Arthroscopic Partial Trapeziectomy and Interposition Arthroplasty of the Thumb Carpometacarpal Joint

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Trapeziometacarpal arthritis, a common and disabling condition, often is treated by open procedures involving trapeziectomy and interposition arthroplasty. A minimally invasive technique potentially could offer advantages over more common open procedures. We describe an arthroscopic technique for the treatment of trapeziometacarpal arthritis. After adequate arthroscopic debridement, interposition arthroplasty may be performed with a variety of materials.

Carpometacarpal (CMC) joint arthritis is a common complaint, particularly among women.[1-13] Radiographic studies estimate that approximately one third of postmenopausal women are afflicted with this condition.[1] Treatment frequently involves conservative measures, including splinting, rest, or injections.[6,11,14] Surgical management may be indicated in cases of persistent pain or functional deficit, recalcitrant to nonsurgical means.[5-7,9,11-16] Multiple techniques have been described, and each has unique risks and benefits.

Partial or complete trapeziectomy has long been used to treat CMC arthritis with reported high success rates.[1,4-6,17] However, when the trapezium is absent surgically, proximal migration of the thumb metacarpal may occur, with subsequent impingement of the thumb metacarpal on the scaphoid or trapezoid.[1,5,11]

Several investigators have described good to excellent patient outcomes after open subtotal or complete trapeziectomy and interposition arthroplasty of the first CMC joint, with or without ligament reconstruction.[2,8,9,12,13,16-20] A diverse variety of materials, including tendon, fascia lata, costochondral graft, Gore-Tex (W. L. Gore & Associates, Newark, DE), Gelfoam (Pharmacia & Upjohn, Kalamazoo, MI), and silicone have been used.[7,9,19,20]

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FIGURE 1. Surgical set-up. The hand is suspended in traction via the thumb and/or index finger, and prepared and draped in the usual sterile fashion.

The use of silicone arthroplasty has fallen out of favor because of problematic synovitis, implant instability, and material failure.[21,22] Likewise, Gore-Tex has been used as an interposition material but its use was characterized by problems with particulate debris and subsequent osteolysis, as well as poor patient outcomes relative to autograft interposition.[7] Belcher and Zic[1] examined the use of a porcine collagen xenograft as an interposition material in 13 patients with osteoarthritis of the first CMC joint. Its use was abandoned because of poor patient outcome and adverse immunologic reactions.[1] Jones and Maser[5] described trapeziectomy with hematoma arthroplasty for relief of symptomatic CMC arthropathy with acceptable outcomes. However, this procedure requires pin placement and subsequent removal after prolonged immobilization.[5]

Recently, other options for interposition materials have been introduced. Both xenograft and human dermal grafts now can be processed to yield an acellular collagen scaffold that can be used as an interposition tissue.[23] Previous *in vivo* studies have shown that these materials appear to create a favorable biochemical and physical environment for infiltration and repopulation of cells.[23] However, the results of traditional autograft interposition, such as palmaris or plantaris tendon, remain the standard by which these newer materials should be measured.

Arthroscopy provides a minimally invasive technique to diagnose and treat pathology of the first CMC joint.[3,7,15] This procedure represents a viable surgical option for patients with CMC arthritis refractory to conservative management.

Surgical Procedure

Arthroscopic debridement of the first CMC joint can be performed with either a regional axillary block or general anesthesia. After sterile preparation of the upper extremity the patient is draped and a sterile pneumatic tourniquet is applied to the upper arm. The thumb is placed in 5 to 8 lb of traction (Figures 1 and 2). A standard vertical traction tower as used for wrist arthroscopy can be applied. Alternatively, a horizontally applied traction system may be used. Some surgeons also prefer to add a traction sleeve to the index finger to give additional support to the wrist. The surface landmarks then are identified with a surgical marking pen with the thumb suspended in traction (Figure 3). It is helpful to mark the flexor carpi radialis (FCR), abductor pollicis longus (APL), and extensor pollicis longus (EPL).

FIGURE 2. Surgical set-up. This arrangement allows the surgeon to monitor fluid inflow and egress effectively and easily while visualizing and manipulating the joint.

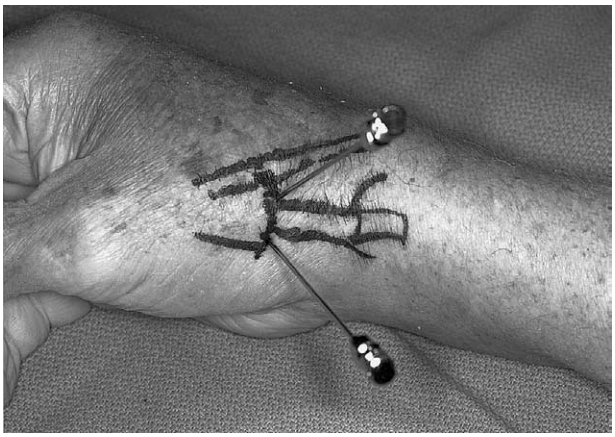

FIGURE 3. The location of subcutaneous landmarks for portal placement have been indicated by a marking pen on the skin. Spinal needles have been inserted into the 1-R and 1-U portal sites.

A small fluoroscopy machine is useful at this point to identify the exact locations of the 2 main portals, particularly if the surgeon has limited experience with first CMC arthroscopy. In patients with significant arthritis and partial subluxation, it is quite easy to enter the scaphotrapeziotrapezoid joint by mistake rather than the CMC joint.

The two standard portals used are the radial (1-R) and the ulnar (1-U) portals (Figure 4). The 1-R portal is made just ulnar to the FCR tendon at the level of the CMC joint. This portal, farthest from the radial artery and the superficial radial nerve branches, transverses the nonligamentous capsular tissue dorsoradial to the anterior oblique ligament (AOL) (Figure 5). The branches of the superficial radial nerve most commonly are found overlying the APL (Figure 6). Consequently, if the 1-R portal is placed in a more radial position, closer to the FCR, the risk for injury to a branch of the superficial radial nerve is less likely.[3] The 1-R portal is useful to examine the dorsal radial ligament (DRL), the palmar oblique ligament (POL), and the ulnar collateral ligament (UCL), and provides a view of the radial aspect of the joint.[10,24] It also allows for visualization of the intermetacarpal ligament (IML) and the distal insertions of the AOL into the first metacarpal (Figures 7-10).[10]

The 1-U portal is placed just ulnar to the extensor pollicis brevis (EPB) tendon (Figure 11). This area can have a higher incidence of superficial radial nerve branches crossing the portal site than the 1-R portal area.[3] Additionally, the radial artery is only a few millimeters from the ulnar side of the portal.[3] It is safest to make the 1-U portal close to the EPB tendon because placing the portal in close proximity to the EPL tendon results in a greater chance of radial artery or superficial radial nerve injury (Figure 12). Similar to the procedure used when establishing the 1-R portal, the skin should be incised carefully and a small hemostat should be used to dissect gently and spread down to the capsular tissue. This will help avoid traumatic injury to

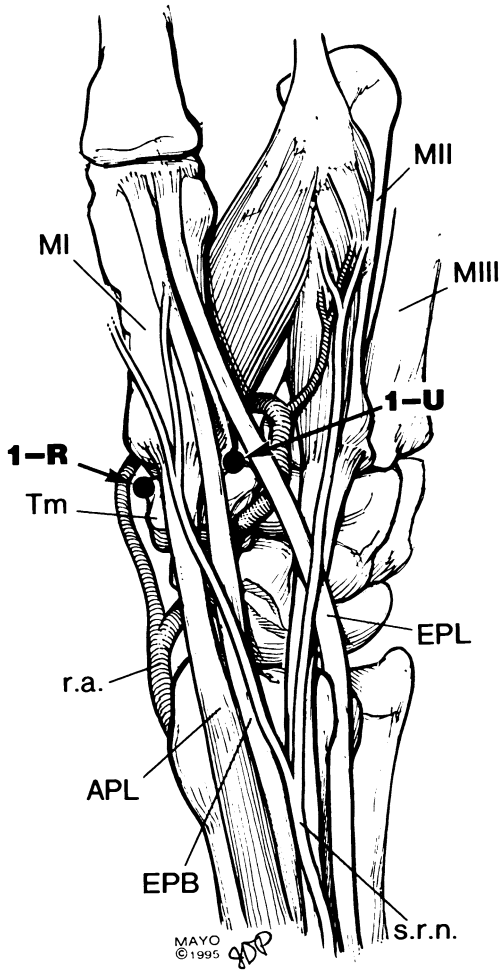

FIGURE 4. The first CMC joint detailing portal sites (1-R and 1-U) and local anatomic structures. The radial artery (R.A.) and the superficial radial nerve (S.R.N.) are in close proximity to the portal sites. MI, first metacarpal; MII, second metacarpal; MIII, third metacarpal; TM, trapezium. Reprinted from Berger[24] by permission of Mayo Foundation for Medical Education and Research. All rights reserved.

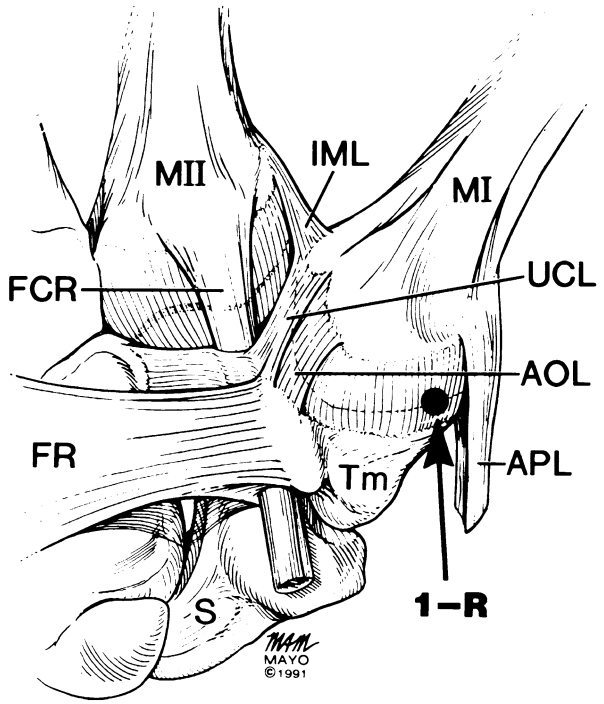

FIGURE 5. This palmar view of the first CMC joint shows the relationship of the 1-R portal and the volar stabilizing ligaments of the thumb: the UCL, AOL, and IML. FR, flexor retinaculum; MI, first metacarpal; MII, second metacarpal; S, scaphoid bone; TM, trapezium. Reprinted from Berger[24] by permission of Mayo Foundation for Medical Education and Research. All rights reserved.

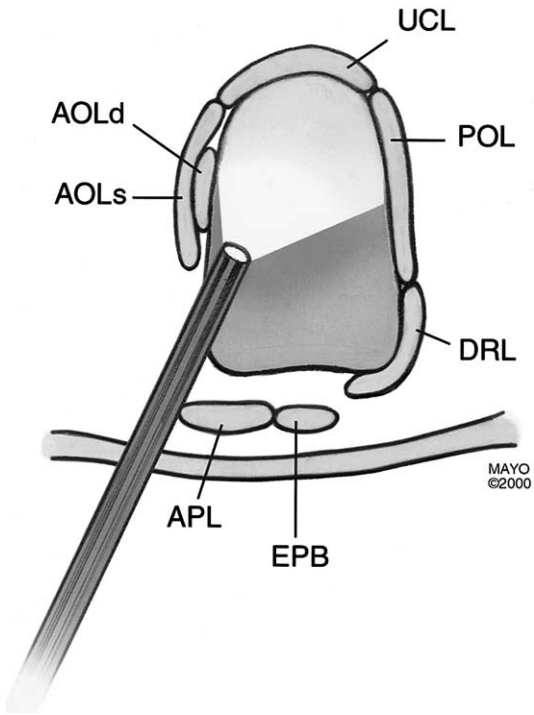

FIGURE 7. The 1-R portal and the viewing area. AOLD, deep anterior oblique ligament; AOLS, superficial anterior oblique ligament. Reprinted from Berger[24] by permission of Mayo Foundation for Medical Education and Research. All rights reserved.

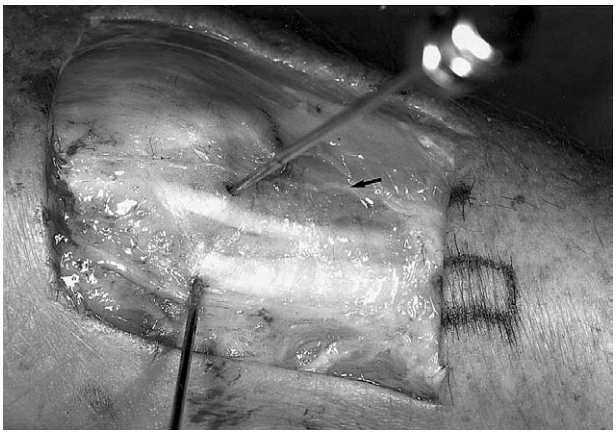

FIGURE 6. Cadaveric dissection. The skin has been removed to reveal the subcutaneous structures, including the branches of the superficial radial nerve (arrow), the APL tendon, and the EPB tendon.

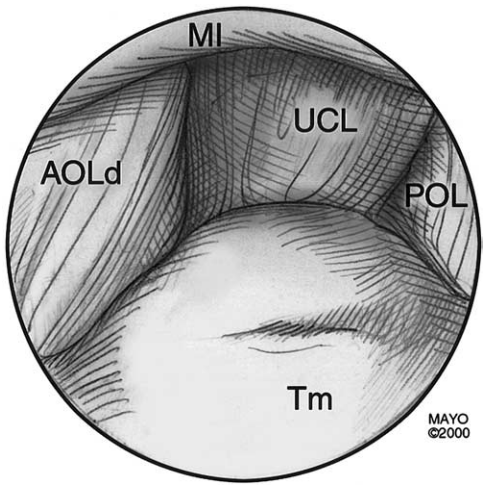

FIGURE 8. Arthroscopic view from the 1-R portal. AOLD, deep anterior oblique ligament; MI, first metacarpus; TM, trapezium. Reprinted from Berger[24] by permission of Mayo Foundation for Medical Education and Research. All rights reserved.

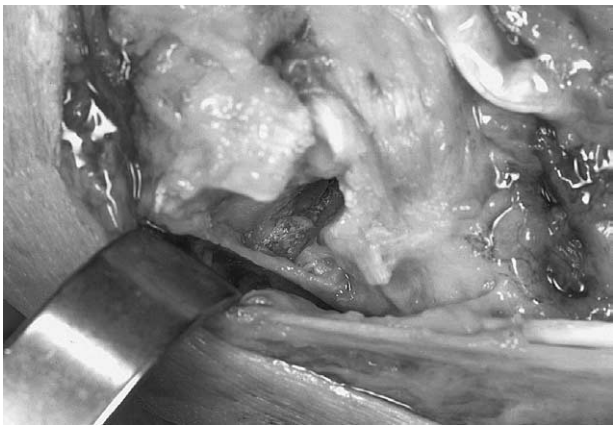

FIGURE 9. The APL has been transected to reveal the TMC joint space.

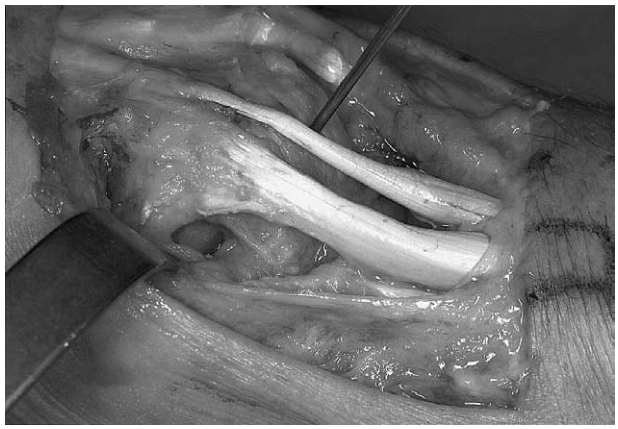

FIGURE 11. The 1-U portal site is delineated with a spinal needle, and joint capsular tissue has been dissected to reveal the AOL.

either branches of the superficial radial nerve or the radial artery.[3,10,25] The 1-U portal tends to enter the joint either through the DRL or between the DRL and the POL.[10,24] This portal allows for excellent visualization of the AOL and the UCL (Figures 13 and 14).[10,24] It also may be used as the main working portal for interventions after diagnostic arthroscopy.[10]

A standard 2.7-mm wrist arthroscope is used to visualize the CMC joint (Figure 15). The camera and working portal can be switched back and forth between the 1-R and the 1-U portal as the arthroscopy progresses. It is helpful to take the trocar and sweep to and fro in the joint before placement of the arthroscope because this tends to help create an initial space for visualization within the joint. A cautery or radiofrequency ablation probe is helpful to use initially for debridement of soft tissue before performing any bony work. Once adequate visualization of the joint is

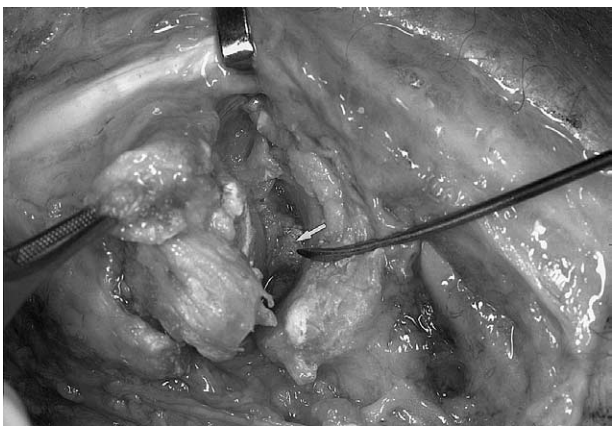

FIGURE 10. Dissection of the first CMC joint has proceeded to expose the POL (arrow), visualized deep within the joint.

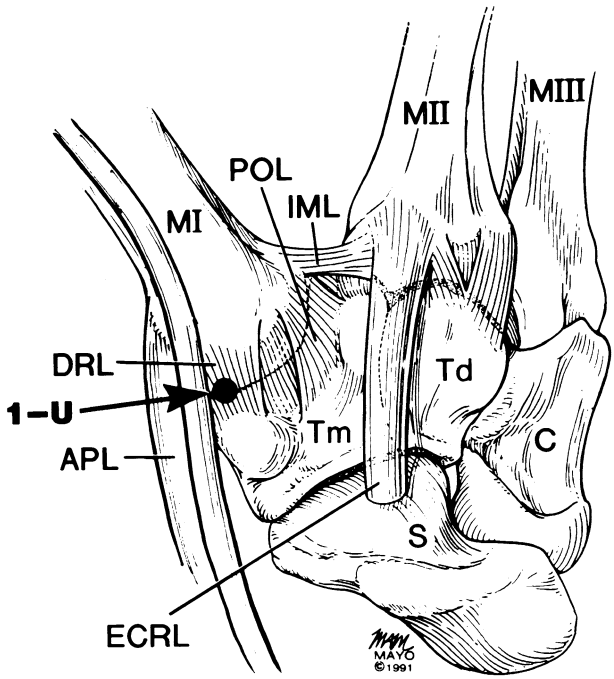

FIGURE 12. The 1-U portal and the anatomic features viewed from the dorsal aspect of the first CMC joint. C, capitate bone; ECRL, extensor carpi radialis longus tendon; MI-MIII, first through third metacarpals; TD, trapezoid; TM, trapezium. Reprinted from Berger[24] by permission of Mayo Foundation for Medical Education and Research. All rights reserved.

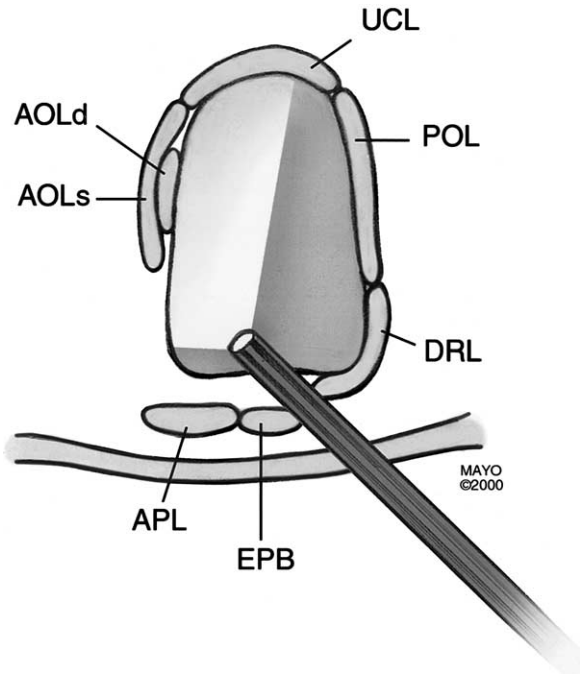

FIGURE 13. The 1-U portal and the viewing area. AOLD, deep anterior oblique ligament; AOLS, superficial anterior oblique ligament. Reprinted from Berger[24] by permission of Mayo Foundation for Medical Education and Research. All rights reserved.

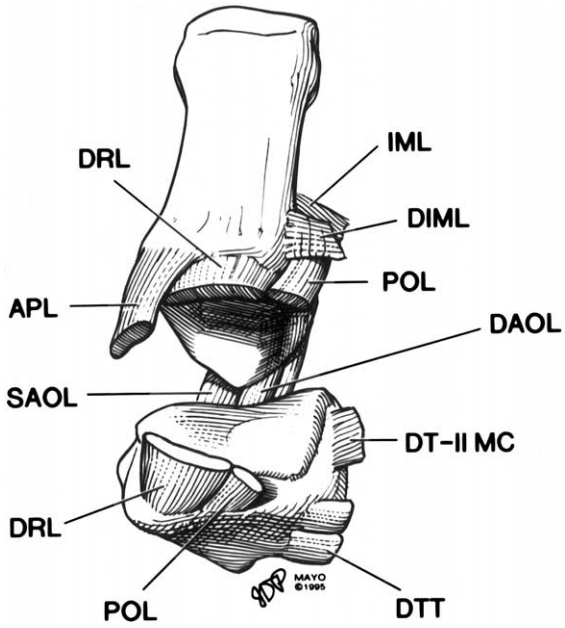

FIGURE 15. Dorsal-to-palmar view of the interior of the first CMC joint shows the position of the ligamentous structures surrounding the joint. DAOL, deep anterior oblique ligament (beak ligament); DIML, dorsal intermetacarpal ligament; DT-II MC, dorsal trapezio–second metacarpal ligament; DTT, dorsal trapeziotrapezoid ligament; SAOL, superficial anterior oblique ligament. Reprinted from Berger[24] by permission of Mayo Foundation for Medical Education and Research. All rights reserved.

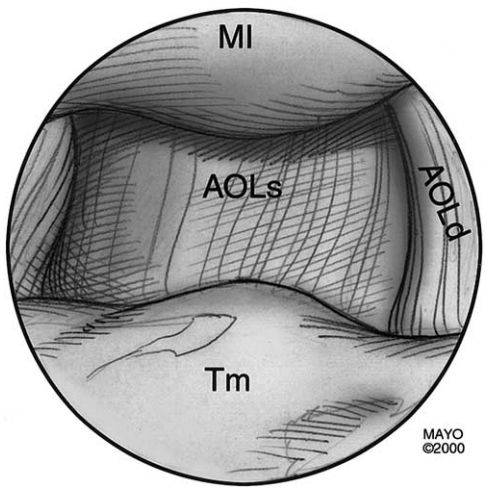

FIGURE 14. Arthroscopic view from the 1-U portal. AOLD, deep anterior oblique ligament; AOLS, superficial anterior oblique ligament; MI, first metacarpus; TM, trapezium. Reprinted from Berger[24] by permission of Mayo Foundation for Medical Education and Research. All rights reserved.

achieved, a small joint shaver (3.5 mm) can be used to debride the joint further. Smaller-diameter arthroscopic shavers tend not to work as well. Likewise, although it is possible to use a smaller arthroscope such as a 1.9-mm arthroscope, the visual field tends to be limited and consequently the pace of the procedure is slowed. Visualization also is enhanced by the use of a standard arthroscopic mechanical pump to irrigate the joint continuously with saline. A dedicated outflow cannula usually is not needed if both working portals are large enough to allow the egress of fluid.

Once adequate visualization has been achieved, bony work can be performed. Typically, an arthritic biconcave trapezium is observed. An arthroscopic burr (3.5 mm) then is used to remove 3 to 4 mm of distal trapezium. A smooth bony surface then is created carefully. Viewing from both the 1-R and 1-U portals is required to be sure accurate planing of the trapezium has been performed.

After bony recontouring has been performed, the joint then is ready for placement of the interposi-

tion tissue. Interposition tissue depends on the surgeon's preference. The arthroscopic use of autograft tissue, such as the FCR or the palmaris longus tendon, has been described by some investigators.[19] Allograft or xenograft materials may be manufactured to be approximately 1-mm thick, but then can be folded to double the thickness and cut to match the articular surface area of the joint. The tissue then is placed into the joint by passing a small curved hemostat into a portal and then manipulated until it exits out the opposite portal. A corner of the folded graft then is placed into the grip of the hemostat and pulled into the joint. Once the graft has been placed into the joint, the arthroscope is replaced into the joint and a probe is used to spread out the graft to cover the cancellous surface of the trapezium completely. The use of sutures to hold the graft in place usually are not needed. The portals then are closed and the thumb is maintained in an abducted position as the traction is removed. Portals should be closed carefully to prevent potential dislocation of the graft. A sterile thumb spica abduction splint then is applied while carefully holding the thumb in an abducted position. Alternatively, a 0.45-inch K-wire can be passed through the base of the first metacarpal into the trapezium to help maintain stability; however, in most cases, a thumb spica splint alone is adequate to maintain reduction. After splinting, a fluoroscopic view can be obtained to confirm restoration of joint space with the interposition graft. This then can be saved and compared with subsequent radiographs obtained during follow-up visits.

The splint is changed to a cast at 2 weeks, at which time the portal sutures are removed. A forearm-based thumb spica abduction cast then is maintained for an additional 4 weeks, for a total of 6 weeks of immobilization. After cast removal, the patient should be seen by a hand therapist and instructed in exercises for progressive mobilization. Full activity as tolerated is permitted after the cast is removed.

Discussion

Arthroscopic evaluation of the first CMC joint provides a minimally invasive technique to diagnose and treat pathology.[7,25,26] By using an arthroscopic technique, ligamentous reconstruction may not be required because the capsular and ligamentous structures relatively are undisturbed because of the nature of the minimally invasive surgical approach.[10] Perioperative immobilization and recovery time are minimized, and complications are infrequent.[7] Other investigators have shown minimal complications and outcomes that compare favorably with open techniques.[7,15]

Arthroscopy allows for the accomplishment of several principles found to be efficacious in the treatment of first CMC joint arthritis: excision of the trapeziometacarpal joint is performed to remove the painful, arthritic joint; interposition arthroplasty prevents bony impingement and further buttresses the first metacarpus; and the integrity of the joint capsule is maintained.[7,13] Recontouring the trapeziometacarpal joint allows the surgeon to perform a partial trapeziectomy and consequently preserve bone stock.[7,22] Although a total trapeziectomy may be indicated in cases of pantrapezial arthritis, it may not be necessary in all patients and may have undesirable sequelae, including reduced pinch strength and proximal migration of the first metacarpal.[7] Because more bone thus is maintained by recontouring the joint, a wider range of surgical options are available should a future procedure be needed.[22]

This procedure represents a potential surgical option for those patients with CMC arthritis. Contraindications to the described procedure include ligamentous or capsular laxity, which may require capsular reconstruction for acceptable outcomes.[2] Future studies are needed to compare arthroscopic techniques with more traditional open techniques.

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