Modified bilaterotricipital approach to the distal humerus: a triceps preserving technique

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Introduction

Achieving a good exposure is the key to successful elbow surgery. This applies to both trauma (open reduction and internal fixation of distal humeral fractures or arthroplasty) and elective surgery (joint debridement or arthroplasty).

The common approaches to the posterior part of the elbow joint and the distal humerus are via an olecranon osteotomy, reflection of the triceps or by making a mid-line split in the triceps.¹ Although, for a variety of indications, all are able to produce an adequate exposure of the distal humerus, each technique has an undesirable complication profile. Olecranon osteotomy has been associated with fixation problems (mainly prominent metal work) and/or non-unions, whereas violating the triceps has been shown to cause significant triceps weakness and reduced range of movement postoperatively.^{2,3} This is the result of a combination of denervation of the distal endplates and scarring limiting excursion of the muscle.

Hence, the need remains for an approach that gives reliable exposure to the dorsum of the distal humerus and the elbow joint, without introducing a new problem (e.g. damaging the extensor mechanism or the need to apply metal work to the posterior surface of the proximal ulna). Bryan and Morrey first described a 'triceps sparing' approach to the posterior humerus in 1975.¹ Subsequently, many surgeons have attempted to refine the technique. Schildlauer et al.⁴ developed the technique further in 2003, although their focus was exclusively on distal humeral fracture fixation. They did not consider how their approach could be used for arthroplasty surgery.⁴ The main issue shared between the 'triceps sparing' approaches is potential triceps weakness. Because the triceps footprint is

detached from the proximal ulna (either purely through the tendon or sometimes a bony sliver depending on the approach), it needs to be repaired at the end of the procedure. Failure of the repair results in weakness of the extensor mechanism, which is mainly perceived during overhead activities.

Here, we describe a triceps preserving posterior approach to the distal humerus and elbow joint, which does not violate the triceps footprint. This approach is a modification of the bilaterotricipital approach popularized by Alonso-Llames.⁵ We routinely use it in both trauma and elective (mainly arthroplasty) surgery and have found that it provides good exposure without the risk of triceps failure.

Operative technique

The patient is set up in a lateral decubitus position with pelvic supports over the upper most anterosuperior iliac spine and the sacrum. The operated arm is rested on a short gutter or an 'L' shaped bar. A high tourniquet is applied (preferably sterile if available) to allow a bloodless surgical field without limiting the exposure or dissection. Appropriate care is given to protect the pressure areas, specifically the face and contralateral arm as they come close to the arm support. The vertical component of the metal arm support is wrapped with Gamgee

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(Robinson Healthcare Ltd, Worksop, UK) to avoid any direct contact with the patient. The contralateral arm is then taped to the chest to allow for anaesthetic access (intravenously) from the back of patient. The arm is prepped circumferentially and placed in a sterile surgical stocking. An exclusion draping system is used (Figure 1).

A midline posterior incision is made. The proximal and distal extent of the incision is determined by the underlying pathology. We do not routinely avoid the skin on the olecranon tip because, in our experience, a painful scar is not a commonly encountered complication. The fascia overlying the triceps is then divided and two fasciocutaneous flaps are raised (Figure 2).

The lateral and medial borders of the triceps can now be readily visualized, as can the tricipital aponeurosis. This is a useful landmark for the identification of the radial nerve because, in 90° of elbow flexion, the radial nerve can reliably be found 1 cm proximal to the lateral aspect of the tricipital aponeurosis.⁶ If indicated, the radial nerve can be identified and protected, by blunt dissection of the muscle fibres.

The radial window is developed by initially lifting the lateral triceps from the lateral intermuscular septum and then the posterior surface of humerus. Distally, the window is extended towards the ulna subcutaneous dorsal ridge. The anconeus is lifted as an

extension of the lateral triceps to ensure that the innervation is not disturbed (Figure 3).

Once the posterolateral border of the humerus has been exposed, attention is turned to the medial side. The ulna nerve is identified proximally in the epineural fat at the medial border of the medial head of triceps and traced distally to the cubital tunnel, where it can be decompressed. Distally, the fascia over flexor carpi ulnaris (FCU) is opened and the nerve is further decompressed between the two heads of FCU to the level of the first motor branch.¹

At this stage, the ulna window is developed by lifting the medial triceps from the intermuscular septum and the dorsal surface of the humerus (Figure 4).⁴ Next, the olecranon fat pad is excised and a posterior capsulectomy is performed (for intra-articular access).

Access for fixation of distal humeral fractures

In extra-articular distal humerus fractures, the two windows give good enough access for fracture reduction, temporary fixation and application of 90/90 or parallel plates. In simple intra-articular fractures, where no joint comminution is encountered, a combination of anatomical reduction of the condyles (extra-articular

Figure 1. Patient set-up and draping.

Figure 2. Medial and lateral fasciocutaneous flaps.

Figure 3. Triceps raised from posterolateral humerus.

Figure 4. Medial paratricipital dissection.

components of the fracture) and intra-operative imaging of the joint surface is all that is needed for an accurate reduction and fixation. When the articular surface is comminuted, then the whole distal articular surface needs to be accessed. This is possible using the surgical technique described below with respect to arthroplasty.

Access for arthroplasty in acute trauma

In this situation, identification and decompression of the ulnar nerve is the initial key component of this approach. More often than not as a result of displacement of the condyles and fracture haematoma, the nerve is displaced and often bruised. Extra care in handling of the nerve is crucial.

Once the two windows are developed, the condyles are displaced, further maintaining all of the soft tissue attachments to them (common flexors/extensors and collaterals origins). The distal humerus can be delivered out of the wound (Figure 5) for reaming and preparation of the canal in order to accept the humeral stem (Figure 6).

Once the trial prosthesis is *in situ*, the condyles are reshaped (if too bulky) to fit around the prosthesis. Fracture reduction at this stage allows for assessment of the correct height of the implant. The condyles can then be fixed to the humerus. We prefer to achieve this

using trans-osseous strong braided non-absorbable sutures; however, plate and unicortical locking screws can be used as an alternative.

Access for arthroplasty in elective setting

Following decompression of the ulnar nerve and creating the two windows, the origins of the common flexors and extensors are sharply dissected. This will ensure access to the radial and ulnar collateral ligaments. At this stage, a stay suture can be inserted in each set of collateral complexes (lateral ulnar collateral ligament and the origin of medial collateral ligament from the undersurface of the medial epicondyle). These ligaments are then sharply dissected off the bone and a 360° capsulectomy is performed. This allows the distal humerus to be delivered out of the wound for the procedure. Following the cementation of the implant, the collaterals are repaired back to the bone and then the common flexors and extensors origins are repaired.

We routinely use this approach for the majority of our elbow procedures. Because the triceps has been minimally violated, early active rehabilitation is possible. The intact triceps covers the implant and avoids an extensor mechanism repair (either trans-osseous or fixation of an olecranon osteotomy.)

Figure 5. Delivering the distal humerus into the surgical site.

Figure 6. Preparation of the distal humerus to accept a humeral stem.

We consider that this approach offers the following advantages over the Alonso-Llames approach to the elbow:

- It preserves the innervation of the anconeus and lifts the muscle as a continuation to the lateral triceps
- By releasing the ulnar nerve between the two heads of FCU, the excursion of the nerve is increased and hence there is less chance of damage and postoperative neuropraxia
- By delivering the distal humerus 'out of the surgical wound', it gives a better access to the distal humerus, specifically the anterior articular components.
- It also minimizes triceps mobilization, which might be one reason for the postoperative lack of full flexion and heterotopic ossification

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