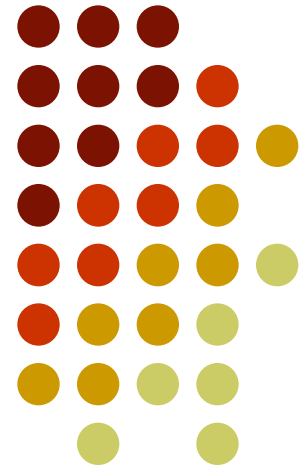


# Arterial and Venous Lower Extremity Ulcers

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UMass Memorial Healthcare



# Lower Extremity Ulceration: Vascular



United States:

- Venous Disease: 72%
- Arterial Disease: 6%
- Mixed Arterial/Venous: 22%

# Lower Extremity Ulceration



- Diagnosis and risk assessment
- Active treatment
- Palliative treatment when wound closure not attainable
- Ongoing care to slow progression, prevent recurrence and/or new occurrence



# Lower Extremity Ulceration

## Wound History and Characteristics:

- Date of onset and site of ulcer
- Date, site of previous ulcers
- Prior treatment, time to heal
- Past vascular surgery (arterial or venous)
- Document:
  - Size: measure largest dimensions, photograph
  - Wound base: granulation, fibrous, slough, necrotic
  - Drainage: heavy, moderate, light, none



# Lower Extremity Ulceration

## Wound Evaluation

- Infection: purulence, odor, cellulitis, necrosis
- Sinus tracking
- Bone exposure
- Gangrene
- Atypical: tumor, vasculitis, SCA, pyogenic gangrenosum
- Pain, Quality of Life, Mobility

# Lower Extremity Ulceration



## Comorbidities:

- Diabetes
- Renal insufficiency
- Obesity
- Tobacco abuse
- Cardiovascular disease
- Drugs (corticosteroids, chemotherapy)
- CTD: RA, SLE
- Allergies: contact dermatitis, latex, silver

# Arterial Insufficiency



## History:

- Claudicating pain
- Rest pain, night pain
- Non-healing, painful ulceration

## Findings:

- Cold limb or feet
- Shiny, atrophic skin
- Hairless
- Dependent rubor
- Elevation pallor
- Dry, punched-out ulcer of toes or over bony prominence





# Arterial Ulcers

- Pale
- Painful
- Slough
- Necrosis
- May be deep
- Dry gangrene
- No staining  
(unless also venous)





# Examine carefully











# Arterial Insufficiency

## Diagnosis – Non-Invasive Studies:

- Ankle brachial index (ABI)
  - 0.5 – 0.8: peripheral arterial occlusive disease
  - $>1.2$  suggests noncompressibility, need TBIs
  - $<0.4$ : severe ischemia
- Toe brachial index (TBI)
  - $<30$  mmHg systolic pressure: severe ischemia

*Ischemia requires vascular surgery referral!*



# Arterial Ulcers

Standard treatment:

- Diagnose level of arterial insufficiency:
  - Segmental pressures, pulse volume recordings
- Arteriography +/- endovascular treatment
- Open surgical bypass
- Medication Management
- Wound Care: surgical debridement, amputation; dry dressing or open to air





# Arterial Ulcers

Wound Care: **Keep Dry!!**

- Dry dressing or open to air
- No ointments or creams
- Minimal to no debridement
- Pressure relief
- Infection control

Advanced therapies not indicated until wound is reperfused but non-healing!

# Arterial Ulcers



## Post-Intervention:

- Keep dry until eschar gone, may trim edges
- For pink wound base, keep moist
- Accommodate wound
- Smoking cessation
- ASA and statin therapy
- Exercise
- Vascular surveillance after procedures







# Venous Ulceration

United States:

- 600,000+ new venous ulcers annually
- Affects 1-4% of the population
- Recurrence rate averages 75%
- >50% out of work or disabled
- >25% depression or anxiety

# Venous Insufficiency



## History:

- Prior SVT, DVT
- Symptomatic varicosities
- LE trauma, vascular injury
- Varicose vein surgery
- Hypercoagulable states  
(cancer, infection, Factor VIII excess, Factor V Leiden)

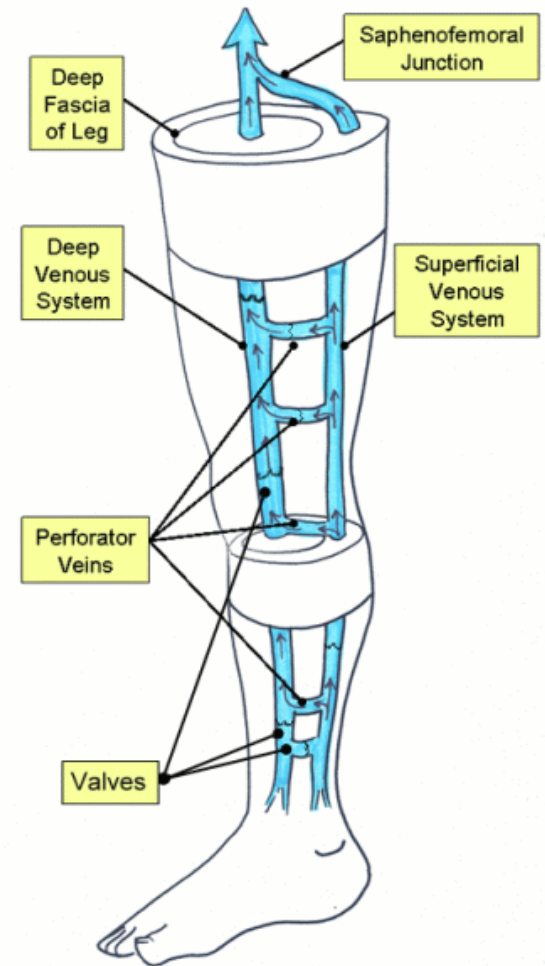
## Findings:

- Edema
- Shallow wound in lower third of leg
- Venous dermatitis
- Lipodermatosclerosis
- Varicose veins

# Normal Venous Flow in the Leg

- Normal Flow
  - Superficial veins → deep veins
  - Feet → Heart
- Superficial vein disease always starts with abnormal valves and interruption to normal flow →

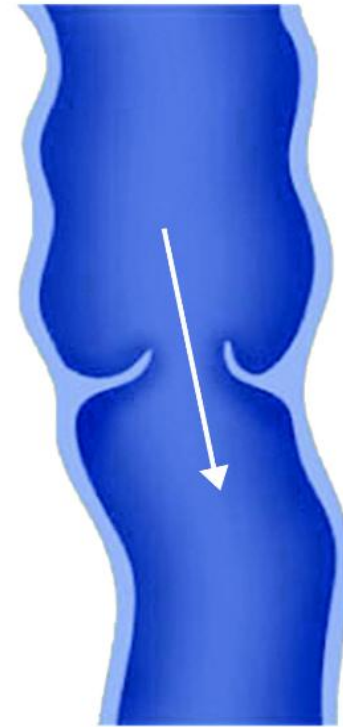
## Venous Reflux



# Venous Reflux



Healthy Vein Valves  
& Correct Blood Flow



Damaged Vein Valve  
& Incorrect Blood Flow

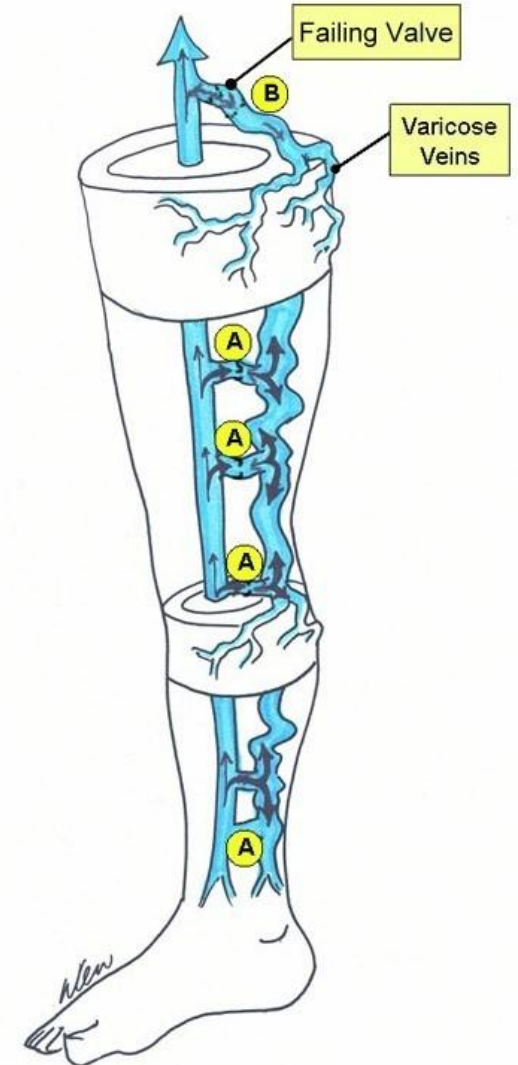


# Abnormal flow = Venous Reflux



## Damaged Valves:

1. Blood flows to the skin
2. Blood is pushed distally and proximally
3. Closed loop recirculation
4. Blood is retained in the leg
  - Increased volume of blood
  - Increased venous pressure
  - Veins dilate



# CEAP Classification



- **“C”** = Clinical
  - C0 - no visible venous disease
  - C1 - telangiectasias or reticular veins
  - C2 - varicose veins
  - C3 - edema
  - C4 - skin changes without ulceration
    - C4a – pigmentation and eczema
    - C4b – LDS and atrophie blanche
  - C5 - skin changes with healed venous ulcer
  - C6 - skin changes with active venous ulcer
- **“E”** = Etiology (congenital, primary or secondary)
- **“A”** = Anatomy (superficial, deep or perforating veins)
- **“P”** = Pathophysiology (reflux, obstruction, both or none)

# Venous Ulcers

- Shallow, moist and red
- Often copious drainage
- Gaiter area
- Brawny staining of skin
- Leg edema











# Venous Ulcers



Standard treatment:

- Compression therapy
- Limb elevation
- Calf exercises and walking
- Wound care
- Diagnostic testing for venous reflux
- Correction of superficial venous reflux



# Compression Therapy



- Two to four-layer bandage kits (Profore, 3M)
- Unna boot
- Double layer compression stocking:
  - 40-50 mmHg
  - Inner stocking (10-15mmHg) stays on 24/7, remove to bathe and change dressing
  - Outer stocking (30-40mmHg) applied on waking, removed at bedtime
- Pneumatic compression pump
- Maintenance: 30-40 mmHg stocking or Circ-Aid

### INSTRUCTIONS FOR USE

Before applying the PROFORE System for the first time:

1. Make certain the ankle Brachial Pressure Index (ABI) is above 0.8. The determination of ABI by Doppler ultrasound testing is recommended.
2. Measure the



ankle circumference. PROFORE should not be applied to legs with an ankle circumference of less than 18cm/7 1/4 inches. If the ankle circumference is less than 18cm/7 1/4 inches, wrap extra padding (PROFORE #1) around the ankle area to increase the circumference to more than 18cm/7 1/4 inches before applying the PROFORE System.  
3. Identify bony prominences on the leg and make sure these bony points are well padded using the PROFORE #1 roll. (See step #3 below).

#### Before subsequent Applications

Measure the circumference (C) of the ankle again because one application of PROFORE can reduce the swelling in the leg over a period of one week. An ankle that measured 8 inches in circumference prior to the first application of PROFORE may have been reduced to less than 7 inches in circumference after a week of compression bandaging and would require extra padding before applying PROFORE.

### APPLY THE PROFORE SYSTEM IN THE FOLLOWING SEQUENCE:

1. Wash and dry the leg and apply a moisturizing cream to the unbroken skin.

To Remove the PROFORE Wound Contact Dressing from the pack with sterile forceps and apply directly over the wound surface. If the wound is larger than the contact dressing, PROFORE Wound Contact Dressings can be purchased separately. The contact dressing will not stick to the surface of the wound and when the wound begins draining after compression is applied, the drainage will pass through the contact dressing to be absorbed by the padding layer.



Wound contact dressing

2. PROFORE #1 Absorbent padding bandage. 10cm x 2.5m (4 in x 7 1/2 ft) (4 in)

Wrap the foot in a spiral manner starting at the base of the toes and continuing in a spiral manner up the leg to the knee. Overlap half the bandage as you wrap it up the leg. Very thin bony legs or legs with a prominent call bone should be protected with extra padding (PROFORE #1). The pressure under the bandage could bruise and harm unprotected or padded skin especially over bony parts of the leg.



Layer 1: PROFORE #1 Absorbent padding bandage absorbs moisture, protects bony prominences, and reduces the pressure evenly around the leg.

any leftover padding bandage directly over the wound to absorb more wound drainage.)

3. PROFORE #2 Light conforming bandage. 10cm x 4.5m (4 in x 14 1/2 ft) (8 in) stretched  
10cm x 3m (4 in x 9 ft) (6 in) unstretched

Again wrap the foot in a spiral manner starting at the base of the toes and continuing over the heel and up the leg to just below the knee. As with bandage #1, overlap half the bandage as you roll it up the leg. Secure at the top with a piece of tape or ask the patient to hold it in place.



Layer 2: PROFORE #2 Light conformable bandage adds elasticity and smooths out the PROFORE #1 layer, preserving the elastic energy of the compression layer.

4. PROFORE #3 Light compression bandage. 10cm x 8.7m (4 in x 28 ft) (5 in) stretched  
10cm x 3m (4 in x 9 ft) (2 in) unstretched

Apply PROFORE Layer #3 bandage from the base of the toes to just below the knee making sure to enclose the heel. To apply PROFORE Layer #3 from the base of the toes to the ankle, use a simple spiral technique. Then, use a simple spiral technique to wrap the leg.



Layer 3: PROFORE #3 Light compression bandage is applied to the leg to provide additional support and compression.

Figure 8 technique at 50% extension. Use the central line as guidance to achieve 50% overwrap. Use tape to secure. Get the feel of 50% stretch by stretching 12 inches of the bandage to its maximum (about 24 to 30 inches) then let it relax to half way back. The tension you feel at 50% stretch should be the tension you feel as you bandage up the leg. With most legs, except the very largest, you will have some of the #3 bandage left over when you reach just below the knee. **WARNING:** Do not continue wrapping until it is all applied. This will create too much pressure at the top of the leg. Cut off the leftover bandage and secure with tape, or ask the patient to hold it in place.

5. PROFORE #4 Cohesive compression bandage. 10cm x 2.5m (4 in x 7 1/2 ft) (2 in) stretched  
10cm x 2.5m (4 in x 7 1/2 ft) (2 in) unstretched

Apply PROFORE #4 from the base of the toes, wrapping the foot in a spiral manner. PROFORE #4 should be applied at 50% tension. Overlap half the bandage as you wrap it up the leg, ending just below the knee. Again, remember to enclose the heel. PROFORE #4 will adhere to itself and no tape is necessary to keep the bandage in place for up to one week.



Layer 4: PROFORE #4 cohesive compression bandage applies compression and maintains the tension in place for up to one week.

DO NOT REMOVE WITH BANDAGES. THE PROFORE SYSTEM SHOULD BE REMOVED BY A HEALTH CARE PROVIDER.

### FREQUENCY OF CHANGE

The wrapped leg may be changed as often as necessary. This will depend on the patient's condition.





# 4-Layer Compression Boot





# 2-Layer Compression Hose = 50 mmHg



# In search of optimal compression therapy for venous leg ulcers: A meta-analysis of studies comparing divers bandages with specifically designed stockings

Felix Amsler, MS,<sup>a,b</sup> Torsten Willenberg, MD,<sup>a</sup> and Werner Blättler, MD,<sup>a,c</sup> *Bern, Biel-Benken, and Winterthur, Switzerland*

Richard P. Cambria, MD, Section Editor

*Objective:* In search of an optimal compression therapy for venous leg ulcers, a systematic review and meta-analysis was performed of randomized controlled trials (RCT) comparing compression systems based on stockings (MCS) with divers bandages.

*Methods:* RCT were retrieved from six sources and reviewed independently. The primary endpoint, completion of healing within a defined time frame, and the secondary endpoints, time to healing, and pain were entered into a meta-analysis using the tools of the Cochrane Collaboration. Additional subjective endpoints were summarized.

*Results:* Eight RCT (published 1985-2008) fulfilled the predefined criteria. Data presentation was adequate and showed moderate heterogeneity. The studies included 692 patients (21-178/study, mean age 61 years, 56% women). Analyzed were 688 ulcerated legs, present for 1 week to 9 years, sizing 1 to 210 cm<sup>2</sup>. The observation period ranged from 12 to 78 weeks. Patient and ulcer characteristics were evenly distributed in three studies, favored the stocking groups in four, and the bandage group in one. Data on the pressure exerted by stockings and bandages were reported in seven and two studies, amounting to 31-56 and 27-49 mm Hg, respectively. The proportion of ulcers healed was greater with stockings than with bandages (62.7% vs 46.6%;  $P < .00001$ ). The average time to healing (seven studies, 535 patients) was 3 weeks shorter with stockings ( $P = .0002$ ). In no study performed bandages better than MCS. Pain was assessed in three studies (219 patients) revealing an important advantage of stockings ( $P < .0001$ ). Other subjective parameters and issues of nursing revealed an advantage of MCS as well.

*Conclusions:* Leg compression with stockings is clearly better than compression with bandages, has a positive impact on pain, and is easier to use. (J Vasc Surg 2009;50:668-74.)

# Compression Therapy



“Leg compression with stockings is clearly better than compression with bandages, has a positive impact on pain, and is easier to use.”





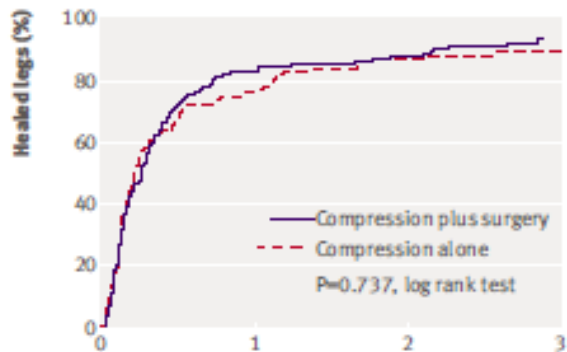
**What about venous reflux?**

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## Long term results of compression therapy alone versus compression plus surgery in chronic venous ulceration (ESCHAR): randomised controlled trial

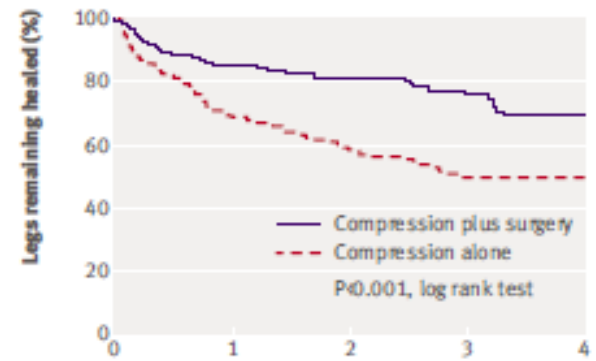
Manjit S Gohel, specialist registrar,<sup>1</sup> Jamie R Barwell, consultant vascular and transplant surgeon,<sup>2</sup> Maxine Taylor, leg ulcer nurse specialist,<sup>1</sup> Terry Chant, vascular nurse specialist,<sup>3</sup> Chris Foy, medical statistician,<sup>4</sup> Jonothan J Earnshaw, consultant surgeon,<sup>5</sup> Brian P Heather, consultant surgeon,<sup>5</sup> David C Mitchell, consultant surgeon,<sup>3</sup> Mark R Whyman, consultant surgeon,<sup>1</sup> Keith R Poskitt consultant surgeon<sup>1</sup>

- RCT: 500 patients (500 legs) : open/recently healed VSU with reflux
- Interventions: compression alone or compression with saphenous surgery
- Measures: Ulcer healing, ulcer recurrence, ulcer free time



	Time (years)			
Numbers at risk	0	1	2	3
Compression plus surgery	185	33	13	6
Compression alone	156	24	15	5

Fig 2 | Kaplan-Meier survival analysis showing ulcer healing at three years



	Time (years)				
Numbers at risk	0	1	2	3	4
Compression plus surgery	216	166	124	68	27
Compression alone	226	139	98	45	10

Fig 3 | Kaplan-Meier survival analysis showing ulcer recurrence at four years

- Surgical correction of superficial venous reflux in addition to compression bandaging does not improve ulcer healing rates (89% [no surgery] vs 93% [surgery])
- Surgical correction can, however, reduce the chance of recurrent ulceration (56% [no surgery] vs 31% [surgery]) and increase ulcer free time (85 wks [no surgery] vs 100 wks [surgery])

# SVS and AVF Guidelines



- To decrease the recurrence of venous ulcers, ablation of the incompetent superficial veins in addition to compression therapy is **strongly recommended**.
- Endovenous thermal ablation (EVLT or VNUS) is **recommended** rather than high ligation and inversion stripping of the GSV to the knee.
- Treatment of refluxing perforating veins located underneath healed or active ulcers is **suggested**.

# SVS and AVF Guidelines



- Vein ligation, stripping and endovenous ablation appear to be equivalent in reducing the time of ulceration and recurrence of ulceration.
- Ulcer recurrence may be associated with perforator incompetence, branch vein reflux or iliac vein obstruction.
- Compression therapy should continue in both surgically treated and conservatively treated patients with healed ulcers.



# Wound Care

- Serial debridement, irrigation
- Infection control:
  - Use clinical findings, don't treat uncomplicated wounds
  - Culture and sensitivity
  - Empiric therapy
  - MRSA: Sulfamethoxizole (creatinine  $<1.2$ ) or doxycycline
  - Longer term treatment, suppression

# Wound Care: Moisture-based Wound Management



- Manage exudate and protect periwound skin
- Dressing should stay in place, minimize friction, not cause pain, atraumatic removal
- Cost-effectiveness, ease of use, provider time
- Dressings are used under compression
- Patient-centered and individualized

# Moist Wound Therapy = Gold Standard



- Alginates
- Foams
- Hydrofibre
- Hydrocolloids
- Gels
- Composites





# Balanced Moist Wound Therapy



- If it's wet, dry it
- If it's dry, moisten it

**Wet-to-Drys are NOT the Standard of Care!!**

# Impede Wound Healing



# Advanced Wound Care



A large, growing array of therapies have been developed . . .

## *Bioengineered Alternative Tissues*

- **Bio-Active Wound Adjuncts:**

- Oasis Porcine intestinal submucosa
- Integra Bovine collagen / chondroitin-6-sulfate
- GammaGraft Gamma irradiated human allograft skin
- Graft Jacket Human allograft product
- Epifix Dried human amnionic membrane

- **Living Tissues / Growth Factors:**

- Platelet rich plasma (PRP) Blood plasma enriched with platelets, releases growth factors and other cytokines
- Regranex (becaplermin) Platelet derived growth factor topical
- Apligraf Living human dermal fibroblasts and epidermal keratinocytes in bovine collagen matrix
- Dermagraft Living human fibroblasts on resorbable mesh



# Advanced Wound Care Therapies for Non-Healing Diabetic, Venous, and Arterial Ulcers: A Systematic Review

November 2012

## Prepared for:

Department of Veterans Affairs  
Veterans Health Administration  
Quality Enhancement Research Initiative  
Health Services Research & Development Service  
Washington, DC 20420

## Prepared by:

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## Research Assistant:

Indy Rutks, B.S.



# QUERI



- Reviewed 20 RCTs for 9 different advanced products for venous ulcers
- Some evidence for Apligraf and Oasis for less time to healing, with less recurrence
- Not much evidence for Dermagraft, Collagen, PRP, Silver products, HBO, or EMT

*So when should we use these products for venous ulcers?*

# Advanced Wound Management

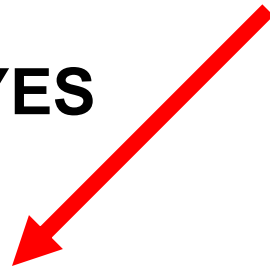


**STANDARD WOUND CARE x 4 weeks**



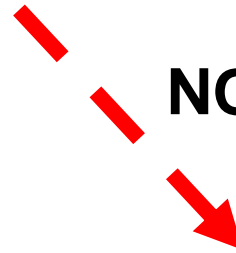
**50% Healed?**

**YES**



Continue with  
treatment

**NO**



Consider the etiology and  
“Advanced Wound Therapy”



# Apligraf Use for VSU



1 wk s/p 2<sup>nd</sup>  
appl Apligraf  
8-5-10



3<sup>rd</sup> Apligraf appl  
8-24-10



9-1-10

# Apligraf Use for VSU



9-15-10



4<sup>th</sup> Apligraf  
appl 9-27-10



1 wk s/p 4<sup>th</sup>  
Apligraf appl  
10-4-10



10-18-10



# Apligraf Use for VSU



New bleeding,  
inflammation  
10-25-10



11-17-10



12-1-10



12-22-10

# Apligraf Use for VSU



2-7-11

4 appl Apligraf; 7 months of care



# Venous Ulceration

Evaluation, debridement of ulcers.  
Weekly multi-layer boot or 2-layer 50 mmHg hose with daily wound dressings, treat any infection, visits q 1-2 wks

Ulcer healing < 50%  
in 4 weeks

Ulcer healed

Compression garment  
30-40 mmHg

Evaluation, duplex imaging to assess for reflux, treatment plan to correct reflux, continue compression and wound care, modify other risk factors

No correctable reflux present

Ulcer healing  $\geq 50\%$

Continue compression and wound care, visits q 1-4 wks, measure and debride wound

Ulcer healed

Correctable reflux present

Education, risk factor modification and long-term compression garment use

Vascular Surgical Intervention:  
- Vein ligation / stripping  
- Endovenous Laser Ablation  
- Phlebectomies

Ulcer healing < 50%  
in 4 weeks

Re-evaluate for infection, compliance, ABIs, reflux. Continue long-term compression. Consider use of Advanced Wound Therapy.

# Education and Risk Reduction



- Nonconstrictive clothing
- Compression garments (venous)
- Weight control
- Smoking cessation
- Exercise, avoid prolonged immobility
- Skin hygiene and protection
- Reduce salt, maintain hydration



**~Thank You~**

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