Arthroscopic Synovectomy Combined with Autologous Fat Grafting in Early Stages of CMC Osteoarthritis of the Thumb

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Abstract

Background Minimal invasive treatments such as arthroscopic techniques may be adequate to restore the anatomy and functional integrity of the thumb CMC (carpometacarpal) joint. In this paper, we reported the interposition of autologous fat tissue in combination with arthroscopic synovectomy/debridement for early stage of the thumb CMC joint osteoarthritis.

Patients and Methods Twelve patients with a mean age of 46 years with early radiological stages of thumb CMC joint osteoarthritis were included. Evaluation of outcome was measured prior and 3, 12, and 24 months after surgery including, Visual Analog Scale (VAS), QuickDASH, grip and pinch strength, range of motion (ROM), and patient satisfaction.

Results Pain at rest (or with load) was reduced from preoperative 4,7 (8,7) to 2 (5,9) at 3 to 6 months; 1,4 (4,3) at 12 months; and 0,75 (2,7) at 2 years after the surgery. Initial preoperative QuickDASH value of 52 points reduced to 33 (17–65) at 6 months, 23 (2–70) at 12 months, and 20 (11–29) at 24 months after the surgery. Grip strength and thumb pinch with respect to the contralateral untreated thumb was reduced in the first 12 months but recovered subsequently. ROM was equal to the contralateral thumb. Three patients suffered from tendinitis and required surgical treatment. One patient indicated prolonged pain symptoms. No infections were noted and no donor-site morbidity or side effects were detected.

Conclusion Arthroscopic synovectomy combined with autologous fat graft is a reliable surgical option for early thumb CMC joint osteoarthritis and that effect continues for more than 24 months.

Keywords

- ▶ autologous fat graft
- ▶ carpometacarpal joint osteoarthritis
- ▶ basilar thumb osteoarthritis
- ▶ minimal invasive treatment
- ▶ small joint arthroscopy
- ▶ osteoarthritis

Trapeziectomy with or without interposition/ligamentoplasty is considered “the gold standard” of surgical treatment for advanced painful thumb CMC joint osteoarthritis. Trapeziometacarpal joint arthrodesis¹ or implantation of prosthesis² is supposed to be effective. However, these surgical procedures alter the anatomical and functional

integrity of the thumb, as postoperative convalescence return to work sometimes takes several weeks. Complications such as proximal migration of the thumb and dislocation of the implant or carpal collapse were noted. Technical progress in arthroscopy offers more indications for the thumb CMC joint such as arthroscopic debridement with or without

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partial trapeziectomy and with or without interposition.³ There is still controversy about the interposition material itself and its effects on the joint. Artificial interposition materials such as polylactic acid implants or Gore-Tex products were introduced while biological interposition tissues such as autologous tendon grafts, allogenic fascia lata or acellular dermal matrix grafts are still in use.⁴ Synthetic interposition material has the disadvantage of high costs and possible inflammatory or allergic reactions.^{5,6} Herold et al first published autologous fat grafts in the thumb CMC joint. In this study, five patients were treated successfully only by fat graft, which was instilled under X-ray control.⁷ This procedure provides a good alternative treatment for the thumb CMC joint osteoarthritis with low donor-site morbidity. The positive effects of the interposition remain unclear. The interposition material buffers the articulating bones, and the fat graft may provoke a regenerative effect caused by adipocyte-derived stem cells. We believe that these effects not only potentiate each other, but that the debridement creating a fresh wound has a positive effect on fat graft survival to generate a long-lasting therapy success.

Surgical Technique

All patients underwent surgery under regional or general anesthesia and 2 kg of vertical distraction of the thumb using two Chinese finger traps and a suspension setup (KLS-Martin). Intravenous cefuroxime (1.5 g) was adminis-

Fig. 1 Arthroscopy portals radial (1-R) and ulnar (1-U) of the extensor pollicis brevis and abductor pollicis longus tendon (T) proximal of the first metacarpal bone (M). A 2-kg distraction using Chinese finger traps.

Fig. 2 Arthroscopic view before debridement showing a partial fourth degree cartilage lesion (*) of the metacarpal joint face (M) and synovitic reaction (S).

tered before applying a tourniquet. For arthroscopy, we set up a radial (1-R) and an ulnar (1-U) portal and used a 1.9-mm caliber 30 degree angle optic (Storz, ►Fig. 1). Thumb CMC joint was debrided using a 3-mm full radius shaver (Stryker). Patients with Eaton/Littler osteoarthritis lower than stage 3 in X-ray imaging were offered arthroscopic therapy including debridement. Additionally, they were introduced that in case of higher cartilage damage, simultaneous autologous fat graft interposition will be performed. Debridement included only resection of synovitis and removal of loose free bodies (e.g., small bone or cartilage tissue). Cartilage surface was not debrided or processed. The final decision for autologous fat graft was made in case of arthroscopic proof of partial cartilage lesions more than stage 3 according to the Outerbridge classification^{8,9} (►Fig. 2, ►Video 1). In case of minor cartilage damage, lower than stage 3, no fat graft was performed. We think that this algorithm secures a reliable approach respecting the different clinical, radiological, and intraoperative stage of thumb CMC joint osteoarthritis.

Video 1

Arthroscopic view of CMC-1-J after debridement with higher cartilage lesions and indication for fat grafting. Online content including video sequences viewable at: www.thieme-connect.com/ejournals/html/doi/10.1055/s-0037-1604045.

For the simultaneous autologous fat graft, subcutaneous fatty tissue in the hypogastric region was infiltrated with 20 mL of tumescent solution, 1% Xylonest (prilocaine) with adrenalin 1:200,000 diluted to 1:5 with physiologic saline solution.¹⁰ We did not use lidocaine due to the negative

Fig. 3 Arthroscopy set up with simultaneous harvesting of fat transplant in the hypogastric region (*) using a Luer lock syringe (S).

survival effects on fat cells.¹¹ After 20 minutes, 5 to 10 mL of fatty tissue was harvested with a Luer lock syringe (► **Fig. 3**). The fat transplant was divided from aqueous portion by sedimentation.¹² Centrifugation or additional procedures were not performed or needed. Following the arthroscopic procedures, 2 mL of fat graft, still kept in the Luer lock syringe, was placed in the thumb CMC joint under arthroscopic vision with a blunt fatty tissue-transfer needle (► **Fig. 4**, ► **Video 2**). The arthroscopic portals were closed with 6 to 0 Ethilon stitches. Four weeks of restricted motion using a custom-made thumb-metacarpal-orthosis was followed by active mobilization, supervised by a physiotherapist, if necessary. Full stress was allowed after 6 weeks.

Video 2

Arthroscopic view of autologous fat graft. Online content including video sequences viewable at: www.thieme-connect.com/ejournals/html/doi/10.1055/s-0037-1604045.

Patients and Methods

From October 2013 to June 2016, 12 patients (2 males and 10 females) with thumb CMC joint osteoarthritis underwent arthroscopic synovectomy and debridement combined with autologous fat graft. The youngest patient was 30 years old. The oldest one, who was already retired, was 67 years old (mean age, 46 years). Six out of 12 patients were workers, 4 out of 12 patients worked in an office, and 2 out of 12 were retired but still very active. In each case, decision for surgical treatment was made after unsuccessful conservative therapy for at least 3 months. The conservative therapy consisted of splinting, nonsteroidal anti-inflammatory treatment, and/or corticoid injection. Diagnosis was clinical and according to the Eaton/Littler radiological classification,^{13,14} but this therapy option was limited to patients with Eaton/Littler stages, 1 and 2. Three

Fig. 4 Arthroscopic view during transfer of the autologous fat graft (F) with a blunt needle (E). M indicates the metacarpal joint face.

patients underwent additional simultaneous surgical treatments: three carpal tunnel releases, 1 trigger thumb, and 1 tenolysis for de Quervain's disease. All patients were regularly evaluated and questioned as we normally do in our practice with common measurements such as visual analogue pain scale (VAS) from 1 to 10, strength (grip and pinch) measured in pounds using a Jamar/Pinch meter, and range of motion (ROM) using a goniometer. Radial abduction of the thumb as an index for the ROM and Jamar/Pinch meter measurements were compared with the nontreated opposite side. Reduction or improvement was noted in $\pm$ percentage. The VAS and QuickDASH scores were obtained preoperatively. Because of the small number of patients, no statistical measurements were obtained; however, mean values were calculated. Complications, if any, were noted.

Results

Regarding gender and age, 12 patients represented a group with compromising thumb CMC joint osteoarthritis. All were mobile patients with a normal-to-high demand to their hand function, not only in professional matters but in normal life activities as well.

As shown in ► **Table 1**, pain at rest (mean 4,7) or with load (mean 8,6) increased preoperatively. After arthroscopic debridement and simultaneous interposition with autologous fat graft, pain at rest and with load reduced after 3 to 6 months. However, the range of VAS was broad (at rest: 1–6; under stress: 2–10). It was nearly similar at 12 months after surgery (at rest: 1–5; under stress: 1–10), but decreased mean values show improvement in general. After 24 months, VAS with load and at rest stabilized. This lasting improvement was also reflected in the initially high QuickDASH scores, which diminished constantly during the following months.

Table 1 Pain reduction and functional outcome of patients treated with arthroscopic debridement and simultaneous autologous fat graft

Basic	Male (m)/female (f)	m	f	m	f	f	f	f	f	f	f	f	f
Age		42	47	46	30	51	52	67	39	53	40	42	41
Eaton/Littler		2°	1°	2°	1°	2°	2°	2°	2°	2°	2°	2°	2°
Treated hand		Right	Left	Left	Left	Right	Left	Left	Right	Left	Left	Left	Left
Profession		Worker	Office	Retiree	Nurse	House wife	Educator	Retiree	Nurse	Gardener	Banker	Worker	Sales woman
Pain	VAS (1–10) rest	3	7		5	5	7	3	8	5	2	3	4
	3–6 mo	0	6			1	0	6	3	4	0	0	0
	12 mo	0	0	0	0	1	1	2	5	5	0		
	24 mo	1	1	1	0								
	VAS (1–10) stress	8	10		8	10	9	7	10	6	10	8	10
	3–6 mo	2	9			7	2	8	10	7	9	3	2
	12 mo	1	2	4	2	2	3	3	10	8	8		
	24 mo	3	3	3	2								
Function	QuickDASH	43						54	56,8	38,6	47,7	40	86,4
	3–6 mo	12,5	65			31,8	20,5	43	50	59	25	6,8	22,7
	12 mo	2,3	26,9	31,8	2,3	9	20,5	44	59	70,9	38		
	24 mo	12,5	27	29,5	11,3								

Interestingly, pain and function obviously improved during the early months but satisfaction was not achieved until 7 to 12 months after surgery (see ►Table 2). At 3 to 6 months, four of the patients were not happy at all and these patients would not redo the surgery when questioned at that time. This changed because 12 months postoperatively, 8 of 10 patients opted again for the arthroscopic procedure with autologous fat graft reflecting almost complete patients' satisfaction. The two unsatisfied patients, a gardener and a nurse with higher demand of strength, were still suffering from pain (VAS with load: 8–10) reflected by unchanged high QuickDASH scores. Another patient with simultaneous instability in thumb metacarpophalangeal (MCP) joint was satisfied in terms of pain reduction in the thumb CMC joint. However, thumb MCP joint instability became more obvious and painful and caused painful problems. Strength was measured in both hands and the difference between treated and nontreated hand is shown in percentage. After 3 to 6 months, strength was reduced in the operated hand, whereas during the following months, strength improved steadily. Range of motion (ROM) reflected by the radial abduction of both thumbs and its difference were quoted in percentage of the treated thumb mobility. The results showed no restriction of movement in comparison to the nonoperated thumb. Recently, we started calculating thumb opposition using the Kapandji score¹⁵ (data not shown). These results suggested as well that there was no restrictive influence of the surgical treatment on thumb motion. In all cases, there was no donor-site morbidity. One patient suffered from prolonged pain symptoms in the whole arm limb for nine months. Diagnosis of complex regional pain syndrome (CRPS) was not confirmed, but additional therapy, such as special pain therapy and physiotherapy, was necessary. Apart from the three patients who suffered from tendinitis (one from de Quervain's disease, two from trigger thumbs), there was no infection.

Discussion

Arthroscopy of thumb CMC joint in combination with autologous fat graft has not been described yet. Arthroscopic debridement alone or in combination with further sophisticated procedures in small joints is an established surgical therapy in early to late stages of thumb CMC joint osteoarthritis.^{3,16,17} Besides, it is a precise diagnostic tool assessing chondral lesions and joint incongruence to determine further treatment. Nevertheless, simple arthroscopic debridement in osteoarthritic joints is controversial^{18,19} but Furia described satisfying outcomes.²⁰ Arthroscopy can be supplemented by interposition of different biological or manufactured materials.^{4–6,17} Poly-L-lactic acid (PLLA) implant is a common synthetic interposition material. Pereira et al³ provided controversial results by combining PLLA with arthroscopy in their long-term follow-up study. A new approach was the use of fat graft interposition.^{7,21} Herold demonstrated after 3 months follow-up early good results of five patients with thumb CMC joint osteoarthritis having undergone simple interposition of autologous fat graft under X-ray control without any arthroscopic or open procedures. Mid-term results from 6 to 24 months as we are presenting here have not been reported

yet. In our study, we showed pain relief at rest and under stress after 3 to 6 months, which persisted and improved during the following months. QuickDASH scores of our patients also showed improvement like the study by Herold and kept improving during 2 years. The two patients with lasting high pain score after 12 months were supposed to receive further treatments e.g., trapeziectomy. The stage of osteoarthritis worsened in comparison to other patients. Thus, arthroscopic debridement combined with autologous fat interposition may be limited to (very) early stages of thumb CMC joint osteoarthritis. Simultaneous thumb MCP joint instability, which is often combined with thumb CMC joint osteoarthritis²² and especially the difficulties in early stages to define the source of pain can negatively influence the postoperative result.²³ We have to highlight that thumb CMC joint instability is also not treated with the surgical procedure presented here. This could be a limiting factor for long-lasting pain reducing results. In cases of severe instability and only Eaton/Littler stage "0" to "1," we proposed a corrective osteotomy according to Wilson. Our patients represented a typical collective of people suffering from thumb CMC joint osteoarthritis: a female majority with an age range between 30 and 67 years. However, the retrospective design, the number of treated patients in our study, and some missing intermediate results allow just a limited message. Nonetheless, the combination of arthroscopy with autologous fat graft interposition showed no donor-site morbidity. Further surgical options in case of failure are still open because the original anatomy is not altered. Side effects such as trigger thumb or de Quervain's disease were also mentioned in other surgical procedures.²⁴ We think that one reason could be the restricted movement postoperatively due to wearing a thumb orthosis for 4 weeks. Therefore, we shortened this postoperative treatment to 2 weeks. But what is the proper reason for pain reduction? Herold has shown that the fat graft itself can already be sufficient for pain relief. Maybe it is just the buffering effect. Other studies showed that adipose-derived stem cells (ADSC) in fatty tissue have anti-inflammatory and chondroprotective effects.^{25,26} It would be absolutely interesting if this procedure could create a kind of remodeled cartilage. These answers are not provided by our study and will need prospective clinical studies. However, our hypothesis was that debrided and fresh surroundings after arthroscopic synovectomy will facilitate survival of the autologous fat graft and may result in a longer-lasting pain reducing effect than simple autologous fat graft. Unfortunately, the study design limited further radiological imaging. So, there is no postoperative magnetic resonance imaging (MRI) or X-ray, which can support this hypothesis. Time will tell whether pain relief will remain during the years to come.

Conclusion

The combination of arthroscopic debridement with autologous fat graft interposition shows no disadvantage with respect to the donor-site morbidity or worsening of basilar thumb osteoarthritis. All other surgical options are still open. The data suggest a good and lasting effect on pain relief, recovery of strength, and patient satisfaction. None of

Table 2 Results of satisfaction, strength, and ROM according to the patients of ▶ **Table 1**

Satisfaction	Satisfaction	Yes	No			Yes	Yes	Intermediate	No	Intermediate	No	Intermediate	Yes	Yes
3–6 mo	Yes		No			Yes	Yes							
12 mo	Yes		Yes			Yes	Yes		No	Intermediate				
24mo	Yes		Yes			Yes	Yes							
Would -re-do OP														
3–6 mo			No					Yes	No	No			Yes	Yes
12mo	Yes		Yes			Yes	Yes		No	Yes				
24mo	Yes		Yes											
Jamar meter	Differences		Percentage											
3–6mo	–33%		–55%			–80%	–75%	–80%	–40%	–33%	–83%	–33%	–20%	
12mo	0		–50%			0	33%	0		–87%	0			
24mo	0		0											
Pinch meter														
3–6mo	0		33%			–67%	–33%	–50%	0	–25%	–50%	0	0	
12mo	0		0			0	0	33%		–75%	0			
24mo	33%		0											
Radial Abduction														
3–6mo	0		0			–17%	0	0	0	0	0	25%	0	
12mo	0		–17%			0	0	0		–17%	0			
24mo	0		0											
Complications			Prolonged pain			de Quervain's disease				Trigger thumb	Trigger thumb			

these patients mentioned above have required any kind of trapeziectomy yet. However, prospective studies with a higher number of patients are necessary to prove these positive effects.

Conflict of Interest

None.

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