An Effective Treatment of Colour Mismatch in Skingrafts Using the Erbium: YAG laser

A Siegel, S Spendal, M Schintler, G Wittgruber, E Prandl, B Hellbom, E Scharnagl

Citation

A Siegel, S Spendal, M Schintler, G Wittgruber, E Prandl, B Hellbom, E Scharnagl. *An Effective Treatment of Colour Mismatch in Skingrafts Using the Erbium: YAG laser*. The Internet Journal of Surgery. 2001 Volume 3 Number 2.

Abstract

Background and Objective: High visibility and irregularities of skin texture in skin grafts are a common cosmetic problem. The purpose of the study was to determine the effectiveness of the Erbium: YAG laser to improve the cosmetic result of skin grafts.

Study Design / Materials and Methods: 20 patients with various skin grafts after plastic surgery were treated with the Erbium: YAG laser. The mean age was 26 years (22- 34 years). Effectiveness after treatment was evaluated in all patients after 12 month (12- 14 months).

Results: Improvement of the skin grafts was good (50-75%) in 12 patients, fair (25-50%) in 3 patients, and poor (0-25%) in 5 patients after laser treatment. Persisting hyperaemia was observed in 4 patients after 12 months. There was no formation of keloids or hypertrophic scars up to the time of follow- up.

Conclusion: The cosmetic result of skin grafts can be effectively improved by the 2940 nm Erbium: YAG laser without major adverse effects.

INTRODUCTION

High visibility (colour mismatch) and irregularities of skin texture in skin grafts (or mesh grafts) are a common cosmetic problem in plastic surgery. Although therapies such as dermabrasion and surgical excision are being used in the treatment of hyperpigmented or hypopigmented skin grafts, laser resurfacing has become a useful treatment modality([1,2]). The Er:YAG laser, with a wavelength of 2940nm, has high water absorption and a short pulse duration. These properties of the Er:YAG laser result in less thermal injury to the skin, and the extend of the thermal injury remains constant regardless of the number of passes. These characteristics enable the operator to have better control of the precise depth and ongoing ablation without significant thermal injury ([3,4,5]). The purpose of this study was to evaluate the effectiveness of the Er:YAG laser in the treatment of irregularities of skin texture and colour mismatch in skin grafts to improve the cosmetic result.

MATERIALS AND METHODS

Twenty patients (12 male, 8 female) with various skin grafts after plastic surgery were treated with the Erbium: YAG laser after application of topical (EMLA® Cream: 1 hour before procedure) or local anaesthesia (Xylocain 1%® with Epinephrin). Several kinds of skin grafts were treated: Skin grafts after burn injury (13 patients), skin grafts after traumatic defects (7 patients) (Table 1).

Figure 1

Table 1: Patient profiles

	Types of skin graft		
Area treated	Skin graft	Mesh graft	No. of patients
Upper extremity	10	4	14
Lower extremity	4	2	6
Total(&percent)	14 (70)	6 (30)	20 (100)

The mean time between the transplantation of the skin graft and the first laser treatment was 36 month (18 month and 65 month). All patients had Fitzpatrick skin types III or IV. The patients ranged in age from 22 to 34 years and the mean age was 26 years. Photographs were taken preoperatively. We explained to the patient about the recovery time, the expected results of the surgery (laser treatment), and the possible side effects and complications, and received written consent. Patients who had history of hypertrophic scars or

keloid formation, active viral (herpes simplex) or inflammatory disorders (acne), and irritation symptoms (contact dermatitis) were excluded (5).

An Er:YAG laser with a wavelength of 2940nm and pulse duration of 300ysec was used for this study. With 5-7 mm spot size, laser parameters were pulse energy 1000- 1700 mJ and a repetition rate of 5-10 Hz. The ablation continued until the reticular dermis was reached. The transition was confirmed visually by the change of skin texture and increased bleeding. We also performed Er:YAG laser ablation on the elevated margin and the surrounding normal skin. The width of the laser treated area was 2 cm into the normal skin. The depth of ablation was to the reticular dermis as well. This provides a sufficient area of featheredging to reduce the marked difference in the laser treated areas and the untreated surrounding skin.

Postoperative wound care was performed with moist burn pads for 2 days. Then wound care was continued with Bepanthen® cream several times a day without any dressing at all until complete re-epithelialisation occurred.

After the procedure we had follow-up consultations with the patient on a 2-month basis. We evaluated the patient`s satisfaction and the degree of clinical improvement was judged by the operator. Photographs were taken on every visit. Laser treatment was repeated every 2 month. The required laser treatments ranged from 2 to 5 times (mean 3 times). Avoiding UV radiation for at least 12 months was prescribed to every patient. When determining the final result 12 to 14 months (mean 12 month) after the first laser treatment we utilised the photographic comparison using preoperative and the latest postoperative photographs. The degree of improvement was graded, according to other studies ([6]), in 25% intervals between 0 (no improvement) and 100% (no level difference between the laser treated area and the adjacent surrounding normal skin) (Table 2).

RESULTS

Most of the patients healed in 5-7 days after each treatment. The follow- up periods were from 12-14 months, with a mean of 12 months. The cosmetic result of the skin grafts improved good (50-75%) in 12 patients, fair (25-50%) in 3 patients, and poor (0-25%) in 5 patients after laser treatment (Table 2).

Figure 2

Table 2: Degree of improvement after laser treatment

	Degree of improvement (%)			
Types of skin graft	**Poor(0-25%)**	**Fair(25-50%)**	**Good(50-75%)**	**Excellent(75-100%)**
Skin graft	1	2	9	0
Mesh graft	4	1	3	0
No. of patients (%)	5 (25)	3 (15)	12 (60)	0

All patients (n=20) developed transient postoperative erythema. Erythema after laser treatment lasted in the average 3 months. In 20% of the patients (n=4) it persisted for more than 12 months. Oedema and pruritus developed in 100% (n=20), but within 14 days the symptoms subsided. Other complications were hypopigmentation (10%, n=2) and persisting surface irregularities (25%, n=5)(Table 3). No formation of keloids or hypertrophic scars occurred in our patients up to the time of follow- up.

Figure 3

Table 3: Number of side effects (n=20)

Side effects and complications	**No. of patients (& percent)**
Erythema, transient (< 3 month)	16 (80)
Erythema, prolonged (>3 month)	4 (20)
Oedema	20 (100)
Pruritus	20 (100)
Hypertrophic scar	0
Keloid	0
Surface irregularities	5 (25)
Hypopigmentation	2 (10)
Hyperpigmentation	0

DISCUSSION

The Er:YAG laser, with a wavelength of 2940 nm, has a high water absorption rate (the water absorption coefficient is 12,800/cm). The zone of thermal necrosis is less than 10 µm for the Er:YAG laser ([7]), and the extent of thermal injury is constant regardless of the number of passes (3). The Er:YAG laser ablates thin layers of tissue with minimal thermal damage to the surrounding skin (7). Therefore very delicate tissue ablation and the achievement of the desired depth of resurfacing is possible (5). Because the side effects and complications are primarily depth of ablation and thermal damage related, less thermal damage causes faster healing and reduces severe side effects and complications postoperatively ([8]).

In our patients persisting erythema occurred in 4 patients (20%). This confirms with the findings reported in other studies (5). Erythema was treated with Bepanthen® application and continuos sun protection. We think that the main cause could be seen in too deep ablation of tissue in this areas. No hypertrophic scars or keloid formation occurred in our patients within the follow-up of 12 months.

The Er:YAG laser shows a lack of any definite end-point markings. Some physicians prefer bleeding as an end-point marker of the epidermal ablation (8). Due to the fact that skingrafts and the surrounding skin are commonly not of the same depth and further more the skin graft itself differs in depth (especially in mesh grafts), this marker is unsafe in some cases. Additionally in cases of using local anaesthetics with epinephrin, bleeding sometimes does not develop even though the epidermis has been ablated. If the operator is not aware of this, excessively deep ablation can result. Therefore we think as other investigators (5), it is safer to use the characteristics of the ablating tissue as an end point for either dermal ablation or the ablation of skingrafts. In our study, the skin grafts and the epidermis of the surrounding skin presented with a brown to darker brown colour. After the first 3-4 passes of the Er:YAG laser, colour changed from brown to a pinkish or even white tone with variable degrees of bleeding. Additionally a moderate amount of tissue shrinkage was observable during the treatment ($_{9}$). In the case of the ablation continued to the reticular dermis, increased bleeding is evident.

The cosmetic result of skin grafts or mesh grafts in our patients improved good (50-75%) in 12 patients, fair (25-50%) in 3 patients, and poor (0-25%) in 5 patients after laser treatment (Table 2 and Figures1) which goes a head with the data of other studies (5) in the treatment of scars with the Er:YAG laser. As shown in table 2 poor improvement occurred mostly in patients with mesh grafts. This is due to the fact that mesh grafts have a higher amount of surface irregularities and therefore good results are sometimes hardly to achieve.

Because there is no standard scale to measure scar improvement we quantified, as other investigators ($_{10}$), scare improvement on visual clinical judgement (Table 2).

In conclusion, the cosmetic result of skin grafts regarding the colour mismatch and the surface irregularities, can be effectively improved by the 2940 nm Erbium: YAG laser without major adverse effects.

CORRESPONDENCE TO

Alexander Siegl, MD Klinische Abteilung für Plastische Chirurgie, Universitätsklinik für Chirurgie Auenbruggerplatz 29, 8036 Graz, Austria, Europe siegla@gmx.at

References

1. Ho C, Nguyen Q, Lowe NJ. Laser resurfacing in pigmented skin. Dermatol Surg 1995; 21:1035-7
2. Nehal KS, Levine VJ, Ross B. Comparison of high-energy carbon dioxide laser resurfacing and dermabrasion in revision of surgical scars. Dermatol Surg 1998; 24:647-50
3. Kaufmann R, Hibst R. Pulsed 2.94 -ym erbium-YAG laser skin ablation: experimental results and first clinical application. Clin Exp Dermatol 1990; 15:389-93
4. Hibst R, Kaufmann R. Effects of laser parameters on pulsed Er-YAG laser skin ablation. Laser Med Sci 1991; 6:391-7
5. Sung In Cho, Yang Che Kim. Treatment of atrophic facial scars with combined use of high-energy pulsed CO2 laser and Er:YAG laser: A practical guide of the laser techniques for the Er:YAG laser. Dermatol Surg 1999; 25:959-64
6. Jimenez G, Spencer JM. Erbium:YAG laser resurfacing of the hands, arms, and neck. Dermatol Surg 1999; 25:831-4; discussion 834-5
7. Kauver ANB, Geronemus RG. A comparison of lasers currently in use for skin resurfacing. In: Coleman WP, Lawrence N, eds. Skin resurfacing. Baltimore: Williams & Wilkins, 1998: pp 162-5
8. Perez MI, Bank DE, Silvers D. Skin resurfacing of the face with the Er:YAG laser. Dermatol Surg 1998; 24:653-9
9. Bass LS. Erbium:YAG laser skin resurfacing: preliminary clinical evaluation. Ann Plast Surg 1998; 40:328-34
10. Jordan R, Cummins C, Burls A. Laser resurfacing of the skin for the improvement of facial scarring: a systematic review of the evidence. Br J Dermatol 2000; 142(3): 413-23
11. Fleming D. Controversies in skin resurfacing: the role of erbium. J Cutan Laser Ther 1999; 1:15-21
12. Coates J. Basic physics of erbium laser resurfacing. J Cutan Laser Ther 1999; 1(2):71-5
13. Majaron B, Sirnivas SM, Huang He, Nelson JS. Deep coagulation of dermal collagen with repetitive Er:YAG irradiation. Lasers Surg Med 2000; 26(2):215-22

Author Information

Alexander Siegel, MD
Department of Plastic Surgery, University Clinic Medical School

Stephan Spendal, MD
Department of Plastic Surgery, University Clinic Medical School

Michael V. Schintler, MD
Department of Plastic Surgery, University Clinic Medical School

Gabriela Wittgruber, MD
Department of Plastic Surgery, University Clinic Medical School

Eva Ch. Prandl, MD
Department of Plastic Surgery, University Clinic Medical School

Bengt Hellbom, MD
Department of Plastic Surgery, University Clinic Medical School

Erwin Scharnagl, MD
Department of Plastic Surgery, University Clinic Medical School