Laser Treatment of Scars

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Disclosures: Off-label uses will be discussed
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Overview

- Why do we treat scars?
- Basics of Lasers for Scar Treatment
- Lasers used for Scar treatment
- Additional considerations for laser treatments of Scars
- Case Discussion
- Summary

Why do we treat scars?

- Annually: ~100 million newly acquired scars
  - ~11 million keloid
  - ~4 million hypertrophic burn scars
- Up to 70% may occur in children
- **“Survivor’s Paradox”**
  - Increased survival after burns and trauma means lifelong disabling/disfiguring scars
  - Physical, psychological, social, and financial sequelae

When is a scar pathologic?

- Many scars itch, hurt, stay red, etc.
- Contracture scars, especially over joints, may limit function
- Scars can contribute to chronic wounds
- Psycho-social discord: under-appreciated, under-reported, under-acknowledged

Light
Amplification by
Stimulated
Emission of
Radiation

Theory of Selective Photothermolysis

Laser energy preferentially absorbed by one structure in tissue

- **Melanin**, *tissue water*, blood, tattoo ink, etc

Surrounding tissue has low absorption

Selective heating/destruction of tissue

If settings set correctly including:

wavelength

pulse duration

energy

Anderson R, Parrish J, Science 1983; 220:524-527

Lasers Used for Scar Treatment

- Pulsed dye laser
- Non-ablative fractional resurfacing
- Ablative fractional resurfacing
- Q-switched lasers

Treatment of redness in scars
Pulsed dye laser/Intense Pulse Light/Long Pulsed 532 nm

Large spot sizes 10-12 mm

Low energies

Ablative and Non-ablative Fractional Resurfacing Cause collagen remodeling (wound healing) by thermal damage

Ablative

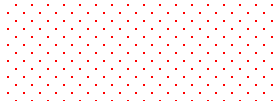
Vaporize whole area

Non-ablative

Heat but don't vaporize

Fractional

Ablative or nonablative



Manstein D, Herron GS, Sink RK, Tanner H, Anderson RR. **Fractional photothermolysis**: a new concept for cutaneous remodeling using microscopic patterns of thermal injury. Lasers Surg Med. 2004;34(5):426-38.

Nonablative
Fractional Resurfacing (NAFR)

10 subjects with second and third degree burn scars

5 treatments at 4 week intervals

3 independent investigators evaluated at 3 months post-treatment

Waibel J, Wulkan AJ, Lupo M, Beer K, Anderson RR. Treatment of burn scars with the 1550 nm nonablative fractional erbium laser. Lasers Surg Med. 2012: 441-446.

1550 nm NAFR

90% of subjects achieved improvement

Moderate to excellent improvement in 60%

- 90% improved texture
- 80% improved dyschromia
- 80% improved hypertrophy/atrophy

Patients also reported improvement in self esteem

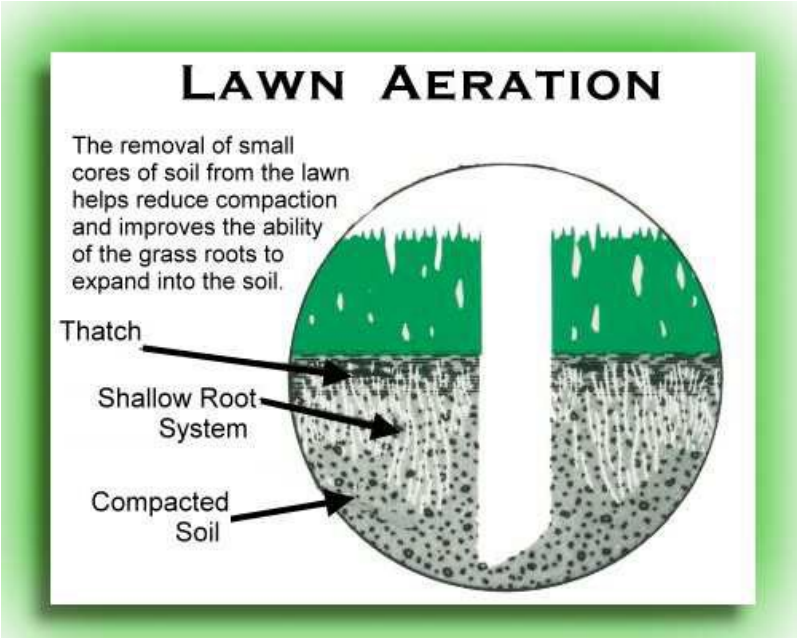
Waibel J, Wulkan AJ, Lupo M, Beer K, Anderson RR. Treatment of burn scars with the 1550 nm non-ablative fractional erbium laser. Lasers Surg Med. 2012:441-446.

Ablative Fractional resurfacing for Scars and Wound Healing

- Mechanical fenestration – near immediate!
- Effects wound contraction and collagen remodeling via localized thermal necrosis (**"heat shock"** response)
- Damage occurs within noncontiguous microscopic thermal zones
- Intact tissue serves as reservoir of normal epidermal/dermal cells; migrate to damaged area and effect healing
- Associated with increased MMP1, decreased Type 1 (adult) collagen expression, increased Type 3 collagen (fetal)
- Inhibits TGFB1

Alster TS. Plast Reconstr Surg (1999); Manstein D, et al. Lasers Surg Med (2004); Xie J, et al. Wound Repair Regen (2008)

Turf Analogy



Acknowledgements to Chris Zachary and Andrew Krakowski

Ablative Fractional resurfacing for Scars and Wound Healing

Physician sets:

1) Area to be treated per pulse

2) Depth of penetration (J/cm2 correlating to micrometers)

3) Density – low density for scars usually 5.5-15%

Ablative Fractional Resurfacing (AFR):
Erbium: Yttrium Aluminum Garnet (Er:YAG)
Carbon Dioxide ($C0_2$)

10 subjects with mature, full thickness, hypertrophic burn scars

3-4 treatments with fractional CO_2

Banded areas also treated with Deep FX

Qu Le, Liu A, Zhou L et al. Clinical and molecular effects on mature burn scars after treatment with a fractional CO_2 laser. Lasers Surg Med 2012; 44:517-524.

General Concepts for Scar Remodeling Treatments (AFR)

- Low Density
- Treat entire scar and 1-2 mm rim
- Can start as early as 2 months after injury (controversial)
- Treatment every 8-12 weeks
- Can combine with triamcinolone suspension (10-40 mg/ml) immediately following the procedure

Uebelhoer NS, Ross EV, Shumaker PR. Ablative Fractional Resurfacing for the Treatment of Traumatic Scars and Contractures. Sem Cut Med Surg:110-120, 2012.

Waibel JS, Wulkan AJ, Shumaker PR . Treatment of scars using laser and laser assisted corticosteroid delivery. Lasers Surg Med. 2013 Mar;45(3):135-40.

****Seagho M et al. Laser Treatment of Traumatic Scars and Contractures: 2020 International Consensus Recommendations. Lasers Surg Med. 2020.**

Treatment of Traumatic Tattoos/Implanted material
Q-switched 1064 nm

Non-laser Devices

- Microneedling
- Radiofrequency microneedling

A Comparative Study of the Efficacy of Fraction CO_2 laser versus Microneedling Fractional Radiofrequency in the Management of Atrophic Acne Scars Among Iraqi Patients

- 42 patients 20-48 years
- Group A fractional CO2; Group B microneedling radiofrequency; once monthly for 4 months
- Assessment 2 months after the final session
- Both groups improved with average percent of improvement
  - 42.9% for fractional CO2
  - 24.3% for radiofrequency microneedling

Al-Sultany, H. Annals of Tropical Medicine and Public Health. 2020

Additional Considerations for Laser Treatment of Scars

Import Discussion Points for Consultation

- Goals must be defined: scars can be improved but not removed
- Laser can help to improve range of emotion and decrease pain
- Laser therapy is often not monotherapy

  - Surgical revision such as Z-plasty

  - Physical and Occupational Therapy

Uebelhoer NS, Ross EV, Shumaker PR. Ablative Fractional Resurfacing for the Treatment of Traumatic Scars and Contractures. Sem Cut Med Surg:110-120, 2012.

Anesthesia

- For laser surgery topical anesthesia under occlusion for 1 hour or more before is often enough
- Focal hyperesthetic areas can be injected with lidocaine
- Forced chilled-air device can also make more comfortable
- Some patients can be given narcotics or anxiolytics
- For very large surface areas or patients who tolerate poorly, general anesthesia can be used

Uebelhoer NS, Ross EV, Shumaker PR. Ablative Fractional Resurfacing for the Treatment of Traumatic Scars and Contractures. Sem Cut Med Surg:110-120, 2012.

Fractional Carbon Dioxide Laser Resurfacing in Combination With Potent Topical Corticosteroids for Hypertrophic Burn Scars in the Pediatric Age Group: An Open Label Study

Imran Majid, MD and Saher Imran, DPD*

- Patient of all ages can be treated
- This study 5-12 years of age but younger can be treated

J Dermatologic Surgery; 2018; 1102-1108

Multiple Devices Can be Used in the Same Session

Hyperpigmented (dark) scars

- Q-switched lasers
- 1927 nm NAFR

Hypertrophic (raised) scars

- AFR + steroid
- Choose depth based on scar thickness approximately
- Low density

Laser therapy of traumatic and surgical scars and an algorithm for their treatment

TABLE 1. Scar Types and Definitions

Erythematous scar	Pink or red scar
Hypertrophic scar	Raised scar contained within original wound confines
Hypopigmented scar	White scar
Scar with low tension	Scars that develop from incisions or punctures without tissue removal and not present on high tension anatomical areas (e.g., extensor surfaces of joints, upper chest, and back)
Scar with high tension	Scars that develop after excisions or loss of large skin areas or present on high tension anatomical areas (e.g., extensor surfaces of joints, upper chest, and back)
Mature/stable scar	Scars with resolving erythema and arrested growth
Immature/unstable scar	Scars with persistent erythema and active growth

Kauvar ANB et al. Laser therapy of traumatic and surgical scars and
An algorithm for their treatment. LSM 2020:125-136.

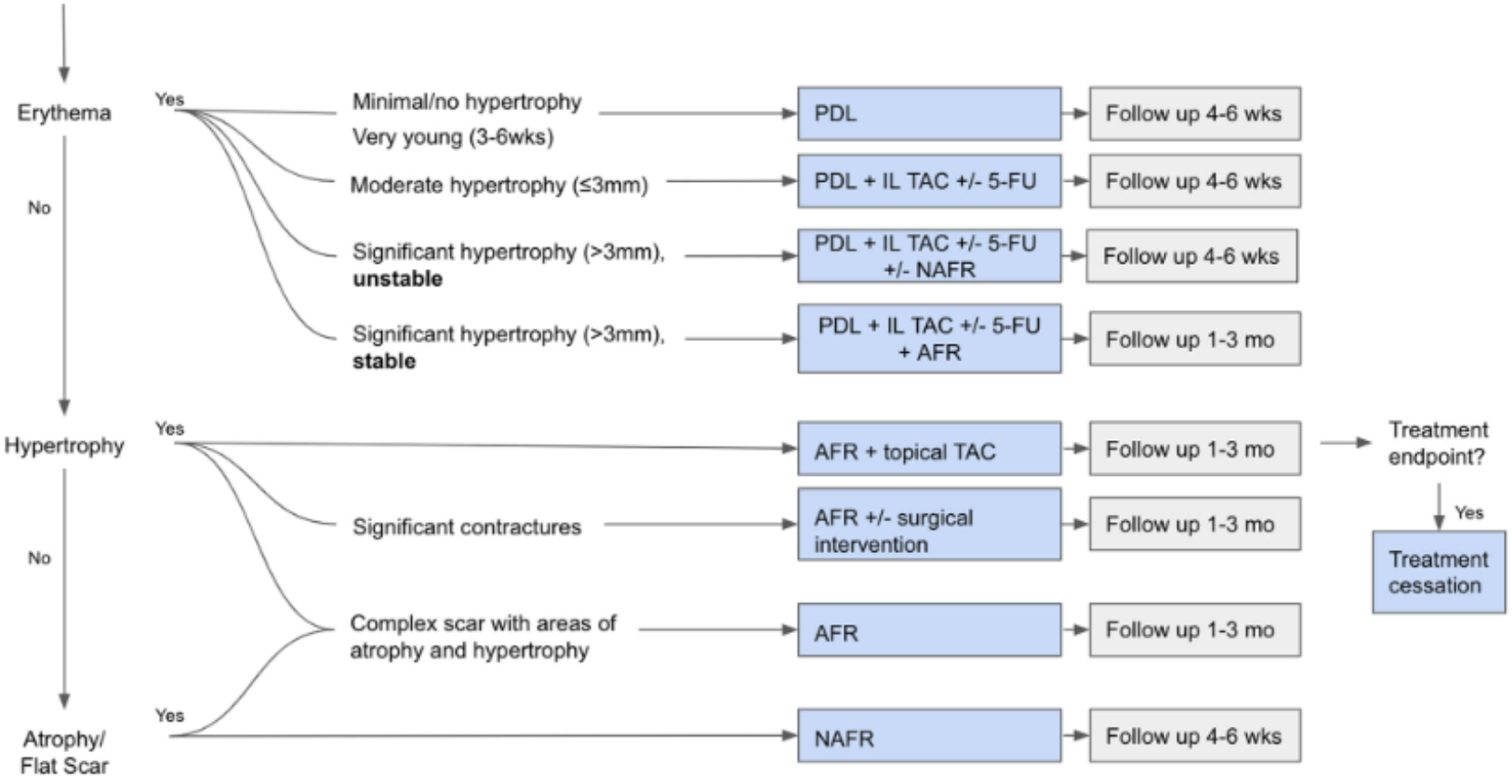


Fig. 6. Algorithm for laser treatment of scars.

Kauvar ANB et al. Laser therapy of traumatic and surgical scars and An algorithm for their treatment. LSM 2020:125-136.

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Post-operative Care

Pulsed dye laser: Sun protection

AFR and Q-switched lasers

- Several times daily petrolatum or petrolatum based ointment and non-stick dressings as needed
- Diluted vinegar soaks several times daily until epithelialized in 3-7 days
- Antivirals when treating certain areas of face
- Antibiotics in high-risk situations
- Avoid pools or ocean until epithelialized

Normal activity

Pain medicine: OTC products or may not need anything

Uebelhoer NS, Ross EV, Shumaker PR. Ablative Fractional Resurfacing for the Treatment of Traumatic Scars and Contractures. Sem Cut Med Surg:110-120, 2012.

Summary

- Lasers are light based devices which when used correctly can be powerful therapeutic tools
- Multiple lasers can be used for treatment of scars
- Lasers can provide dramatic improvement in scar mobility and appearance and are an important part of recovery therapy

Thank you!

- Questions
- Acknowledgements

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