Nonoperative Facial Rejuvenation

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Objectives

• Discuss the history of cosmetic facial rejuvenation
• Discuss Aging and Photodamage to the skin
• Discuss treatment options for adynamic facial conditions and their associated complications
History of Facial Rejuvenation

• 3000 BCE Egyptians
  – Manicures, Make-up, Tattoos of the face (1)

• 1500 BCE Egyptians
  – Used sandpaper for scars as early form of dermabrasion (2)

• 100 BCE Roman poet Ovid: *The Art of Love*
  – Facial mask of barley, bean, eggs, hartshorn, narcissus bulbs, balsam, Tuscany seed, honey (3)

• 200 CE Jewish Talmud
  – Husband must provide 10 dinars for his wife’s cosmetic needs

• 900 CE Arabic Physicians
  – Crushed rice, seashells, marble, crystal, limes, eggs, beans, ground lentils (dermabrasion)
History of Facial Rejuvenation

- 1905 Kromayer
  - Mechanical dermabrasion with wheels and rasps (4)
- 1960’s Facial Peels
- 1990’s CO2 Laser Resurfacing
- Most recently filler agents have become increasingly popular

**Modern techniques are reminiscent of ancient techniques**
Layers of the Skin
Epidermis

- Stratum Corneum
  - Keratinized cells to be sloughed off
- Stratum Lucidum
- Stratum Granulosum
- Stratum Spinosum
- Stratum Basale
  - Basal regenerative cells and melanocytes
  - Regeneration every 12-14 days (1)
Epidermis

- Stratum corneum
- Stratum lucidum
- Stratum granulosum
- Stratum spinosum
- Stratum basale
Dermal Layers

- Papillary Dermis
  - Meshwork of fine type III collagen fibers
  - Anchors epidermis down to dermis

- Reticular Dermis
  - Thick type I collagen bundles
  - Elastic fibers for resiliency
  - Glycosaminoglycans (GAG’s)
    - Ground substance between fibers
    - Can hold up to 1000x their weight in water (5)
  - Hair, sebaceous/sweat glands, nerve receptors and blood vessels
Papillary and Reticular Dermis

Epidermis

Papillary zone

Dermis

Reticular zone
Hypodermis

- Connects skin and underlying bone/muscle
- Loose connective tissue and elastin
- Predominant Cells
  - Fibroblasts
  - Macrophages
  - Adipocytes
Damage to the Dermis

• Age
  – Decreased ratio of Type I : Type III collagen

• Photodamage and Tobacco Smoke (6)
  – Increase tissue collagenases and gelatinases
  – Further decrease collagen in the dermis
  – Decrease capillary and blood flow to skin
  – Decreased skin integrity

**Ultimately leads to decreased skin turgor and elasticity forming wrinkles and sagging skin (7)**
Initial Evaluation

• Patient selection is key
  – Unrealistic
  – Psychiatric history or multiple physician visits
  – Smokers have 12 times increased skin sloughing and scarring

• Must perform proper:
  – Education
  – Counselling
  – Consistent procedural skills
Physical Exam

• Are rhytids dynamic vs adynamic
  – Traction of skin in antagonistic direction
• Hypo- or Hyperpigmented skin
• Associated skin conditions
• Active infection
• Thickness of skin
• Glogau System
Glogau System (8)

- Stratifies patients based on amount of aging and skin damage
- Category I
  - Photoaging down to stratum granulosum or papillary dermis with minimal wrinkles
  - Dermabrasion or superficial chemical peeling
- Category II
  - Photodamage down to upper reticular dermis and wrinkles with facial gestures
  - Medium depth chemical peeling
- Category III
  - Photodamage down to upper reticular dermis and wrinkles at rest
  - Medium depth peels
- Category IV
  - Photodamage to mid reticular dermis, wrinkles, skin discoloration
  - Deep peel required
Treatment Options

1. Dermabrasion
2. Laser Resurfacing
3. Chemical Peels
4. Facial Fillers
Dermabrasion

• Purpose is to level the skin and promote re-epithelialization with new collagen deposition.

• Used for:
  – Scar revision
  – Acne scarring
  – Rhinophyma
  – Facial rhytids

• Contraindicated for Keloids and Hypertrophic Scars

• Must only injure only the papillary dermis
  – Preserves adnexal structures for re-epithelialization
  – Damage through the reticular dermis (Fat visualized) leads to adverse scarring
Dermabrasion

- Performed with high speed diamond fraise or wire brush.
- Local anesthesia +/- IV sedation
- Broad surfaces are frozen to maintain rigid tissue (malar region)
- Brush strokes are made at right angles to the brush rotation to avoid loss of control and damage to normal tissue
- **Feathering**: Edges are slightly brushed for blending
Dermabrasion

- Upper layers of skin are removed resulting in partial thickness wounds
- Small pinpoint bleeding of the wound
- Heal by re-epithelialization in 7-10 days
- Recovery is 2-3 weeks
Microdermabrasion

• Alternative to dermabrasion that attacks just the upper layer of skin
• Disadvantages
  – Only good for early photodamage and superficial wrinkles
  – Not useful for dermal pathology
• Uses Aluminum oxide microcrystals
• Advantages
  – Repeated at short intervals
  – Painless requiring no anesthesia
  – Minimal erythema and side effects
Microdermabrasion

• Freedman 2001 (9)
  – 10 patients treated with 6 treatments
  – Physical exam and tissue biopsy
  – Thickened epidermis and dermis with newly deposited collagen

• Karimipour 2010 PRSJ (10)
  – Very good for skin contour irregularities such as rhytids
  – Less effective with dyschromias than glycolic acid peels
  – No RCT to evaluate uses in acne but decision should be based on patients expectations
Picture of Debridment Instrument
Dermabrasion Results
Laser Resurfacing
Laser Resurfacing

• Works by targeting chromophores
• Each laser has a different chromophore:
  – Water, oxyhemoglobin, melanin, etc.
• Chromophore absorbs the laser heat destroys cells harboring that chromophore
• Amount of chromophore in a cell is proportional to absorption/destruction
• Lasers have opened the door for treatment of periocular skin where dermabrasion cannot reach
Ablative Lasers

- Carbon Dioxide (10,600nm)
  - Used with the same indications as dermabrasion
  - Wavelength selectively targets water in soft tissue
  - More collagen production and prolonged redness due to dispersed thermal injury

- Other advantages
  - Hemostatic properties
  - Depth of treatment is more precise with laser
    - Skin tightening is immediate
    - Skin irregularities are improved immediately
Ablative Lasers

• Erbium:YAG (2,940nm)
  – Reduced thermal damage
    • Less post-therapy redness
    • Less collagen production

• Newman et al. 1999 (11)
  – Compared Er:YAG and CO2 laser
  – 21 patients with half the upper lip treated by each laser
  – Er:YAG had less days of crusting 3.4 compared to 7.7
  – 63% vs 54% improvement at 2 months favoring CO2
Other Lasers

1. Nd:YAG Laser (1,064nm)
   - Infrared, invisible, oxyhemaglobin, deep penetration
   - Good for port-wine stains, telangiectasias, hemangiomas

2. KTP (532nm)
   - Visible, oxyhemaglobin absorption
   - Good for cutaneous lesions

3. Argon (193nm)
   - Visible, broad blue band, oxyhemaglobin
   - Penetrates between CO2 and Nd:YAG
   - Same indications as Nd:YAG

4. Flashlamp Excited Pulsed Dye (595 nm)
   - Visible, yellow light, vascular sensitive
   - Less scarring and hypopigmentation than Nd:YAG & Argon
   - Cutaneous vascular lesions
Effectiveness of Lasers

• Bisson in 2002 evaluated 31 patients (12)
  – At 6 weeks wrinkle depth reduction of 91%
  – At 2 years wrinkle depth reduction of 87%

• 2001 Lasers are falling out of favor (13)
  – 88% of patients considered post-therapy results very good.
  – 77% would not be willing to have procedure again.

**Several studies have shown equivalent results of CO2 lasers compared to dermabrasion (14-16)**
Laser Resurfacing Results
Complications of Dermabrasion/Laser Resurfacing

- **Infection (17)**
  - Bacterial infection rates 4.3 to 12%
  - Fungal infection rates 1.8 to 2.2%
- **Hypo/Hyperpigmentary mismatches**
  - Dark Skinned Patients
  - Melasma or Cholasma associated with OCP’s
  - Photosensitivity post-procedure should be prevented with UV blocking lotions for 2 months (18-19)
- **Scarring Risk**
  - Must stop 13-cis-retinoic acid (Accutane) for 6-12 months prior to therapy (20)
- **Milia Formation**
  - Small epidermal cysts common after dermabrasion
  - Can be prevented with occlusive ointments or dressings for 1-2 weeks
  - Can be treated with abrasive cleansers or scalpel
- **Herpes Simplex Risk**
  - Roberts et al 1997 (21)
    - Studied 907 patients with CO2 laser treatment and found that HSV infection of 3% was reduced to 1% with acyclovir prophylaxis
    - Therefore patients treated with antivirals for 2-3 days prior and 7-10 days post procedure
Laser Resurfacing Redness
Melasma/Chloasma
Milia
Chemoexfoliation

• Controlled wounding of skin to induce regeneration and a more youthful appearance
• Most commonly used for photodamage that leads to
  – Thickened Stratum Corneum
  – Thinned Stratum Spinosum
  – Disorganized maturation and elastin
  – Decreased dermal collagen and GAG’s
  – Irregular melanin dispersion
• Skin is rough, wrinkled and mottled
Damaging Levels

• Stratum Corneum
  – Skin feels smoother

• Epidermal Basement Membrane
  – Melanocytes live here
  – Lighter and evenly pigmented

• Upper Reticular Dermis
  – Smoother and lighter skin
  – Deposition of new collagen, elastin, GAG’s
  – Subsequent reduction of fine wrinkles

• Middle Reticular Dermis
  – More collagen production with reduction of deeper wrinkles

• Deep Reticular Dermis
  – Collagen production can produce a scar
Factors that increase solution penetration

- Solution Concentration
- Condition of Skin
  - Pre-treatment tretinoin, electrolysis, surgery, waxing.
- Pre-peel degreasing with alcohol or acetone
- Application (brush, swab, sponge)
- Rubbing
- Time of contact
- Occlusion with tape or petroleum jelly
Individual Results

• Some argue that test patching is important because each person reacts so differently to each type of peel
  – Depth of penetration
  – Wrinkling response
  – Scarring

• Post-therapy care should include ointment to promote healing, sun avoidance, and proper wound care to prevent infection
Patient Selection

- Post-therapy appearance can be frightening

- Make sure patients are:
  - Psychologically stable
  - Compliant with post-therapy care
  - Willing to stay out of the sun
  - Willing to wear makeup

- Be sure to perform proper informed consent and document it appropriately
Topical Retin-A

• First line therapy

• Advantages
  – Reverses all the previously discussed findings of sun damage
  – Also decreases fine wrinkles, evens pigmentary differences, smoothes the skin

• Disadvantages
  – Photosensitivity
  – Dries the skin out making moisturizers necessary
  – Class C pregnancy media

• Can be combined with alpha hydroxy acids which are less effective but potentiate tretinoin preparations
Process of Skin Peeling

• Cleansing
  – Septisol and acetone to decrease oil and scaliness of the skin
  – Jessner’s or 70% glycolic solution can be used first to break initial barriers and allow TCA to penetrate deeper (8)

• Application
  – Superficial → blotchy white and red frost
  – Medium → white frost with surrounding erythema
  – Deep → solid white with no erythema

• Healing
  – Cool saline presses to decrease inflammation
  – Vinegar soaks Q2 hours while awake for 5-7 days
  – Regular follow up to look for infection
Superficial Peels

- Glycolic Acid
- Trichloroacetic Acid 10%
- Jessner Solution (lactate+salicylate+resorcinol+ethanol)
  - Apply for a few minutes then rinse with water or neutralize with bicarbonate solution
  - Stinging sensation and slight flush
  - Smooth glowing skin with no activity restrictions
  - Repeated doses Q week/2 weeks/4 weeks
- If you want to peels down to the basement membrane
  - Slightly stronger concentration of solution
  - desquamation for 2-3 days
Superficial Peel Results
Medium Depth Peel

- Amount of collagen depends on depth of peel and individual variations
- Scarring occurs with any subepidermal wound but is unpredictable
- TCA >50% have higher incidence of scarring (22-24)
- TCA 35% in combo with Jessner or glycolic solution first help with penetration
- Post treatment
  - Skin turns dark brown
  - Exfoliates for 4-7 days
  - Socially incapacitated for 7 days
  - New skin is very pink
Medium Peel Results
Deep Peels

• Baker-Gordon Peel
  – Formulation
    • 3cc 88% phenol
    • 2cc water
    • 8 drops of septisol
    • 3 drops croton oil
  – Treatment
    • Agitate solution prior to usage
    • Cotton tip application to 1 section of face at a time
    • Slow application to regional subunits
      – Prevents systemic absorption and arrhythmias
  – Post Treatment
    • Frosting of skin is immediate
    • Swelling intense and release of epithelium over 1-2 days
    • Re-epithelialization takes over 1 week
    • Constant serous exudate hourly
    • Very red skin for months
    • Hypopigmentation expected
  – Results
    • Robust collagen formation is long-lasting
    • Fine and deep wrinkles respond well
Baker’s Peel Progression
Complications

• Landau 2007 (23)
  – 181 patients with full face peels
  – 10-15 minutes between each face section
  – 6.6% arrhythmias
  – Increased with Diabetes, HTN, depression

• Prevention
  – Sedation
  – IV hydration
  – EKG, LFT’s, Kidney function prior to therapy
  – Monitoring with close follow up
Complications

• Infection
  – Usually result of poor post-procedural care
  – Bacterial, Fungal, or Herpetic
  – Prophylactic antivirals
  – Post-procedure antibiotics
  – Vinegar washes very important
  – Culture any non-healing wounds
Complications

• Hyperpigmentation
  – Dark skin, OCP’s and pregnancy
  – Prophylaxis with hydroquinone
  – Treatment with Tretinoin, alpha hydroxy acid, and steroid cream
  – Sun avoidance before and after treatment plus sunscreen
  – Repeeling is an option if poor results occur
Complications

• Scarring
  – Post-therapy infection
  – Use of oral accutane
    • Healing is by re-epithelialization from pilosebaceous units
    • Accutane destroys sebaceous units
  – Recently radiated skin
  – Recently operated skin (undermining)
  – History of keloids
Complications

• Hypopigmentation
  – Occurs after deep peeling
  – More apparent in very dark or very light skin
  – Feathering of the peel with dermabrasion can camouflage the edges
Soft Tissue Augmentation
Soft-Tissue Augmentation History

- Began in 1893 Neuber harvested arm fat and injected it into the patients facial defects (24)
- Fillers now used for
  - Scars from trauma and acne
  - Static or dynamic rhytids
  - Lip augmentations
  - Melolabial fold augmentation
- 1900s paraffin injection used but fell out of favor due to paraffinomas (granulomatous reactions)
- 40-50’s Silicone introduced
  - Granulomatous reactions and scarring limited its use
- 1970’s Stanford used human and animal collagen
  - Still in use today in bovine form (25)
Modern Injectable Fillers

• Research is huge in this area for the ideal filler
  – Inert, long lasting, abundant, low cost, no allergy, not carcinogenic, fixable

• Patient demand high
  – Outpatient injection
  – No surgery
  – Minimal recovery 48-72 hours
  – Lower short term cost

• Dermis is the #1 place of injection
  – Fibroblasts that produce type 1 collagen are most abundant in this region
Types of Fillers

1. Xenografts
2. Homografts
3. Autografts
4. Synthetics
Xenografts

• Bovine Collagen
• Most widely used and is the “Gold Standard”
• All are dissolved in saline and lidocaine and Pepsin proteolysis to decrease antigenicity
  – Zyderm I (35mg/mL)
    • Injected into upper dermis
    • Poor long term effect because of low concentration
    • Overcorrection necessary 100% (26)
  – Zyderm II (65mg/mL)
    • Injected into mid dermis
    • Longer effect with higher concentration
    • Overcorrection necessary 50% (26)
  – Zyplast (35mg/mL)
    • Cross linked with glutaraldehyde to decrease degradation
    • Injected into reticular dermis for longer duration/less resorption
    • No overcorrection recommended
Bovine Collagen Complications

• Hypersensitivity reaction
  – Tenderness
  – Induration
  – Erythema
  – Pruritis

• Skin testing before definitive use
  – 3-4% with positive skin test (27,28)

• 20 to 30% may show delayed reaction
  – Must examine skin test site in 4 to 6 weeks prior to initiating therapy

• Some argue that second skin test necessary as reactions can occur with repeated injections

• Other complications
  – Tissue necrosis (29)
  – Foreign body reaction
  – Headache/Nausea/Arthralgias (30)
Homografts

• Cosmoderm and Cosmoplast
  – Bioengineered collagen from fibroblasts
    • No antigenicity so no skin testing required
  – Packaged and concentrated analogously to Zyderm I and Zyplast respectively
    • Cosmoderm for superficial wrinkles
    • Cosmoplast for deeper scars and grooves
  – On average they last 3-6 months but duration is less than bovine equivalents (26)
Homografts

• Alloderm (Cymetra = injectable form)
  – Acellular dermal graft from cadaveric skin
  – Freeze drying process removes cells but leaves collagen IV, VII, proteoglycans and elastin
  – Requires reconstitution with lidocaine prior to injection
  – No skin testing required
  – Duration of 3 to 6 months (31)
Xenografts

- Hyaluronic Acid
  - A Glycosaminoglycans (GAG)
  - Can hold 1000x its weight in water leading to increased skin turgor
  - Overcorrection not required
  - Identical in all species leading to minimal immunogenicity
  - <1% chance of hypersensitivity
  - Correction achieved for 6-9 months with HA (32)

1. Hylaform (500 micron, 5.5mg/mL)
   - Purified from rooster combs
   - Few reports of local or systemic reactions from avian protein
   - Shortened lifespan due to lower concentration (33)

2. Restylane (400 micron, 20mg/mL)
   - Bacterial cultures of Equine steptococci
   - Cross linked with epoxides
   - Also has “Fine Lines” and “Perlane” formulations with different particle sizes

- Isovolumetric contraction where matrix does not disperse water until all hyaluronic acid particles are degraded leading to prolonged effects (34)
HA Pitfalls

• Must inject intradermally
  – Injection too deep
    • Decreased duration of action
  – Injection too superficial
    • Unappealing bumps

**Undesirable injections can be corrected with hyaluronidase injection.
Autografts

- **Fat**
  - Very abundant
  - No antigenic potential
  - Requires additional procedure for harvesting
    - Liposuction
  - Questions regarding how much is reabsorbed
  - Adynamic melolabial folds have prolonged duration of action compared to dynamic glabella (26)
Autografts

- Isolagen (Fibroblasts)
  - Postauricular punch biopsy of patients skin
  - Cultured in vitro with growth factors for 4-6 weeks
  - Overnight delivery for injection the following day
  - Several Treatments required for desired outcome
  - Cost and time considerations make it impractical
  - 6 month histologic evaluation showed integration of fibroblasts but is on hold by FDA due to growth factors and further studies (35)
Synthetic Material

- **Silicone**
  - Been used for over 50 years
  - Requires multiple microdroplet injections over 4 weeks
  - Injections performed into deep dermis 1 to 3mm apart
  - No overcorrection because innate reaction to the product was part of the process
  - Webster studied 235 pts over 2800 injections (36)
    - Good results and few complications
  - Others have shown extensive reactions (37-39)
    - Chronic inflammation
    - Migration
    - Extrusion ulceration
    - Skin necrosis
    - Granulomatous hepatitis
    - Pulmonary emboli
    - Silicosis (pneumonitis)

- FDA declared it illegal in 1991 but recent use for retinal detachment is bringing off label use back

- **American Academy of Dermatology (1993) (7)**
  “There is a wealth of clinical experience in dermatology with the use of liquid injectable silicone by the micro-droplet technique which shows its efficacy and safety in many individuals over many years.”
Synthetic Material

- **Radiesse (25 to 45 micron size)**
  - 35% synthetic hydroxyapatite particles in water, glycerin, and sodium carboxymethylcellulose
  - Injected into deep dermis or subdermally due to viscosity
  - Massage is necessary to contour product
  - Produces augmentation in 2 ways
    1. Collagen ingrowth by fibroblasts
    2. Encapsulation of crystals by fibroblasts to prevent degradation
  - Radiographic evidence of implant for up to 6 years (40)
- **Pitfalls**
  - Injection into lips can produce painful nodules
  - Palpable implant for 2 to 3 months until the product is replaced by collagen
- Tzikas studied 90 patients and found 88% patient satisfaction at 6 months (41)
Post-therapy Findings

- Post-injection pain
- Redness
- Ecchymosis
- Swelling
- Nodularity
- Palpability

**Should be transient and resolve over 1-2 days**
Complications: 0-2 days

• Overcorrection
  – Know the properties of the injectable filler and whether to overcorrect or not
• Implant visibility
  – HA can produce bluish nodule
  – Other fillers cause white nodule
    • Massage can help
    • Hyaluronidase or mechanical deroofing of nodule
• Vascular compromise
  – Arterial: Immediate skin blanching with necrosis (glabella)
    • Aspiration, massage, warm compress, 2% nitropaste
    • +/- hyperbaric oxygen for impending necrosis
  – Venous: violaceous discoloration with dull ache
    • Nitropaste and warm compresses

**Skin breakdown treated with Abx and gentle debridment**
Venous Injury
Complications: 3-14 days

- Noninflammatory Nodules
  - Observation, gentle massage, reassurance
- Early Inflammatory Nodules
  - Treat with antibiotics for 4-6 weeks
    - Macrolide and Tetracycline
  - I&D plus culture if fluctuance is observed
  - Close f/u visit at 48 hours
    - If no response to therapy get tissue culture
Tissue Infection

Immediate

Day 2
Complications: >14 days

- **Hypersensitivity**
  - Bovine collagen 3-4% + skin test
  - HA <1%

- **Nodules**
  - Saline injection and vigorous massage

- **Inflammatory nodules**
  - Evaluate for infection and treat as necessary
  - No infection but no response at 7-10 days $\rightarrow$ add intralesional steroid injection to avoid resistant granuloma
  - Still no response $\rightarrow$ biopsy and culture

- **True Granulomas (0.01-1%)**
  - Massage and Intralesional steroids
Summary

• There are a variety of treatment options available
• Proper knowledge of the product or procedure is necessary to avoid complications
• Patient expectations, informed consent, and proper patient selection is paramount
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