Combination Therapy Involving Ear Cartilage Transfer and Suture-Button Suspension Arthroplasty for Symptomatic Thumb Carpometacarpal Joint Arthritis

Satoshi Usami, MD¹ Kohei Inami, MD¹

¹ Department of Hand Surgery, Tokyo Hand Surgery and Sports Medicine Institute, Takatsuki Orthopaedic Hospital, Tokyo, Japan

J Wrist Surg 2019;8:157–160.

Address for correspondence Satoshi Usami, MD, Department of Hand Surgery, Tokyo Hand Surgery and Sports Medicine Institute, Takatsuki Orthopaedic Hospital, 360 Takatsukicho, Hachioji, Tokyo, Japan (e-mail: s-usaplas@mail.goo.ne.jp).

Abstract

Keywords

- thumb carpometacarpal arthritis
- ear cartilage
- suspension arthroplasty

We describe the short-term outcomes of combination therapy involving ear cartilage transfer and suture-button suspension arthroplasty for the treatment of symptomatic thumb carpometacarpal joint arthritis. The concept is to reduce joint arthritis by separate independent approaches, which are renewing the damaged joint surface of the trapezium and first metacarpal bone suspension. Autologous ear cartilage is a desirable material for joint resurfacing arthroplasty without postoperative synovitis or infection, and it is expected to prevent bone impingement or recurrent joint arthritis when postoperative suture-button slack or failure unfortunately occurs.

Thumb carpometacarpal (CMC) arthritis is a common condition in women during menopause, and many surgical procedures have been developed and used for its treatment. Suture-button suspension arthroplasty (SBS) with the Mini TightRope device (Arthrex Inc., Naples, FL) is a relatively new procedure with good midterm outcomes.^{1,2} The procedure is simple and minimally invasive, and the lack of a need for long-term Kirschner wire fixation allows early postoperative mobilization. However, subsidence of the first metacarpal bone due to slack suspension is one of the postoperative problems, and a case of failed SBS have been reported.³ To prevent and salvage these unfavorable conditions, we developed a new procedure involving a combination of ear cartilage interposition arthroplasty⁴ and SBS for the treatment of symptomatic CMC joint arthritis. This procedure and its short-term outcomes are presented in this case series.

Materials and Methods

Eight patients (one male and seven females) with symptomatic thumb CMC joint arthritis underwent this procedure from February to September 2017, with one Eaton stage⁵ II, six stage III, and one stage IV cases, respectively. Their mean age was 69.5 years (range: 56–77 years). Active range of

motion (thumb radial abduction and palmar abduction), grip strength, pulp pinch, Quick Disability of the Arm, Shoulder, and Hand (Quick-DASH) score, and a visual analog scale (VAS) for pain were compared before and after surgery. For radiological assessment, the trapezial height¹ (the distance from the most distal portion of the distal pole of the scaphoid to the base of the first metacarpal) was measured immediately after surgery and at the most recent follow-up. Statistical analysis was performed using Student's *t*-test to evaluate these outcomes with IBM SPSS Statistics 24.0 for Windows (SPSS Inc., Chicago, IL). Significance was defined as $p < 0.05$.

Surgical Technique

The indication for this procedure is symptomatic thumb CMC arthritis with Eaton stage II to IV joint degeneration on imaging. Surgery is performed under general anesthesia or conduction anesthesia of the upper limb together with local anesthesia for the ear region. The patient is treated in the supine position with the head tilted to the contralateral side to harvest ear cartilage. The ear is bent and fixed with sterilized surgical tape to expose its posterior aspect. Initially, the ear cartilage is harvested in the shape of a circle or ellipse not penetrating the skin of the anterior surface, leaving a 7- to 8-mm margin from the ear border to prevent

received

April 14, 2018

accepted after revision

November 12, 2018

published online

January 15, 2019

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Tel: +1(212) 584-4662.

DOI <https://doi.org/10.1055/s-0038-1676961>.
ISSN 2163-3916.

Fig. 1 Harvested ear cartilage graft, which has the desired elasticity and plasticity as an interposition material.

Fig. 2 Intraoperative fluoroscopic imaging after shaving of the joint surface of the trapezium.

postoperative ear deformity (►**Fig. 1**). The proper size of the cartilage graft should be measured on a preoperative X-ray. The donor site is closed with primary closure.

The CMC joint is then opened by cutting the dorsoradial ligament and the joint capsule after making an incision over the CMC joint. The joint surface of the trapezium is shaved and partially removed using a bone saw with a thickness of 2 to 3 mm (►**Fig. 2**). Thereafter, suspension arthroplasty is performed with the suture-button device. Adjustment of correct tensioning is performed according to Yao and Song¹ to prevent subsidence of the metacarpal bone without overtensioning, which causes impingement and joint stiffness between the first and second metacarpal bases. Finally, the harvested ear cartilage is inserted to cover the shaved surface of the trapezium without suture fixation (►**Fig. 3**), and the dorsoradial ligament and joint capsule are tightly closed. Kirschner wire fixation between the first and second metacarpal bones is unnecessary, and early thumb mobilization is started after 1 week of splint fixation postoperatively.

Results

In the short-term outcome over 6 months (mean follow-up: 7.8 months), this procedure offered effective pain relief in the

Fig. 3 Following suspensionplasty, ear cartilage is inserted to cover the surface of the trapezium.

eight patients (►**Fig. 4**). Active range of motion in CMC joint was maintained, and the pulp pinch, Quick-DASH, and VAS were improved significantly ($p < 0.05$) (►**Table 1**). Average trapezial height was $94.3 \pm 7.6\%$ of the just after surgery at the recent follow-up. As a complication, radial sensory nerve palsy was observed in one hand, and metacarpophalangeal joint pain occurred in one. These complications decreased gradually but remained during the short-term follow-up period.

Discussion

Interposition arthroplasty or suspension arthroplasty for thumb CMC arthritis requires a total or partial trapeziectomy. Total trapeziectomy provided enough work space for suspension arthroplasty, whereas it decreased joint stability and thumb strength postoperatively.^{4,6-8} On the other hand, partial trapeziectomy maintained ligament and soft tissue around the scaphoid–trapezium–trapezoid (STT) joint, and the remaining trapezium supported the first metacarpal during grasping and pinching.⁹ Indeed, the long-term outcomes after partial trapeziectomy resulted in sufficient relief of symptoms without decreased grip and pinch strengths. Main complication of partial trapeziectomy was progression of STT joint degeneration radiologically, although there are less symptoms clinically.¹⁰ This resurfacing arthroplasty is a minimal open and invasive procedure for the trapezium, allowing ligament and intracarpal biomechanics to be maintained.

Artificial materials of interposition arthroplasty, such as polyurethaneurea (Artelon), porcine dermal collagen xenograft (PermacolTM), expanded polytetrafluoroethylene (ePTFE) (Gore-Tex), polypropylene (Marlex), Silicone (Swanson Silastic implant), polyethylene terephthalate mesh (Dacron), and polylactic acid (Arex 615R), have been used after trapeziectomy.¹¹⁻¹⁴ However, these materials are likely to cause a high rate of complications such as postoperative infection, joint arthritis, foreign-body synovitis, exposure of material, and sepsis.^{12,13} Thus, the autologous tissue seems preferable.^{4,8,11} For the autologous tissue for interposition, tendon (or tendon ball),¹¹ costal cartilage,¹⁵ fascia lata,¹⁶ and ear cartilage⁴ have already been reported.

Fig. 4 X-ray imaging of a 74-year-old woman. (A, B) Preoperative image. Bone sclerosis at the joint surface and dorsal subluxation of the first metacarpal bone are observed. (C, D) Image at 6 months postoperatively. Good bony alignment is maintained with enough trapeziometacarpal joint space.

Table 1 The outcomes in each parameter after surgery

	Preoperative	Postoperative	p-Value
Radial abduction (degrees)	39.4 ± 4.2	43.1 ± 5.9	0.22
Palmar abduction (degrees)	41.3 ± 8.3	40.0 ± 7.1	0.62
Grip strength (kg)	10.9 ± 6.8	15.1 ± 8.4	0.12
Pulp pinch (kg)	1.8 ± 1.1	2.6 ± 1.2	0.048
Quick-DASH	51.4 ± 25.7	22.4 ± 10.7	0.026
VAS (100)	65.8 ± 22.6	24.5 ± 16.6	0.004

Abbreviations: DASH, quick disability of the arm, shoulder, and hand; VAS, visual analog scale.

The midterm effectiveness of ear cartilage interposition arthroplasty without ligament reconstruction was described by Nickell,⁴ who reported 53 thumbs in 49 patients over a 30-month follow-up period, with good pain relief, Quick-DASH improvement, and stronger key-palm pinches. These outcomes suggested that ear cartilage had the potential to be a preferred material for joint insertion, without complications of infection or synovitis.

The concept of the present procedure involved two independent approaches for CMC joint arthritis: renewing the degenerated trapezial surface with an ear cartilage graft and first metacarpal bone suspension with the Mini TightRope device. We expect this approach to offer acceptable pain relief and adequate power strength supported by remaining ligament structures and biomechanics similar to a normal joint. The inserted ear cartilage would prevent future unfavorable problems due to suture-button slack or failure. Long-term evaluation of the outcomes of this procedure in many cases is necessary.

Conflict of Interest
None declared.

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