
Professional Errors Caused by Lasers and Intense Pulsed Light Technology in Dermatology and Aesthetic Medicine: Preventive Strategies and Case Studies

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BACKGROUND. The use of lasers and intense pulsed light (IPL) technology has become established practice in dermatology and aesthetic medicine. The increase in popularity and widespread use of such equipment has been accompanied by a sharp increase in the number of case reports about professional errors.

OBJECTIVE. We present 14 case studies of professional errors.

METHODS. Selected representative case reports are used to illustrate and discuss typical professional errors and serve as the basis for creating preventive strategies.

RESULTS. Recommendations have been developed for the following areas: physician training, patient information, documentation, diagnosis, indication, test treatment, and performing treatment.

CONCLUSION. The use of lasers and IPL technology in dermatology and aesthetic medicine requires practitioners not only to have high levels of training and experience, but also to exercise professional judgment. In spite of all of the precautions taken, the risk of complications and side effects can be reduced but not completely eliminated.

IN THE FIELDS of dermatology and aesthetic medicine, the number of cosmetic treatments performed with lasers has tripled in the United States since 1996, and an estimated 3.4 million treatments have taken place in the year 2000.¹ The remarkable successes in treatment have managed, however, to obscure the issue of the potential dangers that accompany such procedures. An increase in patient demand and the hope of prestige and financial profits have served to exponentially increase the number of laser and IPL users. A confusing number of new or improved developments are available, and to some extent laser companies are aggressive in promoting them, even though there is often insufficient scientific evidence of their efficacy.² Also, the complexity of the procedures involved is often underestimated.

Nanni and Alster^{3,4} were among the first to call attention to the adverse effects and complications related to laser use. Additional work followed and is presented in similar reports. The most commonly cited problems are the reactions occurring after skin resurfacing with CO₂ lasers.⁵⁻¹¹

Professional errors can be distinguished from adverse effects and complications in that the former are preventable. The sources of errors can be traced to de-

ficiant training, a lack of documentation, inadequate and inexact patient information, incorrect determination of indications and diagnoses, failure to perform test treatments, and incorrect operation of the laser. A first attempt to correct these problems in Germany has been made with the guidelines of the German Dermatological Laser Society [*Deutsche Dermatologische Lasergesellschaft (DDL)*]¹² and the Work Group for Dermatological Laser Treatment [*Arbeitsgemeinschaft für Dermatologische Lasertherapie (ADL)*].¹³ [Note: Since the German word “*ärztlicher Behandlungsfehler*” can be widely interpreted in English (“misdiagnosis,” “malpractice,” “medical negligence,” “professional error”), we have chosen the general term “professional errors” to simplify matters.]

Preventive Strategies

Training

Deficiencies in or the total absence of training and experience are critical factors that often lead to professional errors. The ideal method of ensuring thorough physician training, or even of making such training possible, would be to establish teaching centers for laser treatment in qualified, certified offices or clinics. In such institutions, guidelines should be taught on topics including didactic, hands-on, and laser-specific clinical techniques. Standards of practice should no longer be handled as if they are top secret information; instead, they should be officially instructed and published. An oral

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Figure 1. Hyperpigmentations after photoepilation with a long-pulsed alexandrite laser. Probable sources of error: noncompliant patient (eg, sun exposure), machine malfunction, fluence too high, inappropriate skin type (too dark).



Figure 2. Keloids after argon laser treatment of a nevus flammeus. Probable source of error: power density too high.



Figure 3. A) Hypertrophic scars on the chin and evidence of hypopigmentations (alabaster skin, "milk mouth") 8 months after skin resurfacing with the CO₂ laser. Probable sources of error: fluence too high and/or too many passes.



Figure 4. Hypertrophic scars and keloids after an attempt to remove a tattoo with a continuous wave CO₂ laser. Probable source of error: wrong laser.

or written board examination might serve as a rational and fair strategy to assess theoretical and practical proficiency objectively after a defined period of continuing education is completed.

Our own experience has shown us that it is essential that physicians have dermatologic training in addition to laser-specific training. Wrinkles and scars are certainly self-evident enough that they do not require an appointment with a dermatologist; however, problems in differential diagnoses can occur if, for exam-



Figure 5. Keloids after treatment of chloasma with a CO₂ laser. Probable sources of error: incorrect indication, fluence too high.

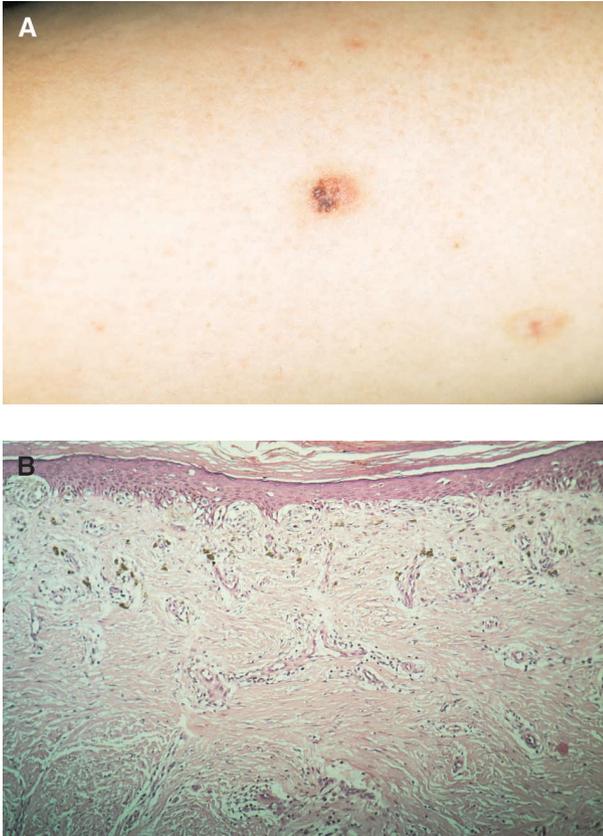


Figure 6. A) Recurrence of a nevus cell nevus with histologic findings of a pseudomelanoma after treatment with an Er:YAG laser. Probable source of error: incorrect indication. B) Histologic profile. Typical trilaminar manifestation with a junctional proliferation of melanocytes bordering corial cicatrization and deep residual banal nevocmelanocyte nests. (Hematoxylin and eosin.)



Figure 7. Keloids on the upper lip after photoepilation with a diode laser without the necessary contact cooling. Probable sources of error: laser operator had no professional training, didn't use the accompanying contact cooling, fluence may also have been too high.

Patient Information and Documentation

In Germany, informing patients is the responsibility of physicians alone, and it must not be delegated to nurses or paramedical staff. In other countries, some aspects of informed consent can be performed by well-trained and conscientious assistants. Conversation is the heart and soul of obtaining informed consent. Written consent is merely a confirmation of what has been discussed. A patient's signature on a preprinted consent form which has not been preceded by a discussion with the physician does not grant doctors free rein, and in the event of a legal dispute, such a form can be declared invalid.

The optimal procedure consists of a thorough discussion, after which the patient is given a consent form

ple, photoaged skin requires additional treatment of such conditions as basal cell carcinoma, squamous cell carcinoma, or lentigo maligna. The consequences could be severe if these problems are treated improperly in the course of skin resurfacing because of the laser operator's ignorance of dermatology. In this context, mention must also be made of treating suspicious (dysplastic) nevi during photoepilation or similar procedures. From a scientific perspective, the outcome of such a scenario cannot yet be foreseen. In the postoperative phase, an operator's lack of knowledge could also cause uncertainty, which in turn could lead to professional error. Laser operators without dermatologic training may not be fully aware of the invasive character of treatments such as skin resurfacing and the related risk potential, the treatment of burned or infected skin, or wound-healing processes and all of the complications they can entail. The board examinations mentioned above would serve to determine whether or not the necessary dermatologic proficiency is present.



Figure 8. Persistent hypopigmentation 3 years after treatment of poikiloderma of Civatte (erythrosis interfollicularis colli) with a pulsed dye laser. Probable sources of error: fluence too high, inappropriate skin type (too dark/tanned). Subsequent attempt (by another physician!) to correct the color with a pulsed CO₂ laser. Source of the error: wrong laser.



Figure 9. Scars after photoepilation. Probable sources of error: no test treatment, insufficient patient information provided, fluence too high.



Figure 11. Atrophic scars after krypton laser treatment. Probable sources of error: power densities too high, no indication.

to which handwritten additions are made as necessary. Detailed information should be provided about the diagnosis; the nature, extent, and process involved in the planned treatment; potential short- and long-term adverse effects; possible alternative treatments; and the costs to be expected. Rare concomitant effects, adverse effects, and risks should also be discussed if they are typical for the procedure in question. Treatment should not be performed on the same day the discussion is held; patients should have the chance to make a deci-

sion without being pressured for time and without being affected by the psychological burden of the procedure awaiting them.

Patient documentation should include information about discussions between the physician and patient, the preoperative diagnosis and histologic findings (to whatever degree present or necessary), the indication for laser treatment, test treatments, the kind of anesthesiology, the kind of laser and parameters of application, the results of treatment, and any concomitant reactions, adverse effects, and complications (intra- or postoperative, infections, late complications, etc.). Especially in the case of cosmetic procedures, additional photographic documentation is recommended. This is relevant from a forensic perspective, as well as being useful if the patient should question the success of the treatment.

Diagnosis

A correct diagnosis is one of the basic requirements of successful and safe laser treatment, and the diagnosis should be confirmed by histologic tests if there is any doubt about the skin being benign. This is of particular relevance if precancerous, malignant, or pigment changes are involved.

Indication

In laser treatments, an incorrectly determined indication or one which is not determined at all have a lack of therapeutic success as its best-case scenario. However, the consequences can be much more severe and even irreversible in some cases. The skin type and the localization of lesions are of great importance. Suntanned patients and those with skin types III–VI (Fitzpatrick) should only be treated for benign pigmented skin lesions (eg, lentigo benigna, ephelides) with pigment-specific lasers and great caution should be exercised, if in-



Figure 10. Scars and hyperpigmentation after treatment of leg telangiectases. Probable source of error: fluence too high.



Figure 12. A) Initial cutaneous strawberry hemangioma on an 18-day-old girl. Percutaneous Nd:YAG laser treatment was used to treat the hemangioma. B) Patient 15 weeks after treatment. The hemangioma ulcerated immediately after treatment and grew to an enormous size. Probable sources of error: wrong laser for the indication, fluence too high.

deed such treatment is performed at all. Dysplastic nevi are considered a contraindication, as are movement-associated rhytides and wrinkles on the neck; these must not be treated with skin resurfacing using CO₂ lasers.



Figure 13. Widespread ink darkening after ruby laser treatment of what was previously skin-colored cosmetic permanent makeup. Probable source of error: no test treatment.

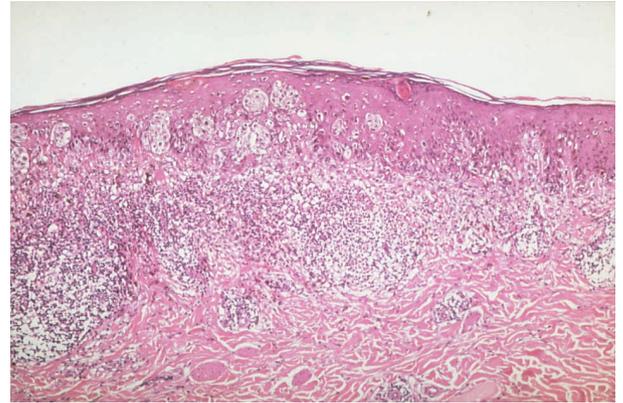


Figure 14. Histologic findings of the biopsy of a superficially spread melanoma after repeated Q-switched ruby laser treatment of a nevus cell nevus. (Hematoxylin and eosin; magnification 100 \times .)

Test Treatments

In general, test treatments are always recommended (whenever possible), particularly for expansive lesions or on exposed areas, in order to evaluate concomitant or adverse effects. Test treatments help prevent professional errors and any resulting claims to financial compensation. This statement deserves particular emphasis in reference to ink darkening during the removal of permanent makeup.¹⁴

Performing Treatment

In performing the treatment, errors can be made in selecting the appropriate laser and parameters and in operating the equipment. Laser treatments performed at intervals that are too short or fluences that are too high can lead to scar formation. Focused and defocused handpieces operate differently and must be held at the proper distance from the skin. Laser impulses that are too close together can result in severe concomitant or adverse effects. In performing skin resurfacing, attention should be paid to treating the surrounding areas in such a way that clear lines of demarcation are avoided.³ Cooling procedures are becoming increasingly important.¹⁵ If cooling is not sufficient, epidermal damage will result. One example is integrated contact cooling, which must be on the skin when the impulse is administered.

Case Studies

Figures 1–14 show patients assessed by Drs. M. Drosner, W. Kimmig, and C. Raulin in their professional capacity as assessors.

Conclusion

Using lasers and IPL technology in dermatology and aesthetic medicine requires practitioners not only to

have high levels of training and experience, but also to exercise sound professional judgment.^{16,17} In spite of all the precautions taken, the risk of complications and side effects can only be reduced, not completely eliminated.

Generally applicable quality guidelines should be created that will guarantee training, safety, and procedural quality in laser treatments. In our opinion, access to lasers should be denied to professionals from nonmedical fields, and legal measures should be implemented to reflect this. Given the preventive strategies listed, additional increases in the number of professional errors should not occur.

"Nil nocere" (Hippocrates, 460–377 BCE)

"If you don't need the laser, don't use it."¹⁸

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