Treatment of Syringoma Using an Ablative 10,600-nm Carbon Dioxide Fractional Laser: A Prospective Analysis of 35 Patients

SUNG BIN CHO, MD, † HEE JUNG KIM, MD, ‡ SEONGMIN NOH, MD, * SANG JU LEE, MD, PhD, ‡ YOUNG KOO KIM, MD, † AND JU HEE LEE, MD, PhD *

BACKGROUND Treatment of syringoma aims to destroy the dermal tumor using methods that can include surgical excision, electrodesiccation, cryosurgery, chemical peeling, and laser ablation, but complete removal of syringomas is often unsuccessful, and recurrence occurs frequently.

OBJECTIVE To investigate the therapeutic efficacy of an ablative 10,600-nm carbon dioxide fractional laser system (CO2 FS) for the treatment of periorbital syringomas.

METHODS Thirty-five patients with periorbital syringomas were treated with two sessions of CO2 FS at 1-month intervals. Laser fluences were delivered in two or three passes over the lower eyelids, using a pulse energy of 100 mJ and a density of 100 spots/cm². Clinical improvement was assessed by comparing pre- and post-treatment clinical photographs and patient satisfaction rates. We examined the histological features of human periorbital syringomas treated with CO2 FS.

RESULTS Evaluation of clinical results 2 months after treatment showed that 15 of the 35 patients (42.9%) demonstrated marked (51-75%) clinical improvement, 12 (34.3%) had moderate (26-50%) clinical improvement, five (14.3%) showed minimal (0-25%) improvement, and three (8.6%) showed near total (≥75%) improvement.

Clinical improvement scores were less 4 months after the second CO2 FS treatment (not statistically significant). The mean maximal depth of the necrotic column was 1,236.3 μm. A specimen obtained from the infraorbital area immediately after treatment showed formation of necrotic columns on the interfollicular skin.

CONCLUSION The use of CO2 FS can have a positive therapeutic effect on periorbital syringomas.

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Syringomas are common benign skin tumors of eccrine origin that mainly appear in the periorbital areas.1 Treatment of syringomas aims to destroy the dermal tumor using methods that can include surgical excision, electrodesiccation, cryosurgery, chemical peeling, and laser ablation.1–4 Local application of topical atropine or tretinoin or temporary tattooing before neodymium-doped yttrium aluminum garnet (Nd:YAG) or alexandrite laser therapy are alternative methods,2,5 but complete removal is often unsuccessful, and recurrence occurs frequently, with syringomas appearing as multiple papules deeply embedded within the dermis.1–4

An effective and safe ablative 10,600-nm carbon dioxide fractional laser system (CO2 FS) has been developed that uses fractional laser technology to maximize the effect of ablative laser therapies and to minimize side effects.6,7 In this report, we analyzed 35 patients with multiple syringomas treated with two sessions of CO2 FS at 1-month intervals. We examined the histological features of periorbital syringomas in mini-pigs and humans treated with CO2 FS analyzed immediately after laser treatment.

Methods

Patients

The Institutional Review Board of Severance Hospital, Yonsei University College of Medicine, Seoul, Korea, approved this prospective study. After obtaining informed consent, we treated the multiple

*Department of Dermatology and Cutaneous Biology Research Institute, College of Medicine, Yonsei University, Seoul, Korea; †Department of Dermatology, Kangbuk Samsung Hospital, School of Medicine, Sungkyunkwan University, Seoul, Korea; ‡Yonsei Star Skin and Laser Clinic, Seoul, Korea

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syringomas of 35 patients (34 women and 1 man; mean age 41, range 22-60; Fitzpatrick skin type: IV) with two sessions of CO₂ FS. Patients were excluded if they had undergone treatment within the previous 6 months, including the use of topical atropine or tretinoin, temporary tattooing before Nd:YAG or alexandrite laser therapy, surgical excision, electrodessication, cryosurgery, chemical peeling, or laser ablation. Patients were also excluded if they had used systemic isotretinoin within the previous 6 months, had a propensity for keloids, or were pregnant or immunosuppressed.

**Laser Treatment**

All patients were treated with two sessions of CO₂ FS using a Mosaic eCO₂ laser (Lutronic Corporation, Goyang, Korea) at 1-month intervals. A topical eutectic mixture of 2.5% lidocaine hydrochloride acid and 2.5% prilocaine (AstraZeneca AB, Södertälje, Sweden) was used as a local anesthetic, applied to the lesions under occlusion 1 hour before laser treatment. Metallic eyeshields for ocular protection were used in the treatment of syringomas located near the ocular structures. Laser fluences were delivered to the entire lower eyelids with a pulse energy of 100 mJ and a density of 100 spots/cm² (coverage of 8.6%). Depending on the severity of the lesions, two or three passes (giving coverage of 17.2% and 25.8%, respectively) were performed in static operating mode over the affected area. Immediately after laser treatment, the postoperative wounds were managed with a cold pack for 10 to 20 minutes. Some patients who developed prominent periorbital edema immediately after the laser treatment were prescribed 10 mg oral prednisolone for 3 days to prevent inflammatory reactions and to reduce periorbital edema.

Patients were instructed to apply 3% ofloxacin ointment (Ocuflox, Sam Il Pharm, Seoul, Korea) twice daily until the crusts peeled off and to use a moisturizer several times daily for several days after each treatment session to promote wound healing and prevent dryness. Patients were advised to avoid overexposure to sunlight and to use a broad-spectrum sunscreen (Anthelios XL, La Roche-Posay, Paris) after the post-therapy crusting subsided. Patients were instructed to avoid the use of any bleaching or antiwrinkle agents during the course of the treatment.

**Objective and Subjective Evaluations**

Digital photographs of each patient were obtained, all with the same camera settings, patient positioning, and room lighting. Photographs were taken at baseline and 2 and 4 months after the last treatment. Two dermatologists blinded to the treatments performed objective clinical assessments of the syringomas. They compared the before and after photos in nonchronological order, using a global improvement scale (grade 0, worsened; grade 1, 0-25%, minimal improvement or steady state; grade 2, 26-50%, moderate improvement; grade 3, 51-75%, marked improvement; and grade 4, >75%, near total improvement).

Patients were asked to rate their overall satisfaction level with the treatment 2 and 4 months after completion as very satisfied, satisfied, slightly satisfied, or unsatisfied. Patients were also asked to report any treatment side effects, including bleeding, oozing, post-therapy dyschromia, scaling or crusting, erythema, and lesion aggravation. Pain scores associated with the CO₂ FS therapy were evaluated using 10-cm visual analog scales (VAS), with 0 being no pain and 10 being extremely painful.

**Histological Evaluation**

Of the 35 patients, 11 had a skin biopsy before CO₂ FS treatment to confirm the clinical diagnosis and to determine the depth and diameter of the syringoma lesion. Because the lesion cannot be histologically compared under identical conditions before and after treatment, we performed an additional biopsy in one participant and a mini-pig immediately after the first of two passes in static operating mode with the laser at 100 mJ of pulse energy and 100-spot/cm² spot density. This tissue was used to assess the
histological effects of the laser on periorbital syringomas and to measure the mean penetration depth of the CO\textsubscript{2} FS.

**Statistical Analysis**

We compared clinical assessment scores and overall patient satisfaction levels 2 and 4 months after the last CO\textsubscript{2} FS treatment using the nonparametric Wilcoxon signed-rank test with SPSS version 18.0 (SPSS, Inc., Chicago, IL). Differences were considered statistically significant when \( p < .05 \).

**Results**

Clinical results 2 months after treatment showed that 15 of the 35 patients (42.9\%) demonstrated grade 3 clinical improvement (Figures 1 and 2), 12 (34.3\%) grade 2 clinical improvement, five (14.3\%) grade 1 improvement, and three (8.6\%) grade 4 improvement (Figure 3). The mean clinical improvement score was 2.5 \( \pm \) 0.9 (Figure 4). Surveys for overall patient satisfaction 2 months after treatment showed that 13 of the 35 patients (34.1\%) were satisfied (Figure 5), 10 (28.6\%) were slightly satisfied, seven (20\%) were very satisfied, and five (14.3\%) were unsatisfied. The overall patient satisfaction rate was correlated with objective clinical assessment score. In addition, 15 of 23 patients (65.2\%) with notable periorbital wrinkles presented marked clinical improvements in facial texture and wrinkles after treatment with CO\textsubscript{2} FS (Figures 1 and 3).

Clinical results 4 months after treatment showed that 15 of the 35 patients (45.9\%) had grade 2 clinical improvement, 13 (37.1\%) grade 3 clinical improvement (Figures 1-3), five (14.3\%) grade 1 improvement, and two (5.7\%) grade 4 improvement (Figure 3). The mean clinical improvement score had decreased to 2.4 \( \pm \) 0.8 (Figure 4), but clinical improvement scores 2 and 4 months after the last CO\textsubscript{2} FS treatment were not significantly different \((p = .16)\). Surveys for overall patient satisfaction 4 months after treatment revealed that 13 of the 35 patients (34.1\%) were satisfied (Figure 5), 10 (28.6\%) were slightly satisfied, six (17.1\%) were very satisfied, and six (17.1\%) were unsatisfied. The overall satisfaction levels 2 and 4 months after the last CO\textsubscript{2} FS treatment were not significantly different \((p = .08)\).

Most of the patients tolerated the CO\textsubscript{2} FS therapy well, and the mean VAS score for pain was 4.1 \( \pm \) 2.0. The mean duration of erythema was 16.6 \( \pm \) 6.4 days, and post-therapy crusting and scaling persisted for a mean of 5.8 \( \pm \) 1.8 days. Nine patients (25.7\%) complained of an itching sensation after the treatment, although application of topical antibiotic ointment relieved it. Five patients (14.3\%) had post-treatment hyperpigmentation, which spontaneously improved within 2 months. Other possible adverse events, including scarring, hypopigmentation, secondary bacterial infection, post-therapy blister formation, and viral infection, were not encountered.

**Figure 1.** Case 10. Syringoma of a 52-year-old Korean woman before (A) and 2 (B) and 4 (C) months after two sessions of ablative 10,600-nm carbon dioxide fractional laser treatment. The clinical improvement of the syringoma was grade 3 at 2 months and grade 3 at 4 months.
The histological analyses of 11 specimens before laser treatment demonstrated that the mean depth of the syringoma lesions was $1.06 \pm 0.34$ mm (range 0.6-1.6 mm). The mean maximal depth of the necrotic column was $1,236.3 \mu$m at a 100-mJ pulse energy. A specimen obtained from the infraorbital area immediately after treatment showed formation of necrotic columns on the interfollicular skin, but serial section of the specimen demonstrated remaining duct-like structures of a syringoma around the necrotic columns (Figure 6).

Discussion

CO$_2$ laser therapy is the primary choice for syringoma removal, having a relatively high success rate.$^3$ Rather than ablating the lesion surface with a CO$_2$ laser, which is difficult for deeply imbedded lesions, syringomas can also be treated with pinhole and multiple-drilling methods. In the pinhole method, single holes are created for small discrete syringoma lesions, and multiple small holes at intervals of 1 to 3 mm, similar in arrangement to sweat pores, are created for plaque-type lesions. A CO$_2$ laser that penetrates from the epidermis to the deeper dermis is used,$^3,4,8,9$ but when applied too closely to the target lesions, this can cause side effects, including delayed wound healing, ulceration of the treated area, postinflammatory hyperpigmentation, and scarring. Moreover, when a large area or numerous syringoma lesions need treatment, pinhole and multiple-drilling methods require longer procedure time.
A previous report on two Asian women with a syringoma described the clinical efficacy of a non-ablative 1,550-nm diode-pumped erbium fiber laser, using a Fraxel SR laser (Reliant Technologies, Mountain View, CA). The patients underwent two to three sessions of laser treatment with a pulse energy of 10 to 13 mJ and a density of 125 microscopic thermal zones (MTZ)/cm², reaching a final density of 2,000 MTZ/cm². The depth of coagulation was 95 µm with a pulse energy of 8 mJ and 727 µm with 20 mJ of pulse energy. A nonablative 1,550-nm fractional photothermolysis system usually requires several treatment sessions to obtain a satisfactory clinical response.

A previous histopathological study reviewed 80 skin biopsy specimens of 45 Korean patients and found that the mean depth of the syringoma lesions was 0.70 ± 0.20 mm (range 0.4-1.2 mm). In the present study, the mean depth of the syringoma lesions was 1.06 ± 0.34 mm (range 0.6-1.6 mm). We delivered laser fluences to the lower eyelids in static operating mode, with a pulse energy of 100 mJ and a density of 100 spots/cm², in two or three passes, depending on the severity of the lesion. According to the histological measurements performed on the mini-pig, the estimated maximal ablation depth was approximately 1,236.3 µm at 100 mJ. We aimed to treat benign dermal tumors, which can be deeply embedded within the dermis. Histopathological evaluation performed immediately after laser treatment showed that the penetration depth of the laser setting seemed to be appropriate, but CO₂ FS with a density of 200 to 300 spots/cm² (coverages of 17.2% to 25.8%) could not treat entire large syringoma lesions. Moreover, the mean clinical improvement score was less than 2 and 4 months after the two sessions of CO₂ FS treatment, although the differences were not statistically significant. Therefore, CO₂ FS may require repeated treatments to completely remove multiple and deeply embedded syringoma lesions. Nonetheless, two sessions of CO₂ FS treatment resulted in grade 3 or grade 4 clinical improvement.
responses in more than 50% of the patients in our study.

CO2 FS provides immediate tissue tightening and induces more collagen stimulation than do non-ablative fractional photothermolysis systems. CO2 laser resurfacing results in sufficient inflammation to eliminate fragmented collagenous matrix and thereby promotes neocollagen synthesis. Nonablative laser therapies may also induce dermal extracellular matrix remodeling although not as effectively as does CO2 laser resurfacing. Because CO2 FS can induce regeneration and realignment of collagen bundles and surrounding fibrous tissues of the syringomas, similar to the pinhole and multiple-drilling methods, improvements in dermal thickness, wrinkles, and texture on the elevated surface of the syringomas are of additional benefit, as presented in our study. Puncturing the targeted lesions with CO2 FS is convenient, offering shorter procedure time, resulting in less post-treatment bleeding, oozing, and producing shorter recoveries. Therefore, fractional photothermolysis is considered to be an effective, safe, and convenient treatment modality for multiple syringomas on the periorbital areas, although our histological evaluation revealed that not all syringoma lesions can be removed with CO2 FS.

In conclusion, we suggest that the use of CO2 FS therapy may provide a new treatment modality for some Asian patients with multiple syringomas on the periorbital areas, although optimized, prospective studies should be conducted to confirm these findings.

References


Address correspondence and reprint requests to: Ju Hee Lee, MD, PhD, Department of Dermatology and Cutaneous Biology Research Institute, Yonsei University College of Medicine, 250 Seongsan-no, Seodaemun-gu, Seoul 120-752, Korea, or e-mail: juhee@yuhs.ac