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Surgical anatomy and technique for the treatment of Dubberley type 1, 2 and 3 capitellar fractures via a limited anterior approach to the elbow

Ballesteros-Betancourt JR [1,2], García-Tarriño R [1], Gutierrez-Medina D [1], Sastre S[1], Combalía A[1,2], Llusá M [1,2].

1 Department of Traumatology and Orthopaedic Surgery. Hospital Clínic. University of Barcelona. Spain.
2 Macro- and Micro-Dissection and Surgical Anatomy Laboratory, Human Anatomy and Embryology Department, Faculty of Medicine, University of Barcelona. Spain.

Abstract

Coronal plane fractures of the elbow can affect the capitellum, the trochlea (or a combination of the two), the radial head and the coronoid processes.The Kocher lateral approach is the most commonly used for open reduction of this type of fractures, although an arthroscopic technique has been used in some cases. When the fracture extends to the trochlea, the Kocher lateral approach may be inadequate for the correct visualisation, reduction and fixation of the fracture. In such cases an associated medial elbow approach may be required, or a posterior transolecranon approach may be preferred. We think that the limited anterior approach to the elbow could be a valid option when treating these types of fractures, as it does not involve the de-insertion of any muscle group or ligament, thereby facilitating the recovery process. In cases involving trochlear fracture (which may or may not be dissociated) the approach can be extended medially. We can also treat associated injuries such as fractures of the radial head or coronoid process with this approach.

In the present study we describe the dissection of the medial and lateral cubital fossa of the elbow in extension in 4 specimens, paying attention to the neurovascular structures of the area. We also describe the surgical technique for the limited approach to the medial and lateral cubital fossa. We demonstrate the accessibility via the cubital fossa to the capitellum, trochlea, radial head, and coronoid process.

Keywords

Capitellum fracture, Kocher approach, lateral exposure of the elbow, open reduction and internal fixation, anterior approach to the elbow, radial nerve.

Introduction

The Kocher lateral approach is the most frequently used approach for open reduction and internal fixation of capitellar fractures. The screws may be positioned either in a postero-anterior direction, which is less biomechanically stable, or in an anteroposterior direction, which is more stable (1-5).

Often the capitellar fragment has a small trochlear fragment attached (lateral trochlear ridge, a Dubberley type 1 fracture), and when the capitellum is reduced correctly, the affected trochlear part is also reduced.

However, the trochlear involvement may be greater: in some cases the capitellar fragment is attached to a large fragment of trochlea (Dubberley type 2) while in others the fractured trochlear and capitellar fragments are separated (Dubberley type 3).

When a Dubberley type 1 capitellar fracture is to be treated with open reduction and internal screw fixation, the most common approach is the Kocher approach. In these cases de-insertion of the extensor-supinator musculature is a technical step usually taken to increase the exposure of the distal humerus articular surface. This step can sometimes involve de-insertion of the origin of the lateral collateral ligament of the elbow (7-9). If the fracture involves the trochlea, a lateral approach may be inadequate, so some surgeons decide to either add a medial elbow approach or to use a single posterior elbow approach with transolecranon osteotomy. Depending on the extent of the approach and the de-inserted structures-which must be repaired after fracture has been fixed-the time required for healing and functional recovery can increase.

In our opinion the limited anterior approach to the elbow could be a valid option for treating these types of fracture (Dubberley 1, 2, and 3), as it does not involve the de-insertion of any muscle group or ligament, thus facilitating the recovery process. We present an anatomical study of the cubital fossa (medial and lateral ´s canals) as well as the proposed surgical technique for approaching and treating these injuries.

Material and Methods

We dissected and studied the neurovascular structures in 4 fresh cadaveric upper extremities, aged 64 to 88 years-old (mean age 78 years-old). The brachial arteries had previously been injected with coloured latex to fill the vascular tree to arteriolar level.

The arms were amputated proximal to the elbow joint. The brachial artery was cannulated with a catheter and irrigated with normal saline. Transverse incisions were made over the distal phalanges of all digits. Liquid latex (40-50cc) was then injected into the brachial artery under firm manual pressure. The adequacy of injection was determined by the appearance of the latex through the transverse incisions in the fingertips. The injected specimens were then refrigerated for 12 hours to ensure the latex solidified. Magnifying loupes were worn during the dissections.

The cubital fossa was dissected with the specimen elbow in extension, paying attention to the neurovascular structures in the area. A limited anterior approach to the elbow was performed, paying special attention to the area of distal humerus articular surface that could be exposed, and the relationship of neurovascular structures with this approach.

Results

Anatomical study

For an anterior approach to the lateral aspect of the cubital fossa, the incision is usually made lateral to the midline (the prominence of the biceps brachii tendon defines an imaginary line that divides the cubital fossa in two) in the anterior distal third of the arm. At this level, after opening the skin, we find the superficial veins (cephalic and median antebrachial veins), which can vary in their course (Fig. 1A). Once the anterior brachial fascia is opened, the biceps brachii muscle can be seen. It has a fleshy appearance and is usually continuous with the bicipital aponeurosis and its main insertion tendon, which passes deep to attach to the posterior aspect of the bicipital tuberosity of the radius. Underneath the biceps brachii muscle we locate the thicker brachialis muscle, which passes the biceps brachii muscle on both sides to insert at the elbow joint

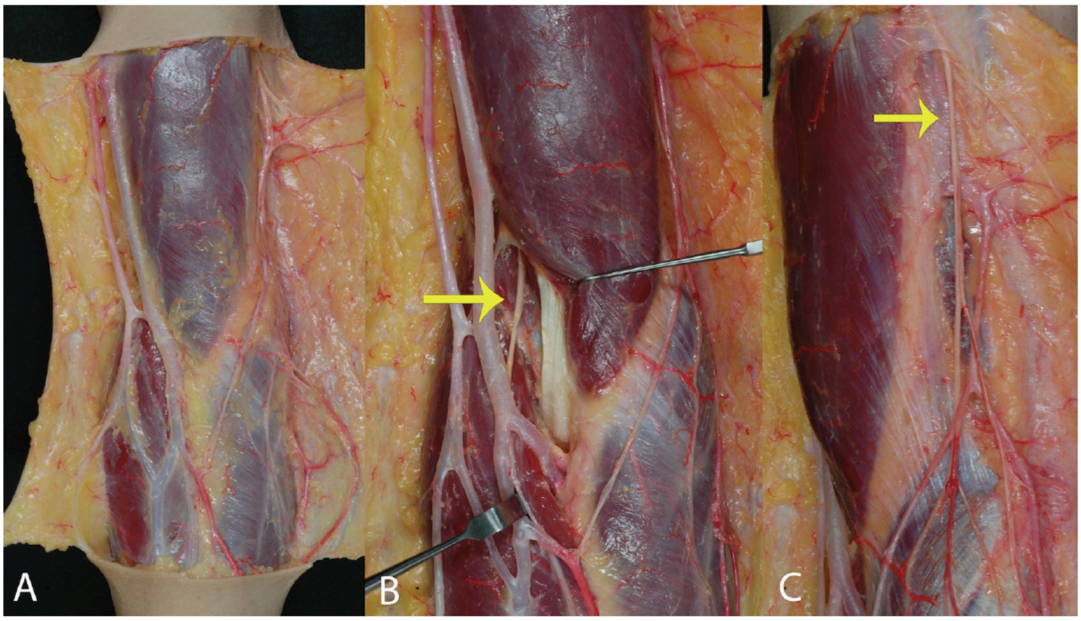

Fig. 1. A) Anterior aspect of the cubital fossa after opening the fascial flaps. Distribution of superficial veins (cephalic and median antebrachial) and relationship of these to the musculocutaneous nerve after it emerges from the lateral aspect of the biceps tendon. B) In this specimen we see how the musculocutaneous nerve runs superficially to the brachialis muscle and deep to the biceps brachii muscle. C) Medial cutaneous antebrachial nerve and it relation with the basilic vein.

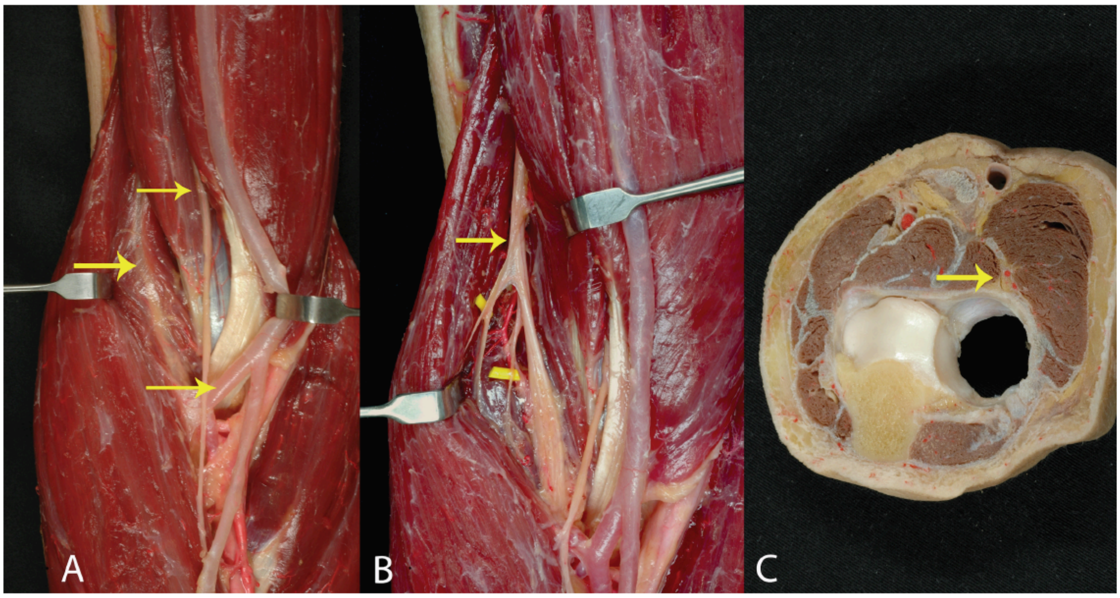

Fig. 2. External bicipital groove. A) The radial is situated in the radial tunnel, in close relation to the deep aponeurosis of the mobile wad of Henry. B) Dissection of the radial nerves and its branches, you can observe the musculocutaneous nerve, running obliquely and emerging superficially at the lateral edge of the biceps brachii insertion tendon. Be careful with the communicating vein that connects the superficial and deep venous system C) In this transverse section of the forearm we see the close relationship that exists between the radial nerve, the recurrent radial artery, and the veins and the joint capsule of the elbow at the level of the humero-radial joint.

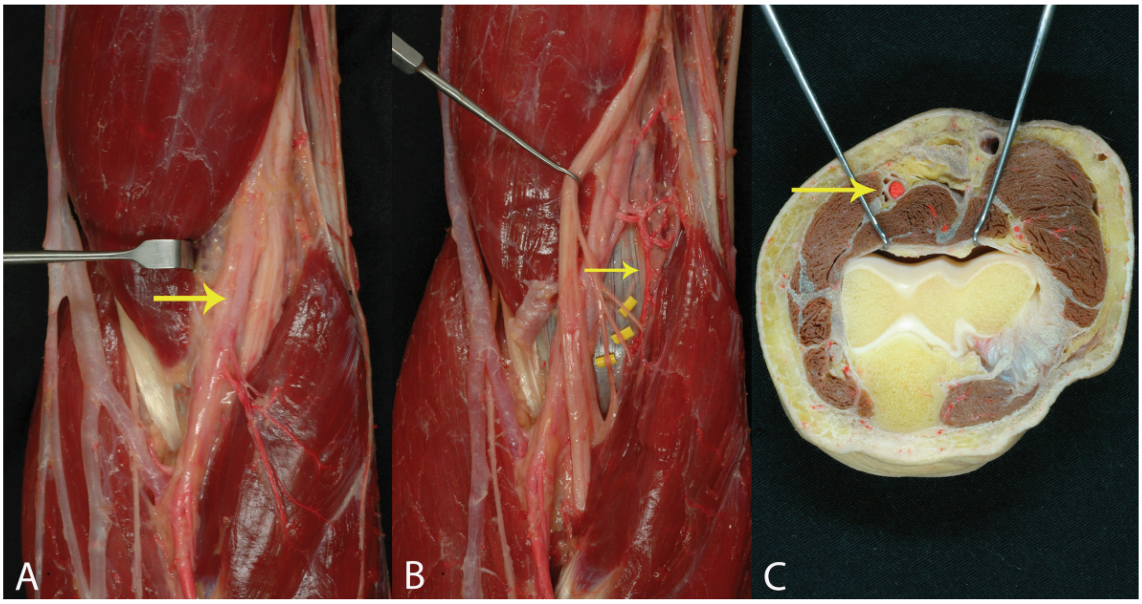

Fig. 3. Internal bicipital groove. A) The neurovascular bundle of the arm formed by the concomitant artery and humerous veins and more internally the median nerve. B) The nerve branches of innervation from the epitrochlear branch of the median nerve for the flexo-pronator muscles of the forearm. C) In this transversal section at the level of the distal humerus, we can see from a different perspective the relationship between the neurovascular bundle and the joint: the neurovascular bundle is not in close relation with the joint, since the brachialis muscle is interposed between both.

capsule and the ulnar tuberosity just below the coronoid process. In 100% of the specimens, the musculocutaneous nerve was identified between the two muscles, running obliquely from the medial superior part to the lateral inferior part and emerging superficially at the lateral edge of the biceps brachii insertion tendon at the level of the Hueter line (Fig. 1B). The medial cutaneous antebrachial nerve runs closely related to the basilic vein in the medial aspect of the elbow (Fig. 1C).

External bicipital groove: in the distal third of the arm, on the lateral aspect, runs the radial nerve, bordered medially by the brachialis muscle in 100% of the specimens. The radial nerve runs almost adjacent to the joint capsule, anterior to the humero-radial joint, and changes from a medial position to a lateral position as the limb moves from a position of maximum pronation to maximum supination. It is situated in the radial tunnel, in close relation to the deep aponeurosis of the mobile wad of Henry (Fig. 2 A and B). Using a retractor, the mobile wad can be moved laterally along with the radial nerve, allowing the joint capsule to be reached and minimising insult to the nerve(Fig. 2 C).

Internal bicipital groove: limited medially by the pronator teres muscle and centrally by the tendon of the biceps brachii muscle. On the surface, above the lacertus fibrosus, the basilic vein is accompanied by the medial cutaneous antebrachial nerve of the forearm and its anterior and posterior divisions, the median vein and the superficial ulnar veins (Fig. 1). The neurovascular bundle of the arm formed by the concomitant artery and humerous veins (one on each side of the artery) and more internally the median nerve (the package follows an oblique downward and outward direction, passes under the lacertus fibrosus to center of the elbow fossa) (Fig. 3A). On the upper border of the flexor-pronator muscles, the nerve branches of innervation from the epitrochlear branch of the median nerve penetrate (or directly from the latter) (Fig. 3B), in close relation with the anterior recurrent ulnar artery. The lower ulnar collateral artery detaches about 3-4 centimeters from the epitrochlea, runs anterior to the brachialis muscle and then enters the mass of epitrochlear muscles and anastomoses with the anterior recurrent ulnar artery, resulting in part of the arterial periarticular circuit of the elbow. The neurovascular bundle is not in close relation

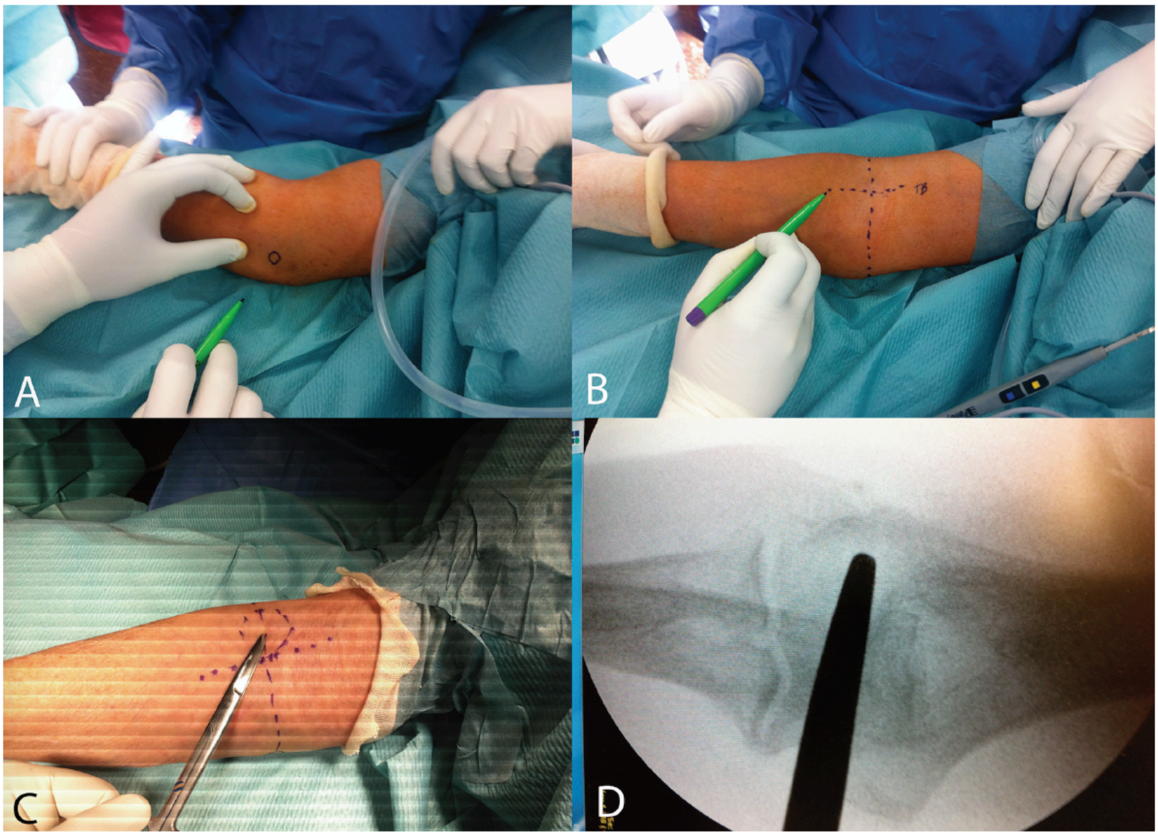

Fig. 4. A) Locating and marking anatomical references, in this case of the medial epicondyle. We will go on to locate and reference the lateral epicondyle. The line that joins the two epicondyles coincides with the flexion crease and the distal limit of the humerus. In addition, it is recommendable to keep the plane formed between the two epicondyles parallel to the operating table to maintain correct orientation of the structures during surgery. B) A longitudinal line is drawn, coinciding with the biceps tendon, that divides the cubital fossa to form its medial and lateral parts. C,D) With these superficial markings it is possible to locate and reference the position of the capitellum, but if unsure, with the help of a radio-opaque instrument (in this case Mayo scissors) and fluoroscopy, we can check the position of the capitellum.

with the joint, since the brachialis muscle is interposed between both (Fig. 3 C).

Surgical technique

Position of the patient, surgeons, and fluoroscopy: The patient is positioned supine on the operating table, with the arm in 90º abduction and supported by an accessory table positioned beside the patient. The surgeon stands at the axilla side of the patient. Fluoroscopy should be introduced at the radial side of the hand, beside the assisting surgeon.

Planning the approach: With the elbow in 0º extension, the biceps tendon is located, and a line is drawn on the skin corresponding to the longitudinal axis that divides the cubital fossa in two to form the medial and lateral halves. Another line is drawn that coincides with the flexion skin crease of the elbow (Fig. 4 A and B). The lateral half of this transverse line coincides with the diameter of the capitellum, and the medial half coincides with the axis of the trochlea (Fig. 4 C and D).

Working position of the elbow: The plane formed between the two epicondyles is a very important reference during the surgery, as we are working in an area of transition between the arm and the forearm, and changes in the rotation of the elbow can lead to changes in the relationship between anatomical structures. When working with the elbow in extension, there is a tendency, without realising it, to put the elbow in supination, which means that all the structures, especially the neurovascular structures, are positioned somewhat more laterally than when the transepicondylar axis is maintained perfectly parallel to the table.

Skin incision and superficial dissection: A transverse incision is made that can be S-shaped if we are only planning to work in the lateral cubital fossa or straight it we are planning to extend the approach to the medial cubital fossa (Fig. 5 A). Subcutaneous tissue dissection is performed by opening the scissors parallel to the longitudinal axis of the elbow (biceps tendon), as the superficial veins run in this direction. The cephalic vein, or one of its branches, is located, and, depending on the vein's morphology, the surgeon decides whether it should be moved laterally or medially. Special care

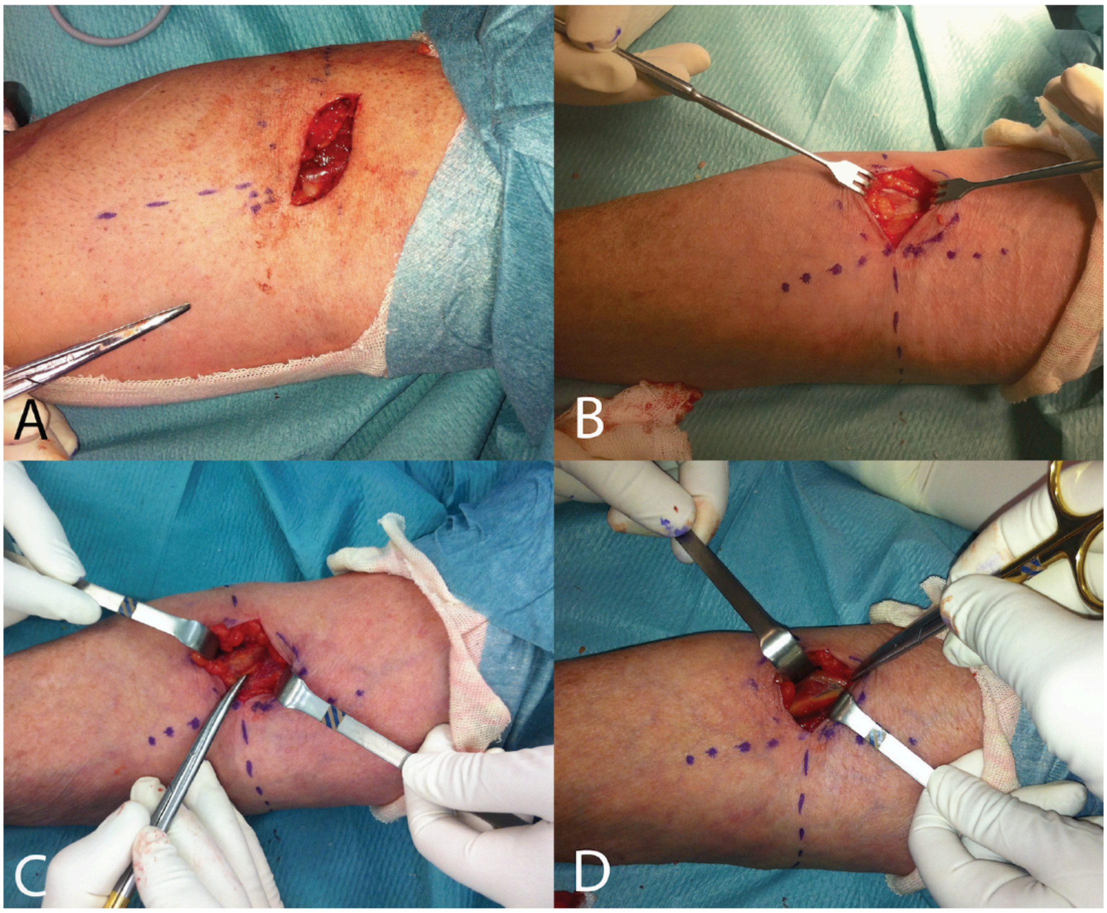

Fig. 5. A) Initially, the incision can be located without going beyond the limits of the capitellum that we have drawn on the lateral cubital fossa. The form is slightly oblique from proximal and lateral to medial and distal, in the form of a slight S, allowing the incision to be extended if necessary: proximally through the radial nerve tunnel, and distally along the longitudinal axis, or even medially allowing access to the medial cubital fossa. Locating the superficial plane of the cephalic vein or one of its branches. If possible, it can be moved carefully from the surgical area or ligated. B) After the superficial dissection we arrive at the superficial fascial plane. The skin-fat flaps should be dissected, taking care not to delaminate the plane between the skin and subcutaneous tissue. Both flaps are dissected using gauze and the pulp of the finger in the same directin as the incision, to extend the exposed fascial plane. We create a window in the fascia wider than the skin incision, that we can expose a bigger area by moving the retractors. C) Locating the radial tunnel and opening the superficial fascia in a longitudinal direction. D) When we move the brachioradialis muscle laterally we expose the radial nerve, which runs protected by fatty tissue below the perimysium.

should be taken not to cut the superficial fascia of the mobile wad of Henry during this superficial dissection.

Locating the radial tunnel: At this point we must locate the radial tunnel, which is the space between the mobile wad of Henry (specifically the brachioradialis muscle) and the brachialis muscle. This initial step is the most difficult and probably the most important, because it in turn determines that the radial nerve is located and handled correctly and that a true inter-nervous approach is performed, with less bleeding and a lower risk of muscular denervation. In addition, exposing the fracture will be easier, especially if distal extension is needed to treat an associated radial head fracture. For the dissection of the plane superficial to the superficial fascia, we recommend using a gauze on the index finger, so that the fascial plane can be exposed (Fig. 5 B). At this point we must observe carefully: in some patients we can identify a fatty plane through the fascia; in others we can see a difference in volume (the muscular bellies of both muscles protrude, with a slight depression between them). If in this first step it is impossible to define the radial tunnel, we proceed to open the fascia longitudinally with a scalpel, following the assumed medial border of the brachioradialis muscle without deepening the plane, opening the fascia only. The fascial flaps should be carefully laid to one side (towards the medial and lateral sides, respectively). Again, we must observe carefully: we must try to identify a change in direction of the muscle fibres that indicates the radial tunnel - remember that the fibres of the brachialis muscle run longitudinally (parallel to the biceps tendon) and the fibres of the brachioradialis muscle run obliquely to this axis (from medial to lateral). Once the possible radial tunnel has been located, with the help of some Metzenbaum curved dissection scissors we can go a little deeper but still only at a superficial level (Fig. 5 C). When we are in the radial tunnel, we can see how the two muscle bellies are easily separated as each one of them is inside a fine perimysium, and how there is even an “airy” connective tissue that makes deeper dissection easier. We can use a finger moistened with saline to perform the dissection between the two muscles, locating the radial nerve that runs, protected by fatty tissue, below the perimysium of the brachioradialis muscle. This makes its dissection unnecessary; in fact, in this position it remains “protected” (Fig. 5 D). Once we have located the interval (which as we mentioned above is an inter-nervous interval) between the two muscles, we proceed to deepen the dissection until we palpate the prominence of the capitellum in the deeper part of the dissected plane.

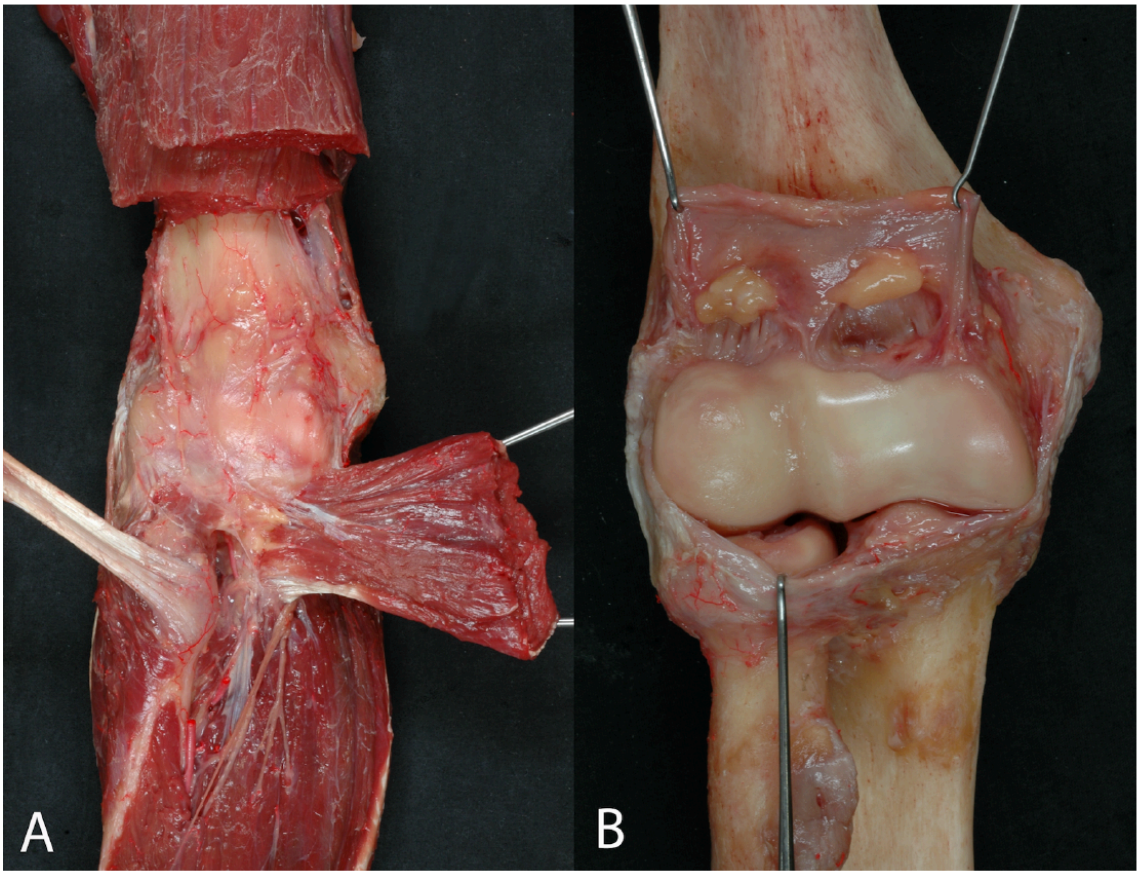

Fig. 6. A) Anterior aspect of the elbow, after moving the brachialis muscle we can observe the joint capsule anteriorly, which at the time of surgery is usually intact. The surgeon should try to create the deep transmuscular window taking care not to damage the capsule. The musculature must be dissected and moved as a window from the anterior capsule plane. This allows us to perform a controlled capsulotomy later. B) Anatomical dissection where we can see the fossae for the radial head and the coronoid process on the anterior aspect of the distal humerus, as well as the fatty pads that occupy this space.

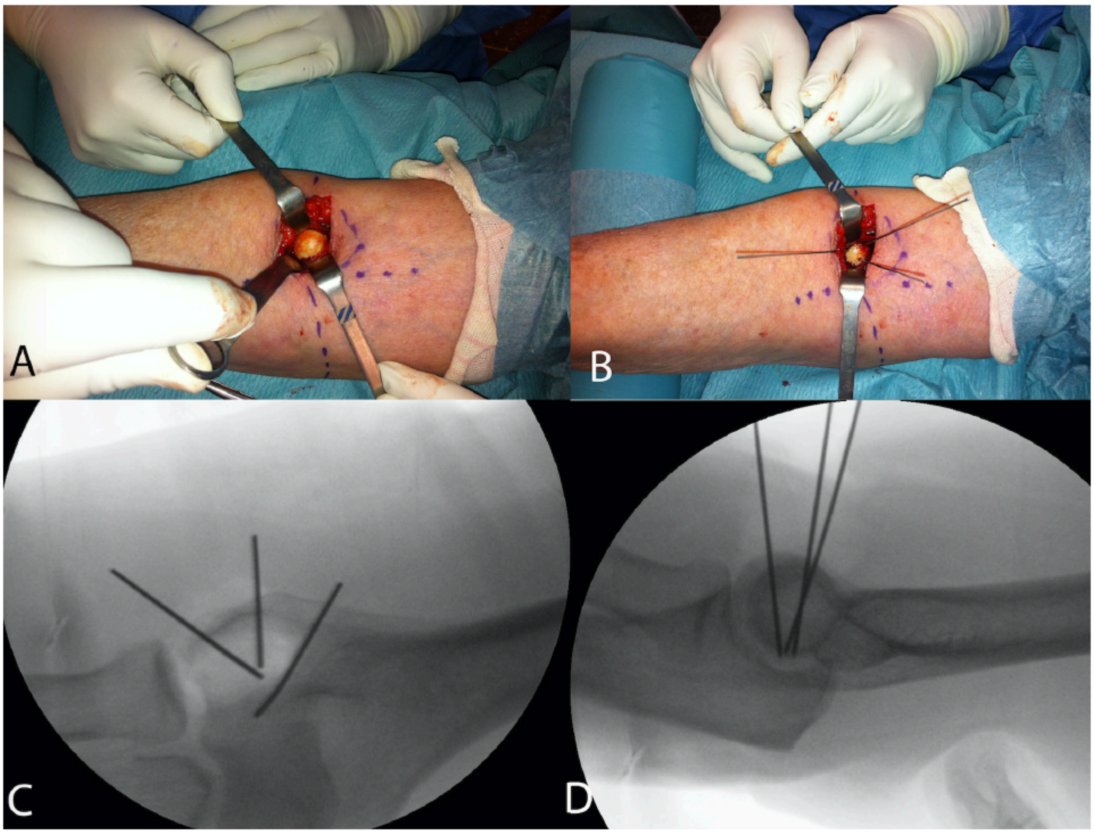

Fig. 7. A) After performing capsulotomy, the capitellum is easily exposed and is reduced to its anatomical positon. B) Positioning of Kirschner wires in divergent directions to each other, and in a plane that is truly perpendicular to the fracture. C) Anteroposterior projection of fluoroscopy check of correct fragment reduction, checking that the articular profile of the distal humerus has been restored. D) Lateral projection of the elbow, which we use to check the correct reduction of the fracture as well as the length of the Kirschner wires for subsequent measurement of the cannulated screws.

Exposing capitellar and radial head fractures: We position two Farabeuf retractors (preferably wide-blade), one that retracts the mobile wad of Henry laterally (this muscle group will include the radial nerve and the recurrent radial artery) and the other retracts the brachialis muscle and the biceps tendon medially. At the bottom of the approach we will be able to see the joint capsule. The joint capsule must be cut. We recommend making a longitudinal incision extending from, proximally, the humerus, to beyond the border of the capitellum. At this point we must make either another transverse perpendicular incision in the capsule, or two symmetrical incisions that run in opposite directions. The aim is to expose the capitellum without compromising the proximal periosteal flap, which is usually kept attached to the distal humerus thus providing blood supply and stability (Fig. 6 A and B). Once the joint capsule is open, the capitellum is exposed, and with the elbow in a position of 0º extension, it usually "reduces itself" to its approximate anatomical position (Fig. 7A). The reduction is performed, paying attention to the distal edge of the distal humerus, a detail that can help us to decide the correct position for reduction; we can also see the relationship of the capitellar fragment to the trochlea, medially. Once we are happy with the reduction, with the help of 2 or 3 Kirschner wires, we fix the fragment in position, using fluoroscopy to check and measure the depth of screw to use (Fig. 7 B, C, and D). We must be careful when inserting the Kirschner wires, taking care not to go beyond the distal humerus and insert the wire in the trochlear notch, as when doing the fluoroscopy check of reduction (a position that requires a certain degree of elbow flexion to obtain the elbow profile image) the Kirschner wire may bend and even break (Fig. 8). Two fluoroscopy checks are done: the first involves an anteroposterior projection that shows us that the distal profile of the humerus is restored and consequently there is a constant intraarticular distance, both between the radial head and the capitellum and between the anterior aspect of the trochlear notch and the trochlea. In addition, we can check that the lateral edge of the trochlea is reconstructed without an articular step. The second check aims to obtain a profile image. We need to put the shoulder in forced external rotation; initially we should not flex the elbow, at least until we are sure that there are no Kirschner wires in the ulna. The fluoroscopy equipment must be manoeuvred to obtain a strict profile, moving the emitter in the opposite direction from our external rotation movement.

Fig. 8. On this lateral projection we can see the incorrect position of a Kirschner wire, which has been pushed too far and is going into the olecranon. As this is a risk, it is advisable not to flex the elbow until you have checked on fluoroscopy on the lateral projection that there are no wires going beyond the distal humerus.

Fig. 9. Sagittal cut at the level of the humero-radial joint, where we can see a displaced capitellar fracture, as well as a radial head fracture with an articular step.

If there is an associated radial head fracture requiring reduction and internal fixation this is the best moment to do so (Fig. 9). We have to extend the inter-nervous plane distally in the radial tunnel, using a wet finger we gradually extend the plane distally, and with the same finger we can palpate the radial head (we move the wrist slightly in pronation and supination to feel the radial head and the step of the fracture) under the pulp of our finger. We need to expose only the area corresponding to the radial head. Next we proceed to longitudinally open the annular ligament with the scalpel or dissection scissors. We continue opening until we expose the fracture and we can confirm that it is reduced correctly. To reduce the fracture it is recommendable to use either a small periosteotome (taking care as it has a sharp edge and could break the bone) or a Freer dissector (neurosurgery), which has a blunt tip and is very useful for de-impacting and mobilising small bony fragments without fragmenting them further (Fig. 10 A). Once the fracture is reduced according to a visual check, we fix it with a Kirschner wire and proceed to fluoroscopy check (Fig. 10 B, C and D).

Extending the approach to expose the trochlea: In cases requiring fixation of the trochlea we need to extend the approach towards the medial cubital fossa (Fig. 11 A and B). The dissection of subcutaneous tissue is performed again by opening the scissors parallel to the longitudinal axis of the elbow (biceps tendon), as the superficial veins run in this direction. We recommend dissecting in a plane superficial to the superficial fascia, with the help of a gauze on the index finger, so that fascial plane can be exposed (Fig. 11 C). Now we must decide where to open the bicipital aponeurosis: this depends on the type of fracture. If it is a Dubberley type 2 fracture (in which the trochlear part is in the same fragment as the capitellum) we can make a longitudinal incision of the fascia at the medial edge of the biceps tendon. A very medial exposure is unnecessary as by correctly reducing the capitellum, we will indirectly be reducing the trochlea. In this case the dissection is easier because we are working further away from the humeral neurovascular bundle. Once we have opened the fascia, we place two Farabeuf retractors (preferably wide-blade) superficially, one that retracts the biceps tendon laterally and the other retracting the neurovascular bundle medially. If it is a Dubberley type 3 fracture (capitellum and trochlea are dissociated), we need to approach the trochlea a little more medially, as the reduction of the capitellum will not directly reduce the trochlea, and we need to expose the edges of the trochlear fragment to reduce it correctly. In these cases we need to go deep in the medial cubital fossa immediately lateral to the neurovascular bundle. After opening the bicipital aponeurosis and with the help of the retractors we move the bundle medially and the biceps tendon laterally. In both cases we expose the brachialis muscle at the bottom of the approach. It is easily identified by the presence of a fine aponeurosis that covers it superficially. We need to perform a transmuscular dissection in a longitudinal direction until we locate the joint capsule. In Dubberley type 2 fractures the dissection is done somewhat more laterally than in type 3, as in type 3 cases we need more medial exposure. During the transmuscular dissection of the brachialis muscle, we may find the brachialis tendon, which as we know has the same thickness as the muscle. The joint

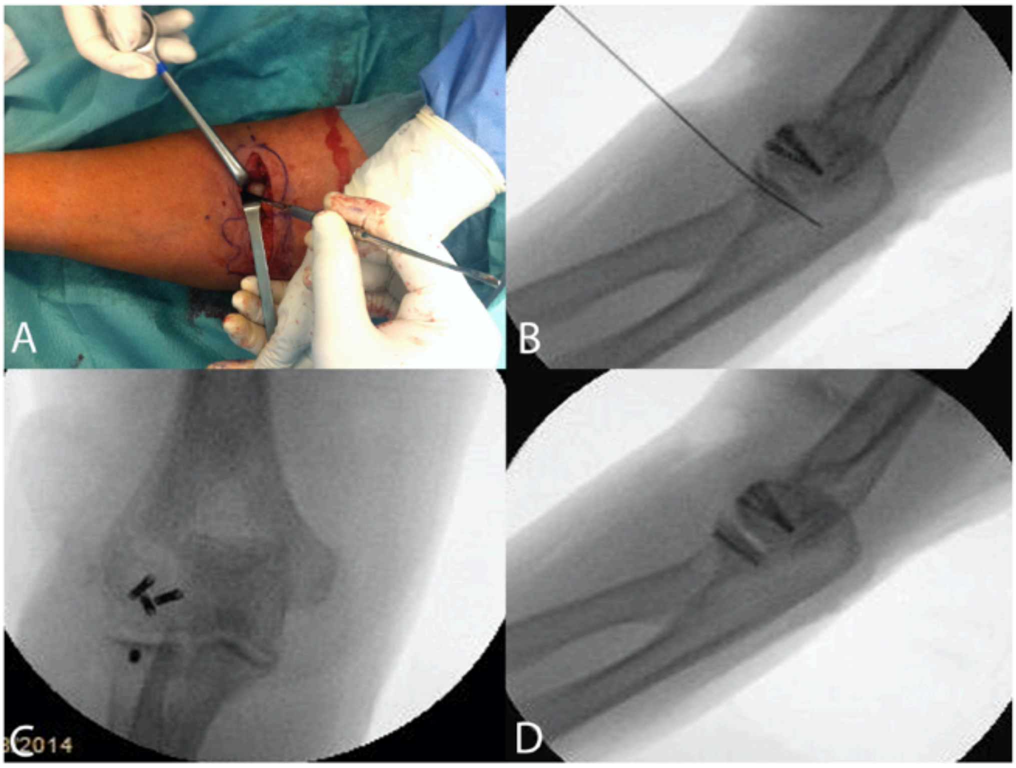

Fig. 10. A) Using a Freer retractor, we carefully reduce the articular fragment, this retractor can also be used to maintain reduction during Kirschner wire fixation. B, C and D) Checking the correct temporary reduction with Kirschner wire and position of cannulated screw fixing the radial head fragment.

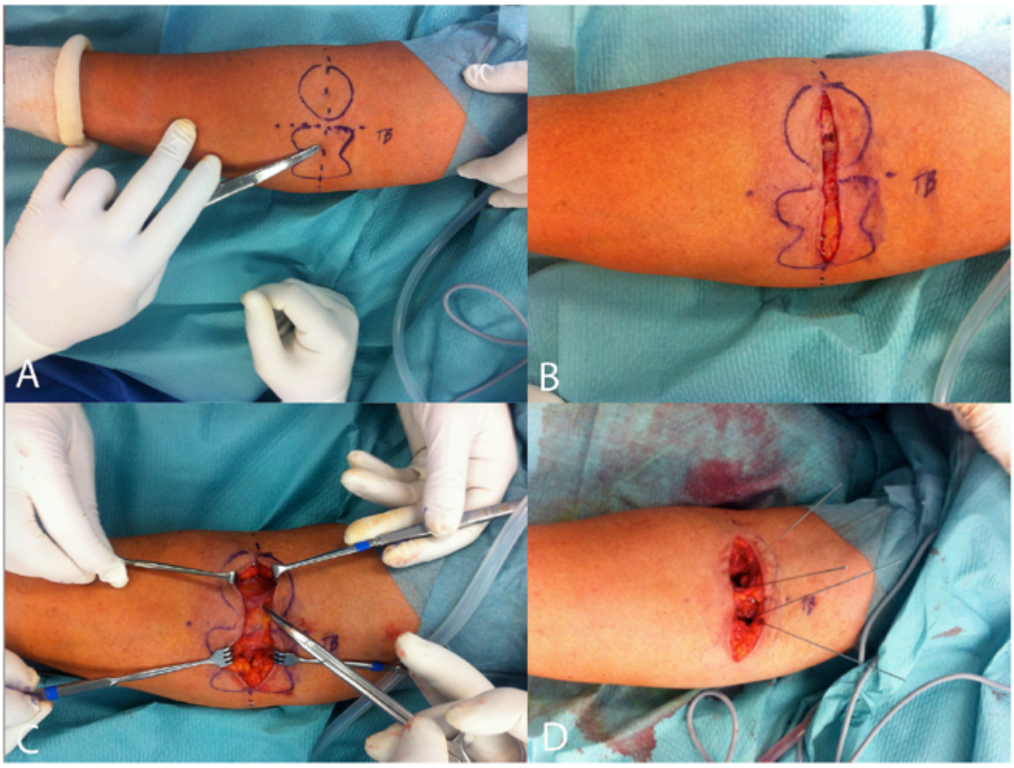

Fig. 11. A) The location of the capitellum and trochlea is drawn on the skin. See how the trochlear axis coincides with the flexion crease of the elbow. B) A skin incision is made that coincides with that line drawn. C) Subcutaneously, we dissect the cubital fossa with scissors. In the medial cubital fossa, once the superficial fascial plane is exposed, the bicipital aponeurosis is opened longitudinally, more medial to the biceps tendon depending on the type and extent of fracture. D) Positioning of Kirschner wires in both sides of the cubital fossa and radiological confirmation.

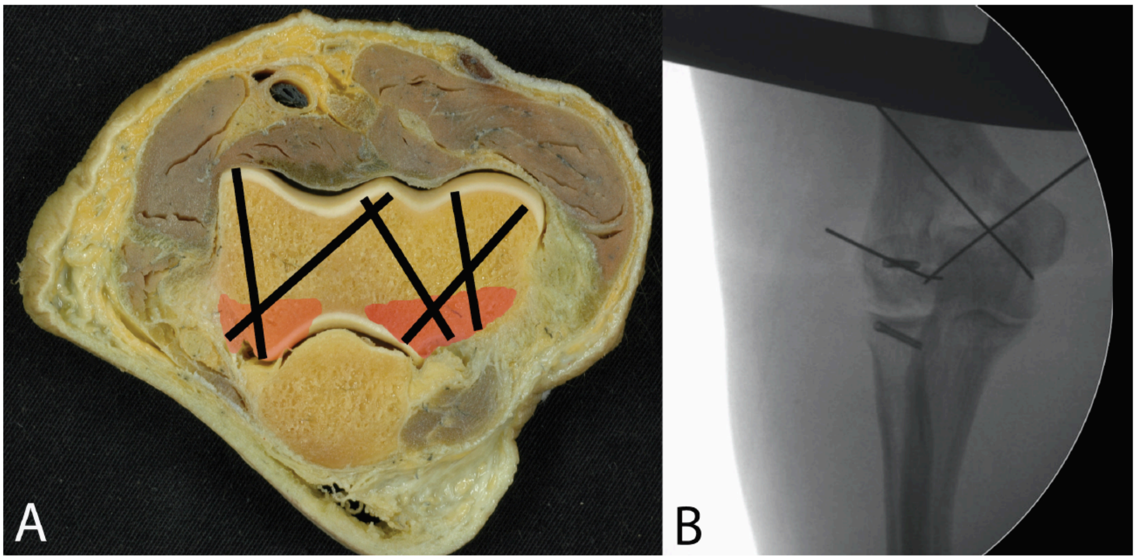

Fig. 12. A) Transverse section of the distal humerus: you can see the optimal direction of the K-wires for fixation of the capitellum and trochlea: you need to fix de screws in the posterior area of the columns. B) Anteroposterior projection check image once definitive fixation of the fracture is finished.

capsule must be opened with three incisions that coincide in the centre of the trochlea: one central proximal incision and the other two distal divergent incisions. Then we can expose the trochlea and perform temporary fixation with Kirschner wires (Fig 11 D). We must reduce it and check with fluoroscopy as we did with the capitellar fracture. We prefer to wait to be sure that both fractures are fixed correctly before proceeding to definitive fixation as some of the Kirschner wires can be adjusted (without completely removing them from the articular fragment), but once the screws are inserted this is more difficult and risky as we could weaken and fragment the trochlear segment that is to be fixed.

Definitive fixation: With the fragments reduced, we proceed to measure and insert the headless screws. We then check with fluoroscopy that the screws are correctly positioned and we also check that the elbow has a range of flexion-extension with no restrictions (Fig. 12 A and B). If the capitellar fracture involves the most distal edge (due to impaction or loss of bone), we will find that when we reduce and stabilize the fracture we do not get a completely smooth, regular surface, there may be some depression. In fractures of capitellum and trochlea, we can find comminution in the most distal area of the humerus (type B of the Dubberley classification) (Fig. 13 A and B), however, the posterior aspect of the external and internal columns of the distal humerus is usually entire. This is a very important detail, because the cannulated screws need to be fixed in this area, and if the CT scan shows a posterior comminuted fracture of the columns, the indication of the surgical approach and the technique to be used will change: it will be necessary to use lateral or posterior plates , approaching the fracture through an extended Kocher approach, or through a transolecranon approach (Fig 13 C).

Skin closure and immobilisation of the elbow: In such cases we must take care when mobilising the elbow once the fracture has been reduced and fixed, because the radial head can impact and stick to this flaw and pull the fracture apart. The most dangerous position of the elbow is the same position involved in the mechanism that produced the fracture: a fall with the

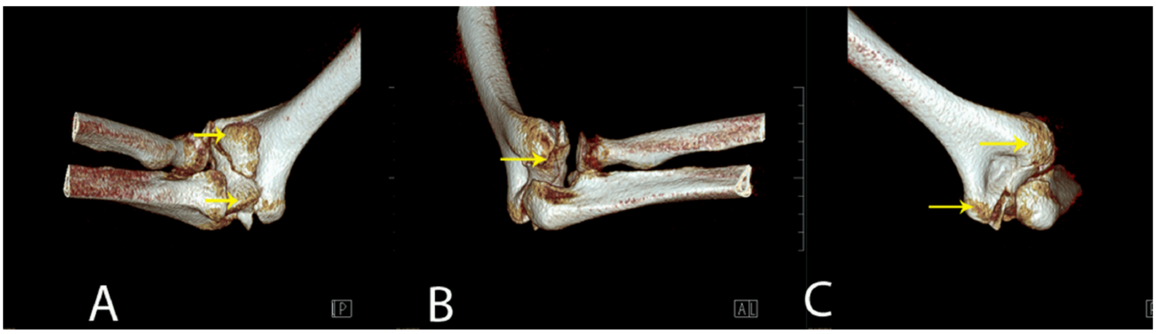

Fig. 13. A) Anterior view of a CT with 3D reconstruction in a Dubberley type 3 fracture: you can see that the fractured trochlear and capitellar fragments are separated.B and C) There are comminution in the most distal area of the humerus, but the posterior aspect of the external and internal columns of the distal humerus is entire.

elbow in extension, so the extension position between 0 and 30 degrees is the most dangerous during manipulation of the elbow. To perform the check in flexion, we prefer to do so slowly, with the index finger controlling the capitellum, and making sure at all times that the radial head passes above the capitellum, and is not reproducing the shearing movement. Therefore we recommend leaving the elbow flexed once we have checked on fluoroscopy that the profile is correct. The assistant must maintain the elbow between 80º to 90º flexion; subcutaneous closure is with resorbable 4-0 sutures, and skin closure is with 4-0 monofilament. Next, and without extending the elbow, we proceed to its immobilisation with a long arm posterior splint.

Discussion

The anterior (Henry) approach to the elbow has been widely used in upper limb surgery. It has been described as the first choice in the synthesis of proximal radius fractures, reinsertion of the distal biceps tendon, excision of anterior elbow tumours and debridement in case of soft tissue infections. However, due to the anatomical characteristics of the area, and because the elbow can be approached from other directions which involve lower surgical risk, the anterior approach is rarely used in everyday practice (1,2,6,7-9,11,12). Other authors have performed reduction and internal fixation by arthroscopy (13-15). Arthroscopy allows a correct visualisation of the fragments and articular surface, but it does not allow adequate implantation of the screws or guarantee a satisfactory reduction. In their report of two cases, Kuriyama et al acknowledge that they were obliged to convert one of them to open surgery because of this problem (13).

In this paper, we present an alternative to Henry's anterior approach, which involves an inter-nervous window bypassing the major vasculo-nervous structures of the anterior surface of the elbow and thus allows access to the anterior plane of the elbow (capitellum, trochlea, radial head and coronoid processes), albeit in a very limited space (16-17). We recognise that this approach is technically demanding but it may be a valid alternative in complex lesions of the elbow in which access via classical routes is limited (11).

The direction of the skin incision is a controversial issue. The option of the longitudinal incision perpendicular to the elbow fold involves a high risk of scar retraction/ contracture and is strongly discouraged by surgeons. We evaluated the possibility of making a transverse incision coinciding with the anterior flexion crease of the elbow, or a bayonet incision (18,19). We recommend starting with a transverse incision limited to the lateral cubital fossa in order to approach the capitellum, and then extending it in the same direction towards the medial cubital fossa if it is necessary to access the trochlea. If this is not sufficient, the ends of this incision can be extended longitudinally.

In order to approach the anterior aspect of the distal humerus through the lateral cubital fossa, we must locate and protect the area's superficial structures: the antebrachial veins and the musculocutaneous nerve which, after leaving the anterior compartment of the arm takes on a sensitive function and for this reason is also called the lateral antebrachial cutaneous nerve. Its point of emergence is difficult to locate, since we know that it crosses the brachial fascia laterally to the biceps tendon, but the height at which it does so varies substantially from patient to patient (16). However, it is usually located in a deeper plane than the antebrachial veins, and so during the dissection of the area this detail must be taken into account in order to identify the nerve and protect it. At a deeper plane, care should be taken to locate the interval between the brachiorradialis muscle and brachialis, leaving the radial nerve (which may already be divided into its deep and superficial bundles) included in the aponeurosis of the brachiorradialis muscle, since it does not have to be dissected20. There are few references to this approach in the bibliography although radial nerve lesions have been reported in the approach for the radius (21-23), but we stress that the approach described here is more proximal to the one required, for example, for biceps reinsertion. We recommend the use of a wide-blade separator to retract the mobile wad of Henry laterally along with the radial nerve, thus minimising the possible insult to the nerve.

Once the muscle belly of the brachialis is exposed through the window, transmuscular dissection in a longitudinal direction should be performed in order to gain access to the articular capsule. Capsulotomy is performed with a "Y" incision that can be extended distally allowing access to the radial head, after partial sectioning of the annular ligament if necessary.

In fractures of the distal humerus, the position of the limb in extension during surgery facilitates the reduction of the articular fragments that are attached to the humerus by means of a proximal periosteal flap responsible for its vascularization. Working with the elbow in extension allows the exposure of all the anterior aspect of the humerus, by moving the radial head and the coronoid process distally. Meticulous surgery with preservation of this flap is essential to ensure its viability, as is performing the dissection within the first days post-injury in order to minimise the risk of fibrosis and retraction that would compromise the subsequent viability of the fragment (11).

The other hypothetical advantage of approaching these fractures via the anterior route is the possibility of implanting the screws in an anteroposterior position in a plane that is truly perpendicular to the fracture. Elkowitz et al found that fixation by the Acutrac screws was significantly more stable than posteroanterior cancellous screws at 2000 cycles (21).

When the capitellum is approached in the classic way using a Kocher approach, despite the detachment of the origins of the lateral collateral ligament and the extensor supinator muscle the lack of space obliges the implantation of the screws from lateral to medial, with a considerable inclination with respect to the plane of the fracture.

Conclusions

In this study we describe the anatomy and technique of the anterior approach to the elbow for the management of fractures affecting the anterior plane of the distal humerus: the capitellum and the trochlea. It can also be used to treat associated lesions of the radial head and the coronoid processes. These lesions have classically been treated via the Kocher approach or via transolecranon osteotomy. We are aware of the technical difficulty of the approach described here, but with sound anatomical knowledge of the area and careful dissection, the possibility of injuring the anterior neurovascular structures is minimised. Comparative studies are needed to assess the merits of this approach with respect to the classical techniques in order to draw further conclusions about its superiority and safety.

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Conflicts of interest statement

The authors certify that they have no affiliations with or involvement in any organisation or entity with any financial interest, or non-financial interest in the subject matter or materials discussed in this manuscript.

Correspondence

Dr. José R Ballesteros-Betancourt, MD, FEBOT.

Trauma Unit. Orthopaedic and Traumatology Surgery Department, Hospital Clínic Barcelona. Barcelona. Spain. Macro- and Micro-Dissection and Surgical Anatomy Laboratory, Human Anatomy and Embryology Department, Faculty of Medicine, Barcelona University.

Address: C/ Villarroel 170 ICEMEQ. Escalera 4, Planta 4. 08036. Barcelona. Spain. E-mail address: jrballes@clinic.ub.es

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