ORIGINAL ARTICLES

New technique: AlloDerm® interposition arthroplasty of thumb carpo-metacarpal joint

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Received: November 14, 2015 **Accepted:** December 14, 2015 **Online Published:** December 23, 2015
DOI: 10.5430/jbei.v2n2p36 **URL:** http://dx.doi.org/10.5430/jbei.v2n2p36

Abstract

Excision arthroplasty is an alternative procedure for degenerative arthritis of the trapezium carpal bone that has failed non-surgical treatment. Autologous or heterologous interposition materials are used following excision of the trapezium, but may not prevent first metacarpal-scaphoid joint collapse or subsidence. AlloDerm® is a cadaver-harvested, immunologically inert dermal collagen graft. This report documents the uncomplicated use of AlloDerm® in 13 thumbs of 9 patients who had first carpometacarpal (CMC) joint excision interposition arthroplasty for degenerative arthritis. Joints functioned well after arthroplasty with AlloDerm®. These clinical results compare favorably to results in 6 Silicon implant CMC arthroplasty patients, and 3 autologous dermal graft CMC arthroplasty patients. Future clinical research, on joint stability, the durability of this collagen graft, newer dermal collagen substrates, and prevention of metacarpal subsidence, will determine the ultimate role of AlloDerm® in interposition arthroplasty.

Key words

AlloDerm®, Interposition arthroplasty, Thumb CMC joint

1 Introduction

Degenerative joint disease (DJD) of the thumb carpometacarpal (CMC) joint causes significant disability and lost hand function. CMC DJD may be classified as mild to severe in various classifications, as in Table 1. Early Stage I DJD involving only the metacarpo-trapezial (MC-TR) joint may be well treated by conservative medical management (see Table 2), and not require surgical management (see Table 3). More advanced Stage II-IV CMC DJD, involving more than one facet or joint surface of the trapezium (TR), so-called “pan-trapezial disease”, may require surgical excision of the entire TR (see Table 3).

When medical management of DJD of the TR does not improve function or adequately reduce pain, hand surgeons may recommend an operation such as excision arthroplasty (see Table 3) [1]. Simple excision of the TR often both eliminates thumb pain, and improves pinch and grip strength, even when no interposition graft is placed in the space from which the TR is removed [2, 3]. A number of autologous materials have been successfully interposed between scaphoid (SC) bone and first metacarpal base following TR excision arthroplasty, including: distally-based flexor tendon rolled into an

"anchovy" [4], free tendon [5, 6] or fascial graft rolled into an "anchovy" [7], and de-epithelialized skin graft rolled into an "anchovy" [8]. Heterologous materials interposed successfully in the CMC joint of the thumb include: implants of silicon or titanium [6, 9-13], costochondral allograft [14], Marlex or Gortex mesh (see Table 4) [15].

Table 1. Classification of CMC DJD

	EATON	BURTON	DELL
Stage I	No joint destruction. Joint space widened if effusion present. < 1/3 subluxation.	Ligamentous laxity, pain+ grind test, MC dorsal Subluxation.	Symptoms with heavy use, + grind test, joint space narrowed, subchondral sclerosis.
Stage II	Slight decrease joint space. <2mm marginal osteophytes. MC=1/3 subluxation.	Crepitus, instability, chronic subluxation. DJD on Xray.	Pain with use, crepitus, Ulnar osteophyte. < 1/3 subluxation.
Stage III	Cysts, sclerosis. >2mm marginal osteophytes MC >1/3 subluxation	Pantrapezial DJD	CMC Adduction deformity MPJ hyperextension. Pantrapezial DJD and1/3 subluxation present.
Stage IV	Multiple joint DJD	Stage II or III with MPJ DJD	Cystic changes, total joint space lost. CMC may be totally immobile

Note. DJD = degenerative changes or arthritis; MPJ = metacarpal phalangeal joint; CMC = carpometacarpal joint. Modified from Wolock BS, Moore JR, Weiland AJ. J Arthroplasty. 1989; 4: 65.

Table 2. Medical management of DJD tumb CMC joint

Primary office treatment	NSAIDs Topical Medications Limit ADLs or Activity Modification
Occupational therapy	Thumb spica cast or splint Activity Modification Adaptive Aids Paraffin Joint Mobilization
Secondary office treatment	Steroid injections into CMC Joint Combinations of above

Note. Modified from: Steinberg D. Management of the Arthritic Hand. In Chapman MW Ed. Chapman's Orthopedic Surgery. Philadelphia: Lippincott Williams. 2000; 2(3rd Ed): ch.70, p1949.

Soft, heterologous, biocompatible collagen products for implantation and arthroplasty are available. AlloDerm® is a human dermal collagen graft harvested from a cadaver, extensively bio-chemically treated, and immunologically inert; AlloDerm® has been used for soft tissue augmentation [16], protective covering over vital structures such as the carotid artery [17] or in reconstruction as a dura mater tissue or fascia lata graft [17]. For many years AlloDerm® has worked well in Plastic Surgery applications. It is used as an infra-mammary sling sutured to lower pectoralis major muscle, to cover breast implants in reconstruction of the breast after mastectomy [18-22]. It is used in abdominal wall reconstruction (AWR) of massive defects, especially when combined with components separation techniques [23-25]. As surgical use and success with AlloDerm® grows, additional uses for it will likely be described. Only over the last decade has use of an acellular dermal matrix been used in AWR, for example. The use of AlloDerm® in AWR, or in interposition arthroplasty may be considered "off-label use" by some physicians. However, since the material was released for use, it's rapidly repopulating human collagen content, low immunogenic potential and successful uses in published reports confirm both its safety and its growing importance in our current surgical armamentarium.

AlloDerm® was rolled and held into an "anchovy" with absorbable sutures, then interposed in 13 thumb CMC joints following excision of the TR for symptomatic thumb CMC DJD. All AlloDerm® grafts were clinically successful in eliminating joint pain, and restoring thumb range of motion. Focused clinical research should reveal the rate of AlloDerm®

collagen turnover, collagen volume loss in the reconstructed joint space, speed and degree of MC-SC joint collapse or "subsidence". Future study should reveal the long-term success of AlloDerm® or other dermal collagen bio-prosthetic grafts in CMC arthroplasty.

Table 3. Surgical management of DJD thumb CMC joint

Diagnosis	Procedures	Author
Laxity ligaments 1st MC-TR joint	Ligament reconstuction	Eaton, Littler, 1973 Eaton *et al.*, 1984
	Partial TR resection	Barron, Eaton, 1995
	Double FCR tendon interposition	
Limited 1st MC-TR joint DJD	Silicon arthroplasty	Ashworth, 1977
	Arthrodesis MC-TR joint	Carroll, Hill, 1973 Bamburger *et al.*, 1992
	Excision TR	Murley, 1960 Breen *et al.*, 1994
	Excision TR with interposition	Froimson, 1970
	Excision TR with suspension plasty	Thompson, 1988 Kleinman, Eckenrode, 1991
	Excision TR with tendon inter-position, ligament reconstruction	Burton, Pelligrini, 1988 Lins *et al.*, 1996 Le Viet *et al.*, 1996
	Excision TR, with implant 1) Hemiarthroplasty:	
Pan-trapezial DJD	a. Silicon	Swanson, 1972 Amadio *et al.*, 1982 Creighton *et al.*, 1991
	b. Silicon/Dacron	Sotereanos *et al.*, 1993
	c. Titanium	Swanson, Swanson, 1991
	Excision TR, with implant	Caffiniere, 1979
	2) Total artroplasty	Sondergaard *et al.*, 1991 Braun, 1985 Ferrari, Steffee, 1986 Cooney *et al.*, 1987
	Arthrodesis intercarpal joints (Tri-scaphe fusion, *etc.*)	Numerous authors

Note. FCR = flexor carpi radialis; MC-TR = metacarpotrapezial joint; TR = trapezium. Modified from: Steinberg D. Management of the Arthritic Hand. In Chapman MW Ed. Chapman's Orthopedic Surgery. Philadelphia: Lippincott Williams. 2000; 2(3rd Ed.): ch.70, p1943.

Table 4. Interposition materials in arthroplasty 1st CMC Joint

Autogenous	Distally-pedicled flexor tendon rolled "anchovy" [4] Free tendon graft [5, 6] Fascial graft rolled "anchovy" [7] Rolled de-epithelialized skin graft [8]
Heterologous	Implants of silicon or titanium [6, 9-13] Costochondral allograft [14] Marlex or Gortex mesh [15] AlloDerm® Alternative bio-prosthetics: Surgimend®, *etc*

2 Surgical techniques

This surgical technique differs from other published techniques in the following ways:

1) Intravenous regional anesthesia is used whenever possible.

2) A 5 cm zig-zag or W-incision is used from the dorsal radial thumb CMC joint to the first extensor compartment for arthroplasty. The incision is marked in the relaxed skin tension lines (RSTLs) of the wrist (see Figure 1) to prevent longitudinal scar hypertrophy or contracture (see Discussion) [26-30].

3) Once the interval between the abductor pollicis longus (APL) and extensor pollicis brevis (EPB) is identified, the first extensor compartment retinaculum is completely released. An occult septum within the first compartment, around the APL or between the APL and EPB, is excised when it is encountered.

This can prevent acute post-operative DeQuervain's (DeQ) disease, which occasionally occurs when patients start post-operative range of motion. In addition, if the patient has DeQ before the arthroplasty, this compartment release and removal of a septum, when present, will prevent recurrent or persistent DeQ [31]. Such a septum has been found in perhaps as many as 5%-10% of all DeQ releases. Persistent septum can be the cause of severe persistent DeQ in previously operated patients for DeQ.

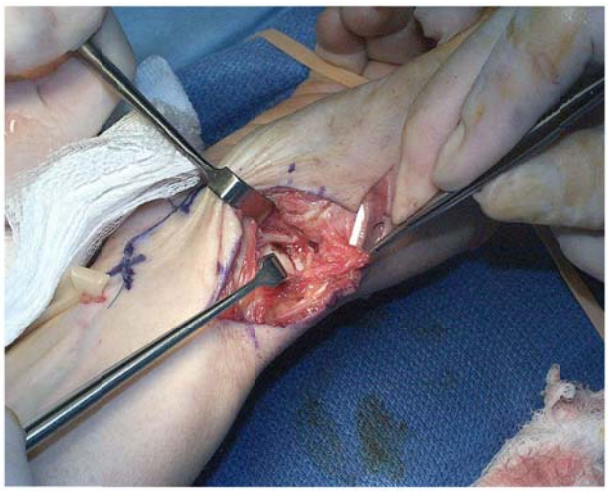

Figure 1. Excision greater multangular (trapezium) completed. Deep in wound is scaphoid, *center*, lesser multangular is just distal. Forcep, *right*, holds capsule over EPB (protecting superficial radial nerve and APL). *Above left* is intact FCR, seen inferior to retractor, W-incision in relaxed skin tension lines (RSTLs).

4) The entire TR is completely removed. No TR chips are left attached to fragile capsule, as is done by some surgeons [30]. Special care is taken to distract the thumb and examine the distal, ulnar TR defect near the degenerated dorsal intermetacarpal ligament. There often are loose bodies, osteophytes, or cystic synovium here that must be removed to prevent persistent pain or destruction of the DJD.

5) After joint irrigation with saline and Bacitracin® solution, Bupivicaine 0.5% local anesthetic solution is injected into the joint and wound margins for post-operative analgesia and anesthesia. Injecting bupivacaine, then using post-operative ketoralac (Toradol®), makes this surgery an out-patient procedure.

Figure 2. Sutured AlloDerm® "anchovy" graft ready for insertion. Graft partially hides the superficial radial nerve; EPB is *right* of graft. W-incision is in relaxed skin tension lines.

6) AlloDerm RTU®, hydrated and pliable, is used after a saline rinse. For smaller hands or joints of female patients, 1 piece of 3 by 7 cm AlloDerm®is used, but for larger male joints I have on 4 occasions (bilateral thumbs of 2 patients) used 2 pieces of 3 by 7 cm AlloDerm®. The AlloDerm® is folded length-wise, held with a clamp, rolled then sutured into a firm "anchovy", very close in size to the removed TR and joint defect (see Figure 2).

Examine the defect in the joint after the TR is removed, and gently distract the thumb metacarpal, to determine the joint size. If one is still not sure, use 1 piece, roll it up, insert it, and determine the fit. If too small for adequate filling of the joint or adequate separation of the metacarpal from the scaphoid, then wrap a second piece around the first, and re-insert it. The assistant distracts the thumb, and the "anchovy graft", dipped in Bacitracin® solution, is placed into the joint space, and rotated to approximate the axis of the TR's saddle shape (see Figure 3).

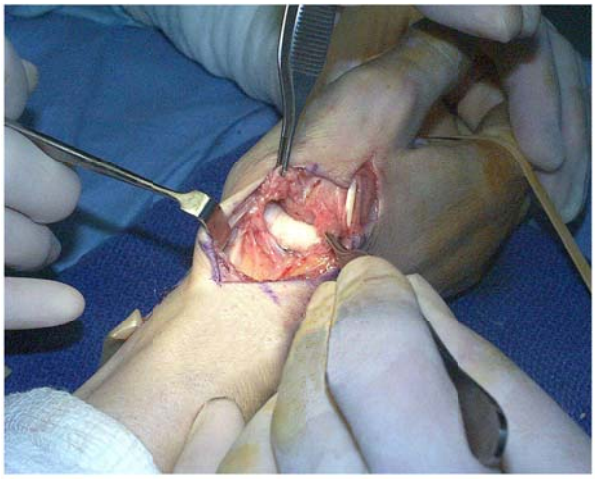

Figure 3. AlloDerm® graft in place. Forceps hold capsule ready for imbrication.

7) The loose, thick CMC capsule is usually imbricated with 4-0 soft, braided polyester sutures. If the joint capsule is thinned by severe cystic degeneration of underlying DJD, additional capsular support is added in one of two ways. An extra piece of AlloDerm® graft may also be used to augment thin or degenerated dorsal CMC capsule at closure [17]. Instead of AlloDerm®, a single slip of the multiple slips of the APL may be taken at or above the proximal first compartment level (for adequate length), the tendon slip draped distally over the capsular repair, and sewn with polyester sutures tightly to reinforce the capsule, and to help prevent dorsal metacarpal subluxation [30].

8) With the thumb held in 45° palmar abduction, two 0.045 K-wires are passed for immobilization. K-wires are removed in 5 weeks, when organized occupational therapy is begun. Function returns rapidly. Within 3 months the same procedure may be done on the opposite hand if indicated and appropriate (see Table 5).

3 Results

Retrospective review has identified 17 operated patients and 23 thumb CMC arthroplasties, 6 bilateral and 11 unilateral (see Table 4). Successful previously reported interposition arthroplasty methods are noted in Table 3 [1, 9-15, 31-51]. Hard, heterologous metal or metal/plastic implants in CMC arthroplasty have never been used [6, 9-11]. Soft, autologous materials should be the surgeon's first choice. A number of years ago, prior to available acellular dermal matrices (ADM) being commercially available, autologous de-epithelialized skin (dermal collagen) grafts were used as a dorsal wrist capsule reconstruction following wrist capsulolysis/arthrolysis. With immediate post-operative continuous passive wrist motion (CPM), and occupational therapy, substantial improvement in wrist motion was achieved, with no cystic degeneration or infection. Autologous dermal grafts should perform well as "biologic implants" in CMC excision interposition arthroplasties. De-epithelialized skin or dermal grafts were then used for 3 successful CMC arthroplasty cases (see Table 5,

Patients LS, BL, DM) [8]. Such autologous dermal grafts are in greater supply, and easier to harvest through hidden, inguinal donor scars. This is compared to tendon or fascia lata grafts harvested through separate visible wrist or thigh incisions, that could potentially form hypertrophic donor site scars [29].

Table 5. All patients: alloderm in excision interposition arthroplasty of thumb CMC

ID	Yr/Sx	R,L, B	Proc	ROM	Wrist	degrees		ROM	Thumb	degrees	Pinch, Gripkg	Comment
				Fl	Ex	UD	RD	IPJ	MPJ	CMC_{ABD}		
SW	50/F	R	SwT	?	?	?	?	?	?	?	>22	ChTR=reop
IR	65/F	B	SwT	?	?	?	?	?	?	?	>22B	SilSynovitis
JW	58/M	R	SwF	65	65	30	30	35/65	0/55	45	>45	Trg,CTS
SE	54/F	R	SwF	?	?	?	?	?	?	?	>22	Unilat
EM	53/F	R	SwF	?	?	?	?	?	?	?	>22	
JA	65/F	R	SwF	?	?	?	?	?	?	?	>22	
LS	45/F	L	FTDG	45	45	15	20	0/30	0/35	45	>22	CTS,inf
BL	55/F	R	FTDG	50	40	15	45	0/35	0/40	45	12	styl, caps
DM	59/F	B	FTDG, R ALD, L	65 65	65 65	30 30	20 20	? ?	? ?	? ?	>22 >22	RSI, FMS
BJC	65/F	R	ALD	65	63	30	20	?	?	?	>22	ChTR=reop
DR	55/F	B	ALD	R65 L65	65 64	30 26	24 25	46 40	+5/51 0/46	37 41	3.4, 20.4 3.4, 20.4	RSI,CTS, deQ
LM	71/M	B	ALD	R70 L80	55 55	22 25	17 15	+10/48 0/45	+15/60 +10/55	52 47	8.1, 39.5 3.6, 22.2	deQ,CTS
VN	59/M	B	ALD	R80 L70	68 65	32 35	10 24	0/52 0/83	0/43 0/50	45 50	3.6, 17.2 5.1, 29	RSI, CTS
DH	50/M	B	ALD	L55 R50	68 55	33 25	10 10	+20/65 +35/58	0/50 0/52	45 0/43	4, 36.3 6.8, 30	CMfus,CTS LTF
PT	42/F	R	ALD	75	65	38	12	0/30	+23/56	50	6.4, 33.4	LTF
MW	63/F	R	ALD	66	73	?	?	0/55	0/60	55	6.2, 24	LTF
BP	69/F	R	ALD	62	53	?	?	0/44	0/16	40	3.6, 6.2	LTF

Note. SwT= Swanson great toe silicon implant.// SwF=Swanson great toe implant and FCR capsular weave // ChTR= chips TR on capsule, reop= reoperation// FTDG=dermis graft // SilSyn=silicon synovitis // RSI=overuse // styl=rad. styloidectomy, caps=wrist capsular graft reconstruction // ALD=Alloderm@//deQ=de Quervain's / FMS= fibromyalgia syndrome // B=bilateral // CM fus=MC/TR fusion // LTF= Lost to Follow-up.

AlloDerm® is labelled and approved for the replacement of injured or degenerated tissues, which is precisely what remains of the weakened bone of the trapezium and the CMC cystic joint capsule. The material has been successfully and safely applied in many clinical situations; intra-articular placement, next to vascularized tissue is conceptually as harmless as published subcutaneous lip placement or rectus fascial replacement in AWR [16-17, 24-25]. Replacing or reinforcing degenerated CMC bone or joint capsule does not appear "off-label".

AlloDerm® is used for CMC arthroplasties with strict informed consent. No IRB was active at time of these surgeries; otherwise IRB support would have been sought. All patients were first followed at length for appropriate medical DJD management. At the time for surgical treatment, patients were counseled at length about: 1) the alternatives to AlloDerm®, including implants or autogenous dermal grafts, and 2) potential risks and complications of the operations, including bleeding, infection, hypertrophic scar, thumb subsidence or dorsal subluxation, lost range of motion and lost grip strength. They were counseled about potential risks and complications of AlloDerm®: it may be resorbed or replaced by native scar collagen just as one's own skin dermis grafts could be, absorption may lead to MC-SC joint collapse or subsidence, or to the need for future operations for advancing DJD. Many patients will choose an off the shelf, safe alternative to their own dermis (skin graft), after considering the additional scar and possible complications at their donor site-bleeding, infection, hypertrophic scar.

To date, 13 thumbs in 9 patients have been operated with AlloDerm® with excellent results. The results of these 13 interposition arthroplasty are compared in Table 5 to the 6 silicon joint prosthesis arthroplasties, and to the 3 autologous dermal graft arthroplasties. One patient had a dermal graft in one thumb and AlloDerm® in the other. Joint pain relief and range of motion was equally good in both thumbs (see Table 5). The availability of sterile, non-allergenic, soft dermal collagen grafts eliminates the donor site scar and morbidity of autogenous dermal grafts, reduces operating time for the surgeon and reduces anesthesia time for the patient. Results with AlloDerm® are comparable to results using autogenous dermis grafts, or other tendon interposition implants. All 9 patients expressed satisfaction with thumb and hand function. All patients reported increased hand use in ADLs, reduced pain, and improved grip or pinch strength (see Table 5).

4 Complications

Only one minor wound infection occurred in this series of 16 patients; the infection cleared with oral antibiotics. No infections occurred in the AlloDerm® group. No graft infections occurred. With use of AlloDerm®, prophylactic peri-operative antibiotics (*e.g.* cefazolin), and appropriate joint irrigation, there should be few wound infections, shorter operative times, and no donor site scars or infections.

One idiosyncratic local erythema reaction, without infection, did occur around the incision in our first AlloDerm® patient, a 58 year-old female with fibromyalgia syndrome (FMS). Her inflammatory reaction may have been due to underlying immune factors, triggered by surgical wounding, and may have been unrelated to cadaver collagen grafts. Cultures from her wound were “No Growth”. Her thumb pain, range of motion, and pinch and grip strength all improved after surgery. No other patient has developed any reactive signs or symptoms. AlloDerm® is well tolerated in this application.

5 Discussions

While treatment of degenerative disease of the TR may be categorized as both medical and surgical, Lister was correct when he wrote: “most patients come to surgery” [1]. In early Stage I DJD (see Table 1) of the basilar joint due to lax capsular support, prophylactic CMC ligament reconstruction may be successful in preventing arthrosis or later excisional arthroplasty [31-41]. If there is recurrence of symptoms after ligament stabilization, even with splinting or NSAIDs, or if palmar-adducted collapsed thumb deformity occurs reducing function, as in Stage III or IV DJD (see Table 1), CMC arthrodesis or arthroplasty is usually then considered (see Table 3) [1, 9-15, 31-51].

Pan-trapezial disease-involvement of all joint surfaces of the greater multangular bone is common. However, the first metacarpal (MC) facet of the TR is sometimes the only facet with significant DJD, as in Stage I disease. Some patients have done well after limited, first MC-TR Silastic® arthroplasty or fusion [13, 31-51]. It may be counter-intuitive, though, to excise or fuse this one TR facet or joint and leave the other three TR facets with disease when it is present [30]. Nevertheless, surgeons have reported good results after treating only the MC-TR joint.

Total TR excision may be indicated when at surgery more than one joint is found involved. Some patients may avoid a second operation by having total excision arthroplasty performed early, instead of a first more limited MC-TR procedure with ligament reconsruction in an attempt to relieve pain and improve function only for a limited time before DJD in other TR joints inevitably causes more pain and lost function.

Some generally accepted principles in the surgical staging of thumb DJD are:

1) One of the three thumb joints should remain mobile [1].

2) Thumb stability for grip and thumb-index pinch may require fusion (arthrodesis) of the thumb metacarpal-phallangeal (MP) or interphallangeal (IP) joints [1].

3) The CMC is the most important thumb joint for circumduction and palmar abduction function in thumb opposition [44].

Therefore, it makes most sense that the CMC not be fused in the event of limited, MC-TR single joint involvement, but be left mobile, with a soft interposition graft. Fusion can then be done, as indicated for stability at the distal MP or IP thumb joints [44].

After well-performed bilateral fusions of his first MC-TR joints, one patient (DH) developed persistent severe dorsal CMC pain. X-rays and flouroscopy confirmed impingement and DJD that was made worse by the biomechanical transfer of torque of his APL and EPB tendons from the base of thumb MC, to the base of the TR against his second MC. I believe this probably would never have occurred, had he been offered an excision arthroplasty at the outset. He elected bilateral TR excisions from the MC base, and had much improvement in pain and function after interposition arthroplasty of the CMC joints. Early consideration of excision interposition arthroplasty of the TR is recommended when more than one facet of the TR is involved with DJD; following the other principles noted above, patients have had preserved motion, and improved grip and pinch strength. No patient returned over 20 years for first MC subsidence at the CMC joint, nor with any worsening of DJD requiring additional surgery. One lady with bilateral Swanson Silastic® great toe-for-trapezial implants had resorption of one implant, but no symptoms or lost function, so declined operation.

An elective wrist incision that incorporates a W zigzag pattern in relaxed skin tension lines (RSTLs) is used whenever possible. This is like a W-plasty, providing camouflage of the scar in wrinkles, and accordion-like elasticity with wrist motion. The incision design provides excellent exposure and may prevent longitudinal, hypertrophic scar contractures that could require future revision or steroid injections with attendant morbidity of hypopigmentation, atrophy, or telangiectasia [25-29].

Interposition materials have improved through the years (see Table 5). Autogenous de-epithelialized dermis interposition grafts were successful in 3 patients' CMC joints, similar to previously reported temporo-mandibular joint (TMJ) arthroplasties [52, 53]. While "anecdotal", these positive results support ongoing, effective use of autogenous dermis in thumb interposition arthroplasty. Autogenous dermis is "always" available, non-immunogenic, inexpensive, and consistently well tolerated. Currently plastic surgeons are using large sheets of lower abdominal de-epithelialized dermis as inframammary slings in reconstruction, instead of AlloDerm® or other bio-prosthetics [54-56].

After AlloDerm® interposition, range of motion was nearly normal in these patients, and grip and pinch strength generally exceeded age-correlated norms [57]. Pinch strength was recorded in occupational therapy; however some patients were lost to follow-up. Most patients' pinch strength returned to pre-arthritic levels. There was substantial improvement in pinch strength and grip strength in most patients. No patient reported weakness in pinch or key grip.

AlloDerm® appears well tolerated in this use. More focused study appears important to confirm the long-term host tolerance and the durability of acellular dermal matrices (ADMs) in the CMC joint. AlloDerm® and other bio-prosthetics have not been used long enough, or in enough arthroplasty patients to document CMC joint subsidence, which is known to occur after interposition arthroplasty with or without other interposition grafts [58, 59]. There is yet no reported comparison with combined ligament reconstruction and tendon interposition arthroplasty technique [59]. Perhaps radio-dense markers could be used to follow CMC subsidence. For example, pieces of K-wire, micro-fixation screws or screw-anchors could be imbedded in the non-articular surfaces of the first metacarpal base, the distal scaphoid, or other locations. X-rays or tomograms could be taken at intervals to measure the loss of joint height, which could be the compaction or host dissolution (loss) of dermal collagen in grafts over time, as the joint space narrows. Perhaps a prepared, "bio-labeled" AlloDerm® or bio-prosthetic ADM graft could perhaps be developed and used for TR or TMJ arthroplasty. Then, at intervals and after several years, open or needle biopsies of the graft could be done, and studies performed on the graft and native collagen to determine the degree of lost and renewed collagen. Such studies will help to establish degree of host

tolerance, and incorporation of the grafts over time. Grip and pinch strength, hand use in activities of daily living, and other indicators of improved function could be documented to support continued use.

Simple excision arthroplasty of the TR without interposition material can improve motion and strength in some patients; biocompatible interposition materials theoretically should both provide for these improvements and also stand up to joint mechanics over long periods. Surgeons want to prevent further joint destruction, lost strength and lost motion at first operation. Future study should show AlloDerm® and other ADMs are stable and effective over years in joint replacement, and prove that joint collapse, subsidence and further arthrosis does not occur faster after AlloDerm® or other ADM implantation, than after other interposition materials. Then patients can know that they will benefit from a readily available, effective interposition material placed during a short operative procedure, for their CMC DJD.

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