# BASE OF THUMB ARTHROSCOPY

*– Written by Mike Hayton, Edward Jeans and Chye Yew Ng, United Kingdom*

## INTRODUCTION

The base of thumb is one of the most common areas in the body to cause problems and referral to a specialist hand clinics[1]. Historically, base of thumb pathology, particularly for osteoarthritis was ignored, and treatment was dictated by late stage presentation resulting in limited options other than salvage procedures. Base of thumb arthroscopy is an increasingly popular technique for the investigation and management of base of thumb pathology. It allows for the direct visualisation of the internal architecture including articular cartilage and capsular ligamentous structures that otherwise may not be seen on even advanced imaging such as an MRI scan. Pathology may be identified at an earlier stage and less invasive treatment offered as an alternative to the salvage procedures available.

This article gives an overview of the indications for surgery, background on the anatomy and how this relates to safe portal positioning and surgical techniques for the various pathologies that commonly present.

## INDICATIONS

The capsulo ligamentous structures around the 1st CMC joint are important in maintaining stability between the trapezium, index metacarpal and 1st metacarpal and as such open approaches to the joint are best avoided, especially in early disease, when further weakening and subsequent instability may cause disease progression. Base of thumb arthritis is described by the Eaton stages, I-IV; I being inflammation and joint space widening, II joint space narrowing and osteophyte formation <2 mm, III severe joint space narrowing and subluxation of the joint with osteophytes >2 mm and finally stage IV which is pan trapezial arthritis[2].

Arthroscopy allows direct visualization, assessment and therapeutic interventions on the joint without the need for incising and potentially damaging the surrounding structures as occurs during open approaches.

There are currently several main indications for 1st CMC joint arthroscopy;

- Arthroscopically assisted reduction of a Bennett fracture prior to fixation.
- Diagnostic assessment and treatment of capsular ligamentous structures following injury.
- Diagnostic assessment of the articular cartilage in early base of thumb osteoarthritis (Eaton grades I-III)
- Arthroscopic resection of degenerate joints

## ANATOMY

The articulation between the thumb metacarpal and the trapezium is classified as a saddle joint with the trapezium being convex when viewed in the sagittal plane and concave when viewed in the coronal. The base of the thumb metacarpal being the reciprocal of this. This joint configuration allows for a highly mobile articulation capable of uniplanar motions such as flexion /extension and adduction / abduction as well as composite movements such as opposition. Due to this mobility the 1st CMC is an inherently unstable joint. The ligamentous structures therefore are key to maintaining congruency when the joint is loaded[3]. The shape of the articulation and contact area changes with advanced degeneration giving the classic deformity of squared thumb base due to an adducted metacarpal in advanced osteoarthritis[4]. Stability is conferred dynamically with the joint mobile when unloaded then locking with the contraction of Abductor Pollicis Longus (APL) which tightens the capsule, dorsal and beak ligaments.

Study of the ligaments of the thumb base has been reported as early as 1742, when Weitbrecht described 3 ligaments; the palmar, dorsal, and lateral. Most authors now agree there are 7 ligaments associated


**Image:** Thumb injuries are common in Rugby players (illustration).

with the 1st CMC, divided into 2 dorsal, 3 volar and 2 intermetacarpal ligaments[5].

*Dorsal*
- Dorsoradial ligament
- Posterior oblique ligament

*Volar*
- Superficial anterior oblique ligament
- Deep anterior oblique or Beak ligament
- Ulnar collateral ligament

*Intermetacarpal ligaments*
- Volar 1-2 intermetacarpal ligament
- Dorsal 1-2 intermetacarpal ligament

The Beak ligament if often cited as an important stabiliser of the CMC joint. Nanno et al in a study of ten cadaveric hands identified the beak ligament as the only intra articular ligament of the CMC and closest the centre of rotation, giving it a mechanical advantage. It is thought that this ligament due to its short intra articular course is the first ligament to tension during circumduction, acting as a pivot point and is the primary stabiliser of the CMC in pinch and grasp grips[5-7].

The Dorsoradial ligament (DRL) has also been studied in detail in the setting of CMC dislocation. Strauch et al applied a dorsal dislocating force to 38 cadaveric thumbs and concluded that the DRL was the primary restraint to dorsal dislocation. Further anatomic and biomechanical studies by Najima and Bettinger came to the same conclusion[7,8].

While there have been various anatomic and biomechanical studies of the ligaments of the 1st CMC joint the role that dynamic stabilisers play in joint stability is less well investigated. Extensor Polliciis Longus / Brevis, Abductor Pollicis Longus, Flexor Pollicis Longus and the Thenar muscles all cross the joint. We know that dynamic stabilisers of the scapholunate joint allow the ligaments to resist forces that would lead to injury if unopposed, further study is required to determine how dynamic stabilisers of the CMC joint are affected in early disease and if targeted rehabilitation can alter disease progression[9].

During portal placement the sensory branch of the radial nerve (SBRN) is at risk. Proximal to the wrist joint the SBRN divides into 3 terminal branches named S1 -3 from dorsal to volar. The S2 branch crosses the Extensor Pollicis Longus tendon at the level of the 1st CMC and the S3 branch runs along the first extensor compartment putting both of these branches at risk when establishing arthroscopic portals. The last structure to be aware of is the terminal branch of the radial artery that runs on the floor of the anatomical snuff box before passing between the two heads of the adductor pollicis muscles.

## PORTALS AND TECHNIQUE

A general anaesthetic or regional block can be used depending on anesthetic availability and patient preference with a pneumatic tourniquet usually applied. More recently Wide Awake, Local Anaesthesia, No Tourniquet (WLANT) has gained popularity and dynamic feedback is possible intra-operatively. The arm is prepared and draped as standard and most surgeons would use a finger trap on the thumb with the arm suspended from an arthroscopy tower. However, over the last few years, the senior author has preferred the arm and finger trap to be on an arm table and the weight allowed to hang over the side the table. The procedure is performed with a small joint arthroscope (1.9 mm) and can be performed dry or with irrigation with the a syringe pump or 20 ml syringe. A 2 mm full radius shaver can be used to remove inflamed synovium and a radiofrequency wand used for the same purpose or perform capsular shrinkage. A bone burr can resect degenerate bone, to a bleeding cancellous surface that will hopefully be covered with mature fibro-cartilage as the new articular surface.

Fluid, if used, should be kept running continuously especially when using a radiofrequency wand to avoid thermal injury to the articular cartilage. Landmarks should be palpated and marked prior to joint injection and incision. These include the proximal posterior edge of the base of the first metacarpal, the radial artery, and the tendons of APL and EPB.

The classic portals described by Berger are the 1-R and 1-U[10] and allow adequate visualisation of the articular surface and allow for instrumentation of the joint and therapeutic procedures. The 1-R portal is established with an incision volar to the APL tendon. This portal enters the joint lateral to the anterior oblique ligament. The 1-U portal is posterior and ulnar to the EPB tendon and passes between the dorsoradial and posterior oblique ligaments. A 20 gauge needle is initially passed into the joint and insufflated with 1 - 2 mls of N saline The position of the needle within the joint can be confirmed on fluoroscopy or with the aspiration sign when the syringe back fills when the thumb pressure is released. When establishing portals, the skin and dermis only should be incised and then blunt dissection down to the capsule to avoid injury to the S2 and S3 branches of SBRN. A Thenar portal has also been described which is used in place of the 1-R portal. Established under direct vision via the 1-U portal anatomic studies have shown it lies further from structures at risk than the 1-R portal. The disadvantage when authors have compared complication rates is that it can leave a painful scar on the thenar eminence. Any sensory deficit reported from the 1-R portal tend to resolve without intervention by 2 months[11,12].

## ARTHROSCOPICALLY ASSISTED REDUCTION OF A BENNETT FRACTURE PRIOR TO FIXATION

A Bennett's fracture is a fracture dislocation of the first metacarpal base and is the most common intra articular fracture of the 1st CMC[13,14]. The volar ligaments described previously that attach to the ulnovolar base of the first metacarpal maintain a portion of the metacarpal articular surface congruent with the trapezium while the deforming force of Abductor Pollicis Longus causes the shaft fragment to displace dorsally and shorten leaving the joint subluxated. Given the poor results of non-operative management, due to progressive proximal migration of the metacarpal, there is a low threshold for operative intervention[15,16].

There has been an increasing trend towards open reduction and internal fixation (ORIF) in an effort to achieve anatomical reduction and stable fixation[17]. but a recent meta-analysis of published studies shows high rates of post traumatic OA and failure with ORIF[18]. While percutaneous reductions and K wire fixation are associated less failures, a cadaveric study showed that fluoroscopic imaging correlates poorly with actual reduction. A less <1.5 mm step off in the joint surface on fluoroscopy, when measured directly could have a residual displacement of up to 3.1 mm[19]. This is not ideal considering that long term outcome correlates with adequacy of reduction[20].

Arthroscopic assisted fixation has the perceived advantages that it allows assessment of chondral damage and articular step off plus confirms that fixation does not violate the joint surface intra operatively. The operative technique is described by Culp using tower traction and a combined fluoroscopic and arthroscopic reduction and fixation[21]. Studies are so far limited in number though they have shown advantages in time to mobilisation, lower complication rates and better functional and radiological outcomes, though long term results are not available[22,23]. A Comparative study by Pomares et al found that 30% of patients treated with ORIF where unable to return to pre injury employment verses 10% in the arthroscopically assisted fixation group[22].

## DIAGNOSTIC ASSESSMENT AND TREATMENT OF CAPSULAR LIGAMENTOUS STRUCTURES FOLLOWING INJURY

Chu et all[24] reported the results of arthroscopic thermal shrinkage of the volar ligaments and capsule for instability. 17 patients underwent the procedure with a mean age of 35.3 years and a minimum

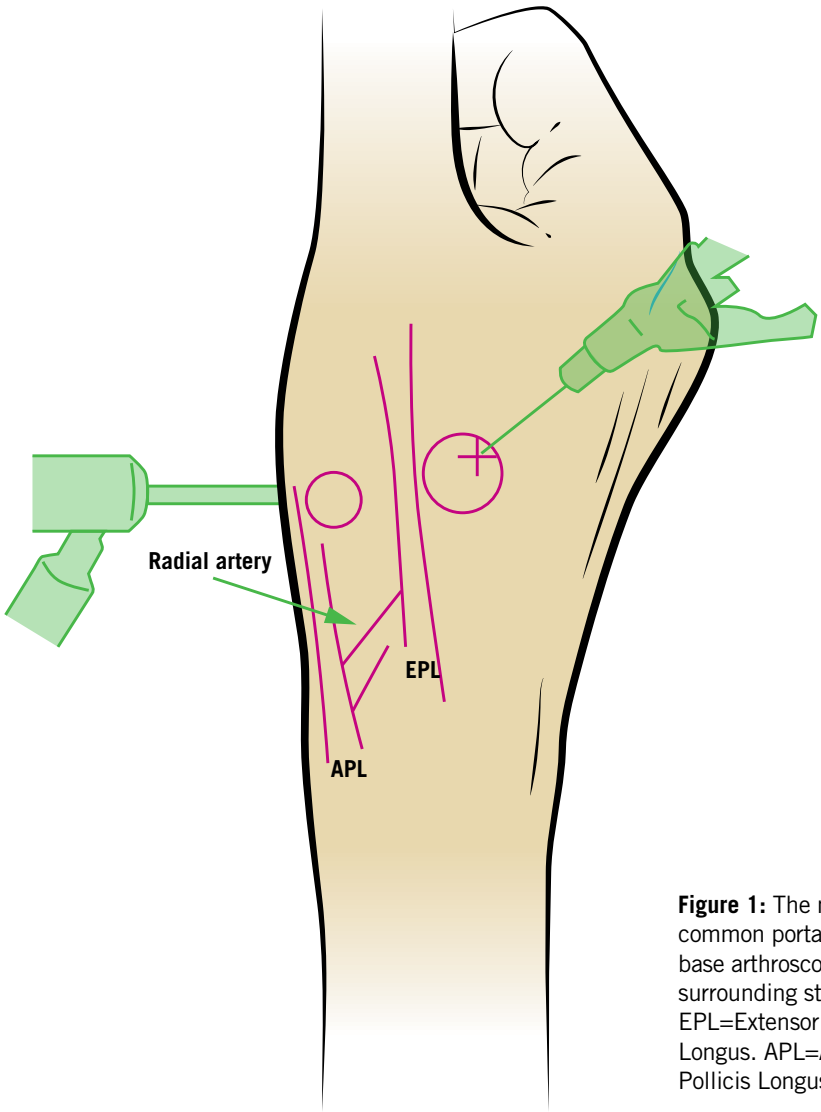


**Figure 1:** The most common portals in thumb base arthroscopy and the surrounding structures. EPL=Extensor Pollicis Longus. APL=Abductor Pollicis Longus.

follow up of 24 months. 16 of the 17 patients were satisfied with surgery and there was a significant improvement in grip strength recorded. While the majority of 1st CMC chronic instability progresses to early arthritis likely secondary to failure of the beak ligament. There is another group of instability patients that present with an acute traumatic dislocation of the 1st CMC. Whilst an uncommon event, if improperly managed can lead to chronic problems and degenerative change. The dislocated joint should be reduced emergently and depending on stability either placed into as thumb Spica in abduction for 6 weeks or if gross instability present move to operative intervention in the form of ligament repair or pinning. While we could find no reports of arthroscopic assistance for the reconstruction of ligaments in the acute setting in the CMC joint, techniques for repair and reconstruction of the ulnar collateral ligament in the thumb metacarpal phalangeal joint have been described with good outcomes.

Diagnostic assessment of the articular cartilage in early base of thumb osteoarthritis and Arthroscopic resection of degenerate joints

There are various different theories as to how degenerative changes in the 1st CMC joint develop but there is agreement that insufficiency of the beak ligament plays an important role in the pathogenesis of the condition[6]. In Eaton stage I osteoarthritis of the 1st CMC there is a role for arthroscopy in the debridement of inflamed synovium and thermal shrinkage but once joint space narrowing has occurred then treatment options move on to trapeziectomy with or without ligament interposition, arthroplasty and arthrodesis. A Cochrane review of published studies of open trapeziectomy +/- interposition concluded that no technique displayed an advantage over another and that simple trapeziectomy which had the lowest side effect profile[25,26]. All of these open techniques require a prolonged period of immobilisation and rehabilitation due to the destructive nature of the surgery required to remove the trapezium. Arthroscopic methods of distal hemi trapeziectomy have been described and show equivalent good results to open techniques. Edwards[27] describes a series of 23 patients treated with arthroscopic hemi trapeziectomy, thermal shrinkage without interposition for patients with Eaton stage III disease. Set up as described above and a bone burr used to resect 3-4 mm of trapezium before release of traction and thermal shrinkage. The joint was held in place at the end of the procedure with a K wire. A thumb spica was applied for 4 weeks until removal of K wire then a removable splint applied and active movements commenced from 6 weeks. Minimum follow up was 4 years and DASH score improved from 61 to 10 3 months and this improvement maintained to last follow up. Özçelik et al in a series of 21 patients treated with arthroscopic trapeziectomy plus suture button suspensionplasty reported DASH scores improving to 5.5 from 23.4 pre-operatively with a follow up period of 50.1 months[28]. A study by Cobb et al reported their experience of 144 patients treated with either hemi trapeziectomy or hemi trapeziectomy and interposition with "Graft Jacket" a human acellular dermal matrix. Outcomes measure where pain, grip and pinch strength. Follow up in both groups was over 5 years. The conclusion was there was not difference in outcomes with or without interposition therefore interposition was not a cost effective intervention[29]. As with open trapeziectomy it would seem that additional procedures do not confer any benefit to simple trapeziectomy. In terms of outcomes it appears than open verses arthroscopic procedures are equivalent. The perceived advantages of arthroscopic hemi trapeziectomy such as better cosmesis, earlier return to activity and improved outcome due to minimal soft tissue dissection are yet to be proven and properly constructed trails are required.

COMPLICATIONS SPECIFIC TO THUMB CMCJ ARTHROSCOPY

*Nerve and vessel injury*

Branches of the superficial radial nerve pass through the operative field and division can lead to sensory alteration or painful neuroma[10]. The radial artery also runs close to the common portal sites and if injured could lead to haematoma or in rare cases where a patient has a radial dominated perfusion, ischemia of the thumb and digits.

*Articular cartilage damage*

The thumb CMCJ is small and the delicate articular cartilage is at risk during needle and arthroscope placement. To reduce the risk, traction "opens" up the joint, allows safe needle placement and fluid distention. Blunt dissection through the capsule of the joint releasing the fluid confirms joint entry before the blunt arthroscope is introduced. In all cases the arthroscope introducer should be blunt and the sharp alternative avoided.Inadvertent cannulation of the scaphotrapezium or radioscaphoid joints is possible and fluoroscopic conformation of position is recommended for this reason.

*Thermal injury to the articular cartilage*

In cases of radiofrequency ablation or shrinkage high flow fluid irrigation should be used to avoid thermal injury to the articular damage. An additional wide bore needle in the joint will facilitate free fluid flow reduceing the internal temperatiure.

*Summary*

Arthroscopy of the thumb CMCJ joint improves the diagnostic capabilities, allows earlier intervention for disease management , and may reduce risks from collateral damage to surrounding structures improving outcomes.

*References*

*Available at www.aspetar.com/journal*

*Mike Hayton M.D.*
*Consultant Orthopaedic Hand Surgeon*

*Edward Jeans M.D.*

*Chye Yew Ng M.D.*
*Consultant Hand and Peripheral Nerve Surgeon*

*Wrightington Hospital*
*Wigan, UK*

*Contact: mikehayton@gmail.com*