Fractional Resurfacing: Ablative, Non-ablative and combining energy based devices

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Background Skin Resurfacing

• Traditional ablative resurfacing ~ began 1980/90’s
  – CO\textsubscript{2}, Er:YAG lasers; Er:YSGG
  – Complete removal of epidermis with dermal collagen contracture and remodeling
  – Great results for facial rhytides and photoaging, scarring, rhinophyma
  – Risk of scarring, infection, dyspigmentation including delayed hypopigmentation, prolonged erythema
  – **Limited utility in rejuvenation off face: high risk of infection and scarring, very slow healing time, minimal results**
  – May be used for destruction of epidermal or dermal skin lesions in all areas of the body
    • Epidermal nevi, ILVEN, lymphangioma
Background Skin Resurfacing

• Non ablative fractional resurfacing ~ began 2004
  – Evolved as an answer to unacceptable side effects of fully ablative resurfacing while achieving rejuvenation
  – Microscopic columns of thermal injury sparing the surrounding skin (microscopic thermal zone -MTZ’s)
  – Remodeling of dermal matrix, removal of epidermal and dermal pigment
  – Faster healing and minimal unwanted effects
  – Ability to treat darker skin types
History of Skin Resurfacing

• Ablative fractional resurfacing ~2007
  – Followed nonablative fractional resurfacing
  – First device was fractional CO2 then Er:YAG
  – Deep dermal tissue removal showing enhanced tissue contraction and tightening over nonablative fractional resurfacing
  – Dermal remodeling and removal of pigment
  – Today- CO₂, Er: YAG, Er: YSGG
History of skin resurfacing

• Latest nonablative/subablative device
  – 1927 nm
  – More affinity for water than nonablative, but not as much as ablative
  – Confines damage to just below epidermis
  – Good for epidermal lesions and especially pigment

• Latest trend is microneedling with radiofrequency
Physics of Skin Resurfacing

Targeting Water
Water absorption

Water Absorption by Wavelength

- 2790 nm YSGG = 5000
- 2940 nm Er:YAG = 12,500
- 10,600 nm CO₂ = 1000
- 1927 nm
- 1550 nm (Er Fiber) Fraxel = 10
Ablative Fractional Resurfacing

- Paraffin embedded, H&E stained sections show tapering thermal treatment voids that are lined by a thin layer of eschar formation and surrounded by a zone of thermal coagulation representing denatured collagen. The arrows outline the extent of denatured collagen zones.

Nonablative fractional resurfacing

• Immediately after treatment:
  – Epidermal and dermal necrosis
  – Stratum corneum remains intact
• 24 hours after treatment:
  – Complete repair of epidermis
  – Extrusion of epidermal components – MENDs (micro-epidermal necrotic debris)
• 1 week after treatment:
  – Dermal necrosis still present
  – MENDs slough
• 3 months after treatment:
  – MTZ is healed
  – Thickens epidermis, restores rete ridges, increases dermal collagen
Microneedling with Radiofrequency
Needle depths of from 0.5 mm to 3.5 mm are illustrated at a constant power level of 4 and an exposure time of 100 ms.

Space bar = 200 μm for all, but note that the 3.5 mm depth specimen is at a smaller final magnification to fit the photomicrograph into the figure with the others.

Courtesy of S.B. Cho, MD, Dermatologist, S. Korea
Fractional Treatment Parameters

• Wavelength
  – Non-ablative: 1440, 1540, 1550, 1927nm
  – Ablative: \(\text{CO}_2\) (10,600 nm), Er:YAG (2940 nm), Er:YSGG (2790 nm)

• Fluence
  – Determines depth of treatment

• Density
  – Amount of skin treated per pass
  – Expressed as % or MTZ/cm\(^2\)
Wavelength

• Ablative vs. Non-ablative
  – Considerations
    • Downtime
    • Fitzpatrick Skin Type
    • Location-
      – High risk locations: neck, chest, upper lip, mandible

• Depth
  – Ex. 1550 nm vs. 1927 nm
Wavelength

- 1927 has greater affinity for water
- 1927 nm good for actinic keratoses, pigmented lesions including lentigines, melasma, etc.
Fluence

- Match fluence/depth of penetration with target
- Applies for both ablative and non-ablative treatment
Density

- Determines how “aggressive” a treatment is
- Greater density = more downtime
- Lower density should be used for darker skin types
Indications

• Striae distensae
• Scarring (surgical or traumatic)
  – hypertrophic vs. atrophic
• Photoaging – rhytides, solar elastosis, mild laxity
• Poikiloderma of Civatte
• Lentigines
• Flat seborrheic keratoses (SK)/dermatosis papulosa nigra (DPN)
• Actinic keratoses
Scarring

• Hypertrophic scarring and scars restricting movement
  – Ablative fractional lasers are preferred over nonablative fractional lasers (CO$_2$ over Er:YAG)
  – Combine with ILK and vascular lasers

• Atrophic scarring (acne, surgery, traumatic)
  – Either ablative or non-ablative fractional lasers can give good results
  – Ablative fractional lasers give higher risk of complications
    • More PIH, prolonged erythema, risk of further scarring
  – Nonablative fractional lasers require more treatments

Scarring

• Energy/depth of laser should be set to match the depth of scar

• Lower densities are better, especially for hypertrophic scars
Photoaging

- Well-established for improvement of rhytides, dyspigmentation (both hyper and hypopigmentation), skin texture, laxity
- Ablative fractional more utility for skin laxity
- Caution off face
6-12 mJ
s/p 4 treatments
spaced 4-7 days
apart
B. 1.5 mo later
D.
3 mo later
E. 1 mo
later
Lentigines, Flat SK’s/DPN’s

• Ablative vs. Nonablative
• Fraxel 1927 nm nonablative laser is my treatment of choice–
  – Good mix of downtime and results
• Ablative fractional treatments
  – Decrease depth and density off face
  – Can consider increase size of microbeam and drastically decreasing energy/depth
Complications

- Prolonged erythema
- Hyperpigmentation
- Infection
  - HSV (vesicles)
  - Bacterial (pain, pustules, erosions)
  - Candida (itching, small pustules)
- Scarring
- Acne eruption
- Milia
- Exacerbation of melasma
Combination therapy

– Light electrocautery followed by fractional laser
– Vascular laser + fractional laser
– QS laser + fractional laser
Future of fractional resurfacing

• At home devices
  – Fractional laser- low energy/low density
  – Meant to use daily

• Drug delivery
  – Lasers + Topicals
    • Antioxidant after non-ablative fractional resurfacing- quicker healing, less erythema
References


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