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Scar Management for Therapists

Synthesizing and Utilizing Best Evidence

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Patricia.sharp@cchmc.org

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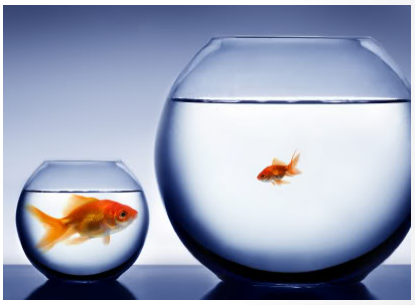
Objectives

- At the end of this presentation, the learner will be able to:
  - describe recommendations for identifying and managing hypertrophic scars in a wide variety of clients.
  - outline methods for finding and synthesizing best available evidence into practical recommendations at the point of care in a variety of areas of practice.
  - explain the importance of evidence based practice in all areas of occupational therapy.

2

Patricia A. Sharp, OTD, MS, OTR/L

- 9 years in pediatric burns, Shriners Hospital for Children
- 2010 - Move to Cincinnati Children's
- 2011-2012 Returned to school to attain OTD
- 2014 - Publication of BESt
- 2015 – Publication of BESt as manuscript

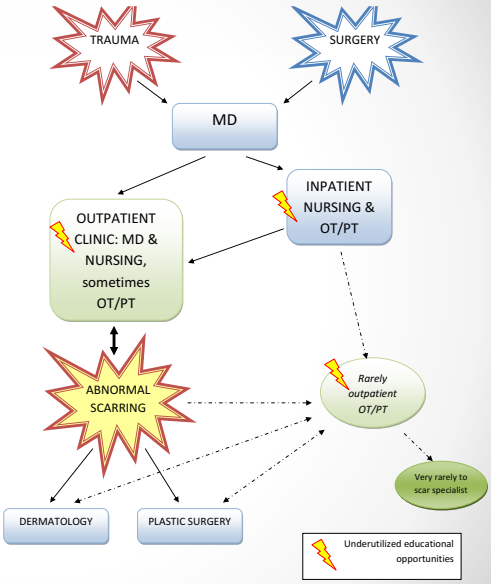


rosstheology.wordpress.com

3

Initial state of care

http://themasqueradestore.com//



4

Scars are a problem?

- Hospitals see many patients with conditions that that can result in scarring
- Hospitals see a lot of patients who undergo treatments, procedures, surgeries, or traumas that can result in scarring
- This warrants some formal way of addressing and managing scars

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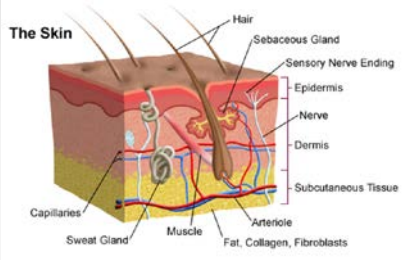
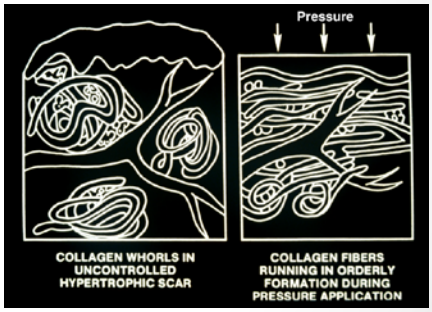
What is a scar?



www.childrenshospital.org

- Develops any time the dermal layer of the skin is damaged
- The collagen fibers in hypertrophic scarring are orientated in a "whorl-like" pattern, as compared to normal skin in which collagen aligns in a parallel pattern



Shriners Hospital, 2000

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What causes a scar?

- Intentional
  - Surgical incision
  - Skin grafting
    - Sheet grafting
    - Meshed grafting
  - Cosmetic
    - Piercings
    - Tattoos
    - Branding
- Accidental
  - Trauma
  - Burns
  - Scalds
  - Chemicals
  - Friction
  - Infection

7

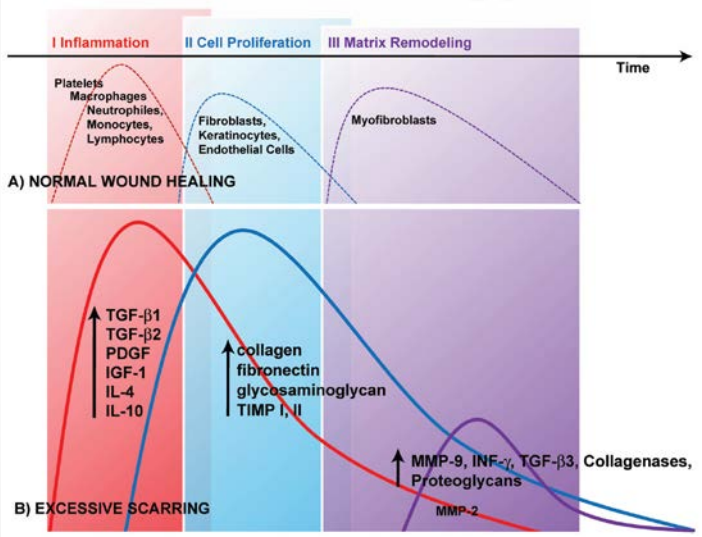
Picket fence analogy

withinonesmemory.blogspot.com

diaryofanewmom.net

8

Scar biology



(Gauglitz, 2011)

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Who develops scars?

Many factors contribute to how a person heals and develops scars

- **Wound healing is the best predictor**
  - If a wound heals within 2 weeks (closed, not wet), it will scar minimally
  - 14-21 days of wound healing time poses a risk for scarring – 30% incidence of scarring
  - 21+ days of healing will likely lead to hypertrophic scarring, with length of healing time directly related to the extent of hypertrophy – 78% incidence

(Bloemen, 2009; Davoodi, 2008; Deitch, 1983; Staley, 1997)

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Who develops scars?

- Scar outcome is highly dependent on genetics and race
- Worst scars:
  - Those with a history or with relatives with a history of hypertrophic scarring
    - Incidence in general population is 1.5-4.5%
  - Those with increased pigment – African Americans, Hispanics, Asians
    - Incidence in these groups is 4.5-16%
  - Following surgery, incidence is 40-70%

(Alster, 2003; Bombaro 2003, Deitch, 1983; Esselman, 2006; Gauglitz, 2011)

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Skin Grafting

- Generally performed when an otherwise healthy (non-infected) wound would take longer than 3 weeks to heal on it's own
- The only biologically acceptable permanent coverage for a wound of this magnitude is a patient's OWN skin

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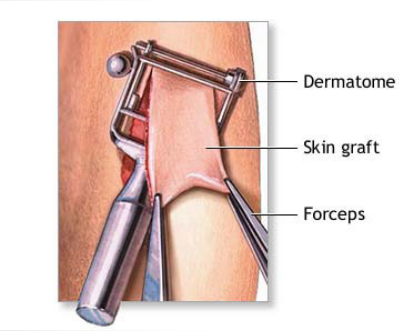
Sheet Grafting



health.rush.edu

Shriners Hospital, 2000

nursing.advanceweb.com

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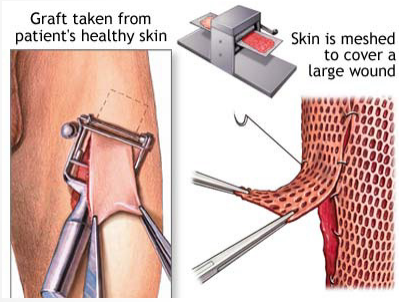
Meshed Grafting



citymousecountrymouse.blogspot.com

sciencedirect.com

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Active Hypertrophic Scarring

- Identified by changes in four characteristics of the skin:
  - Vascularity (increases; may be red, pink, purple)
  - Height (increases; thick)
  - Pliability (decreases; firm)
  - Pigmentation (can either decrease or increase; may be hypo or hyper)

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Hypertrophic Scarring

melbournelaser.com

dermnetnz.org

asds.net

CCHMC, 2011

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Keloid scarring

- Although hypertrophic scars are often referred to as Keloids, this is incorrect
- Keloids are scars that grow beyond the border of the initial wound boundary
- It is a genetic condition with generally poor outcomes and minimal treatment options

brownskin.net

dermatologist.sg

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So, why does this matter?

- Uncontrolled hypertrophic scarring has both physical and affective repercussions on a child.
- The scar will contract until it meets an equal and opposite force.
- Scar tissue is estimated to have 12 times the contractile strength of normal skin, which is clearly strong enough to pull features and joints out of place.

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Functional problems

- If a scar crosses a joint, it can limit range of motion and cause functional deficits

sciencedirect.com

www010.upp.so-net.ne.jp

dermis.net

19

Contractures due to uncontrolled scar

Shriners Hospital, 2000

20

Psychosocial problems

- There are several psychosocial repercussions associated with visible, abnormal scarring (Spuiibroek et al., 2011)
- The importance of developing a healthy body image for successful participation in childhood occupations of cannot be underestimated (Fauerbach et al., 2000)

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Hidden scars

- Scars impact social and emotional functioning even if they are not visible to others
- Edwards, K. Phoenix Society Burn Support Magazine. (1) 1: p 8.

More Than Meets the Eye: Learning to Live With Hidden Burns

By Kathy Edwards, PhD

These who meet Elaina Meier or David Vogel for the first time don't realize they are burn survivors. The scars that tell their stories at a glance have faded or are covered by clothing. It's only when you hear Elaina talk about facilitating the Phoenix Society for Burn Survivors' online chat or David talk about working with a burn survivor support group in Boston that you realize there's more to the story.

Facing a Unique Set of Challenges

"Hidden" burns present a unique set of challenges for burn survivors. He or she may not be "seen" by others as a burn survivor, which, according to both Elaine and David, can have its advantages and disadvantages.

Because the scars can be covered by clothing, talking about the injury is optional. They can choose when and where to tell the story, or choose to not tell it at all.

However, the question of whether to "show or "not show" their scars may create an inordinate amount of angst when they consider wearing bathing suits, shorts, sandals, or sleeveless tops. They may struggle with intimacy and wonder how and when to talk about their burn injury in new romantic relationships.

Adapting to a New You

David recalls that after he left the rehab hospital many people didn't understand the extent of his injuries or the reason for his lengthy hospitalization and recovery. Given what he'd been through, he was struck by the indifference shown to him by his coworkers and acquaintances.

He had been in a drug-induced coma for weeks due to burns from a house fire. He suffered smoke inhalation and had to relearn how to breathe and swallow on his own. He went through withdrawal from morphine and pain management drugs. There were moments that sent his whole body into a panic, like the time he burned his finger on the stove or when he smelled smoke from a chimney while walking down the street.

For the first year, David wore pressure garments and looked like a burn survivor. He remembers seeing people stare and hesitate when he went to shake hands. Gradually his hair grew back and covered the parts of his ears where cartilage was missing. Over time his grafts began to fade and fewer people noticed that he looked different. It surprised him when he realized that many people no longer saw him as a burn survivor.

"There is a window of time when people empathize with a burn injury, but the healing process takes much longer than that," David reflects. "Once you look normal, you are expected to be over it."

Although David could see the positive side to the dwindling reactions, it required yet another adjustment to his self-concept and body image.

David says that since his burn injury and recovery he has more empathy for others. "We all carry hidden traumas and even when you see a survivor with very visible scars, you are only seeing some of the injury," he has realized. "A burn survivor may have lost loved ones in a fire. You can't see that from the outside."

At the time of her injury, Elaina was a college athlete. But returning to the locker room was difficult, not only because of her scars but because she no longer felt like

David Vogel

Phoenix Burn Support Magazine | 8 | Issue 1 | 2014

22

Treatment

- Best available evidence at this time supports use of the combination of manual massage, early and aggressive range of motion, positioning during periods of non-activity, and pressure via conformed wrappings or custom garments and inserts

thehcexperience.wordpress.com

(Berman, 1998; Berman 2008; Bloemen, 2009, Davoodi, 2008; Esselman, 2006; Gauglitz, 2011; Latenser, 2002; Mustoe, 2002; Niessen, 1999; Ogawa, 2009; Robson, 1992; Staley, 1997; Sharp, 2014)

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In other words…

- Best treatment for hypertrophic scarring at this time comes from
  - Prophylaxis: Preventing scars from becoming severe with early conservative treatment (versus later surgical revision)
  - Manual pressure from massage and pressure therapy
  - Maintenance of range of motion through stretch and activity

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Massage

- The scar is constantly trying to contract→ massage physically counteracts the contractile forces
- Pressure is applied with fingers, lubricated by alcohol-free massage cream
- Frequency: 2-3x/day, 5-10 minutes per area
- Duration: Until the scar matures; defined by being pale, soft, pliable or stops responding to treatment

(Field, 1998; Roh, 2007; Roques, 2002)

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Stretching and activity

- Generally acceptable to resume normal activity 5-10 days after a wound is sustained or a graft is placed → ***defer to the physician for full orders***
- Monitor for range of motion deficits and consult with scar specialist, if range is not regained with normal activity within 1-2 weeks

(Berman, 1998; Berman 2008; Bloemen, 2009, Davoodi, 2008; Esselman, 2006; Gauglitz, 2011; Latenser, 2002; Mustoe, 2002; Niessen, 1999; Ogawa, 2009; Robson, 1992; Staley, 1997)

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Range of Motion

- Passive range of motion should be completed starting 5-7 days following injury to full range (unless underlying structures are damaged)
- Frequency: 2-3x/day
- Duration: Hold terminal range 1-2 minutes; perform until full active range is easily achieved daily
- Amount of force needed for stretch is significantly more than most diagnoses (Flowers & LaStayo, 2012)

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Treatment: Splinting

- For scars crossing a joint
- If active range is limited and passive range cannot be achieved within 1-2 minutes, night splinting should be initiated
- The joint should be splinted in opposition to the scar contracture
- Progress to 24-hour splinting if night splinting does not work
- Advanced scar contractures should be treated with serial casting

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Treatment: Therapeutic Activity

- Follow all passive stretches with
  - Active range of motion
    - Repetitions
    - Track maximal range over time with landmarks (reaching a sticker on a wall and moving it higher)
  - Functional skills
    - For example passive fisting should be followed with activities which require power grasp, like carrying a basket or holding on to the monkey bars
    - Elbow extension should be followed with activities that require extended reaching, like for a ball

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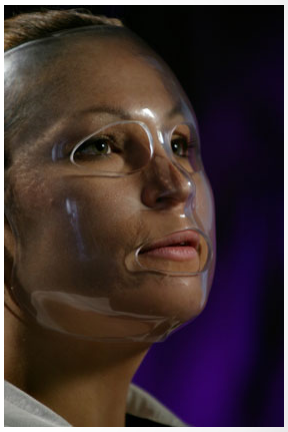
Pressure Therapy

comar-medical.com

Wholesale-first-aid.com

macom-medical.com

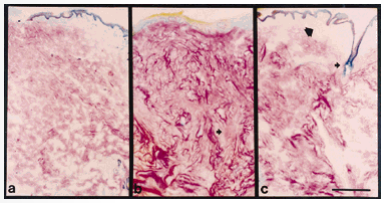


hanger.com

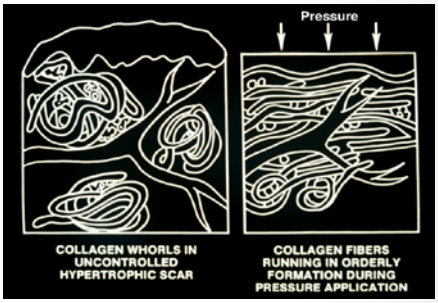
30

m.

Effect of pressure on a cellular level



Krötzsch-Gómez, et al., 1998; Nature.com



Shriners Hospital, 2000

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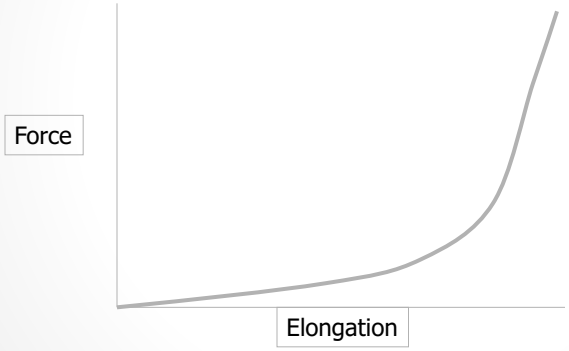
Why does therapy work?

The Biomechanics of Skin



The Stress-Strain Curve

(Dewey, Richard, & Parry, 2011)

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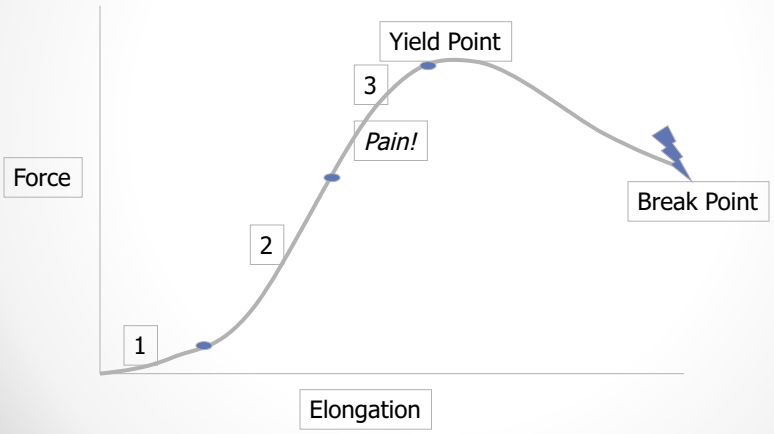
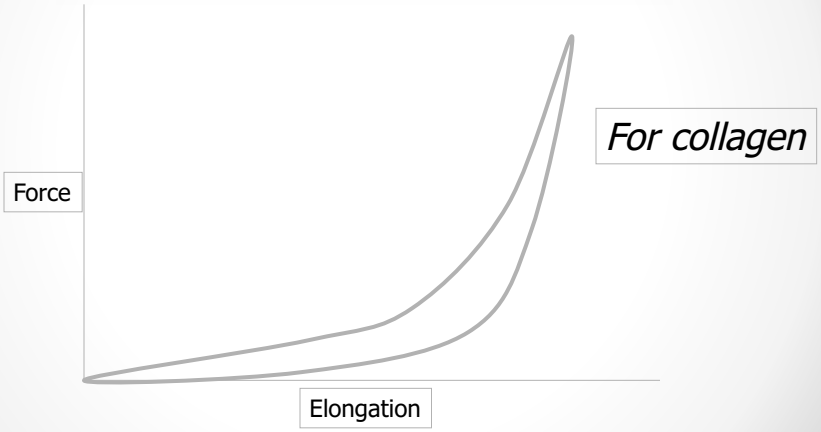
Stress-Strain/Yield/Break



(Dewey, Richard, & Parry, 2011)

33

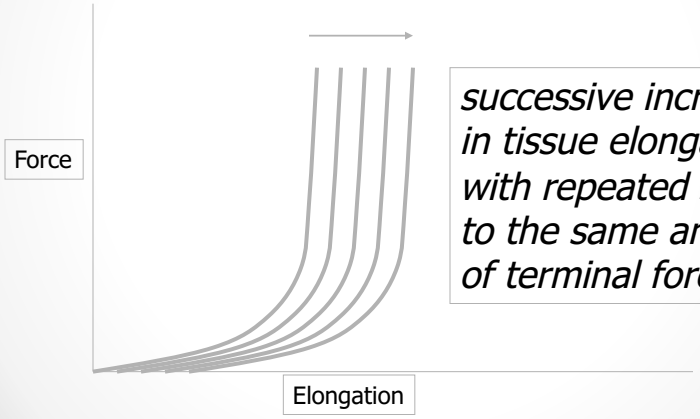
Hysteresis Loop



(Dewey, Richard, & Parry, 2011)

34

Stress-Strain… Hysteresis… ELONGATION over TIME!



successive increase in tissue elongation with repeated stretching to the same amount of terminal force

(Dewey, Richard, & Parry, 2011)

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- Shoulder graft

Post-op 3 weeks

Post-op 3 months

Post-op 1 year

Shriners Hospital, 2000

36

Shriners Hospital, 2000

Neck graft post-op 3 weeks, 3 months, 1 year

37

Shriners Hospital, 2000

Thigh donor site, post-op 5 days, 1 month, 1 year

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Pressure Garments

- Bioconcepts: http://www.bio-con.com/
- Jobst: http://www.jobst-usa.com/
- Juzo: http://www.juzousa.com/
- Medi: http://mediusa.com/compression-products/
- Torbot: http://www.jobskingarments.com/

- Face masks:
  - http://www.hangerclinic.com/bracing-support/burn-masks/Pages/default.aspx
  - http://www.totalcontact.com/

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Treatment: Pressure therapy

- Start simple and progress as needed
- If scars don't respond, that's an indication that increased pressure is needed

- Coban
- Ace
- Tubigrip
- Custom garment or appliance

Simplest

40

Treatment: Inserts

- To increase pressure when scars are hard to reach or are not responding, add inserts under the wrapping
- Start with the simplest and change as needed
- Inserts should be cut to slightly larger than the size of the scar

Simplest

- Velfoam
- Hydrogel (Elastogel)
- Silicone gel sheet
- 50/50 putty or silicone elastomer

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Assessment/Outcome Measures

- Most easily completed with the Vancouver Scar Scale (VSS), which measures changes in the 4 main scar characteristics over time - pigmentation, vascularity, pliability, and height. (Baryza & Baryza, 1995).
- This scale has been shown to be a reliable and useful for objective assessment of hypertrophic scars and is recommended in a systematic review (Brusselaers et al., 2010; Forbes-Duchart et al., 2007; Powers et al., 1999; Tyack, et al., 2012) .

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Vancouver Scar Scale

Pigmentation

0 = Normal color
1 = Hypopigmentation
2 = Hyperpigmentation

Vascularity

0 = Normal
1 = Pink (slight increase in blood supply)
2 = Red (significant increase in blood supply)
3 = Purple (excessive local blood supply)

Pliability

0 = Normal
1 = Supple (flexible with minimal resistance)
2 = Yielding (giving way to pressure, offering moderate resistance, but does not behave as a solid scar mass)
3 = Firm (solid/inflexible unit, not easily moved, resistant to manual pressure)
4 = Banding (rope-like tissue that blanches with extension of scar, does not limit range of motion)
5 = Contracture (permanent shortening of scar producing deformity or distortion; limits range of motion)

Height

0 = Normal
1 = <2 mm
2 = ≥2 mm and <5 mm
3 = ≥5 mm

archderm.ama-assn.org

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Assessment: POSAS

- The Patient and Observer Scar Assessment Scale is a reliable and valid tool for measuring patient/family perception of the scar over time (Draaijers, et al., 2004).
- The POSAS is recommended for this type of use in a systematic review (Tyack, et al., 2012).

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Assessment: POSAS

Observer Scar Assessment Scale

Normal skin	1 2 3 4 5 6 7 8 9 10	*Worst scar imaginable*
Vascularization	○○○○○○○○○○	
Pigmentation	○○○○○○○○○○	Hypo ☐ Mix ☐ Hyper ☐
Thickness	○○○○○○○○○○	
Relief	○○○○○○○○○○	
Pliability	○○○○○○○○○○	
	---------- +	
Total score Observer Scar Scale:		

Patient Scar Assessment Scale

No, no complaints	1 2 3 4 5 6 7 8 9 10	*Yes, worst imaginable*
Is the scar painful?	○○○○○○○○○○	
Is the scar itching?	○○○○○○○○○○	
No, as normal skin	1 2 3 4 5 6 7 8 9 10	*Yes, very different*
Is the color 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:		

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Assessment: Serial photographs

- Photographs taken at every visit are also helpful in helping patients/families and clinicians become aware of change over time
- To facilitate consistency and control, take the photos with the same camera in the same location with the same lighting, every time
- (Staley, 1997; Tyack, et al., 2012)

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LEGEND

- Using the "LEGEND" (let evidence guide every new decision) tools…

P (population)	Among individuals with or at risk for developing active hypertrophic scars
I (intervention)	Does treatment with pressure therapy
C (comparison)	
O (outcome)	Improve aesthetic and functional outcomes?

- cincinnatichildrens.org/evidence

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Literature Search

- **Dates:** January 1950-February 2014
- **Databases:** MEDLINE, CINAHL, Cochrane Database for Systematic Reviews (CDSR), Burntherapist.com, Cochrane Libraries, Ebsco, Google Scholar, OT Seeker, Ovid, MedLine, PEDro.org, Pubmed.gov, Pubmed Clinical Queries, and hand search of relevant articles through use of reference lists.
- **Search terms:** scar, hypertroph*, pressure therapy, compression therapy, pressure garment, burn, scald, trauma as well as MeSH terms cicatrix and hypertrophic.

48

Results

- 45 articles found
- 28 pertinent to the PICO
  - Level 1: 1
  - Level 2: 7
  - Level 3: 3
  - Level 4: 2
  - Level 5: 15

Levels of Evidence

DOMAIN OF CLINICAL QUESTION	TYPE OF STUDY / STUDY DESIGN																			
	Systematic Review Meta-Analysis	Meta-Synthesis	RCT +	CCT +	Psychometric Study	Qualitative Study	Cohort – Prospective	Cohort – Retrospective	Case – Control	Longitudinal (Before/After, Time Series)	Cross – Sectional	Descriptive Study Epidemiology Case Series	Quality Improvement (PDSA)	Mixed Methods Study	Decision Analysis Economic Analysis Computer Simulation	Guidelines	Case Reports N-of-1 Study	Bench Study	Published Expert Opinion	Local Consensus Published Abstracts
Intervention *Treatment, Therapy, Prevention, Harm, Quality Improvement*	1a* 1b*		2a 2b	3a 3b		4a 4b	3a 3b	4a 4b	4a 4b	4a 4b	4a 4b	4a 4b	4a 4b	2a/2b 3a/3b 4a/4b	5a 5b	5a 5b	5a 5b	5a 5b	5a 5b	5
Diagnosis / Assessment	1a 1b			2a 2b	2a 2b		3a 3b	4a 4b			4a 4b	4a 4b		2a/2b 3a/3b 4a/4b	5a 5b	5a 5b	5a 5b	5a 5b	5a 5b	5
Prognosis	1a 1b						2a 2b	3a 3b	4a 4b		4a 4b	4a 4b		2/3/4 a/b	5a 5b	5a 5b	5a 5b	5a 5b	5a 5b	5
Etiology / Risk Factors	1a 1b		2a 2b	3a 3b			3a 3b	4a 4b	4a 4b		4a 4b	4a 4b		2/3/4 a/b	5a 5b	5a 5b	5a 5b	5a 5b	5a 5b	5
Incidence	1a 1b						2a 2b	3a 3b				4a 4b				5a 5b	5a 5b	5a 5b	5a 5b	5
Prevalence	1a 1b								2a 2b		3a 3b	4a 4b				5a 5b	5a 5b	5a 5b	5a 5b	5
Meaning / KAB+		1a 1b				2a 2b								2/3/4 a/b		5a 5b	5a 5b	5a 5b	5a 5b	5

* *a = good quality study* *b = lesser quality study*

+ *CCT = Controlled Clinical Trial* *KAB = Knowledge, Attitudes, and Beliefs* *RCT = Randomized Controlled Trial*

Shaded boxes indicate study design may not be appropriate or commonly used for the domain of the clinical question.

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Scar Characteristics

- Vascularity (redness)
- Pigmentation (brown hues)
- Thickness (height above normal skin)
- Pliability (flexibility = range of motion = function)
- Best measured by the Vancouver Scar Scale
  (Baryza & Baryza, 1995)

Pliability	0	Normal
	1	Supple
	2	Yielding
	3	Firm
	4	Adherent
Height	0	Normal
	1	1-2 mm
	2	3-4 mm
	3	5-6 mm
	4	>6 mm
Vascularity	0	Normal
	1	Pink
	2	Red
	3	Purple
Pigmentation	0	Normal
	1	Slightly ☐ / ☐
	2	Moderately ☐ / ☐
	3	Severely ☐ / ☐

woundmaster.blogspot.com

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Highlights from literature

Study Citation	Results	Conclusions
Author Year [Quality Level][1]	Description of Results	Description of Conclusions
Anzarut, 2009 [1b]	Studies were found to be homogenous enough for comparison. Global scar scores not significantly different between test and control groups. Significant decrease in scar height noted for the PGT group (p=0.05). No significant differences for pigment, vascularity, pliability, and color.	Insufficient evidence to support the widespread use of PGT, but this does not mean that PGT is equivalent to controls; PGT improves scar height.
Candy, 2010 [2a]	Those with high pressure garments (20-25mmHg) had significantly better improvements in scar thickness and redness than those with low pressure. Improvements were also seen in low pressure though. No changes in color or pliability.	Pressure of at least 20 mmHg accelerates scar remodeling with generally better clinical presentations compared with the lower pressure level on scars with severe hypertrophy (thickness >5mm). Authors recommend adding inserts to achieve needed pressure and changing garments every 2 months to accommodate for inevitable loss of pressure.
Chang, 1995 [2b]	No difference between pressure/no pressure groups in terms of RATE of maturation or TIME to maturation	Use of garments does not speed scar maturation. No conclusions can be drawn about the ultimate function or appearance of scars between groups.
Cheng, 2001 [4a]	Peak scarring occurred ~18 months after injury with use of these garments	Improvement in all areas related to pressure garments, minimum wear time 12 months
Deitch, 1983 [4a]	Wound healing 14-21 days resulted in 30% incidence of HSc development; >21 days resulted in 78% incidence of HSc development. No correlation between age and propensity to develop HSc. Black race develops HSc more than white.	Time to wound healing directly correlates to likelihood of developing abnormal HSc. Treatment algorithm: No pressure if healing <10 days; pressure for black patients healing 10-14 days; pressure for all offered healing 14-21 days; pressure mandatory >21 healing.
Engrav, 2010 [2a]	Hardness: significant difference for ultimate scar hardness between the normal and low pressure groups Thickness: scars in the normal compression group were found to be significantly thinner than in the low compression group Color: no relationship in color change to pressure Clinical appearance: NNT= 14 patients treated for 1 benefit	Benefit most agreed upon for those with moderate to severe scars. Pressure garment therapy does improve scars
Garcia-Velasco, 1978 [2b]	75-80% improvement in all scar measures (color, consistency, thickness) for PGT group compared to control after 6 months	PGT improves scar color, consistency, and thickness Garments should be changed every 2-3 months
Haq, 1990 [3b]	100% improvement with button (localized pressure); Improvement seen with zinc plaster and tubigrip, but significantly more improvement seen with PGT (>75% in 12/15 patients) compared to plaster and tubigrip. Overall 61.8% cases showed >50% improvement with pressure.	Pressure therapy improves scars and increases ROM. PGT has several advantages over other pressure methods. PGT should be used Q24 for 12-18 months.
Kloti, 1979 [3b]	Scars in early fit group regressed quickly and did not develop as severely as compared to the late fit group. 9/10 affected joints regained normal ROM and function. Scars in the late fit group also regressed, but more slowly and took longer treatment.	Early application of pressure leads to faster scar regression Pressure leads to improved function in terms of ROM

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Highlights from literature

Kloti, 1982 [3a]	Improvement noted in all areas related to pressure garments (color, height, pliability, ROM). Early fitting (before scar formation) resulted in decreased wear time	Early application of pressure leads to faster scar regression/decreased wear time required Pressure leads to improved scar appearance and improved function in terms of ROM
Li-Tsang, 2010 [2b]	Pressure group resulted in significantly larger decreases in thickness as compared to control, no significant difference for vascularity, pigmentation and pliability. Subjects were satisfied with the intervention.	PGT decreases scar thickness.
Van den Kerckhove, 2005 [2a]	Normal compression garments (20mmHg) provided significantly improved thickness as compared to the low pressure garments	Pressure therapy > 15mmHg significantly decreases scar thickness and "accelerates scar maturation," but not erythema
Yamaguchi, 1986 [2a]	Good skin immobilization achieved at 30mmHg and resulted in no significant difference in arterial pulsations or skin temperature. Optimal pressure resulted with skilled application.	Optimal pressure to apply skin traction is ~30mmHg. Skilled persons should perform application only.
Berman, 1998 [5a]	N/A	Supports use of pressure – considered standard 1st line therapy "Pressure devices have proven effective in reducing scar height"
Berman, 2008 [5b]	N/A	Prevention of HSc is the best strategy to avoid functional and aesthetic problems. Pressure therapy is an integral part of this. Pressure has been successfully used to produce thinning and pliability in scars. Should be above capillary pressure (20-30mmHg, Q24, 6-24 mo). Standard "first line of therapy" in many centers.
Bloemen, 2009 [5a]	N/A	Prevention of HSc is the best strategy. Treatment algorithm – pressure recommended as preventative measure for time to heal >10-14 days or those requiring grafting. Fit as soon as possible after wound closure. 24-40mmHg, Q23 until scar maturation. Pressure is preferred method for conservative management of scars, especially for improving thickness and pliability. Keep pressure until scar matures – early d/c of garments tends to be followed by rebound hypertrophy.
Davoodi, 2008 [5b]	N/A	The body's natural response to a burn injury is scar formation. The worst HSc develops in wounds taking >3 weeks to heal. Peak scarring 3-6 months, resolving by 12-18 months. Tx of HSc is accomplished by PGT. Fit right after wound closure, 24 mmHg, Q23. Compliance is difficult – patients find garments uncomfortable and restricting. Pressure garments with flexible inserts over joint surfaces aid in the maintenance of soft tissue length (function).
Esselman, 2006 [5a]	N/A	Garments should be changed every 2-3 months to maintain adequate pressure.
Latenser, 2002 [5a]	N/A	"Prevention of scar tissue contracture and deformity is usually the first step through the use of compression garments"

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Highlights from literature

Gauglitz, 2011 [5a]	N/A	Excessive scars form as a result of aberrations of physiologic wound healing and may develop following any injury to the deep dermis including burn, lacerations, abrasions, surgery, piercings, and vaccinations. Good differential diagnosis for HSc vs. Keloid. Recommends pressure at 15-40mmHg Q23 >/=6 months of scar healing for prophylaxis. Prophylaxis is more effective than tx for HSc. "Both clinicians and patients are highly concerned with minimizing scar appearance and value as clinically meaningful even small improvements in scarring." It's a difficult issue – we know little about the pathology of scar formation and remediation, other than studies re: extensive use, but not well-designed clinical studies.
Mustoe, 2002 [5a]	N/A	p. 561 "the most successful treatment of a HSc is achieved when the scar is immature but the overlying epithelium is intact" – somewhere between prevention and tx! A treatment algorithm is proposed with pressure therapy utilized as both initial and secondary management tools
Niessen, 1999, [5a]	N/A	Garments need to be worn until scars are mature. Early release of the garments tends to be followed by rebound hypertrophy
Ogawa, 2010 [5a]	N/A	Proposed treatment algorithm recommends pressure as part of non-surgical multimodal therapy. Pressure therapy is recommended following surgical revision
Robson, 1992 [5b]	N/A	Pressure is an effective adjunct in the control of scar maturation, important in prevention of deformity, also states importance of pressure following each surgical reconstruction. "PGT should be applied to prevent further shortening of collagen"
Staley, 1997 [5b]	N/A	Supports general algorithm for pressure recommendations and dosage at 24-25 mmHg. Recommends applying garments as soon as skin can tolerate shear force of garment.

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Recommendations

- 1. It is strongly recommended that pressure therapy is utilized to decrease hypertrophic scar height (Anzarut 2009 [1b], Candy 2010 [2a], Engrav 2010 [2a], Van den Kerckhove 2005 [2a], Li-Tsang 2010 [2b], Garcia-Velasco 1978 [2b], Cheng 2001 [4a], Bloemen 2009 [5a], Berman 1998 [5a], Berman 2008 [5b]).

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Recommendations

- 2. It is recommended that pressure therapy is utilized:
  - As soon as the healing skin can tolerate the pressure and/or shear force generated by the intervention, in order to promote optimal scar outcome (Kloti 1982 [3a], Kloti 1979 [3b], Gauglitz 2011 [5a], Ogawa 2010 [5a], Bloemen 2009 [5a], Esselman 2006 [5a], Latenser 2002 [5a], Mustoe 2002 [5a], Davoodi 2008 [5b], Staley 1997 [5b], Robson 1992 [5b]).
  - As a prophylactic measure for wounds that take longer than 14-21 days to heal, as well as all skin grafts, as these wounds are more likely to develop hypertrophic scars than those which heal more quickly (Deitch 1983 [4a], Bloemen 2009 [5a], Davoodi 2008 [5b], Staley 1997 [5b]).
  - To decrease hypertrophic scar erythema (Candy 2010 [2a], Garcia-Velasco 1978 [2b], Cheng 2001 [4a]).
  - For 23 hours per day for approximately 12 months, or until scar maturation is achieved (Haq 1990 [3b], Bloemen 2009 [5a], Latenser 2002 [5a], Niessen 1999 [5a], Berman 2008 [5b], Davoodi 2008 [5b]).

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Recommendations

- 3. It is recommended that pressure therapy appliances are:
  - Fit to achieve compression force near capillary pressure (20-30mmHg) to promote optimal scar outcome (Candy 2010 [2a], Engrav 2010 [2a], Van den Kerckhove 2005 [2a], Yamaguchi 1986 [2a], Garcia-Velasco 1978 [2b], Bloemen 2009 [5a], Latenser 2002 [5a], Berman 1998 [5a], Davoodi 2008 [5b], Staley 1997 [5b]).
  - Replaced every 2-3 months in order to maintain the pressure needed to achieve optimal outcome (Candy 2010 [2a], Garcia-Velasco 1978 [2b], Esselman 2006 [5a]). Alternatively, pressure appliances can be modified by re-sewing or inserts can be added to assure pressure of 20-30mmHg (Candy 2010 [2a], Davoodi 2008 [5b]).

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Recommendations

- 4. It is recommended that pressure wrappings or appliances are applied or fit by skilled individuals in order to assure optimal pressure and prevent tissue damage (Yamaguchi 1986 [2a]).

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Recommendations

- 5. It is recommended that pressure therapy is not utilized:
  - For decreasing abnormal scar pigmentation (Anzarut 2009 [1b], Candy 2010 [2a], Engrav 2010 [2a], Van den Kerckhove 2005 [2a]).
  - To hasten the rate or time to scar maturation (Chang 1995 [2b]).

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Recommendations

- 6. There is insufficient evidence and a lack of consensus to make a recommendation for the use of pressure therapy to increase scar pliability or resulting joint range of motion (Engrav 2010 [2a], Li-Tsang 2010 [2b], Garcia-Velasco 1978 [2b], Kloti 1982 [3a], Haq 1990 [3b], Gauglitz 2011 [5a], Bloemen 2009 [5a], Berman 2008 [5b]).

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Knowledge dissemination

- Education must be provided to
  - OT/PT staff
  - Patients and caregivers
  - Referral sources
- Education must be "palatable"
- Information must be applicable and useful

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Scar Risk Assessment

Who to treat?

Low Risk — Prophylactic Management
- Wound healing < 10 days
- No joint involvement
- Not bothersome to patient/family

Increased Risk — Increased Monitoring
- Wound healing 10-21 days
- No joint involvement
- Aesthetic concerns in < 3 categories (thickness, redness, pliability, pigmentation)
- Minimally bothersome to patient/family

High Risk or Evident Scar — Conservative Treatment
- Skin graft or Donor site
- Wound healing 21+ days
- Joint involvement
- Aesthetic concerns in 3+ categories
- Bothersome to patient/family

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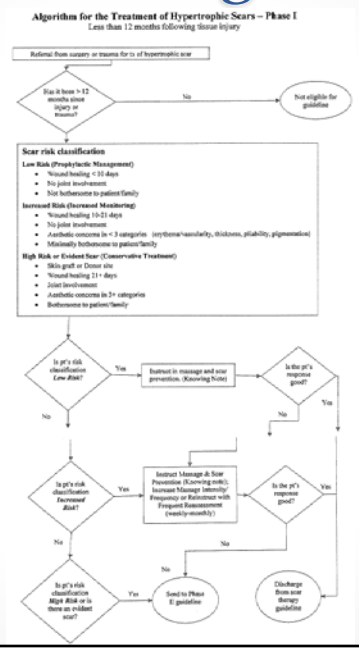
Treatment algorithms



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Recommendations Simplified

Recommendations for use of pressure therapy

Desired Outcome	Strongly Recommended	Recommended	Insufficient evidence and lack of consensus	Not Recommended
Decreased height	X			
Decreased erythema		X		
Increased pliability			X	
Increased range of motion			X	
Decreased pigmentation				X
Decreased time to maturation				X

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Recommendations Simplified

Recommendations for Pressure Therapy Implementation

Target scars	Skin grafts, wounds requiring 14-21+ days to heal
Initiation	As soon as healing wound can tolerate pressure and shear
Frequency	23 hours/day
Duration	Approximately 12 months with garment replacement every 2-3 months
Dosage	20-30 mmHg, ensured by skilled fitting and regular monitoring

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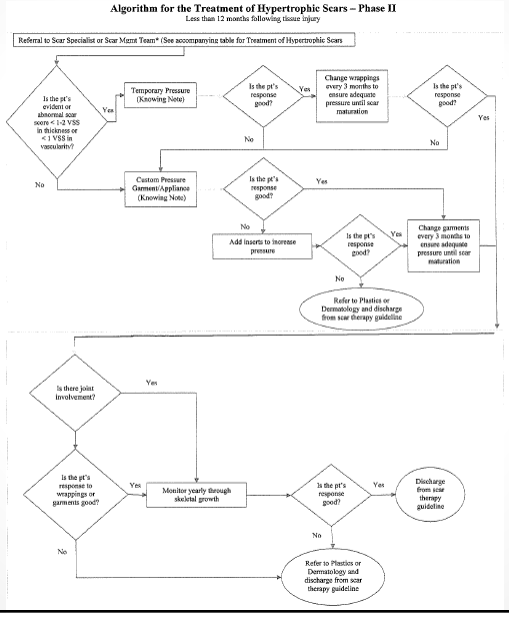
Treatment algorithms



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Treatment algorithms

* Treatment of Hypertrophic Scars – Phase II

Problematic Scar Classification	Minimal Risk Classification	Increased Risk Classification	Mildly increased thickness >2mm (score 1-2 VSS)	Significantly increased thickness >4mm (score 3-4 VSS)	Mildly increased vascularity (score 1 VSS)	Significantly increased vascularity (score >1 VSS)	Decreased pliability (score >2 VSS)	Decreased AROM or PROM	Decreased PROM (>25% loss)	Altered pigmentation
Recommended Treatment										
Scar Prevention Knowing Note	X	X	Review		Review		Review			
Massage	X	X	X	X	X	X	X	X	X	
Sunscreen	X	X								X
Normal Activity	X	X					X			
Increased Monitoring by Therapist		X	X		X		X	X		
Pressure Therapy Knowing Note			X	X	X	X				
Over-the-counter Pressure Therapy (wrapping or tubing)			X		X					
Custom Pressure Therapy				X		X				
Inserts (Progress foam - hydrogel - silicone as needed)				As needed		As needed				
ROM or stretching exercises								X	X	
Splinting									X	
Referral to MD	• no response to treatment • rigid joint contracture • keloid scars • > 12 months after would closure • chronic ulceration • infection									X

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OT/PT

- Presentation at "Blitz Day"

  See scars early

  Conservatively treat

  Assess regularly

  Refer to Patti as needed

- Formation of Scar Management Team for difficult cases

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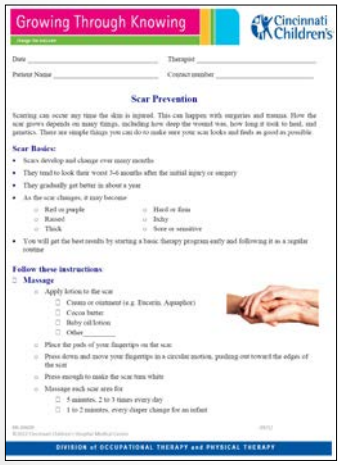
Knowing Note – "Scar Prevention"


Growing Through Knowing

Cincinnati Children's

Date _____ Therapist _____

Patient Name _____ Contact number _____

Scar Prevention

Scarring can occur any time the skin is injured. This can happen with surgeries and trauma. How the scar grows depends on many things, including how deep the wound was, how long it took to heal, and genetics. There are simple things you can do to make sure your scar looks and feels as good as possible.

Scar Basics:

- Scars develop and change over many months
- They tend to look their worst 3-6 months after the initial injury or surgery
- They gradually get better in about a year
- As the scar changes, it may become
  - Red or purple
  - Raised
  - Thick
  - Hard or firm
  - Itchy
  - Sore or sensitive
- You will get the best results by starting a basic therapy program early and following it as a regular routine

Follow these instructions:

☐ **Massage**

- Apply lotion to the scar
  - ☐ Cream or ointment (e.g. Eucerin, Aquaphor)
  - ☐ Cocoa butter
  - ☐ Baby oil/lotion
  - ☐ Other _____
- Place the pads of your fingertips on the scar.
- Press down and move your fingertips in a circular motion, pushing out toward the edges of the scar
- Press enough to make the scar turn white
- Massage each scar area for
  - ☐ 5 minutes, 2 to 3 times every day
  - ☐ 1 to 2 minutes, every diaper change for an infant

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Growing Through Knowing

Cincinnati Children's

☐ **Movement**

- ☐ Continue to move and participate in all activities
- ☐ Gently stretch the area with the scar during the day
- ☐ Do exercises _____
- ☐ Do activities _____

☐ **Sun precautions**

- If scars are exposed to sun and get tanned or burned within the first year, permanent color changes can happen
- Scarred areas should be covered and protected with good (30 SPF) sunscreen every day, and reapplied as instructed

☐ **Sensitivity**

- At the beginning scars may be sore or extra sensitive
- Start with gentle massage, and increase pressure over a few days
- Sensitivity should decrease within a week or two of doing regular scar massage

☐ **Contact your therapist if:**

- New wounds or blisters develop
- Soreness or sensitivity doesn't get better
- Scarring continues to get worse

☐ **Other**

- _____
- _____
- _____
- _____

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Knowing Note – "Pressure Therapy"

Growing Through Knowing

Cincinnati Children's

Date _____ Therapist _____

Patient Name _____ Contact number _____

Pressure Therapy for Scars

Scarring can occur any time the skin is injured. This can happen with surgeries and trauma. How the scar grows depends on many things, including how deep the wound was, how long it took to heal, and genetics. While many scars get better on their own some need treatment to look and move better.

Scar Basics:

- Scars develop and change over many months
- They tend to look their worst 3-6 months after the initial injury or surgery
- They gradually get better in about a year
- As the scar changes, it may become
  - Red or purple
  - Raised
  - Thick
  - Hard or firm
  - Itchy
  - Sore or sensitive
- Following a basic therapy program early and as part of a regular routine gives the best results

You can think of the parts that make up your skin as pieces of a picket fence. When a wound happens, the fence breaks. As part of the healing process, we have to put the fence back together with the broken parts. These parts tend to stick up on each other instead of lining up nicely. How "messy" the fence is, or how your scar looks depends mostly on how long it takes the wound to heal.

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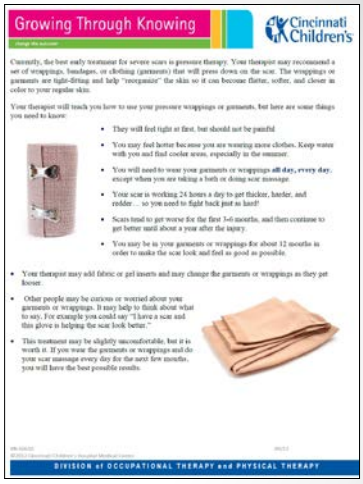

Growing Through Knowing

Cincinnati Children's

Currently, the best early treatment for severe scars is pressure therapy. Your therapist may recommend a set of wrappings, bandages, or clothing (garments) that will press down on the scar. The wrappings or garments are tight-fitting and help "reorganize" the skin so it can become flatter, softer, and closer in color to your regular skin.

Your therapist will teach you how to use your pressure wrappings or garments, but here are some things you need to know:

- They will feel tight at first, but should not be painful
- You may feel hotter because you are wearing more clothes. Keep water with you and find cooler areas, especially in the summer.
- You will need to wear your garments or wrappings **all day, every day**, except when you are taking a bath or doing scar massage.
- Your scar is working 24 hours a day to get thicker, harder, and redder … so you need to fight back just as hard!
- Scars tend to get worse for the first 3-6 months, and then continue to get better until about a year after the injury.
- You may be in your garments or wrappings for about 12 months in order to make the scar look and feel as good as possible.
- Your therapist may add fabric or gel inserts and may change the garments or wrappings as they get looser.
- Other people may be curious or worried about your garments or wrappings. It may help to think about what to say. For example you could say "I have a scar and this glove is helping the scar look better."
- This treatment may be slightly uncomfortable, but it is worth it. If you wear the garments or wrappings and do your scar massage every day for the next few months, you will have the best possible results.

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Referral sources

- The 4 P's
  - Presenting
  - Publishing
  - Pleading
  - Prodding

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Clinical Scenario

- A patient is seen in sports-ortho PT 4 months following surgical intervention to the leg, including compartment syndrome release with grafting.
- All surgical precautions have been lifted and PT intervention is focused on strengthening and return to sport at this time.
- Small linear scars are noted along graft sites, but the thigh donor site is scarring heavily.

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Clinical Scenario

- Donor site with hypertrophic scarring

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Clinical Scenario

- Assessment: The scar is within 3-6 months post injury, so it is treatable.
- Evaluation VSS:
  - Pigmentation: 0=Normal
  - Vascularity: 2=Red, significant increase
  - Pliability: 3=Firm
  - Height: 2=Between 2-5mm
  - Total score: 7
- Evaluation POSAS:
  - Has the scar been painful in the past few weeks? 9
  - Has the scar been itching in the past few weeks? 8
  - Is the scar color different from the color of your normal skin at present? 10
  - Is the stiffness of the scar different from your normal skin at present? 10
  - Is the thickness of the scar different from your normal skin at present? 10
  - Is the scar more irregular than your normal skin at present? 10
  - What is your overall opinion of the scar compared to normal skin? 10
  - Average: 9.6
  - "I hate it. It's gross. I don't even want to look at it. I never want to touch it."

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Clinical Scenario

- Treatment:
  - Scar massage (used Knowing Note)
  - Custom pressure shorts, 20-30mmHg (used Knowing Note)
  - Silicone insert to increase pressure due to minimal change in scar thickness
  - Garments replaced every 2 months, requiring 2 sets
  - Scar intervention was discontinued after 7 months, or 11 months post-injury

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Clinical Scenario

- Outcome VSS:
  - Pigmentation: 0=Normal
  - Vascularity: 0=Normal
  - Pliability: 1=Supple
  - Height: 2=Between 2-5mm
  - Total score: 3 (down from 7 at initial visit)
- Outcome POSAS:
  - Has the scar been painful in the past few weeks? 1
  - Has the scar been itching in the past few weeks? 5
  - Is the scar color different from the color of your normal skin at present? 2
  - Is the stiffness of the scar different from your normal skin at present? 3
  - Is the thickness of the scar different from your normal skin at present? 3
  - Is the scar more irregular than your normal skin at present? 3
  - What is your overall opinion of the scar compared to normal skin? 2
  - Average: 2.7 (down from 9.6)
  - "It doesn't bother me much. I can't believe it was such a big deal!"

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Results ☺

12/5/2011

1/28/2013

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New Referrals

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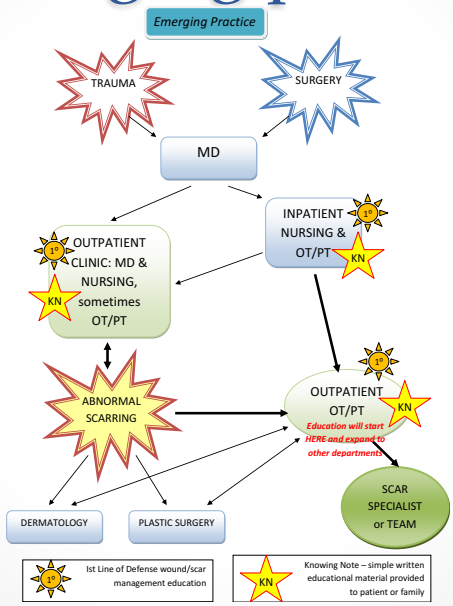
Emerging practice



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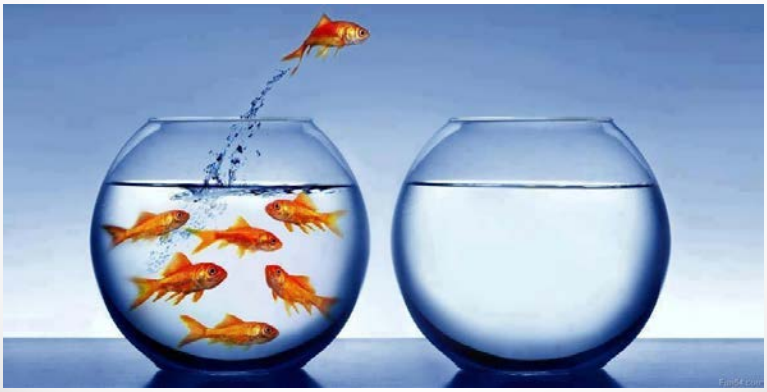
"THE ART AND SCIENCE OF ASKING QUESTIONS IS THE SOURCE OF ALL KNOWLEDGE."

THOMAS BERGER



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