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TECHNIQUE

Arthroscopic Indications and Technique for Artelon Interposition Arthroplasty of the Thumb Trapeziometacarpal Joint

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■ ABSTRACT

Advanced basal joint arthritis that has failed conservative treatment has traditionally been treated with some type of procedure that encompasses complete trapezium excision. An arthroscopic technique entailing only minimal trapezium debridement coupled with insertion of a synthetic interposition material is described. This provides the implicit benefits of a minimally invasive procedure, with less pain and faster recovery, along with the great advantage of trapezium preservation. The surgical technique is described along with a preliminary clinical series supporting its use.

Keywords: trapeziometacarpal, basal joint, thumb, osteoarthritis, arthroscopy, small-joint arthroscopy, interposition arthroplasty, Artelon, first carpometacarpal

Basal joint osteoarthritis of the thumb has a variety of treatment options ranging from conservative means to aggressive surgical procedures. Except for the young laborer or much older low-demand patient, arthroscopic evaluation and management may be indicated for the most arthritic thumb basal joints recalcitrant to conservative treatment.^{1,2} Radiographic changes occasionally correlate with the true articular cartilage loss, but an arthroscopic classification proves to be decisive for selecting the appropriate management protocol for different stages of arthritis. Badia¹ clearly outlined 3 well-defined arthroscopic stages of trapeziometacarpal joint arthritis.

Arthroscopic stage III arthritis (Eaton stage II or stage III) is characterized by full-thickness cartilage loss on most of the trapezium and a portion of the metacarpal. This is the ideal indication for Artelon interposition arthroplasty. The Artelon spacer, which has been devised to prevent articular impingement and to provide

scaffolding for tissue ingrowth, has shown promising results in advanced stages of basal joint arthritis. It is a synthetic material made of polyurethane urea and can be introduced in the joint arthroscopically or by open surgery depending on the grade of subluxation associated with the arthritis. Basal joint arthritis with minimal subluxation is best suited for arthroscopic Artelon interposition. However, on occasion, younger active patients may present with advanced arthritic changes coupled with a high degree of trapeziometacarpal subluxation. This grossly lax joint may be best suited for an open Artelon placement because the T-shaped wings of the Artelon implant serve to additionally stabilize the trapeziometacarpal joint (TMC). These wings can be fixed with either screws, sutures, or, preferably, bone anchors. However, the arthroscopic indication is superior in that the TMC capsule is not violated. Therefore, the joint stability is maintained by performing the interposition arthroplasty via arthroscopic means. This not only allows for a minimally invasive approach, which patients prefer and often demand, but also the postoperative recovery is faster and generally less painful due to diminished swelling from the arthroscopic approach. Because the primary problem is painful bone-to-bone contact in the well-aligned but advanced arthritis scenario, the interposition of a material to prevent this process and allow for native tissue ingrowth is an attractive and logical concept. Once the patient is indicated for Artelon arthroscopic interposition arthroplasty, the procedure is scheduled on an outpatient basis.

■ MATERIALS AND METHODS

The biomaterial used in the Artelon spacer is polycaprolactone-based polyurethane urea that weighs approximately 0.3 g and degrades by hydrolysis in approximately 6 years' time.³ The spacer can be inserted both by arthroscopic or open technique depending on the grade of subluxation associated with the arthritis. Hence, with greater subluxation, an open method is preferred, whereas in minimal subluxation, an arthroscopic technique

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should be used. In a preliminary series, the Artelon spacer was implanted in 13 thumbs in 12 patients from October 2005 to December 2006 using an arthroscopic technique. The average age of the patients was 58 years (range, 44–70 years). There were 9 women and 3 men. The dominant hand was involved in 7 patients and non-dominant in 6 patients. One patient had the procedure performed bilaterally because she did well after the first implant. A second patient is included who had the first side performed with a tendon graft interposition (data not included), but for the other side, Artelon was used.

■ SURGICAL TECHNIQUE

The procedure is generally done under regional block anesthesia, most typically a wrist block along with intravenous sedation to minimize tourniquet discomfort. Tourniquet time is approximately 35 minutes. The procedure is usually done with a 1.9-mm arthroscope; however, the 2.7-mm arthroscope typically used in the wrist can often be used because the procedure will entail removal of several millimeters of the eburnated trapezial surface. Therefore, a larger arthroscope can be used that may prove more comfortable and provide superior visual-



FIGURE 1. Joint insufflation with saline while thumb is under 5 lbs of finger trap traction. The needle needs to be directed cephalad to clear the metacarpal flare.

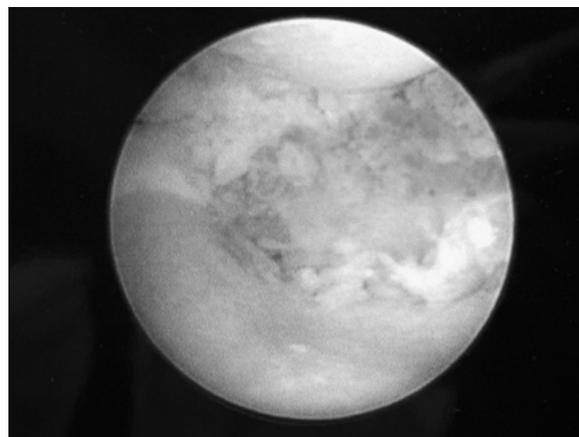


FIGURE 2. Arthroscopic view of stage III basal joint arthritis with near-complete loss of trapezial articular cartilage, marked wear on the metacarpal base, and diffuse synovitis. Small loose bodies are present within the volar capsule.

ization. The joint is insufflated with several cubic centimeters of saline to localize the TMC and help indicate the direction of scope introduction (Fig. 1). The arthroscope is then introduced into either the radial or ulnar portal as first described by Berger,⁴ with any additional portals being localized using an 18-gauge needle to determine the point of entry. The procedure is essentially free of complications, but one must ensure to make small, longitudinal incisions, followed by spreading of a small clamp to avoid iatrogenic injury to the distal branches of the radial sensory nerve. Once the arthroscope has been placed and saline outflow is established, one can then determine the arthroscopic stage. If, indeed, stage III is present, a full radius shaver is inserted through the other portal to perform a synovectomy and debride the joint for better viewing (Fig. 2). Occasionally, loose bodies will be found, and these should be excised with a small joint grabber to avoid impingement by these floating bodies despite the interposition material. Once adequate debridement is performed, the remaining cartilage and subchondral bone are removed from the trapezium in a carefully orchestrated manner. It is important to avoid leaving any prominent bone surfaces because these can cause focal impingement and possibly pain in the future.

Therefore, the trapezium is divided into 4 quadrants, being careful to attack each quadrant with a 2.9-mm barrel burr to remove approximately 3 mm of subchondral bone, leaving bleeding cancellous bone (Fig. 3). This is important because the tissue factors that will create fibrous ingrowth encompassing the Artelon material will come from the bleeding subchondral bone once the tourniquet is released in the immediate postoperative period. Once an adequate amount of trapezium is excised, fluoroscopy can then be brought in to ensure that there is no prominent region of the trapezium abutting the metacarpal base. At

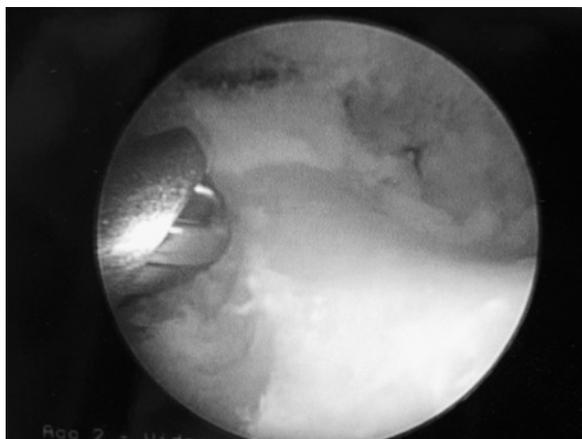


FIGURE 3. Arthroscopic limited trapeziectomy via a 2.9-mm burr. Only eburnated bone and superficial subchondral bone are excised.



FIGURE 5. Artelon spacer deployed in joint lying on surface of trapezium after subchondral bone excision.

this point, the arthroscopy is much easier technically because there is a much larger space within which to work. The metacarpal is not debrided, although any interposed capsular tissue or synovitis should be excised. Once adequate trapezial excision has been confirmed, the Artelon material can now be interposed. This can be done through either one of 2 approaches. The portal can be extended longitudinally, allowing the capsule to be opened with a larger clamp, and then the Artelon material can be folded longitudinally into a tube shape and inserted bluntly through the capsule (Fig. 4), or, as often seen, the capsule may be rather noncompliant, and a technique using an inserted cannula may prove easier. Occasionally, the metacarpal base and trapezium at the portal entry site need additional bone excision to allow implant introduction. A rigid material serving as a portal is inserted with arthroscopic visualization so that the cannula lies within

F4



FIGURE 4. Insertion of Artelon spacer via ulnar portal using clamp technique. Entire spacer is folded longitudinally to be deployed within the joint after it clears dorsal capsule.

the joint between the metacarpal base and trapezium. The Artelon material is similarly folded into a longitudinal tube, and a trochar-type instrument is used to deliver the material into the joint.³ Once the Artelon is within the joint, it is laid down flat to cover most of the surface of the trapezium with the assistance of a hook probe or blunt trochar (Fig. 5). Although the Artelon implant

F5



FIGURE 6. Radiograph illustrating oblique K-wire fixation maintaining centralized metacarpal onto trapezium after trapezial burring and Artelon implant placement.



FIGURE 7. Fluoroscopy at time of pin removal demonstrates well-maintained joint space and centralized metacarpal. Trapezial minimal resection maintains saddle configuration of joint with no flattening of surface.

via an occult capsular rent, it may be prudent to fixate the material with the TMC in a reduced position, securing it with K-wire fixation. This is done by removing the arthroscope once the Artelon is in a good position, and with the thumb still in 5 lbs of traction, the fluoroscopy device is brought in sterilely at a perpendicular angle, and a 0.045 K wire can be driven obliquely across the

TMC, ensuring that the metacarpal is well centralized on the trapezium and there is no impingement (Fig. 6). The K-wire fixation serves to not only ensure that the metacarpal base lies well centered over the trapezium but also prevents micromotion, thereby assisting fibrous ingrowth to the Artelon fibers. However, fixation may not be necessary in all the cases because the arthroscopic technique essentially guarantees that the spacer will not migrate because the capsule remains intact. Once fluoroscopy has determined a good position of the joint, the K wire is cut underneath the skin, and the arthroscopy portals are closed simply with benzoin and Steri-Strips. This helps minimize the scarring on the very apparent dorsum of the hand. Occasionally, the larger portal used to insert the Artelon material may need closure with a Vicryl Rapide suture that is absorbable. This obviates any need for stitch removal because the patient will be in a cast. F6

■ POSTOPERATIVE CARE

After skin closure, the hand is placed in a well-padded thumb spica plaster splint over generous cast padding, allowing the fingers to be free to move and encouraging early light pinch maneuvers. The patient is seen within 1 week to remove this bulky dressing and apply a light thumb spica fiberglass cast. The cast is in place for a 5- to 6-week period that would allow the fibrous ingrowth to the Artelon material as the material gets incorporated in the joint. At the time of cast removal, the pin is removed as a simple office procedure with local anesthesia and fluoroscopic assistance (Fig. 7). The patient is then given a removable hand-based carboxymethylcellulose-type Elastoplast splint that protects the base of the thumb but allows for increased activity. The patient should only wear it intermittently as they begin their course of hand therapy. It has F7



FIGURE 8. A, B, Postoperative thumb range of motion 2 months after arthroscopic Artelon interposition arthroplasty. This is only 2 weeks after pin removal and having had minimal hand therapy. Portal sites at base of thumb are barely discernable with more distal single punctate scar due to recent pin removal.

been our experience that hand therapy typically lasts only a few weeks to a month because the recovery is quite rapid due to the fact that the joint capsule has not been violated and only minimal swelling is present (Figs. 8A, B) Pinch strength will recover over time and normal use.

The patient is typically seen at 1 week, 6 weeks, and 3 months. X-rays are taken at 1 week postoperation to confirm good pin placement. Follow-up x-rays are taken at the time of pin removal at 5 to 6 weeks with final x-rays taken at 3 months, at which time the patient is usually discharged from care.

■ PRELIMINARY RESULTS

The patients are still under active follow-up, and the preliminary results have been encouraging. All patients, without exception, had marked pain relief as compared with the preoperative levels. All the patients had slightly improved pinch strength as compared with preoperatively. The pinch strength has recovered gradually with the activities of daily living over a period of time. Follow-up x-rays demonstrate a narrow space present between the metacarpal base and trapezium that was not present preoperatively. Our experience using this technique has been encouraging and has shown that symptom resolution has maintained itself. In fact, several patients have requested the contralateral hand to undergo the same procedure. This may very well be the best indicator of its success.

■ DISCUSSION

High-demand patients with arthroscopic grade III arthritis are suitable candidates for a degradable spacer with capsular augmentation because good grip function and pinch strength may not be as compromised as in trapezium resection and open tendon interposition procedures.⁴ The complete trapezium resection arthroplasty is an aggressive procedure for this group of patients and perhaps should be reserved for patients with associated severe STT arthritis or marked trapezium deformity because it results in gross alteration in anatomy and subsequent shortening of the thumb that may compromise pinch and grip strength. Once the trapezium has been completely excised, there are little salvage options in case of failure.

Because of the great force demands placed on this small but critical joint, the track record for implant arthroplasties has been mixed. Silicone trapezium implants, which were so frequently used in the past, have the drawbacks of greater wear and implant failure. These were also implicated in severe foreign body reactions associated with silicone. Pelligrini and Burton⁵ documented a 25% failure rate with silicone implants and a much higher rate of revision surgeries owing to higher incidence of subluxation of implants and silicone synovitis. Creighton

et al,⁶ in their evaluation of 151 silastic trapezium arthroplasties, observed scaphoid cysts in 56% and intramedullary radiolucency of the first metacarpal in 74% of the patients.

Muermans and Coenen⁷ compared Gore-Tex and Marlex (polypropylene) implants with interposition of extensor carpi radialis longus in patients after trapezium resection. They reported a 30% incidence of synovitis characterized by pain and osteolysis in patients with Gore-Tex implants as compared with the other study group. Greenberg et al⁸ observed that 80% of their patients developed osteolysis around the Gore-Tex implants. Liljensten et al⁹ reported encouraging results by using polyurethane for anterior cruciate ligament reconstruction in rabbit knee. They concluded that the material had mechanical properties similar to human ligament and, from a histologic and perhaps functional point of view, has good clinical implications. Sollerman et al¹⁰ showed encouraging initial results with the trapezium replacement using a polyurethane implant with no reactive synovitis due to this implant. However, the implant had similar frequency of implant dislocations as silicone counterparts. Gretzer et al,¹¹ in their in vitro comparison of titanium, polystyrene, and polyurethane urea, concluded that polyurethane urea was the material least affected by the cell-mediated immunity. Nilsson et al,³ in their landmark study, compared the Artelon spacer with tendon arthroplasty using abductor pollicis longus. They concluded that the pain-relieving effect of Artelon TMC spacer implantation was equivalent to that after a tendon arthroplasty, but the key and tripod pinch strength proved to be considerably better than the abductor pollicis longus group. They also affirmed that there was no foreign body reaction in the vicinity of Artelon, and the tissue ingrowths were appreciable without any intervening structures between bone and Artelon fibers.

We used the arthroscopically placed Artelon spacer in arthroscopic stage III arthritis with minimal subluxation. There is a learning curve associated with the procedure, and surgeons have to be facile with small-joint arthroscopy to identify key landmarks and perform an adequate resection across the contact areas in the joint. In our series, the immediate postoperative recovery of the patients was excellent, as well as rapid, with later follow-up encouraging. Long-term follow-up results with more frequent use of this interposition material may change the scenario in management of advanced basal joint arthritis. The most convincing argument for use of an interposition material with limited trapezium resection may be the rapidity of recovery and return to normal activities. This may have a profound economic impact for many patients undergoing the procedure and could certainly offset the increased cost of this or other implants. Whereas ligament reconstruction tendon interposition often demonstrates

good long-term results, it is an accepted fact, supported by the literature and surgeon opinion, that pain relief and pinch strength recovery are slow in most cases. The rapid recovery allowing a rapid return to near-normal function may justify Artelon's use in more active patients. The possibility of a revision procedure, if deemed necessary, is an added benefit when compared with an aggressive surgery that resects the entire trapezium, the base of the thumb pillar. Moreover, the Artelon material may have implications in the management of advanced arthritis in other small joints as well.

Long-term results are necessary to establish its place within the treatment armamentarium of thumb basal joint arthritis.

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