

A New Technique of Fixing Intra-articular Fractures of the Distal Humerus without Exposing the Ulnar Nerve by Posterior Approach

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Learning Point of the Article:

Avoid pestering the ulnar nerve.

Abstract

Introduction: Distal humerus fractures constitute around 0.2 to 7% of all fractures, 30% of all humerus fractures, most common in young adults, are due to high energy trauma and in old age due to osteoporosis. A common step in all currently available approaches is to identify the ulnar nerve, expose, mobilise, and retract this from its surrounding bed or in situ release. Ulnar neuropathy is either observed immediately after surgery or delayed up to one year after surgery. We are describing a new posterior approach for intra-articular distal humerus fractures, where identification and retraction of the ulnar nerve are not required to fix the intra-articular fractures of the distal humerus, thereby avoiding injury to the ulnar nerve.

Material and Methods: Seven patients with AO type B and C were treated using our new ulnar nerve-sparing approach between January 2017 and December 2019. Postoperatively, all the patients have been examined for ulnar neuropathy symptoms.

Results: We have no ulnar nerve neuropathy either in the post-operative period or at 2 years follow-up (five cases were followed up for 2 years and two patients lost to follow-up after 6 months). At the end of 2 years, the mean range of motion achieved at elbow was 134°. The mean oxford elbow score was 45.2 (42–47). Heterotopic ossification and infection were not found in our cases.

Conclusion: Our ulnar nerve-sparing approach for intra-articular fractures of distal third humerus by posterior approach helps in fixing articular fractures of distal humerus without exposing ulnar nerve during surgery without compromising on the exposure of fracture for fixation, thus reducing the chances of ulnar nerve injury and post-operative neuropathy.

Keywords: A new technique, distal humerus intra-articular fractures, avoid ulnar neuropathy, surgical approach to elbow, posterior surgical to elbow, elbow fractures, ORIF elbow fractures, latest posterior approaches to the elbow.

Introduction

Distal humerus fractures constitute around 0.2% to 7% of all fractures, 30% of all humerus fractures, most common in young adults is due to high-energy trauma and in old age due to osteoporosis [1]. Commonly used surgical approaches are Campbells [2], Alonso-Lhames [3] Paratricipetal, and Olecranon osteotomy [4]. Triceps flexor carpi ulnaris approach (TRIFCU) [5] and the Triceps peel approach, a modification of

TRIFCU [6], are other approaches used to fix these fractures. A common step in all the above approaches is to identify the ulnar nerve, expose, mobilise, and retract this from its surrounding bed. These approaches are associated with high incidence of ulnar nerve injury leading to post-operative ulnar nerve neuropathy [7, 8, 9, 10]. Ulnar neuropathy is either observed immediately after surgery or delayed up to 1 year after surgery. During surgical fixation of distal humerus, Shearin et al. [11]

Author's Photo Gallery



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Access this article online

Website:
www.jocr.co.in

DOI:
10.13107/jocr.2022.v12.i08.2946

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Submitted: 01/03/2022; Review: 22/05/2022; Accepted: July 2022; Published: August 2022

DOI:10.13107/jocr.2022.v12.i08.2946

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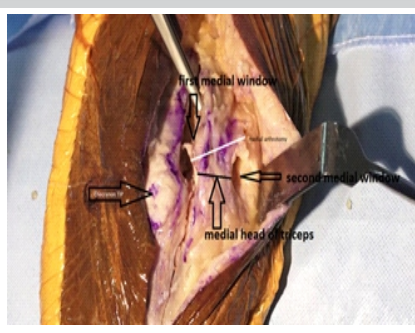


Figure 1: Cadaveric dissection of elbow showing the position of the first medial window and the second medial window. Between these windows, the ulnar nerve is present within the medial cuff of the triceps.

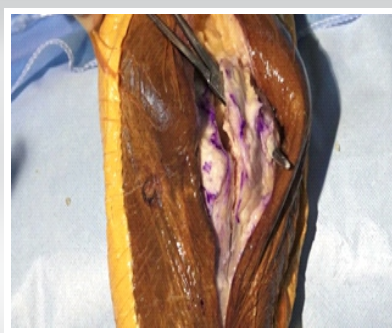


Figure 2: Cadaveric elbow dissection showing an artery forceps passed from the first medial window to the second medial window.

Ulnar neuropathy incidence of 19.3%. Of those patients undergoing in situ release, the incidence was 15.3% and of those who underwent transposition, there was a 23.5% incidence of ulnar neuropathy. We are describing a new posterior approach for intra-articular distal humerus fractures, where identification and retraction of the ulnar nerve are not required to fix the intra-articular fractures of the distal humerus, thereby avoiding injury to the ulnar nerve.

Surgical Technique

Position

Lateral decubitus position operative side limb facing up, elbow flexed to 90° over the sandbag.

Bony landmarks

Medial epicondyle, Olecranon Tip, and Lateral epicondyle.

Skin incision

Midline incision starting 7 cm proximal to the olecranon and extending 6 cm distal to the olecranon with a medial curve over the tip of the olecranon, curving laterally over the ulna.

Superficial dissection

Superficial dissection is carried out medial to the medial epicondyle and lateral to the lateral epicondyle on the medial and lateral sides. Skin, subcutaneous tissue, and superficial fascia are cut in the same line of skin incision. Superficial dissection is continued between the superficial fascia and the deep fascia of the triceps muscle.

Lateral superficial dissection

Superficial dissection on the lateral side extends up the posterior surface of the lateral epicondyle for posterior plating and can be carried over the lateral and superior surface distal humerus for lateral anatomical plate

positioning.

Medial superficial dissection

Medial superficial dissection is done up to the medial and anterior to the medial epicondyle. Care is taken not to cut or perforate the brachial fascia over the medial head of the triceps.

Deep surgical dissection on the lateral side

Deep dissection on the lateral side is the same as described in standard approaches and must be restricted proximally up to 10 cm from the lateral epicondyle.

Deep dissection on the medial side

This consists of creating two windows for fracture exposure and fixation after identifying the medial epicondyle, olecranon tip, and medial epicondyle.

The Medial First window is in the midline (Fig. 1) along the medial border of the triceps tendon, olecranon, and medial border of the proximal ulna. The triceps tendon is divided, leaving a 2–3 mm wide tendon sheath attached to the medial head of the triceps, along the medial border of the olecranon continued 4 cm distally along the medial border of the proximal ulna, medial head of the triceps is separated subperiosteally dissecting the medial head of flexor carpi ulnaris and flexor digitorum superficialis attachments. The medial head of the triceps is retracted medially to do a medial arthrotomy on the medial side.

Then, the medial expansion of the first window is done subperiosteally along the medial surface of the cubital tunnel (extra-articular portion of the medial surface of trochlea), posterior surface of medial humeral condyle up to the supracondylar ridge, and dissection is carried by elevating medial triceps from the medial intermuscular septum and posterior surface of the medial distal humerus up to medial epicondyle. Brachialis fascia presents over the medial triceps and the intermuscular septum must be left intact.

A Medial Second Window (Fig. 1) is now created on the medial



Figure 3: Intraoperative image showing the second medial window being widened to pass the plate.



Figure 4: Intraoperative image showing the medial distal humerus anatomical plate passing from the second medial window and across the first medial window onto the posterior surface of the humerus during fracture fixation.



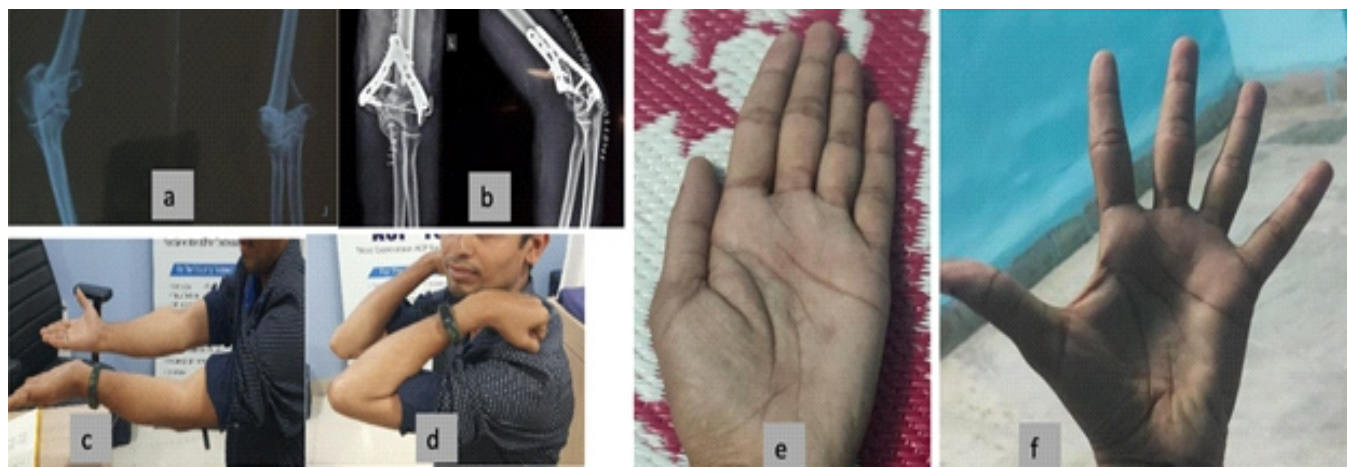


Figure 5: (a and b) Pre-operative and post-operative radiographs, respectively; (c and d) show patient elbow range of motion at 1 year follow-up; (e and f) show intact finger movements indicating an intact ulnar nerve.

side between the medial head of the triceps and the medial intermuscular septum. Initially, the medial epicondyle is palpated and identified, the triceps muscle is elevated from the posterior surface of the medial intermuscular septum 4 cm proximal to the medial epicondyle, and a periosteal elevator is passed to free the remaining soft tissues from the medial supracondylar ridge; then, a blunt artery forceps is passed along the supracondylar ridge and the superior surface of the medial epicondyle piercing the fascia superior to the medial epicondyle by a blunt method. Communicating the second medial window and posterior humerus from the medial side (Fig. 2), Struthers ligament needs to be cleared from the superior portion of the medial epicondyle for the plate to sit properly on the medial supracondylar ridge and medial epicondyle. The second medial window is widened by 3–4 cm to pass the plate (Fig. 3). This will allow medial distal humerus anatomical plates to slide through the second medial window to the first medial window (Fig. 4). Olecranon osteotomy can be added if the reduction is difficult due to severe comminution of the fracture fragments. We have also studied this on the cadaver (Fig. 1). A case from our series is shown in Fig. 5.

Extension: Proximal extension of the first medial window along the triceps can be done up to the proximal humerus to fix associated shaft fractures or to include the proximal extension of the distal humerus fracture. Distal extension of the approach can be made along the medial border of ulna to fix ulna shaft fractures and along the lateral border of the ulna to fix radial head fractures.

Materials and Methods

Between January 2017 and December 2019, seven patients (males – 5 and females – 2) aged between 22 and 62 years with AO type B and C closed intra-articular fracture of the distal

humerus were managed using our new technique without exposing ulnar nerve by posterior approach. Fractures were fixed as per AO principles. Postoperatively, all the patients have been examined for ulnar neuropathy symptoms. All patients were followed up for 2 years (range, 2–4 years). Two cases were lost to follow-up after 6 months, five had follow-up of 2 years. All patients at 2-year follow-up were examined clinically for ulnar neuropathy. Functional outcome was measured using the oxford elbow score, range of motion, and complications were noted.

Results

We have no ulnar nerve neuropathy either in the early post-operative period or at 2 years (5 cases were followed up for 2 years and 2 patients lost to follow-up after 6 months). Union achieved by the end of 6 months with a mean duration of 22 weeks. At the end of 2 years, 134° mean flexion was achieved with a mean extension lag of 6°. The mean Oxford elbow score was 45.2 (42–47). Heterotopic ossification (HO) and infection was not found in any of our cases.

Discussion

Incidence of post-ORIF ulnar nerve neuropathy is reported by various authors ranging between 0% and 38% [13]. Holdsworth and Mossad [14] reported 51% incidence. Ulnar nerve exploration, mobilization, and in situ release without mobilization and anterior transposition are the established causes of post-operative ulnar nerve neuropathy [8, 9, 10, 11]. Ulnar nerve contusion, laceration by sharp bony fragments, and hematoma are the causes due to injury. Iatrogenic causes of ulnar nerve injury include exposure and mobilization from its bed, anterior transposition [11] excessive retraction or inadvertent injury during surgical exposure, fracture

manipulation, or implant irritation [12]. Post-operative swelling and hematoma formation contribute to compression of the ulnar nerve. Delayed causes of ulnar neuropathy can be related to soft tissue scarring, HO, and prominent hardware. Unfortunately, no surgical technique has been described standardizing the surgical handling of the ulnar nerve to prevent ulnar nerve neuropathy.

In our new technique, adequate exposure of the distal humerus intra-articular region is achieved without the need for exposure of the ulnar nerve, significantly decreasing the chances of iatrogenic ulnar nerve injury. In this approach, the muscular coverage of the ulnar nerve over a length of 8 to 9 cm from cubital fossa to Struthers ligament is preserved. The muscular cuff around the ulnar nerve, which is left intact, prevents devascularization and hardware-related injury to the ulnar nerve.

None of our cases had immediate post-operative or delayed ulnar nerve injury at a minimum follow-up of 2 years.

Limitations

Our study is on a small group of patients. Further, multicenter randomized control studies with larger sample size are required to substantiate our findings.

Conclusion

Our new technique does not need the exposure of the ulnar nerve during exposure for intra-articular fractures of the distal humerus by posterior approach. This helps in minimizing injury to the ulnar nerve during surgery without compromising on the

Clinical Message

Three window posterior ulnar nerve sparing approach described by us is unique in a way that the ulnar nerve need not be exposed; rather, the medial first window can be used to expose the humeral shaft proximally up to proximal humerus by creating a plane between medial head distally, long head of triceps medially, and lateral head of triceps muscles laterally thereby sparing innervation of the radial nerve to the whole of triceps. The medial second window also goes through the inter nervous plane and can be extended proximally up to 5 cm and not beyond that to prevent damage to the blood supply of ulnar nerve. These windows allow the surgeon to attain reduction, fix fracture, preserve vascularity of ulnar nerve, preserve innervation of the triceps muscle, protect the ulnar nerve from direct handling by the surgeon, and implant irritation. Olecranon osteotomy can always be added in severely comminuted fractures to get a perfect reduction.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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Conflict of Interest: Nil

Source of Support: Nil

Content: The authors confirm that informed consent was obtained from the patient for publication of this case report

How to Cite this Article

Pappu R, Vavilalaa AR, Reddy AVG, Boddeda S, Reddy K. A New Technique of Fixing Intra-articular Fractures of the Distal Humerus without Exposing the Ulnar Nerve by Posterior Approach. *Journal of Orthopaedic Case Reports* 2022 August;12(8): 14-18.

