Painful Basal Joint Arthritis of the Thumb

Part II: Treatment

Jay F. Pomerance, MD

ABSTRACT

Treatment of arthritis of the basal joint has evolved from resection of the trapezium, to joint replacement, to reconstruction of the lost anterior oblique ligament. These, along with other operative options, will be discussed in detail. The advantages and disadvantages of each will be presented. The complications of earlier methods of management have allowed refinements in surgical intervention. It is these improvements that have allowed the clinician to more reliably treat the arthritic thumb carpometacarpal joint.

The first step in treatment of symptomatic patients is conservative care in the form of either oral anti-inflammatory, local steroid injections, splinting, or a combination of these. For those patients in which nonoperative measures fail, surgery should be offered. Nonoperative measures are given a 3-month trial prior to surgical intervention. Operations for the painful basal joint fall into five categories: excisional arthroplasty, fusion, total joint replacement, silicone replacement of the trapezium, and ligamentous reconstructions with trapezial excision.

EXCISIONAL ARTHROPLASTY

Excisional arthroplasty with or without interposition has been reported by various authors. Gervis presented the first series of patients treated with trapezial excision for symptomatic carpometacarpal arthritis. A supporting study of 39 arthroplasties with follow-up of 1 to 9 years found that trapezial excision reduced grip strength in over 50% of the cases, while having a minimal effect on range-of-motion. In addition, there was a complication in one-third of the patients, mainly related to neuritis of the superficial sensory branch of the radial nerve. Despite this, patient satisfaction was high, largely due to pain relief.

Modifications were attempted to fill the void left by the excised trapezium. All of these reports substantiated claims made by earlier investigators of adequate pain relief; however, these studies showed that all of the metacarpals subsided and generally had weakness with respect to pinch and grasp. The mechanics of the trapeziometacarpal were altered by shortening of the thumb metacarpal. There was no correlation with which autologous material was used with respect to results.

Excisional arthroplasty has fallen out of favor; however, a recent paper by Moy et al. has rekindled interest in the procedure. A retrospective analysis of 37 patients followed up for an average of longer than 3 years was presented. Their technique, termed distraction-resection arthroplasty, involved pinning the first metacarpal in a distracted position over the space left by the resected trapezium. No interposition material was used. Postoperative radiographs revealed maintenance of the resected space. Results were graded 87% good to excellent. Its simplicity as well as its functional outcome are appealing.

FUSION

The first series using carpometacarpal fusion was reported by Muller in 1949. There have been studies by other surgeons with good results. The trade-off for pain relief is loss of joint motion. An optimum position for fusion has been described. This position can best be called a "fist" position, with the thumb metacarpal in 35° to 40° of palmar abduction and 10° to 15° of extension. Multiple methods have been described for obtaining the arthrodesis. The average time for fusion appears to be 2.5 months. The most successful method for fusion, according to numerous studies, is the use of wires with a bone graft. In a series of 18 carpometacarpal fusions, all patients were able to touch the base of the fifth metacarpophalangeal joint with the pulp of the thumb. Postoperative cineradiographs performed on some patients revealed that the loss-of-motion of the carpometacarpal joint was compensated for by increased motion at the metacarpophalangeal joint. The average loss-of-motion was 5° to 10°.
of palmar abduction and 10° to 15° of extension. This relatively small loss-of-motion does not coincide with results of others, who report losses of palmar abduction and extension in the range of 60% to 70%, when comparing the operated with the unoperated side.¹⁵,¹⁶

Bamberger et al.¹⁶ found that the position of the fusion did not affect thumb function.¹⁶ The fist position was strived for, but on postoperative radiographs, this position was not always achieved. This contrasts with the results of Eiken and Carstam¹⁵, who found the major determinant of a good result was fusion position. Problems reported by Bamberger et al’s patients include difficulty putting on a glove, getting the hand into a pocket, and flattening the hand. Dexterity problems were also noted by some; interestingly, this was the major complaint of Eiken and Carstam’s group. Although there has been concern over the increased load transferred to neighboring joints, the literature has not borne this out.¹⁹ Despite the forementioned problems, patient satisfaction with the procedure is high.¹⁴,¹⁵,¹⁷,¹⁹ It appears that fusion offers a durable result: a stable, relatively painless thumb which can withstand heavy labor. The disadvantages are a loss of dexterity and motion, with increased laxity of the metacarpophalangeal joint.

**TOTAL JOINT REPLACEMENT**

During the 1970s there was a wave of enthusiasm for joint replacement. This also extended to the basal joint. One method, originated by de la Caffinierre and Aucouturier²⁸ in Luxembourg and later modified by Braun,²³ involved a metal and plastic arthroplasty without loss of the trapeziocapitate joint. The other more widely accepted method was complete or partial excision of the trapezium and replacement with a silicone “joint” (Figure 1). This was originated by Swanson²⁴ and later modified by others.²⁵-²⁸

The joint arthroplasty of de la Caffinierre and Aucouturier²³ consisted of a polyethylene cup that was fitted into the trapezium, and a cobalt chromium stem that is fixed into the shaft of the first metacarpal with cement. Its design is similar to that used for total hip arthroplasty. A series of 34 operations in 29 patients followed up for an average of 2 years was presented. The indications were instability, pain, and deformity. This group was unique in that the largest group of patients had rheumatoid arthritis. Good results were reported in 66% of the cases, which were graded on a scale weighted equally for pain, stability, mobility, and agility. The best results were in those patients with rheumatoid arthritis, and worst, in those patients with osteoarthritic hands. At follow-up there was a nearly 15% loosening rate, with all affected cases involving the trapezium.

Braun²⁵ presented 29 arthroplasties with follow-up ranging from a few months to 7 years. The largest group of patients had osteoarthritis. Generally, good results were found. Only three cases of implant loosening were seen, and two of these followed an episode of trauma. There were other complications, including cement extrusion, ossification in the area of insertion of the abductor pollicis longus, and two cases of postoperative development of trigger thumbs. The author felt that the operation deserved “cautious optimism.”

The largest series of carpometacarpal total joint arthroplasty has been presented by the Mayo Clinic.²⁹ This series considered 62 arthroplasties with an average of 4.6 years follow-up. The majority of patients had osteoarthritis. Indications were a painful basal joint with Eaton grade III or grade IV changes, good bone stock, freedom from pantrapezial arthritis, and no heterotopic bone. Forty-nine of the arthroplasties had a good or excellent result according to criteria outlined by Braun.²³ Increases in both range-of-motion and strength were shown. Despite this, 32% of the
prostheses had radiolucent lines and 19% were loose at follow-up. In addition, 36% showed heterotopic bone.

**SILICONE REPLACEMENT OF THE TRAPEZIUM**

The most popular way to treat disabling arthritis of the basal joint, especially in the 1980s, was with silicone replacement of the trapezium. This method was originated by Dr A.B. Swanson. The original design of the implant had a convex head that articulated with the scaphoid. This prosthesis evolved into one that had a concave head for better fit against the distal pole of the scaphoid and was made out of a newer, high performance elastomer that had a 400% greater tear resistance. It was designed as a spacer to fill the void left after trapezium resection. An important concept of the silicone implant was its encapsulation by the host. If the remaining carpectometacarpal capsule was found to be deficient at the time of closure, augmentation using local tissue to give implant stability was recommended.

Swanson et al have presented their results with 150 trapezial arthroplasties. The outcome was a stable, pain-free mobile thumb in 147 out of 150 cases. The average follow-up was 42 months. Ninety-three arthroplasties were performed for a diagnosis of osteoarthritis. All patients were reported to make gains in postoperative strength and range-of-motion. Preoperative key pinch increased from 7 lbs to 11 lbs and grip strength increased from 30 lbs to 43 lbs. Patients gained an average of 12° of extension. There was an average postoperative gain in opposition of approximately 25%.

A 25% incidence of implant subluxation and dislocation occurred despite capsular augmentation and/or transfixation of the prosthesis with sutures or wires. The shape of the implant and type of elastomer had no significant effect. There were 24 subluxations, 6 dislocations, and 8 instances of complete erosion of the scaphoid so that the implant articulated with the radial styloid.

Eaton designed a perforated implant so that a slip of abductor pollicis longus could be passed through the implant and anchored to an adjacent carpal bone for stability (Figure 2). In a series of 50 thumbs using this new implant, the subluxation/dislocation rate decreased to 10%. In this study, subluxation was defined as a loss of contact of the scaphoid implant surface by 50% or greater. This definition is less strict than the 33% contact loss defined by Swanson et al. and may be a reason for the improved results. Strength and motion were improved, with postoperative pinch strength at about 13 lbs and 82% of the patients regaining 90% of "normal" motion. Pain-free status was noted in 88% of patients.

A different method of implant stabilization was introduced by Poppen and Niebauer. Dacron mesh coated the intramedullary stem to promote bone ingrowth, and heavy Dacron ties extended from the prosthesis into either the flexor carpi radialis or the index metacarpal for fixation. Technical points for fixing the implant were to err on the side of choosing a smaller implant to prevent subluxation and a tight capsular closure. In reviewing 17 implants at an average of 4 years' postsurgery, 6 had subluxation and 2 were dislocated. Seventy percent of the subluxations occurred prior to 3 months after surgery. Factors contributing to the subluxation were first web-space contracture, inadequate capsular repair, hyperextension deformity of the metacarpophalangeal joint, failure to resect osteophytes, inadequate postoperative immobilization, lack of fixation on the scaphoid, and inappropriate size of the implant. Grip and pinch strength, expressed as a percentage of that of the opposite thumb, were improved in most patients. Fourteen of 15 patients reported good-to-excellent pain relief.

In the longest follow-up reported, Sotereanos et al found that 83% of the implants had subluxation at 9 years. Postoperative subluxation did correlate with time and was also seen in the study by Adams et al. Interestingly, this subluxation was not painful unless the implant completely dislocated. Adams et al found symptomatic subluxation when the implant became subluxed by 75% or more. Range-of-motion and strength measurements...
showed slightly less power and motion when compared with that of the opposite, unoperated thumb.

Another solution to the instability problem was proposed independently by Ashworth et al.26 and Kessler and Axer.28 Instead of completely resecting the trapezium, only the diseased surface of the trapezium26 or the metacarpal base28 was removed. The surfaces of the respective bones are then replaced with a silicone implant. The Kessler and Axer implant achieved its stability by use of an intramedullary stem, which was Dacron®-coated and fitted into the metacarpal shaft, while the Ashworth et al device was actually a neurosurgical burr hole cover that had been trimmed to fit the surface of the trapezium and whose short stem was fitted into the body of the trapezium.

Ashworth et al.29 presented a series of 42 patients followed up for an average of 31 months, with an excellent outcome in 40 of the patients. To achieve this end, patients must not have any pain and maintain or increase their strength and range of abduction. The advantages of this procedure were believed to have been implant stability, minimal resection, and that, should a complication have occurred, it would not have precluded other procedures. The Kessler and Axer device was also based on an "economical" resection of bone. Only one joint dislocation was reported, and motion appeared to be similar to the opposite hand.

Early enthusiasm for silicone replacement was tempered by difficulty in obtaining implant stability. Later reports began to note multiple carpal cysts and collapse in cases in which silicone implants had been placed.34-40 This process later became known as "silicone synovitis." Pellegrini and Burton40 followed up 32 silastic trapezial implants for an average of 3.9 years and found a 50% loss of vertical height and subluxation of 35% of the prosthesis width. There was a 16% reoperation rate at 3 years. Creighton et al.38 reported on a series of 151 Swanson trapezial implants followed up histologically and radiographically for an average of 51 months. A total of 56% had cysts within the scaphoid and 74% had cysts within the first metacarpal. All metacarpals had changes at the implant-bone interface and 16 of 151 implants had pannecaral cysts. Radiographic grading scales of scaphoid and metacarpal cysts were presented. Mild changes at both sites were noted in 18%, while 12% showed severe changes.

Histologic evaluation at revision showed foreign-body giant cells associated with bony changes about a foreign nonbirefringent material consistent with silicone.38 At operation, the synovium was usually yellow-gray and fibrous with little joint fluid. This synovial reaction to silicone had been reported previously.34-37,39 Implants in Creighton et al.'s series were stabilized by a slip of the abductor pollicis longus as advocated,31 and 48% had Kirschner wire fixation. Cysts appeared in the carpus of both pinned and nonpinned implants; thus the wire did not "seed" adjacent carpal bones, a finding that was supported by Smith et al.36 The roentgenographic changes did not appear to be time-dependent. An early finding in implants with intramedullary stems may be the loss of cortical bone adjacent to the stem.41 Later changes may show a "ground glass" appearance and widening or scalloping of the endosteum.34 A similar high incidence of silicone-particulate synovitis was found with the Eaton implant.42 The authors of this study speculated that the constraint of the abductor pollicis longus passing through the implant may have led to silicone-wear synovitis.

Lacerations or defects on the implant surface that were propagated with use were believed to be the cause for prosthetic deterioration.43 Peimer44 believed that the silicone microparticles were generated by cyclic physiologic bearing, shear, and compressive forces for which these implants have not been tested. The synovitis is incited when the body is unable to encapsulate a foreign object and the particles become ingested by phagocytes that initiate an inflammatory reaction.45 The importance of particle size in determining the body's response to any nontoxic material has been recognized in human and experimental models.45,46

The treatment of the hand affected with silicone synovitis has not been rewarding.34,35,37,39,43 Conservative treatment, such as splinting and steroid injections, has provided only temporary relief of symptoms with all patients eventually coming to surgery. Weiby and Sondorf37 specifically looked at the results following removal of 16 silicone trapezial implants due to silicone synovitis, treated with implant excision and tendon interposition arthroplasty. Eighteen percent remained painful with 41% having reduced motion. All thumbs had at least 5 mm of shortening.

Wilgis and Clark39 recently presented a long-term study of 15 patients treated for silicone synovitis at the level of the wrist. The patients were treated with implant excision, synovectomy, and skeletal stabilization surgery. The implants were in place an average of 5.6 years and the follow-up averaged 3.7 years. Four patients experienced recurrent synovitis and 40% reported pain subsequent to implant removal. Peimer et al.34,43 and others recommended that, for hands affected by trapezial silicone synovitis, at the time of synovectomy the basal
joint should be converted to a resection arthroplasty and that all cysts greater than 5 mm in diameter should be curetted.34,43

**LIGAMENTOUS RECONSTRUCTIONS**

Thompson47,48 has pointed out that the ideal reconstructive procedure for the basal joint should be simple, predictable, mobile, stable, biomechanical, contain no foreign material, and be consistent in pain relief. Originally used to salvage a failed silicone arthroplasty, "suspensionplasty" became the treatment of choice for patients requiring operative intervention. This procedure uses the most dorsal slip of the abductor pollicis longus to provide stability to the thumb metacarpal (Figure 3). Tendon interposition arthroplasty in the form of a palmaris longus "anchovy" is also part of the procedure, although its need has been questioned. Early and late follow-up reports have shown that the strength and range-of-motion do not deteriorate with time and that patient satisfaction remains high.48,49 Results show pinch strength in the range of 10 lbs, with most patients regaining the ability to touch the thumb tip to the base of the fifth metacarpophalangeal joint.

Eaton et al50 and Burton and Pellegrini51 have separately published ligament reconstruction with tendon interposition procedures. From prior work,52 it has been shown that the incidence of pantrapezial changes is low. Eaton et al50 reasoned that if only the involved joint could be reconstructed with establishment of the ligament stability and provision for a new joint surface, complete trapeziectomy would then be unnecessary. Twenty-five patients were treated with limited resection of the surfaces of the first metacarpal base and trapezium and reconstruction of the palmar oblique ligament by using one half of the flexor carpi radialis with interposition using this tendon. A total of 92% showed good-to-excellent results at an average of 37 months of follow-up.50 Excellent results were correlated with maintenance of the space between the metacarpal base and the trapezium.

Burton and Pellegrini51 advocated complete trapeziectomy or excision of one half of the trapezium. Resection was dictated by the amount of arthrosis in the neighboring joints. The other modifications from Eaton et al’s procedure are in the method of attachment of the flexor carpi radialis slip and in not dividing off a separate piece of tendon for the interpositional material. Excellent results were reported in 25 of 25 cases, with no revisions at 2-year follow-up; subluxation of the construct averaged only 7% of the metacarpal base width. Proximal migration averaged an 11% loss of the initial postope-

![Figure 3. Abductor pollicis longus suspensionplasty.](image-url)

erative space. Twenty-eight percent of the patients could not touch the thumb tip to the base of the small finger, but grip and pinch strength revealed an increase of 19% over preoperative values.

A long-term follow-up of the ligament reconstruction with tendon interposition arthroplasty has been presented by its originators.53 Ninety-five percent of the patients were very satisfied with the result. Average grip strength increased over preoperative values. Patients made steady gains for up to 6 years after surgery. Measurements of pinch strength showed similar results with a 65% improvement. Restoration of motion was maintained, with 79% of the patients being able to touch the thumb tip to the base of the fifth finger. Stability of the construct was supported by values of subluxation of the metacarpal width of 11% and loss of joint space height of 13%, on average.

This widespread use of biologic reconstructions led to modifications in the hopes of further improvement.54,55 Kleinman and Eckenrode54 have presented a tendon sling arthroplasty which uses one half of the flexor carpi radialis in a double figure-of-eight fashion in an attempt to reconstruct both the palmar oblique ligament and the intermetacarpal ligament. Follow-up of the 40 arthroplasties averaged 21 months with grip and key pinch approximately 87% of the opposite side.

Uriburu et al55 have also modified the ligamentous reconstruction techniques. Their technique appears to orient the ligament reconstruction in a more transverse fashion using a shorter length of flexor carpi radialis. A large series of 159 arthroplasties using this method has shown outstanding results with 97% of the patients able to touch the thumb to the fifth metacarpophalangeal joint, and with 29% and 19% increases in grip and key pinch over preoperative statistics. Patients were followed up an average of 7.8 years, with some arthroplasties having analysis as long as 17 years.
### Table. Operative Procedures for Painful Basal Joint Arthritis of the Thumb

<table>
<thead>
<tr>
<th>Operation</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Excisional Arthroplasty</strong></td>
<td>Technically easy</td>
<td>Predictable subsidence of thumb ray</td>
</tr>
<tr>
<td></td>
<td>No prolonged postoperative immobilization</td>
<td>Weakened grip and pinch strength</td>
</tr>
<tr>
<td></td>
<td>Consistent pain relief</td>
<td>Does not stabilize first metacarpal joint</td>
</tr>
<tr>
<td><strong>Fusion</strong></td>
<td>Consistent pain relief</td>
<td>May lead to problems in</td>
</tr>
<tr>
<td></td>
<td>Durable</td>
<td>metacarpophalangeal joint</td>
</tr>
<tr>
<td></td>
<td>Can withstand heavy use</td>
<td>Prolonged immobilization</td>
</tr>
<tr>
<td></td>
<td>in manual labor</td>
<td>Nonunion</td>
</tr>
<tr>
<td></td>
<td>Maintains thumb length</td>
<td>Decreased motion</td>
</tr>
<tr>
<td><strong>Total Joint Arthroplasty</strong></td>
<td>Attempts to restore lost anatomy</td>
<td>Problems with implant loosening</td>
</tr>
<tr>
<td></td>
<td>Maintains thumb length</td>
<td>No widespread acceptance</td>
</tr>
<tr>
<td><strong>Silicone Implant Arthroplasty</strong></td>
<td>Consistent pain relief</td>
<td>Must have adequate bone stock</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technically demanding</td>
</tr>
<tr>
<td><strong>Ligament Reconstruction &amp; Excisional Arthroplasty</strong></td>
<td>Maintain thumb length</td>
<td>Silicone synovitis</td>
</tr>
<tr>
<td></td>
<td>Durable</td>
<td>Instability</td>
</tr>
<tr>
<td></td>
<td>Consistent pain relief</td>
<td>Technical demanding</td>
</tr>
<tr>
<td></td>
<td>Reproducible</td>
<td>Few long-term follow-up reports</td>
</tr>
<tr>
<td></td>
<td>Biologic</td>
<td>No single method shown to be superior</td>
</tr>
<tr>
<td></td>
<td>Motion sparing</td>
<td></td>
</tr>
</tbody>
</table>

Comparative research has been performed evaluating the three most currently popular techniques: arthrodesis, silicone arthroplasty, and ligament reconstruction with soft-tissue interposition. All procedures provided excellent pain relief. Arthrodesis resulted in largest gains in pinch strength, and silicone arthroplasty had the highest complication rate due to instability and silicone synovitis. The best results were seen in the ligament reconstruction group. These results are confirmed by the study of Wolock et al.

**SUMMARY**

Operative treatment for painful arthritis of the basal joint originally attempted to alleviate pain without regard for variables such as dexterity, strength, and treatment of associated lesions. Options of arthrodesis and excisional arthroplasty met the early needs of both patient and surgeon by providing a reasonably consistent, pain-free thumb, albeit with some restrictions in either motion or strength. As success with total joint arthroplasty in hips and knees became published, surgeons extended the technology to the thumb. Initial enthusiasm for joint replacement of the thumb carpo-metacarpal joint with a metal and plastic prosthesis has waned, largely due to problems with implant fixation and poor long-term results.

Swanson introduced silicone replacement arthroplasty and early results were promising. Unfortunately, despite numerous modifications of the prosthesis and the technique of insertion, it has been problematic due to implant stability, which can lead to erosion of the prosthesis with secondary silicone synovitis of the wrist. This complication presently does not have a satisfactory solution.

Biologic reconstructions appear to provide the most promise. All published methods strive for reconstitution of the palmar oblique ligament, which has been shown to be the major stabilizer of the first carpo-metacarpal joint. When evaluating and comparing these techniques, the surgeon will find it difficult to decide which reconstruction is best. Each method has shown very little deterioration of early results. The problems of earlier techniques, such as prosthesis wear and instability with implants, and loss of strength and dexterity with excision and fusion, have not surfaced (Table).

There has not been one widely accepted method for evaluation of the basal joint. Despite the limitations of evaluation, authors are making efforts to critically analyze results of their surgeries and to investigate causes of poor outcomes. This has led to refinement of treatment and hopes of further improvement in results.
REFERENCES


