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Rehabilitation Protocol after Suspension Arthroplasty of Thumb Carpometacarpal Joint Osteoarthritis

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ABSTRACT:
Study Design: Retrospective case series.
Introduction: When conservative modalities and therapies fail to control symptoms of thumb carpometacarpal (CMC) joint osteoarthritis, surgery may be indicated.
Purpose of the Study: To present a rehabilitation protocol used in a series of patient cases after suspension arthroplasty and to evaluate outcomes.
Methods: Twenty-seven patients with CMC osteoarthritis were treated by the same arthroplasty technique and the same rehabilitation program. Patients were evaluated before and 12th week after surgery, and at the last follow-up using a visual analog scale; the Disability of the Arm, Shoulder, and Hand questionnaire; strength measurements; range of motion evaluations; and radiographic assessment.
Results: Average follow-up period was 31.5 months. There was a decreasing trend in both subjective scores during follow-ups ($p = 0.0001$). Thirty-three percent and 30% improvements on radial and palmar abductions, respectively, and 29% improvement on pinch strengths were recorded at the final follow-up. Postoperative grip improvement was not preserved at the last follow-up.
Conclusions: The results demonstrate a high degree of patient satisfaction suggesting the efficacy of this surgical technique and postoperative rehabilitation protocol.
Level of Evidence: Level 4.

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Osteoarthritis of the thumb carpometacarpal (CMC) joint is a common cause of major functional hand disabilities with pain and swelling over the base of the thumb often associated with deformity, instability, and limited range of motion (ROM). It primarily affects postmenopausal woman.[1–4] When conservative treatment modalities such as the use of orthotics, thenar strengthening exercises, nonsteroidal anti-inflammatory medications, and steroid or viscosupplementation injections into the joint fail to control the pain and improve the limitation of function associated with radiographic deterioration of this disease, surgical treatment may be indicated.[5–8] Numerous surgical techniques have been developed, including arthrodesis, silicone-implant arthroplasty, total joint arthroplasty, and trapezium resection arthroplasties. Although simple trapezium resection provides excellent pain relief, it may result in shortening of the thumb osteoarticular column associated with adduction deformity, weakness, and the stiffness.[1,9–11] To stabilize the thumb base and address the trapezial void created by trapeziectomy, a ligament reconstruction and tendon interposition (LRTI) technique, called suspension arthroplasty, was described. Although various techniques of suspension arthroplasty have been performing in which the tendons of flexor carpi radialis (FCR), abductor pollisis longus, or extensor carpi radialis longus can

The preliminary reports of this study were presented at the meeting of Federations of European Societies of Surgery of the Hand in Bucharest, Romania, 2010 and European Federation of Societies for Hand Therapy congress in Oslo, Norway, 2011.

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be used, resection of total or some part of trapezium and ligament reconstruction using the FCR tendon is one of the most well-known procedures. In this technique, the trapezium is excised to remove painful arthritic joint surface; the distally based total or half of the FCR tendon is used to reconstruct the beak ligament and to restore the transverse stability; and the rest of this tendon is used as a tissue interposition of the trapezial void to reduce the likelihood of proximal migration of the thumb column.[9,12,13]

Conservative treatments, including orthotic immobilization, have been well described in the literature. In addition, effectiveness of the surgery of LRTI with the subjective and objective outcomes has been reported in multiple studies.[5–8,13,14] However, there is no specific postoperative rehabilitation protocol described for a specific LRTI technique. This study defines our rehabilitation protocol and describes the functional and radiological results in a series of patients after suspension arthroplasty with total trapezium resection and LTRI using half of the FCR tendon in the first CMC joint osteoarthritis.

METHODS

Twenty-three consecutive patients (21 women and 2 men) with 27 thumbs who had CMC joint arthritis were treated in our institution between March 2004 and October 2010. The patients were involved in a prospective data collection effort; however, variables and evaluation parameters have been defined retrospectively after database research was initiated.

After examination of the patients and evaluation of the radiographic findings, surgical treatment option was considered by hand surgery and rehabilitation team in those patients for whom all the conservative modalities had failed and who continued to have pain over the first CMC joint and loss of strength and motion of the thumb that limited their active daily living. The average age of the patients was 63.5 years (range: 30–83 years) at the time of surgery. There were four bilateral cases. The dominant hand was involved in 13 patients and nondominant in 14. Mean duration of symptoms was 12.6 months (range: 6–36 months). None of the patients had a previous thumb surgery. In addition, excluded from the study were patients with rheumatoid arthritis, gout, or cervical radiculopathy. Positive physical findings were a grinding test reproduction of symptoms, joint crepitance, deformity, and limited ROM of the first ray. According to Eaton–Littler classification system,[1] radiographic assessments showed stage III in 18 thumbs and stage IV in 9 thumbs (Figure 1). Additional procedures performed at the time of surgery included carpal tunnel release (three patients), trigger release (three patients), de Quervain tenosynovitis surgery (two patients), and extensor pollicis brevis tenodesis for the first metacarpophalangeal (MP) joint reconstruction (one patient).

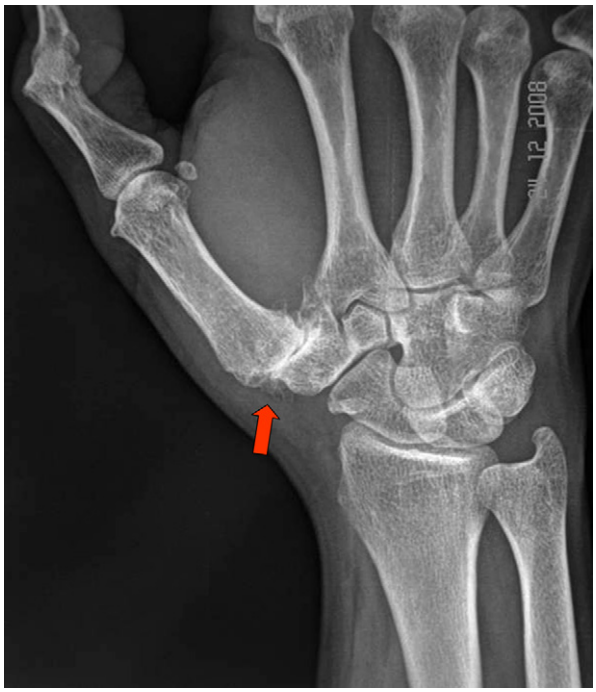

FIGURE 1. *Classic radiographic signs of stage III osteoarthritis with joint space narrowing, prominent osteophytes, and moderate subluxation the carpometacarpal joint (arrow).*

All the patients were evaluated subjectively and objectively before the surgery (preoperatively), at the end of 12th week after surgery (postoperatively), and at the final follow-up. Subjective measures included pain evaluation using visual analog scale (VAS), and physical function status using Disability of the Arm, Shoulder, and Hand (DASH) questionnaire in Turkish version score. The VAS scale ranges from zero (no pain) ten (severe pain). Strength measurements, ROM evaluations, and trapezial height measurements based on the radiographic views were the objective parameters. Grip strength measurements were performed using a dynamometer in kilogram force (Jamar manual dynamometer; Sammons Preston Rolyan; USA), lateral pinch strength using a pinch gauge in kilograms (Jamar manual pinchmeter, Sammons Preston Rolyan, USA), and ROM evaluations using a standard goniometer. The ability to oppose the thumb was evaluated with Kapandji score indicating the scores from zero (the tip of the thumb at the base of the index finger) to ten (tip of the thumb at the base of the little finger).[15] Standard anteroposterior radiographs of the thumbs were obtained to measure the height of the trapezium and the trapezial space preoperatively, postoperatively, and at the final follow-up. The distance between the distal margin of the scaphoid and the base of the first metacarpal was measured in millimeter.[16]

Statistical Method

Statistical calculations were performed with NCSS 2007 statistical software (Number Cruncher Statistical System, Kaysville, UT, USA) program for Windows. Besides standard descriptive statistical calculations (median, interquartile range [IQR], mean, and standard deviation), treatment group Friedman's test was used to determine the differences in measurement at each time point; post hoc Dunn's multiple comparison test was used in the comparison of time subgroups. Statistical significance level was established at p-value less than 0.05.

Surgical Summary

The surgical technique performed in our patients was a modification of the LRTI arthroplasty, which was originally developed by Burton and Pellegrini.[12] The entire trapezium is excised through the volar incision in between first metacarpal bone and the thenar muscles to remove diseased joint surface. The FCR tendon is then exposed by making another curvilinear incision over it. Half of it is prepared as a distally based split tendon by cutting proximally from the main body and protecting distally to the base of the second metacarpal at the level of insertion point. After a bony tunnel is created at the first metacarpal base, split tendon strip is passed through this tunnel and fixed using a bony anchor under appropriate tension to reconstruct the beak ligament, to restore the transverse stability, and to suspend the whole first ray. The remnant free end of this strip is then rolled into an anchovy and placed in space between the scaphoid and the base of the thumb metacarpal as an interposition to reduce the likelihood of proximal migration of the thumb column (Figures 2 and 3). After closing the wound, thumb spica cast is applied with the wrist in 20° extension, thumb in midway between extension and abduction, and the interphalangeal (IP) joint of the thumb is free (Figure 4).

Rehabilitation

During the time of immobilization in the spica cast, patients are asked to perform ROM exercises for the unaffected fingers, IP joint of the thumb, elbow, and shoulder; and flexor and extensor tendon gliding exercises as a home-based program. At the end of two weeks, the cast and the sutures are removed and a custom-made short opponens orthotic device is made (Figure 5). Patients continue to perform home exercise program until the end of postoperative fourth week. The home exercise program includes ten repetitions of isolated and composite flexion and extension movements at the MP, proximal and distal IP joints, and finger abduction and adduction exercises of second to fifth fingers. Every exercise is set to be repeated four times daily. They are allowed to take off their orthoses only during washing hands. The importance of immobilizing the operated thumb during washing hands is emphasized.

By the end of the fourth week, active and active-assistive ROM exercises for the new CMC and first MP joint supervised by a physiotherapist are initiated. During this phase, excessive metacarpal flexion and adduction (trying to do opposition from tip of the thumb to the base of the fourth or fifth finger) are restricted to protect the ligament reconstruction. Orthoses are used during the day and night until

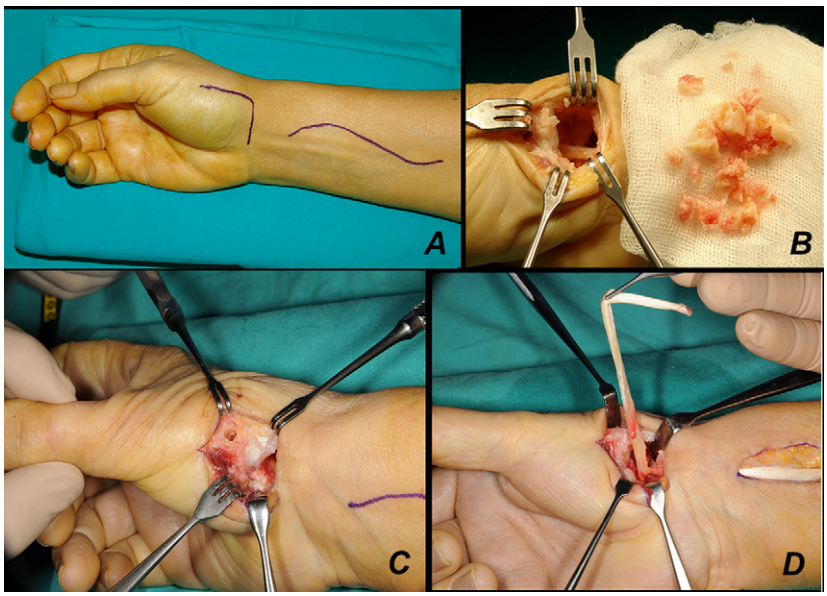

FIGURE 2. *Surgical summary 1: The design of incisions in the beginning of the operation (**A**). The excision of the entire trapezium through the distal incision (**B**). Bony tunnel at the base of the metacarpal (**C**). Preparation of half of the flexor carpi radialis as a distally based split tendon graft (**D**).*

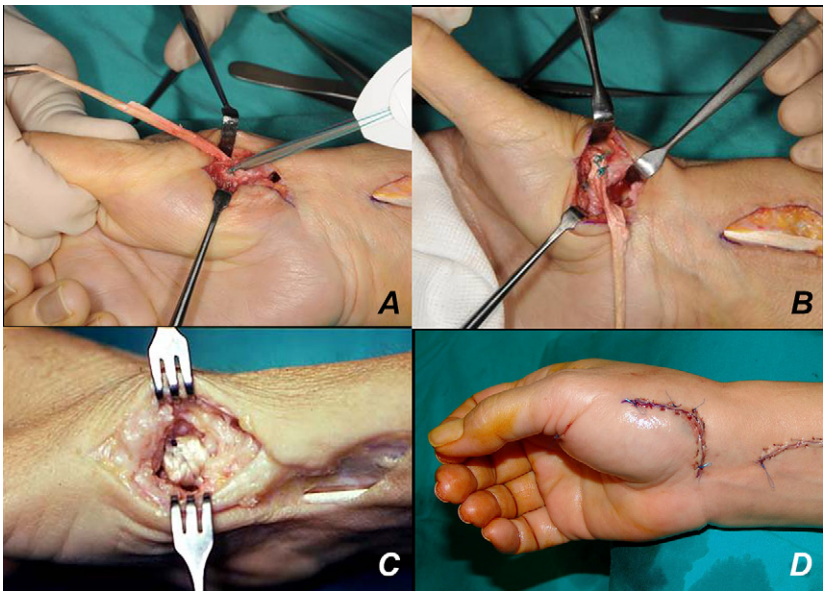

FIGURE 3. *Surgical summary 2: Passed split tendon graft through the bony tunnel is fixing using a bony anchor under appropriate tension (**A** and **B**). The remnant free end of this strip is placed in the space as an anchovy (**C**). Closed incisions (**D**).*

the end of the sixth week. Patients remove their orthoses only during therapy sessions and washing hands. For scar tissue management, massage, silicone sheaths, and ultrasound applications are added to the treatment protocol according to the patients' need.

After six weeks, progressive ROM and strengthening exercises, including isometric abduction, extension, and adduction, are initiated. If the patient can perform opposition to the tip of the fifth finger (Kapandji score 6) without any pain, complete flexion across the palm can be attempted gradually (Figure 6). After the week 6, the orthosis is used only at night for two additional weeks and completely stopped at the end of eighth week. During this period, active ROM exercises of the thumb IP, MP, and CMC joint; and thumb opposition with the other fingers (from tip to the bases) are added to the home exercise program as four sets per day, every set includes ten repetitions. Isotonic strengthening exercises are initiated by gentle pinch, grip using putties, and power webs; and the resistance is increased gradually by the end of eight weeks. Strengthening exercises with putty are given as discharge home exercise program after tenth week of surgery. If the treatment team is sure about the stability of the joint without any pain, then the patients can let them use their hands during active daily living without any restrictions after 12 weeks.

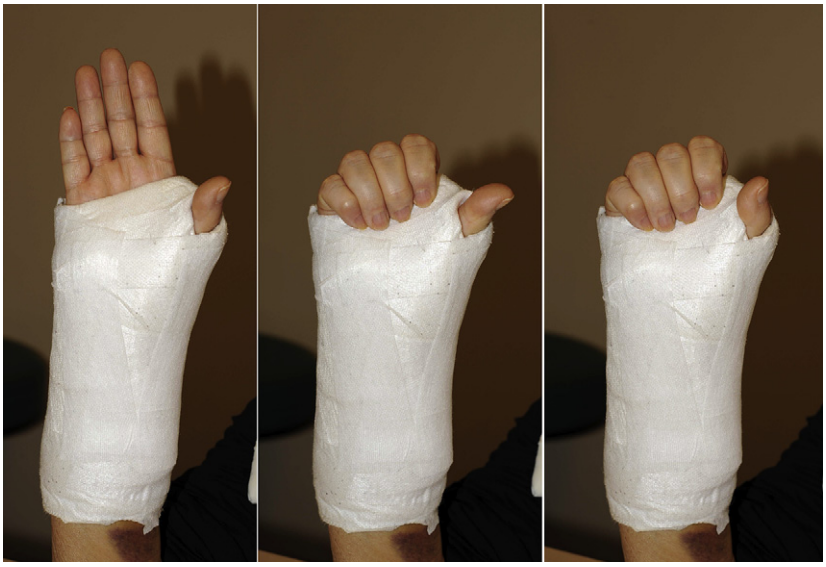

FIGURE 4. *The movement of the fingers within the thumb spica after surgery.*

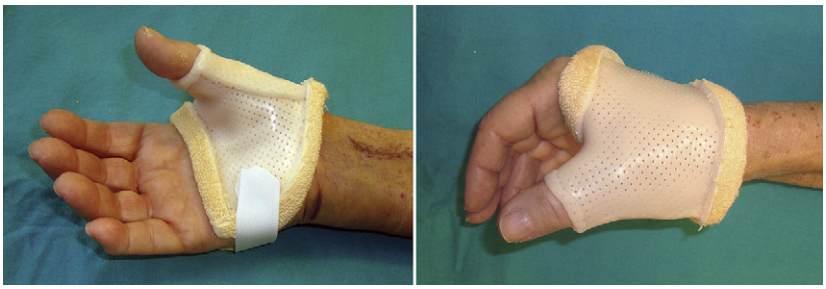

FIGURE 5. Custom-made short opponens orthotic device.

RESULTS

The average follow-up period was 31.5 months (range: 12–57 months). Average therapy session was 16.8 (range: 10–20 sessions).

The median (IQR) VAS score was eight preoperatively, three postoperatively, and three at the final follow-up examination. This time period changes showed statistically significant difference ($p = 0.0001$; Table 1). Both postoperative and final follow-up VAS scores were significantly less than preoperative values ($p = 0.0001$; Table 2).

There was a statistically significant decreasing trend in DASH scores during the time period ($p = 0.0001$; Table 1). There were significant differences between each time period evaluation values ($p = 0.0001$; Table 2).

Although there was a statistically significant difference between the grip strength measurements during time period ($p = 0.0001$; Table 1), only the postoperative strengths were significantly greater than the preoperative values ($p = 0.0001$, 50% improvements; Tables 2 and 3). However, this postoperative improvement in strength significantly decreased at the final follow-ups ($p = 0.011$; Figure 7).

Both postoperative and final follow-up lateral pinch strengths significantly exceeded the preoperative measurements ($p = 0.0001$ and $p = 0.004$, respectively; Table 1). The postoperative and final follow-up lateral pinch strength measurements showed 25% and 29% improvements, respectively, comparing with preoperative values (Table 3). However, there was a slight decrease (not statistically significant) in final follow-up pinch strengths compared with postoperative values (Figure 7 and Table 2).

There was a statistically significant increasing trend in palmar abduction degrees during the time period ($p = 0.0001$; Table 1). Postoperative palmar abduction degrees were significantly greater than the preoperative values ($p = 0.03$). Final follow-up palmar abduction degrees were significantly greater than preoperative values and postoperative ones ($p = 0.0001$ and $p = 0.001$, respectively; Table 2 and Figure 8). A 30% improvement in final follow-up and an 11% improvement in postoperative palmar abduction degrees were noted compared with the preoperative values. In addition, there was an 11% improvement in final follow-up degrees compared with the postoperative values (Table 3).

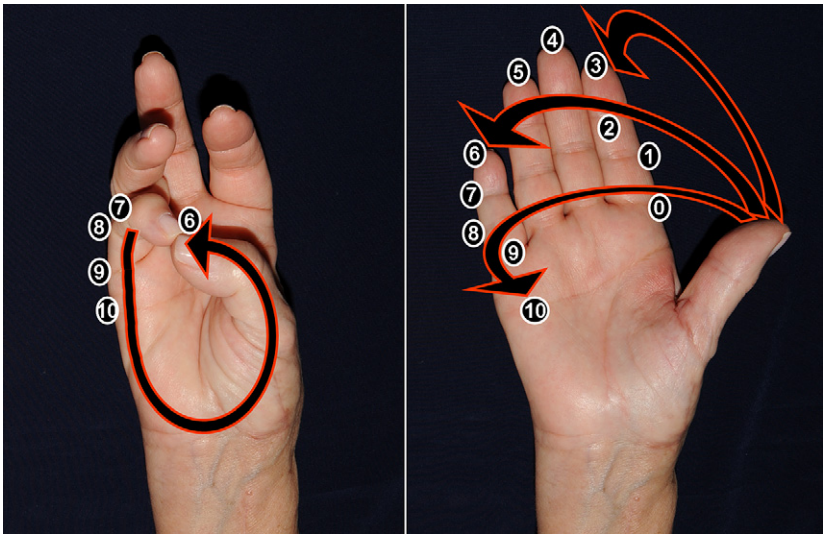

FIGURE 6. Kapandji score evaluation for the ability of the thumb opposition.

TABLE 1. **Subjective and Objective Results**

	Preop	*Postop*	*Final Follow-Up*	*p-Value*
VAS (score)	8 (8–9)	3 (2–4)	3 (2–4)	0.0001
DASH (score)	56 (51–65)	29 (24–45)	24 (18–29)	0.0001
Grip (kg)	12 (8–14)	18 (13–20)	13 (11–15)	0.0001
Lateral pinch (kg)	3 (2–4)	5 (3–6)	4 (3–6)	0.0001
Palmar abduction (degrees)	45 (35–55)	50 (45–60)	60 (55–65)	0.0001
Radial abduction (degrees)	40 (28–45)	55 (45–60)	55 (47–58)	0.0001
Kapandji (score)	4 (3–4)	6 (5–8)	6 (5–8)	0.0001

Preop = preoperative; Postop = postoperative; VAS = visual analog scale, DASH = Disabilities of Arm, Shoulder, and Hand.
Note: All data are given in median statistical value with interquartile range (IQR) in parenthesis.

Friedman tests showed a significant difference between preoperative, postoperative, and the final follow-up radial abduction degrees ($p = 0.0001$; Table 1). According to Dunn's multiple comparison test, postoperative and final follow-up radial abduction degrees were significantly greater than the preoperative values ($p = 0.0001$). However, there were no statistically significant differences between the postoperative and the final follow-up radial abduction degrees ($p = 0.510$; Table 2 and Figure 8). A 33% improvement in final follow-up and a 50% improvement in postoperative radial abduction degrees were recorded compared with the preoperative ones. Radial abduction measurements did not show any changes between the final follow-up and the postoperative values (Table 3).

Kapandji opposition scores changed statistically during the time period ($p = 0.0001$; Table 1). Although both postoperative and final follow-up opposition scores were significantly greater than preoperative values ($p = 0.0001$), there were no statistically significant changes between the final follow-up and the postoperative scores ($p = 0.238$; Table 2 and Figure 9).

Radiologic evaluations revealed an average distance between distal margin of the scaphoid and the base of the first metacarpal preoperatively of 11 mm (range: 8–13 mm) and postoperatively of 5 mm (range: 4–6 mm). At the end of final follow-up, the distance had further reduced to 3 mm (range: 2–3 mm; Figure 10). No metacarpal scaphoid impingement was noted.

Complications such as neuropathy of the radial nerve on the area of sensory branches, stiffness, chronic regional pain syndrome, or infection were not recorded in any of our patients.

DISCUSSION

In 1992, Imaeda et al.[17] clearly demonstrated the importance of the anterior oblique ligament as the primary stabilizer and the intermetacarpal ligament as a secondary stabilizer of the CMC joint. In osteoarthritis of this joint, the attenuation of these ligaments has been shown as one of the most important etiologic factor.[12] The purpose of the Burton–Pellegrini technique is to create ideal thumb function, which includes a pain-free, stable, and mobile basal joint with adequate strength and appropriate balance of the entire ray using reconstruction of the anterior oblique ligament. The reconstruction of this ligament with FCR strip has been advocated to stabilize the first metacarpal and improve strength.[12] However, the optimum results depend on good surgical technique and appropriate postoperative rehabilitation protocol. To report scientifically significant results, a standardized protocol would be preferred using both a specific LRTI technique and postoperative rehabilitation programs. Although Burton and Pellegrini[12] technique and its modifications have been widely reported with indications and results in the literature, no specific clinical postoperative management after one specific type of surgery has been described in detail in recent years.[8,13,18,19] Our study describes a clinical protocol for therapeutic management with statistical support for the functional outcomes.

Although the outcomes of many different ligament reconstruction techniques with different incisions by using a part or total of tendons have been reported in the literature, we have been using a half of the FCR tendon in ligament reconstruction surgery for years. Some of the studies support the protection of the reconstruction could be maintained by using temporary Kirschner wires.[1,13,20] Because better rigidity owing to different fixation materials has been published in literature, immediate stabilization of the ligament reconstruction using bone anchor was not needed as supplemental temporary pin fixation to augment stabilization of the thumb metacarpal in our patients.[21] In addition, this approach avoided

TABLE 2. **Statistical Comparisons in Time Subgroups**

Dunn's Multiple Comparison Test	*Palmar Abd*	*Radial Abd*	*Kapandji*	*Lat Pinch*	*Grip*	*VAS*	*DASH*
Preop/postop	0.03	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Preop/final follow-up	0.0001	0.0001	0.0001	0.004	0.139	0.0001	0.0001
Postop/final follow-up	0.001	0.510	0.238	0.528	0.011	0.487	0.0001

Preop = preoperative; Postop = postoperative; Abd = abduction; Lat = lateral; VAS = visual analoge scale; DASH = Disabilities of Arm, Shoulder and Hand.

TABLE 3. **Improvements in Percents Between Time Subgroups**

	Preop–Postop	*Preop–Final*	*Postop–Final*
Grip	50	8	−25
Lateral pinch	67	33	−20
Palmar abd	11	33	20
Radial abd	38	38	0

Preop = preoperative; Postop = postoperative; Final = final follow-up; Abd = abduction.

the complications of pin irritation, which would be possible, including pain, skin problems, and infections.

In our postoperative protocol, the thumb spica cast for two weeks was followed by a custom-made hand-based orthotic device for another two weeks for protection of the ligament reconstruction. Even in the literature, six weeks of immobilization by using a forearm spica cast after K wire augmentation has been supported[16,19,20,22]; in our opinion, as the inflammation decreases 10 to 15 days after surgery, there is no need to immobilize the wrist after two weeks. None of our patients complained about wrist pain or discomfort owing to the use of hand-based orthotic device. Immobilization for four weeks was adequate to maintain the thumb in a correct position. The literature supports our immobilization period and early rehabilitation approach after immediate stabilization of the ligament reconstruction without using K wire.[21]

With an average of 16.8 therapy sessions and 31.5 months follow-ups, our subjective results are comparable with the similar studies, which reported theirs after the same surgery and/or modifications. Satisfaction rates changed in literature between 80% and 95%.[13,18,22,23] Our VAS and DASH improvements can be speculated as an achievement of satisfaction level similar to the literature.

Tomaino et al.[24] reported 34% improvements in pinch strength compared with preoperative levels at the nine-year follow-up. There was a 72% improvement in key pinch in the study by Nylén et al.[25] study

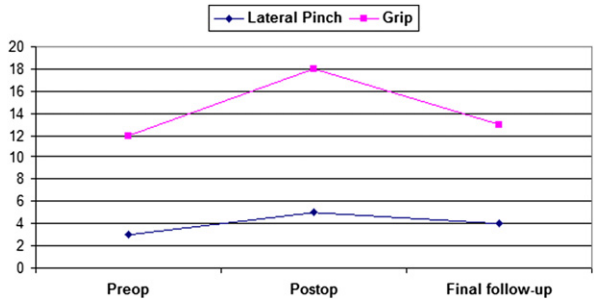

FIGURE 7. *Strength measurements. The median preoperative, postoperative and final follow-up lateral pinch and grip strength measurements were given in y-axis as kilogram force. Preop = preoperative; Postop = postoperative.*

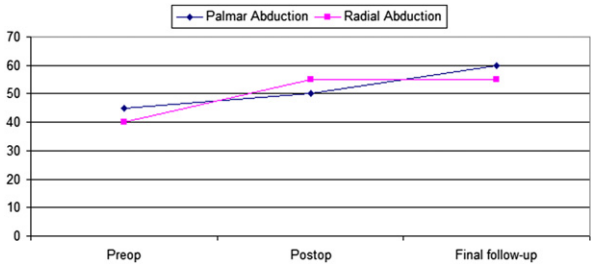

FIGURE 8. *Range of motion of the CMC joint. The median preoperative, postoperative and final follow-up palmar and radial abduction measurements were given in y-axis. Preop = preoperative; Postop = postoperative.*

after 36 months. Our results showed 25% and 29% improvements in postoperative period and at the end of 31.5 months follow-up, respectively compared with the preoperative values in lateral pinch measurements. Although our grip strength measurements improved 50% at the postoperative phase, this improvement was not preserved at the final follow-up. However, the grip measurements published in the literature shows a wide range of disparity from 44% to 93% gaining in grip.[8,18,24,25] Roberts et al.[26] reported 22.5 and 29.5 lb improvements in grip power, 3.5 and −1.0 lb improvements in tip pinch measurements in their study. Although these authors presented the results of two different trapeziometacarpal arthroplasty techniques followed by a rehabilitation regimen, weaknesses of the article, such as heterogeneity of the surgical techniques and lack of using standardized tools of subjective evaluation parameters (VAS and DASH), necessitated of a descriptive study. Our study included the results of one specific type of surgery and one standardized

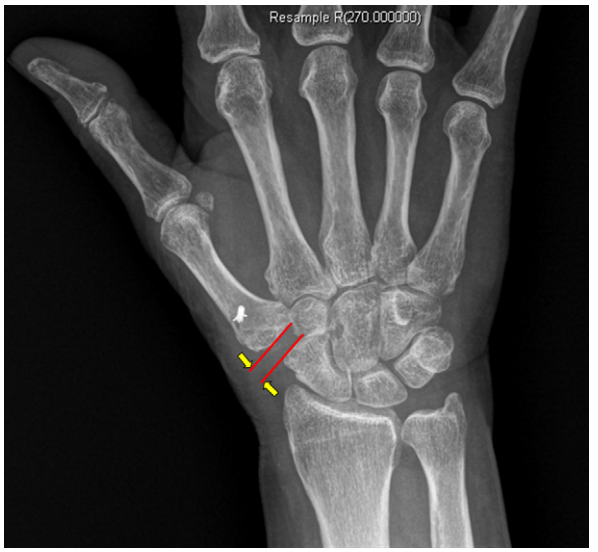

FIGURE 9. *The height of the trapezial space measuring between base of the metacarpal bone and distal margin of the scaphoid.*

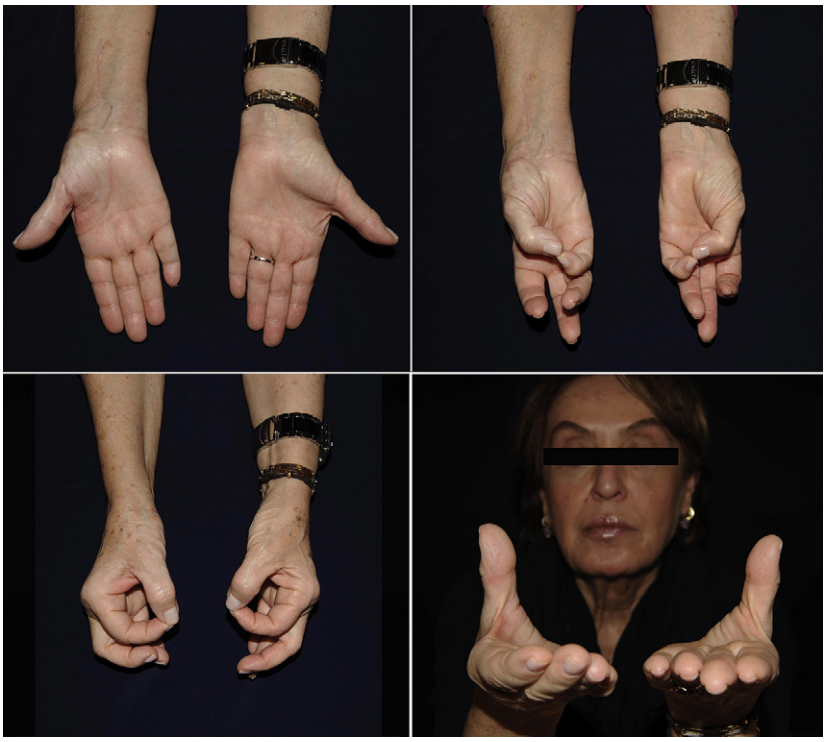

FIGURE 10. *Functional photographs of the patient at 12th months after surgery.*

rehabilitation protocol with standardized tools of self-report and performance-based outcomes.

Our ROM in palmar (60°) and radial (55°) abduction at the final follow-up showed equivalence to series in the literature, which reported similar parameters.[16,21,22,27] In a prospective cohort study, which was published by Vermeulen et al.,[28] palmar abduction was stated as an intermetacarpal distance measurement in centimeters rather than goniometric evaluation. Preoperative 5.4-cm measurement in distance was significantly improved to 5.9 cm at 12th months after the surgery. Although the statistical significance of increase in postoperative and follow-up ROM measurements were in conflict with the literature, our results showed a statistically significant increase in ROM in both the early postoperative and the final follow-up periods.

Gradually collapsed arthroplasty space detected during followed-up time was not associated with instability or weakness of the thumb in any of our patients. Because it was widely believed that shortening of the first ray could cause weakness of the pinch strengths, our results showed no correlation found between scaphoid−metacarpal distance and changes in lateral pinch strength.[14,19,20,23] Despite the decrease in trapezial space and grip strength, these objective outcomes did not reflect a decrease in patient satisfaction. Our subjective results, DASH score, and VAS continued to improve. Because bony contact did not occur in any patient, ligament reconstruction could prevent instability and provide strength and comfort.

There are some major weaknesses of the present study. This study retrospectively assessed the data from a single cohort of patients; therefore, future studies should be prospective and include a comparison group. We did not include a control group that did not receive therapy. With that, it is not possible to compare the results between treated and nontreated patients after surgery from the rehabilitation point of view. It is possible that patients managed differently (e.g., more conservatively or more aggressively) could do as well or worse. Our description of the surgery and a rehabilitation protocol, however, should provide guidelines for hand therapists and surgeons.

CONCLUSION

The subjective and objective results of this descriptive study demonstrate a sense of high patient satisfaction and efficacy after the surgical technique and postoperative rehabilitation protocol described.

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REFERENCES

1. Eaton RG, Glickel SZ, Littler JW. Tendon interposition arthroplasty for degenerative arthritis of the trapeziometacarpal joint of the thumb. J Hand Surg Am. 1985;10:645–54.
2. Pellegrini VD. Osteoarthritis of the trapeziometacarpal joint: the pathophysiology of articular cartilage degeneration. I.

Anatomy and pathology of the aging joint. J Hand Surg Am. 1991;16:967–74.
3. Pellegrini VD. Osteoarthritis of the trapeziometacarpal joint: the pathophysiology of articular cartilage degeneration. II. Articular wear patterns in the osteoarthritic joint. J Hand Surg Am. 1991;16:975–82.
4. Imaeda T, Cooney WP, Niebur GL, Linscheid RL, An KN. Kinematics of the trapeziometacarpal joint: a biomechanical analysis comparing tendon interposition arthroplasty and total joint arthroplasty. J Hand Surg. 1996;21A:544–53.
5. Davenport BJ. An investigation into therapists' management of osteoarthritis of the carpometacarpal joint of the thumb in the UK. Hand Ther. 2009;14:2–9.
6. Sillem H, Blackman CL, Miller WC, Li LC. Comparison of two carpometacarpal stabilizing splints for individuals with thumb osteoarthritis. J Hand Ther. 2011;24:216–25.
7. Yao J, Park MJ. Early treatment of degenerative arthritis of the thumb carpometacarpal joint. Hand Clin. 2008;24(3):251–61.
8. Davis DI, Catalano L. Treatment of advanced carpometacarpal joint disease: carpometacarpal arthroplasty with ligament reconstruction. Hand Clin. 2008;24(3):263–9.
9. Pellegrini VD. Osteoarthritis at the base of the thumb. Orthop Clin North Am. 1992;23(1):82–102.
10. Fitzgerald BT, Hofmeister EP. Treatment of advanced carpometacarpal joint disease: trapeziectomy and hematoma arthroplasty. Hand Clin. 2008;24(3):271–6.
11. Badia A, Sambandam SN. Total joint arthroplasty in the treatment of advanced stages of thumb carpometacarpal joint osteoarthritis. J Hand Surg. 2006;31A:1605.e1–1605.e13.
12. Burton RI, Pellegrini VD. Surgical management of basal joint arthritis of the thumb. Part II. Ligament reconstruction with tendon interposition arthroplasty. J Hand Surg. 1986;11A: 324–32.
13. Rayan G, Young BT. Ligament reconstruction arthroplasty for trapeziometacarpal arthrosis. J Hand Surg. 1997;22A:1067–76.
14. Glickel SZ, Gupta S. Ligament reconstruction. Hand Clin. 2006; 22(2):143–51.
15. Kapandji AI. Physiologie Articulaire: Schémas Commentés de Mécanique Humaine. Paris, France: Maloine, 2005.
16. Atroshi I, Axelsson G. Extensor carpiradialis longus tendon arthroplasty in the treatment of primary trapeziometacarpal arthrosis. J Hand Surg. 1997;22A:419–27.
17. Imaeda T, An KN, Cooney WP. Functional anatomy and biomechanics of the thumb. Hand Clin. 1992;8(1):9–15.
18. Varitimidis SE, Fox RJ, King JA, Taras J, Sotereanos DG. Trapeziometacarpal arthroplasty using the entire flexor carpiradialis tendon. Clin Orthop Relat Res. 2000;370:164–70.
19. Tomaino MM. Suspensionplasty for basal joint arthritis: why and how. Hand Clin. 2006;22(2):171–5.
20. Tomaino MM. Ligament reconstruction tendon interposition arthroplasty for basal joint arthritis. Hand Clin. 2001;17(2): 207–21.
21. Wysocki RW, Cohen MS, Shott S, Fernandez JJ. Thumb carpometacarpal suspension artroplasty using interference screw fixation: surgical technique and clinical results. J Hand Surg. 2010;35A:913–20.
22. Trumble TE, Rafijah G, Gilbert M, Allan CH, North E, McCallister WV. Thumb trapeziometacarpal joint arthritis: partial trapeziectomy with ligament reconstruction and interposition costochondral allograft. J Hand Surg. 2000;25A: 61–76.
23. Sai S, Fujii K, Chino H, Inoue J. Tendon suspension sling arthroplasty for degenerative arthritis of the thumb trapeziometacarpal joint: long-term follow-up. J Orthop Sci. 2004;9: 576–80.
24. Tomaino MM, Pellegrini VD, Burton RI. Arthroplasty of the basal joint of the thumb: long-term follow-up after ligament reconstruction with tendon interposition. J Bone Joint Surg Am. 1995;77:346–55.
25. Nylén S, Johnson A, Rosenquist AM. Trapeziectomy and ligament reconstruction for osteoarthrosis of the base of the thumb: a prospective study of 100 operations. J Hand Surg Br. 1993;18: 616–9.
26. Roberts RA, Jabaley ME, Nick TG. Results following trapeziometacarpal arthroplasty of the thumb. J Hand Ther. 2001;14: 202–7.
27. Soejima O, Hanamura T, Kikuta T, Iida H, Naito M. Suspensionplasty with the abductor pollicis longus tendon for osteoarthritis in the carpometacarpal joint of the thumb. J Hand Surg. 2006;31A:425–8.
28. Vermeulen GM, Brink SM, Sluiter J, Elias SG, Hovius SER, Moojen TM. Ligament reconstruction arthroplasty for primary thumb carpometacarpal osteoarthritis (Weilby Technique): prospective Cohort Study. J Hand Surg. 2009;34A:1393–401.

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#1. The design of this study was
   a. qualitative
   b. RCTs
   c. retrospective case series
   d. prospective case series

#2. The study investigated the following surgical intervention for thumb CMC arthritis
   a. suspension arthroplasty
   b. silicone implant arthroplasty
   c. arthrodesis
   d. trapezium resection arthroplasty

#3. At follow up evaluation the authors report improvement in
   a. ROM
   b. pinch strength
   c. patient satisfaction
   d. all of the above

#4. During the initial post op period
   a. the hand, including the thumb but not the wrist, was immobilized in a snug bulky dressing
   b. the hand, including the thumb and wrist, was immobilized in a snug bulky dressing
   c. the thumb IP joint was free to move
   d. the thumb IP joint was immobilized in a cast

#5. The original immobilization was discontinued and an orthosis was applied at
   a. 1 week post op
   b. 2 weeks post op
   c. 3 weeks post op
   d. 4 weeks post op

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