Thumb Carpometacarpal Joint Arthroscopy: A Classification System and Rationale for Treatment

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The thumb carpometacarpal (CMC) joint is the second most common site for osteoarthritis in the hand, after the distal interphalangeal joint. There have been many studies in the literature that have shown a correlation between volar ligament instability and development of early degenerative changes in this joint.

A number of treatment options for this condition have been described in the literature, ranging from splinting to resection arthroplasty. Advances in arthroscopic technology have allowed examination of the small joints throughout the body with minimal morbidity. Synovitis, osteophytes, fractures, loose bodies, and ligamentous tears have been successfully managed with the arthroscopic surgery. Moreover, arthroscopy has already been proven to be reliable for direct evaluation of the first CMC joint. Recently, many authors have described new portals to help further define the topographic anatomy of this joint.

The senior author (A.B.) has described an arthroscopic classification for thumb CMC osteoarthritis that has therapeutic implications when compared with radiographic classification (Table 1). Arthroscopic assessment of the CMC joint facilitates easy identification and classification of the joint pathology without compromising the capsular integrity of the joint. It allows direct visualization of all the components of the joint including synovium, articular surfaces, ligaments, and the joint capsule and allows the pathology to be treated either arthroscopically or by an open procedure in the same sitting, as warranted by the initial arthroscopic assessment.

**Indications for Arthroscopy**

Arthroscopic evaluation of thumb CMC joint is indicated in all patients with basal joint arthritis who fail the conservative treatment, with the following exceptions:

1. Eaton stage IV arthritis with severe scapho-trapezial-trapezoid changes. In this situation, trapezial excisional capsuloplasty using a slip of abductor pollicis longus or arthrodesis is our preferred treatment.
2. Elderly, low-demand patients who are candidates for cemented total joint arthroplasty, as this requires minimal immobilization and therapy.
3. Patients with severe adduction contracture of the thumb.
4. Younger patients with high demand, as in a manual laborer. Arthrodesis may be a better option in this situation. Open insertion of an Artelon (Small Bone Inno-
5. Thumbs with severe CMC subluxation may not be amenable to arthroscopic techniques because this minimally invasive technique does not enhance joint stability.

Table 1 Badia’s Arthroscopic Classification

<table>
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<th>Stage</th>
<th>Arthroscopic Changes</th>
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<tr>
<td>I</td>
<td>Intact articular cartilage. Disruption of the dorsoradial ligament and diffuse synovial atrophy. Inconsistent attenuation of the anterior oblique ligament (AOL)</td>
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<tr>
<td>II</td>
<td>Frank eburnation of the articular cartilage on the ulnar third of the base of first metacarpal and central third of the distal surface of trapezium. Disruption of the dorsoradial ligament and more intense synovial hypertrophy. Constant attenuation of AOL.</td>
</tr>
<tr>
<td>III</td>
<td>Widespread full-thickness cartilage loss with or without a peripheral rim on both articular surfaces. Less severe synovitis. Frayed volar ligaments with laxity.</td>
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Arthroscopic and Radiographic Correlation

Arthroscopic stage I correlates with radiographic stage I. Arthroscopic stage II usually corresponds to radiographic stage II changes, but some radiographic stage I patients may display focal loss of articular cartilage consistent with arthroscopic stage II. Herein lies one of the great advantages of this technique. Only the rare case demonstrates less cartilage wear than expected on the plain radiograph. Radiographic stage III usually will reveal widespread cartilage loss when arthroscopy is performed.

Surgical Technique

The procedure is performed under wrist block regional anesthesia with tourniquet control. A single Chinese finger trap is used on the thumb with 5 to 8 lbs of longitudinal traction. A shoulder holder, rather than traction tower, is used to facilitate easy use of fluoroscopy. The thumb CMC joint is localized by palpation. The incision for the 1-R (radial) portal is placed just volar to the abductor pollicis longus tendon. This portal is used for assessment of the dorsoradial ligament,
posterior oblique ligament, and ulnar collateral ligament. The incision for the 1-U (ulnar) portal is made just ulnar to the extensor pollicis brevis tendon. This portal is helpful for visualizing the anterior oblique ligament and ulnar collateral ligament. Joint distension with 1 to 3 mL of normal saline (Fig. 1) facilitates the placement of a short-barreled, 1.9-mm 30° arthroscope (Fig. 2). A full radius mechanical shaver with suction is used in all the cases, particularly for initial debridement.

In arthroscopic stage I disease (Fig. 3), management includes arthroscopic synovectomy using a 2.0 mechanical shaver augmented with radiofrequency ablation. Ligamentous laxity and capsular attenuation are treated with thermal capsulorrhaphy using a radiofrequency shrinkage probe (Fig. 4). We are careful to avoid thermal necrosis and, hence, a stripping technique is more appropriate to tighten the capsule of the lax joints. A short thumb spica cast is placed for 4 weeks, in the presence of dorsal subluxation. Lesser changes allow immediate mobilization of the thumb.

Arthroscopic stage II patients have focal wear of the articular surface that requires a procedure to alter the forces across the joint (Fig. 5). After arthroscopic synovectomy, debridement, and occasional loose body removal, the joint is reassessed to determine the extent of instability and capsular attenuation. A thermal shrinkage capsulorrhaphy is performed to tighten the attenuated ligaments and capsule. A thermal chondroplasty is performed to anneal the cartilage borders at the sites of cartilage erosions and fibrillation. The arthroscope is then removed and the ulnar portal is extended distally to expose the metacarpal base. A dorsoradial closing wedge osteotomy is performed to place the thumb in a more extended and abducted position, which minimizes the tendency for subluxation and changes the contact points of worn articular cartilage (Fig. 6A). The osteotomy is fixed by a single oblique 0.0045-inch Kirschner wire placed across the first CMC joint in a reduced position (Fig. 6B). A short arm thumb spica is used for 4 to 5 weeks until the wire is removed.

Arthroscopic stage III disease is characterized by severe cartilage loss and frayed volar ligaments (Fig. 7). This condition requires an interposition procedure, an arthrodesis, or a joint replacement depending on the patient’s requirement and surgeon’s preference. For an interposition procedure, an arthroscopic hemitrapezeectomy is performed by burring away the remaining articular cartilage and removing the subchondral bone to a bleeding surface. This technique not only increases the joint space but also forms an organized thrombus, which helps stabilize the interposition material. Ideally, approximately 3 to 4 mm of

![Figure 3](image3.png) Arthroscopic appearance of the first CMC joint showing synovitis in arthroscopic stage I disease.

![Figure 4](image4.png) Arthroscopic view demonstrating thermal capsulorrhaphy with radiofrequency probe in corticosteroid laden capsule. Note the attenuation of the ligaments caused by the effect of steroids.

![Figure 5](image5.png) Arthroscopic view of arthroscopic stage II basal joint arthritis. Note the deep cartilage loss on the metacarpal base and central cartilage loss on distal trapezium.

Figure 3 Arthroscopic appearance of the first CMC joint showing synovitis in arthroscopic stage I disease.

Figure 4 Arthroscopic view demonstrating thermal capsulorrhaphy with radiofrequency probe in corticosteroid laden capsule. Note the attenuation of the ligaments caused by the effect of steroids.

Figure 5 Arthroscopic view of arthroscopic stage II basal joint arthritis. Note the deep cartilage loss on the metacarpal base and central cartilage loss on distal trapezium.
the distal trapezial articular surface should be resected (Fig. 8). The interposition material can either be palmaris longus graft or the volar slip of the abductor pollicis longus (palmaris deficient patients). The graft is inserted through the dorsal portal with the arthroscope in the volar portal. The tendon end is brought into the trapeziometacarpal joint using a large, smooth needle holder through the slightly enlarged dorsal portal (Fig. 9). The remaining tendon is packed into the joint. The joint capsule and the portal are closed with a horizontal mattress stitch to minimize chance of tendon slip extrusion. A thumb spica splint is applied at the end of the procedure and changed to a cast some days later. Alternatively, an Artelon spacer can be used as an interposition material, which also can be placed in the joint arthroscopically (Fig. 10A and B) or open (when there is severe joint subluxation). In older, low-demand patients, a cemented total joint replacement is a good option. A resection arthroplasty or an arthrodesis can be performed in late stage III disease and stage IV disease depending on the extent of joint damage, patient’s needs and the surgeon’s preference.

**Discussion**

Clinical assessment and radiological studies have been the only tools available to define for thumb CMC arthritis. Eaton and Glickel proposed a radiographic staging system.
for this disease that has been widely applied not only to stage the disease but also to define treatment. Bettinger and coworkers described the trapezial tilt as a parameter to predict further progression of the basal joint disease. We believe that the radiographic classification is important for the assessment of progression of this disease; however, it is very difficult to make an accurate diagnosis regarding the extent of arthritis by this method alone.

Arthroscopy has already proven to be reliable for the evaluation of the thumb carpometacarpal joint. The arthroscopic classification proposed by the senior author (A.B.) fills the niche of a suitable diagnostic modality for this common and disabling condition. This classification helps the surgeon not only to reach an exact diagnosis but also to choose an appropriate treatment (Fig. 11).

We see patients who have thumb pain with normal radiographs that don’t respond to nonoperative treatment. These patients often have mild-to-moderate synovitis that responds to joint debridement with thermal capsulorraphy. The resulting change in the joint milieu may even arrest further cartilaginous loss.

Tomaino concluded that first metacarpal extension osteotomy is a good treatment option for Eaton stage I disease. We find this technique to offer the greatest benefit to patients with focal cartilage loss as is seen in arthroscopic stage II (Fig. 12A and B). In a retrospective study of 43 thumbs in whom we performed extension osteotomies, only one developed progressive arthritis, that required further surgery. Studies suggest that metaphyseal osteotomy results in decompression of the medullary canal and reactive hyperemia, which not only relieves the pain but also retards the progression of arthritic destruction of the joint.

If arthroscopic evaluation depicts complete articular cartilage loss, the next logical step is to perform a partial trapezial resection with an interposition procedure. Meenon described a technique for arthroscopic debridement of the trapezial articular surface and interposition of autogenous tendon or gortex into the CMC joint in patients. We have modified this technique by resecting only the most distal aspect of the trapezial articular surface. An Artelon spacer for interposition is a good option as it obviates the need for tendon procurement. Nilsson and coworkers in their prospective study comparing tendon interposition arthroplasty and Artelon spacer have concluded that Artelon is a non reactive material that markedly improved tripod and key pinch strengths, as compared with tendon interposition arthroplasty. In summary, arthroscopic evaluation of the thumb CMC joint...
Figure 11 Flowchart showing the treatment algorithm of basal joint arthritis by arthroscopic assessment.
joint defines the degree of cartilage loss and allows the surgeon to select further operative intervention.

References


Figure 12 (A) Preoperative radiograph showing the first CMC joint subluxation in stage II. (B) Postoperative radiograph showing healed osteotomy and reduced joint after 3 months of the osteotomy. This metacarpal centralization has been shown to maintain itself for long time.