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ORIGINAL ARTICLE

Efficacy and Safety of 1,064 nm Q-switched Nd:YAG Laser Treatment for Removing Melanocytic Nevi

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Background: Until recently, the removal of melanocytic nevi has been performed with a CO_2 laser or Er:YAG laser. These lasers have been useful for removing affected spots. However, enlargement of spots or some sequelae, including depressed or hypertrophic scars, could develop as unwanted results. The Q-switched Nd:YAG laser has been used to remove deep-seated melanocytes, such as Ota nevus or tattoos. However, there have been no previous experiments performed to test the efficacy and safety of this laser treatment for melanocytic nevi. **Objective:** The objective of this study was to investigate the efficacy and safety of the 1,064 nm Q-switched Nd:YAG laser for removing melanocytic nevi, including congenital nevomelanocytic and acquired nevomelanocytic nevi. **Methods:** Two thousand and sixty four Korean patients with small melanocytic nevi were treated with a Q-switched Nd:YAG laser from 2005 to 2009. High-resolution photographs were taken in identical lighting and positions before and after the six weeks of treatment to observe the procedural efficacy. **Results:** About 70% of the nevi treated using a 1,064 nm Q-switched Nd:YAG laser were completely removed after one session. The other 30% were completely treated within three sessions. The appearance of sequelae such as hollow scars noticeably decreased compared to the results seen in CO_2 or Er:YAG laser treatments. **Conclusion:** Use of the 1,064 nm Q-switched Nd:YAG laser is a safe and effective treatment modality for melanocytic nevi. **(Ann Dermatol 24(2) 162~167, 2012)**

-Keywords-
Melanocytic nevi, Nevi, Q-switched Nd:YAG

INTRODUCTION

Melanocytic nevi are very common and usually harmless. The vast majority require no treatment. However, some people may request nevi removal for cosmetic reasons, especially when they are located on exposed areas of the body such as the face, arms, hands and legs. Since the treatment of melanocytic nevi is often done for cosmetic reasons, it must not only be effective but also safe, and is performed so that the appearance of adverse sequelae is minimized as much as possible.

Melanocytic nevi are traditionally removed by surgical excision, cryotherapy or electrodessication. More recently, CO_2 and Er:YAG laser therapies have been used due to their simple application and ability to treat multiple lesions in a short time. This advantage maximizes the optimal cosmetic results[1,2]. However, the CO_2 laser may cause post-operative scarring and pigmentary changes in the procedure site. Furthermore, the use of pigment-specific lasers, such as the Q-switched ruby laser and Q-switched alexandrite laser, may lead to an incomplete removal of nevus cells.

The Q-switched Nd:YAG laser emits a longer, near-infrared ray of 1,064 nm that is capable of penetrating into the deeper regions of the skin. Therefore, it is able to destroy deep-seated dermal melanocytes by selective photothermolysis[3]. For this reason, many dermatology clinics commonly use this laser to treat nevus of Ota and

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Hori, or to remove tattoos[4-6]. Its effectiveness for dermal melanocytosis treatment has been demonstrated, but problems with bleeding have prevented this laser from being used for melanocytic nevi. Based on this information, we postulated that control of bleeding can facilitate removal of melanocytic nevi with the Q-switched Nd:YAG laser, since nevi have a histology similar to the nevus of Ota and Hori. This study investigated this hypothesis.

MATERIALS AND METHODS

Patients

After a full explanation of the procedure and potential risks, informed consent was obtained from 2,064 healthy Korean patients with clinically benign melanocytic nevi between 2005 and 2009. The lesions were evenly pigmented, flat or just palpable and did not exceed 10 mm in diameter. The color of the nevi varied from light

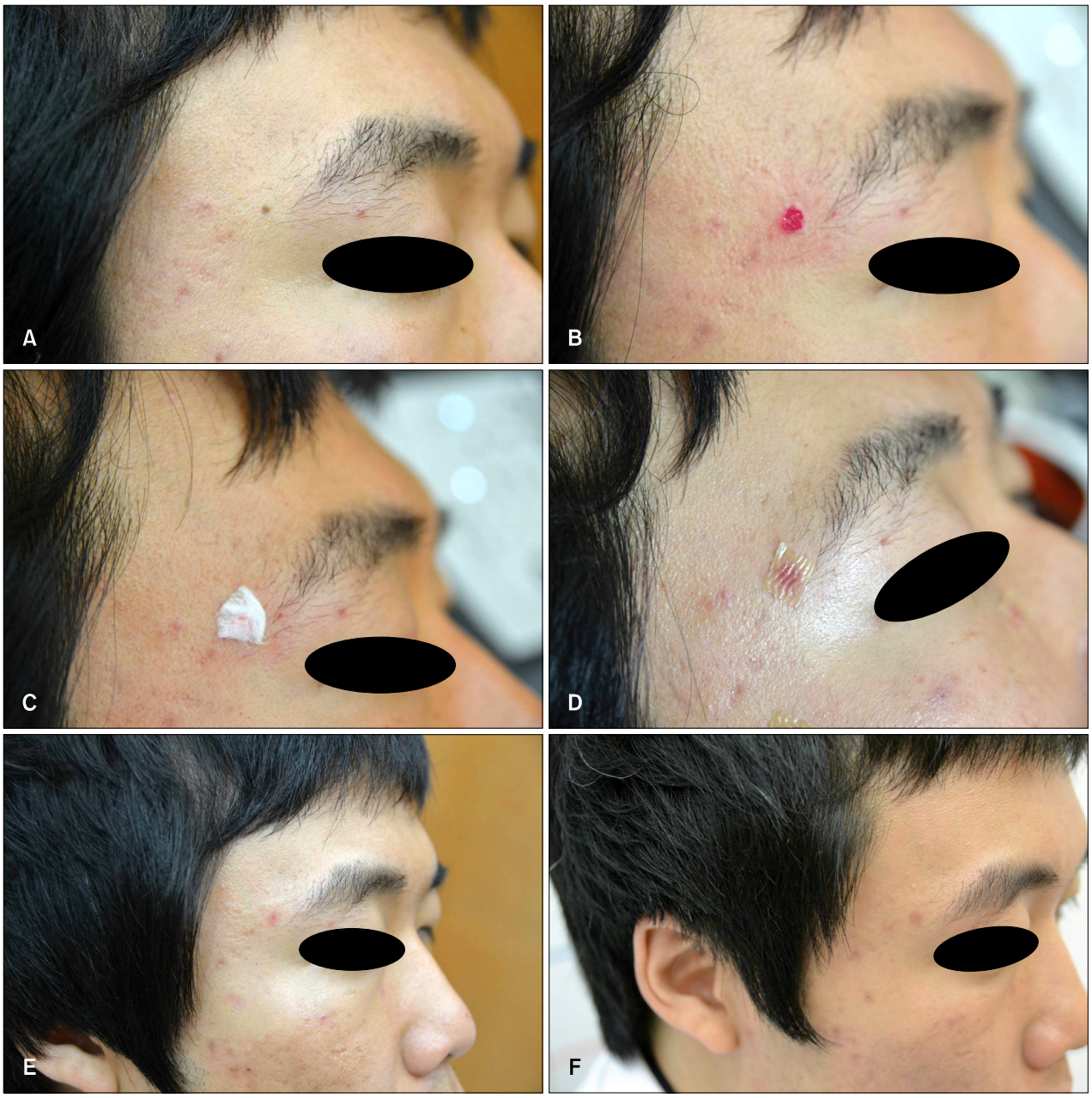

Fig. 1. (A) Melanocytic nevi before treatment. (B) Temporarily localized inhibition of blood flow by pulling the skin taut during the treatment. (C) Hemostasis by covering with tissue paper and applying tension in the vertical direction immediately after the laser treatment. (D) Dressing with Tegasorb® (thin hydrocolloid band; 3M, North ryde, Sydney, Australia) right after laser treatment. (E) Results 7 days after laser treatment. (F) Results 14 days after laser treatment.

brown to dark brown. Patients with small-sized congenital melanocytic nevi, acquired melanocytic nevi, blue nevi and spitz nevi were also enrolled, but individuals with a personal or family history of melanoma were excluded. Except for 28 men, all patients with melanocytic nevi were women. Patient age at the start of treatment ranged from 15 to 59 years. All patients had Fitzpatrick's skin types III, IV and V.

Laser treatment

EMLA® 5% cream (eutectic mixture of 2.5% lidocaine and 2.5% prilocaine, AstraZeneca, Sodertalje, Stockholem, Sweden) was applied to the nevi 40 min before laser treatment (Fig. 1A). The areas were then cleaned with normal saline and eye shields were applied. All patients were treated with a single session of the Q-switched Nd:YAG laser (Medlite II, Conbio, Fremont, CA, USA). The lesions were irradiated at a wavelength of 1,064 nm and delivered over a spot 2 mm in diameter with a frequency of 10 Hz and power of 10 to 12 J. The laser shot was performed by shooting above the nevi while focusing and rapidly defocusing. Pulling the skin taunt temporarily blocked blood flow and inhibited bleeding during the treatment (Fig. 1B). Bleeding caused by the laser treatment was stanched with sterilized tissue paper, and tension was applied in the vertical direction for several minutes (Fig. 1C). Tissue papers were sterilized with a model EOG300 ethylene oxide gas sterilizer (Delta Medical, Ansan, Korea). To ensure consistency, all laser treatments were performed by the same physician who did not participate in the evaluation.

After treatment, the lesions were cleansed with normal saline and secondary skin (Tegasorb®, thin hydrocolloid band; 3M, North ryde, Sydney, Australia) was applied for two consecutive days (Fig. 1D). The dressing was changed every other day by each patient until complete re-epithelialization occurred (Fig. 1E). The patients were also advised to avoid exposure to the sun and to use a broad-spectrum sunscreen. When some hyperpigmentation remained, the patients were able to undergo another session.

Evaluation

1) Anatomical site

The nevi on the faces of all the patients were removed. The face was further segmented into forehead, zygoma, cheek, nose and chin, which were evaluated after the final treatment. Even the case of multiple lesions was included for the evaluation.

2) Clearance

All photographic documentation was performed using an identical camera (Nikon Coolpix 4500; Nikon, Tokyo, Japan) settings, lighting and patient positioning. Before each treatment and 6 weeks after the final session, photographic documentation was repeated. Two independent, experienced dermatologists performed objective clinical assessment of the pigmented lesions by separately comparing photographs taken before and after treatment. The mean data of the pigment clearance of each patient were classified into four categories: excellent clearance (>80% cleared and does not need further treatment); good clearance (51~80% cleared); moderate clearance (25~50% cleared); and poor (<25% cleared). Photos were evaluated in blinded fashion (i.e., the photographs were

Table 1. Summary of the subjective improvement scoring by anatomical site

	Excellent	Good	Fair	Poor	Total	Excellent or good cases (%)	Excellent cases (%)
Forehead	658	483	203	31	1,375	84.9	47.9
Zygoma	432	351	476	34	1,293	60.6	33.4
Cheek	1,002	614	265	11	1,892	85.4	53.0
Nose	124	104	150	42	420	54.3	29.5
Chin	387	257	386	24	1,054	61.1	36.7

Table 2. Summary of the subjective improvement scoring from the blinded evaluation by two dermatologists

	Excellent	Good	Fair	Poor	Total	Excellent or good cases (%)	Excellent cases (%)
One treatment	821	618	407	218	2,064	69.7	39.8
Two treatments	726	278	218	21	1,243	80.8	58.4
Three treatments	419	46	50	2	517	89.9	81.0
Total	1,966	942	677	239	3,824	76.0	51.4

randomly ordered and the examiners were unaware of whether the photographs were pre- or postoperative).

3) Patient satisfaction

Some patients completed a questionnaire to assess their subjective satisfaction with the laser treatment using a 5-point grading system as follows: very satisfied, satisfied, somewhat satisfied, dissatisfied and very dissatisfied.

4) Side effects

Any possible complications and side effects (erythema, edema, texture changes, scarring, milia, postinflammatory hypopigmentation and hyperpigmentation) were recorded during post-operative follow-ups.

RESULTS

This study included 2,064 patients (2,036 women and 28 men; aged 18 to 56 years; mean age, 28.3 years). The number of nevi per patient ranged from 1 to 23. All patients had Fitzpatrick's skin types III, IV and V. Multiple nevi could be treated in a short time, and a single treatment for one nevus took approximately 2 to 4 seconds.

Anatomical site

The treatment was conducted for the nevi on the faces of a total of 2,064 patients. The number of patients by section of face was as follows: forehead, n=1,375; zygoma, n=1,293; cheek, n=1,892; nose, n=420; and chin, n=1,054. The treatment effect was the highest for cheeks and the lowest for noses (Table 1).

Clearance

In 821 patients (39.8%), the nevi were completely removed with a single session of laser treatment and did not require additional sessions (Table 2). About 70% of the patients who underwent only one treatment received good-to-excellent results and, after more than two treatments, 90% of the patients received good-to-excellent results. Fig. 2 and 3 demonstrate the clinical results seen in the patients.

Patient satisfaction

A total of 1,302 patients (63%) returned the questionnaire assessing patient satisfaction with treatment results. The

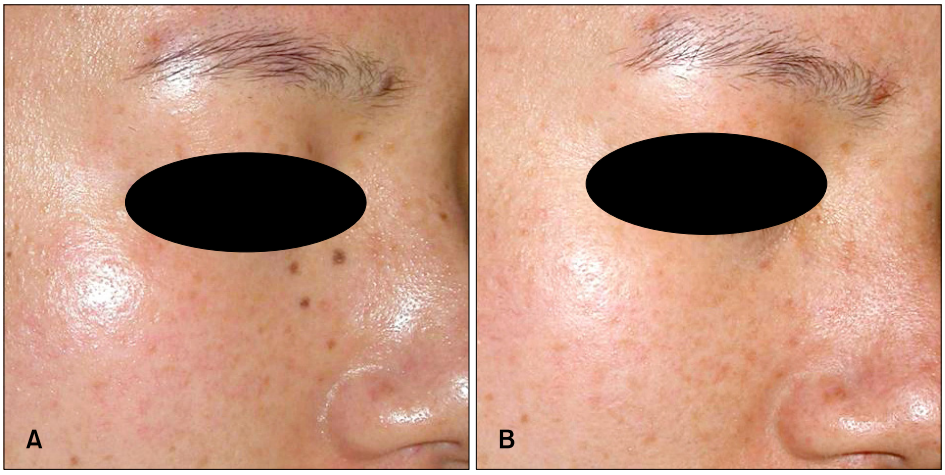

Fig. 2. Results before (A) and after (B) the Q-switched Nd:YAG laser (Medlite II, Conbio, Fremont, CA, USA) treatment.

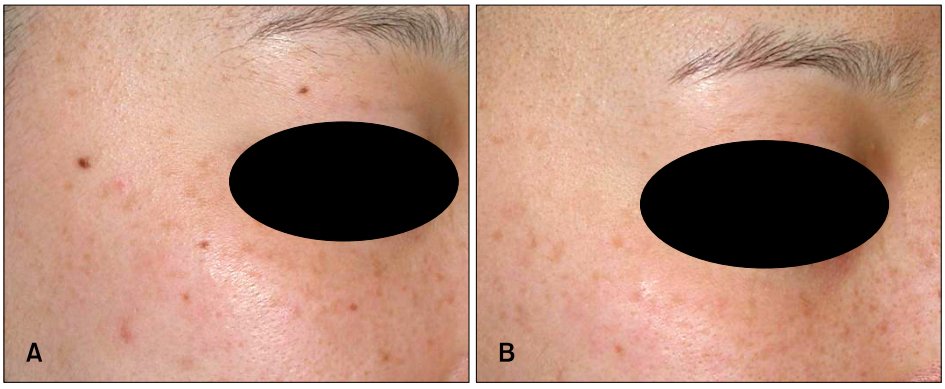

Fig. 3. Results before (A) and after (B) the Q-switched Nd:YAG laser (Medlite II, Conbio, Fremont, CA, USA) treatment.

Table 3. Patient satisfaction with the surgical outcomes

Patient's satisfaction level	n (%)
Satisfied	621 (47.7)
Somewhat satisfied	487 (37.4)
Very satisfied	158 (12.1)
Dissatisfied	36 (2.8)
Very dissatisfied	0

responses revealed that 621 (47.7%) patients were satisfied with their outcomes, 487 (37.4%) patients were somewhat satisfied and 158 (12.1%) patients were very satisfied (Table 3).

Side effects

In all patients, re-epithelization was completed between 7 and 10 days. Redness persisted up to 2 weeks in all cases. No infection was observed postoperatively. Observed side-effects were a mild prickling sensation during treatment and mild post-treatment erythema, both of which were resolved within a few hours. Treatment-induced pinpoint bleeding lasted 3 to 5 days, and swelling cleared in 2 to 4 days. Otherwise, noticeable major adverse effects such as atrophy, scars, hypopigmentation or hyperpigmentation were not observed.

DISCUSSION

The 1,064 nm Q-swithced Nd:YAG laser, a non-ablative and selective photothermolysis system, is commonly used in many dermatology clinics to treat various pigmentary disorders and for tattoo removal. In particular, therapeutic trials on post-inflammatory hyperpigmentation, melasma and acquired bilateral nevus of Ota-like macules have shown that this treatment approach is effective with minimal downtime and with no crust formation[7-9]. The principal laser-skin interactions observed in dermal melanocytosis by Q-switched Nd:YAG laser treatment is based on photothermal and photomechanical interactions induced by selective photothermolysis[10]. The 1,064 nm Q-switched Nd:YAG laser can cause dermal and epidermal melanosome rupture, melanosome rupture in melanocytes and destruction of dermal melanophages[11,12]. Anderson et al.[12] conducted a study examining selective photothermolysis of cutaneous pigmentation in guinea pigs using a Q-switched Nd:YAG laser with single-pulse exposures at 1,064, 532 and 355 nm that resulted in melanosome rupture within melanocytes and keratinocytes. In addition, Rosenbach et al.[13] reported the reduction of epidermal melanocytes and the number of functional and dermal melanocytic nests after treatment of benign acquired melanocytic nevi with Q-switched lasers. Therefore, we postulated that the Q-switched Nd:YAG laser could be an effective treatment modality to remove melanocytic nevi, which have histological features similar to dermal melanocytosis, as long as bleeding could be controlled.

To our knowledge, this is the first and largest study specifically investigating the efficacy and safety of the 1,064 nm Q-switched Nd:YAG laser treatment for melanocytic nevi. In this study, 821 of 2,604 nevi (39.8%) were completely removed, and 1,439 of 2,064 nevi (69.7%) were almost cleared (excellent-to-good results) with a single session of laser treatment. Furthermore, 90% of the patients showed good-to-excellent results after two to three treatments without hyper- or hypopigmentation. This type of laser treatment is safe, brief and well-tolerated. Multiple lesions can be treated in a short time and postoperative care is minimal. Our data suggest that a single treatment is usually sufficient.

The safety of the Q-switched Nd:YAG laser is comparable to that of pigment-specific lasers in the treatment of melanocytic nevi. In our study, no apparent scarring was noted in any of the treated lesions. With a secondary skin dressing, wounds were re-epithelialized between 7 and 10 days. Bleeding resulting from the procedure was minimal as it was easily controlled with sterilized tissue paper. Heavier bleeding was observed during treatment with the Nd:YAG laser compared to CO_2 or Er:YAG lasers. However, our results indicate that less heat damage to the skin and appendages is essential for better skin regeneration, and the bleeding caused by laser treatment was actually helping re-epithelialization, leading to a reduction of recovery time and possibility of scarring.

Nevertheless, the treatment modality used in this study has some limitations. Noticeable improvements shown in the experiment only occurred with Medlite II laser equipment, and some patients required additional treatment sessions to achieve a higher level of clinical improvement. In addition, as the present study has limitations associated with a retrospective and uncontrolled study, optimized prospective studies are required. The CO_2 laser treatment could not be conducted for the same patient at the same time because a large-sized study had to be performed for cosmetic outpatients. Taking into account that the efficacy and safety of Q-switched Nd:YAG laser have yet to be reported, a prospective study for outpatients could not be conducted. However, this study provides clinical evidence that Q-switched Nd:YAG and CO_2 laser show similar effects concerning the removal of nevi, which is expected to lay the foundation for a future study for comparing the CO_2 laser and Q-switched Nd:YAG.

In conclusion, 1,064 nm Q-switched Nd:YAG laser treat-

ment of melanocytic nevi is comparable to other pigment-specific laser treatments based on speed, convenience, excellent cosmesis and the ease of repetition, if required. As previously noted, the present report lacks a histopathological study and further investigations to address this should be performed. Nevertheless, the results clearly indicate that the 1,064 nm Q-switched Nd:YAG is an attractive option for treating melanocytic nevi at local dermatology clinics.

REFERENCES

1. Stratigos AJ, Dover JS, Arndt KA. Laser treatment of pigmented lesions--2000: how far have we gone? Arch Dermatol 2000;136:915-921.
2. Alster TS, Lupton JR. Laser therapy for cutaneous hyperpigmentation and pigmented lesions. Dermatol Ther 2001; 14:46-54.
3. Anderson RR, Parrish JA. Selective photothermolysis: precise microsurgery by selective absorption of pulsed radiation. Science 1983;220:524-527.
4. Chan HH, Alam M, Kono T, Dover JS. Clinical application of lasers in Asians. Dermatol Surg 2002;28:556-563.
5. Chan HH, Ying SY, Ho WS, Kono T, King WW. An in vivo trial comparing the clinical efficacy and complications of Q-switched 755 nm alexandrite and Q-switched 1064 nm Nd:YAG lasers in the treatment of nevus of Ota. Dermatol Surg 2000;26:919-922.
6. Polnikorn N, Tanrattanakorn S, Goldberg DJ. Treatment of Hori's nevus with the Q-switched Nd:YAG laser. Dermatol Surg 2000;26:477-480.
7. Cho SB, Kim JS, Kim MJ. Melasma treatment in Korean women using a 1064-nm Q-switched Nd:YAG laser with low pulse energy. Clin Exp Dermatol 2009;34:e847-e850.
8. Cho SB, Park SJ, Kim MJ, Bu TS. Treatment of acquired bilateral nevus of Ota-like macules (Hori's nevus) using 1064-nm Q-switched Nd:YAG laser with low fluence. Int J Dermatol 2009;48:1308-1312.
9. Cho SB, Park SJ, Kim JS, Kim MJ, Bu TS. Treatment of post-inflammatory hyperpigmentation using 1064-nm Q-switched Nd:YAG laser with low fluence: report of three cases. J Eur Acad Dermatol Venereol 2009;23:1206-1207.
10. Kim SD, Kim SW, Huh CH, Suh DH, Eun HC. Changes of biophysical properties of the skin measured by non-invasive techniques after Q-switched Nd-YAG laser therapy in patients with nevus of Ota. Skin Res Technol 2001;7: 262-271.
11. Anderson RR. Laser-tissue interactions in dermatology. In: Arndt KA, Dover JS, Olbricht SM, editors. Lasers in cutaneous and aesthetic surgery. Philadelphia: Lippincott-Raven, 1997:25-32.
12. Anderson RR, Margolis RJ, Watenabe S, Flotte T, Hruza GJ, Dover JS. Selective photothermolysis of cutaneous pigmentation by Q-switched Nd:YAG laser pulses at 1064, 532, and 355 nm. J Invest Dermatol 1989;93:28-32.
13. Rosenbach A, Williams CM, Alster TS. Comparison of the Q-switched alexandrite (755 nm) and Q-switched Nd:YAG (1064 nm) lasers in the treatment of benign melanocytic nevi. Dermatol Surg 1997;23:239-244.