TECHNIQUE

Treatment of Early Basal Joint Arthritis Using a Combined Arthroscopic Debridement and Metacarpal Osteotomy

Alejandro Badia, MD and Prakash Khanchandani, MS
Hand, Upper Extremity and Microsurgery
Miami Hand Center
Miami, FL

ABSTRACT

Osteoarthritis of the thumb basal joint is a common and disabling condition, and early stages of which are often seen in middle-aged women. Arthroscopic assessment of the first carpometacarpal joint allows easy identification and classification of joint pathology with minimal morbidity. This allows the condition to be managed either arthroscopically or converted to an open procedure as indicated. Different procedures have been described to treat different stages of this disease. The senior author has recently described an arthroscopic staging system to determine treatment for basal joint osteoarthritis. We now present our surgical technique and early clinical experience with arthroscopic synovectomy, debridement, and corrective osteotomy for arthroscopic stage II of thumb basal joint arthritis. Forty-three patients (38 women and 5 men) were arthroscopically diagnosed as having stage II basal joint osteoarthritis of the thumb between 1998 and 2001, and they were the focus of the present study. In all the patients, there was no improvement after a period of 6 to 12 weeks of conservative treatment. All the procedures were performed by the senior author. The surgical procedure included arthroscopic synovectomy, debridement, and occasional thermal capsulorraphy, followed by an extension-abduction closing wedge osteotomy in all the cases. A 0.045-in Kirschner wire provided stability to the osteotomy. By performing an osteotomy that redirects the axial loads in this joint, we have obtained satisfactory results in terms of pain relief, stability, and pinch strength. Arthroscopy allows us to not only determine the optimum indication for this osteotomy, but also to debride the joint and minimize the inflammatory response. Hence, we recommend arthroscopic synovectomy, debridement with or without a thermal capsulorraphy, and a dorsoradial closing wedge osteotomy for the treatment of arthroscopic stage II of thumb carpometacarpal joint osteoarthritis.

Keywords: thumb, carpometacarpal, osteoarthritis, arthroscopy, osteotomy

Address correspondence and reprint requests to Alejandro Badia, MD, Miami Hand Center, Suite 100, 8905 SW 87th Ave, Miami, FL 33176. E-mail: alex@surgical.net.

HISTORICAL PERSPECTIVE

The trapeziometacarpal (TMC) joint displays an exclusive anatomic design that allows arc of motion in three different planes to place the thumb for axial loads. For this reason, it is not uncommon for this joint to develop osteoarthritis even when other small joints in the vicinity stay unchanged.[1] It has been demonstrated that there is a strong correlation between extreme basal joint laxity, specifically volar ligament instability, and evolvement of the early degenerative changes.[1–8] These alterations are common causes of pain, weakness, and adduction deformity.[9] Different procedures have been proposed for the treatment of first carpometacarpal (CMC) joint arthritis.[1,3–5,9–32] Clinical and radiographic assessments have constituted the basic tools for evaluation of the first CMC joint during the last several decades.[1,5,29–31] Eaton and Glickel[5] proposed a staging system for thumb CMC arthritis, which has been extensively used not just to categorize the disease, but also to provide a treatment rationale. Bettinger et al[30] introduced the trapezial tilt as a parameter to predict further progression of the disease. They found that in advanced stages (Eaton III and IV), the trapezial tilt was high (50° ± 4°; normal, 42° ± 4°). Barron et al[1] concluded that there appeared to be no indication for magnetic resonance imaging (MRI), tomography, or ultrasonography in the routine evaluation of basal joint disease. Despite the importance of a radiographic classification to understand the progression of the disease, our experience has showed us that there are instances when it is very difficult to make an accurate diagnosis of the disease stage, based solely on radiographic studies. Clinical symptoms are often much more pronounced than plain radiographs would suggest.[29]

Recent advances in arthroscopic technology have allowed complete examination of smaller joints throughout the body with minimal morbidity.[33] Moreover, arthroscopy has already been proved to be reliable for direct evaluation of the first CMC joint.[32] This technique is often used initially for diagnostic purposes and, once established, can be incorporated into our treatment plan. Arthroscopy of the thumb basal joint allows us to look within a joint that is commonly affected by both traumatic and chronic conditions, providing clear visualization of the articular surfaces and assessment of ligamentous integrity, and hence permitting confirmation of the preoperative radiographic staging in all the cases. The senior author recently described an arthroscopic classification for thumb CMC osteoarthritis[29] (Table 1).

The benefits of basal joint arthroscopy are evident in early stages of the disease. For instance, in arthroscopic stage I, it is very common to have normal radiographic studies in the presence of painful limitation of the thumb. In our experience, we have found that this group of patients displayed mild to moderate synovitis that could benefit from a thorough joint debridement/synovectomy, combined with thermal shrinkage of the ligaments to enhance the stability if necessary. Tomaino[24,25] concluded that Eaton stage I disease is a good indication for thumb metacarpal extension osteotomy. A more reliable indication might be when there is only focal articular cartilage loss and the joint is, therefore, worth preserving. First metacarpal osteotomy has been advocated to modify the mechanical stress areas of the joint.[9,23–29] Based on the arthroscopic changes found in stage II, we support the fact that it may be feasible to modify the joint by an osteotomy and preserve the trapezium. Moreover, the metaphyseal osteotomy leads to decompression and reactive hyperemia that may help in arresting the progression of the arthritis.[34,35] Menon described a technique demonstrating arthroscopic debridement of the trapezial articular surface and interposition of autogenous tendon, fascia lata, or Gore-Tex patch into the CMC joint in patients with stage II and III.[31] The main goal of the present study is to present the surgical technique and results of our arthroscopic stage II patients treated with an arthroscopic basal joint debridement with capsulorraphy and a closing wedge extension-abduction metacarpal osteotomy.

TABLE 1. *Badia's Arthroscopic Classification*

Stage	Arthroscopic Changes
I	Intact articular cartilage; disruption of the dorsoradial ligament and diffuse synovial hypertrophy; inconsistent attenuation of the anterior oblique ligament
II	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 the anterior oblique ligament
III	Widespread full-thickness cartilage loss with or without a peripheral rim on both the articular surfaces; less severe synovitis; frayed volar ligaments with laxity

INDICATIONS AND CONTRAINDICATIONS

Stage II arthroscopic CMC joint arthritis is our indication for the extension abduction metacarpal osteotomy coupled with a thorough arthroscopic synovectomy and capsulorraphy. The joint findings that we have previously described for arthroscopic stage II of the disease warrants a modification of the joint by changing the load vector on both the articular surfaces through an osteotomy. Arthroscopy not only allows staging of the arthritis but the joint can also be effectively debrided, and capsulorraphy can be done. However, this procedure should be avoided in advanced basal joint arthritis or when scaphotrapezial-trapezoid joint is arthritic, wherein a more aggressive procedure is warranted. Eaton stage I might be amenable to a simple synovectomy/debridement, reserving the osteotomy for more advanced arthroscopic findings. On the other hand, if the arthroscopic evaluation depicts complete articular cartilage loss, the next logical step is to perform partial trapezium excision with tendon interposition arthroplasty.

ARTHROSCOPIC AND RADIOGRAPHIC CORRELATION

Arthroscopic stage I universally correlate well with that of 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 lays one of the great advantages of this technology. Only the rare case demonstrates less cartilage wear than expected on the plain radiograph. Consequently, radiographic stage III rarely is considered arthroscopic stage II, but that does greatly influence and diversify the treatment options. More advanced radiograph findings will usually reveal widespread cartilage loss when arthroscopy is performed. Hence, later stages are not necessarily a panacea as related to the use of arthroscopy.

Surgical Technique

The procedure was performed under wrist block regional anesthesia with tourniquet control. A single Chinese finger trap was used on the thumb with 5 to 8 lb of longitudinal traction. The arm was held down with wide tape around the tourniquet securing it to the hand table to serve as countertraction. A shoulder holder, rather than a traction tower, was used to facilitate fluoroscopic intervention more easily. The Trapeziometacarpal joint was detected by palpation. Joint distension was achieved by injecting 1 to 3 mL of normal saline (Fig. 1). It is important to distally direct the needle approximately 20 degrees to clear the dorsal flare of the metacarpal base and enter the joint capsule. This course should be reproduced upon entering with arthroscopic sleeve/trocar assembly to minimize iatrogenic cartilage injury. Fluid distention is important to facilitate this. The incision for the 1-R (radial) portal, used for proper assessment of the dorsoradial ligament, posterior oblique ligament, and ulnar collateral ligament, was placed just volar to the abductor pollicis longus tendon. The incision for the 1-U (ulnar) portal, for better evaluation of the anterior oblique ligament and ulnar collateral ligament, was made just ulnar to the extensor pollicis brevis tendon. A short-barrel, 1.9-mm, 30-degree inclination arthroscope was used for complete visualization of the CMC joint surfaces, capsule, and ligaments, and then appropriate management was done, as dictated by the stage of the arthritis detected (Fig. 2A). A full-radius mechanical shaver with suction was used in all the cases, particularly for initial debridement and visualization. Most of the cases were augmented with radiofrequency ablation to perform a thorough synovectomy and radiofrequency was also used to perform chondroplasty in the cases with focal articular cartilage wear or fibrillation. Chondroplasty refers to the debridement of the fibrillated cartilage to improve vascularity of the cartilage and enhance the growth of fibrocartilage. Ligamentous laxity and capsular attenuation were treated with thermal capsulorraphy using a radiofrequency shrinkage probe. We were careful to avoid thermal necrosis; hence, a striping technique was used to tighten the capsule of the lax joints. The striping technique refers to thermal shrinkage performed in longitudinal stripes on the lax capsule, so as to leave vascular zones between the stripes; hence, thermal necrosis is prevented. Arthroscopic stage I disease was characterized by synovitis without any cartilage wear, wherein a synovectomy coupled with thermal capsulorraphy as described was performed.

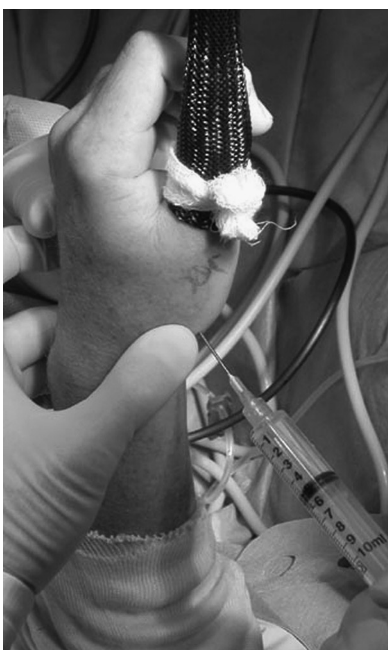

FIGURE 1. Insufflation of the TMJ joint after palpation.

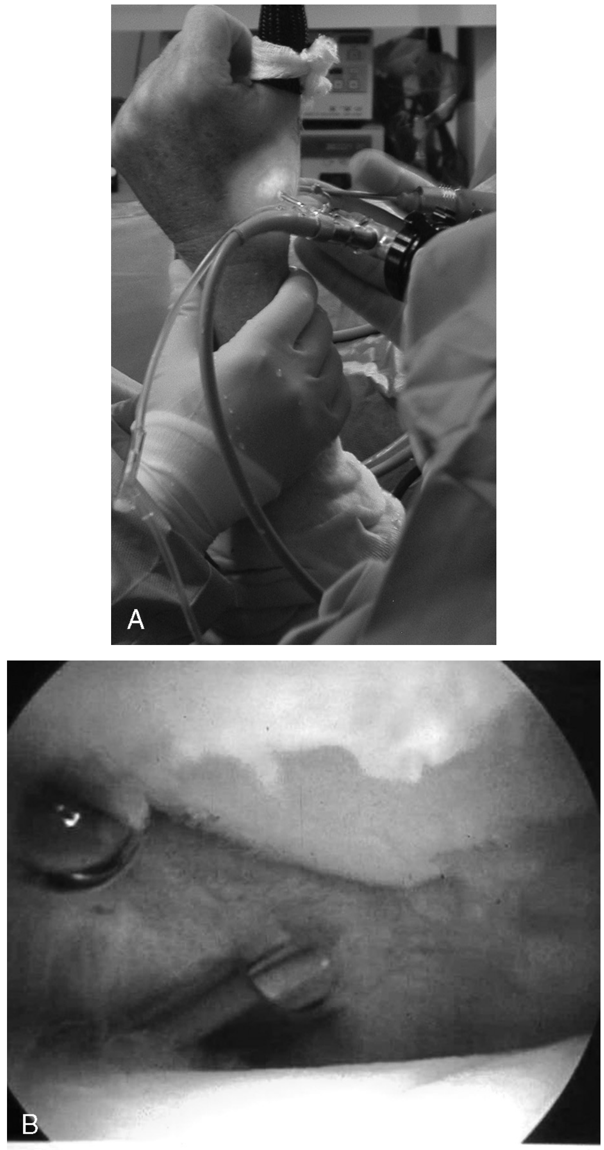

FIGURE 2. A, Carpometacarpal arthroscopy using ulnar portal. B, Arthroscopic appearance of the joint showing denuded cartilage and synovitis.

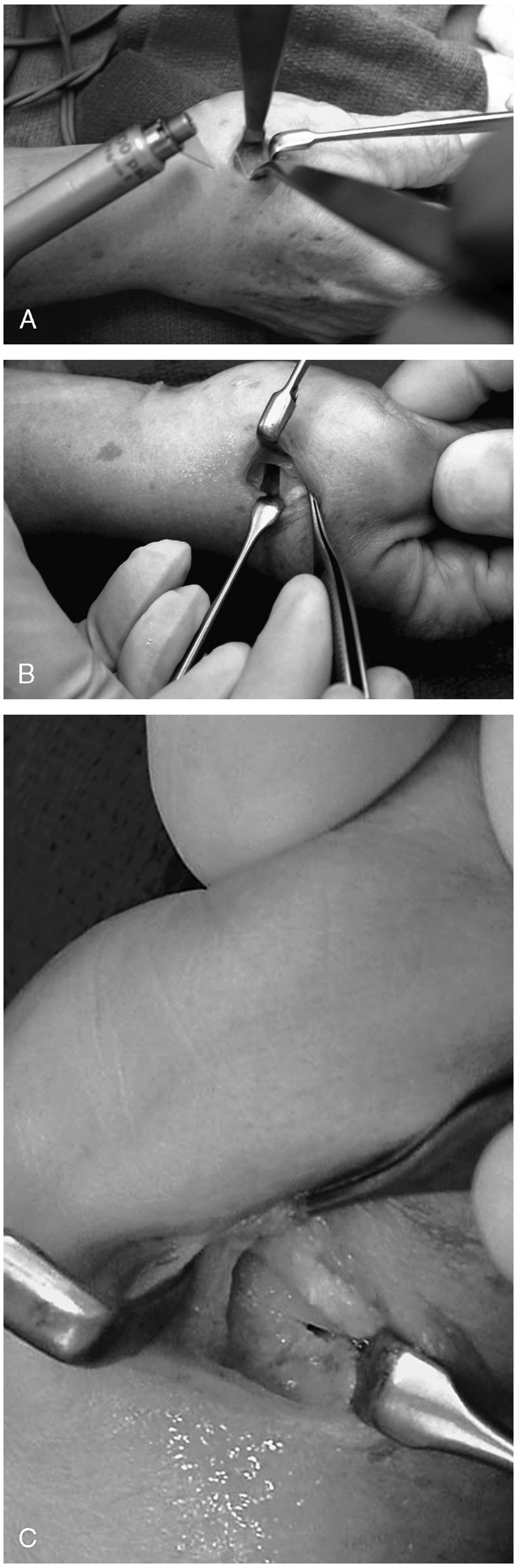

FIGURE 3. A, Preparation for the osteotomy of metacarpal metaphysis. B, Dorsoradial metacarpal osteotomy performed. C, Closure of the metacarpal osteotomy.

Arthroscopic stage II patients were characterized by focal wear of the articular surface (Fig. 2B) that required a joint modifying procedure, to alter the vector forces across the joint. After synovectomy, debridement, and occasional loose body removal, the joint was reassessed to determine the extent of instability and capsular attenuation. A shrinkage capsulorraphy was performed in many of the cases, with chondroplasty done to anneal the cartilage borders. The arthroscope was then removed, and the ulnar portal extended distally to expose the metacarpal base. Mini Hohmann retractors were placed around the base allowing good access for the oscillating saw (Fig. 3A). A dorsoradial closing wedge osteotomy was then performed to place the thumb in a more extended and abducted position (Fig. 3B and C), which minimized the tendency of subluxation and changed the contact points of worn articular cartilage. This wedge of bone is usually 3 mm wide dorsally and should also be wider on the radial side. This places the thumb in the requisite dorsal and radially abducted position. The osteotomy was fixed by a single oblique 0.045-inch Kirschner wire placed across the first CMC joint in a reduced position (Fig. 4A and B). This not only allowed for healing of the osteotomy in the desired position but also corrected the metacarpal subluxation, so often seen in this stage (Fig. 5A and B). As the metaphysis heals, the volar capsule also tightens minimizing the chance of recurrent subluxation. A thumb spica cast was given for protection, and the wire

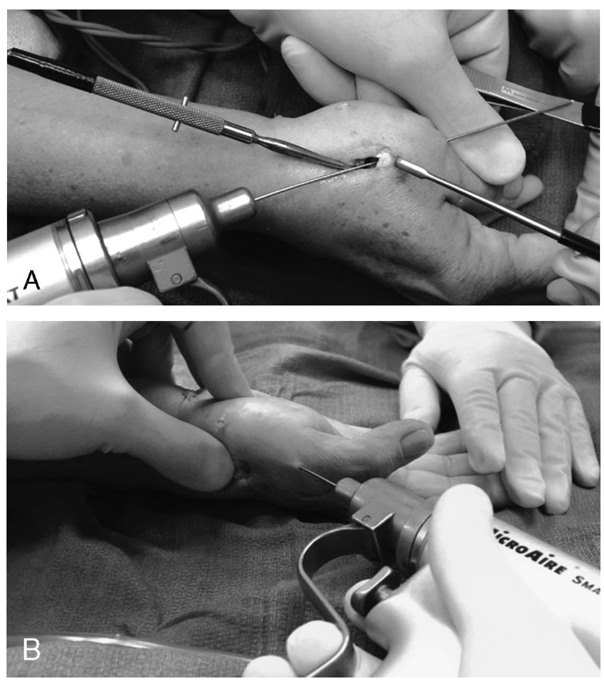

FIGURE 4. A, Retrograde fixation of the metacarpal osteotomy by Kirschner wire. B, Centralizing Kirschner wire fixation of the metacarpal osteotomy.

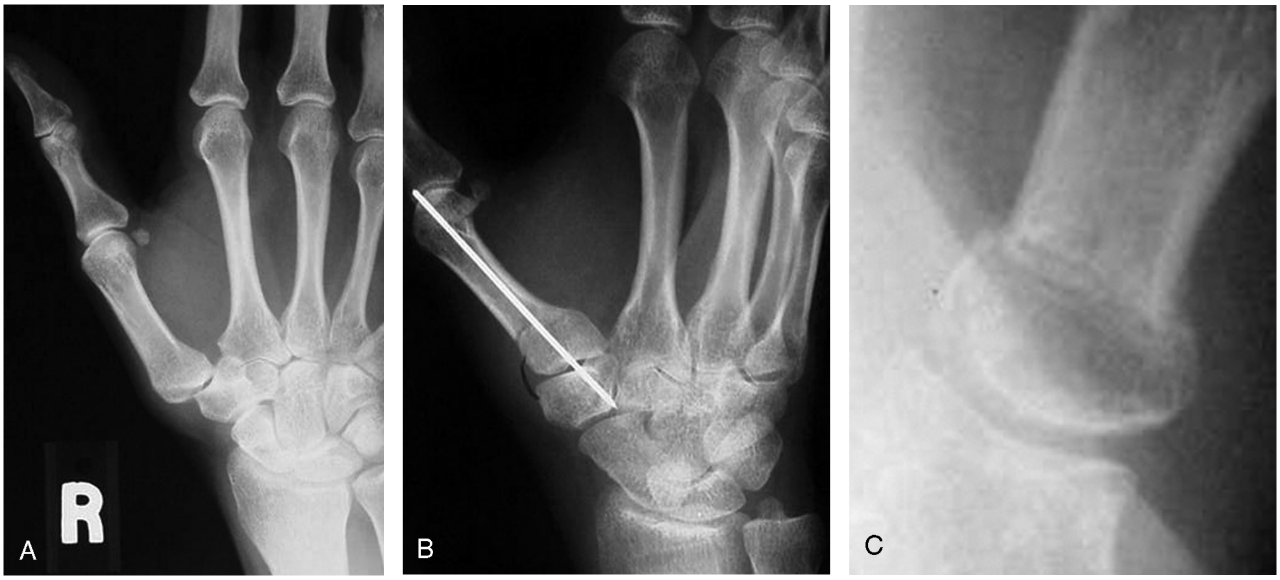

FIGURE 5. A, Preoperative radiograph showing subluxation of the metacarpal. B, Postoperative radiograph showing well-reduced joint surfaces fixed with a Kirschner wire. C, Healed osteotomy of the metacarpal after Kirschner wire removal.

was removed at approximately 4 to 5 postoperative weeks. After the wire removal, the patient is subjected to an intense rehabilitation protocol for about 4 to 6 weeks to gain maximum motion and strength.

COMPLICATIONS

In the present series, one of the patients developed constant pain later owing to the progression of osteoarthritis after the procedure. She did not respond to steroid injections and physical therapy. Eventually, she had to undergo an arthroscopic assisted hemitrapezectomy, with a good result. The second complication encountered in our series was complex regional pain syndrome (type I) in one patient, who developed it after the pin removal. This patient was managed with continuous physical therapy, stellate brachial plexus blockades, and neurontin.

SUMMARY

As arthroscopy becomes validated as a technique, we might see a day where less intra-articular injections are given and more joint preservation, rather than palliation, is sought. Arthroscopic assessment of the CMC joint allows direct visualization of all components of the joint including synovium, articular surfaces, ligaments, and the joint capsule. Hence, it allows the evaluation and staging of the joint pathology. Furthermore, the most suitable intraoperative management decision can be made based on this information. We recommend closing wedge extension-abduction osteotomy of the first metacarpal combined with synovectomy and capsulorraphy for the arthroscopic stage II patients. By preserving the joint, we have "burned no bridges," and a more aggressive procedure, either arthroscopic or open, can be done in the future if symptoms warrant. Hence, arthroscopic visualization allows for the least aggressive procedure to be performed as dictated by the intraoperative findings. According to the arthroscopic classification proposed, we recommend arthroscopic synovectomy and thermal capsulorraphy in patients with stage I, whereas in patients with stage II disease, we combine the synovectomy and capsulorraphy with dorsoradial osteotomy of the first metacarpal.

REFERENCES

1. Barron OA, Glickel SZ, Eaton RG. Basal joint arthritis of the thumb. *J Am Acad Orthop Surg*. 2000;8:314–323.
2. Freedman DM, Eaton RG, Glickel SZ. Long-term results of volar ligament reconstruction for symptomatic basal joint laxity. *J Hand Surg [Am]*. 2000;25:297–304.
3. Eaton RG, Littler JW. Ligament reconstruction for the painful thumb carpometacarpal joint. *J Bone Joint Surg*. 1973;55A:1655–1666.
4. Eaton RG, Lane LB, Littler JW, et al. Ligament reconstruction for the painful thumb carpometacarpal joint: a long-term assessment. *J Hand Surg [Am]*. 1984;9:692–699.
5. Eaton RG, Glickel SZ. Trapeziometacarpal osteoarthritis. Staging as a rationale for treatment. *Hand Clin*. 1987;3:455–471.

6. Kuczynski K. Carpometacarpal joint of the human thumb. *J Anat*. 1974;118:119–126.
7. Pellegrini VD Jr. Osteoarthritis of the trapeziometacarpal joint: the pathophysiology of articular cartilage degeneration. I. Anatomy and pathology of the aging joint. *J Hand Surg [Am]*. 1991;16:967–974.
8. Pellegrini VD Jr. Osteoarthritis of the trapeziometacarpal joint: the pathophysiology of articular cartilage degeneration. II. Articular wear patterns in the osteoarthritic joint. *J Hand Surg [Am]*. 1991;16:975–982.
9. Wilson JN, Bossley CJ. Osteotomy in the treatment of osteoarthritis of the first carpometacarpal joint. *J Bone Joint Surg*. 1983;65B:179–181.
10. Burton RI, Pellegrini VD Jr. Surgical management of basal joint arthritis of the thumb: part II. Ligament reconstruction with tendon interposition arthroplasty. *J Hand Surg [Am]*. 1986;11:324–332.
11. Eaton RG, Glickel SZ, Littler JW. Tendon interposition arthroplasty for degenerative arthritis of the trapeziometacarpal joint of the thumb. *J Hand Surg [Am]*. 1985;10: 645–654.
12. Barron OA, Eaton RG. Save the trapezium: double interposition arthroplasty for the treatment of stage IV disease of the basal joint. *J Hand Surg [Am]*. 1998;23: 196–204.
13. Swigart CR, Eaton RG, Glickel SZ. Splinting in the treatment of arthritis of the first carpometacarpal joint. *J Hand Surg [Am]*. 1999;24:86–91.
14. Varley GW, Calvey J, Hunter JB, et al. Excision of the trapezium for osteoarthritis at the base of the thumb. *J Bone Joint Surg*. 1994;76B:964–968.
15. Froimson AI. Tendon arthroplasty of the trapeziometacarpal joint. *Clin Orthop*. 1970;70:191–199.
16. Tomaino MM, Pellegrini VD Jr, Burton RI. Arthroplasty of the basal joint of the thumb: long-term follow-up after ligament reconstruction with tendon interposition. *J Bone Joint Surg*. 1995;77A:346–355.
17. Lins RE, Gelberman RH, McKeown L, et al. Basal joint arthritis: trapeziectomy with ligament reconstruction and tendon interposition arthroplasty. *J Hand Surg [Am]*. 1996;21:202–209.
18. Eaton RG. Replacement of the trapezium for arthritis of the basal articulations: a new technique with stabilization tenodesis. *J Bone Joint Surg*. 1979;61A:76–82.
19. Diao E. Trapezio-metacarpal arthritis. Trapezium excision and ligament reconstruction not including the LRTI arthroplasty. *Hand Clin*. 2001;17:223–236.
20. Klimo GF, Verma RB, Baratz ME. The treatment of trapeziometacarpal arthritis with arthrodesis. *Hand Clin*. 2001;17:261–270.
21. Fulton DB, Stern PJ. Trapeziometacarpal arthrodesis in primary osteoarthritis: a minimum two-year follow-up study. *J Hand Surg [Am]*. 2001;26:109–114.
22. Lisanti M, Rosati M, Spagnolli G, et al. Trapeziometacarpal joint arthrodesis for osteoarthritis. Results of power staple fixation. *J Hand Surg [Br]*. 1997;22:576–579.
23. Wilson JN. Basal osteotomy of the first metacarpal in the treatment of arthritis of the carpometacarpal of the thumb. *Br J Surg*. 1973;60:854–858.
24. Tomaino MM. Treatment of Eaton stage I trapeziometacarpal disease. Ligament reconstruction or thumb metacarpal extension osteotomy? *Hand Clin*. 2001;17:197–205.
25. Tomaino MM. Treatment of Eaton stage I trapeziometacarpal disease with thumb metacarpal extension osteotomy. *J Hand Surg [Am]*. 2000;25:1100–1106.
26. Hobby JL, Lyall HA, Meggitt BF. First metacarpal osteotomy for trapeziometacarpal osteoarthritis. *J Bone Joint Surg*. 1998;80B:508–512.
27. Holmberg J, Lundborg G. Osteotomy of the first metacarpal for osteoarthrosis of the basal joints of the thumb. *Scand J Plast Reconstr Surg Hand Surg*. 1996;30: 67–70.
28. Molitor PJ, Emery RJ, Meggitt BF. First metacarpal osteotomy for carpo-metacarpal osteoarthritis. *J Hand Surg [Br]*. 1991;16:424–427.
29. Badia A. Trapeziometacarpal arthroscopy: a classification and treatment algorithm. *Hand Clin*. 2006;22:153–163.
30. Bettinger PC, Linscheid RL, Cooney WP III, et al. Trapezial tilt: a radiographic correlation with advanced trapeziometacarpal arthritis. *J Hand Surg [Am]*. 2001;26:692–697.
31. Menon J. Arthroscopic management of trapeziometacarpal joint arthritis of the thumb. *Arthroscopy*. 1996;12:581–587.
32. Berger RA. Technique for arthroscopic evaluation of the first carpometacarpal joint. *J Hand Surg [Am]*. 1997;22: 1077–1080.
33. Chen YC. Arthroscopy of the wrist and finger joints. *Orthop Clin North Am*. 1979;10:723–733.
34. Arnoldi CC, Lempberg RK, Linderholm H. Immediate effect of osteotomy on the intramedullary pressure of the femoral head and neck in patients with degenerative osteoarthritis. *Acta Orthop Scand*. 1975;42:357–365.
35. Illarramendi AA, De Carli P. Radius decompression for treatment of Kienbock disease. *Tech Hand Up Extrem Surg*. 2003;7:110–113.