of gunshot injury of the left shoulder 2006. Upon presentation in 2011, the patient had a loss of most of his shoulder bony and muscular structures. Due to deltoid muscle deficiency, the patient underwent Lattisimus Dorsi muscle flap followed by reverse shoulder arthroplasty in order to establish an upper limb function.

Upon discharge, 11 days after the surgery, the patient was able to achieve 150° flexion and 90° abduction while in the supine position and 45° in each direction, while sitting. He was able to perform internal rotation (behind back) up to the level of the L1 vertebra, assisted active abduction of 90°, and external rotation of 20°. Power tests showed power of grade 4/5 for both shoulder flexion and extension and grade 2+/5 for both abduction and adduction.

At the last follow up one year after the operation, The patient still had passive pain-free full range of motion, but no progress in active range of motion beyond that upon discharge.

*CONCLUSION:* Reverse shoulder arthroplasty after Latissmus dori flap in patient with deltoid deficient shoulders can be a successful and reproducible approach to treat such conditions.



## 1. Introduction

The introduction of Grammont's Delta prosthesis, which, as its name suggests, serves the role of the deltoid muscle for the success of the reverse shoulder arthroplasty has prompted surgeons to consider only the anatomical rather than the functional existence of the muscle. We think that this has limited the scope and the benefits of reverse shoulder arthroplasty and, possibly, a considerable proportion of the reported failure rates.

Here, we present a case of traumatic shoulder injury resulting in arthritis with loss of the rotator cuff and deltoid muscles, which was successfully treated by reverse shoulder arthroplasty, following a latissimus dorsi myocutaneous flap transfer.

This procedure has been described as a solution to arthritic shoulders with rotator cuff deficiency and loss of abduction and external rotation. Ortmaier et al. [13] reported improvement of the functional scores of patients underwent reverse shoulder arthroplasty with Latissimus dorsi transfer in his systematic review. However, using this procedure after severe traumatic shoulder injury has not been described according to our knowledge. This report would add to the indications of such procedure and to the clinical practice.

This case report was written in line with SCARE Guidelines [8]

## Case description

The patient was an otherwise healthy 51-year-old male with a history of gunshot injury of the left shoulder by a large caliber machine gun (DShK) in Darfur, Sudan, in December 2006. The patient is smoker with irrelevant drug histoy. As treatment, the patient underwent multiple debridement surgeries (Sudan, Ethiopia). However, he had not received any form of physical rehabilitation, leading to a painfully stiff left shoulder, with a significant loss of bone elements, scarring, and soft tissue loss. There were no available records for the details regarding the initial injury, nor the abovementioned debridement surgeries; however, pre-operative assessment in Qatar (Dec 2011) revealed almost complete loss of the left shoulder components, namely, the humeral head, acromioclavicular joint, along with at least the lateral fifth of the clavicle, tendons of the rotator cuff muscles, and the main bulk of the deltoid muscle, as well as retained ammunition particles of variable sizes (Fig. 1). He also had ipsilateral elbow injury with ulnar nerve neu-

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roma and neuropathy, which were resolved by neuroma resection and nerve transposition with no consequent nerve compromise.

The patient was referred to the reconstruction surgeon at the plastic surgery unit, where he underwent pedicled myocutaneus (latissimus dorsi) flap coverage, followed by skin grafting a week later, in December 2011.

Five months later, and after satisfactory soft tissue healing, he was admitted to the orthopedic ward, where he was scheduled to undergo an elective joint replacement in May 2012.

Preoperative assessment: Clinical examination, as shown in the photo (Fig. 1); showed a healed scar indicative of previous soft-tissue reconstruction surgeries, with mild keloid formation. Examination of the axillary nerve revealed intact motor function and normal sensation over the deltoid "patch." Neurovascular examination of the rest of his arm showed tingling and numbness along the ulnar nerve distribution.

Shoulder examination: The patient had very limited active and passive range of movement. He tended to move the scapula instead of the shoulder's glenohumeral joint itself; 15° of forward elevation, 20° of abduction, 15° of external rotation, and internal rotation to L3, with grade "zero" power for shoulder flexion, extension, and external and internal rotation. Passive flexion and abduction was possible to a maximum of 30° only.

Needle electromyography test of the left shoulder was performed to assess the viability of the latissimus dorsi flap transposition; it showed normal amplitudes and potentials. Moreover, the remnant part of the native anterior deltoid muscle showed muscle potentials upon attempt to voluntarily elevate the arm. Radiological images were then reviewed, followed by preoperative planning and both digital and analog templating.

## 2. Procedure

After the risks and benefits of the procedure were discussed with the patient, implantation of the Delta III reverse shoulder arthroplasty prosthesis (DePuy, Saint-Priest, France) was performed on 30th May 2012 by a senior consultant adult reconstruction orthopedic surgeon. The operation was performed with the patient in the beach chair position; examination under anesthesia confirmed the restricted range of motion, suggesting the presence of significant contracture. A slightly lateral surgical incision was made to avoid injury to the latissimus dorsi, using a more extensile than the traditional deltopectoral approach. Care was taken to prevent injury to the anterior portion of the deltoid muscle, the axillary nerve, and the rotator-cuff tendons. Scar tissue was cleared from the subdeltoid–subacromial space, including the area between the conjoined tendons and the subscapularis. The subscapularis tendon was divided 1 cm medial to its humeral attachment, and up to two-thirds of the pectoralis major tendon was released from its humeral insertion. The humeral head was identified and was found to be completely destroyed with central and posterior defects and some rotator-cuff fibers, present mainly posteriorly; the remaining cuff tissue was of poor quality, and so further disruption was avoided. Many pieces of shrapnel were detected around the shoulder joint and during the surgery; only those pieces that prevented the movement of the shoulder and those in close proximity to neurovascular structures were removed; the remaining pieces were left in situ to prevent soft tissue damage during dissection. Intramedullary resection of the humeral head was performed, followed by glenoid preparation. A standard baseplate with a 38-mm eccentric glenosphere was inserted into the glenoid. This was secured with 3 locking screws. The humerus was prepared, and the definitive stem (size, 12 mm) was inserted into the prepared pre-existing cement mantle. The reduction was checked for stability (especially during abduction, extension, and internal rotation), and achievement of full passive elevation was confirmed. The subscapularis was reattached through drill-holes into the native proximal humerus, followed by a routine closure using 2-0 vicryl sutures. The range of motion was retested: forward elevation was possible for 60–70°, external rotation for 45°, abduction for 60°, and internal rotation to the level of the iliac crest. Good hemostasis was achieved, and a closed-drain system was left in situ. The patient's recovery was uneventful. Postoperative radiographs showed good positioning of the implant components (Fig. 2).

Early postoperative intensive physiotherapy was started. Passive range of motion was started on the 1st postoperative day along with assisted active range of motion. The wound healed uneventfully. Upon discharge, 11 days after the surgery, the patient was able to achieve 150° flexion and 90° abduction while in the supine position and 45° in each direction, while sitting. He was able to perform internal rotation (behind back) up to the level of the L1 vertebra, assisted active abduction of 90°, and external rotation of 20°. Power tests showed power of grade 4/5 for both shoulder flexion and extension and grade 2+/5 for both abduction and adduction. The physiotherapy was continued for three months after the operation and then stopped since the patient travelled back home. Later serial assessment showed progressive improvement, until eventual discontinuation of follow up after postoperative month 6 since the patient was involved in some political activities at his home-

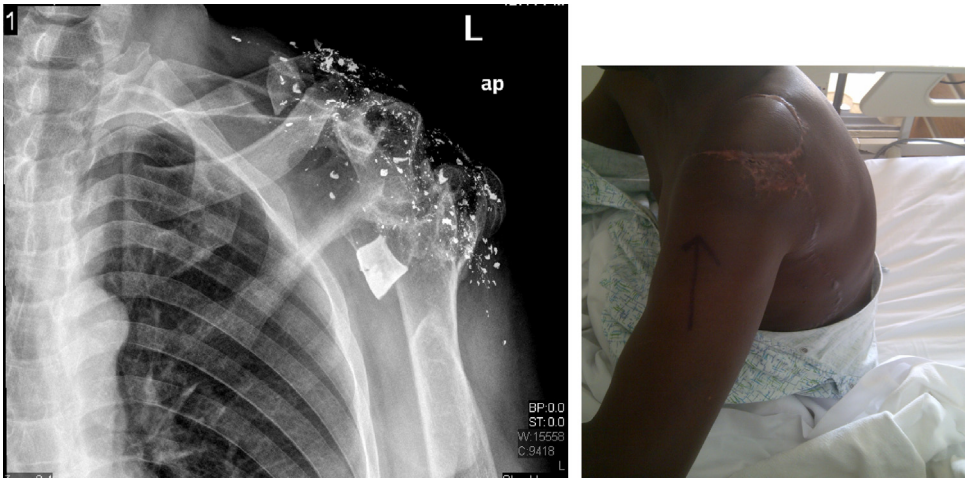


**Fig. 1.** Preoperative AP shoulder view demonstrating the destroyed joint components as well as the retained ammunition particles. The photograph represents the healed surgical scar of the pedicled latissimus dorsi flap.

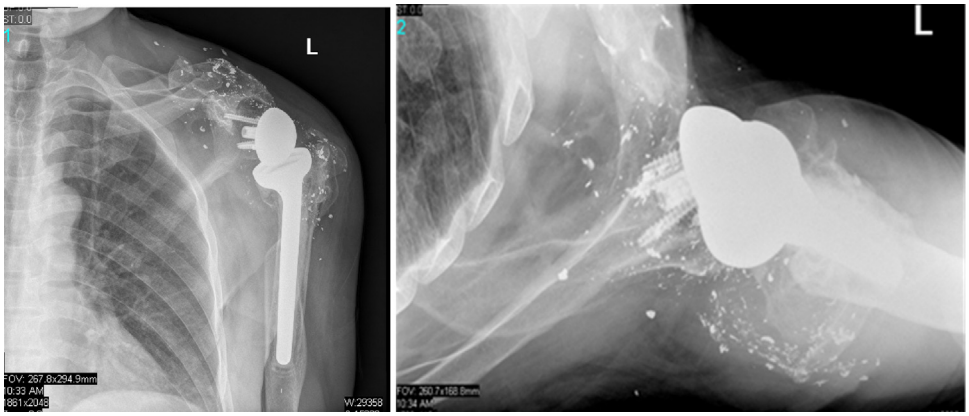


**Fig. 2.** Postoperative radiograph in AP and axillary views, showing the implant components.

land. Later, the patient was seen again and for the last time one year after the operation, the patient reported that he continued to have tolerable pain on exertion and no pain at rest. The patient still had passive pain-free full range of motion, but no progress in active range of motion beyond that upon discharge. The implant was found to be intact in position. The patient was lost afterward and he was unreachable.

## 3. Discussion

Rotator cuff-deficiency with chronic osteoarthritis of the shoulder has proved to be a difficult condition to treat successfully, and a surgical option that both relieves pain and improves shoulder function remains elusive. Treatment options have included, but are not limited to, non-operative management, glenohumeral arthrodesis, resection arthroplasty, constrained or conventional total shoulder arthroplasty, and hemiarthroplasty [1,2]. However, patient dissatisfaction with functional outcomes and high long-term complication rates with traditional management strategies have revived interest in reverse shoulder arthroplasty. Ithas been shown that this procedure relieves the pain and improves the function in shoulder arthritis associated with massive rotator cuff tears [3]. In 1993, Grammont and Baulot first reported the development of the reverse shoulder arthroplasty (Delta) for the repair of rotator cuff rupture [4]. The principle of the this arthroplasty design increases the deltoid movement of the arm by medializing the centre of rotation and by shifting the deltoid insertion site distally. These two factors render the centering function of the rotator cuff less important for shoulder elevation and improve the mechanical advantages of the deltoid. Both factors result in an improvement in shoulder function in the presence of an insufficient rotator cuff. To our knowledge, no report has been published regarding reverse shoulder arthroplasty in a patient with gunshot extensive injury to the shoulder with massive rotator cuff tear with severe osteoarthritis.

In our patient, shoulder function was extremely limited due to pain. Total shoulder arthroplasty would have failed because of the massive tear and degeneration of the rotator cuff in this joint due to the extensive soft tissue injury. The clinical presentation of a glenoid and a deformed humeral head with severe degeneration of the rotator cuff, but a reasonable deltoid muscle, led us to recommend reverse shoulder arthroplasty, even though joint replacement is generally considered risky in such injury with residual shrapnel because of the higher chances of infection. Adequate glenoid bone stock is a prerequisite for the placement of the glenoid component of a reverse shoulder arthroplasty implant. In this patient, the effect of gunshot injury is more in the humeral head and soft tissue round the shoulder joint, without the involvement of the glenoid. All patients in a previous series had significant decline in their functional outcome after the anterolateral deltoid rupture and the report seemed to support the concept that the anterior deltoid is vital for a successful outcome after reverse shoulder arthroplasty [5]. However, Glanzmann et al. [6] reported a successful reverse shoulder arthroplasty implantation after a previous deltoid muscle flap transfer, suggesting that the entire deltoid may not be necessary for a successful outcome. These diverging reports underscore the importance of clearly elucidating the role of the anterior deltoid before and after reverse shoulder arthroplasty.

To our knowledge, no suitable surgical options are available for younger patients [11] with pain and loss of function after the extensive soft tissue injury to the shoulder with chronic glenohumeral arthritis, severe rotator cuff deficiency and partial deltoid muscle functioning. On the other hand, the advances in successful muscle flap and tendon transfer surgeries have made it possible to compensate for a great proportion of muscle loss [12] due to injuries, and in the presence of sufficient glenoid anatomy and bone stock and proper physiotherapy and rehabilitation. The absence of a native deltoid as a contraindication for the reverse shoulder arthroplasty could be rendered rather questionable. Despite the fact that the current practice still consider reverse shoulder arthroplasty as being associated with a high complication rate [9,10], recent study by DG Schwartz et al. [7] has proved the significance of the anterior deltoid as a superior factor in reverse shoulder arthroplasty success. The success of the procedure in our case report may be attributed to the viability of the anterior deltoid, as evident by preoperative needle EMG, as well as being reinforced by the transferred flap.

On the basis of our experience, we think that this two-staged reconstruction strategy could be reproducible for patients with preserved glenoid after similar trauma or post-tumor excision surgeries, where both the deltoid and the rotator cuff are deficient. In such cases, the transferred muscle flap can be attached to the anatomical site and (or) remnants of the deltoid, with special consideration for the anterior muscle component, and thereby afford redundancy to accommodate the arthroplasty prosthesis and sufficient bulk to stabilize the prosthesis; this will allow the patient to perform abduction and also assist in flexion and extension [13].

It is essential to emphasize that since reverse shoulder arthroplasty is a relatively recent development, it should be recognized as an evolving field with scope for re-consideration in order to achieve outcomes comparable to those afforded by well-established joint reconstruction surgeries. It worth mentioning that major guidelines for the procedure are still evolving and some concepts and phenomena earlier assumed to be solid facts could dramatically change or even prove to be otherwise.

## 4. Conclusion

Reverse shoulder arthroplasty after Latissmus dori flap in patient with deltoid deficient shoulders can be a successful and reproducible approach to treat such conditions.

## Conflicts of interest

All of the Authors declare that they have no conflict of interest either personally or with any of their relatives.

## Funding

All authors declare that they did not receive any source of funding by any mean to run this case report. They wrote this paper and they edit it on their own fund.

## Ethical approval

This article has been reviewed and approved by Medical Research centre (MRC) in QATAR.

## Consent

Informed consent was taken from the patient father in order to publish this case report

## Author contribution

Dr Mohamed Aldosari: is the corresponding author he shared in study design, data collection and analysis and writing the paper, reviewing literature. Dr. Shamsi Hamid: Study design and data analysis Dr. Khalid Mokhtar: Study design and data analysis Dr. Aissam Elmhiregh: he shared in data analysis and publication.

## Guarantor

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Consent form was obtained from the patient in order to publish this case report.

This report was written in line with SCARE criteria [8].

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