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Case Report

Aesthetic removal of large melanocytic nevi using CO_2 lasers with a programmed 4-step approach

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Abstract: Laser therapy provides an excellent cosmetic outcome for melanocytic nevi smaller than 3 mm in diameter, while surgical removal is recommended for larger ones, especially, those needing pathological examination. The authors have designed a programmed, 4-step approach of using CO_2 lasers to aesthetically remove large melanocytic nevi having a diameter of 3-7 mm. Fifty-six cases were treated by CO_2 lasers using a programmed, 4-step excision technique. First, a sufficient dose of anesthetic was injected subcutaneously. Second, the skin was cut along the periphery of the nevus. Third, the nevus was excised along the lower surface using a "laser scalpel". Last, the base of the wound was vaporized with several passes. Forty-eight patients completed the follow-up time of 3-12 months. The wound closed in 7-10 days, and most of the scars with hyperpigmentation became imperceptible in 3 months; most of the cases had excellent results. Compared with surgical removal of large, 3-7 mm nevi, our method of using CO_2 lasers with a programmed, 4-step approach has proven to be a simple and satisfactory alternative, offering a low recurrence rate and good cosmetic appearance.

Keywords: Melanocytic nevi, carbon dioxide, lasers

Introduction

Lasers have long been used in treating benign skin lesions [1]. Ablative laser devices are mainly used for superficial ablation of tissue without damage to the surrounding structures. The ablation depth of the laser depends on wavelength, fluence rate, and spot size. One of the most common treatments for ablating of skin lesions is CO_2 laser use, because of little bleeding and ease of performance [2]. At a wavelength of 10,600 nm, the energy is mainly absorbed by the extracellular fluid of biologic structures, leading to nonspecific vaporization and coagulation of tissue. Ultrapulsed CO_2 lasers emit short light pulses (600-900 ms) with high peak energies so that tissue can be ablated precisely, layer by layer [2, 3]. According to the fluence rate of the CO_2 lasers, its surgical effects can be divided mainly into cutting, vaporizing, and coagulating [4, 5].

From the cosmetic point of view, the melanocytic nevus smaller than 3 mm in diameter is a good indication for CO_2 lasers treatment. The deep ablation mode is usually used, immediately forming a fresh ulcer in the dermis. In most cases, the wound healing mechanism leads to granulation and reepithelialization of the lesion within 1-2 weeks. The final appearance is approximately flat compared with the adjacent normal skin [6]. When using CO_2 lasers, the clinician must distinguish the nevus from a malignant lesion by detailed observation and inquiry into the history, including the time of occurrence and growth of the lesion [7-9]. The lesions described in our study were all proven to be benign through postoperative histological examination.

However, if the lesion is larger than 3 mm, many clinicians prefer surgical resection to CO_2 laser therapy because the latter often results in the formation of a conspicuous dimple [6].

Considering that the post-surgical scar is generally larger than the melanocytic nevus itself, and also may result in structural deformi-

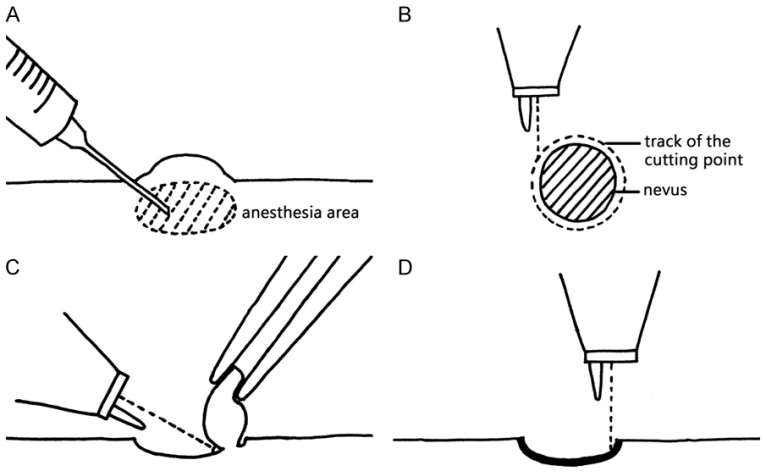

Figure 1. The programmed 4-step aesthetic resection technique. A. First step: a sufficient dose of anesthetic was injected beneath the nevus. B. Second step: the periphery of the nevus was outlined. C. Third step: the threadlike tissues connecting the nevus and the normal tissues were cut off using the laser as a scalpel till the whole nevus was excised. D. Fourth step: the base of the wound was vaporized with several passes, and the residual surface debris produced by the final pass was preserved.

ty, based on our clinical experience, we designed a 4-step, programmed CO_2 laser excision technique for treating 3-7 mm melanocytic nevi. We consider this technique to be a simple and acceptable alternative for complete removal of nevi, having a low recurrence rate and good cosmetic appearance.

Case reports

Cases

A total of 48 Chinese patients (including 21 males and 27 females) comprising 56 cases underwent the 4-step, programmed CO_2 laser excision between January 2011 and May 2016. The diagnosis was based upon the clinical characteristics and history of the lesion preoperatively and was histologically confirmed postoperatively. Patients were excluded if they (1) were pregnant or lactating; (2) had local infections, spotty ulceration, coagulopathy, photosensitivity, or keloid formation; or (3) were immunocompromised. All patients signed an informed consent prior to laser therapy. All therapy was performed by the same surgeon (WQT).

Case 1

A 45-year-old woman with Fitzpatrick skin type III had a melanocytic nevus below the left angulus oris measuring 7 mm in diameter (**Figure 2A**).

Two types of laser equipment were used separately in this technique. One was a Coherent Ultrapulse 5000C laser (Coherent Medical Corp, Palo Alto, CA) at 200-500 mJ/cm^2 with a 0.2-mm collimated handpiece (for the third step of our technique), at 100-300 mJ/cm^2 with a 1.0-mm collimated handpiece (for the second and fourth step), and a repetition rate of 10 Hz in the pulsed mode. The other instrument was a Alma Pixel CO2 laser (Alma Lasers, Caesarea, Israel) at 5-10 W with a 0.125-mm (F50) collimated handpiece (for the third step of our technique), at 5-15 W with a 1.0 to 4.0-mm collimated handpiece (for the second and fourth step), and a repetition rate of 5-10 Hz in the pulsed mode. Standard precautions for laser therapy were followed.

For the first step, a sufficient dose of infiltration anesthetic of 2% lidocaine (0.5-2 ml) was injected subcutaneously with a 23-gauge needle (**Figure 1A**). The anesthetic was prolonged until the skin of the surgical area was pale, firm and swollen (**Figure 2A**). Thus, the surrounding tissues, which absorbed an oversupply of anesthetic, would be distinctly stratified. This was helpful for surgeons to find the proper operation layer to make sure of complete removal.

For the second step, the nevus was outlined with the laser beam by cutting the skin to the estimated depth along its periphery (**Figures 1B**, **2B**).

For the third step, the nevus was drawn aside using a pair of ophthalmic-toothed forceps for a better approach to the base of the nevus (**Figure 1C**). The laser beam was used as a scalpel to cut off the threadlike tissues connecting the nevus and normal tissues. The anesthetic could be seen clearly at the base of the nevus, which indicated the proper layer (**Figure 2C**). The nevus was then excised till all the threadlike connective tissues had been removed, and the completely removed nevus would be sent for histological examination if necessary (**Figure 2D**).

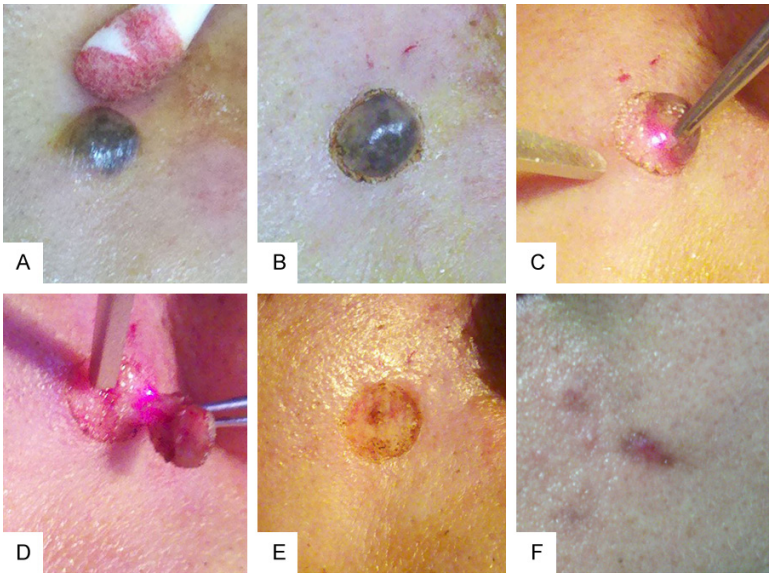

Figure 2. A nevus below the left angulus oris measuring 7 mm in diameter, in a 45-year-old woman with Fitzpatrick skin type III. A. The surgical area was pale, firm and swollen after a sufficient dose of anesthetic was injected. B. The nevus was outlined with a pulsed laser beam. C. The nevus was drawn aside to expose its base, then the threadlike tissues connecting the nevus and normal tissues were cut off by bit. Anesthetic could be seen at the bottom of the nevus. D. The nevus just prior to excision. A completely removed nevus was sent for histological examination if needed. E. The base of the wound was vaporized with several passes and the residual surface debris was preserved after the final pass. F. The scar was acceptable, and hyperpigmentation was noticed 1 month postoperatively in spite of the large postoperative wound. Postoperative pathologic examination confirmed the nevus to be benign.

For the fourth step, t he base of the wound was vaporized with several passes (usually 1 to 3) for hemostasis and shrinking the wound area. At this point, the residual surface debris should be wiped off with a saline-soaked swab to avoid "skip" areas after each pass. However, the debris produced by the final pass should be maintained to protect the wound (**Figures 1D**, **2E**).

A thin layer of recombinant human epidermal growth factor gel (Yifu, Huanuowei, Guilin, China) was applied to the wound immediately after the operation, with the instructions that it should be used twice a day simultaneously with oculentum aureomycin for 10-14 days. The patient was also instructed to protect the wound from water for 10-14 days. She was then allowed to wash the face gently and to apply sunblock. Direct sun exposure was not permitted for the duration of the evaluation period. All patients were encouraged to return for a visit any time a problem occurred.

The surrounding skin converged to close the wound, scabs forming in 7-10 days postoperatively. The scar was acceptable, and hyperpigmentation was noticed 1 month postoperatively in spite of the large wound (**Figure 2F**). Postoperative pathological examination confirmed the nevus to be benign. At the end of the third month, the hyperpigmented scar lost its color; its appearance was smooth and imperceptible. The result was excellent, and the patient was satisfied with the result.

Case 2

A 61-year-old man with Fitzpatrick skin type III had a 5-mm melanocytic nevus on the right upper eyelid (**Figure 3A**). The lesion was successfully removed using our new method of using CO_2 laser with a programmed, 4-step approach. The residual surface debris was preserved to protect the wound (**Figure 3B**). Postoperative pathological examination confirmed the nevus to be benign. The wound almost healed within a week (**Figure 3C**). It healed well and the result was excellent 1 month postoperatively (**Figure 3D**). The eyelashes grew back normally, and the scar could hardly be seen 3 months postoperatively (**Figure 3E**). The result 1 year later was similar to that of 3 months, when the skin attained its nearly final state (**Figure 3F**).

Discussion

The removal of various melanocytic nevi is a relatively frequent demand in daily clinical practice, and several treatment options have been reported including surgical resection [7, 10], cryotherapy [11], and laser resection [6, 8, 10]. In the treatment of nevi smaller than 3 mm, the final appearance is the most important consideration for patients, and the best state should be a flat surface equivalent to the surrounding skin. Surgical resection should be avoided from

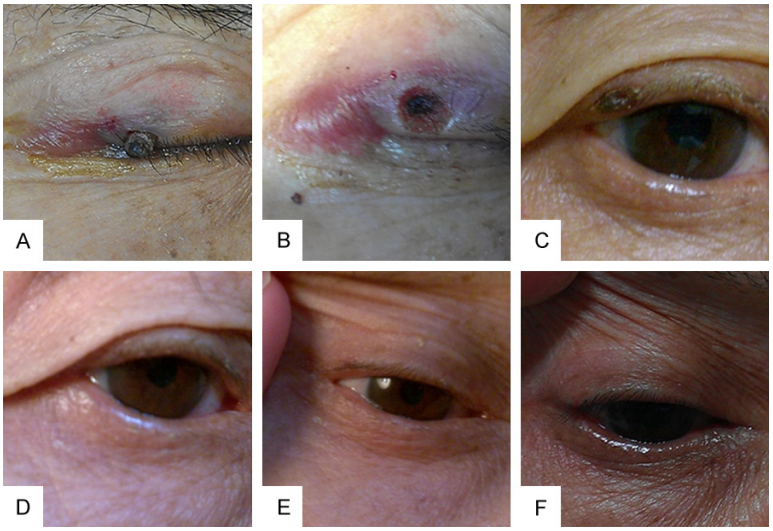

Figure 3. A 5-mm nevus on the right upper eyelid in a 61-year-old man with Fitzpatrick skin type III. (A) The lesion before excision. (B) After treatment. The residual surface debris was preserved to protect the wound. (C) The wound almost healed 1 week postoperatively. (D) The wound healed well and the result was excellent 1 month postoperatively. (E) The eyelashes grew back normally, and the scar could hardly be seen 3 months postoperatively. (F) One year postoperatively. There was no noticeable difference between (E and F). Postoperative histologic examination confirmed the nevus to be benign.

Table 1. Characteristics of 56 cases

Patient Characteristics	No.	%
Total lesions	56	100
Previous treatments		
Caustic substances	3	5.4
Cryotherapy	2	3.6
Surgery	2	3.6
Laser therapy	2	3.6
None	47	83.9
Localization		
Head	44	78.6
Torso	7	12.5
Upper extremity	3	5.4
Lower extremity	2	3.6
Mean diameter of lesions, mm	5.1 (range 3-7)	

a cosmetic standpoint if the surgical scar is to exceed the area of the primary nevus. For this reason, laser treatment is preferable, and the CO_2 laser is regarded as the best option cosmetically.

In excising small, benign skin lesions, the CO_2 laser has four advantages over the scalpel: (1) The wound is insusceptible to postoperative infection because there is no direct contact between the surgical site and the laser instrument. Moreover, the CO_2 lasers have been shown to sterilize contaminated or infected wounds [12-14]; (2) CO_2 laser surgery seals small nerve endings rather than leaving frayed endings as occurs in steel scalpel surgery. This may result in less postoperative pain. Small lymphatics are also sealed with the CO_2 laser, which reduces postoperative edema. Blood vessels of 0.5 mm or smaller in diameter are photocoagulated and sealed, resulting in a relatively bloodless surgical field [10, 15-17]. In conclusion, this technique has a distinct advantage for patients who have a bleeding diathesis such as hemophilia, severe anemia, and so on; (3) The CO_2 laser surgery can be accuracy-orientated. Damage to surrounding healthy tissue is minimized, and (4) The CO_2 laser surgery shortens treatment time, simplifies the operative process, and eliminates the suturing process.

However, when dealing with nevi larger than 3 mm, the limits of the previous CO_2 laser technique are obvious in that it has a limited effect on subcutaneous tissue. Usually, laser ablation of melanocytic nevi should reach the reticular dermis for complete removal of nevus cells. When the lesions are larger than 3 mm, the final scar often makes a dimple, resulting in an unfavorable appearance. Superficial ablation may avoid such a dimple, but it leaves some nevus cells intact, resulting in recurrence. Previously therefore, CO_2 laser removal was unsuitable for benign skin nevi larger than 3 mm.

Our new treatment is especially designed for nevi larger than 3 mm, assuming an acceptable treatment size of up to 7 mm, which consisted of 4 steps: (1) a sufficient dose of anesthesia was given; (2) the skin was outlined along the periphery; (3) the nevus was excised using a "laser scalpel"; and (4) the base of the wound was vaporized. We have applied our technique to 56 patients, among which 48 finished the

Table 2. Evaluation of responses

Improvement Cases/ Percentage	Clear (≥95%)	Excellent (76-95%)	Good (51-75%)	Fair (26-50%)	Poor (≤25%)	Total
Cases	20	23	10	3	0	56
Percentage (%)	35.7	41.1	17.9	5.3	0	100

Table 3. Posttreatment side effects

Elements	Number of cases (percentage)	Notes
Intractable operative bleeding	3 (5.4%)	Controlled by the end of operation
Post-operative infection	0	
Prolonged exudative drainage	0	
Postoperative pain	1 (1.8%)	Resolved within 2 days
Recurrence	0	
Hypertrophic scarring	2 (3.6%)	Became smooth and unapparent as time going
Hyperpigmentation	6 (10.7%)	
Hypopigmentation	2 (3.6%)	

follow-up time of 5.5 months (rang, 3-12 months). Characteristics of the 56 cases were shown in **Table 1**. In general, all patients tolerated the procedure well, and the cosmetic outcome was satisfactory. Under postoperative pathological examination, all the nevi were confirmed to be benign. The scar was acceptable, but hyperpigmentation was noticed 1 month postoperatively. However at the end of the third month, most of hyperpigmented scars had lost all color, and their appearances were smooth and imperceptible.

The success of the outcome was assessed based on the scar information, pigmentation, recurrence, and patient satisfaction with the cosmetic results 3 months after the laser therapy. Both objective and patient assessments were done with the 5-point grade scale established by Kilmer and Lee [18] as followed: 1 = poor (no change, with lightening of ≤25%); 2 = fair (slight improvement, with lightening of 26-50%); 3 = good (improvement, enabling differentiation from the surrounding healthy skin, with lightening of 51-75%); 4 = excellent (difficulty in differentiating the lesion from the surrounding healthy skin, with lightening of 76-95%); 5 = clear (near-complete disappearance of the lesion, with lightening of ≥95%). The evaluation of responses with the 5-point grade scale at the third month was shown in **Table 2**. Most of the cases presented excellent and clear results. During the follow-up time, no recurrences or serious complications were noted other than some side effects showed in **Table 3**.

Compared with previous CO_2 laser treatments, our method has many advantages. First, it provides a programmed process to obtain stable effects of the treatment. Second, a sufficient dose of anesthetic applied to the surgical area not only eases pain but also raises the cellular water content, which facilitates laser incision and avoids the thermal damage from boosting the laser output power in incising excess hyperkeratotic tissue. Normal tissues absorb more moisture than the nevus, and the tissues with different moisture content will be clearly stratified on macrostructure. This helps the surgeon find the proper operating layer to make sure removal is complete, thus contributing to a low recurrence rate. Third, the chances of infecting operating personnel are reduced by excising the nevus rather than vaporizing it. The unpleasant odor produced by vaporizing tissue is also reduced. Fourth, the excised nevus can be preserved for histological examination, if needed. Fifth, compared with the conventional method of curettage, the high risk of scarring is avoided [19]. Sixth, residual surface debris protects the wound from contacting with pathogens in the early days of healing. Thus, infection is reduced to some extent. Therefore, our 4-step, programmed CO_2 lasers excision technique is a simple and effective technique for melanocytic nevi having a diameter of 3-7 mm.

One drawback of our method is that the CO_2 laser excision technique is used for resection of lesions larger than 3 mm but smaller than 7 mm. We excluded lesions larger than 7 mm to

avoid significant scars and hyperpigmentation, but we tried to use this method if the patient with larger nevus was not suited for surgery.

To the best of our knowledge, a similar technique was first used by Serour [5] in treating recalcitrant warts. A 100% remission rate was achieved in pediatric patients with one treatment session and a 12-month follow-up period. This rate was much higher than most of previous studies [20-25]. In our study, a 100% remission rate was also achieved. That might be partly due to the short follow-up period. The fact that our cases were all solitary melanocytic nevi might also have contributed to the high remission rate.

In conclusion, with the two modifications (a programmed 4-step approach and precisely excising the base of the nevus with the help of a sufficient dose of anesthetic), compared with surgical removal, this improved technique was a simple and satisfactory alternative for complete removal of large melanocytic nevi having a diameter of 3-7 mm, and it offered a low recurrence rate and good cosmetic appearance.

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Disclosure of conflict of interest

None.

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