Arthroscopic Partial Distal Ulnar Head Resection

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Abstract

Arthroscopic partial distal ulnar head resection is most often used in ulnocarpal abutment or impaction syndrome, which is a degenerative condition presenting as chronic ulnar sided wrist pain. It is usually associated with positive ulnar variance; pain occurs with a power grip typically with the wrist extended and the forearm pronated. Should non-operative measures fail to resolve the symptoms, surgical procedures including an ulna-shortening osteotomy or a partial distal ulnar head resection may be performed. We review the literature of partial distal ulnar head resection surgery, also known as the wafer procedure, and present our preferred technique for this arthroscopically assisted approach.

Keywords

Ulnocarpal abutment, ulnocarpal impingement, distal ulna resection, wafer procedure, arthroscopy

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Ulnocarpal abutment or impaction syndrome is a degenerative condition that results from an excessive load passing across the ulnar side of the wrist from the ulnar head through the triangular fibrocartilage complex (TFCC) to the lunate and triquetrum of the carpus.¹ The condition is often acquired and may occur secondary to trauma, such as with a malunited distal radius fracture causing a relative change in lengths of the radius and ulna at the wrist.² It may also occur following wrist arthrodesis when the carpus is shortened resulting in impingement of the carpus at the distal ulna. However, ulnocarpal abutment can also be idiopathic, i.e. constitutional (see Figure 1).

Biomechanically, the ulna is the major ’fixed point’ at the wrist around which the radius turns or rotates. Understanding this fixed point concept underlies the principle that the ulna is the cornerstone of hand, wrist and forearm function.³ This explains why resection of the ulnar head may be a devastating procedure for some patients, as it removes the fixed point of the wrist.

In supination, the radius and ulna are parallel and most often of the same length, reference from -4 to +2mm of ulnar variance.⁴ As the forearm pronates, the radius turns around the ulna resulting in a relative difference in lengths at the wrist level. The ulna gets relatively longer and the radius relatively shorter in pronation, which is important to understand when discussing the interpretation of wrist pathology if the X-rays have been taken as an antero-posterior (AP, i.e. in supination) or postero-anterior (PA, i.e. in pronation) view. Therefore, this is a dynamic situation of utmost importance to interpret accurately.

Due to the anatomical construct of the distal radioulnar joint (DRUJ), which includes the joint mechanical constraints, the joint capsule and the ulnoradial and ulnocarpal ligaments, the ulnar head will appear as if it pistons into the wrist with forearm rotation, because of this difference in relative length.⁵

In normal forearm rotation approximately 20% of the applied axial load is transmitted through the distal ulna.¹⁶ Forces transmitted across the ulnar side of the wrist increase further with forearm pronation, ulnar deviation and wrist extension.¹⁷ A forced fist grip also causes a relative increase in the length of the ulna at the radio-ulna-carpal joint increasing the load further.¹⁷

The TFCC is the buttress to this pistoning action and functions as a shock absorber of the pistoning forces as the carpus hits the distal ulna (see Figure 2). Under certain conditions this can result in degeneration of the surrounding soft tissue and bony structures. Therefore, in the case of positive ulnar variance, with the wrist extended and the forearm pronated there is an increased risk of ulnocarpal abutment with overloading of the ulnar side of the wrist. However, ulnocarpal abutment is also seen in ulnar neutral and negative individuals.

Clinical Presentation

Clinically, patients complain of ulnar sided wrist pain under load, in later presentations also at rest. Pronating and extending the wrist exacerbates this. Often grip strength is reduced compared with the normal contralateral side. Range of movement of the wrist is most often normal⁶ or can be reduced and associated with a click.¹⁷,⁸

Typically, the foveal sign test, i.e. pressing on the palmar part of the TFCC in the fovea, just radial to the flexor carpi ulnaris (FCU) tendon, is positive. Furthermore, the waiter’s test is positive, i.e. with the wrist extended bringing the forearm into pronation. This can be tested further by asking the patient to push up from a table with the palm of the hand on the table and the wrist extended at approximately 45–60⁰.
Quite often, the plain radiograph is normal despite a history and clinical examination being very clear for an ulnocarpal abutment problem. An ulnar plus variance is possibly noted and in later stages a cyst in the ulnar part of the proximal lunate may be seen (see Figure 1).

Magnetic resonance imaging (MRI) may be normal, show a degenerative tear of the TFCC or an oedema in the ulnar proximal part of the lunate, which is sometimes mistakenly reported as a partial Kienbock’s disease (see Figure 3). MRI or computed tomography (CT) with arthography may show a leak of contrast through the TFCC as a sign of the degenerative central perforation tear of the TFCC seen at arthroscopy. Arthroscopy is gold standard for this diagnosis, complete understanding and most often for the treatment.

The first stage of ulnocarpal abutment shows chondromalacia of the ulnar proximal part of the lunate (see Figure 4), the TFCC will be thinner than normal, most often with a wear of the central portion at arthroscopy (see Figure 2). At this stage, the TFCC is still able to withstand the forces that pass across it; however, with arthroscopic signs of wear. In theory, a waffer procedure is available but a hole in the central TFCC has to be made with a banana blade cutter or with a shaver to get access to the distal ulnar head. Most surgeons will in this situation move on to an ulnar-shortening osteotomy.

Stage 2 ulnocarpal abutment occurs with a degenerative, circular, central, membranous TFCC perforation secondary to the grinding mechanism of the relative pistoning of the ulna against the carpus, or rather the carpus towards the fixed point of the distal ulna (see Figure 2). The ulnaradial ligament always remains intact at the rim of the TFCC. These degenerative TFCC tears have been classified according to Palmer as grade II A–E.7,15 The associated lunate chondromalacia is variable and further arthroscopically classified according to Outerbridge into one to five stages16 based on arthroscopic findings. Direct visualisation of the lunate may require the arthroscopic viewing and working portals to be switched for a complete assessment of the involvement of the lunotriquetral (LT) ligament. Sometimes the proximal ulnar part of the lunate is completely denuded of cartilage with bare bone visible, obviously not found on a X-ray (Figure 4b).

An LT ligament tear together with the above findings signifies stage 3 ulnocarpal abutment. This disruption is secondary to fatigue because of the repetitive microforces passing across the LT joint, again as the pistoning forces from the carpus towards the distal ulna. The LT joint must be inspected from both the radiocarpal and midcarpal joints to be completely assessed.

In a normal wrist, the LT ligament is difficult to visualise; in fact, it is seen as a hollow in the continuation of the lunate towards the triquetrum at radiocarpal assessment. In a ligamentously lax individual a fold of ligament may be visualised. Even with a tear of this ligament it is difficult to pass a probe or the scope because of the orientation of the joint, starting at the radiocarpal articulation from ulnar articulating towards radial.

At midcarpal assessment, in LT tears a step is seen from the triquetrum down to the lunate, and with a dynamic assessment with the scope in the midcarpal joint, the instability is most often seen while stressing the pisiform towards the triquetrum, maintaining the lunate stable. The extent of the movement at this joint secondary to the tear must be assessed at both the radiocarpal and midcarpal joints. Occasionally but still quite rarely, there may be early signs of osteoarthrosis at the tip of the hamate. This is known as Hamate Arthrosis Lunotriquetral (HALT) instability. This condition is more often seen in type II lunates, where the lunate has a particular joint surface...
The operative options include radius corrective osteotomy, ulna-shortening osteotomy, ulnar head replacement with a bit of shortening, ulnar head resection or partial resection of the distal ulna, also called the wafer procedure. This can be carried out openly or arthroscopically.

Open or arthroscopically assisted partial distal ulna resection or wafer procedure is indicated when the ulna+ variance is >2mm, i.e. when a maximum of 2mm of the distal ulna needs to be resected. The DRUJ and ulnar styloid is preserved and the TFCC may be debrided or repaired.

If the ulnar variance is >2mm, the DRUJ is degenerative or unstable or carpal instability is present then a partial ulnar head resection is contraindicated.

There are no evidence-based outcomes to help the surgeon decide which procedure to perform. In the limited literature, open partial ulnar head resection or the wafer procedure are reported as being excellent or good, however, only in the small amount of case series published, totalling 38 out of 44 patients. Pain almost universally resolves and grip strength improves significantly compared with the normal contralateral side, allowing all but six of the 44 patients to return to their previous employment, and one to modified work, by three months following surgery. A complication reported after open treatment is that of extensor carpi ulnaris (ECU) tendinitis, which occurred in three of the 44 patients.

The partial ulnar head resection or wafer procedure compares favorably with an ulna-shortening osteotomy with no difference in subjective outcome. Both groups returned to work by three months and despite the grip strength in the ulnar shortening and wafer groups being 98 and 85%, respectively, this difference was not significant. However, the time to union of the osteotomy was three months and in nearly half the cases the metalwork required removal because of irritation to ECU tendon.

The partial ulnar head resection or wafer procedure, when performed arthroscopically with TFCC debridement and subsequent resection of the distal ulna, results in excellent/good or very satisfied/satisfied patients in 21 out of 23 patients. Pain persisted in some of those patients with a LT ligament tear, either partial or a complete, suggesting that a more complete treatment should have been considered. This was not addressed at the time of initial surgery with K-wire stabilisation of the LT joint. All patients returned to their previous employment by eight weeks. On average, grip strength increased following the arthroscopic wafer procedure. Range of movement and grip strength only seem to be incomplete following this procedure in some patients who have a partial LT ligament tear.

In summary, when the arthroscopic partial ulnar head resection or wafer procedure is compared with an ulna-shortening osteotomy, there is no significant difference in outcome. A greater proportion return to work following the arthroscopic procedure and those that return seem to return sooner.

However, there is a significant increase in secondary procedures for the ulnar-shortening osteotomy group requiring removal of metalwork due to ECU tendinitis. Complications following the arthroscopic wafer procedure are similar to those following standard
wrist arthroscopy, i.e. very few. As yet, no studies compare open and arthroscopic partial distal ulna resection or wafer procedures, particularly not with a prospective randomised approach.

**Surgical Technique – Our Preferred Method**

Wrist arthroscopy is performed under regional anaesthesia in all cases in our unit and always as a day case. Following skin preparation and draping, the arm is exsanguinated. Traction is applied to the limb via finger traps to the index and middle digits. With diagnostic arthroscopy, counter traction is not applied so that any abnormal joint movement can be assessed accurately. Only a few millilitres of normal saline is injected into the radiocarpal joint to ensure correct placement of the trocar and not to distend the joint capsule, i.e. a ‘dry arthroscopy’ approach is envisaged.

After marking the surface anatomy and planning the portals, the skin is incised with a 10 blade and the subcutaneous tissue plane and the capsule is approached by blunt dissection with a small artery clip to penetrate the capsule to make the standard 3–4 portal; i.e. between the third and fourth extensor compartments. Correct placement of the arthroscope is confirmed and a dry arthroscopy is performed. A needle is sometimes used to provide outflow from the ulnar side of the wrist, should saline flow be used or particularly if a vaporiser is used to debride the TFCC as this needs saline to ‘cool’ the vaporiser. Similarly, in a safe, blunt way, an appropriate ulnar sided portal, 4–5 (between the fourth and fifth extensor compartment) or 6R (radial to the sixth extensor compartment) is made that allows inserting a probe to assess the ulnocarpal area. Most often this initial 4–5 or 6R working portal is exchanged to being a viewing portal to fully assess not only the TFCC and the ulnar lunate, but also more importantly to fully assess the radiocarpal appearance of the LT ligament.

A midcarpal portal is essential in the complete assessment of ulnocarpal abutment syndrome. In the assessment of the LT joint, the midcarpal portal allows the surgeon to assess not only any step of the LT interval, but also whether a type II lunate is present and, if so, if there is any sign of early osteoarthritis at the tip of the hamate, suggesting a HALT lesion (see above). Once the ulnocarpal abutment syndrome has been confirmed and staged according to our guidelines above, the therapeutic procedure commences.

Loose cartilage fragments on the lunate can be resected to a stable rim as well as a partially or completely torn LT ligament. Debridement of the central, circular TFCC tear follows (see Figure 5). This allows resection of the unstable flaps of the TFCC to a stable peripheral rim and to gain access to the distal ulna to perform the partial ulnar head resection. We perform this using a punch to define our defect and then complete the debridement using either an aggressive shaver or a vaporiser. It is essential that when partially resecting the TFCC, the peripheral ulnoradial ligament is preserved to maintain stability of the DRUJ.

Through the central defect in the TFCC the distal ulnar head dome is partially resected using the barrel abrader burr in a similar way to performing an acromioplasty of the shoulder (see Figure 6). We prefer to use a 3.5mm barrel abrader burr.

Pre-operative planning from plain radiographs will determine the required level of resection. The burr is pressed down into the ulna head to the required pre-operatively planned level of resection and then levelled off ensuring that the ulnar styloid and the deep attachment of the TFCC at the fovea is preserved. Once the ulnar head in view is levelled the forearm is rotated in full pronation and supination and the prominent area of the ulna head that comes in to view is resected to match up with the previous resection. This is repeated so that the distal ulna is resected throughout full prono-supination to the required level. This can be confirmed by viewing the TFCC from full pronation to supination. When the distal ulna throughout the range does not tent the TFCC, then sufficient ulna has been resected. In any uncertain situation, a flouroscan or a C-arm should be used to confirm adequate resection. Sometimes, only the cartilage cap and a small amount of subchondral bone will need to be resected and, therefore, post-operative radiographs will be seemingly unchanged (Figure 7).

Should the LT ligament be torn, implying a more advanced and a stage 3 ulnocarpal abutment syndrome, the LT joint may be temporarily stabilised using K-wires introduced from the ulnar-sided via a mini-open approach. This mini-open approach ensures dorsal branches of the ulnar nerve are identified and protected. These wires are screened using image intensification. They are buried and require removal at eight weeks from surgery under local anaesthesia.
Figure 7: Postoperative X-ray after Arthroscopical Partial Ulnar Head Resection

The postoperative X-ray is sometimes almost normal with only the tip of the ulnar dome resected, so as not to jeopardise the distal radial-ulnar joint stability.

Alternatively, in such an advanced case, the operative treatment should be to perform an ulnar-shortening osteotomy as this will use the ulnocarpal ligaments of the TFCC to further stabilise the LT joint, which is for the surgeon to consider at the time of this procedure. Our advice is to carry out a LT pinning in an ulnar neutral or minus variance, and to move into an open ulnar shortening osteotomy in an ulnar + variance to further improve the LT component of this advanced ulnocarpal abutment syndrome.

Postoperative treatment of an arthroscopically assisted partial ulnar head excision need only be a big compression dressing for comfort and gently mobilisation. It is our impression that the bare bone/cancellous bone left at the end of an arthroscopic wafer leaves a lot of enzymes and substances from the cancellous bone that take a lot of time to settle. In fact, the overall recovery time is most often the same between an ulnar-shortening osteotomy and this arthroscopic procedure. The rest, we think, is not evidence-based but rather based on personal preferences and personal philosophy.

Conclusion

Wrist arthroscopy is mandatory in assessing any kind of ulnar-sided wrist pain, particularly for a complete diagnosis and staging of ulnocarpal abutment. The partial ulnar head resection or wafer procedure provide a favourable alternative to an ulnar-shortening osteotomy in the management of ulnocarpal abutment syndrome particularly in the ulna-neutral or ulna-minus patient. It obviates the often frequent requirement of metalwork removal associated with ulna-shortening osteotomies and has a lower incidence of ECU tendinitis.

The complete diagnosis is impossible to get without arthroscopy and it is therefore natural to continue with an arthroscopic approach to this problem. Following correct diagnosis of ulnocarpal abutment the appropriate management plan will be confirmed intraoperatively, with arthroscopy. There are several critical points to ensure optimum outcome following arthroscopic wafer procedure.

First, preservation of the volar ulnocarpal ligaments, the deep TFCC attachment and the ulnar styloid. Second, ensuring that the ulnar dome is resected to the required level so that no impingement remains throughout the full range of pronosupination. This is confirmed by visualising the TFCC not tenting during this range of forearm movement. Third, should there be abnormal movement associated with a LT ligament tear as observed at the midcarpal joint assessment, the LT joint should be stabilised temporarily and an open ulnar-shortening osteotomy should be considered particularly in ulna+ variants.

In essence, arthroscopic partial ulna resection or wafer procedure provide good pain relief while maintaining function and allowing patients an early return to work. There is no need for removal of any hardware.