

A Podiatrist's Amazing Experience with Collagen

Wound healing time may be significantly reduced by using collagen as an adjunct therapy

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About a year ago a sales representative called on me to present information on Kollagen™. When he closed his presentation to me, he said, "Doctor, give me your worst case." I looked at him skeptically and thought, "Yeah, right, buddy. You want it, you got it."

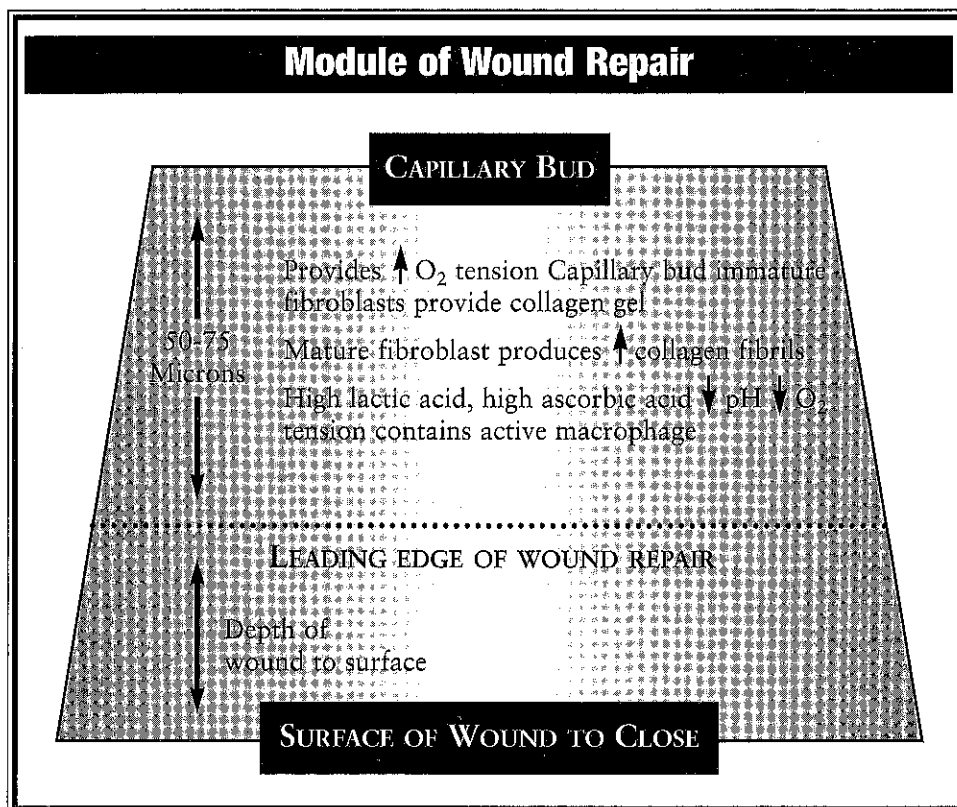
I had a patient who was slated for an A-K amputation due to rheumatoid vasculitis, no

blood flow, osteomyelitis, and open draining infected ulcer associated with his fourth toe. I had worked diligently with this patient for six months, having tried numerous IV and oral antibiotics, serial debridement, and multiple assorted topical products. It seemed that all I was doing was losing ground. As the patient continued to get sicker from the diseased toe, the decision had been made to amputate the leg.

Several hours later, the patient presented as I was about to explain the A-K amputation to him. (I had checked with the internist and the surgeon who was going to do the amputation and obtained clearance for the patient to remain under my care for an additional week). I presented this concept of Kollagen™ application and had the sales representative apply the material to the patient.

I was honest with my patient after the sales rep left. I told him flat out that I had absolutely no experience with this material, although I vaguely recalled hearing different things about it over the years. My patient's comment to me was, "Well, doc, you were going to take my leg off anyway. What else do I have to lose?"

One week later, the patient returned to my clinic. I inspect-



Permanent Nail Surgery (Non-Collagen)

SEX	AGE	LENGTH OF HEALING TIME	STYLE OF CARE USED	COMMENTS
M	33	31 days	Spectazole	Ultravate cream
F	10	23 days	Diluted vinegar soaks	Trouble tolerating diluted vinegar. Started Liquid Dial soap soaks (1 oz. : 1 pint lukewarm water)
F	47	34 days	Diluted vinegar soaks	D/C peroxide and vinegar soaks, start Liquid Dial soap soaks
M	82	22 days		
M	80	26 days		Diabetic
M	65	39 days	Diluted vinegar soaks	
F	47	34 days	Diluted vinegar soaks, Cortane B	Diabetic, D/C peroxide
M	80	34 days	Diluted vinegar soaks	D/C diluted vinegar, start Liquid Dial soap soaks
F	39	33 days	Diluted vinegar soaks	Last dressing on toe, Betadine whirlpools
M	59	28 days	Diluted vinegar soaks	
F	84	46 days	Diluted vinegar soaks	D/C peroxide and diluted vinegar soaks, start Liquid Dial soap soaks
F	83	31 days	Diluted vinegar soaks	Whirlpools, D/C peroxide and diluted vinegar, start Liquid Dial soap soaks
M	71	43 days	Diluted vinegar soaks	Diabetic, Keflex 500 mg
F	73**	39 days	Diluted vinegar soaks, Cortane B	Macerated tissue, betadine whirlpools, Cleocin 300 mg, Darvocet N100
F	59	28 days	Diluted vinegar soaks	
F	79	31 days	Diluted vinegar soaks	Diabetic
F	85	31 days	Diluted vinegar soaks	
F	97	28 days	Diluted vinegar soaks	At 1st postop visit, D/C peroxide and diluted vinegar soaks. Start Liquid Dial soap soaks 1:16 x 20 min bid, continue Triple
M	67	21 days	Band-Aid	
F	47	36 days	Band-Aid	Minimal infection
F	13	29 days	Band-Aid	
M	14	30 days	Band-Aid	
F	45	33 days	Band-Aid	
M	71	28 days	Band-Aid	
M	73	41 days	Diluted vinegar soaks	D/C peroxide and diluted vinegar soaks, start Liquid Dial soap soaks
F	81	56 days	Diluted vinegar soaks, Cortane B (2 drops)	
M	11	42 days	Band-Aid	
F	68	34 days	Diluted vinegar soaks	D/C peroxide and diluted vinegar soaks, start Liquid Dial soap soaks x 20 min. bid. Continue Neosporin and betadine whirlpools
F	80	64 days	Liquid Dial soap soaks, saline flush	Foot burned in dial soap soaks
M	14	26 days	Gentamycin, H ₂ O ₂	
F	64	29 days	Diluted vinegar soaks, Cortane Otic drops	Diabetic
F	91	21 days	Diluted vinegar soaks	At 1st post op visit, D/C diluted vinegar, start Liquid Dial soap soaks
M	81	31 days	Diluted vinegar soaks	
F	66	66 days	Diluted vinegar soaks	Diabetic, D/C diluted vinegar soaks, start Liquid Dial soap soaks, betadine, sugar, peroxide on Q-tip
M	57	35 days	Diluted vinegar soaks, Cortane B	Cephalexin 500 mg
F	50	31 days		
F	50	67 days	Diluted vinegar soaks	Patient developed late granuloma with draining secondary to trauma that was not reported until 60th postop day. Wound closed with betadine cream
M	32	38 days	Diluted vinegar soaks	
F	58	32 days	Diluted vinegar soaks	D/C diluted vinegar soaks on the 10th day, start Liquid Dial soap soaks

All patients treated with H₂O₂ and Neosporin in addition to regimen noted. Culture findings: **No organisms isolated, yeast.

ed the wound and saw granular wound healing cells for the first time on this case. Needless to say, I was stunned.

To this day, this patient has all 10 toes, wears shoes, and has even regenerated a toenail on the affected toe. There is minimal residual scarification associated with the digit.

What Research Confirms

Sixty percent of a person's dry body weight is made up of collagen, a naturally occurring protein that typically has a GLY-X-Y structure (glycine-hydroxyproline-hydroxylysine) in a triple helical arrangement. Collagen has existed for thousands of years, yet only recently have we developed the technology to utilize it efficiently. Today we can mass produce and bring to market in a cost-effective form that which occurs naturally.

During the past year, I studied some 300 podiatric cases to consider rate of time to wound closure. The cases included: infected and noninfected ingrown toenails; warts; superficial and deep ulcers; and superficial and deep primarily closed postop wounds from bunionectomies, hammertoes, neuromas, and other surgical procedures performed in podiatric medical practice.

My research appears to confirm that with good quality continued medical care, wounds can be adjunctively assisted toward closure sooner than would otherwise be anticipated. One caveat: continued quality medical care such as strict adherence to aseptic technique, appropriate wound debridement, antibiotics, removal of pres-

sure from wound site, and so forth, are still mandatory.

Before healing can begin, hemostasis must occur. Medical literature states that collagen applied at the time of hemostasis acts as an assistive mechanism to augment clotting. Collagen actually increases platelet adherence to the endothelial vessel wall, thus sealing it off. Fibroblasts combine and build amino acids into a sugar protein structure to form collagen at the wound site. This advances the wound environment by five or six days. Collagen also attracts additional monocytes to the wound, thus increasing the amount of debris removed, which leads to speedier wound healing.

During angiogenesis, collagen assists with epithelialization of the endothelial lining of the blood vessel wall.

By developing this system, a healthy pink wound, or granulating in, will develop. When granulation tissue is present, it signifies wound healing by secondary intent.

Types of Wound Healing

There are two types of wound healing.

1. Primary wound healing is defined as a sharply made wound that is accurately re-approximated from end to end within hours of its occurrence. There is minimal space between wound ends (i.e., surgical incision or deep laceration.)

2. Secondary wound healing is defined as the healing of an open wound or dead space by the development of capillary budding (neovascularization) and filling in of the tissue defect via the development of large amounts of connective tissue on the wound area. This typically requires the differentiation of development of wound epithelialization to close the wound site.

In both types of wound healings, fibroblasts must be generated to allow collagen synthesis to occur at the wound site. In the uncomplicated healing wound, a "typical wound module" develops about three days after the wound occurs [see figure on page 1].

As angiogenesis and inflammation occur, wounds will accept collagen to assist with epithelialization. Typically, this causes contracture of the wound as it narrows in width. Thus, secondary granular wounds become shallower and narrower.

At the same time as collagen is being synthesized by cells, enzymatic breakdown of collagen occurs, causing a lysis or breaking up of old collagen from the wound. Scar tissue is kept to a relative minimum. If excessive amounts of collagen

Permanent Nail Surgery (Collagen)

SEX	AGE	LENGTH OF HEALING TIME	COMMENTS
M	59	21 days	Excising granuloma at 15 days, wound closed after 21 days, granuloma formation from shoes at 28 days
F	70*	11 days	Cellulitis. Betadine whirlpools
M	22	28 days	Steel-toed boots irritated sites
M	77	35 days	Developed granuloma at 19 days, excised. Diabetic.
M	40*	40 days	Shower water contamination at 8 days. 2nd toe closed at 21 days
M	67*	32 days	Patient contaminated from rain water
F	68	17 days	Neosporin
F	75	23 days	Neosporin
F	32	20 days	
F	67	26 days	
F	62	28 days	Went on 2-week vacation at day 14, 80% healed. Returned on 28th day, closed.
M	69	28 days	Developed influenza, lost to follow-up from 10th to 28th day.
M	25	40 days	Neosporin. Patient injured toe on 11th day with hematoma I & D'd. Patient jammed tow on 24th day and reopened site.
F	82*	34 days	Patient noncompliant with protocol. No dressing change first 7 days. Walked in yard without any dressing during 2nd postop week. Required home health nurse starting 14th postop day. Healed 20 days later.
F	21	27 days	Developed skin inclusion cyst on 12th day, excised.
F	86	26 days	Allergic reaction to Neosporin 19th day. Discontinued Neosporin.
M	55	22 days	
F	24	22 days	Cortisporin
M	69	25 days	
F	65	17 days	
F	75	23 days	
F	72**	39 days	Patient exposed to infection because of poor hygiene.
M	63	21 days	
F	12	18 days	
F	45	22 days	Neosporin
F	58	24 days	Neosporin
F	72	24 days	
M	81	26 days	
M	14	20 days	Cortisporin
F	58	26 days	
F	74	33 days	Neosporin. Diabetic went on sugar binge, found on 10th postop day and 24th postop day. Wounds 95% closed on 19th postop day, broken down 5 days later, probably due to elevation in blood sugar.
M	20	19 days	Cortisporin. Wound closed on 19th day, injured nail bed, I & D'd on 25th day at work. Developed cellulitis to nail bed, I & D'd on 25th day, healed on 33rd day.
F	27	15 days	
M	74**	33 days	Cellulitis—Betadine whirlpools. Developed methicillin resistant staphylococcus aureus between 4th & 9th postop day. Required debridement; clindamycin 30 mg TID; Betadine whirlpools through 18th postop day.
F	71	27 days	
F	64	22 days	Neosporin
F	89	36 days	Cellulitis on 18th postop day.

All patients were treated with SkinTemp® and other drugs as noted. Culture findings: *Staph Aureus; **Enterococcus Faecalis; ***MRSA

Steps to Wound Healing

The body attempts to heal wounds in an orderly sequence of events.

► 1. INITIAL RESPONSE

Initially, mast cells secrete hormones to assist first with vasoconstriction followed by vasodilatation of blood vessels. In addition, white blood cells, namely polymorphonuclearcytes (PMNs) and monocytes migrate to the wound to clean up debris and attract fibroblasts.

► 2. CLOTTING MECHANISMS

Platelets aggregate (clump together) at the wound site. Prostaglandins, complement, and phospholipids with clotting factors create a clot at the wound site. As a rule, collagen is not yet present.

► 3. INFLAMMATORY RESPONSE

As the clotting mechanism occurs, PMNs, primarily, and macrophages, secondarily, arrive at the wound site. The macrophages stimulate fibroblasts to arrive and begin the production of collagen. Early on, immature fibroblasts secrete a collagen gel-like matrix that helps develop an environment conducive to wound healing. As fibroblasts mature, a

stronger collagen matrix is built. These fibroblasts create a combination of mild-to-moderate oxygen tension and slightly acidic wound environment.

► 4. ANGIOGENESIS

The regeneration of vasculature to the area, angiogenesis, is the development of small capillary buds that will merge to form capillary loops and eventually blood vessels.

► 5. NUTRITION

Without adequate nutrition, wounds will not heal. Blood supply to the wound provides the necessary nutrients such as amino acids, B vitamins, ascorbic acid, copper, zinc, and other minerals.

► 6. EPITHELIALIZATION

Early on, wounds will begin to develop epithelial cells at the margin. As the epithelial cells mature, there is a vast migration of epithelial cells across the entire wound. This in turn allows for wound contracture and closure to occur.

remained, scars could enlarge, becoming hypertrophic. In addition, keloids commonly form.

Ideally, we want a wound that is moist in a mildly acidic environment and has good nutrition supply and mild oxygen tension. These conditions lead to an optimum environment and the most rapid rate of wound healing and allow for optimum proliferation of fibroblastic production of collagen.

Methods and Materials

Permanent Nail Surgery. Either partial or total permanent nail avulsion was performed with standard modified phenol-alcohol technique. Metabolic and additional pathophysiologic states were not considered in this review. Retrospective review of 37 cases using traditional bid application of hydrogen peroxide, slow dripped for 10 minutes followed by a 20-minute soak in diluted vinegar water (1:4 dilution) followed by triple antibiotic ointment compared with 37 cases in which collagen wound management (SkinTemp® Biocore, Inc., Topeka, KS) products were applied qod. In six cases in which patients complained of pain with regard to the peroxide soaks, both of the above were discontinued and wound care was changed to 20-minute soaks with Liquid Dial Soap®, Dial Corp., Phoenix, AZ (1:16 dilution). Triple antibiotic was discontinued, SkinTemp® was continued, and Band-Aids® (Johnson & Johnson, Arlington, TX) were used to cover wounds.

Average length of time until wounds had

epithelialized in the collagen group was just under 24 days as compared to just under 36 days in the traditional wound care group. [See tables, pp. 2, 3 for comparison data.]

Acute infected paronychia. A total of 50 patients, 30 male and 20 female and ranging in age from 9 years to 85 years, were compared. All had positive wound cultures. Culture and sensitivity of infection site were performed on all digital wounds that had either partial or total non-permanent removal with incision and drainage of abscess. Appropriate oral antibiotics were prescribed. In non-collagen cases, similar local wound care as described above was provided, except that gentamycin cream was prescribed to assist with antimicrobial action and drying out of wounds. No prescription for any ointment base in acute infected paronychia is utilized by this author. Collagen cases had SkinTemp® applied to the site.

Traditional care cases took an average of 20.87 days to heal as compared to an average of 14.88 days in the SkinTemp® group.

For standard surgical cases involving primary closure of wounds, identical suture techniques were compared in 38 cases, with no consideration to metabolic disease in the analysis. Ambulation was not considered as a factor as patients in both groups were similarly ambulated. Adaptic® (Johnson & Johnson) covering was followed with dry sterile gauze and elastic compressive dressing in 18 traditional-dressing cases. The duration before sutures were removed ranged from 10 to

Verruca (Non-Collagen)

SEX	AGE	LENGTH OF HEALING TIME	COMMENTS
F	71	23 days	Cryotherapy
M	7	13 days	Cryotherapy, vitamin A therapy 50,000 units
M	15	18 days	Cryotherapy
F	67	12 days	Cryotherapy
M	46	13 days	Cryotherapy
F	70	19 days	Cryotherapy
M	48	24 days	Cryotherapy, went away after 12th post-op day, returned and closed
F	75	12 days	Cryotherapy
F	40	24 days	Cryotherapy
M	71	18 days	Cryotherapy, D/C'd peroxide, day 3, started Liquid Dial Soap soaks and Neosporin
F	59	22 days	Cryotherapy
F	44	18 days	Cryotherapy, patient has S.L.E.
M	23	14 days	Cryotherapy
M	82	13 days	Cryotherapy
F	72	14 days	Cryotherapy, on LITT
F	5	11 days	Cryotherapy
M	14	12 days	Cryotherapy
M	7	36 days	Cryotherapy, recurrence, received vitamin A therapy 50,000 units, diluted vinegar soaks, Elase with Chloromycetin
F	34	48 days	Excision, silver nitrate, diluted vinegar soaks, Elase with Chloromycetin
F	14	60 days	Excision, silver nitrate, had recurrence of warts, diluted vinegar soaks, Elase with Chloromycetin
M	26	57 days	Excision, silver nitrate, diluted vinegar soaks, Elase with Chloromycetin
F	68	39 days	Excision, silver nitrate, diluted vinegar soaks, Elase with Chloromycetin
M	75	49 days	Excision, silver nitrate, NuGauze, Betadine in sugar
M	15	62 days	Excision, silver nitrate, diluted vinegar soaks, Elase with Chloromycetin
F	49	68 days	Excision, silver nitrate, diluted vinegar soaks, Elase with Chloromycetin
M	34	46 days	Excision, silver nitrate, diluted vinegar soaks, Elase with Chloromycetin
M	48	63 days	Excision, silver nitrate, patient diabetic, FBS 162-264, diluted vinegar soaks, Betadine in sugar
F	78	103 days	Excision, silver nitrate, sub-1, patient ambulated while healing, NuGauze, Betadine in sugar
M	27	48 days	Excision, silver nitrate, diluted vinegar soaks, Elase with Chloromycetin
F	44	44 days	Excision, silver nitrate, diluted vinegar soaks, Elase with Chloromycetin
F	73	118 days	Excision, silver nitrate, PVD lesion had infection at start, Rx Cipro 500 mg bid x 28 days, diluted vinegar soaks, Elase with Chloromycetin, D/C'd 56th day, started Betadine in sugar
F	15	30 days	Excision, silver nitrate, on vitamin A therapy 50,000 units, diluted vinegar soaks, Elase with Chloromycetin
M	17	42 days	Excision, silver nitrate, on vitamin A therapy 50,000 units, diluted vinegar soaks, Elase with Chloromycetin
F	26	48 days	Excision, silver nitrate, diluted vinegar soaks, Elase with Chloromycetin

All patients treated with H₂O₂ and Neosporin, other drugs as noted.

21 days, with an average of 14.1 days. In 20 collagen cases, SkinTemp® with the nylon removed was applied directly to the surgical site. Wounds were then dressed with dry sterile gauze followed by elastic compressive dressing. This group ranged from three to 10 days to suture removal, with an average of 6.7 days to removal, or a 50 percent shorter healing time to suture removal.

Verruca

Cases were divided into two types: superficial warts or deep warts. All superficial wart cases were treated with liquid nitrogen as cryotherapy; all deep cases involved surgical excision fol-

lowed by chemocauterization with silver nitrate. A total of 35 cases received cryotherapy, with 18 cases having traditional local wound care involving hydrogen peroxide on a cotton swab followed by Neosporin® (Warner Wellcome, Morris Plains, NJ) ointment twice daily. The other 17 cases were treated with SkinTemp®, its nylon backing kept intact and external to the wound, applied every other day. All wounds were again covered with a Band-Aid.

In traditional cases, wound healing ranged from 11 to 24 days, with an average of 15.9 days to epithelialization. In the collagen group, wound healing ranged from five to 17 days,

Verruca (Collagen)

SEX	AGE	LENGTH OF HEALING TIME	COMMENTS
M	79	5 days	Cryotherapy
F	80	13 days	Cryotherapy
M	50	21 days	Cryotherapy, initial treatment 10 days, additional spreading 11 days
M	8	12 days	Cryotherapy
F	13	13 days	Cryotherapy, 3 sites: 2.8 cm, 8 cm, 1.6 cm
F	13	14 days	Cryotherapy, 5mm x 6 mm
M	24	13 days	Cryotherapy, lesion area 8 mm circumferentially
F	47	17 days	Cryotherapy, 4mm
F	39	7 days	Cryotherapy, small lesion 7mm circumferentially
F	33	7 days	Cryotherapy, 1.2 cm, 7mm, 2.2mm 3.1mm
F	23	11 days	Cryotherapy and silver nitrate, 1.5 cm. Blister reaction with Neosporin
M	50	10 days	Cryotherapy. Additional spreading at 11 days
M	74	7 days	Cryotherapy
M	44	7 days	Cryotherapy, 1.6cm x 1.4 cm, 0.3cm to 0.5 cm
M	60	7 days	Liquid nitrogen
M	38	9 days	Liquid nitrogen, 8mm x 6mm
M	38	17 days	Liquid nitrogen. Lesions measured from 1.5cm to 1.2 cm and 0.6cm. At 1 week almost healed, went out of town.
F	82	21 days	Neosporin. Patient developed possible hemangioma 8-9mm circumferentially. Removed hemangioma 3rd post-op day
F	13	34 days	Silver nitrate, 1.3-1.4cm
M	16	16 days	Silver nitrate, 1.6cm x 1.4cm
M	24	21 days	Silver nitrate, 1.7cm and 1.3 cm
F	33	20 days	Silver nitrate, 1.8cm
F	18	20 days	Silver nitrate, 1.8cm x 1.6 cm
M	68	51 days	Silver nitrate, 2.4cm x 2.6cm, 1.8cm 2 x 3cm, 1.6cm x 1.4 cm, 1.4cm x 1.3cm and 1.1cm x 1.6cm. Traumatized wound sites; 75% closed on 18th day, back to original depth on 27th day. 2 sites closed by 27th day, 3 sites closed by 34th day, injured sites closed 23 days after redeborde and start over.
F	39	56 days	Silver nitrate, 2.6cm x 2.4cm, 8 lesions. Cryotherapy. Allergic reaction to Neosporin at 27 days, took additional 28 days
F	77	32 days	Silver nitrate, 2.7cm and 2.5cm. Developed MRSA infection 20th day
F	13	29 days	Silver nitrate, 3 sites
F	47	46 days	Silver nitrate, 3.2cm and 1.6cm. Traumatized at 14th day and 21st day
F	20	27 days	Silver nitrate, developed allergic reaction to Neosporin 4 days post-op; developed nummular eczema 9 days post-op. Prescribed Prednizone. 3 lesions 1.7cm x 1.5 cm, 8mm x 9mm, 2.6cm x 2.4cm
F	33	41 days	Silver nitrate, injured almost closed site at 20th day, took 21 days to reclose deepest wound
M	49	40 days	Silver nitrate, left deeper and larger than right at 2.8cm x 2.4 cm
M	49	47 days	Silver nitrate, right 1.1cm x 1.0cm
F	17	23 days	Silver nitrate chemocautery
M	20	32 days	Silver nitrate. Traumatized site 2 days after closed, ulcer closed at 14 days

All patients treated with SkinTemp and other drugs as noted.

with an average of 10.5 days to epithelialization. Although the surgical technique was identical in deep excision of warts, various wound-care techniques were utilized in both the traditional and the collagen groups. The traditional care group included 17 cases: 14 received topical Elase® (Parke-Davis, Morris Plains, NJ)

application after hydrogen peroxide slow-dripped for 10 minutes followed by diluted distilled white vinegar soaks (1 part vinegar to 4 parts water). Topical Elase® with or without chloromycetin was continued until sufficient separation of eschar from the wound could be surgically accomplished. In no case did topical

Ulcers (Collagen)

SEX	AGE	LENGTH OF HEALING TIME	COMMENTS
F	74	7 days	Abscessed hallux
M	78	7 days	Abscessed hallux
M	63	42 days	Abscessed hallux, patient changed out Collagen daily, was not able to interface
F	72	7 days	6mm x 4mm
F	69	14 days	2.5mm circumferentially. Collagen/Neosporin
F	69	21 days	5mm circumferentially. Collagen/Neosporin
F	75	16 days	5mm x 4mm
F	90	10 days	3mm circumferentially
M	69	21 days	4mm circumferentially
F	91	14 days	7mm circumferentially. Skin Temp/Gentamycin
F	67	14 days	5mm x 4mm
M	62	5 days	4mm circumferentially
F	62	7 days	6mm x 4mm
F	80	14 days	5mm circumferentially
F	80	60 days	Patient had several ulcers from 6mm - 9mm in size
F	80	75 days	Venous stasis ulcer at ankle 7mm x 5mm. Granules/Gentamycin
F	80	41 days	5mm x 3mm with gangrene. Granule/Gentamycin (1 week)
M	74	7 days	4mm
F	76	7 days	3mm abscess
F	62	20 days	5mm circumferentially
F	79	43 days	8mm, granulation tissue
M	21	14 days	Ulcerated surgical site playing basketball, reclosed at 14 days

Ulcers (Non-Collagen)

SEX	AGE	LENGTH OF HEALING TIME	COMMENTS
F	87	24 days	Minor ulcer with and without significant cellulitis 4mm x 6mm and 3mm deep, Cephalexin 500 mg
F	77	59 days	6mm x 8mm and 4mm deep, Cephalexin 500 mg tid pc
F	63	33 days	Doxycycline 100mg bid x 7 qd x 14
M	33	28 days	3mm x 5mm, Rx Cephalexin 500mg
F	43	27 days	Diabetic, 5mm x 4mm and 4mm deep, Rx Cephalexin 500 mg
F	52	47 days	Diabetic, 9mm x 7mm and 5mm deep, Rx Bactrim DS
M	63	63 days	8mm x 9mm and 8mm deep, -bone scan, Rx Floxin 400 mg
M	79	47 days	Diabetic, 8mm x 7mm and 5mm deep, Rx Cleocin 300 mg, cellulitic
M	76	58 days	Diabetic, tendon sheath, FDL involvement, Rx Cleocin, 8mm circumferentially
F	44	29 days	Rx Cleocin, cellulitic, 4th LS ulcer 7mm x 9mm
F	57	37 days	Diabetic, Rx Duricef 500 mg bid
F	73	14 days	4mm x 3mm and 2mm deep
M	62	28 days	5mm x 4mm and 3mm deep
F	74	32 days	5mm x 6mm and 4mm deep
F	91	57 days	Rx Duricef 500 mg, 5mm x 4mm and 6mm deep
F	41	23 days	4mm x 3mm and 3mm deep
F	72	38 days	5mm circumferentially
F	83	32 days	Diabetic, 3mm x 6mm and 4mm deep
M	77	27 days	6mm x 7mm and 2mm deep
F	49	31 days	5mm x 8mm and 3mm deep
F	86	35 days	7mm x 4mm and 4mm deep

Non-permanent Nail Surgery (Collagen)

SEX	AGE	CULTURE FINDINGS	LENGTH OF HEALING TIME	COMMENTS
F	82	Proteus Miralbus	9 days	
M	22	Group B beta-hemolytic strept and staph aureus	13 days	
M	32	Group B strept and staph aureus	11 days	
M	77	Enterococcus faecalis	13 days	
M	76	Group B strept	31 days	Granules. Abscess with bleb blister ulceration. Pregangrene.
M	21	Beta-hemolytic strept and staph aureus	14 days	
M	68	No growth	20 days	Granules/Gentamycin. Digit was gangrenous w/ ulcer
M	17	Group A beta-hemolytic strept and staph aureus	18 days	
F	14	Staph aureus	14 days	
M	14	Staph aureus	11 days	
F	21	Staph aureus	11 days	
F	62	N/A	11 days	
M	69	Escherichia coli; Enterococcus faecalis	23 days	Patient had osteomyelitis
F	65	Staph coagulase, Negative	10 days	
F	65	Staph coagulase, Negative	14 days	
F	76	Staph epidermatous	30 days	Liquid/Granules/ SkinTemp. Patient had osteomyelitis
M	74	No growth	17 days	
M	75	Staph coagulase negative escherichia coli	18 days	
M	23	Staph aureus	12 days	
M	14	Staph aureus	13 days	
F	87	Staph coagulase negative	7 days	
F	71	Serratia marcescens	11 days	
M	20	Proteus miralbus, staph aureus	20 days	
M	72	Methicillin resistant staph aureus	14 days	
F	17	Staph aureus	11 days	
F	42	N/A	11 days	Neosporin

All patients treated with SkinTemp® unless otherwise noted.

enzymes adequately allow for eschar to be eradicated without an additional procedure to eliminate black eschar from the wound. Neosporin® was then substituted in the regimen until wounds closed. In 20 cases, no Elase® was used. Overall, wound healing ranged from 36 to 118 days, with an average of 57 days.

In collagen wound care, 17 cases were treated with Skin Temp®. No additional removal of eschar was needed as the area treated with silver nitrate was autogenously debrided. Only minimal superficial debridement of excess dissolved collagen was required. Wound healing ranged from 20 to 47 days, with an average of 30.3 days.

Ulcers

Over the past 10 years in my own practice, I have used hydrocolloids, wet-to-dry, occlusives, and other dressings to close ulcers. In some cases, one or another product would work. In some cases, almost any product in my lineup

would work. But in some cases, no product seemed to work. Meanwhile, I continued to compare and use my own mixture of granulated table sugar with Betadine® (Purdue Frederick, Norwalk, CT) solution. It was cost efficient to make, and my results were as efficacious as any of the products I had tried. Consequently, my data in ulcer cases compare collagen with my home-made remedy.

In all ulcer cases—whether superficial or deep—wounds were appropriately debrided surgically on a serial basis weekly. The traditional cases were treated with diluted distilled white vinegar (1:4), repacked with Betadine® sugar paste twice daily, and appropriately dressed with sterile dressings. Patients were advised about non-weightbearing, limited weightbearing, and full ambulation, pads, orthotics, or shoes as indicated. The care regimen, thus, included depressurizing plantar ulcers with appropriate shoes, antibiotics, insulin, oral medications as prescribed by the

Products Used

When collagen is applied at the time of hemostasis, it acts as an assistive mechanism to augment clotting. Collagen actually increases platelet adherence to the endothelial vessel wall, thus sealing it off.

Kollagen™ products are very similar to human collagen. They are derived from Type I bovine collagen and are available commercially in three forms: a gel, a sheet, and particles. All three forms are designed to be applied directly to wound surfaces alone, or they can be mixed with other medications and/or topical agents. It has been my experience that mixing triple antibiotic and other ointments does lead to significant complications with macerated skin and heavy skin slough.

The following Kollagen™ woundcare products, provided by the manufacturer, Biocore, Inc., were used in this retrospective research.

- **Medifil® Particles.** Indicated for deep wounds or wounds with tracts such as osteomyelitis or ulcers with severe cellulitis following tendon sheaths.

- **SkinTemp®.** I have used SkinTemp® extensively in ulcers, nail and wart surgeries, and primarily closed surgical procedures. I typically will replace Medifil® Particles with SkinTemp® as deep ulcers have become shallower.

SkinTemp® has a nylon mesh backing. To keep wounds moist when necessary (e.g., permanent nail surgeries), I leave the nylon backing intact external to the SkinTemp® and allow the nylon mesh to function partially as an occlusive barrier. When I want moisture maintained with parti-

cles, I have utilized Tegaderm®, Bioclusive®, and Telfa® pads and have observed no superiority of one product over the other.

When Medifil® Particles are compared to SkinTemp®, the surface area of material delivered to the wound appears to be greater than the surface area of SkinTemp®. As we know, if crushed ice as opposed to an ice cube containing the same volume of water is placed in water, a larger surface area of exposure exists to the crushed ice. I believe that this may be a similar phenomenon. Hence my observation reported in this article of utilization of Medifil® Particles and SkinTemp®.

- **Medifil® Gel.** I have used Medifil® Gel mixed with Medifil® Particles as a vehicle in wounds and also mixed gentamycin cream with Medifil® Particles. In six cellulitis cases, all treated with appropriate

medical care (including complete bed rest, warm moist compresses, elevation of lower extremity, and oral antibiotics such as Floxin® (McNeil, Ft. Washington, PA) 400mg bid or Cleocin® (Pharmacia Upjohn, Kalamazoo, MI) 300mg tid pc with yogurt), I observed a more rapid resolution of the cellulitis as compared to cases with similar management and Medifil® Gel instead of gentamycin cream. Other observers have noted that in methylmethacrylate beads impregnated with gentamycin as administered in osteomyelitis, direct local delivery of gentamycin from the beads appeared to eradicate the infection better than IV administration of gentamycin alone. I believe that similar results may be found, but additional studies are required.

patient's attending medical doctor, and other appropriate and necessary care. Average time to epithelialization was 34.5 days. Traditional cases requiring more than 100 days of care were not considered in this comparison.

Still, I was seeking improved alternatives. I added Gentamycin cream as a vehicle to Medifil® Particles to increase the moldability of the particles and to reduce particle spill from the wound in the plantar aspect of the foot. Four cases were treated in this manner until the wound granulated to approximately 50 percent of its original depth.

In collagen wound care cases, both Medifil® Particles and/or SkinTemp® were used. Wound healing ranged from seven days to 75 days to epithelialization. The average was 21.25 days.

Conclusion

I believe it is fair to say that the use of collagen as an adjunct therapy in wound care significantly reduces time it takes for the body to heal itself. As demonstrated in these approximately 300 cases covering two years of retrospective research in my clinic, the introduction of collagen in the appropriate stage of wound treatment of permanent and nonpermanent nail surgeries, traditional primary closure of wounds, post-excision of verruca, and ulcer care was superior to all traditional care methods reviewed. This phenomenon occurs in both healthy and

unhealthy patients. In fact, in chronic disease states, e.g., rheumatoid vasculitis or diabetes mellitus, recalcitrant wounds do appear to close fully with resultant restoration of patients to their usual activity levels. Moreover, complications in collagen-treated patients occurred with less-than-expected frequency.

As with any new surgical procedure, drug or wound care product, the physician must go through a learning curve. Additional comparisons following a rigid scientific method protocol are still needed to reach the conclusions implied here.

Still, I submit that collagen is a quality adjunct that can be easily applied to many different types of wounds in many different disease states. □

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- Next installment: verruca, conclusions, and speculation on future research in wound healing.

Dr. Kollenberg, who practices in Hot Springs, Arkansas, recently presented these experiences at the Ohio College of Podiatric Medicine.

A retrospective review of wound healing

by Lawrence O. Kollenberg D.P.M., F.A.C.F.A.S., C.W.S.

In a retrospective review of over 225 assorted podiatric cases, Medifil® and SkinTemp® collagen wound management products were compared to standard care treatment.

Types of wounds include:

- deep verruca plantaris (warts)
- surgical wounds
- ulcers
- acute infected paronychia
- chronic paronychia (with and without onychomycosis)

All wounds were compared from beginning of treatment until complete epithelialization was noted.

Medifil® and SkinTemp® were supplied by BioCore Medical Technologies, Inc.

Deep Excision Verruca (warts)

All patients were treated with sharp surgical debridement of warts with silver nitrate cautery. Rate of wound healing with Medifil® and SkinTemp® wound management products averaged 30.3 days (see figures A & B) as compared to 57 days with standard care (enzymatic debridement).

Medifil® and SkinTemp® Products

N=17

healing range: 20-47 days

average: 30.3 days

H₂O₂, diluted vinegar soaks, enzymatic debridement

N=17

healing range: 36-118 days

average: 57 days

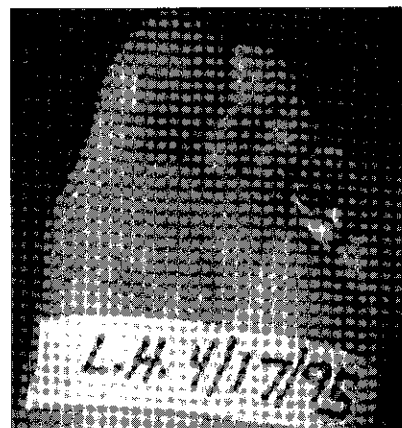


Fig. A - Four days post-op excision and silver nitrate. Note the early epithelialization at margins, granulation, and autolytic debridement.



Fig. B - Same case at 30 days post-op. Wound has completely epithelialized. The perimeter shows normal skin striations and quality closure.

Surgery with Primary Closure

All skin wounds closed with 4-0 Ethilon® in either simple interrupted or continuous lock technique. One group used SkinTemp® wound management products (see figures A & B) and the control group used non-adherent dry sterile covering (Adaptic®) with both groups getting gauze secondary dressing.

SkinTemp® Products

(without complications)

N=16

suture removal: 3-11 days

average: 6.7 days

Non-adherent sterile dressings

(without complications)

N=14

suture removal: 10-18 days

average: 14 days

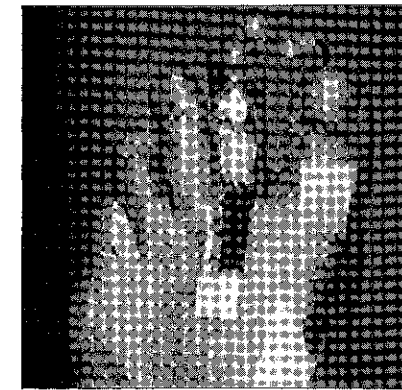


Fig. A - Post-op bunionectomy and hammertoe correction at post-op day #7 (post-op visit 1). SkinTemp® still intact. Minimal bleeding with clotting adsorbed by SkinTemp®.

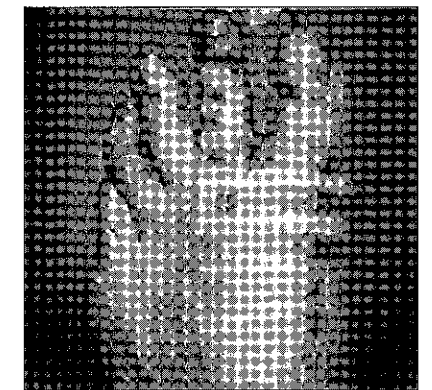


Fig. B - Post-op day #7 (same visit). SkinTemp® and sutures removed and Steri-Strips® applied. Note epithelialization and quality of closure in 7 days.

Steri-Strips® is a registered trademark of 3M
4-0 Ethilon® is a registered trademark of Ethicon
Adaptic® is a registered trademark of Johnson & Johnson

Ulcers

All cases considered in this review were judged to be Wagners Type II ulcers. Cases were not sorted for diabetic or other etiologies nor for infection at the initial presentation. Rate of wound healing with Medifil® and SkinTemp® wound management products averaged 18.67 days (see figures A & B) as compared to 36.66 days with Povidone-iodine-calcium alginate.

Medifil® and SkinTemp® Products

N=21

healing range: 7-56 days

average: 18.67 days

Povidone-iodine - calcium alginate

N=21

healing range: 14-63 days

average: 36.66 days

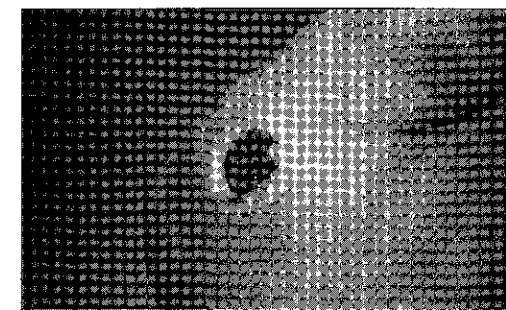


Fig. A - Eleven month diabetic neurotrophic ulcer which had been treated with topical ointments, enzymes, calcium alginates, hydrocolloids, and contact casts.

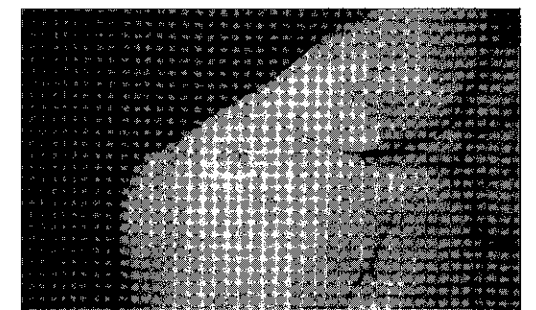


Fig. B - Same foot after 8 weeks of topical application of SkinTemp®. Patient was non-compliant with non-weight bearing orders, depressurizing pads in shoes were included. Quality of skin shows minimal scarring, a key in preventing future breakdown.

Acute Infected Paronychia

All cases had partial/total non-permanent nail avulsion with incision and drainage abscess. Rate of wound healing with SkinTemp® wound management products (see figures A & B) averaged 12.86 days as compared to diluted vinegar soaks and gentamycin cream which averaged 17.52 days.

SkinTemp® Products

N=26

healing range: 7-31 days

Diluted vinegar soaks, gentamycin cream

N=24

healing range: 11-61 days

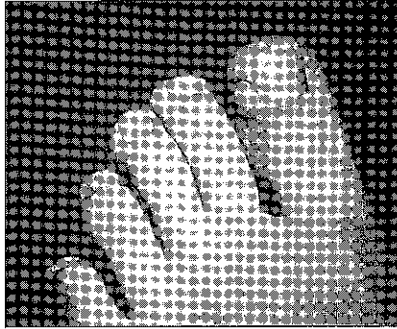


Fig. A - Initial visit with acute infected paronychia, pre-operative minor abscess present to distal fibular labial fold.

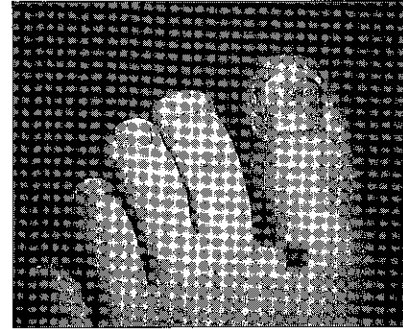


Fig. B - Same patient at post-op day #4, post-op visit #1. Wound shows epithelialization at abscess perimeter and full granulation bed with angiogenesis and margination.

Chronic Paronychia

All cases had standard modified alcohol-phenol surgical technique. Rate of wound healing with SkinTemp® wound management products averaged 26 days (see figures A & B). These dressings were changed once every other day.

With standard soaks and triple antibiotic ointment, the rate of wound healing averaged 36 days. These dressings were changed twice daily.

SkinTemp® Products

N=39

healing range: 15-40 days

average: 26 days

Diluted vinegar soaks, triple antibiotic ointment

N=37

healing range: 21-67 days

average: 36 days

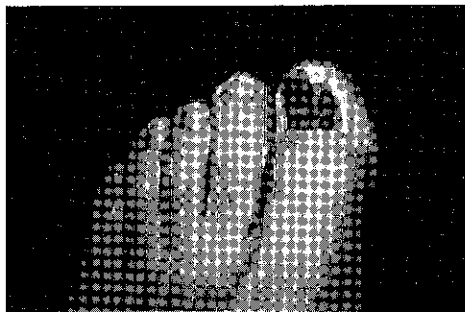


Fig. A - Post-op day #3. Total permanent removal of nail. Note the lattice of SkinTemp® collagen sheet saturated with drainage and blood. Digit shows excellent granulation with minimal erythema and maceration.

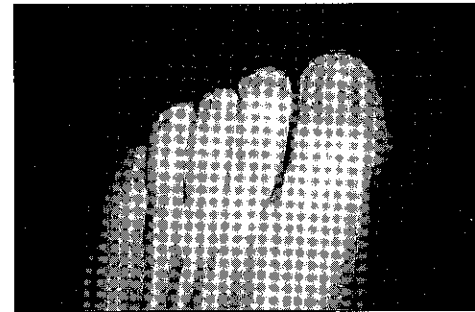


Fig. B - Same toe, post-op day #45. Nail bed is pink, clean, clear of debris and closed.