An Examination of the Phenol–Croton Oil Peel: Part IV. Face Peel Results with Different Concentrations of Phenol and Croton Oil

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In Part IV of this examination of the phenol–croton oil peel, the author presents peeling solutions using phenol in concentrations between 16% and 50% as the carrier for croton oil. Previously, in Part I, the author showed that phenol alone in concentrations of less than 50% has no significant peeling effect on the skin in the absence of taping. All of these formulas are dependent on the addition of croton oil for their peeling action.

A topographic map of the face is presented that divides the face into the zones that the author believes are best treated with different strengths of croton oil.

Five patients peeled between late 1992 and late 1995 were chosen as examples to illustrate the effect of different strengths of croton oil between 0.25% and 2.78%. The author has documented their immediate postoperative course photographically to show the effect of the different concentrations.

It is clinically apparent that peels using croton oil between 0.25% and 0.5% generally heal within 7 days; peels between 0.6% and 1.0% usually heal within 9 or 10 days, and peels using concentrations higher than 1% heal later and have some risk of pigmentation loss. Peels using croton oil concentrations at 2% and above almost always have pigmentation loss and have healing delays in areas other than the thick skin of the lower nose and perioral area.

The practical clinical formulas distributed at the time of the presentation of this article at the 1996 Annual Meeting of the American Society for Aesthetic Plastic Surgery in Orlando, Florida, entitled “Heresy Phenol Formulas—1996,” are provided here. These have been used in both the United States and Europe over the past few years.

A metric standard for drop size is suggested at 0.04 ml. This relates to the drop size used clinically over the years to measure croton oil. The adoption of this unit will make formulas around the world easier to calculate and compare. The author has produced a metric formula using the suggested standard size drop for croton oil. This uses 35% phenol as the carrier and provides the same range of treatment dilutions as the 1996 “Heresy Phenol Formulas.”

The need for research into “carriers” and solvents for croton oil is pointed out. Despite what is not known about how it works, the combination of croton seed extract and phenol has been a success story in providing facial rejuvenation from the 1920s to the present. The croton oil–phenol peel in its many formulas still sets the standard for facial rejuvenation.

For now we see through a glass, darkly; but then face to face—

—1 Corinthians 13:12

In Part IV of this inquest into the history and use of croton oil, I will show five clinical cases that illustrate various aspects of what we have come to know about the use of croton oil in phenol for peeling. These cases, done between 1992 and 1995, trace my increasing understanding of the role played by croton oil in the peel and the belief that phenol is mainly the “vehicle” to carry the cytotoxic resin into the dermis.

There are persuasive scientific observations based on animal and human studies that render obsolete the dogmas of the past 40 years. This material was presented in Part III. The bases for the clinical application of croton oil in phenol for peeling are the following:
Regarding phenol:
1. Phenol above 50% peels more deeply with increasing concentration to a maximum with 88% U.S.P. phenol.1–4
2. Unoccluded phenol less than 35% does not peel the skin.2
3. Unoccluded U.S.P. 88% phenol without croton oil gives only a light peel.3
4. Phenol does not possess an “all-or-nothing action.”1

Regarding croton oil:
1. Croton oil contains a powerful cytotoxic resin.5
2. Minute amounts of croton resin will cause a skin burn.6
3. Tiny amounts of croton oil added to any concentration of phenol will cause a peeling or skin burn.2,7
4. The peel depth increases with increasing concentrations of croton oil.2

Application techniques:
1. Tape occlusion increases the depth of the peel.1,8
2. Petrolatum-based antibiotic ointments used as occlusion increase the depth of the peel.1,9
3. The depth of the peel can be judged somewhat by clinical signs popularized by Obagi.10
4. Multiple applications of croton oil in phenol can increase the depth of the peel.1,7

With these basic understandings in mind, I want to present five different patients peeled with different concentrations of croton oil in phenol. I have chosen to present the postpeel healing process photographically so that the reader will be encouraged to correlate the concentrations applied with the degree of burn achieved and the relative healing times. Comparing the five cases day by day yields important clinical information regarding the concentrations necessary for different skin types and conditions.

Since the late 1980s, I had diluted the Baker solution to half strength (25% phenol, 1.05% croton oil) and believed it as effective as Baker’s solution but thought that this dilution caused less apparent pigment loss and healed somewhat earlier. Using some of Obagi’s clinical signs,10 I believed I had more understanding and control of the depth of penetration than before learning the Obagi technique for trichloracetic acid application.

Often I would use half-strength Baker solution for the perioral area, add 1 ml of water and do the cheeks and forehead, then add another milliliter of water and do the temples, the preauricular area, and the ear lobes. I usually did the eyelids, neck, and chest with 40% trichloracetic acid with Obagi Formula V8. These results were very satisfactory. There were fewer postoperative problems than I had seen when using full-strength Baker. I was happy from a clinical standpoint but unhappy from a scientific standpoint.

MATERIALS AND METHODS

The patients were treated according to the regimen outlined in Part I. It should be noted particularly that no tape occlusion was used; Zovirax prophylaxis and perioperative steroids were used.

Mixing the Solutions

In general, I add the croton oil to the undiluted phenol and it dissolves totally. Then I add the water, which drives the oil out of solution, then I add the Septisol. This is done on the unproven but plausible assumption that the cytotoxic croton resin may have an affinity for phenol while the fats are driven out of solution. There are times when I do not do this and I cannot yet say it matters.

Calculations

The formulas are calculated by adding the water content in U.S.P. phenol 88% to the water part. Septisol, which is mostly water, is listed as is because I have not been able to obtain the exact formula of Septisol from Delasco (Council Bluffs, Iowa). A gutta of Septisol is 1/33 of a milliliter with my dropper, or 0.0303 ml. A gutta of croton oil is 1/27 of a milliliter with my dropper, or 0.037 ml. Rounding is used when calculating the amounts and percentages, which may result in totals slightly more or less than 100.0 percent.

Judging the Depth of Peel

I judge the depth of the peel arbitrarily by the healing time: 5 days is a light peel, 6 or 7 days a medium-light peel, 8 or 9 days a medium peel, 10 to 12 days a medium-heavy peel, and more than 12 days a heavy peel. This is an overall judgment of the healing process. Pho-
Photographs cannot impart all that the eye sees in the examination room.

**The Clinical Cases**

**Case 1: One-Half to One-Third Strength Baker Solution**

This 58-year-old patient presented with long-term desert sun exposure, multiple medium wrinkles of the whole face but especially of the mouth and chin, uneven pigmentation, and laxity in a thin face.

I arrived at the topographical map of the patient’s face seen in Figure 1 in the mid-1980s. I interpreted these areas as the thickness of the skin, the density of skin appendages, and, hence, the tolerance to peeling. Note especially that the preauricular area, the geniomandibular area, and the temple-lateral periorbital area are zones that tend not to heal well if overdone. Therefore, I use lesser concentrations of croton oil in these areas.

To document what I had been doing with diluted Baker’s solution since 1989, I peeled this patient with descending concentrations of phenol and croton oil but in the same relationship to each other: 24 parts phenol to 1 part croton oil. I started with 28% phenol–1.2% croton oil solution and diluted it with water for four dilutions. Subsequent recalculation of the mixtures gave the exact numbers shown in Table I.

Dilution 1 was used for the lower nose, perioral area, and chin, marked area 1 in Figure 1. Dilution 2 was used for the upper nose, cheeks, and forehead, marked area 2. Dilution 3 was used in the lateral periorbital area (crows feet), marked area 4. Dilution 4 was used on the lower eyelids, brow, preauricular area, geniomandibular area, and ear lobes, marked area 3. Trichloracetic acid 33% with Obagi Formula V was used on the upper eyelids and neck (marked area 5).

**Observations**

The patient was treated on December 14, 1992. Figure 2, above, left, shows the patient on postoperative day 1, with the dense gray color associated with phenol–croton oil peels but not seen with 25% phenol alone. There is generalized moderate edema. Note that the ear lobes have been peeled. By postoperative day 2 (Fig. 2, above, right), the edema has rapidly subsided (thanks to steroids), and the gray color has largely disappeared from most areas except the perioral area and forehead (where the highest concentration of croton oil was used). The patient appears almost healed by postoperative day 7 (Fig. 2, below, left). There are a few raw areas on the chin, the lips, the philtrum, the forehead hairline, and the periorismissural area. By day 9, the patient was healed. Therefore, I judge this peel to be a medium to medium-deep peel. The patient is seen below, right, ready for makeup to be applied on day 22.

In Figure 3, the patient is seen in the preoperative frontal view (above, left), and at 7 (above, right), 15 (below, left), and 33 months (below, right) postoperatively. The longevity of the peel is apparent. Skin color is well preserved. Figure 4 shows preoperative and 33-month postoperative oblique views of the patient. Figure 5 shows the mouth preoperatively and 7 months postoperatively. The radiating lines from the nasolabial fold and lateral lower lip have been almost abolished while the rugae of the chin have been eradicated. The lateral left lower lip shows some lack of take, with persisting lines on the vermilion border. That this was missed by the surgeon can be seen in Figure 2, below, left, at postoperative day 7, where there is no significant erythema of the left lower lateral lip. Note the deeper wounding near the right in-
Fig. 2. (Above, left) Postoperative day 1. Moderate edema. Note the dense gray color of croton-treated areas and the red on the neck treated with trichloracetic acid. Note the brown color of the glabella, the tip of the nose, the chin, and pericommissural areas, indicating heaviest peel. Brows, lower lids, ear lobes, and mandibular lines were treated with the lightest peel formula: 16% phenol and 0.7% croton oil (Baker’s formula diluted with two-thirds water). Note that the eyes are not swollen shut. (Above, right) Day 2. Rapid resolution of edema. Rapid epidermolysis. Persisting gray in the most heavily peeled areas. Note that no epidermolysis is seen in the lower neck peeled with trichloracetic acid, where instead desquamation occurs often in sheets. (Below, left) Day 7. The neck is healed and the face is almost healed. There is some slow healing on the tip of the nose, vermilion borders, pericommissural areas, upper nose, glabella, medial inner brows, lateral inner brows, right mid lower lid, and hairline. (Below, right) Day 22. Facial makeup is removed except for lipstick and eyelash liner. Compare with preoperative view seen in Figure 3, above, left. Note especially the improvement in the glabellar area, chin, lips, lateral nasolabial folds and texture, tone, and pigmentation of skin.
FIG. 3. (Above, left) Pres operative view on December 14, 1992, of patient 1, who presented with irregular, blotchy pigmentation, especially of the cheeks. Glabellar, lateral orbital, nasolabial, and geniomandibular rhytids are seen. Chin rugae are present, and the lower vermilion border is poorly demarcated. (Above, right) View 7 months postoperatively. There is vast improvement in all parameters: texture, tone, pigment, rhytids, and rugae. (Below, left) View 13 months postoperatively. There is slight lateral cheek rhytid recurrence. All other areas retain improvement. (Below, right) View 33 months postoperatively. Compare with above, left. The mouth, chin, and glabella retain improvement. Lateral cheek rhytids and crow’s feet show some recurrence.
ner canthus, bridge of the nose, on the left lower eyelid and lateral brow areas.

Discussion

This patient received a medium to medium-heavy peel as judged by a 9-day healing time. Here we see the effect of lower percentages of croton oil and phenol but in the same proportion to each other as in Baker’s formula and at one-half to one-third the strength of Baker’s. These have produced results that appear as good in tightening as what we have come to expect from Baker’s classic formula, but without evident pigment loss and with a shorter healing time. The left epicanthal area needed to be treated with a small steroid injection. The heavy transverse glabellar lines and lateral brow ptosis demanded extra application to these areas, and Figure 2, below, left, shows the more severe wounding that resulted. I now consider the concentration of croton oil to area 3 of 0.7% to be too high, even though it is only one-third of the amount used in the classic Baker formula. The healing delays seen are evidence of this. We have seen in Part I that phenol alone at 18% produces no peeling whatsoever, yet with this patient 16% phenol with 0.7% croton oil contributed to a medium to medium-heavy peel. The startling improvement of the mouth and chin is noteworthy for a peel healing in only 9 days. The longevity of the peel can be seen in Figure 3.

Case 2: A Heavy Peel Using Serial Dilution (Geometric Progression)

This is a case of a severe desert sun exposure: a 64-year-old northern European woman who had been exposed to the dry Las Vegas desert climate for more than 30 years. She had bronzing of the skin exposed to the sun, actinic keratoses, and an almost leather-like skin with deep criss-cross rhytids and severe perioral rhytids. Unexposed areas, such as the preauricular area where her hairstyle had shielded her skin, revealed a normal, pale complexion as seen in Figure 6.

With this patient I decided I could use a very strong peel solution around the lower nose, perioral area, and chin to treat the severe perioral rhytids, chin rugae, and leather-like skin and progressively less for other areas. By the time of this peel, 1994, I believed that the effect of the croton oil concentrations were geometric rather than arithmetic in nature. Therefore, I chose to serially dilute croton oil in the same concentration of phenol (about 49%) as the carrier or vehicle, halving the concentration of croton oil for each dilution (a geometric progression). The last dilution contained no croton oil (the control). Baker’s formula is provided as a reference (Table II).

In Figure 6, area 1 was treated with dilution 1, area 2 with dilution 2, and area 3 with dilution 3. The preauricular area (note paleness) was treated with dilution 4 (the control). The periorbital area 4 and the neck and décolleté were treated with 40% trichloracetic acid with Obagi’s Formula V.
Observations

Figure 7, left, shows the dense gray cast of croton oil–phenol and massive edema of a deep peel on postoperative day 1. Note that the eyelids are not swollen shut after the peel with trichloracetic acid. Peel patients are much easier to care for when they are able to open their eyelids.

Figure 7, center, shows the status on day 3, with resolving edema, epidermolysis, and the beginning of superficial peeling of the neck from trichloracetic acid. There is shaggy slough of the superficial layers of the perioral area, chin, and cheeks and less reaction on the forehead where the concentration was less. But the forehead is always slower to clear than the cheeks in my experience.

An oblique view on day 5 (Fig. 7, right), shows the different levels of peeling. The peeling from trichloracetic acid on the neck and chest is almost healed. Punctate bleeding is seen on the nose, lips (dilution 1), and cheeks (dilution 2), indicating a deep dermal peel. Note that there is no visible effect on the preauricular area where dilution 4 (no croton oil) was used.

On day 7 (Fig. 8, above, left), the lips, nose, and cheeks remain raw. The forehead is further along. Compare day 7 of this peel with the previous patient’s day 7. By day 10 (above, right), epithelialization is almost complete yet the left cheek and lips show persisting unhealed areas. The photographs below show the patient healed on day 14, which puts this peel in my deep peel category. Note the absence of preauricular erythema where no croton oil was present in the 49% phenol solution as compared with the adjacent cheek, where 1.4% croton oil was present in the same concentration of phenol. In retrospect, the patient would have benefited from submental, upper neck, and preauricular treatment with low-dose croton oil (0.2%) to tighten these areas.

Fig. 5. (Above) Preoperative view of the mouth on December 14, 1992. Irregular blotchy pigmentation, chin, rugae, marked lip, and cheek rhytids are present. (Below) Postoperative view of the mouth at 7 months. All chin rugae and rhytids abolished except on the left lateral lower lip and the vermilion border (missed by surgeon). Skin color is good.

Fig. 6. Topographic map of the face of patient 2, a 64-year-old woman, on April 4, 1994. Area 1 is designated for a peel with 2.8% croton oil, area 2 for 1.4%, area 3 for 0.7%, and the preauricular area for 0% (control), all in 49% phenol. Areas 4 and 5 (except for the preauricular area) are designated for trichloracetic acid 40% treatment.
Figure 9 shows the preoperative and 1-year postoperative results. There is obliteration of the severe lip rhytids (prune lines) and pericommissural lines and disappearance of the rugae of the chin. There is tightening of the submental and genioglabellar area. The irregular pigmentation, bronzing, and actinic keratoses have been eliminated. The cheek rhytids have completely smoothed out, and the crow’s feet are vastly improved. The heavy glabella lines responded to extra application to that area. There is apparent loss of pigmentation commensurate with a deep peel. The Obagi trichloracetic peel of the neck has eliminated irregular pigmentation and produced improvement of the finer lines.

Discussion

This case of severe sun damage demonstrates what higher doses of croton oil in phenol can achieve. No other treatment modality comes close to giving this kind of result in one sitting. The aesthetic price to be paid is some loss of pigmentation or opacity. Here the concentration of phenol remained the same at 49%, and the percentage was serially reduced from 2.78% to 0.7%. Because of serial dilutions, the areas of thinner skin showed no delay in healing compared with the perioral area, as seen in the previous case. It is important to recognize the bright erythema that always characterizes the croton oil–phenol peel when compared with the Obagi trichloracetic formula. I interpret this to be a difference in the healing process, which we as yet do not understand and is caused by croton resin. The area peeled with 49% phenol alone (preauricular area) showed no reaction or peeling.

Please note that the high concentration of croton oil (2.78%) in 49% phenol used in the perioral...
FIG. 8. (Above, left) Postoperative day 7. Nose tip, lips, chin, and cheeks show raw dermis. Exudate persists on forehead. (Above, right) Day 10. There are raw areas on the lips and cheeks and slow healing of the right forehead. Note difference in color of areas where trichloracetic acid 40% was used (eyes and neck) and where croton oil–phenol was used. (Below, left) Day 14. The patient healed completely but the skin is fragile (lipstick on lips and eyebrow pencil). Compare with the preoperative view in Figure 9, above, left. (Below, right) Day 14. Profile view shows no effect of phenol 49% without croton oil on the preauricular area. Compare with Figure 9, below, left.
FIG. 9. (Above, left) Preoperative view. The patient had undergone no previous cosmetic procedures. She suffered severe sun damage with discoloration of the face and neck. Marked criss-cross rhytids, glabellar rhytids, deep lip rhytids extending to the nasal base, and chin rugae are present. Her skin is almost leather-like, and her natural skin color is quite pale as judged by the inside of her upper arm (German heritage). (Above, right) Postoperative view at 9 months. The patient had no intervening cosmetic surgery. Lip rhytids, chin rugae, and cheek rhytids are abolished. Glabellar rhytids and crow’s feet are markedly improved; irregular pigmentation has been removed. The trichloracetic acid treatment of the neck has removed discoloration. (Below, left) Preoperative oblique view. Deep lip and pericommissural rhytids and skin discoloration are very pronounced. (Below, right) Postoperative oblique view at 9 months. There is marked improvement of the tone, texture, and color of the face. Lip and cheek rhytids and chin rugae have been abolished. Relative hypopigmentation is present but there is no demarcation line on the neck.
region in this case will often cause scarring if used in the geniomandibular groove, on the eyelids, in the preauricular region, or along the mandibular line. I urge the use of much lower concentrations in these areas.

Case 3: A Secondary Peel with Low-Dose Croton Oil to the Neck

A 62-year-old patient wanted a secondary peel. She had previously undergone an augmentation rhinoplasty in 1987 and a rhytidectomy and facial suction in 1988, and she had been peeled with 40% trichloracetic acid with Obagi Formula V in November of 1991. The patient had required 9 days to heal from her Obagi peel. She had complained of postoperative “blotchiness” and lack of improvement around the lips. A perioral dermabrasion “touch-up” had been carried out in early 1992 because of persisting lines at the vermilion border.

By October of 1993, the patient was back, complaining about the periorbital area, the lower lids, and general skin quality—one can see why in her preoperative photograph. She asked for any additional treatment available. This patient had demonstrated “hyperactive” skin following her Obagi peel, with some persisting, uneven erythema, itching, and burning. She had spotty loss of pigmentation and had not obtained much improvement either to her eye or to mine.

Her neck remained hyperpigmented.

This was a difficult case that included both patient dissatisfaction and a hyperactive skin. It would be easy to try for too much, to undertreat this patient, or to refer her away to avoid addressing her problems altogether.

By the end of 1993, I had redone previous Obagi peels with a light to medium-light croton oil peel. I believed the neck and periorbital area could be improved by low-dose croton oil in phenol as well. I chose two dilutions as shown in Table III.

The patient’s medical chart stated “lighter treatment of the temporal area, somewhat more strokes to the forehead and cheeks and light stroking to the neck and submental area.” This was done to obtain a deeper peel to the forehead and cheeks by virtue of more coats without having to change the dilution. This was supported by Stegman’s 1980 observations1 and my own using the Obagi technique to apply croton oil–phenol since 1988.

Observations

On the first postoperative day (Fig. 10, above, left), the patient exhibits the typical gray cast of croton oil–phenol with modest edema. There is immediate epidermolysis and blistering on the neck. Compare this appearance of the neck to those of the previous patients peeled with trichloracetic acid.

By day 5 (above, right), we see resolving edema, and the epidermolysis of the neck is complete. Trichloracetic acid usually results in desquamation rather than epidermolysis. By day 8 (below, left), the patient is healed in all areas. There is rather marked erythema for a low concentration of croton oil commensurate with her hyperactive skin response.

Figure 10, below, right, shows the patient at day 15, ready to use makeup. The peel appears very even, and the neck shows an erythema not seen with the trichloracetic acid; the periorbital area in particular is tightened.

Figure 11, above, shows preoperative and 8-month postoperative frontal views. These views show good improvement of cheek lines and contraction of the submental, upper neck area. The lateral periorbital and lower lid skin has tightened. Pigmentation has evened out.

Discussion

This reoperative procedure illustrates the use of a moderate concentration of croton oil (0.7%) to deal with the patient’s complaint of failure of her Obagi peel around the mouth and a low concentration (0.25%) for the remainder of the face and the neck. Truppman told me in August of 1999 that he has used the Maschek formula (0.2% croton oil) on the neck with light strokes without occlusion since the mid-1970s.

This difficult patient received real benefit from this low-concentration peel. In her case, it nearly fell into the classification of a medium peel as judged by a healing time of 7 or 8 days. Remember, her original Obagi trichloracetic peel took 9 days to heal.

This case also illustrates that a medium peel can be achieved on the forehead and cheeks with 0.25% croton oil, and a light peel can be achieved on the neck with the same solution by altering the application (more or fewer coats).
FIG. 10. (Above, left) Postoperative day 1 shows the gray cast of croton oil–phenol, modest edema of the face treated with 0.8% croton oil to the perioral area and 0.25% to the remainder of the face and neck. Immediate epidermolysis of the neck resulted from the full neck and décolleté croton oil–phenol peel. (Above, right) Day 3. Some raw dermis is visible on the nose, cheeks, chin after epidermolysis of these areas. Forehead epidermis has not yet sloughed. (Below, left) Day 8. Note the brilliant erythema of the neck from the croton oil–phenol peel. The patient healed in all areas, but blotchy hyperemia indicates “hyperactive” skin. (Below, right) Day 15. The perioral area shows more hyperemia commensurate with a stronger concentration of croton oil (0.8%) used there.
Fig. 11. (Above, left) Preoperative view of the 61-year-old woman in Figure 10 on December 20, 1994. She had undergone blepharoplasty, face lift with facial suction, and augmentation rhinoplasty 7 years previously and an Obagi peel 2 years previously. She has skin discoloration and general skin laxness; the periorbital laxness is especially striking. (Above, right) Postoperative view at 8 months. She had no intervening surgery. The periorbital area has tightened markedly after the croton oil–phenol peel. Skin color is more even and skin texture is improved. The submental area has tightened from the neck peel. (Below, left) Preoperative profile view. Irregular, spotty pigmentation loss from the Obagi peel is seen in the preauricular area. There is general laxity in the submental area and along the mandibular line. (Below, right) Postoperative profile view at 8 months. Pigmentation is more even. The neck-face transition is improved by the croton oil–phenol neck peel, and there is marked tightening of submental-mandibular line.
Case 4: Light to Medium-Light Peel for Early Skin Changes

A 51-year-old woman presented with medium complexion, thin skin with multiple fine lines, and crow’s feet and requested face lift surgery. She did not require enough changes to justify a typical “phenol” (i.e., classic Baker) peel. She would not accept hypopigmentation. The patient had had a reconstructed nose and maxillary denture after an automobile accident in her early 20s, which limited treatment to the nasal tip area.

Drawing from experience gained between 1992 and 1995, I decided on a mixture of 0.5% croton oil in 33% phenol. The actual formula is shown in Table IV. The forehead, cheeks, nose, and perioral area and the horizontal parts of the neck were treated with this solution. The eyelids, vertical neck, and décolleté were treated with 40% trichloracetic acid with Obagi Formula V.

Observations

On postoperative day 1, the patient shows modest edema (Fig. 12, left). Compare this with the photographs of previous peels on the first postoperative day. The patient did not complain of pain. By day 6 (center), she shows basically full epithelialization. Note that the perioral area is more healed than the cheeks from a single concentration. The early recuperation possible with this lighter peel is seen in Figure 12, right, on day 9. Compare this with previous peels at day 8 or 9.

The patient was too busy to keep intervening appointments and was next seen 5 months after treatment, when the final postoperative pictures were taken in September of 1995. Figure 13 shows the frontal and oblique preoperative and postoperative views. These show good improvement of crow’s feet and obliteration of multiple early cheek rhytids. The lateral lower lid-malar area is nicely improved, and facial pigmentation is much more even.

Close-up passive views of the mouth seen in Figure 14, above, show good improvement in the pericommissural area, lips, and medial cheeks and in the texture of the skin. Similar improvement is seen in the close-up views of the smile in Figure 14, below. Observe especially that there is no pigment loss yet good improvement in texture and obliteration of early rhytids.

Discussion

In this case I was able to treat a youthful-looking 51-year-old woman with the early changes that bring so many patients to the plastic surgeon. The use of the classic Baker formula would be a great disservice to this kind of patient. Any of the lay peel formulas would be a better choice, but—if taped—might have been too heavy also. In this case, by lowering

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<th>Water</th>
<th>6 ml</th>
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<tr>
<td>U.S.P. phenol 88%</td>
<td>4 ml</td>
<td>33.38%</td>
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<tr>
<td>Septisol</td>
<td>16 gutta</td>
<td>4.65%</td>
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<tr>
<td>Croton oil</td>
<td>1 ½ gutta*</td>
<td>0.53%</td>
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<td>TOTAL</td>
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* See the footnote to Table III for the formula for ½ gutta.
FIG. 13. (Above, left) Preoperative view on March 14, 1995. She had no previous cosmetic surgery, but had reconstructive rhinoplasty and maxillary denture after an automobile accident in her early 20s. She had fine, thin skin with medium complexion with fine rhytids. (Above, right) Postoperative view at 6 months showing correction of early cheek and lip rhytids and improvement of skin texture and no pigmentation loss. (Below, left) Preoperative oblique view. Solar damage shows in irregular pigmentation. Natural skin color is seen on suprathyroid neck skin. There is general fine wrinkling. (Below, right) Postoperative oblique view at 6 months. The patient has good general texture, tone, and color of skin, with a better color match between the face and neck. Early cheek rhytids have been eradicated.
the croton oil to 0.53% (one-fourth of Baker’s) in 33% phenol as the carrier, with a light application, I was able to achieve a light peel with just the necessary improvement and little or no pigmentation loss. This is the kind of refreshment many patients are seeking. It is my observation that rhytid improvement with the laser results in the inevitable sequela of hypopigmentation. It is also my observation that at levels of croton oil of 0.50% or less, patients complain of much less or sometimes no pain.

This patient was epithelialized by postoperative day 6, falling into my category of medium-light peel. She kept few postoperative appointments and required no “hand holding,” as is typically necessary for peel patients. This peel can be repeated at this strength a number of times.

Case 5: Forehead Lift and Medium Face Peel

Many patients present with aesthetic problems that require different treatment modalities; such was the case of this 52-year-old English woman. She showed the need for a forehead lift and what some plastic surgeons would say were indications for a face lift. She had undergone a face lift 10 years previously elsewhere. There was now some general relaxation, especially in the jowl area, fine lines of the cheeks, fine rugae of the chin, irregular pigmentation changes of the skin in general, and multiple fine crow’s feet. She was a nice-looking woman who just looked “tired out” despite her previous face lift.

A standard carrier solution consisting of the following was made:

- 6 ml of water (61.77%)
- 4 ml of 88% U.S.P. phenol (33.58%)
- 16 drops (0.49 ml) of Septisol (4.67%)

This produced a total of 10.49 ml of solution. One milliliter of this solution was used to treat the forehead and upper eyelids; it contained no croton oil (the control). One drop of croton oil was added to the remaining 9.5 ml, which created a concentration of 0.39% croton oil. This was used to treat the nose, cheeks, and temple, which required 1.5 ml.

To the remaining 8 ml, 1 drop of croton oil was added, which increased the concentration of croton oil to 0.85% (basically doubling the concentration). This was used to treat the perioral area and chin. The eyelids, neck, and décolleté were peeled with 40% trichloracetic acid with Obagi’s Formula V.

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**Fig. 14.** (Above, left) Preoperative close-up view of the mouth at rest. Note the texture of the chin. (Below, left) Six-month postoperative close-up view of the mouth at rest. Compare the texture and color to above, left. (Above, right) Preoperative close-up view of the smile. Active rhytids are seen in the cheeks. (Below, right) Six-month postoperative close-up view of the smile. There is good improvement of active cheek rhytids.
Observations

Figure 15, *above, left*, shows postoperative edema from both the forehead lift and the facial peel on day 1. Note that there is no epidermolysis of the neck from the trichloracetic acid at this time. By day 3 (*above, center*), the edema is subsiding, and shaggy slough of the superficial layers of the face is seen. Glabellar swelling and ecchymosis are apparent from the coronal lift. Compare this result to that of case 3. By day 4 (*above, right*), epidermolysis of the face is almost complete, whereas the neck treated with trichloracetic acid has desquamated. Periorbital ecchymosis persists. The perioral area is much brighter red than the cheeks. By day 8 (*below, left*), the cheeks have healed, but a few perioral and chin area spots are not quite healed (commensurate with the double-strength croton oil concentration used in those areas). Glabellar ecchymosis is resolving. By day 10, healing is obviously complete and the smoothing phase has begun (*below, right*). There was no peeling seen on the forehead, where 33% phenol alone was used without croton oil (control). Compare this patient’s perioral area at 10 days peeled with 0.8% croton oil with the results of patient 4 (Fig. 12, *right*) at 9 days but peeled with 0.53% croton oil in the same 33% phenol carrier.

It is always important to review patients without makeup. Figure 16 shows the patient 1 month postpeel. Preauricular and presideburn scarring from her 10-year-old face lift is visible. The pericommissural area looks much better than any face lift result. The chin rugae (un治 treatable by face lift) are obliterated. The crow’s feet are much improved and pigmentation is more even. The upper neck has tightened. The coronal lift has accomplished what I expected from it. Compare her preoperative photographs in Figures 17, *left*, and 18, *left, above and below*, with her 1-month postoperative photographs without makeup in Figure 16 and the postoperative views with makeup in Figures 17, *right*, and 18, *right, above and below*.

Discussion

The selective peeling, in this case with a forehead lift, shows how two separate modalities can combine to give a result better than either alone could possibly provide. Skin improvement always gives a youthful dimension never obtainable by surgery alone. Chin rugae in particular often remain a devastating fault in an otherwise good face lift result. The submental and pericommissural areas are much improved.

Here again, I used a serial dilution of croton oil in the same percentage of phenol—33%. The patient reported no postoperative pain in the cheek area, where the 0.4% croton oil was used. Doubling the strength of croton oil to 0.85% caused a deeper peel around the perioral area and a complaint of pain. The 33% phenol without croton oil used on the forehead with no response validated once again that it is the presence of croton oil that causes the peel. Judging by the healing time (9 days), this was a medium peel.

CLINICAL IMPLICATIONS

The foregoing clinical case reports illustrate my search for peeling solutions between late 1992 and 1995. I peeled patients with a variety of different concentrations of croton oil and used different concentrations of phenol as the carrier or vehicle.

The clinical conclusions that follow are based not only on the cases illustrated but on my experience of all cases between 1992 and 1995. It is instructive to compare the photographs of the first-postoperative-day reactions and those taken at the seventh or eighth postoperative day to compare the state of healing with the various formulas. Some generalizations are warranted based on this experience:

1. If the phenol vehicle concentration is the same, then each dilution of croton oil shortens the healing time (and by inference reduces the depth of injury) whether the phenol concentration is 50%, 33%, or 25%.
2. The phenol vehicle concentration has little or nothing to do with the depth of injury, as shown by the controls used in cases 2 and 5.
3. I can confirm Stegman’s 1980 observation in animals that it is possible to increase injury by applying more coats (more rubbing) of the same concentration. After this study ended in 1996, Stone published this very point in a comprehensive 1998 article.
4. In general terms, subject to individual variation, the perioral area and the lower nose tolerate croton oil concentrations as high as the 1.2% range with little healing delay. The cheeks and forehead tolerate...
up to about 0.8% with the same risk, while the upper nose, temple, and lateral brow tolerate up to about 0.4% with little risk. Most patients do well with lower concentrations, as seen in cases 3, 4, and 5, where the treatment range was 0.25% to 0.8% croton oil. Overtreatment gains nothing, adds risk, and delays healing. The neck and eyelids themselves can tolerate up to 0.2% if peeled lightly. For safety’s sake I currently use 0.1% with a few more applications.

5. Concentrations of croton oil above 1% have an increasing incidence of hypopigmentation.

Fig. 15. (Above, left) Postoperative day 1 of patient 5, a 52-year-old woman who underwent a medium croton oil–phenol peel (0.4% and 0.8%). Perioral areas are gray (0.8% croton oil). Periorbital area and forehead were treated with 33% phenol but no croton oil (control) with no reaction. The patient underwent a coronal lift at same time. Trichloracetic acid was used to treat the neck and décolleté. She has glabellar fullness from a coronal lift. (Above, center) Day 3. The patient has epidermolysis of lower half of face but no desquamation of the neck. Transudate from the face coagulated on the neck. There is no effect on the upper half of the face from phenol without croton oil. (Above, right) Day 4. Glabellar ecchymosis from the coronal lift is beginning to resolve. Raw dermis of the nose, cheeks, and perioral area is apparent; epidermolysis is complete. The neck has desquamated from trichloracetic acid. (Below, left) Day 8. The patient is healed except for a few spots in perioral areas treated with higher-concentration croton oil. (Below, right) Day 10. The patient is totally healed, showing florid erythema typical of the croton oil–phenol peel.
Fig. 16. (Left) Frontal view 6 weeks postoperatively with facial makeup removed (except for lipstick and eye liner). Erythema is resolving with a good tightening effect. Compare with Figure 17, left. (Center) Profile view 6 weeks postoperatively. Previous face lift scars are visible. Compare with Figure 18, above, left. There is good tightening and her complexion is improved. The edge of the croton oil–phenol peel is visible on the neck just below the mandibular line, but the neck skin color is improved. Cheek rhytids are eradicated. (Right) Oblique view 6 weeks postoperatively shows improvement of all early rhytids and vast improvement of postinflammatory hyperpigmentation and sun damage seen in Figure 18, below, left.

Fig. 17. (Left) Preoperative view of patient 5 on August 1, 1995. She had had a face lift 10 years previously elsewhere and brachioplasties 2 years previously. She suffered sun damage with much irregular hyperpigmentation, in addition to general skin relaxation and skin changes. (Right) Postoperative view at 1 month with makeup. The patient is able to return to work and other social settings.
FIG. 18. (Above, left) Preoperative profile shows general relaxation, especially along the mandibular line, medial cheek, and submental areas. Neck pigmentation is a problem. (Above, right) Postoperative profile at 1 month with makeup shows tightening of the mandibular line and improvement in neck color from trichloracetic acid. (Below, left) Preoperative oblique view shows lateral periorbital and pericommissural fine lines and pigmentation problems. Compare with Figure 16, right. (Below, right) Postoperative oblique view at 1 month with makeup shows the periorbital improvement from the coronal lift and the malar skin tightening, giving the eye a bright, youthful look. The skin texture of the chin is improved.
In 1996, after my presentation at the ASAPS meeting in Orlando, I distributed what were called “The Heresy Phenol Formulas—1996,” which have been used by plastic surgeons in both the United States and Europe. These have stood the test of time and provide a range of formulas sufficient for the peel practitioner. They are shown in Table V.

More Accurate Formulations

Eventually, to be scientific we must move away from expressing croton oil in drops dispensed with a dropper and use metric units dispensed with a syringe. Because physicians did not understand the importance of the croton oil concentration, little thought was given to the size or number of drops. Everybody’s dropper is different, although many supplied earlier with the croton oil bottles are in the 25-to-30 drops/ml range. Because there is a huge clinical experience based on formulas using drops of croton oil, it makes sense to establish a metric standard that relates to the size of actual drops used in the formulas.

Suggested Standard

To standardize the drop size, I suggest we use 25 drops/ml. It makes sense to use a number divisible evenly into 100, and this is not a random choice—my dropper delivers 27 drops/ml. The difference between 25 and 27 drops/ml is only 8 percent. Twenty-five drops per milliliter means each drop would be defined as 0.04 ml.

To prepare the formulas, we need to dilute the drop of croton oil in a much larger amount of solvent to measure such a small amount accurately. The easiest way to do this is to dissolve 1 ml (25 drops by definition) of croton oil in 24 ml of U.S.P. phenol 88%, which provides a stock solution of 25 ml total with a content of 0.04 ml (or 1 drop) of croton oil in each 1 ml of this stock solution. To mix any formula, you first take as many milliliters of the stock solution as drops of croton oil desired in the formula, then you add whatever remaining amount of phenol and other ingredients needed to complete the formula. This makes it easy to formulate the quick “lay formulas” based on U.S.P. phenol 88%, which I provided in Part II, and all other formulas based on drops. Then we will be able to more accurately compare results from formula to formula and surgeon to surgeon.

Table VI provides a set of formulae using a 35% phenol solution as the vehicle. (For a 48.5% phenol solution as the vehicle, see Table VII.) I prefer 10 ml of final solution because it is easy to calculate percentages. It is most important to identify each strength clearly and consistently. I do this with color-coded “shot” glasses. The Obagi application technique uses more solution because the 2 × 2-inch gauzes absorb more than Q-Tips. Thus, 10 ml is a better amount for this. It is important to read the article on the clinical signs used in the Obagi technique.

**Speculations on the Physical Chemistry of Phenol–Water–Croton Oil Emulsions**

Let me state clearly that I am not knowledgeable in physical chemistry. I want to be the first
to say that the speculations that follow may prove to be mostly wrong. But testing these hypotheses in animal and physical chemistry experiments will provide us a lot of necessary knowledge, whereas their blind acceptance provides us with nothing. In short, I hope these speculations will stir a new curiosity about how these peels work, which has been absent for many years.

An observation that piques my interest is that very low concentrations of phenol (16% to 28%) produced very dark gray responses on postoperative day 1 in cases 1 and 3 and others not pictured. What makes this observation interesting is that it fits so well the Brownian dogma that low concentrations of “phenol” penetrate more deeply than higher concentrations. I and others have shown that this is simply not true for phenol. Could it be true for phenol–water–croton oil emulsions? We do not know the answer. But we do know Brown used croton oil formulas but did not publish them. Perhaps, like others after him, he attributed the action of croton oil to phenol.

Where Is the Croton Resin?

We need to speculate about and then investigate what happens to the toxic croton resin when the emulsion is mixed. If the croton resin has a selective affinity for the phenol and does not dissolve at all in water, and if the phenol is the vehicle that penetrates to the upper-mid dermis—then an interesting situation could arise when the same concentration of croton oil is present in two different concentrations of phenol in the emulsions.

Take the example of 1% croton oil in a 25% phenol-water mixture and a 50% phenol-water mixture. The 1% of croton oil is calculated on the volume of the total mixture, not on the volume of the phenol only. If the croton resin has an affinity for the phenol in the 25% phenol-water mixture, it will be twice as concentrated as in the 50% phenol-water mixture because there is twice as much phenol in the latter solution and the same amount of croton resin in both.

This speculation makes it imperative that we carry out experiments to verify where the toxic croton resin resides in the phenol-water croton oil emulsion. Then we can choose the ideal phenol concentration as a “carrier” or “vehicle.”

Change of Solvent

The next step in the examination of the physical chemistry would be to eliminate the water phase and replace it with ethyl alcohol because it is miscible with both the croton oil and phenol. This would eliminate the emulsion and obviate the need for constant mixing during application. Depending on the penetration characteristic of this mixture, new percentages of croton oil might have to be determined by animal and then by clinical experience.

### TABLE VI
Formulas Using 35% Phenol Vehicle*

<table>
<thead>
<tr>
<th>Croton Oil %</th>
<th>0.4%</th>
<th>0.8%</th>
<th>1.2%</th>
<th>1.6%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>U.S.P. phenol 88%</td>
<td>3.0</td>
<td>2.0</td>
<td>1.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Stock solution containing croton oil</td>
<td>1.0</td>
<td>2.0</td>
<td>3.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Septisol</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>TOTAL</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

All amounts are in milliliters.
* For those wishing to use the phenol vehicle at the same percentage as Baker’s classic formula, refer to Table VII.

### TABLE VII
Formula Using 48.5% Phenol Vehicle*

<table>
<thead>
<tr>
<th>Croton Oil %</th>
<th>0.4%</th>
<th>0.8%</th>
<th>1.2%</th>
<th>1.6%</th>
<th>2%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>4.0 ml</td>
<td>4.0 ml</td>
<td>4.0 ml</td>
<td>4.0 ml</td>
<td>3.5 ml</td>
</tr>
<tr>
<td>U.S.P. phenol 88%</td>
<td>4.5 ml</td>
<td>3.5 ml</td>
<td>2.5 ml</td>
<td>1.5 ml</td>
<td>1.0 ml</td>
</tr>
<tr>
<td>Stock solution containing croton oil</td>
<td>1.0 ml</td>
<td>2.0 ml</td>
<td>3.0 ml</td>
<td>4.0 ml</td>
<td>5.0 ml</td>
</tr>
<tr>
<td>Septisol</td>
<td>0.5 ml</td>
<td>0.5 ml</td>
<td>0.5 ml</td>
<td>0.5 ml</td>
<td>0.5 ml</td>
</tr>
<tr>
<td>TOTAL</td>
<td>10 ml</td>
<td>10 ml</td>
<td>10 ml</td>
<td>10 ml</td>
<td>10 ml</td>
</tr>
</tbody>
</table>

* All amounts are in milliliters.
† This is U.S.P. phenol 88% with 0.04 ml croton oil dissolved in each milliliter. See text for preparation.

For eyelids and neck, take 1 ml of the 0.4% solution and mix it with 1.70 ml of U.S.P. phenol 88% and 1.30 ml of water for a 0.1% solution of croton oil in 50% phenol.
Other Solvents

Further, we need to see if any other solvent alone (or in mixtures) can be an effective carrier of the croton resin on its own without phenol. Perhaps it can. But perhaps the resin has some special affinity for phenol or benzene derivatives (closed six-carbon rings), which it does not have for straight chain alcohols in which it is, nevertheless, soluble.

Final Thoughts

Since the 1920s, croton oil has been used very successfully for face and neck peeling by lay peelers and since the 1960s for face peeling by physicians. We have a huge clinical experience but not a clear understanding of how it works.

I have sought to tell the story of croton oil. How interesting, how tantalizingly close in time were Otto Bames’s first paper on face peeling in 1927 and Spies’s 1935 paper on the effect of croton resin on human skin. Like two shooting stars in the night, their paths never crossed. Spies’s paper remained forgotten until now.

How appropriate, in this dichotomous age of fascination with the hi-tech yet insistent demand for natural products, that the choice for a face peel be between a laser and the resin pressed from the seeds of a croton plant. How appropriate for our time that it is easier to understand the effect of the laser than the workings of the resin. Will we come to understand how 1 mg of this natural resin mixed with a little of this and a little of that provides the platonic standard for face peeling?

Should we start calling it what it is—the croton peel?

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REFERENCES

Erratum

The article “An Examination of the Phenol–Croton Oil Peel: Part II. The Lay Peelers and Their Croton Oil Formulas,” by Gregory P. Hetter, M.D., M.S., in the January 2000 issue of Plastic and Reconstructive Surgery®, contained an error. The simplified Gradé formula in Table VII, page 247, was printed without the olive oil in the original Gradé formula. The olive oil is ¼ the amount of the croton oil. In the simplified formula, there is only 1 drop of croton oil. Thus, ¼ drop of olive oil is necessary. To accomplish this, add 1 drop of olive oil to 1 ml of phenol USP 88%, mix well, and draw up 0.25 ml of this mixture in a syringe and then draw up phenol USP 88% to the prescribed 9.5 ml of phenol needed for the formula. In this manner you will add the needed ¼ drop of olive oil.