A Review Paper

Total Joint Arthroplasty for the Arthritic Thumb Carpometacarpal Joint

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Abstract

Thumb basal joint arthritis remains one of the most common and functionally limiting conditions that orthopedic and hand surgeons encounter in daily practice. Nevertheless, surgical treatment options have largely centered on ablative procedures in which the critical trapezial carpal bone is excised completely. Newer orthopedic techniques, such as arthroscopy and implant arthroplasty, have not gained widespread acceptance for this particular joint. Despite equivocal results for basal joint implant arthroplasty in early studies, improved implant design and refinement of surgical indications support adding this option to the surgeon's treatment armamentarium.

For painful arthritis of the thumb, the main treatment goals are to restore thumb function; provide a pain-free, stable, and mobile joint; and preserve strength. Various surgical methods have been proposed to achieve these goals. Metacarpal osteotomy is best for earlier stages, when joint destruction is limited.[1] Arthrodesis is associated with loss of mobility and transfer of reaction forces to the neighboring joints.[2] Arthroscopy is excellent for early stages but should be coupled with other procedures, such as osteotomy, while advanced arthrosis requires some type of interposition arthroplasty.[3] This implies a period of immobilization to allow spacer adherence, whether artelon or tendon graft. Procedures like ligament reconstruction/tendon interposition include trapezium excision, which is associated with some loss of thumb length and therefore pinch strength.[4] Trapezium excision also requires a period of immobilization and allows little salvage option if failure should occur. Silicone implant arthroplasty was proposed as an alternative but has been shown to be associated with instability, silicone wear, synovitis, prosthesis fracture, and prosthesis subluxation.[5] Total joint arthroplasty was first described by de la Caffiniere and Aucouturier.[6] This procedure applies the concept of total hip arthroplasty to create a permanent swivel, within the base of the thumb, that obviates the need for ligament reconstruction, replaces the joint surface with a mechanical bearing surface for frictionless movement, and provides stability for strong pinch and grasp. The main advantage is rapid functional recovery with trapezium sparing (options are therefore maintained).

Various implant designs are available for total joint arthroplasty of the thumb. Historically, the de la Caffiniere implant was the most widely used and most extensively studied implant, but it is no longer commercially available. De la Caffiniere reported his own experience with this implant in 1979[6] and 1991.[7] The GUEPAR implant has been reported in the French literature.[8] Even though surgeons in different parts of the world continue to use other implants, the indications and long-term outcomes of those implants are not reported frequently and are therefore not adequately established. The Braun prosthesis (Zimmer, Warsaw, IN) is one such implant. Braun[9] first reported its use in a 1982 study of his experience with 22 patients (29 thumbs); in 1985, he reported on his experience with 50 patients.[10] There have been few reports on this prosthesis other than these 2 studies, and they were more about implant design and surgical technique rather than about results and outcome. So, until a retrospective clinical series was reported in 2006 (Badia & Sambandam[11]), there had been no clinical series on this implant since 1985 (Braun[10]).

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This paper reviews the indications, contraindications, and surgical technique for the Braun-Cutter trapezio-metacarpal joint prosthesis (SBI, Morrisville, PA) and the outcomes in treatment of stage III and selected cases of stage IV osteoarthritis of the thumb carpometacarpal joint.

Indications

Optimal patient selection and sound technical execution are the keys to success with total joint arthroplasty of the thumb carpometacarpal joint. Typically, this alternative is indicated for stages III and IV (Figure 1). It is imperative that, given the stresses at this joint during pinch activity, only low-demand patients be offered this prosthesis. Cooney[12] reported that pinch forces at the pulp are magnified 10- to 13-fold when measured at the carpometacarpal level.

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Figure 1. Preoperative thumb radiographs of a patient with advanced trapeziometacarpal arthritis.

Therefore, it is important to offer this implant only to older patients (because of implant longevity) and to ensure that they do not have demanding work or hobby activities that can increase the risk for loosening and subsequent failure. If this basic tenet is followed, the procedure may be one of the most rewarding for the most typical patients presenting with this painful arthrosis.

The significant advantages of this procedure are rapid functional recovery and minimal postoperative pain and inconvenience. Patients seldom require more than several weeks of hand rehabilitation, which can begin as early as 4 or 5 days after surgery. Early rehabilitation is of particular benefit to the infirm and to the elderly who live alone, as rapid return to activities of daily living with minimal outside help is highly valued by these patients, who are often preoccupied with other, far more significant health issues. Any surgery that requires a cast or prolonged recovery will be a great hindrance.

Patients with advanced thumb deformity, including adduction contracture, are also ideal candidates for the procedure. During excision of the metacarpal base, a complete adductor release can be performed to restore functional and cosmetic abduction of the thumb ray. Hyperextension of the metacarpophalangeal joint can be addressed with volar capsulodesis, or even arthrodesis in severe cases, restoring the normal kinematics and stable opposition post required of the thumb. A z-plasty may be necessary for the first web space. That the implant is constrained helps correct chronic deformities, as the construct neutralizes joint-deforming forces.

Contraindications

No young or highly active patient should undergo basal joint metal implant arthroplasty, as it will be doomed to failure. Not only are joint reactive forces excessive, as previously stated, but the size of the bones limits the osseous surrounding support on which each component depends. The trapezial component has only limited carpal bone encompassing the cement mantle that maintains the cup in correct orientation. Dorsoradial migration, or even subsidence, can occur if the implant is subjected to excessive and prolonged stresses. Decisions must be made about each particular patient as to whether he or she is too young or too active to undergo this surgery.

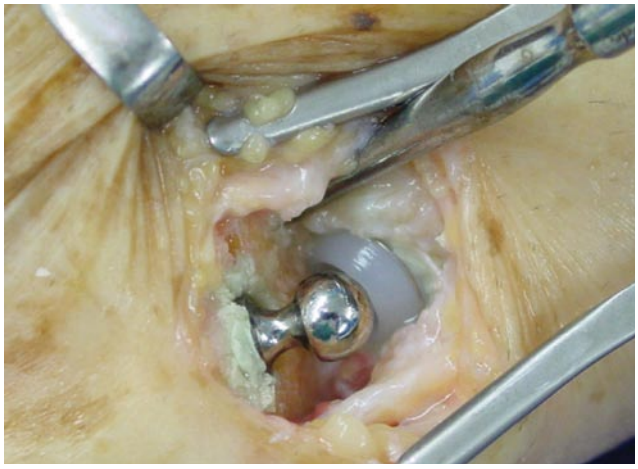

Figure 2. Intraoperative view of metacarpal component and trapezial cup cemented in place prior to reduction.

Other contraindications include bone stock that will not support the components and a flattened trapezium, which is best managed by complete resection. In other words, implant acceptance requires ample trapezium. When there is any doubt, the device should not be used, and the procedure can be altered to trapezium resection and ligament reconstruction.

Presence of arthritis in the scaphotrapezial-trapezoidal (STT) joint is a source of controversy. Advanced radiographic changes or symptomatic findings at this joint preclude use of the implant, as pain may persist or even become magnified at this level. However, presence of mild STT joint degenerative changes on radiography does not necessarily present a contraindication in our experience. It is important to directly palpate this joint on the hand dorsum to rule out painful STT arthritis if the radiograph suggests any. Again, excisional arthroplasty would be more appropriate with these findings.

Less common contraindications include prior infection at this level and neurologic deformity, such as Charcot joint (eg, syringomyelia) or paralytic contracture affecting the hand.

Surgical Technique

Surgical approach for thumb basal joint arthroplasty consists of a 3- to 4-cm longitudinal lazy S incision performed over the dorsum at the base of the thumb. This curvilinear incision is a smaller incision that permits better side-to-side retraction. It is also less apparent than simple straight lines. Branches of the superficial sensory radial nerve are identified and protected. Further dissection is carried between the extensor pollicis longus and extensor pollicis brevis tendons protecting the dorsal branch of the radial artery. The dorsal capsule of the trapeziometacarpal joint is opened longitudinally. A transverse incision of about 1.5 cm is made in the periosteum at the base of the metacarpal, also elevating the insertion of the abductor pollicis brevis. The periosteum and the dorsal capsule are reflected proximally as a single flap so that it can be repaired later. A small sagittal saw is used to remove the proximal 8- to 10-mm base of the metacarpal. This maneuver facilitates complete release of the joint

Figure 3. Postoperative thumb radiographs showing Braun-Cutter thumb implant (SBI, Morrisville, PA) in place and clearly illustrating cement mantle around components.

capsule and the adductor pollicis from the metacarpal shaft. This step allows abduction of the thumb metacarpal away from the palm to improve hand function. At this point, longitudinal traction and flexion are applied to better expose the trapezial surface. A rongeur is used to remove the marginal osteophytes. A high-speed burr or the rasp in the tray is used to create a deep channel within the trapezium or can be used where the polyethylene cup is to be cemented. For the thumb metacarpal, 2 broaches of different sizes are available for preparing the metacarpal canal and allowing the component to have a generous cement mantle. Both sides of the joint are prepared for implant placement by irrigating them with antibiotic solution and drying the cancellous bony surfaces with gauze. The cup is cemented in the trapezium. Once the cup has been inserted and the cement cured, a second batch of cement is placed in the metacarpal, and the metacarpal component is inserted. As this stem is collarless, adequate neck length must be maintained after insertion so that dislocation does not occur. Dislocation can occur when the stem neck impinges on the edge of the trapezium because of inadequate placement. After proper hardening of this component, the stem is pressed into place in the cup, and stability and circumferential motion are assessed with no impingement on the implant. Any excess cement is excised. With experience, the surgeon can cement both sides of the joint in one stage, considerably shortening operative time (Figure 2). The periosteum–capsule flap is closed with absorbable suture, and meticulous hemostasis is achieved. Intraoperative fluoroscopy is used to check proper alignment and placement of the prosthesis (Figure 3). I typically close the skin with 4-0 Vicryl Rapide (Ethicon, Inc., Somerville, NJ) and apply a well-padded short-arm thumb spica splint with the thumb in opposition (worn for 2 weeks). At this time, rehabilitation is started, and an orthoplast thumb-based spica splint is indicated for further protection during certain activities. Patients rapidly regain thumb-to-base-of-small-finger opposition with a gentle, active-assisted range-of-motion protocol (Figure 4).

> **"In other words, implant acceptance requires ample trapezium."**

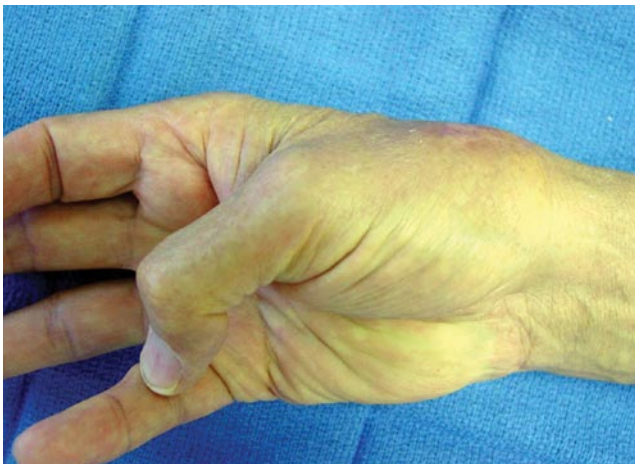

Figure 4. Photograph taken at follow-up visit 3 weeks after surgery demonstrates functional thumb adduction to small finger metacarpophalangeal volar crease.

In the event that a volar capsulodesis is needed, a Bruner-type incision is made over the palmar aspect of the metacarpophalangeal joint. The flexor pollicis longus tendon is identified and reflected and the A1 pulley released. Then a U-shaped incision is made on the volar plate to create a distally based flap. The metacarpophalangeal joint is then held in 10° of flexion, and the proximal end of the volar plate is reattached more proximally to the metacarpal neck with a suture anchor with enough tension to maintain the desired degree of flexion. In these cases, a short-arm thumb spica cast up to the interphalangeal joint is used for 1 month.

Outcomes

Badia and Sambandam[11] recently published results from a retrospective analysis of 25 assessed patients (26 thumbs) who underwent the procedure between 1998 and 2003. Complete pain relief was achieved in 24 patients (96%). Mild pain was present in 1 patient after traumatic injury to the hand. Revision of her prosthesis was required for secondary loosening, believed to be caused by the injury.

In that study, preoperative pinch strength was 6 kg in the noninvolved side and 3.5 kg in the affected thumb (61% from contralateral side), and postoperative pinch strength was 6.5 kg in the noninvolved side and 5.5 kg in the affected thumb (85% from contralateral side). Final range of thumb radial abduction was 60° (range, 50°-65°). Thumb opposition reached the base of the small finger in all cases.

In addition, radiographs at final follow-up showed no evidence of implant loosening, cup migration, stem subsidence, or subluxation in both anteroposterior and lateral views of the thumb. This was also the case for the 1 patient who underwent joint revision. There were 24 excellent results and 1 good result. The result after the revision was also good.

Conclusions

Careful patient selection, sound implant design, and strict adherence to surgical technique have been key factors in successful clinical outcomes of the rarely used procedure of prosthetic carpometacarpal joint reconstruction of the thumb. My clinical experience with this procedure has shown that it is an excellent treatment option for elderly, low-demand patients who would most benefit from the advantages described in this article.

Author's Disclosure Statement

The author wishes to note that he is on the Surgeon Advisory Board of Small Bone Innovations.

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