Hypertrophic Scar in Burn Patients

Dhaval Bhavsar, MD
UCSD Burn Center
Wound Healing - 3 Classic Phases

- Inflammation
- Proliferation
- Remodeling

Proliferation

- Fibroplasia
- Matrix deposition
- Angiogenesis
- Re-epithelialization
Burn Wound Healing

- Deep partial thickness burn wounds when allowed to heal primarily, take long time >2 weeks
- Long inflammatory phase and prolonged proliferation phase
- Poor quality wound bed for epidermis
- Myofibroblast activity
Hypertrophic Scar - Keloid

Common features
Imbalance between deposition and destruction of collagen

Clinically
– Red
– Raised
– Painful
– Itchy
Hypertrophic Scar - Keloid

Differences

Typical Distinction between Hypertrophic and Keloid Scars Based on Clinical Features

<table>
<thead>
<tr>
<th></th>
<th>Hypertrophic Scar</th>
<th>Keloid Scar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall incidence</td>
<td>More common</td>
<td>Less common</td>
</tr>
<tr>
<td>Association with race</td>
<td>No</td>
<td>Increasing association with increasing racially determined pigmentation</td>
</tr>
<tr>
<td>Always preceded by injury</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Anatomical association</td>
<td>No</td>
<td>Can occur anywhere but areas particularly prone are earlobes, deltoid region, and presternal region</td>
</tr>
<tr>
<td>Extent of growth</td>
<td>Confined to area of original injury</td>
<td>Extends into surrounding tissue</td>
</tr>
<tr>
<td>Resolves spontaneously</td>
<td>Most will eventually resolve</td>
<td>No</td>
</tr>
<tr>
<td>Recurs after surgery</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Associated with contracture</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Pathology

• Imbalance between collagen deposition and destruction

• Fibroblast no. is comparable to normal skin

• Each fibroblast produces more collagen
Pathology

**Soil:**
- Mechanical forces
- Oxygen tension
- Matrix components

**Seed:**
- Stromal cells (fibroblasts)
- Inflammatory cells
- Endothelial cells
- Keratinocytes
- Stem cells

Epidermis
Dermis
Subcutaneous Tissue
Collagen

- Normal Skin and Mature Scar - Type 1 (approx 80-85%)
- Hypertrophic Scar – Type 1 (55-60%)
- More Type 3 and 5
- Narrow, unorganized fibrils with larger interstices
- Histology - whorls or nodules
Matrix Components

Proteoglycans (Protein+ GAG)
- Responsible for physical properties of skin and scar-turgor, resilience, and compression
- Hypertrophic scars have more GAG (chondroitin sulfate)-higher water content-turgor
- \( \downarrow \)Decorin (normal) – Collagen regulation and organization Vs \( \uparrow \)Versican (Scar) – disorganized collagen

Glycoproteins
- Responsible for cell-matrix interaction and resultant fibroblast phenotype
- \( \uparrow \)glycoprotein concentration
- \( \uparrow \)fibronectin- effect on fibroblast – matrix interaction
Fibroblast Phenotype

- Hypertrophic scars have higher fibroblast density
- Produce more collagen, fibronectin
- Less collagenase, decorin
- Delayed fibroblast apoptosis due to unorganized matrix
- Role of TGF-beta
Myofibroblast

http://www.grad.ucl.ac.uk/comp/2003/research/gallery/entries/large/016.jpg

Lab Invest 2003, 83:1689-1707
Prevention of scar hypertrophy

- Closure without tension, good quality skin grafts, early excision, pre-emptive excision
- Prevention of hematoma, seroma, infection
- Look for early signs- redness, elevation, itching
## Treatment Options

<table>
<thead>
<tr>
<th>Therapy (Manufacturer)</th>
<th>Category</th>
<th>Active Principle</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rose hip oil (various)</td>
<td>Natural remedies</td>
<td>Unknown</td>
<td>Anecdotal</td>
</tr>
<tr>
<td>Vitamin E (various)</td>
<td>Natural remedies</td>
<td>Unknown</td>
<td>Anecdotal</td>
</tr>
<tr>
<td>Corticosteroids (various)</td>
<td>Pharmaceutical</td>
<td>Unknown; may be anti-inflammatory</td>
<td>OBS</td>
</tr>
<tr>
<td>Juvista (Renovo)</td>
<td>Pharmaceutical</td>
<td>Anti-inflammatory</td>
<td>EXP, CT [81]</td>
</tr>
<tr>
<td>Neosporin (Pfizer)</td>
<td>Pharmaceutical</td>
<td>Antibiotic</td>
<td>OBS</td>
</tr>
<tr>
<td>Compression garment (various)</td>
<td>Wound dressing</td>
<td>Unknown; may interfere with mechanotransduction pathways and tissue perfusion</td>
<td>OBS, CT [82]</td>
</tr>
<tr>
<td>Hydrogel sheeting (Avogel)</td>
<td>Wound dressing</td>
<td>Unknown; may be anti-inflammatory</td>
<td>EXP, CT [83,84]</td>
</tr>
<tr>
<td>Silicone sheeting (various)</td>
<td>Wound dressing</td>
<td>Unknown; may interfere with tissue perfusion</td>
<td>OBS, CT [85,86]</td>
</tr>
<tr>
<td>Smoothbeam laser (Candela)</td>
<td>Nonablative laser</td>
<td>Unknown; may stimulate collagen remodeling</td>
<td>OBS [87]</td>
</tr>
<tr>
<td>Erbium laser (various)</td>
<td>Ablative laser</td>
<td>Removes surface of scar</td>
<td>OBS, CT [88]</td>
</tr>
<tr>
<td>Chemical peel (N/A)</td>
<td>Surgical</td>
<td>Removes surface of scar</td>
<td>OBS, CT [89]</td>
</tr>
<tr>
<td>Revision surgery (N/A)</td>
<td>Surgical</td>
<td>Removes scar</td>
<td>OBS, CT [90]</td>
</tr>
</tbody>
</table>

CT, clinical trial; EXP, laboratory data; N/A, not applicable; OBS, observational
Silicone gel sheet

• Mechanism- exact not know
  1. Increased oxygen tension
  2. Improved scar hydration
  3. Direct action of the silicone oil
  4. Polarization of the scar tissue

• Can be started as early as 4 weeks in small facial scars

• Pt should be explained the regime
Indication

- Treatment or prevention of scar hypertrophy and keloids

- Especially over areas non manageable with compression

- Can be used for large areas- custom made compression garments with silicone lining
Silicone gel sheet

- Self adhesive - most cases no need of tapes
- Easy application over most areas
- No discomfort - rare skin allergic reaction
Silicone gel sheet

- Wait till wound is epithelized
- Sutures are removed
- No scab
- No infection, serous secretion
Silicone gel sheet

• Initially apply for shorter time- few hrs
• Gradually increase duration- 2 hr every 1-2 day
• Minimum advised time after that- 12 hrs
• Some studies have utilized 24 hr application
• Preventive application- up to 6 months
• Established scars- up to 12 months
Silicone gel sheet

- Most important care - hygiene
- Clean the sheet twice a day with mild soap
- Dry it with soft cotton towel
- Clean scar surface with warm water and gentle soap
- COMPLETE CONTACT IS ESSENTIAL
## Scheduler

| Day number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 2 mths | up to 4 mths |
|------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Hours      |   |   |   |   |   |   |   |   |   | 4 hrs |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | 2 mths | up to 4 mths |
|            |   |   |   |   |   |   |   |   |   | 8 hrs |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | up to 4 mths |
|            |   |   |   |   |   |   |   |   |   | 10 hrs |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | up to 4 mths |
|            |   |   |   |   |   |   |   |   |   | 12 hrs |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | up to 4 mths |
|            |   |   |   |   |   |   |   |   |   | 14 hrs |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | up to 4 mths |
|            |   |   |   |   |   |   |   |   |   | 16 hrs |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | up to 4 mths |
|            |   |   |   |   |   |   |   |   |   | 18 hrs |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | up to 4 mths |
|            |   |   |   |   |   |   |   |   |   | 20 hrs |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | up to 4 mths |
|            |   |   |   |   |   |   |   |   |   | 22 hrs |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | up to 4 mths |
|            |   |   |   |   |   |   |   |   |   | 24 hrs |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | up to 4 mths |
Effect

- Most hypertrophic scars and Keloids respond
- Effect varies - from region to region
- Many anecdotal reports and some systematic studies have documented the effective role in scar reduction (height and symptoms)
Prophylactic

- Prophylactic use- shown considerable reduction in scar hypertrophy incidence and severity
Steroid Injection

- Most commonly used: Triamcinolone
- Kenalog, Kenacort: 10 mg, 40 mg in 1 ml
- Available in thick viscous base
Mechanism of Action

• Softens scar

• Modifies collagen type from III to I

• Modulates inflammatory processes

• Reduces capillary density
Indications

• Scars difficult to treat with compression or silicone
• Or patient is non-compliant
• Lesion over a small area
• Patient has intractable pain, itching, redness
Application

• Intralesional injection
• 1 cc syringe with leur lock- Tuberculin (glass), Toomey
• 25 gauge needle
• Fan out equally through lesion
• Repeat every 3-4 weeks for up to 6 times
Time

• For preventive – start 1st dose intraoperative if excising Keloid

• Can be started after 4 weeks (at the earliest) following incised wounds
Local Complications

- Telangiectasia
- Local fat atrophy
- Hypopigmentation
- Procedure is extremely painful for the patient - vasovagal shock
Systemic complications

- Rare
- Immune deficiency
- Stop injection
Compression

- Reduces vascular density and blood supply
- Decreases tissue metabolism
- Increases collagen breakdown
Materials

- ACE wrap - elastic bandages
- Compression stockings
- Custom made compression garments
- Elastic gloves for hands
- Pressure clips for ear lobe
Indication

• Hypertrophic scar- usually post-burn

• Over large areas- small areas like ear lobe can be easily managed also

• Preventive or therapeutic

• Difficult to achieve adequate compression over face, neck, mobile areas
Duration

• To be worn 24 hrs

• Continue for 18 months in burn patients

• Preventive- 6-9 months
Disadvantage

• Patient non compliance

• Skin erosion- if not properly worn or improper fit

• Uncomfortable – esp. in hot and humid climates
Earlobe Keloid

- Excision after steroid injection
- Steroid injection immediately after excision &/or
- Radiation
- Compression
Mederma

- Herbal preparation
- May contain garlic – onion extract
- Available OTC at most retail drug stores
- 20 g, 50 g tube
- No data suggesting clinical improvement
- Animal study suggested better organization of collagen
LASER

- Pulsed dye LASER 595 nm
- In multiple studies it was shown to be effective
- Avoid ablation of hypertrophic tissue itself
- Mechanism- Reduction of blood vessels
X-rays

- In treatment of Keloids
- Especially in combination with intralesional excision and steroid application
- 10 Gy radiation immediately after excision (1 day) (100 KV)
• Massage
• Vit E, Steroid cream
• Reconstruction with Flap, Skin grafts