Combination therapy for scars: what to use and when.

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Disclosures

- No financial disclosure
Excess production of collagen from deep dermal fibroblasts (Wang 2008)

Inc. Type III and Type V collagen (Hayakawa 1979, Bailey 1975)

Altered GAG production
  - Dec. Decorin $\rightarrow$ Inc. TGF-$\beta$ (Yamaguchi 1990)
  - Inc. Versican $\rightarrow$ Inc. turgor (Scott 1996)

Wound tension implicated in formation (Yagmur 2010).
Sequelaes of burns

Contractures  Scar Hypertrophy/Keloids  Loss of Structures
History of scar therapy

- 900AD: Ifa Literary Corpus
- 1678: Ambrose Parey
- 1790: Retz
- 1806-1817: Alibert
- 1835: Rayer: hypertrophic burn scar
- 1890: Unna
- 1961: Cronin
- 1970: Larson, Huang, Willis
### Vancouver scar scale

<table>
<thead>
<tr>
<th>Pigmentation (0-2)</th>
<th>Normal</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hyperpigmented</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Hypopigmented</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vascularity (0-3)</th>
<th>Normal</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pink</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Red</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Purple</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pliability (0-5)</th>
<th>Normal</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Supple</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Yielding</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Firm</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Banding</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Contracture</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Height (0-3)</th>
<th>Normal (flat)</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-2mm</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2-5mm</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>&gt;5mm</td>
<td>3</td>
</tr>
</tbody>
</table>

### Patient/observer subjective assessment scale

**Observer Scar Assessment Scale**

- **Normal Skin**
  - Vascularisation
  - Pigmentation

- **Thickness**
- **Relief**
- **Pliability**

**Total score Observer Scar Scale:**

**Patient Scar Assessment Scale**

- **No, no complaints**
- **Yes, worst imaginable**

**Is the scar painful?**

- **No, as normal skin**
- **Yes, very different**

**Is the scar itching?**

**Is the colour of the scar different?**

**Is the scar more stiff?**

**Is the thickness of the scar different?**

**Is the scar irregular?**

**Total score Patient Scar Scale:**

Draaijers et al. PRS 2004
• 1986: Hosoda – laser doppler flowmeter
• 1988: Bartell – elastometer
• 1990: Esposito – modified tonometer
• 1992: Hambilton – USS
• 1997: Welzel – optical coherence tomography
• 1999: Davey – computer analysis of video
3D photography: for surface area, texture, volume and color.

Ultrasound: for histological thickness measurements.

Colorimetry measure: for color changes

Mechanical changes measure: for viscoelastic measurements of the skin.

Measurement of trans-epidermal water loss

Lee et al. Burns & Trauma (2016)
Patient complaints

- Reduced mobility
- Constant symptoms
- Altered appearance
Therapeutic options

- Rehab: compression, massage/stretching, exercise
- Medical: Corticosteroids, antimetabolites
- Surgical: Excisional vs. non-excisional
Rehab

- Compression
- Massage/Stretching
- Exercise
• Compression – how much is too much?
• Massage/Stretching
• Exercise
Rehab

- Compression
  - Interim garment
  - Custom garment
  - Facemask
Rehab

• Silicone (1980s)
  – Sheets/Strips, Gels, Creams, Sprays, Foams

• Mech:
  – Inc hydration and local temp
  – Polarization of scar tissue
  – Decreased TGFB2 level
  – Decreased fibroblast contraction

Armour et al. 2007, Quinn et al. 1987, Gold et al. 1994
Rehab

- Compression
- Massage/Stretching
  - 10mins, 5 times per day
  - Non-frictional → Frictional
  - Heat: Paraffin wax, ultrasound, hot packs
Moisturizers

- Product vs Application
  - Scar height
  - Vascularity
  - Pliability
  - Pain
  - Pruritus
  - Depression

Paratz et al Burns 2017
Rehab

- Compression
- Massage/Stretching
- Exercise
  - Acute
    - Reduce edema
    - Maintain mobility, strength
  - Intermediate
    - Passive → Active
  - Long term
    - 12 weeks
    - Cardio (3-5/wk) and resistance work (2-3/wk)
Corticosteroid injection (Triamcinolone)

– Dose: 10-40mg/ml

– Benefit:
  • Inc. pliability
  • Dec. height, volume, pain, itching

– Mechanism:
  • Inhibition of fibroblasts, TGFβ and IGF-1
  • Suppression of inflammation
  • Increased collagenase activity

– Side effects: hypopigmentation, s/c atrophy

• 5-Fluorouracil (5FU)
  – Dose: 50mg/ml
  – Benefit:
    • Inc. pliability
    • Dec. volume
  – Mechanism:
    • Inhibition thymidylate synthesis
    • Increased fibroblast apoptosis
  – Side effects: ulceration, hyperpigmentation, pain

Fitzpatrick et al. 1999, Apikian et al 2004
Medical

- Interferon
- Bleomycin
- Imiquimod 5%
- Botox
- TGF-β inhibitors
Surgical options

- Excision of scar and primary closure
- Incisional release and graft (FTSG vs STSG)
- Dermal regeneration templates
  - BTM/Integra
- Tissue expansion
- Laser: CO$_2$ and Vascular
- Microneedling
- Fat grafting
- Flaps: local, pedicled, free
Timing of Surgical Options

• **Urgent (immediate) procedures**
  – Release of eyelid to protect the cornea to avoid cicatricial ectropion
  – Release of microstomia (severe contractures of the mouth)
  – Release of compressed neurovascular bundles
  – Release of synechia (severe neck contractures) that limit neck extension

• **Essential (early) procedures**
  – Non-synechial neck contractures
  – Contractures of major joints (eg, elbow, knee, ankle)
  – Contractures of areas that limit mobility (eg, axilla, groin)
  – Contractures of the hand

• **Desirable (late) procedures**
  – Reconstruction of passive areas (eg, trunk, extremities)
  – Esthetics (eg, face, breast)
Urgent Surgical Procedures
Desirable Surgical Procedures

Photo courtesy of Max Murison
Excision of scar and primary closure

Pre-op

Post-op
Incisional release and graft
Incisional release and graft
Dermal regeneration templates

- Integra
- BTM
• Inner layer: 2 mm porous matrix of bovine collagen and chondroitin-6-sulfate
• 30-120 micron pore size
• Outer layer: 0.23 mm polysiloxane polymer
Dermal regeneration template - Integra
Dermal regeneration template - Integra
5 months postoperatively
Dermal regeneration template - Integra
Tissue expansion

1. Burn wound

2. Balloon-like bag slowly filled with saline solution

3. Expander removed, skin flap moved and sutured over wound
Tissue expansion
Tissue expansion
Reduction of scar thickness
Increasing scar elasticity
Surface modulation
Treatment of Hyper- and hypopigmentation
Dermal restructuring – reduction of TGF-β1 Expression, readjustment of Collagen type I and III ratio
Thickening of Epidermis
• SCAAR FX (60-100mJ at 3%, 100 -150mJ at 1%)
• Deep FX (10-20mJ, 10%)
• Active FX (60-100mJ at 3% (5% if used alone), 125Hz)
• Truespot
Laser – CO$_2$ - Cases

Preop

After 1st Laser

After 2nd Laser
Laser – Vascular - Settings

- **PDL – 585-595nm, 7J/cm²**
  - Reduces erythema
  - Reduces Pruritus
  - Marked purpuric response
  - Slow
- **M22 – Nd:YAG – 1064nm**
  - Telangiectasia
- **M22 – IPL + 590nm filter, 17J/cm²**
  - Reduces erythema
  - Reduces Pruritus
  - Less Purpura
  - Fast (35cm sq handpiece)

2 months post treatment
Laser – Vascular - Cases

Dec 2016

March 2016

March 2016

Dec 2016
Microneedling

- Indication: for large scar plates
- Mech: Percutaneous induction of collagen formation
- Medical needling results in thinning of dermis, improvement of scar texture, and does not lead to hypo/hyperpigmentation
- May be used to repigment hypopigmented burn scars
Fat Grafting – Coleman technique
Fat Grafting – Burn Scar Pruritus

December 2011: Initial condition

July 2012: Improvement

Jan 2014: Further improvement
Flaps

- Local
- Pedicled
- Free
Flaps - local
Flaps – local – Z-plasty
Flaps – local – Z-plasty
Flaps – local – Z-plasty
Flaps – local – V to Y and Y to V
Flaps – local – Y to V
Flaps - Pedicled
Flaps - Pedicled
Flaps - Pedicled
• Compression garments and Vascular laser
• Vascular laser + 5FU + triamcinolone
• Vascular laser followed by CO2 laser
• CO2 laser plus topical agents (Kenalog / triamcinolone / PRP)
• CO2 laser plus injected agents (Kenalog / triamcinolone)
• Surgical release +/- CO2 laser
Pitfalls

• Deleterious combinations
  – Pressure garments and Vit E / Petroleum-based
  – Fat transfer in cases of sodium hydroxide burns

• Deleterious products
Future directions

- Antibody therapy - intracellular proteins
- Drug delivery
- Targeted photodynamic therapy
- USS-assisted laser penetration
- Inc. speed of laser application
- Prevention of PIH recurrence
- Fast, easily applied, reproducible, objective measure of scarring
Thank you