A Split-Face Comparison Study of Pulsed 532-nm KTP Laser and 595-nm Pulsed Dye Laser in the Treatment of Facial Telangiectasias and Diffuse Telangiectatic Facial Erythema

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BACKGROUND AND OBJECTIVES Pulsed 595 nm and 532 nm lasers can effectively diminish or eliminate facial telangiectasia. We performed a split-face, single-blind, controlled, comparison study in an effort to determine their individual and comparative efficacy.

STUDY DESIGN/MATERIALS AND METHODS Fifteen patients were treated using a 595-nm PDL on one side of the face and a pulsed 532-nm potassium-titanyl-phosphate (KTP) laser on the other. Each subject was evaluated at 3 weeks after three treatments.

RESULTS Both devices improved telangiectasia. The 532-nm device, however, was at least as effective or more effective than the 595-nm laser in all subjects. On average, the KTP laser achieved 62% clearing after the first treatment and 85% clearing 3 weeks after the third treatment, compared to 49% and 75% for the PDL, respectively. Seventy-nine percent of KTP laser-treated patients continued to have swelling for greater than 1 day versus 71% of PDL-treated patients. Of those patients who noted persistent erythema for at least 1 day after treatment, 58% noted more erythema on the KTP laser-treated side compared to 8% on the PDL-treated side.

CONCLUSIONS Both the 595-nm and the 532-nm pulsed lasers are highly effective in the treatment of facial telangiectasia and redness. The 532-nm KTP laser appears to be more effective but causes more swelling and erythema.

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A variety of different pulsed laser and light sources have been developed that effectively treat facial redness and telangiectasia.[1,2] Photoaging-induced and rosacea-associated facial redness and telangiectasias do not respond to topical or systemic medications. Although electrocoagulation can be used for focal or individual vessels, this is an impractical option for extensive vessels seen in telangiectatic photodamage and in patients with rosacea or diffuse facial redness.

The three most effective laser and light devices for treatment of extensive facial telangiectasias and telangiectatic erythema are the pulsed dye laser (PDL), the high-energy 532-nm pulsed potassium-titanyl-phosphate (KTP) laser, and a variety of intense pulsed light sources. The availability of longer millisecond domain pulsed PDL technology since 2000 (Candela, Wayland, MA; Cynosure, Chelmsford, MA) has limited the need for the induction of purpura in the treatment of vascular lesions with the PDL. Utilizing stacked pulses and multiple passes with the 10-ms 595-nm PDL at subpurpuric settings has been considered by many to be the best parameters for diffuse facial telangiectasias.[3–6] With improved epidermal sparing from contact cooling, increased spot size, and increased

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fluence, however, the pulsed 532-nm KTP laser (Gemini, Laserscope, Santa Clara, CA) has recently been reported to be highly effective in the treatment of vascular lesions including facial telangiectasia and facial redness.[1,7] Recent studies have demonstrated excellent comparative results between the high-powered, large-spot KTP and an intense pulsed light after a single treatment for these common conditions.[8] Neither controlled nor comparative studies, however, have been performed to compare the effectiveness of a series of treatments with the PDL and the KTP. The purpose of this study was to compare the efficacy and patient acceptance of subpurpuric PDL and the pulsed KTP laser in the treatment of facial telangiectasias and redness.

Materials and Methods

This was a randomized split-face institutional review board–approved study. Informed consent was obtained from 15 subjects who were selected based on the presence of significant diffuse facial telangiectasias due to photoaging or rosacea. Exclusion criteria included systemic etiologies for persistent facial erythema, a history of prior laser- or light-based procedures, and current use of topical or systemic antirosacea or antiacne therapy. The study protocol conformed to the guidelines of the 1975 Declaration of Helsinki.

We performed a randomized, single-blind, split-face study in which one side of the face was treated with the 532-nm KTP laser (Gemini, Laserscope) and the other treated with the 595-nm flashlamp-pumped, long-pulsed PDL (V-Beam, Candela). Randomization was achieved by determining the treatment side for each laser for each subject number before assigning any subject with a subject number. Each subject was treated on the corresponding side of the face with the same laser every 3 weeks for a total of three treatments.

Global improvement measured as the percent resolution of baseline diffuse telangiectasia was independently evaluated by a nontreating blinded investigator. The subjects were asked to select the side which showed greater improvement, which treatment was least uncomfortable, and degree and amount of posttreatment side effects including redness, swelling, and crusting. These assessments were made before each treatment and 3 weeks after the third and final treatment.

Before all treatments, all makeup was removed and the volunteer's face was gently cleansed with an alcohol wipe. The PDL settings were a 10-mm spot, a fluence of 7.5 J/cm^2, a 10-ms pulse width, and dynamic cooling settings of 30-ms spray and a 20-ms delay before the laser pulse. The entire affected area of the face was treated with a minimum of one full pass with a goal of at least 13% overlap of pulses to insure that no areas of the surface of the skin were left untreated.[9] Stacked pulses (up to 4) at 1.0 Hz were performed on all pronounced ectatic individual vessels. In addition, areas of pronounced telangiectatic erythema were treated with up to two passes.

A water-soluble refractive gel (Aquasonic Clear, Parker Laboratory, Fairfield, NJ) was applied before each KTP laser treatment. The most prominent individual telangiectasias were first treated with the 5-mm spot at 8 to 11 J/cm^2 and pulse widths of 18 to 20 ms. Using the 10 mm spot handpiece, a single pass was then performed over the entire affected area at fluences ranging from 7 to 10 J/cm^2 and 20- to 25-ms pulse duration with 5% to 10% overlap. Owing to the greater hemoglobin and melanin absorption of 532 nm and the less aggressive form of cooling (sapphire contact cooling) utilized by the Gemini laser, pulse stacking was strictly avoided to optimize epidermal sparing. The majority of subjects were treated with 10 J/cm^2 at 18 ms and 9 J/cm^2 at 23 ms with the 5- and 10-mm spot sizes, respectively.

Treatment volunteers were randomly assigned by alternating from one subject to the next to receive either a 3-day taper of oral prednisone (30 mg the day of treatment, 20 mg the next day, and 10 mg the third day) or ice packs applied for 20 minutes immediately after treatment and for 20 minutes every 2 hours for the next 4 hours. Forty-seven percent of the subjects received the prednisone taper and 53% received the ice-pack regimen. The subjects maintained diaries documenting postoperative edema, redness, and crusting.

Results

There were seven female and eight male subjects and the mean age was 52.4 years (range, 35–70 years). One patient was Fitzpatrick skin type IV, two were type III, six were type II, and six were type I. Fourteen subjects completed the study; one subject (skin type I) was lost to follow-up after the second treatment.

For each PDL treatment, a mean of 1,843 J (315 pulses) was delivered per half-face treatment. The mean total number of Joules delivered per half face treatment with the KTP laser was 1,197 J.

The blinded mean improvements of individual telangiectasias and telangiectatic erythema on the KTP laser treated side were 62, 76, and 85% 3 weeks after the first, second, and third treatments, respectively. The PDL produced 49, 67, and 75% at the same follow-up intervals (Figure 1). Thirteen of 14 (93%) subjects were able to discern a difference between the two treatment sides. All found that the KTP laser-treated side had cleared more overall redness than the PDL treated side after every treatment. Upon completion of the study, all 13 subjects that had noted a difference between sides rated the KTP laser-treated side as the overall preferred laser in terms of effect, downtime, and treatment experience.

All 14 subjects who completed the study experienced bilateral transient facial swelling and diffuse erythema immediately after treatment. Seventy-nine percent of the KTP-treated sides continued to have swelling 1 day after treatment compared to 71% of the PDL-treated sides (Figure 2). The majority of the swelling on both sides resolved within 4 days with complete resolution of swelling on both sides by Posttreatment Day 7, according to the subjects. After the first treatment, although 86% of patients reported at least 24 hours of continued bilateral transient posttreatment erythema, 7 subjects (58% of those reporting persistent erythema) noted a greater degree of erythema on the KTP laser-treated side. Only 1 patient (8%) noted more erythema on the PDL-treated side. Erythema resolved completely within 5 days. There was no reported difference in the duration of edema or erythema between those who used oral prednisone and those who used ice-pack cooling. Five subjects considered the PDL treatments more painful and three reported more

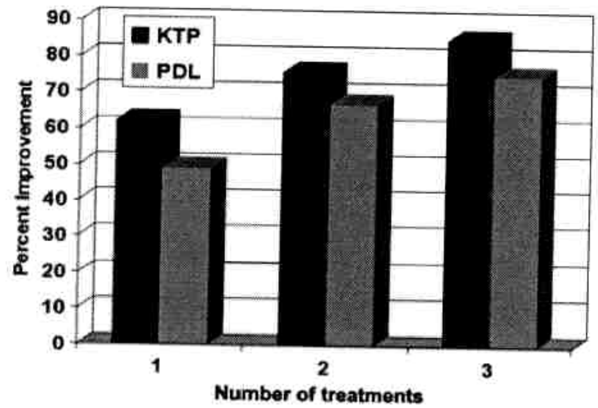

Figure 1. Comparative percent improvements. The mean percent improvement (blinded) of individual telangiectasias and telangiectatic erythema on the KTP laser (black)-treated side compared to the PDL (gray)-treated side (Treatment 1, 3 weeks after the first treatment; Treatment 2, 3 weeks after the second treatment; Treatment 3, 3 weeks after the third and final treatment.)

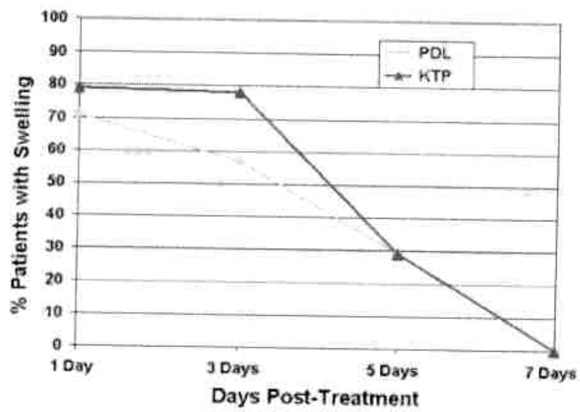

Figure 2. Posttreatment transient facial swelling. A greater number of patients reported swelling on the KTP laser-treated side than on the PDL-treated side. All facial swelling resolved within 7 days after treatment.

pain with the KTP laser treatments. The remaining six felt no difference between the two sides. Of the 42 total treatments, 9% of PDL treatments resulted in focal transient purpura. The KTP laser treatments produced no purpura. One patient had crusting of the chin overlying prominent vessels on the PDL side after the second treatment (Figure 8B). The wound healed without textural irregularity or dyschromia. No other adverse events occurred.

Discussion

The flashlamp-pumped PDL was originally used for treating facial vasculature at 577-nm with short pulse widths.[10] With its transition to longer wavelengths of 585 and 595 nm and larger spot sizes in the late 1980s,[11] and the development of the dynamic cooling device in the late 1990s,[12,13] the predictability of results and patient tolerance improved and fewer adverse effects were seen. As a result, the PDL has been the gold standard for the treatment of unwanted superficial facial vessels for over a decade.[4,14,15] In 2000, longer-pulse-duration PDLs were developed. For the first time purpura-free, high-energy treatments were available. In 2003, the effectiveness of stacking longer PDL pulses for facial telangiectasias was demonstrated. Compared to single subpurpuric pulses, this technique increased facial telangiectasia clearance and was only associated with an increased level of posttreatment facial transient swelling.[5]

Other millisecond-domain pulsed-light devices have emerged as safe and viable options for reducing superficial facial telangiectasias including intense pulsed light sources and pulsed high-energy green light lasers.[1,16] In the past few years, technologic advances in millisecond-pulsed KTP lasers have included improved integrated contact cooling, larger spot sizes, and greater fluence, all of which increase safety and efficacy. The 532-nm wavelength lasers have a slightly higher coefficient of absorption for melanin than the 595-nm PDL but an even greater coefficient of absorption for oxyhemoglobin. Therefore, there is a lower theoretical risk of producing epidermal damage at 532 nm because the ratio of the fluence for efficacy to the fluence for epidermal damage is greater with the KTP laser.[1,17] Furthermore, this laser rarely induces purpura due to a smoother macropulse profile of the Gemini KTP compared to the four stacked microsecond pulses within each pulse of the V-beam PDL.

In contrast, the contact cooling utilized with the Gemini laser, although recently improved with a circulating water coolant device, is less aggressive than the Dynamic Cooling Device cooling of the PDL. Compared to the V-beam, the contact cooling allows for better targeting of epidermal melanocytic targets but results in greater risk to the epidermis when overwhelmed with stacked pulses. For this reason we avoided overlapping pulses to further eliminate the risk of complications. It could be argued, however, that as a result of dermal scatter the 532-nm pulses should have been overlapped to achieve optimal efficacy and was therefore compromised. By using nonoverlapped pulses with the KTP laser, a minimum of 27% of the surface of the face was left untreated due to the circular shape of the beam.[8] This percentage of nontreated area increases even further as the beam penetrates the skin due to the effects of dermal scatter. This was the main reason for addressing the most prominent individual telangiectasias on the KTP-treated side with the 5-mm spot first.

In this study we compared 1-Hz stacked 10-ms PDL treatments to single long-pulsed KTP laser treatments of facial telangiectasia and telangiectatic erythema. The KTP laser was found to be more effective than the PDL for both individual telangiectasia and telangiectatic erythema after each treatment. After the first treatment, the blinded assessor measured differences in clearing on the KTP laser-treated side averaging 13% greater compared to the PDL-treated side. At the final follow-up, 3 weeks after the third treatment, both the KTP and the PDL had achieved excellent results, 85 and 75%, respectively (Figures 3–5). At each follow-up, however, the KTP laser showed a greater clearance level

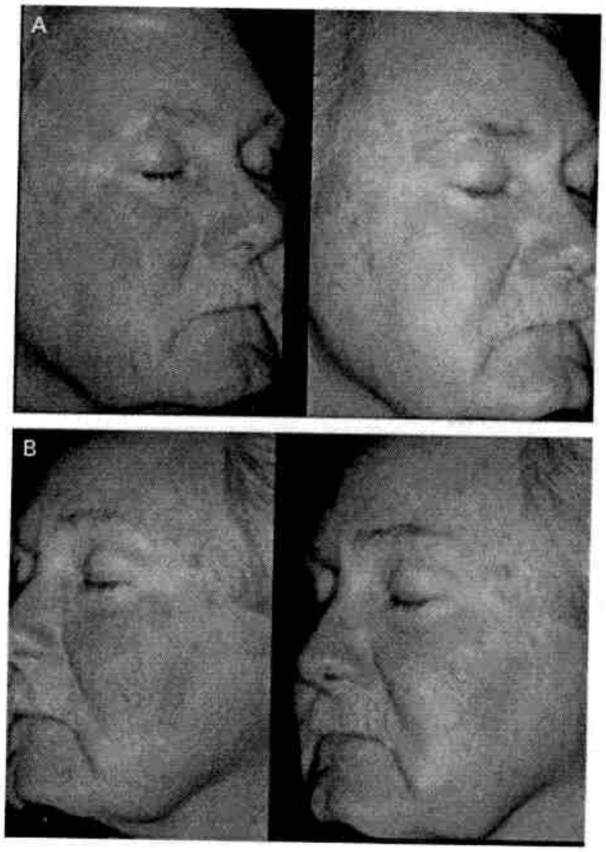

Figure 3. (A) Before treatment (left) and after three treatments (right) with the KTP laser. Note the greater improvement in both diffuse telangiectatic erythema and individual telangiectasias compared to the pulse dye laser (PDL)-treated side (B).

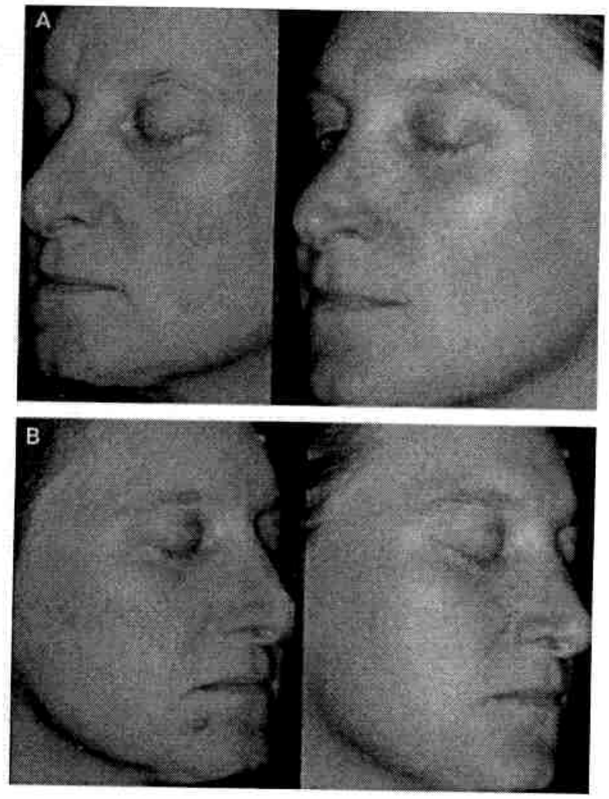

Figure 4. (A) Before treatment (left) and after three treatments (right) with the KTP. Note the greater improvement in both diffuse telangiectatic erythema and individual telangiectasias compared to the PDL-treated side (B).

that was appreciated by the blinded assessor in all subjects and by 93% of the subjects themselves even after a single treatment (Figure 6). Furthermore, the PDL required three treatments to achieve the level of clearance (75%) that the KTP had achieved after only two (76%; see Figure 1).

Side effects including discomfort during treatment, and redness and swelling after treatment were frequent, expected, and well tolerated. Forty-three percent noted no difference in the discomfort of treatment between the two sides. Of those who did note a difference in pain between the two devices, 63% found the PDL-treated side more painful. All 35% of subjects noting a difference in swelling from one side to the other described a greater degree of swelling on the KTP laser-treated side. There was, however, no difference in the mean duration of edema between the different laser treatments, which may be related to the aggressive posttreatment edema countermeasures used in this study of bulk ice cooling or oral prednisone. Bulk cooling with ice limited swelling as effective as systemic glucocorticoids.

Based on the study by Rohrer and coworkers,[5] multiple passes and stacked pulsing of the PDL were used on each patient in an attempt to optimize its effectiveness and to ensure unbiased and reproducible results. Up to 4 pulses were stacked at 1 Hz over the most pronounced individual ectatic vessels with the end point being spasm of the vessel. Crusting

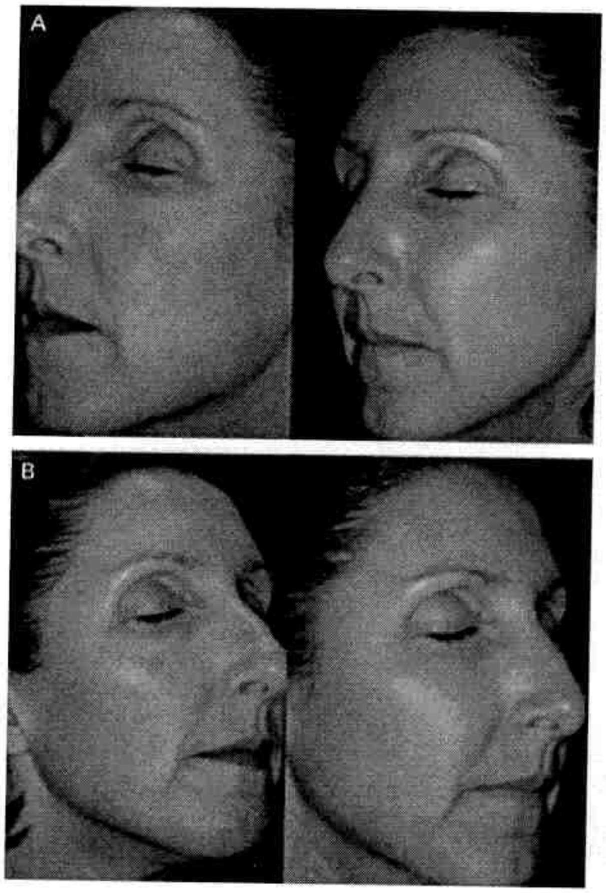

Figure 5. (A) Before treatment (left) and after three treatments (right) with the KTP. Note the greater improvement in both diffuse telangiectatic erythema and individual telangiectasias compared to the PDL-treated side (B).

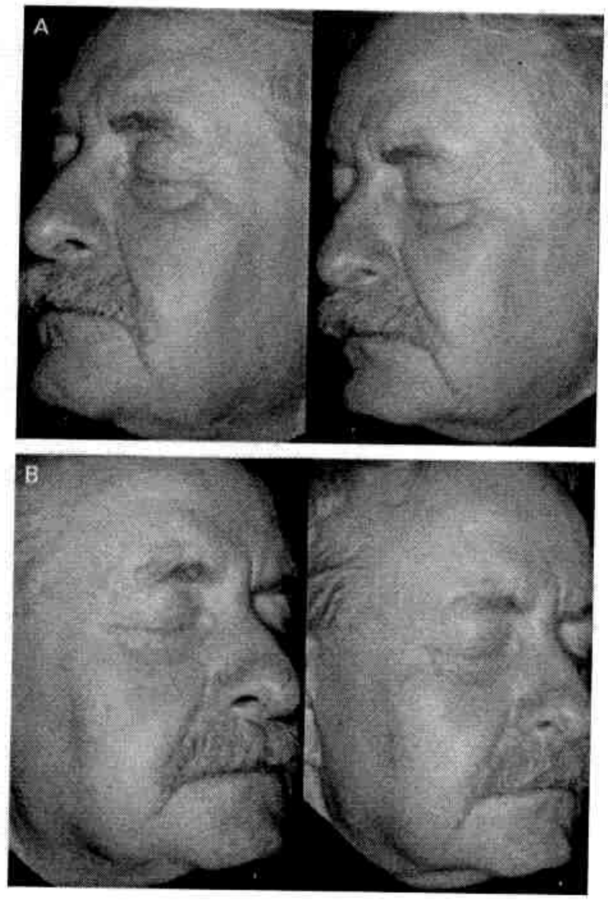

Figure 6. (A) Before treatment (left) and 3 weeks after (right) a single treatment. The improvement is greater on the KTP laser side (A) compared to the PDL-treated side (B).

occurred after one PDL treatment. Nine percent of treatments induced purpura; all were associated with PDL treatments.

The added effect of the less aggressive cooling of the KTP laser to allow targeting of lentigines was not a focus of the study. After the first treatment, however, three subjects spontaneously requested treatment of their "brown spots" on the PDL-treated side of the face after noting the improvement of the lentigines on the KTP laser-treated side. This unilateral benefit was clearly observed (Figures 7 and 8) and suggests that the KTP laser with sapphire contact cooling may have an even stronger role in overall photorejuvenation.

Conclusions

This study demonstrates that both the 595-nm and the 532-nm pulsed lasers are highly effective in the treatment of facial telangiectasia and redness. The high-power pulsed KTP laser appears to be more effective than the subpurpuric multiple-pass and stacked-pulse PDL treatment for the reduction of facial telangiectasias. Although posttreatment edema is more common with the KTP laser treatment, it appears that with proper posttreatment care, the effectiveness of the KTP laser treatment outweighs the risk. Finally, our data suggest that aggressive posttreatment bulk cooling may be as effective at preventing excessive edema and erythema as oral

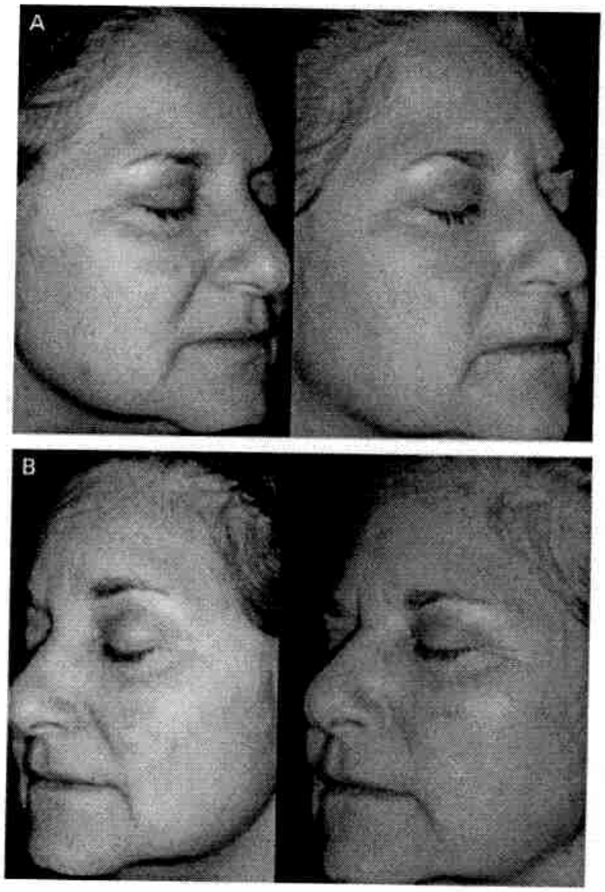

Figure 7. (A) Before treatment (left) and after three treatments (right) with the KTP. Note the improvement of facial lentigines compared to the PDL-treated side (B).

corticosteroids, thus further reducing potential side effects.

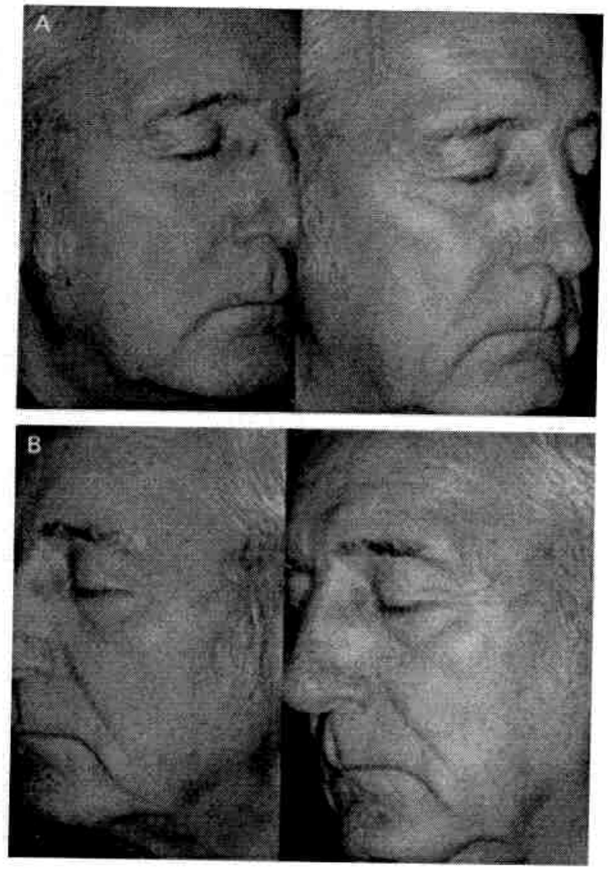

Figure 8. (A) Before treatment (left) and after three treatments (right) with the KTP. Note the greater improvement in both diffuse telangiectatic erythema and individual telangiectases compared to the PDL-treated side (B). The improvement in lentigines is impressive on the KTP side only. (B) Before treatment (left) and after three treatments (right) with the PDL. Small erosion and crusting occurred over a group of prominent vessels on the chin. This healed without textural or pigmentary irregularity.

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