Disclosure

- Galderma: speaker, physician trainer, clinical investigator, advisory board member
- Allegan/Kythera: speaker, trainer, clinical investigator, advisory board member
- Merz: advisory board member
- Lumenis: speaker, physician trainer
- Lutronic: speaker, consultant
- BTL: speaker, clinical investigator

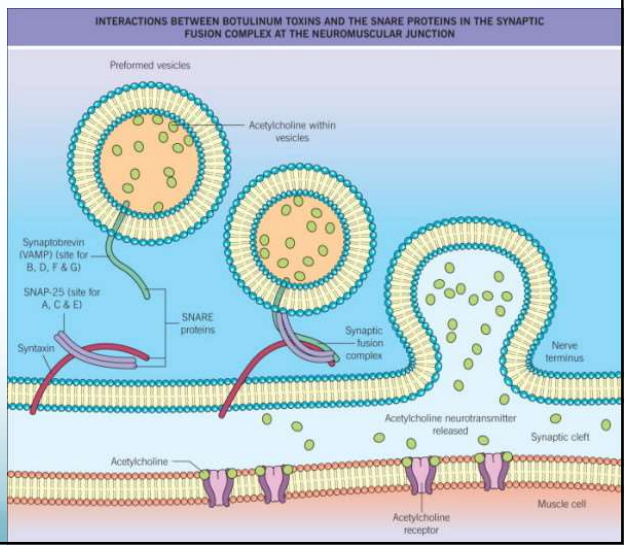
Topics for Discussion

- Injectables
- Dermabrasion
- Chemical peels
- Laser technology
  - Nonablative
  - Ablative

Injectables

Botulinum Toxin

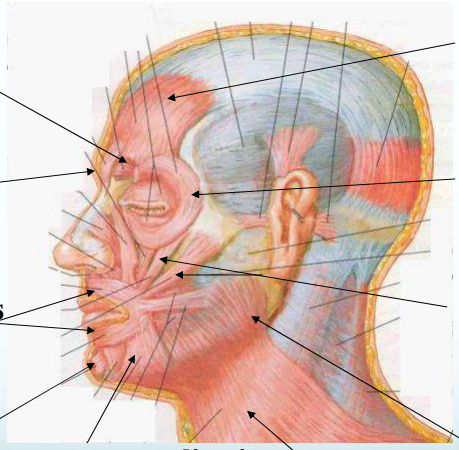
- Subtypes: A, B, C1, D, E, F, G
  - Type A approved for cosmetic use
  - Type B faster onset, but increased risks, more painful
- MOA:
  - Block acetylcholine release from presynaptic neuromuscular junction



Botulinum Toxin

- Indications for cosmetics: glabellar use, blepharospasm, axillary hyperhidrosis, frontalis, lateral canthal lines
- Contraindications:
  - Hypersensitivity to any botulinum toxin preparation
  - Cow milk protein
  - Infection in treatment area
- Warnings/Precautions: Neuromuscular disorders, human albumin
  - Drug interactions: aminoglycosides, curare-like agents, muscle relaxants
  - Pregnancy (category C): animal studies—may cause fetal harm
- Antibody production: exceedingly rare event, test not commercially available
- Consider facial musculature, and side effects from over-/under-treatment of various areas
  - Blepharoptosis: treat with aproclonidine 0.5% drops TID (alpha adrenergic agonist recruiting Muller muscle)—3-6 weeks to resolve

Musculature of the Face



Corrugator supercilii

Placement too inferiorly—affects lid levator—eyelid ptosis (treat with aproclonidine drops)

Procerus

Orbicularis oris

Overtreatment: oral incompetence, difficulty with elocution

Mentalis

Depressor anguli oris

Medial treatment: may affect DLI

Platysma

Overtreatment--?dysphagia, breathing difficulties, neck weakness

Masseter

Too superficial of treatment—bulging of deep portion of muscle

Zygomaticus major and minor

Orbicularis oculi

Treatment below zygomatic arch—affect zygomaticus with facial/mouth droop

Overtreatment jelly roll—scleral show

Frontalis

Overtreatment: brow ptosis

Undertreatment laterally: quizzical brows

Netter 1997

Collagen

- No human collagen product commercially available at this time—but still FAIR GAME on test
- Products
  - Zyderm (superficial dermis)/Zyplast (deep dermis): bovine collagen
    - Requires prior skin test before placement
    - 1-2% of patients develop allergic rxn after single skin test
    - Zyplast contraindication: placement deep in glabellar area
      - Intravascular placement→livedoid vascular pattern→skin necrosis
  - Cosmoderm/Cosmoplast: human collagen—not currently produced
    - No skin test prior;
    - however h/o bovine collagen allergy necessitates 2 negative skin tests
  - Evolence: porcine collagen—not currently produced

Hyaluronic acid fillers

- Non-animal stabilized HAs (NASHA) produced by strep bacterial fermentation
- Indication: mid to deep dermal placement for facial folds and contour deficiencies, hand rejuvenation
  - Frequently used for lip augmentation—Restylane, Restylane Silk, Juvederm, Volbella, Restylane Kysse now have FDA indication
- Contraindications:
  - Severe allergies, allergies to bacterial proteins, bleeding disorders, implantation other than in dermis/sub Q
- Adverse events
  - **Intravascular placement**: blanching→purplish discoloration →skin necrosis
    - Treat with hyaluronidase, heat, topical nitropaste, massage, hyperbaric oxygen, NSAIDs/ASA, sildenafil, pentoxyfiline
  - Moderna COVID-19 vaccine trial: 3 patients with temporary, resolved edema in areas of recent HA filler placement

Calcium hydroxylapatite (Radiesse)

- Composition:
  - Matrix of CaHA 25-45 µm particles suspended in gel carrier of carboxymethylcellulose, glycerin, and water
  - Results in collagen production; can cause new bone growth
  - Radiopaque—visible on CT and X-rays
- Indication: facial lipoatrophy (including HIV)
- Contraindications:
  - Hypersensitivity to any component
- Adverse events:
  - Avoid lip placement—visible papules
  - Intravascular placement
  - Pronounced ecchymosis
  - Avoid superficial placement
- Possible reversing agent: sodium thiosulfate

Poly-L-lactic acid (Sculptra)

- Biostimulatory agent: neocollagenesis through series of treatments
- Indications: HIV lipoatrophy, facial lipoatrophy
  - No skin testing required
- Contraindications: hypersensitivity to components, h/o keloid formation/ hypertrophic scarring
- Adverse events:
  - Papule formation: avoided through deeper placement, longer reconstitution time (disproven), higher dilution volumes, avoid placement around facial sphincteric muscles
    - Treatment of papules: ILK, 5-FU, time, excision
    - Granulomas: oral TCNs, intralesional steroid/5-FU, light therapy, excision

PMMA gel (Bellafil, Artefill)

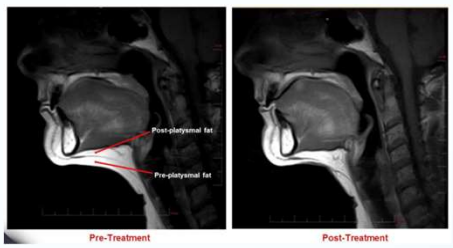
- Polymethylmethacrylate (PMMA) beads suspended in collagen carrier
- Indications: NLF correction, acne scarring
- MOA: collagen production in areas of placement
- Pros: longer-lasting results
- Cons: earlier issues with particle size consistency leading to delayed reactions, granulomas

Microdroplet Injection Silicone

- Soft tissue augmentation considered "off-label use" of a Health Protection Branch approved product
- MOA: microdroplets of 0.002-0.004 cc creates build up of collagen in a predictable, controlled foreign-body like reaction

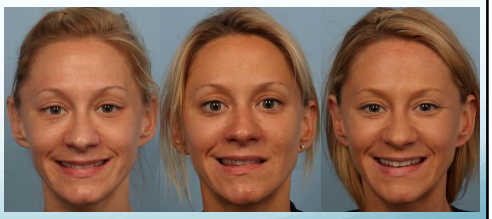
Deoxycholic Acid (Kybella)

- FDA indication: treatment of submental fullness (preplatysmal fat)
- Treatment regimen:
  - Clinical study: injection into subcutaneous region at 4 week intervals, up to 6 treatments
  - MOA: adipocytolysis



Deoxycholic Acid (Kybella)

- Adverse Events:
  - Edema, erythema, hematoma, pain, paresthesia/numbness, asymmetric smile (marginal mandibular nerve)
- Contraindications:
  - Allergy to drug
  - Active infection or inflammation in area of treatment



Submental Fullness

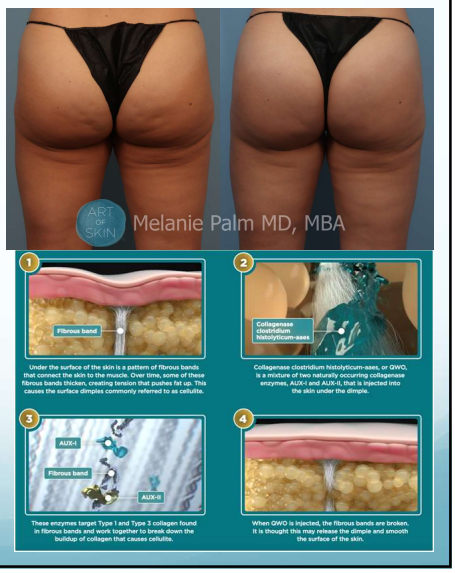
Photo courtesy of Melanie D. Palm, M.D., MBA

Submental Fullness

Photo courtesy of Melanie D. Palm, M.D., MBA

Collagenase Clostridium Histolyticum (Qwo)

- FDA indication: moderate/severe cellulite on buttocks of adult women
- Treatment regimen:
  - Clinical study: up to 12 dimples per side, every 3 weeks, 3 treatments
  - MOA: enzymatic subcision & release of fibrous septae through AUX-1 and -2 (collagenase I and III)



Word of Advice

- Know implantable devices that could be used as alternative to fillers in the face
  - Silicone, Gortex, PTFE, etc.
  - Know indications, adverse events (extrusion)
- Know Fat transfer as alternative to fillers
  - Ideal candidate (age, BMI)

Wound Healing

Tenets of Skin Wounding

- 1. Wound healing is enhanced by **moisture/humidity** 'epiboly'
- 2. When injuring the skin by laser, dermabrasion or chemical peeling do not go beyond the mid-reticular dermis (i.e. bifurcation of sebaceous glands from hair follicles)
  - Papillary dermis = Location of vertical collagen
  - Deeper collagen (reticular dermis) is parallel-will lead to alabaster skin

Tenets of Skin Wounding

- 3. As new collagen is laid down fibronectin gradually disappears;
  - Type III collagen is replaced by Type I collagen
- 4. Increased cross-linking of collagen mediated by lysyl oxidase provides increased tensile strength of re-modeled skin
- 5. New epidermis occurs from keratinocyte migration from wound edges and hair follicles

Stages of Wound Healing After Chemical Peeling

I. Coagulation and inflammation

II. Granulation (neo-angiogenesis)

III. Re-Epithelialization

(Epiboly begins at day 2)

IV. Fibroplasia-matrix collagen re-modeling

Skin Wounding

Level I	Epidermal
Level II	Papillary dermis
Level III	Reticular dermis

Resurfacing Modalities

Chemical Peels

Indications for Chemical Peeling

1. Actinic changes and actinic pre-neoplasia
2. Rhytides
3. Pigmentary dyschromia
4. Superficial scarring
5. Radiation dermatitis
6. Acne vulgaris and rosacea

Contraindications to Chemical Peels and Resurfacing Procedures

- Isotretinoin within last 6-12 months
- Absence of intact pilosebaceous units on face
- Active infection or open wounds
- Abnormal wound healing (hypertrophic scars, keloids, h/o radiation)
- Poor general health or nutritional status
- Unrealistic expectations, psychological/mental instability
- Poor patient-physician relationship
- Pregnancy

Skin Diseases Exacerbated by Resurfacing

- Sarcoidosis
- Acne
- HSV
- Folliculitis
- Milia
- Skin cancer
- Verruca plana
- Xanthelasma
- Telangiectasias
- Vitiligo

- *Herpes prophylaxis should be carried out for 7-10 days after chemical peeling; start the day before procedure*
- *If breakout starts on therapy, increase dosage of antiviral*

Ablative Skin Resurfacing Methods	
Superficial—very light	To stratum spinosum (removal of stratum corneum)
•Low potency glycolic and other AHAs •10-20% TCA •Tretinoin •Modified Unna's resorcin paste •Salicylic acid (beta hydroxy acid) •microdermabrasion	*Heals in 3 weeks or less*
Superficial--light	To papillary dermis (removal of epidermis)
•70% glycolic acid •Jessner's solution •Solid CO_2 slush •10-20% TCA	*Heals in 6 weeks or less*
Medium Depth	To upper reticular dermis
•88% phenol •35-40% TCA •Jessner's + 35% TCA •Solid CO_2—35% TCA •Conservative manual dermabrasion/sanding •Erbium:YAG laser resurfacing •Conservative CO_2 laser resurfacing	*Heals in 4-6 months*
Deep	To mid reticular dermis
•Unoccluded/occluded Baker-Gordon formula •>50% TCA •Wire brush or diamond fraise dermabrasion •Aggressive manual dermasanding •Aggressive Erbium:YAG laser resurfacing •Full CO_2 laser resurfacing •Combination Erbium:YAG/CO_2 laser resurfacing	*Heals in 1 year or longer*

Chemical Peel Observations and Wounding Agent Considerations

***Before peel*:**

- Fitzpatrick skin types I-VI
- Sebaceous gland density: mild, moderate, severe
- Actinic damage: mild, moderate, severe
- Topical and systemic skin desiccators
- Defatting agent, how applied, how long (e.g. gauze acetone abrasive scrub for 2 minutes)

***During peel*:**

- Number of cotton applicators, gauze, or sable brush, very wet vs. damp, rubbed for how long
- Dilution (if performed)—when, how long
- Occlusion—tape variety, when removed

Non-Facial Peels

- Healing times 50-100x longer
- Use only superficial peels
- Peeling of the neck: treacherous territory
  - Hypertrophic scarring

Superficial Chemical Peels

Caveats: Superficial Chemical Peeling

- Degreasing (acetone & EtOH): strips stratum corneum—ensures even application
- AHAs: require neutralization
  - MOA: weakens intercellular cohesion (desmosome attachments)
- Salicylic acid MOA: keratolysis & lipolysis of cornified envelope
  - Salicylism? Never reported but theoretical risk
  - Self-neutralizing
- TCA MOA: protein precipitation
- Jessner's solution: keratolysis
- Resorcinol: disrupts keratin bonds
- Treatment endpoints:
  - α and β hydroxy acids: splotchy frosting + erythema
  - TCA: solid frost (white)

Jessner's Solution

- 14g Resorcinol
- 14g Salicylic Acid
- 14g Lactic Acid
- Ethanol (95%) qS to 100 mL

- Resorcinol—phenol derivative, may cause contact allergy, myxedema, and methemoglobinemia
- Salicylic acid: beta-hydroxy acid
- Lactic acid: alpha-hydroxy acid

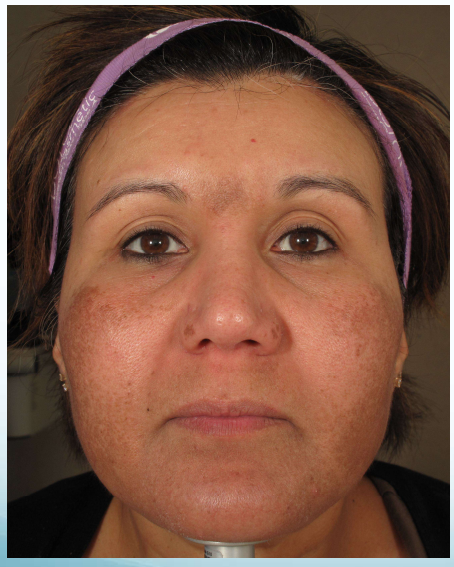
Pre β Salicylic Acid Peel

Post β Salicylic Acid Peel

Pre 70% glycolic acid peel

Post 70% glycolic acid peel
3 tx

Melasma: Melanage Peel (retinoic acid and arbutin)



Before treatment

1 month after treatment

Medium depth chemical peels

Caveats for Medium depth

- ASA pretreatment blocks nerve fibers
- If peel gets into eye:
  - TCA: flush with water
  - Phenol: flush with mineral oil
- Eyelids: do not use greater than 35% TCA
- Use cool compresses/ice packs after procedure for pain relief
- Post-peel emollients hastens re-epithelialization

TCA

- TCA an alcoholic acid; diluted in small amount of water
- Jessner's used prior to TCA as a keratolytic
  - allow more uniform penetration of TCA
  - lower effective % TCA to be used (increased safety)
- Frosting
  - Level I:
    - Speckled white frosting with mild erythema
  - Level II:
    - White-coated frosting with erythema showing through
  - Level III:
    - Solid white enamel frosting with little/no underlying erythema

Persistent Erythema/Scarring Post Peel

- Class I corticosteroids
- Intralesional corticosteroids (5-10 mg/cc)
- Intralesional 5-fluorouracil
- Pulsed dye laser
- Imiquimod

Pre Jessner's medium depth peel

35% TCA

Post Jessner's medium depth peel

35% TCA

Pre Jessner's/
40% TCA peel for acne

Post Jessner's/
40% TCA peel for acne

35% TCA peel
Xanthelasma

Pre Jessner's/
35% TCA chemical
peel frosting

Post Jessner's/
35% TCA chemical
peel

Photo courtesy of Deborshi Roy

1 Month post 35% TCA/Jessner's Peel

Persistent medium depth peel erythema/ impending scar

Deep Chemical Peeling

Considerations in Deep Chemical Peeling

- Agent
  - Solution
  - Concentration
  - Frequency of application
  - Volume
- Patient Characteristics
  - Skin thickness
  - Integrity of the epidermal barrier
  - Age of patient
  - Cumulative sun exposure
- Occlusion

Baker-Gordon Formula

Phenol USP 88%	**3 mL**
Tap or distilled water	**2 mL**
Septisol liquid soap	**8 drops**
Croton oil	**3 drops**

- Phenol MOA: toxic--enzymatic inactivation, protein denaturation
  - Peels more deeply in higher concentrations
- Water: used to dilute phenol
- Septisol: emulsifier (surface tension-lowering agent)
- Croton oil: increases phenol depth of injury

Hetter G. An examination of the phenol-croton oil peel: Part I dissecting the formula. *Plast Reconstr Surg 2000;105(1):222.*

Practical Aspects: Phenol Peeling

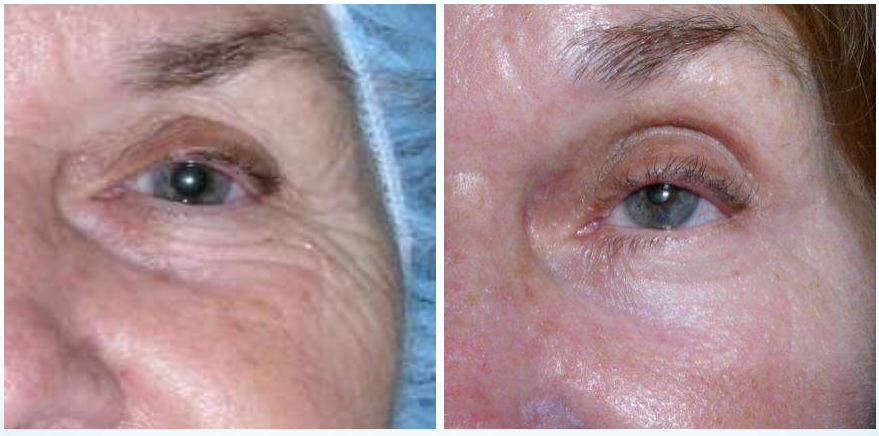
- Baker/Gordon formula is an emulsion and thus must keep stirred up
- Pre-hydration is of utmost importance
- **Phenol is cardiotoxic, nephrotoxic, and hepatotoxic**
  - Space peel in facial segments of 1.5 hours
  - Cardiac monitoring required to avoid cardiac arrhythmias
- Vigilon and Second Skin are helpful post peel occlusive dressings

Complications of Phenol Peeling

- Pigmentary changes
- Scarring
- Infection
- Prolonged erythema or pruritus
- Poor physician/patient relationship
- Atrophy
- Textural changes
- Cold sensitivity
- **Cardiac arrhythmias**
- Laryngeal edema
- Toxic shock syndrome

Pre Phenol Peel

Post Phenol Peel



Pre Phenol Peel

Post Phenol Peel

Post Phenol Peel Hypopigmentation

Post Phenol Peel Scarring

Dermabrasion

Dermabrasion

- Dermabrasion: mode of mechanical resurfacing using a rotating abrasive surface attached to a handheld, power-driven engine
  - Original method: wire brush
  - Diamond fraise developed in 1957: less aggressive, more forgiving
- Dermasanding: manual form of dermabrasion
  - Resurgence of this technique (deliberate and controlled skin planing)
  - Silicon carbide sandpaper or wallscreen
- Overall trend toward laser skin resurfacing, replacing dermabrasion and deeper chemical peeling techniques

Physical Principles of Effective Dermabrading

- The normal contour of the skin should not be altered during dermabrasion
- When the skin is frozen to a solid state, the dermabrasion is most effective
- There are certain larger areas where post-operative scars are more likely to occur
  - Philtrum, cleft of chin, angles of the mouth, nasolabial fold, alae nasi

Practical Tips in Performing Dermabrasion

- Perform dermabrasion in segmental zones
  - (lateral to medial)
- Use an assistant to keep skin taut (and flat)
- As soon as desired depth of abrasion achieved, apply 2% lidocaine with epinephrine-soaked sponges for anesthesia

Pre-Op for Dermabrasion

- Anesthesia:
  - Hydroxyzine hydrochloride (Vistaril 50 mg)
  - Meperidine hydrochloride (Demerol 50 mg)
- Topical regimen prior to procedure:
  - Retinoids, α-hydroxy-acids, hydroquinones
  - Pre-operative antibiotics
  - Herpes Simplex Virus (HSV) prophylaxis:
    - Valtrex 500 mg BID x 7-14 days
    - Famvir 250 mg BID x 7-14 days

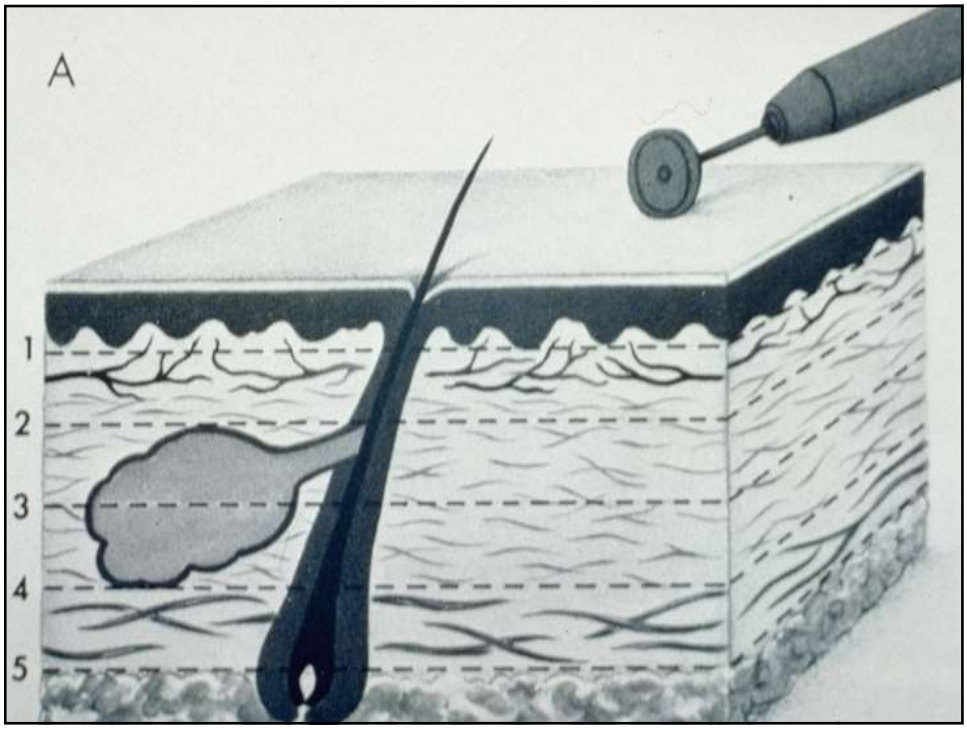
Dermabrasion Indications

Major:

- Acne scars
- Fine wrinkling
- Scar revision
- Melasma
- Perioral rhytides
- Tattoo removal

Minor:

- Epidermal nevus
- Rhinophyma
- Benign appendageal neoplasms
- Actinic keratoses
- Fox-Fordyce disease
- Darier's disease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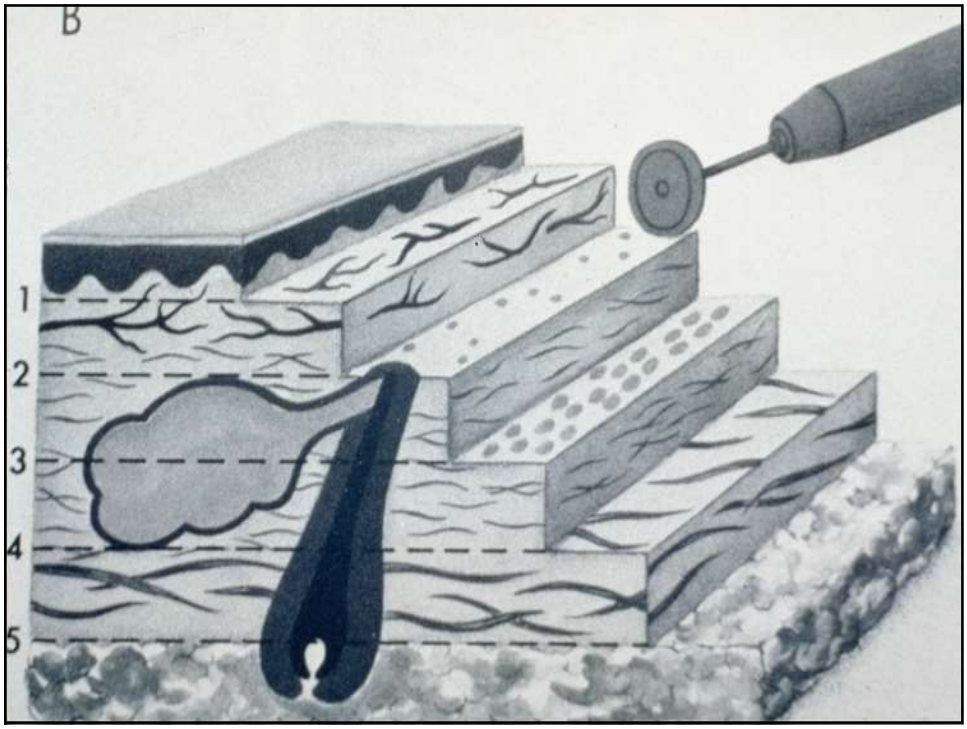
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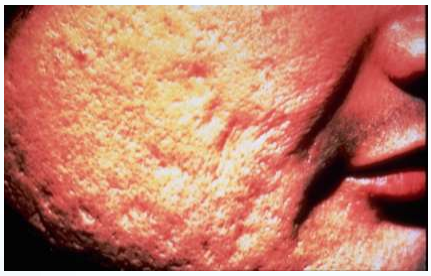
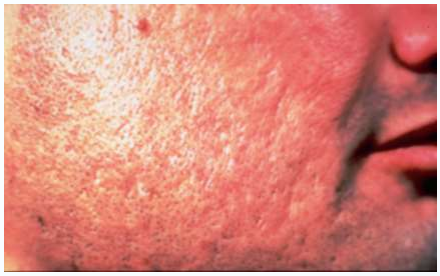


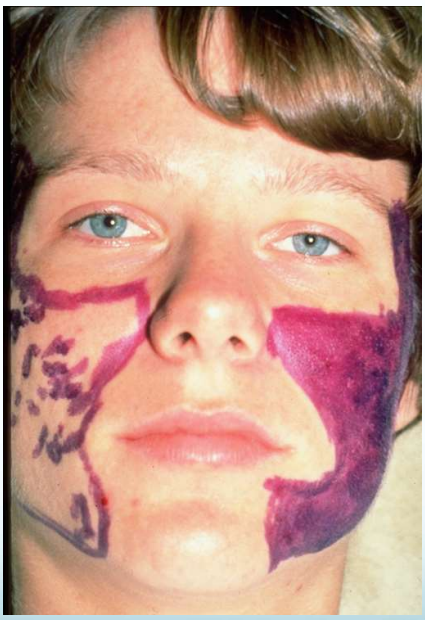
Pre dermabrasion



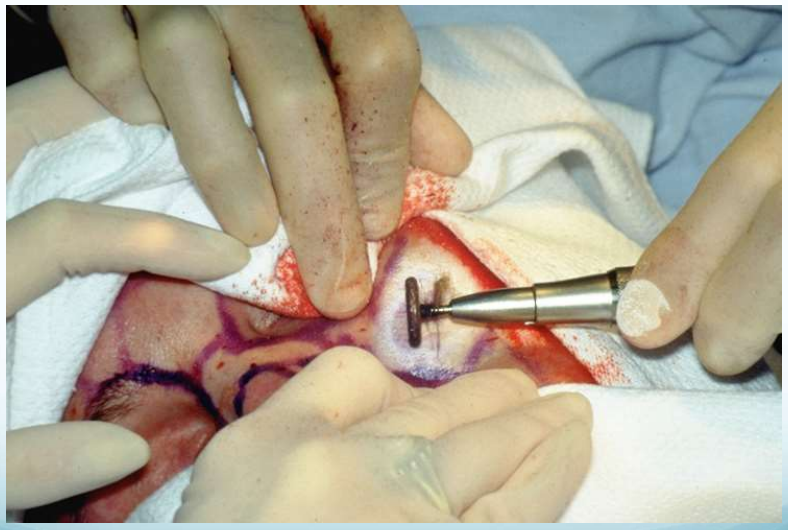
Post dermabrasion

Pre dermabrasion

Post dermabrasion



Pre dermabrasion

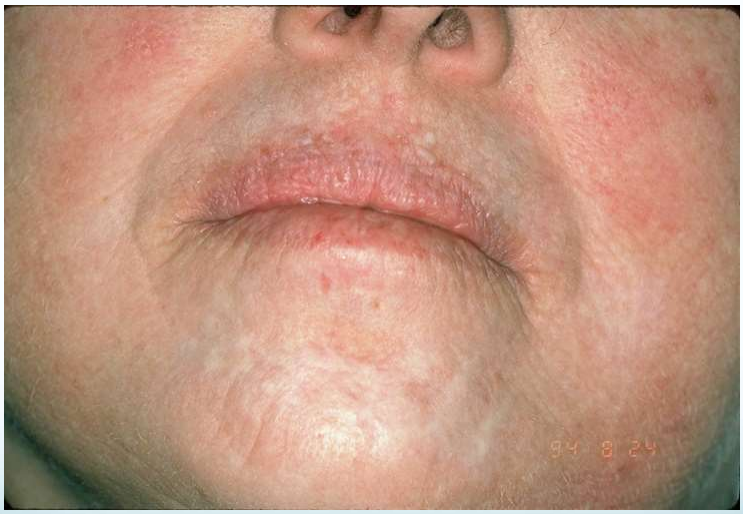


Anticipated Sequelae Following Dermabrasion

- DURING RE-EPITHELIZATION
  - Edema
  - Exudate
  - Discomfort
  - Crust formation
- FOLLOWING RE-EPITHELIZATION
  - Erythema
  - Pruritus
  - Pustules
  - Milia
  - Flushing (cold, alcohol, exercise)

Side Effects of Dermabrasion

1. Purpura & Petechiae
2. Scarring
3. Hypopigmentation (transitory)
4. Hyperpigmentation (transitory)
5. Comedones, milia, cysts



Post dermabrasion scarring

Complications of Dermabrasion

1. Persistent erythema
2. Infection (bacterial, fungal, viral)
3. Scarring
    (a) Isotretinoin therapy
    (b) Infection-bacterial/viral
    (c) Patient manipulation
    (d) Deep dermabrasion

Advantages of Dermabrasion vs. Other Resurfacing Procedures

1. Controlled depth of wounding

2. Removes telangiectasias vs. chemical peels or lasers

Post-Operative Dressings

Open-hydration and emollients

VS

Occlusion-Vigilon, Second Skin- N-ter face, Silon

Silon

Laser Technology

Ablative and Nonablative

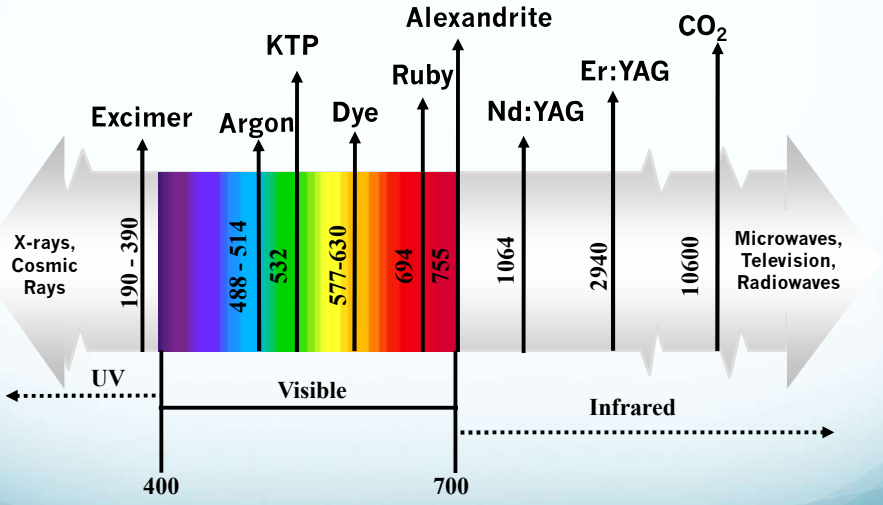
Laser Basics

- LASER: light amplification by stimulated emission of radiation
- Theory of selective photothermolysis
  - Light energy selectively destroys a target chromophore
    - Melanin: laser hair removal, pigmented lesions
    - Hemoglobin: vascular lesions
    - Water: laser resurfacing (CO_2)
  - Energy fluence must be sufficiently high to damage target
  - Pulse duration $\leq$ *Thermal Relaxation Time*
    - Destroys target but disallows heat damage to surrounding tissues

Laser Safety

- Eye safety
  - Cover for wavelength & optical density (OD) of laser
  - Eye damage: primarily retinal (400-1400 nm)
    - <400 nm: corneal damage
- Fire safety
  - Turn off oxygen supplies
  - Ensure ethanol-cleansed skin is completely dry before firing laser

Electromagnetic Spectrum



Slide courtesy of Palomar Medical Technologies, Inc.

Laser/Light type	Wavelength (nm)	Target chromophore	Derm application
Argon (continuous or pumped tunable dye)	488/514 577/585	Hemoglobin	Vascular lesions
Copper vapor/bromide	510/578	Hemoglobin, melanin	Pigmented lesions, vascular lesions
KTP—Potassium- titanyl-phospate	**532**	**Hemoglobin, melanin**	**Pigmented lesions, vascular lesions**
Pulsed dye	**585-595**	**Hemoglobin, very weak melanin**	**Vascular lesions, keloidal scars, striae, verrucae, nonablative dermal remodeling**
Ruby (QS, normal mode)	**694**	**Melanin, dark pigment**	**Pigmented lesions, blue/black/green tattoos (QS), hair removal**
Alexandrite (QS, normal)	**755**	**Melanin**	**Pigmented lesions (QS), blue/black/green tattoos (QS), hair removal (normal), leg veins (normal)**
Diode	**800-810**	**Melanin, weak hemoglobin**	**Hair removal, leg veins**
Nd:YAG (QS, normal)	**1064**	**Melanin, collagen, hemoglobin**	**Pigmented lesions & blue/black tattoos (QS), hair removal, leg veins, nonablative dermal remodeling (normal mode)**
Nd:YAG, long-pulsed	1320	Collagen	Nonablative dermal remodeling
Diode, long-pulsed	1450	Collagen	Nonablative dermal remodeling, acne
Erbium: glass	1540	Collagen	Nonablative dermal remodeling
Erbium:YAG	**2940**	**Water**	**Ablative skin resurfacing, epidermal lesions**
CO2 (contnuous wave and pulsed)	**10,600**	**Water**	**Ablative skin resurfacing, rhinophyma, actinic cheilitis**
Intense Pulsed Light (IPL) NOT A LASER!	**500-1200**	**Melanin, hemoglobin, collagen**	**Vascular lesions (rosacea), pigmented lesions (solar lentigines, melasma), dermal remodeling**

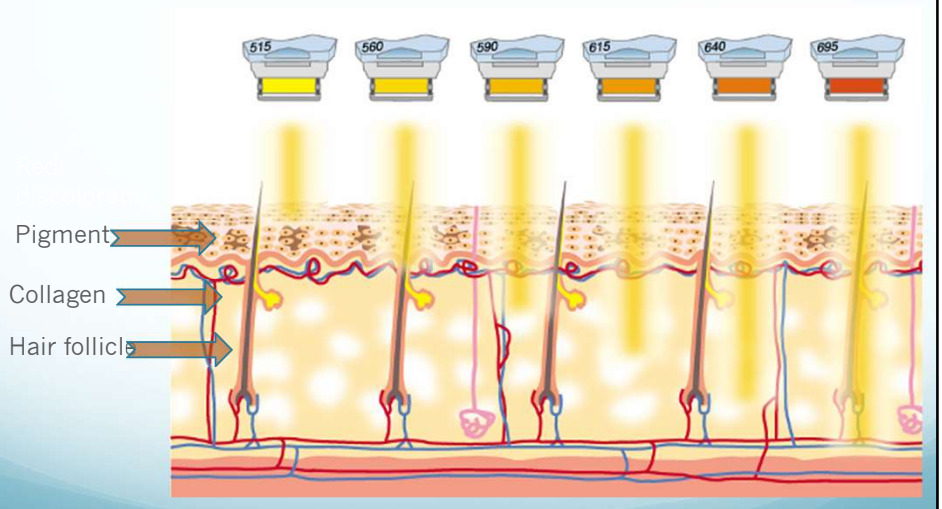
Laser Tattoo

Laser	Light emitted	Tattoo color treated
QS Nd:YAG 532 nm	Green light	Red, orange, yellow
QS Ruby 694 nm	Red light	Green, dark/black
QS Alex 755 nm	Red light	Green, dark/black/blue
QS Nd:YAG 1064 nm	Near infrared	All dark colors, safest for skin of color
Dye module 585 nm	Yellow/green light	blue
Picosecond lasers		Multitude of colors

IPL technology

- Broad band source of light (500-1200 nm)
- Cut off filters control band of light exposure, and thus depth of injury and chromophore
- Treats pigment (melanin), vascular lesions (hemoglobin), and dermal remodeling (collagen)
- Can be combined with aminolevulinic acid (photosensitizer) for photodynamic therapy in treatment of precancerous lesions (actinic keratoses)

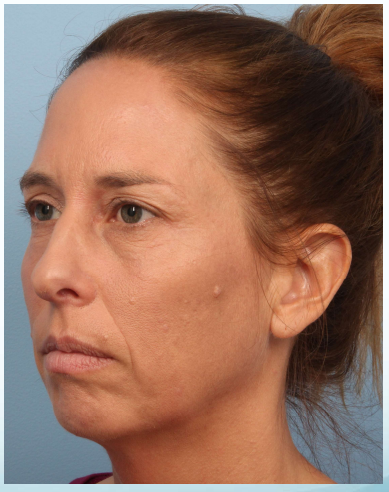
IPL Cut-off filters



Courtesy of Lumenis

Photodamage/Lentigines

Baseline



3 sessions of IPL

Courtesy of Melanie D. Palm, MD,MBA Solana Beach, CA

Photodamage/Lentigines

Baseline

2 sessions of IPL

Courtesy of Melanie D. Palm, MD,MBA Solana Beach, CA

Telangiectasias

Baseline

2 sessions of IPL

Courtesy of Melanie D. Palm, MD,MBA Solana Beach, CA

Photodynamic Therapy

- Photosensitizing agent (aminolevulinic acid) + light source + oxygen→ reactive oxygen species that destroy vulnerable cells
  - Light sources:
    - Blue light (410-417 nm)—Soret band
    - Red light (630 nm)
    - IPL (500-1200)
    - PDL (585-595 nm)
    - Ultraviolet light!!!
  - Targets
    - Abnormal keratinocytes (AKs, superficial BCCs)
    - Sebaceous glands (acne, sebaceous hyperplasia)
    - Abnormal blood vessels (rosacea)
    - Pigmentation and abnormal collagen (photorejuvenation)

PDT with IPL:

AKs, Photodamage

Baseline

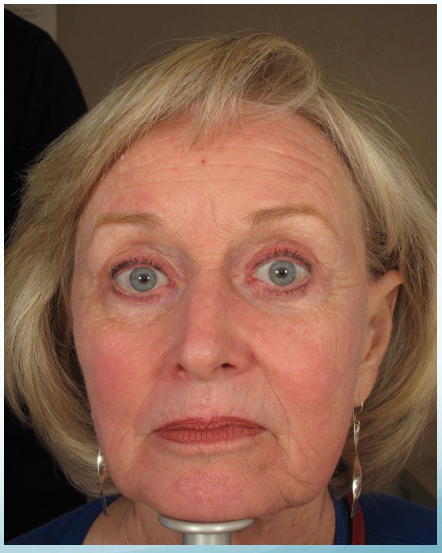
1 month after 1 session IPL during PDT

M22: 560 nm filter, 3.5/3.5 ms duration double pulse, 15 ms pulse delay, 18 J/cm2

Courtesy of Melanie D. Palm, MD,MBA Solana Beach, CA

Rosacea & AKs: PDT with IPL

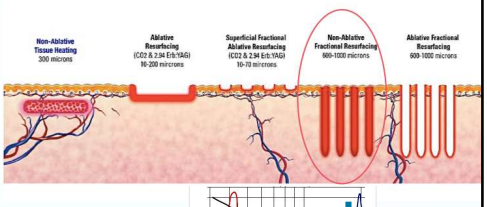
Before treatment

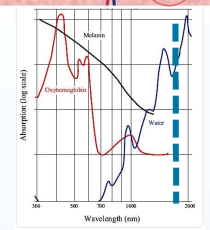


1 week after treatment

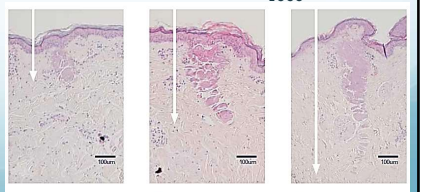
Nonablative Laser Skin Resurfacing

- Soft tissues is an organic composite mainly composed of water and structural proteins
- At the wavelength of 1550-1565 nm,
  - The primary chromophore is water
    - Enough to result in denaturing of tissue, leading to neo-collagenesis
  - The absorption by the main competing chromophores is low
  - Deep dermal penetration of light energy is permitted



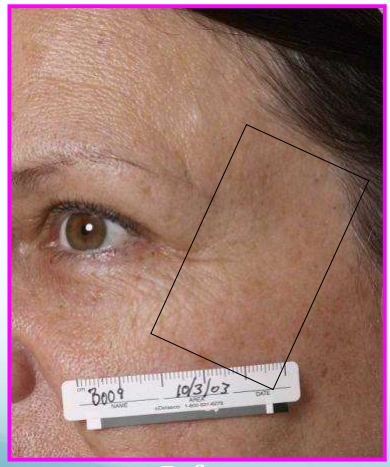


1565



Nonablative Laser Resurfacing

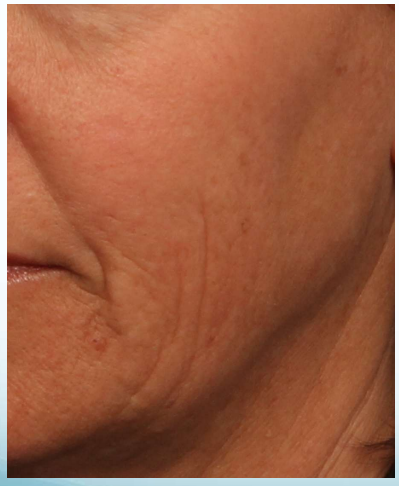
(NABL) – i.e. Fraxel Re:Store, ResurFX



Before

After 3 treatments

ResurFX: 2 Treatments



Baseline

1 month after 2 treatments:
ResurFX: 12mm square, 250 density, 50 J/cm$^{2;}$ 2nd pass over medial cheek area

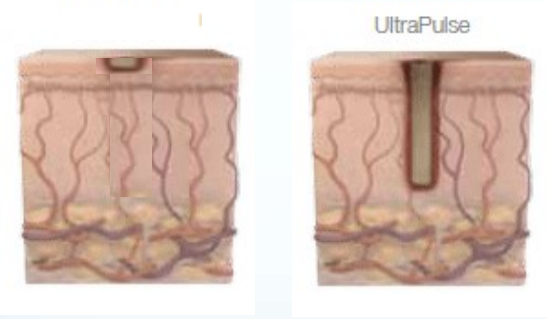
Courtesy of Melanie D. Palm, MD,MBA Solana Beach, CA

Ablative Resurfacing

Comparison of Erbium:YAG and CO_2 Lasers

	CO_2	Er: YAG
Wavelength	10,600 nm	2940 nm
Pulse Duration	60-900 µm	200-300 µm
Fluence	250-500 mJ/cm²	2-20 J/cm²
Tissue ablated per pass	20-30 µm	2-3 µm
Thermal damage produced	30-100 µm	5-30 µm
Reepithelialization	7-10 days	4-5 days
Duration of erythema	3-6 months	2-4 weeks

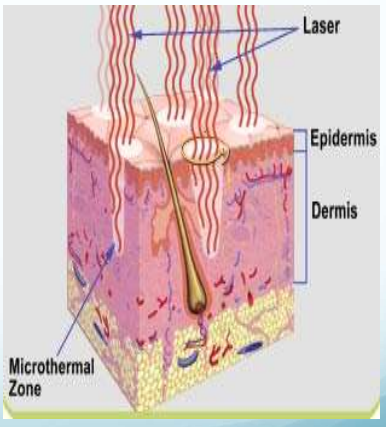
Penetration Depth in Tissue



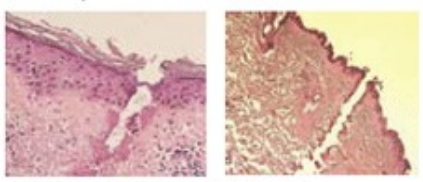
Erbium:YAG CO_2

Fractional (Microablative) Laser Resurfacing

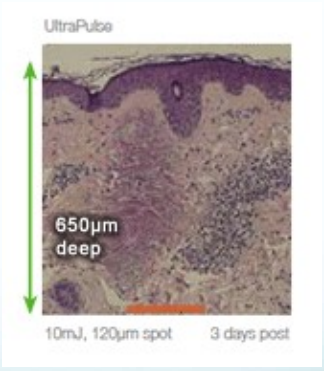
- Ablative microthermal zones interspersed with area of normal, untreated tissue
- Epidermal and dermal wounding occurs in each microthermal zone
- Healing is more rapid due to islands of normal tissue



Fractionated CO_2 Laser Resurfacing


histology courtesy of Vladimir Lemberg, PhD

Microthermal columns of injury and subsequent healing at 3 days post-procedure



Figures Courtesy of Lumenis

Indications/Contraindications for Laser Resurfacing

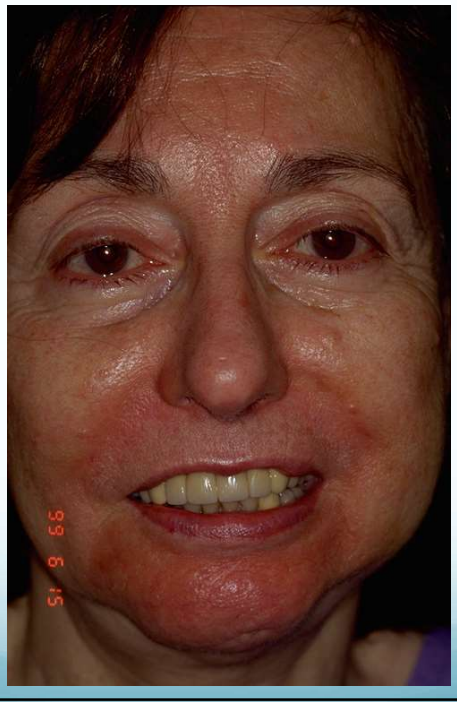
Primary Indications	Secondary Indications	Relative Contraindications	Absolute Contraindications
Pale skin tones (I-II)	Dark skin tones (III-V)	Perpetual UV light exposure	Unrealistic expectations
No UV light exposure	Movement-associated rhytides (glabella/forehead)	Nonfacial involvement	Concomitant Isotretinoin use
Non-movement-associated rhytides (perioral/periorbital /cheek)	Diffuse facial lentigines	Collagen vascular disease or immune disorder	Concurrent cutaneous bacterial or viral infection
Actinic cheilitis	Dermal lesions (appendageal tumors	Prior lower biepharoplasty (for infraorbital resurfacing)	Presence of ectropion (for infraorbital resurfacing)
Epidermal lesions (keratoses)		Propensity for hypertrophic scars or keloids	

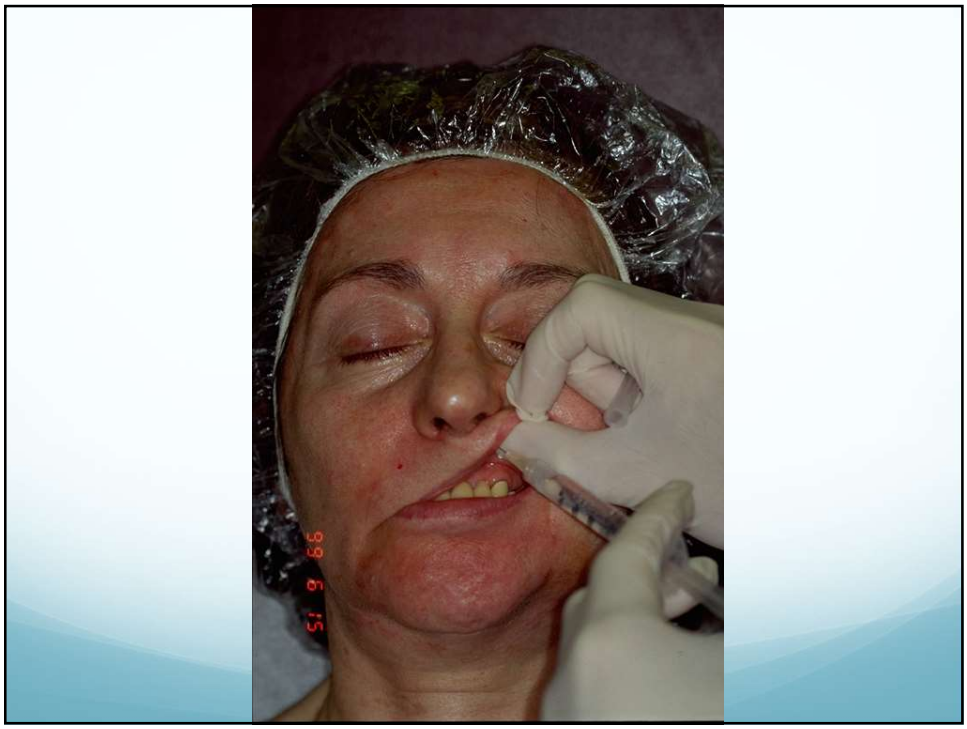
CO_2 Laser Resurfacing Effect

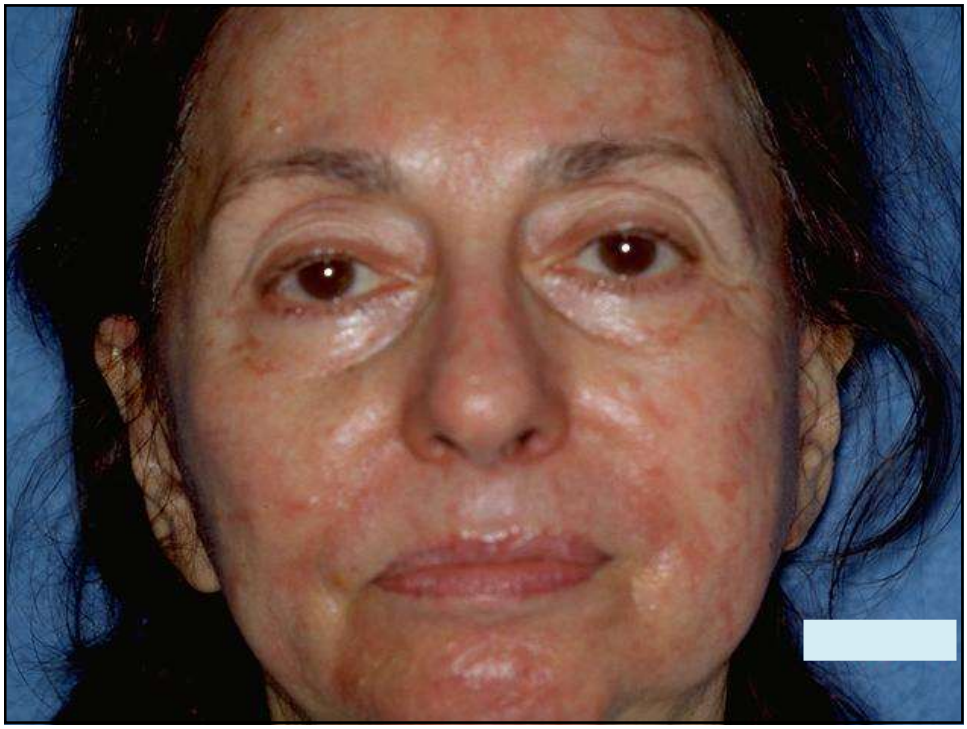
- Wound plus thermal damage effect (tissue contraction)
- Collagen remodeling
- Thermal effect with collagen contraction
- Ablative removal of aged epidermis
  - Excellent hemostasis
- Endpoint dermal whitening
- Disadvantage: prolonged post-op healing

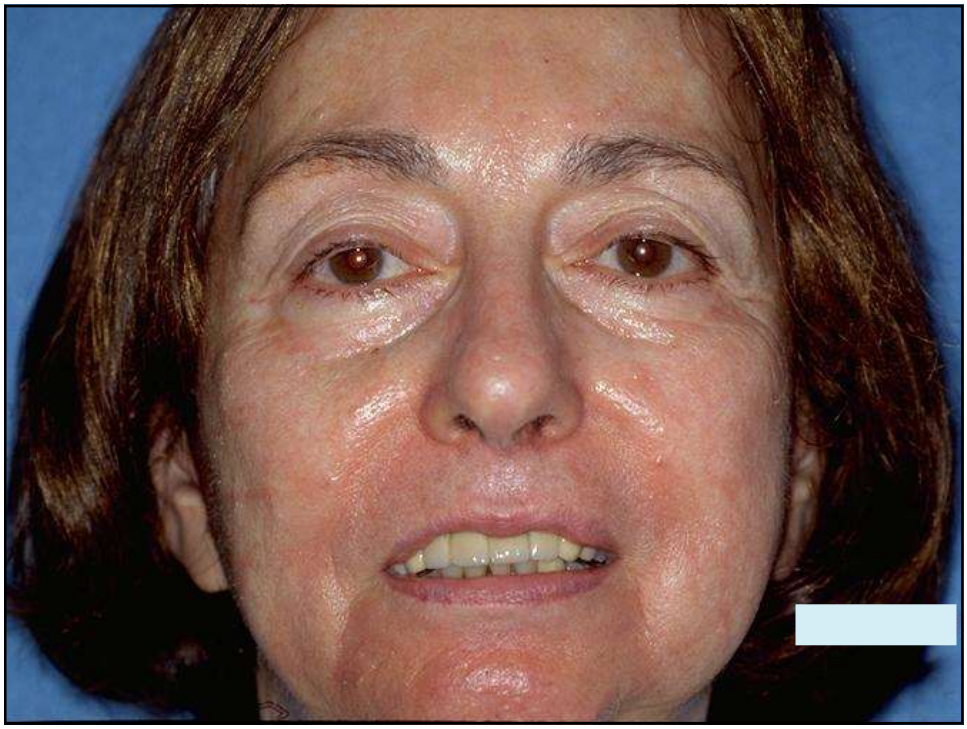
Protocol for CO_2 Laser Resurfacing

- Adjacent non-overlapping spots
- Wipe skin with saline or water-soaked gauze between passes to remove residual partially desiccated tissue
- Additional passes are delivered until complete lesional effacement in a bloodless char-free environment is achieved

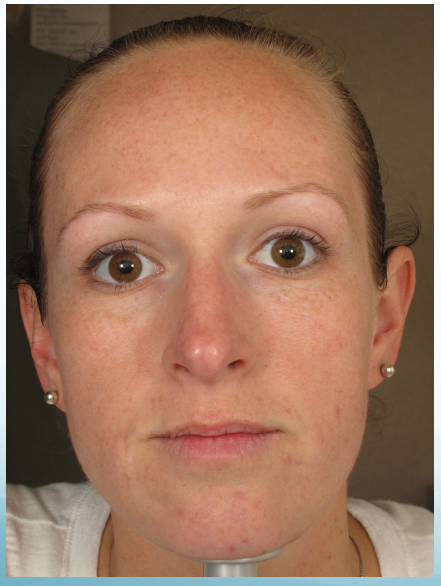




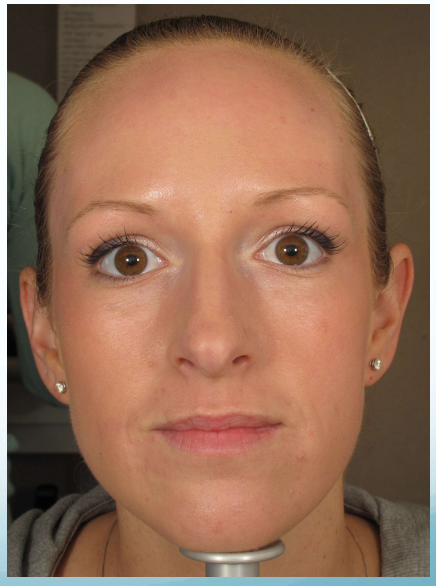




Active/Deep FX®

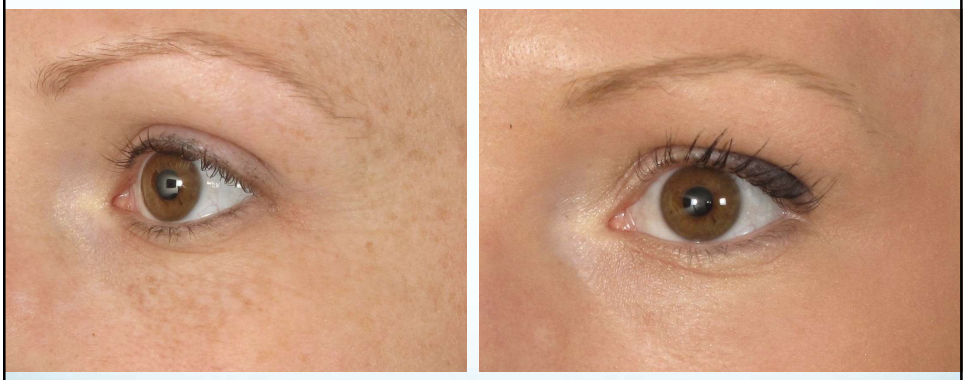


Before treatment



2 weeks after treatment

Active/Deep FX®



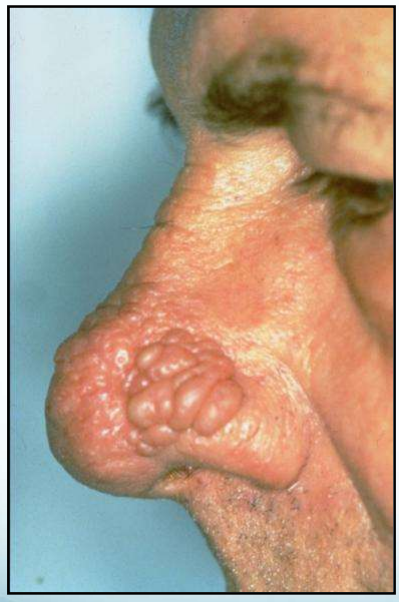
Before treatment

2 weeks after treatment

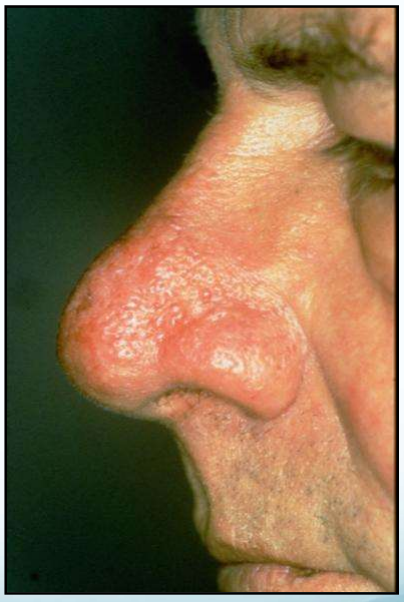
IPL +Fractionated CO_2 Laser

Baseline

Lutronic eCO2: 110-140 mJ, 30 W, 1-2 passes, 120 um tip



Pre CO_2 laser resurfacing rhinophyma



Post CO_2 laser resurfacing rhinophyma

Erbium Laser Resurfacing

- Wound plus milder thermal damage effect
- Ablative removal of aged epidermis
- Some damage with collagen remodeling (?)
- Collagen absorption peak 3,030 nm
- Endpoint pinpoint bleeding

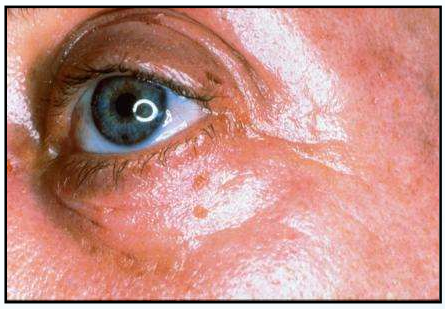
Erbium Laser Resurfacing

Indications		Contraindications	
Primary	Secondary	Relative	Absolute
Mild photodamage	Moderate photodamage or scars	Perpetual UV exposure	Concurrent Isotretinoin use
Perioral or periorbital rhytides	Recalcitrant melasma	Nonfacial involvement	Concurrent bacterial or viral infection
Mild atrophic scars	Diffuse lentigines	Collagen vascular or immune disorders	Ectropion (for infraorbital resurfacing)
Superficial keratoses and other epidermal lesions	Various dermal lesions	Keloid former	Unrealistic expectations

Protocols for Er:YAG Laser Resurfacing

- 2 to 3 passes usually removes the epidermis
- Must keep track of pulses and passes as irradiation of skin produces an imperceptible difference between ablated and non-ablated tissue
- Removal of partially desiccated tissue is unnecessary because of high degree of skin vaporization producing minimal desiccation
- Increased pinpoint bleeding

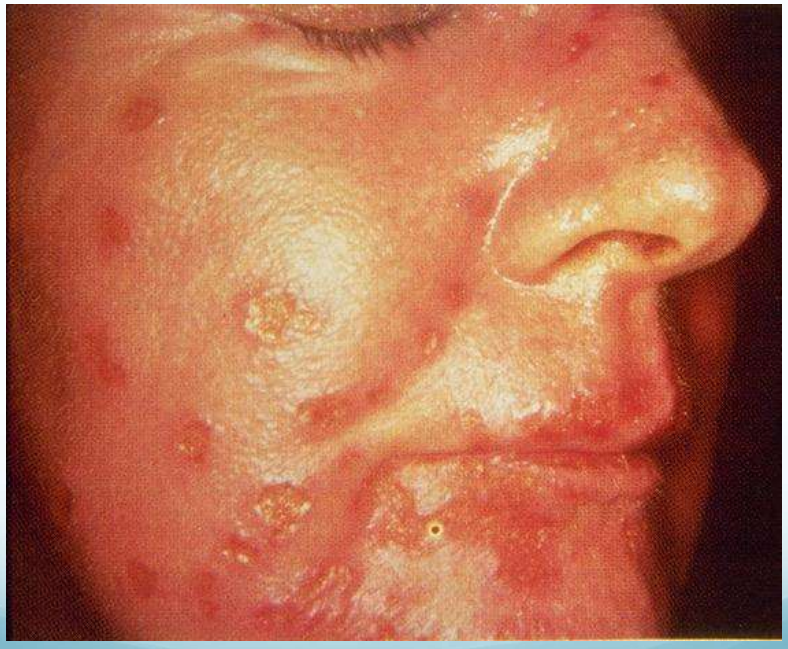
Pre Er:YAG laser resurfacing



Post Er:YAG laser resurfacing

Complications of Ablative Resurfacing

- Infection: PAIN almost always present
  - Viral: HSV—always prophylax (Tzanck smear, viral cx)
    - PE: shallow erosions of skin
  - Bacterial: most commonly staph, strep (aerobic cx)
    - PE: pustules and edema, cellulitis
  - Atypical mycobacterium—contaminated water source (AFB)
    - PE: Pink papules and acneiform eruption several weeks after procedure
  - Yeast: Candida (KOH, fungal cx)
    - PE: Redness and itching/pain with satellite pustules
- Dyspigmentation
  - Hyperpigmentation in darker skin types (Treat with bleaching agents-HQ/sunscreen)
  - Hypopigmentation
- Prolonged erythema
- Contact dermatitis (treat by d/c'ing offending agent and topical steroids)
- Post-treatment acne & milia (use topical anti-acne meds and extraction)
- Scarring

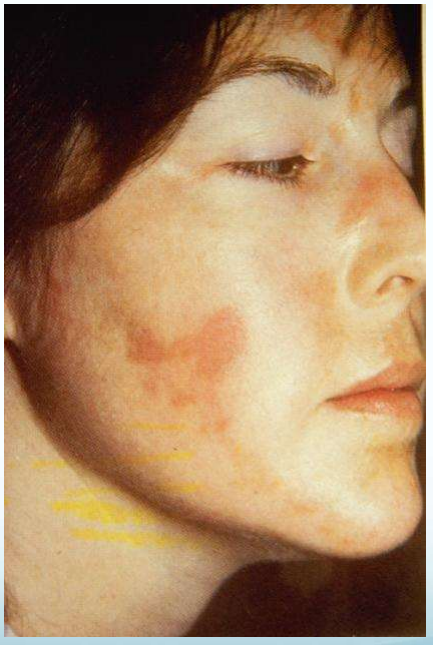


Post CO_2 laser - Herpes simplex

Post laser resurfacing - Candida infection

Mycobacterium chelonae infection following fractionated CO_2 resurfacing

Palm MD, Butterwick KJ, Goldman MP. *Mycobacterium chelonae* infection after fractionated carbon dioxide facial resurfacing (presenting as an atypical acneiform eruption): Case report and literature review. *Dermatol Surg* 2010; 36:1-9.



Post Erbium Laser - hyperpigmentation/scarring

Post CO_2 hypopigmentation

Post CO_2 laser scarring

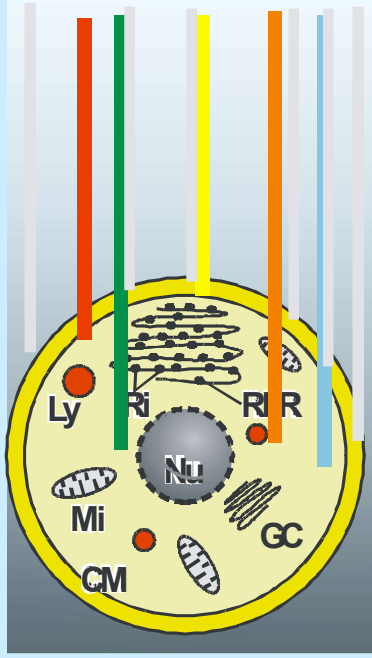
Post Erbium laser scarring

Caveats for post-operative success

- Herpes prophylaxis
  - Increase dosage if breakthrough occurs
- Antibiotic prophylaxis?
- Appropriate post-op hydration and emollients
- Aggressive treatment of post-op erythema with steroids +/- LED, IPL
  - Consider differential diagnosis: Contact dermatitis?

Non-Light Based Devices

Light Emitting Diodes



- Low intensity visible/infrared light works by PHOTOMODULATION
  - *Intracellular effects:*
    - Mitochondrial membrane permeability increases, pH rises
    - cAMP activation
    - Increased RNA/DNA synthesis
    - Cell motility increases
- Applications:
  - Acne (blue-415 nm), photorejuvenation (red—633nm), wound healing (830 nm)

Radiofrequency

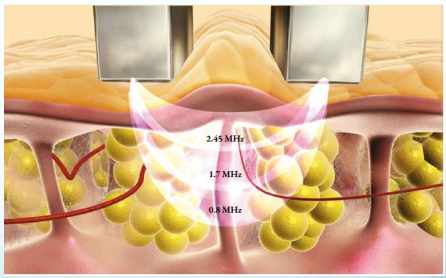
Radiofrequency: Depth of Penetration

- Depth of Penetration (δ) determined by:
  - Frequency of RF (f)
  - Magnetic permeability (μ)
  - Conductivity (σ)

$$\delta \approx \frac{1}{\sqrt{\pi f \mu \sigma}}$$

**Skin cooling can help enhance determination of depth

- Therefore:
  - Lower frequencies= greater penetration

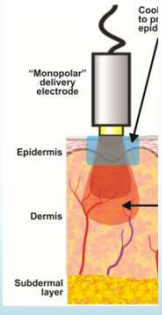


Monopolar/Bipolar Radiofrequency Technology

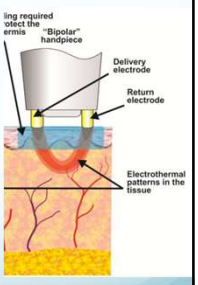
- Mechanism of Action:
  - Impedance of radiofrequency energy leads to heat generation in dermis, with protection of epidermis
  - Dermal heating leads to collagen remodeling→Collagen induction, fibrosis, volumization and tissue contraction
  - RF Energy Flow + Tissue Resistance = Heat Accumulation
- Applications
  - Skin tightening, firming, rhytid reduction
  - Examples: Thermage, ePrime, Infini
  - May be combined with IPL, Diode, microneedling technology

Types of RF

- Monopolar
  - energy conducted through two electrodes (+ and -)
    - + = grounded electrode
    - - = active treatment electrode
  - Energy concentrated greatly near tip of active applicator & decreases rapidly with distance
  - Rule of thumb: size of electrode/2 = depth (mm) of penetration
  - Ex: Thermage, Exilis



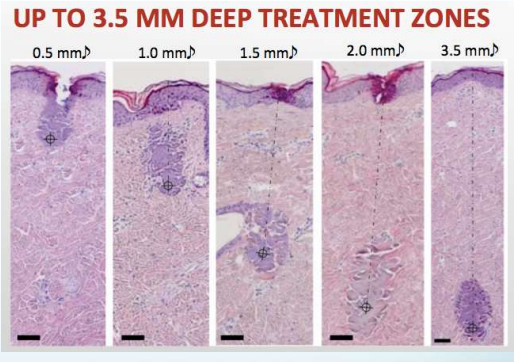
- Bipolar
  - Again, + & - electrodes
  - Electrodes' distance fixed and both in contact with skin
  - RF current has more controlled distribution
  - Less energy required to achieve heating effect due to local deposition b/w electrodes
  - Rule of thumb: penetration = ½ distance between electrodes
  - Ex: eMatrix, ePrime, Polaris



Types of RF

- "Multipolar"
  - Newer emerging RF technologies
  - Examples: "tripolar, "octapolar"
  - Just new configurations of mono- or bipolar electrodes
  - Ex: Viora, Venus Freeze, Tripollar
- "Unipolar"
  - One electrode, no grounding pad
  - Large field of RF emitted in omnidirectional field
  - Analogy: like radio tower broadcasting signal in all directions
  - Ex: Accent

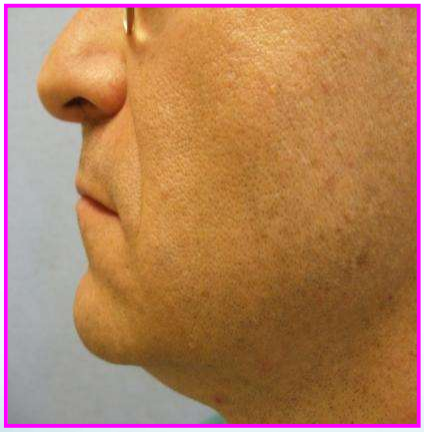
Radiofrequency-Microneedling



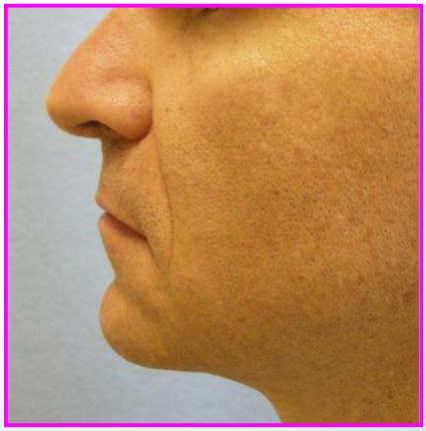
Potential Advantages/Disadvantages of RF Treatment

- Advantages
  - Noninvasive to minimally invasive
  - Pure thermal effect on target tissue = Relatively "color-blind"
- Disadvantages
  - Not a substitute for surgical intervention
  - Consumable part for operator (grounding, tips)
  - Monopolar: current passes through body

Cheek and Neck



Pre ThermaCool TC



6 wks post treatment

RF=91J/cm²
1 treatment/3 passes

Monopolar RF: Periocular Laxity

Baseline
6 mos. post-treatment
(1 cc Restylane to tear troughs + 4 sessions monopolar RF)

RF Microneedling: Periorbital Rhytides

Courtesy of Melanie Palm MD

Pre Polaris WR

Post Polaris WR

Optical=30J/cm²; RF=50J/cm³
5 treatments/3 passes

TREATMENT WITH RFM

Courtesy of Franco Lauro, MD, Plastic Surgeon, Italy

TREATMENT WITH RFM

Before **1 Month After 2nd Session**

Courtesy of Dr. Devrim Gursoy, Medicana International Hospital, Turkey

RF Microneedling: Acne Scarring

Before **1 Month After 1st Session**

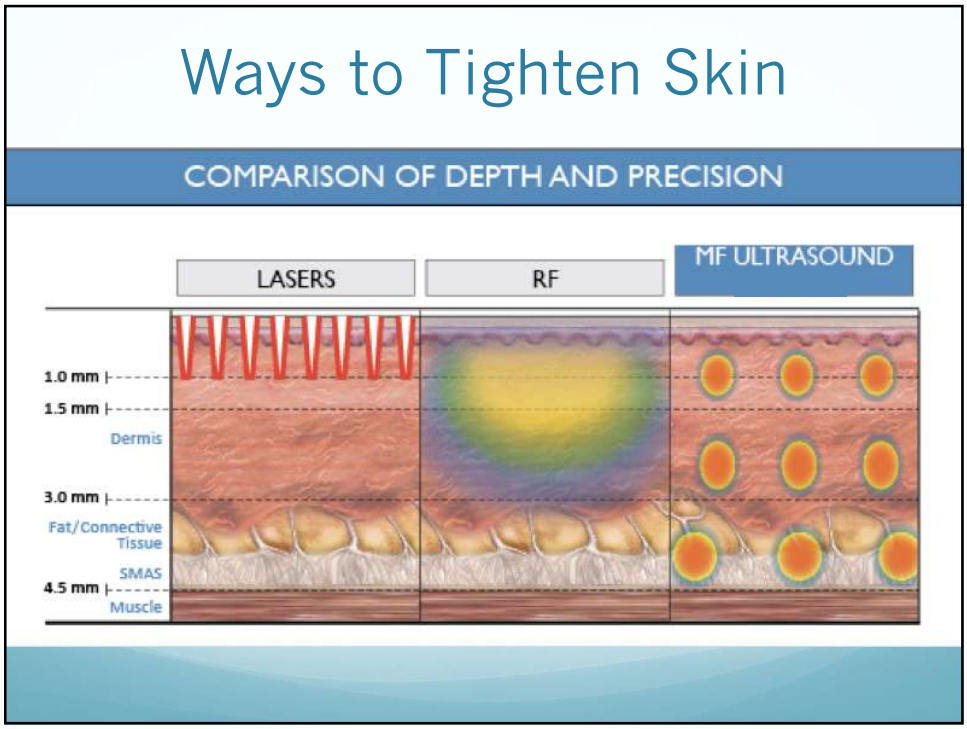
Courtesy of S.S.Savant, MD, Dermatologist, India

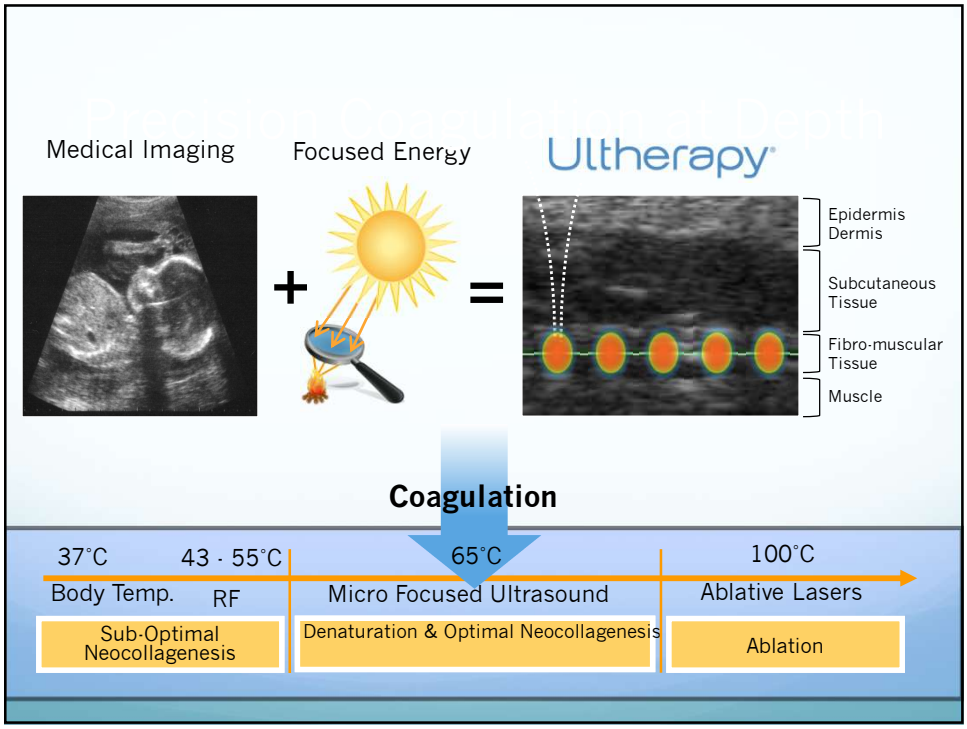
Micro-Focused Ultrasound

Micro-Focused Ultrasound

- FDA-cleared for skin lifting of neck, chin, brow, decollete (chest)
- Microfocused ultrasound heats tissue at predetermined depths (4.5 mm, 3 mm, 1.5 mm)
- Causes neocollagenesis and gradual skin tightening over a period of months

Ways to Tighten Skin

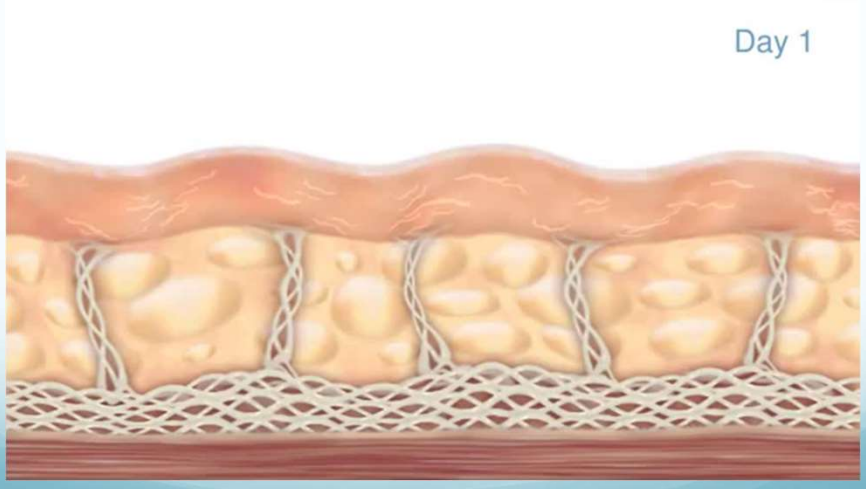




Treatment Zone Marking

Approximately 10,000 discrete coagulation points are placed at dual depths, causing immediate tissue contraction and initiating neocollagenisis

Ultrasound at Work



Courtesy of Ulthera, Inc.

Pre-Treatment

120 Days Post Treatment

CONFIDENTIAL

Courtesy of Ulthera, Inc.

Pre-Treatment

120 Days Post Treatment

CONFIDENTIAL

Brow Elevation / Improved Upper Lid Laxity

Pre-Treatment | 90 Days Post Treatment

CONFIDENTIAL

Improved Upper Lid Laxity

Pre-Treatment | 90 Days Post Treatment

CONFIDENTIAL

End of Section II

Dermatologic Cosmetic Surgery