Medium and deep chemical peeling
Clinical science and practice

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Conflict of interest disclosure

Genentech
Investigator, advisory board
Combination chemical peel
Perioral Baker-Gordon phenol, unoccluded
Facial Jessner’s + TCA 35% solution
Medium chemical peel
Medium depth peel

- Wound to the level of the papillary or upper reticular dermis
  - Actinic keratosis, dyschromia, fine wrinkling

- Historically
  - TCA 50% solution
  - Penetration of solution unpredictable, risk of scarring

- Similar wounding and clinical results achieved consistently and safely by first inducing epidermolysis with a superficial peeling or physical agent, followed by application of TCA 35%
  - Solid CO2 + TCA 35% (Brody)
  - Jessner’s solution + TCA 35% (Monheit)
  - Glycolic acid 70% + TCA 35% (Coleman)
Jessner’s solution characteristics

- 14g resorcinol
- 14g lactic acid (85%)
- 14g salicylic acid
- q.s. 100mL ethanol

- Induces corneocyte dyscohesion, intercellular edema and cleavage of the stratum corneum above the stratum granulosum
- Frost: precipitation of salicylic acid crystals
Trichloroacetic acid characteristics

- Available as United States Pharmacopeia (USP) TCA crystals
- Prepare by weight to volume method to ensure consistency
  - TCA 35% = 35g USP TCA crystals q.s. distilled water 100mL
- Different concentrations may be used to achieve different levels of histologic injury
  - 10-35% superficial peel
  - 50% medium peel
  - 100% deep peel
- Frost: keratin denaturation and coagulative necrosis of dermal collagen and elastin
  - Neutralized by serum of papillary dermis
  - ‘Neutralization’ with water or NaHCO3 unnecessary
Medium-Depth Chemical Peeling of the Skin: 
A Variation of Superficial Chemosurgery

HAROLD J. BRODY, M.D.
CHENAULT W. HAILEY, M.D.

Solid CO2 (hard) and TCA 35% in 2 patients, 35 years 
Punch biopsies: H&E, Verhoeff’s stain, colloidal iron 
Day 0 (pre-peel) 
  Day 5 
  Day 30 
  Day 90 
  Day 120 

Histologic effects common to medium depth chemical peeling: H&E

Day 5: epidermal necrosis with lymphocytic inflammation to upper reticular dermis (depth of 0.62mm)

Day 30: epidermal regeneration with expansion and homogenization of dermal collagen

Day 120: papillary and upper reticular dermal collagen organized in parallel array

Pre-peel control: disorganized papillary dermis

Medium depth chemical peels induce glycosaminoglycan synthesis in the papillary and upper reticular dermis: colloidal iron stain

Day 0

Day 90

Medium depth chemical peels induce formation of a Grenz zone of collagen above pre-treatment regions of solar elastosis.
Combination medium depth chemical peels (Solid CO2, 70% glycolic acid, or Jessner’s solution + TCA 35%) afford more safety than single-agent medium depth peels (TCA 50%)

Histology: increased glycosaminoglycans and expansion of the papillary dermis above a band of pre-treatment solar elastosis (Grenz zone)
Deep chemical peel
Deep chemical peel

- Wounds to the mid-reticular dermis
  - Glogau photoaging type III, IV, atrophic scars

- Composition
  - Croton oil
  - Phenol
  - Surfactant or vegetable oils
  - Water

- Baker-Gordon phenol peel formula
  - Phenol USP 88%  3 mL  50%
  - Croton oil    3 drops  2%
  - Hexachlorophene 8 drops  5%
  - Water        2 mL   43%
Dogma

1. Phenol is the active ingredient. High concentration phenol (80-90%) denatures keratin and ‘blocks’ deeper dermal penetration

2. Lower phenol concentrations penetrate more deeply

3. Croton oil is an ‘irritant’
Cosmetic

An Examination of the Phenol–Croton Oil Peel: Part I. Dissecting the Formula

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This article investigates which ingredients are the active ones in the most popular peel formula. The benefits of the "phenol" peel have been attributed to the effects of phenol on the dermis. Baker published a simple peel formula in 1962 that became a classic that has been used since by almost all Plastic Surgeons and dermatologists. Brown et al., in 1960, passed along a set of dogmas: (1) phenol is the active ingredient; (2) phenol peels more deeply in lower concentrations; and (3) adding a surface tension-lowering agent increases the peel.

This article seeks to dissect the Baker formula by removing the croton oil. A patient was peeled serially with 18% phenol, 35% phenol, and 50% phenol solutions containing Septisol (surface tension-lowering agent) but no croton oil. This showed that increasing concentrations of phenol caused more clinical tissue reaction as evidenced by edema and erythema, but no significant dermal injury was seen. USP 88% phenol without Septisol did cause increasing concentrations of phenol without croton oil cause increasing skin reaction but insignificant peeling effect. The addition of croton oil to 50% phenol, however, causes a marked increase in the depth of peeling into the dermis. Lowering the concentration of croton oil caused a lesser burn, as evidenced by fewer days to heal. The depth of the peel, therefore, seems to be more dependent on the concentration of croton oil than phenol. This will be further explored in Parts II, III, and IV. (Plast. Reconstr. Surg. 105: 227, 2000.)

“For we know in part, and we prophesize in part.”

I Corinthians 13:9

Experiment 1
18% phenol to forehead
35% phenol to face
88% phenol to the glabellar rhytids

Experiment 2
50% phenol to forehead and upper cheek
50% phenol with croton oil to perioral area, lower cheek and glabella
The wounding effect of phenol increases with increasing concentration.

Addition of croton oil results in deeper wounding, prolongs healing time, and yields clinical results typical of a deep chemical peel.
Characteristics

1. Croton oil
   - Pressed from the seeds of *croton tiglium*
   - Hydroxyl radicals mediate epidermolysis and vesiculation at low concentration
   - Increasing croton oil concentration deepens penetration, prolongs healing, and improves clinical outcome

2. Phenol
   - 1-hydroxy-benzene or carbolic acid
   - Solvent in which croton oil is delivered to skin
   - Secondarily, a wounding agent: keratin disulfide bond disruption and denaturation to the papillary dermis
   - Cardiotoxicity depends on individual myocardial sensitivity (reports of non-toxic serum concentration are wide: 0.68-23mg/dL)

3. Surfactant or vegetable oils
   - Decreases surface tension to enable emulsification and even penetration

4. Water
   - Diluent
Cardiac Complications in Deep Chemical Peels

MARINA LANDAU, MD*

BACKGROUND  Deep chemical peels have been used in dermatology for more than a century. The main indications for this procedure include photoaging, perioral wrinkling, acne scars, and precancerous skin lesions. The most important potential complication of deep peels is cardiotoxicity.

OBJECTIVE  The objective was to estimate incidence of cardiac complications during full-face deep chemical peel and to suggest the methods to reduce the rate of this potential complication.

METHODS   Clinical data on the patients being treated by full-face deep chemical peel between December 1, 2004, and November 30, 2005, were recorded. Full cardiomonitoring was performed during the peeling procedure. Any arrhythmia or medical intervention was recorded.

RESULTS  A total of 181 patients have been treated during the study period. All the patients were female; the mean age was 56 years (range, 30–77 years). In 12 patients (6.6%), cardiac arrhythmia has been recorded during the procedure. Cardiac arrhythmia was more common in patients with diabetes, hypertension, and depression. In 4 patients the arrhythmia was self-limited and did not require any intervention. In the other 8 patients, 100 mg of lidocaine was given intravenously to control the arrhythmia.

CONCLUSION  The incidence of cardiac complications in appropriately performed deep chemical peeling is lower than previously appreciated.

Marina Landau, MD, has indicated no significant interest with commercial supporters.

One of the first scientific articles on use of a combination of phenol and croton oil for cosmetic purposes was published in 1927. The popularity of this method has fluctuated since, until the final legitimization by two American plastic surgeons, Thomas J. Baker and Howard L.

Patients and Methods

In this retrospective study, we collected data on 181 consecutive, nonselected patients treated by full-face deep chemical peel between December 1, 2004, and November 30, 2005.
Histology

1. Epidermal remodeling
   - 2 days: Protein denaturation to the upper or mid-reticular dermis, marked inflammation
   - 7-12 days: re-epitheliazation complete with normal epidermal polarity. Melanocytes present, but melanosomes small and sparsely distributed
   - 60-90 days: dermal remodeling

1. Dermal remodeling
   - Quantity
     - Increased dermal thickness due to increased collagen and glycosaminoglycans synthesis
   - Quality
     - Collagen and elastin structural reorganization
Recognized photo-aged animal model: Skh:HR-1 hairless mice (n=100)
Subjected to 14 weeks of UVB irradiation
Randomized to 5 groups: control, GA50%, TCA30% TCA50%, BG Phenol

Comparative analysis:
• Collagen and glycosaminoglycan synthesis measured by spectrophotometry day 0 through 60
• Dermal thickness measured by micrometer at day 60
• Collagen and elastin structural integrity measured by polarized light & Verhoeff stain

Quantitative and Qualitative Effects of Baker-Gordon phenol and TCA 50%

Dermal collagen and glycosaminoglycan synthesis significantly greater than control and superficial agents
Synthesis returns to baseline at day 60
Associated with significantly increased dermal thickness

Plast Reconstr Surg 2001; 107:222-8
Photo-aged mouse model
A: photo-aged control
E: Baker-Gordon phenol

Collagen
A. Loss of collagen birefringence = collagen microfibril structural disarray
   • most prominent in papillary dermis
E. Polarized light shows collagen fiber birefringence through all dermal layers
   • horizontal compact bundles

Elastin
A. Verhoeff stain demonstrates elastosis in papillary and reticular dermis
E. Replacement of elastosis with dense, horizontal network of fine elastic fibers
Summary

• Medium depth chemical peels (Solid CO2, 70% glycolic acid, or Jessner’s solution + TCA 35%) afford more safety than single-agent medium depth peels, TCA 50%.

• Histologically: expanded papillary dermis (Grenz zone) separates pre-treatment band of solar elastosis and increased dermal glycosaminoglycans.
Summary

• Croton oil is the principal wounding agent in phenol-croton oil peels

• Short-term histology: coagulative necrosis through mid-reticular dermis with re-epithelialization at day 7-12. Melanocytes present, but melanosomes sparse

• Long-term histology: Increased dermal thickness (Grenz zone) due to collagen, glycosaminoglycans synthesis, as well as structural reorganization of collagen, elastin, and normalized epidermal polarity
Clinical practice
Preparatory regimen

• Topical retinoid
  – Enables even and efficient peel penetration by compacting the stratum corneum
  – Tretinoin 0.05% cream, apply a pea-sized amount to entire face qhs over moisturizer x 4 weeks
  – May continue until procedure date for Fitzpatrick type I, II; consider stopping 1 week before peel for Fitzpatrick type III, IV

• Minimize sun exposure
  – Fitzpatrick type III, IV 4 weeks before procedure

• Prophylaxis begins day prior to procedure
  – Cephalexin 500mg, 1 tab po QID x 7 days
  – Valacyclovir 1g, 1 tab po daily x 7 days
Procedure

• No make up, no lotion, cleanse with chlorhexidine
• Degrease
  – Gauze dampened with acetone removes sebum and keratin
• Mark cosmetic subunits
  – Mandibular shadow and nasolabial fold
• Anxious or low pain threshold
  – Trigeminal nerve block or clonidine 0.1mg
• Apply peeling solution
  – 2 cotton tipped applicators to eyelids (2mm before ciliary line)
  – 4x4 gauze to remainder of face
  – Allow 3-4 minutes to achieve maximal frost before re-applying Jessner’s or TCA 35% to prevent over-peeling
  – Feather into hairline
  – Immediate frost occurs with phenol-croton oil peel, but must rub to achieve gray-white frost
• Accidental eye exposure
  – Flush with saline (TCA) or mineral oil (phenol-croton oil)
Jessner’s solution + TCA 35%
Aftercare

• Medium peels
  – Acetic acid soaks 4 times daily on day 1
    • 1 tablespoon white vinegar in 1 pint of warm water
  – Emollient 2-3 times daily
    • Ointment on day 1-3, transition to cream day 4-7

• Deep peels
  – Narcotic analgesia and acetic acid soaks day 1
  – $\text{H}_2\text{O}_2$ debridement on day 2
  – Emollients as above, may take 12 days to re-epithelialize
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