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ORIGINAL ARTICLE

# A New "Trapdoor technique" for Fixation of Displaced Greater Tuberosity Fractures of the Shoulder

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**Abstract** Isolated greater tuberosity fractures of the proximal humerus are frequently displaced posteriorly and superiorly by the pull of the rotator cuff. This displacement can lead to a decline in function if left untreated. Traditionally these fractures have been treated surgically using screw fixation. On occasions this metalwork can remain prominent and potentially cause impingement. We present a new surgical "trapdoor" technique for fixation of isolated greater tuberosity fractures which can avoid these problems and be utilised either open or arthroscopically. Following reduction of the isolated greater tuberosity fragment, two double loaded metal screw in anchors are placed through stab incisions in the rotator cuff at the bone-tendon interface and secured into the humeral head. A suture from each of the anchors is tied together to secure the tuberosity fragment proximally and a suture-less anchor is inserted distal to the fracture site forming an inverted triangle. The remaining sutures are placed through the suture-less anchor and tensioned independently. As the sutures are tied and snugged tight, the distal aspect of the fracture reduces, thus closing the "trapdoor." This is a newly described versatile technique that can be used regardless of the size and comminution of the tuberosity fragment and can be performed either open or arthroscopically. It avoids the problems of metalwork prominence and irritation and the use of the suture-less anchor allows independent tensioning of the sutures to ensure adequate fracture reduction.

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Isolated greater tuberosity fractures of the proximal humerus are frequently displaced posteriorly or superiorly by the pull of the rotator cuff. This postero-superior displacement is associated with poor outcomes if left untreated [1]. Superior migration of the tuberosity may result in impingement and weakness of abduction whilst posterior migration may result in a loss of external rotation.

Historically greater tuberosity fractures have been treated surgically using either screw fixation or the use of sutures inserted through drill holes [2].

We present a new surgical option, the "trapdoor technique", which utilises versatile suture anchors and provides a stable fixation of the greater tuberosity without the prominence and associated problems of metalwork.

There is only one documented paper using suture anchor techniques arthroscopically for treating isolated greater tuberosity fractures but this excluded fractures with displacement of more than 20 mm [3]. The advantage of our technique is that it can be used both arthroscopically for minimally displaced fractures and open for fractures with significant displacement. The same technique can be used regardless of fracture size and comminution.

## Surgical Technique

All our patients had sustained isolated greater tuberosity fractures (Fig. 1. Isolated greater tuberosity fracture) and were operated under general anaesthesia with antibiotic cover, according to local policy, in a beach chair position.

**Fig. 1** Isolated greater tuberosity fracture

For the open procedure, a McKenzie approach is utilized i.e., an incision from the anterolateral tip of the acromion longitudinally down approximately 4 cm. The plane of dissection is through the anterolateral deltoid raphe with the axillary nerve palpated for reference in each case. This is located digitally at the level of the inferior part of the subacromial bursa. The overlying bursa and any organized haematoma are removed.

The greater tuberosity fragment and its corresponding bed are identified and cleaned using normal saline and a periosteal elevator. Under direct vision a tendon hook or a transtendinous suture is used to confirm the ability to reduce the cuff and tuberosity fragment. (Fig. 2 Mobilised greater tuberosity fragment).

With the cuff reduced, two metal screw in suture anchors of at least 5 mm diameter and double loaded with Orthocord [4] are placed through stab incisions in the rotator cuff at the bone-tendon interface and secured into the humeral head (Fig. 3 Proximal anchors inserted through cuff).

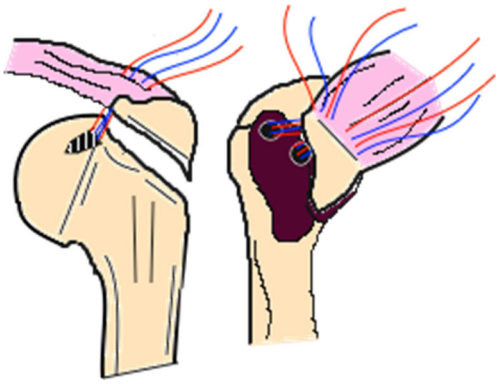

**Fig. 3** Proximal anchors inserted through cuff

One of the sutures from each anchor is tied together forming a "bridge" over the proximal aspect of the greater tuberosity fragment securing it in place. This creates a "Trapdoor" effect where the remaining fracture fragment can hinge on the proximal part of the fragment.

A suture-less anchor, such as the Versalok [4] is then inserted into the humerus at the distal apex of the tuberosity bed. The three anchors have now formed an inverted triangle. The remaining sutures from each of the double loaded anchors are inserted through the Versalok [4]. The sutures can now be tensioned independently using the Versalok [4]. This ensures that as the sutures are snugged tight, the distal aspect of the greater tuberosity reduces by hinging on the proximal row, thus "closing the trapdoor" (Fig. 4 Final position of anchors with reduction of tuberosity fragment).

Closure is performed in layers and the arm is supported in a polysling.

We follow a standard post-op rehabilitation protocol in which patients are initially limited to passive movement of the shoulder as pain allows for the first 2 weeks and then active assisted movement after this time.

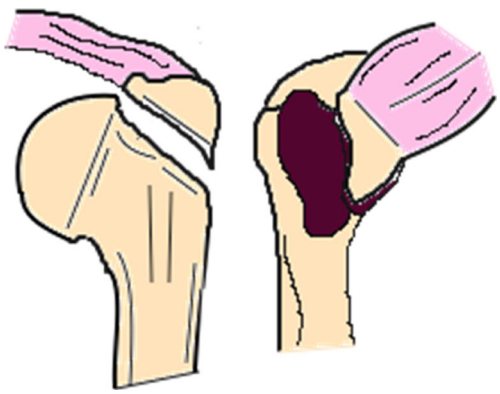

**Fig. 2** Mobilised greater tuberosity fragment

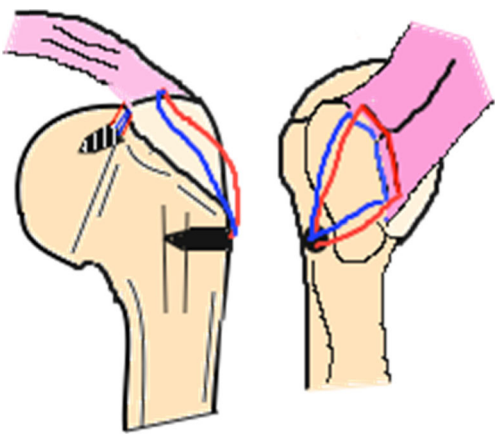

**Fig. 4** Final position of anchors with reduction of tuberosity fragment

**Fig. 5** Radiograph of post-operative tuberosity fixation

Check radiographs are taken at 2 and 6 weeks post-operatively to ensure that no displacement has occurred (Fig. 5 Radiograph of post-operative tuberosity fixation).

Subsequent follow up occurs at 3 and 6 months post-operatively for a clinical assessment. By 6 weeks 57 % of patients have achieved flexion and abduction of at least 90°. 28 % of our patients have achieved a full range of movement when compared to the contralateral shoulder at 3 months and by 6 months this has increased to 85 % of patients.

To date we have had one complication in which an anchor was advanced too far into the humeral head and appeared to have penetrated the articular surface on follow up radiographs. A subsequent repeat arthroscopy revealed that the anchor had penetrated posteriorly in a non-articulating part of the humeral head. There were no associated clinical symptoms and the patient was followed up for a year with repeat radiographs, which showed union of the greater tuberosity fracture and no evidence of anchor migration.

This is a newly described versatile technique that can be used regardless of the size and comminution of the tuberosity fragment and can be performed either open or arthroscopically. It avoids the problems of metalwork prominence and irritation and the use of the suture-less anchor allows independent tensioning of the sutures to ensure adequate fracture reduction.

**Compliance with Ethical Standards**

**Conflict of Interest** Iain McLaughlin-Symon, Peter Kenyon, Barnes Morgan and Matt Ravenscroft declare that they have no conflict of interest.

**Ethical Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

## References

1. Verdano MA, Aliani D, Pellegrini A, Baudi P, Pedrazzi G, Ceccarelli F (2014) Isolated fractures of the greater tuberosity in proximal humerus: does the direction of displacement influence functional outcome? An analysis of displacement in greater tuberosity fractures. Acta Biomed 84(3):219–228
2. Wang YP, Zhao JZ, Huangfu XQ, Liu WX, Jiang Y, Zhou XH, He YH (2012) Arthroscopic reduction and fixation for isolated greater tuberosity fractures. Chin Med J 125(7):1272–1275
3. Ji JH, Shafi M, Song IS, Kim YY, McFarland EG, Moon CY (2010) Arthroscopic fixation technique for comminuted displaced greater tuberosity fracture. Arthroscopy 26(5):600–609
4. Depuy Synthes Mitek manufacturer of products Leeds UK