Fractional Q-Switched 1064 nm Laser for Treatment of Atrophic Scars in Asian Skin

Steven Paul Nisticó 1,†, Mario Sannino 2,†, Gaia Fasano 1,*©, Miriam Marigliano 1, Francesca Negosanti 3, Luigi Bennardo 1© and Giovanni Cannarozzo 2

1 Department of Health Sciences, Magna Graecia University, 88100 Catanzaro, Italy
2 Villa Bella Dermatologic Center, 40121 Bologna, Italy
3 Unit of Lasers in Dermatology, Tor Vergata University, 00100 Rome, Italy
* Correspondence: fasano.gaia@gmail.com; Tel.: +39-098-468-1790
† These authors contributed equally to this work.

Abstract: Background and Objectives: Asian patients with Fitzpatrick skin type III–IV are a less studied subtype of patients in the medical literature. Q-Switched, 1064 nm neodymium-doped yttrium aluminum garnet (Nd: YAG) laser with a fractionated beam profile (QSF) is a new modality that was reported to be effective in the treatment of scars. This study aims to evaluate the efficacy and safety of QSF Nd: YAG laser in treating scars in Asian patients. Materials and Methods: A total of 29 Subjects were treated with 1064 nm QSF laser. Each patients had three treatments with a fractionated microlens array handpiece every 8 weeks. Efficacy of treatment was evaluated using the Goodman and Baron’s quantitative grading scale before and 3 months after the last treatment. Results: All 29 patients treated had significant improvement of acne scars according to Goodman and Baron’s Quantitative Global Acne Scarring Grading System. No side effect has been observed except some minor eryhematous reactions in three patients. Conclusions: Our results confirm that the 1064 nm QSF Nd: YAG laser is a safe and effective technique for treating scars in Asians.

Keywords: Nd: YAG laser; fractional Q-switched; scars; Asian skin

1. Introduction

Scars result from abnormal wound healing. Genetic, systemic, and local factors, such as inflammatory and proliferative processes, lead to excessive extracellular matrix deposition and overgrowth scars formation. The most common scar types are atrophic, hypertrophic scars, keloids, and striae distensae [1].

Acne is an inflammatory disorder that causes atrophic scars. Many therapeutic strategies can be used for atrophic scars, such as hyaluronic acid fillers, chemical peeling, and lasers [2].

Several treatments have been proposed for hypertrophic and keloid scars, like intrale-sional steroid injection, steroid tapes, surgical revision, cryotherapy, radiotherapy, and laser therapy [3]. Treatment should also consider skin phototype, anatomic site, and racial differences. White and Asian skin presents many anatomic and physiological differences that lead to different kinds of side effects. Acne, hypertrophic, and keloid scars are more common in Asian patients than Caucasians [4]. Post-inflammatory hyperpigmentation (PIH) and keloids are the most common adverse events after laser treatment in Asian skin and force operators to use conservative parameters [5].

In the past decade, the safety and efficacy of a Q-Switched domain, 1064 nm neodymium-doped yttrium aluminum garnet (Nd: YAG) laser have been widely demonstrated in many different conditions like melasma, tattoo removal, hair removal, and skin rejuvenation [6–10]. A growing interest in treating scars with fractional Nd: YAG laser is present [11].

To the best of our knowledge, QSF 1064 nm laser has never been used to treat scars in Asian patients, and this study aims to investigate the effectiveness and safety of this laser.
2. Materials and Methods

The study retrospectively recruited patients at the Magna Graecia University of Catanzaro, La Sapienza University of Rome, and Villa Bella Dermatological Centre in Bologna. Twenty-nine Asian subjects (2 males and 27 females), with Fitzpatrick skin type III-IV and residual acne scars evaluated by Goodman and Baron’s Quantitative Global Acne Scarring Grading System, were assessed by an investigator.

Inclusion criteria were as follows: age ≥ 18 years, presence of cosmetic scars, no severe underlying pathologies, and compliance to follow-up.

Exclusion criteria included a history or suspicion of active infection at the sites of treatment, immunocompromised status, steroid and immunosuppressive drug assumption, history of skin cancer, recurrent herpes viral infection, chronic diseases influencing the skin (e.g., diabetes, autoimmune disease), oral retinoid within six months before the treatment, light hypersensitivity, taking phototoxic medication (such as some antibiotics), history of chemical peeling one month prior to the study, facial laser treatment in the past three months, history of connective tissue disease, pregnancy, and breastfeeding status.

All patients provided informed written consent.

2.1. Laser Device

QFS 1064 nm Nd: YAG laser (Smart PICO®; DEKA M.E.L.A. S.p.A., Calenzano, Italy) was used for all laser treatments. SmartPICO® has multiple handpieces with several different spot sizes for all the targets. Each spot has a microlens array (MLA), which optimizes energy delivery and fractionates the laser beam into microbeams with circular diameter.

The fractionated system produces micro-injuries in micro-regions that trigger the new dermal collagen formation and a repair process.

2.2. Laser Session Protocol

Patients were treated by the same dermatologist with a 1064 nm QSF laser (Spot size of 9 mm fractionated handpiece for scar treatment and 0.7–0.8 J/cm² of fluence; repetition rate, 5 Hz; pulse width, 450 picoseconds. Each patient had 3 treatments with a fractionated microlens array handpiece every 8 weeks. No topical anesthesia was used prior to treatment.

Desired endpoints were immediate moderate erythema and mild oozing of bloody serous exudates, a sign of epidermal ablation. A dynamic cooling device during the treatment was used; the technique results in the reduction of skin temperature to 5 °C and −9 °C to approximately 200 µm of superficial tissue. Therefore, we safely used high fluences with a good margin of safety.

After the treatment, patients were instructed to use an antibiotic cream twice a day for 7–10 days to avoid sun exposure and sun protection SPF50+ over the treated area for 30 days. All subjects received treatment every eight weeks for three sessions and followed up 3 months after the last procedure.

2.3. Efficacy and Safety

Before and after each session, the patient was visited and photographed with a professional dermatological camera with and without polarized light (Anthology—DEKA M.E.L.A., Florence, Italy) at different angles (frontal and profile from right and left side).

Efficacy was evaluated at baseline, and 3 months after procedures.

Efficacy of the treatment was assessed using Goodman and Baron’s quantitative grading scale assessed by an investigator as compared with the baseline digital photographs before and 3 months after the last treatment (Table 1) [12]. Also, a Visual Analogue Scale (VAS) of 10 points (0, none; 1–2, slight pain; 3–6, moderate pain; 7–8, severe pain, 9–10, intolerable pain) to evaluate pain was used to evaluate patients’ tolerance.
Table 1. Goodman and Baron’s quantitative grading scale.

| (Grade) Type                        | Number of lesions: 1 (1–10) | Number of lesions: 2 (11–20) | Number of lesions: 3 (21–30) |
|-------------------------------------|-----------------------------|------------------------------|-------------------------------|
| A Milder scarring (1 point each)    | 1 point                     | 2 points                     | 3 points                     |
| B Moderate scarring (2 points each) | 2 points                    | 4 points                     | 6 points                     |
| C Severe scarring (3 points each)   | 3 points                    | 6 points                     | 9 points                     |
| D Hyperplastic (papular)            | 2 points                    | 4 points                     | 6 points                     |
| E Hyperplastic                       | <5 cm² Area                 | 5–20 cm² Area                | >20 cm² Area                 |
|                                     | 6 points                    | 12 points                    | 18 points                    |

Efficacy of the treatment was assessed using the multispectral analysis which is an optical imaging method to characterize skin tissue with high resolution and discrimination the changes in the macroscopic structure. The spectral imaging device perform quantitative per-pixel spectral analysis of tissue for evaluation of laser treatment of skin lesions.

The appearance of side effects such as blistering, scarring, burns, hypopigmentation, or hyperpigmentation was also monitored.

Statistical analysis was executed using a paired Student’s t test. Statistica 14.0 was used to analyze data (mean, standard deviations, and rate calculations) (TIBCO Software, Palo Alto, CA, USA).

3. Results

All the patients completed the study. The cohort was a total of 29 patients (93% female and 7% male) with a mean age of 29.66 ± 7.77 years. Participants’ skin color ranged (using the Fitzpatrick scale) from type II (n = 1; 3.4%) to type III (n = 14; 48.3%) and type IV (n = 14; 48.3%). All treated patients had significant improvement of acne scars according to Goodman and Baron’s Quantitative Global Acne Scarring Grading System and photographic evaluation. The scores decreased significantly from baseline to 3 months follow-up after the last treatment (initial score 22.59 ± 7.44; final score 14.14 ± 7.06; p < 0.001). Treatment was well tolerated with a low pain VAS score (2.45 ± 1.09) (Figures 1–3).

Figure 1. Patient 14 before (A) and 3 months after (B) treatments.
Figure 2. Patient 14 before (A) and 3 months after (B) treatments under polarized light.

Figure 3. Patient 14 before (A) and 3 months after (B) treatments at multispectral analysis.

The most common immediate post-treatment side effects were erythema, edema, and exfoliation that resolved within 10 days. No prolonged erythema and no pigmentation alterations were reported at 12 weeks after treatment. No severe adverse events were observed. Post-inflammatory hyperpigmentation was not observed in our study. Patients’ characteristics are reported in Table 2.
Table 2. Patients’ characteristics.

| ID | Sex | Age | Photo Type | Acne Scarring Grading System before | Acne Scarring Grading System after 3 Months | Pain VAS | Side Effect |
|----|-----|-----|------------|------------------------------------|------------------------------------------|---------|------------|
| 1  | F   | 24  | 3          | 15                                 | 8                                        | 3       | None       |
| 2  | F   | 31  | 3          | 21                                 | 12                                       | 2       | None       |
| 3  | F   | 19  | 4          | 18                                 | 9                                        | 2       | None       |
| 4  | F   | 26  | 4          | 24                                 | 18                                       | 1       | None       |
| 5  | F   | 25  | 4          | 31                                 | 23                                       | 2       | None       |
| 6  | F   | 31  | 3          | 32                                 | 21                                       | 4       | Erythema   |
| 7  | F   | 42  | 2          | 13                                 | 4                                        | 1       | None       |
| 8  | F   | 28  | 4          | 28                                 | 15                                       | 2       | None       |
| 9  | F   | 29  | 3          | 37                                 | 26                                       | 3       | None       |
| 10 | F   | 20  | 3          | 25                                 | 13                                       | 2       | None       |
| 11 | F   | 33  | 4          | 21                                 | 9                                        | 1       | None       |
| 12 | F   | 37  | 4          | 17                                 | 6                                        | 2       | None       |
| 13 | F   | 29  | 3          | 30                                 | 18                                       | 2       | None       |
| 14 | M   | 19  | 3          | 21                                 | 16                                       | 3       | Erythema   |
| 15 | F   | 44  | 3          | 16                                 | 13                                       | 2       | None       |
| 16 | F   | 41  | 4          | 24                                 | 22                                       | 5       | None       |
| 17 | M   | 31  | 4          | 31                                 | 27                                       | 3       | None       |
| 18 | F   | 28  | 3          | 34                                 | 31                                       | 1       | Erythema   |
| 19 | F   | 32  | 4          | 35                                 | 16                                       | 5       | None       |
| 20 | F   | 37  | 4          | 14                                 | 14                                       | 2       | None       |
| 21 | F   | 21  | 4          | 10                                 | 4                                        | 4       | None       |
| 22 | F   | 26  | 4          | 18                                 | 11                                       | 3       | None       |
| 23 | F   | 24  | 3          | 21                                 | 9                                        | 2       | None       |
| 24 | F   | 21  | 3          | 13                                 | 5                                        | 3       | None       |
| 25 | F   | 27  | 3          | 15                                 | 9                                        | 2       | None       |
| 26 | F   | 18  | 4          | 24                                 | 12                                       | 2       | None       |
| 27 | F   | 37  | 4          | 21                                 | 11                                       | 1       | None       |
| 28 | F   | 34  | 3          | 17                                 | 9                                        | 3       | None       |
| 29 | F   | 46  | 3          | 29                                 | 19                                       | 3       | None       |

4. Discussion

Scars are fibroproliferative disorders resulting from an alteration of wound healing processes; can be distinguished into atrophic scars, hypertrophic scars, keloids, and striae distensae [13].

Atrophic scars result from collagen fibers and subcutaneous fat loss during an inflammatory process such as acne vulgaris; hypertrophic scars are raised within the injury site and develop within 4–8 weeks after the injury; keloids, instead, extend beyond the site of injury [14]. Many traumas can lead to scarring, such as surgery, burns, piercings, infections, insect bites, and physical trauma [15]. Patients reported functional and cosmetic problems such as sensation of tension, itching, and discomfort that affected their quality of life [16].

According to the width and depth, atrophic acne scars can be classified into icepick, rolling, and boxcar scars; classification helps us choose the best treatment for each patient. Icepick scars extend vertically into the dermis and subcutaneous tissue and cannot be treated with superficial resurfacing; rolling scars are shallower than icepick scars and result from abnormal fibrous anchoring; boxcar scars, instead, are rectangular and vertical depressions; the shallow ones can be treated with superficial skin resurfacing [17].

Lasers are widely used for acne scars treatment; ablative and non-ablative are valid treatment options and can be used in fractional modality. Fractional laser resurfacing cause microscopic columns of epidermal and dermal tissue damage and is a good option for rolling and boxcar scars [18].

Ablative lasers, 10,600-nm CO$_2$ and 2900-nm Er: YAG, target water in the skin, causing epidermal and dermal destruction and stimulating the formation of new collagen [19]. Prolonged erythema, PIH, and long recovery time have made ablative lasers less popu-
lar [20]. Non-ablative lasers, 1064-nm Nd: YAG and 585-nm pulsed dye laser (PDL), target the dermis and leave the epidermis intact, so they can be considered less invasive than ablative lasers, and, furthermore, aim to stimulate collagen and dermal remodeling [21–24]. Shallow boxcar and rolling scars, compared to icedpick scars, have a more significant improvement [25]. Non-ablative fractional lasers (NAFL) have a faster recovery time and fewer adverse events than fractional ablative lasers (AFL). However, more sessions are required, and improvement is not as much as with AFL [26].

Different treatment modalities are used for hypertrophic, keloid scars, and striae distensae. For atrophic scars, other possible treatments are dermabrasion, micro-needling, platelet-rich plasma, and radiofrequency [27]. The goal of current strategies is to reduce inflammation with a different mechanism. Intraläsional steroid injections, steroid tapes, and steroid ointments reduce inflammation and decrease the proliferation of fibroblast and collagen synthesis, but the most common side effects are atrophy and telangiectasia [28]. Surgical revision or excision of scars is a traditional treatment that aims to reduce skin tension and can be carried out at least one year after scar formation [29]. Results are often not encouraging due to the recurrence rate, especially for keloids [29]. Combination therapy with postoperative steroid application can improve surgical outcomes [30]. Cryotherapy is used to induce vascular damage and scar tissue necrosis and can be associated with intraläsional steroid injections to induce a higher success rate [31].

Several laser treatments with different wavelengths are primarily reported, including 585-nm PDL, 1064-nm Nd: YAG laser, 308-nm excimer laser, non-ablative 1450-nm diode laser, ablative fractional CO$_2$ resurfacing, and fractional Er: YAG laser [32,33]. PDL 585-nm and Nd: YAG 1064-nm lasers are frequently used to vaporize blood vessels to reduce the intake of substances that promote the growth of the scar [34]. The most common side effects are hyperpigmentation and hypopigmentation, followed by blister formation and postoperative purpura [35].

The intensity and severity of side effects depend on anatomy site, skin phototype, and racial differences.

Efficacy of laser treatment can be assessed with different techniques such as multispectral analysis, Raman spectroscopy, and high-resolution ultrasound.

Raman spectroscopy is a non-invasive technique that monitors the collagen presence on resurfaced skin and studies the collagen regeneration during the wound healing process of acne scars after laser procedures [36].

High-resolution ultrasound can be used to objectively measure the increase of dermal thickness and hydration, due to collagen neosynthesis and conformational changes in the extracellular matrix component, signs of the efficacy of the laser treatment; it can also predict efficacy by measuring the initial skin thickness [37].

The properties of multispectral analysis technique to hold the histological structure of skin disease and to investigate spectral features of abnormal parts, even if the normal parts have color variations, is an effective tool for capturing the information in a better way than other techniques.

Racial differences in skin pathophysiology have been reported based on genetic and environmental factors. The most frequent skin phototypes in the Asian population are Fitzpatrick types III or IV [38]. An essential difference between white and nonwhite skin is in the amount of epidermal melanin with larger melanosomes; no difference in melanocyte quantities is reported [39]. Melanosomes are degraded slower and absorb more laser energy in dark skin than white skin, which leads to damage to melanin cells resulting in an alteration of pigmentation (hypopigmentation, hyperpigmentation, and depigmentation) [40]. The thickness dermal, the more vulnerable melanocytes, and the increase in the reactivity of mesenchyme result in a higher risk of hypertrophic scars and keloid formation. As a result of acne, scarring and hyperpigmented macule are more common in darker skin [41].

Asian develop keloids and pigmented problems more frequently than Caucasians, therefore, any procedures, especially laser treatment, must be carried out with caution [42].
In Asian skin, laser therapy can be used to treat various skin diseases such as vascular lesions, hypertrophic scars, keloids, striae, and pigment alteration [43].

The competition between laser energy and epidermal melanin makes lasers less effective. The 585-nm PDL is the treatment of choice for hypertrophic scars and keloids on white skin, but the clinical improvement of thickness and viscoelasticity is lower in dark skin [44]. The treatment intervals and the appropriate energy should be selected with caution due to the risk of pigmentary alteration, which is higher than in fair-skinned patients [45].

Skin resurfacing to treat sun damage, wrinkles, and scars can be performed by CO₂ laser [46]. PIH is the most common complication, especially in dark skin, developing during the first month and becoming more evident within four months [47].

Er: YAG laser is an alternative to the CO₂ resurfacing lasers because of the lower depth of necrosis and the shorter thermal damage induced by Er: YAG laser, leading to lower melanocytic activity and minimizing the inflammatory reaction [48]. Postoperative complications are often less severe and resolve quicker than CO₂ laser treatment [49]. Sometimes we can use combined CO₂ and Er: YAG lasers to reduce the sequelae such as the post-laser erythema and induce a faster healing time and better cosmetic results [50]. We can perform a single-pass CO₂ laser followed by Er: YAG laser to vaporize and reduce the thermal damage [51].

Fractional resurfacing systems utilize microscopical treatment zones of thermal injury to the skin, leading to some areas of untreated skin repopulating the damaged areas with faster recovery and fewer side effects [18]. The 755-nm Alexandrite picosecond laser improves acne scars in Asians [52].

The fractional picosecond laser is effective in the treatment of acne scars with minimal side effects [53]. Fractional handpieces focus high precision microbeams in a grid pattern to deliver the effect on the epidermis and, above all, on the dermis [54].

The Q-switched lasers have short impulses (nanoseconds or, even, picoseconds) with a power peak of mega- or giga-watts. Picosecond lasers differ from the nanosecond ones in that they deliver ultra-short pulse durations, which generate more photoacoustic effect and less photothermal damage. QSF Nd: YAG laser has already been used to treat post-surgical facial scars with decreased scar severity with mild and transient adverse events. To prevent and reduce the side effects of laser treatment in Asian skin, we use some regimens such as sun avoidance, sunscreen, and epidermal cooling [55].

5. Conclusions

Management of Asian skin requires different considerations because new laser technology, which prevents epidermal damages, is in high demand. This is the first study that confirms the efficacy and safety of QSF 1064 nm laser for scars treatment in Asian skin with excellent clinical results, little downtime, and no reported PIH. This study opens new horizons in the laser treatment of scars in Asians.

Limitations of this study include relatively small sample size, lack of a control group, and the absence of histopathologic assessments. Long-term follow-up on its efficacy and a larger sample size may be required in further studies to confirm our results.

Author Contributions: Conceptualization, G.C. and S.P.N.; validation, M.S., S.P.N. and G.C.; formal analysis, M.M.; data curation, F.N.; writing—original draft preparation, G.F.; writing—review and editing, L.B.; supervision, S.P.N. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of Center Calabria (protocol code 2019/373; date of approval 17 December 2019).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.
Data Availability Statement: Data available form the corresponding author upon reasonable request.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Goodman, G.J.; Baron, J.A. Postacne scarring—A quantitative global scarring grading system. Lasers Med. Sci. 2020, 36, 227–231. [CrossRef] [PubMed]
2. Taub, A.F. The Treatment of Acne Scars, a 30-Year Journey. Am. J. Clin. Dermatol. 2019, 20, 683–690. [CrossRef] [PubMed]
3. Jaloux, C.; Bertrand, B.; Degardin, N.; Casanova, D.; Kerfant, N.; Philandrianos, C. Les cicatrices chéloïdes (deuxième partie): Arsenal et stratégie thérapeutique [Keloid scars (part II): Treatment and prevention]. Ann. Chir. Plast. Esthet. 2017, 62, 87–96. [CrossRef] [PubMed]
4. Kono, T.; Chan, H.H.L.; Do, W.F.G.; Manstein, D.; Sakurai, H.; Takeuchi, M.; Yamaki, T.; Soejima, K.; Nozaki, M. Prospective direct comparison study of fractional resurfacing using different fluences and densities for skin rejuvenation in Asians. Lasers Surg. Med. 2007, 39, 311–314. [CrossRef] [PubMed]
5. Chan, I.L.; Cohen, S.; Da Cunha, M.G.; Maluf, L.C. Characteristics and management of Asian skin. Int. J. Dermatol. 2018, 58, 131–143. [CrossRef]
6. Cannarozzo, G.; Negosanti, F.; Sannino, M.; Santoli, M.; Bennardo, L.; Banzola, N.; Negosanti, L.; Nisticò, S.P. Q-switched Nd:YAG laser for cosmetic tattoo removal. Dermatol. Ther. 2019, 32, e13042. [CrossRef]
7. Cannarozzo, G.; Nisticò, S.; Zappia, E.; Del Duca, E.; Provenzano, E.; Patruno, C.; Negosanti, F.; Sannino, M.; Bennardo, L. Q-Switched 1064/532 nm Laser with Nanosecond Pulse in Tattoo Treatment: A Double-Center Retropective Study. Life 2021, 11, 699, Published on 16 July 2021. [CrossRef] [PubMed]
8. Del Duca, E.; Zingoni, T.; Bennardo, L.; Di Raimondo, C.; Carofalo, V.; Sannino, M.; Petuni, N.; Cannarozzo, G.; Bianchi, L.; Nisticò, S.P. Long-Term Follow-Up for Q-Switched Nd:YAG Treatment of Nevus of Ota: Are High Number of Treatments Really Required? A Case Report. PhotobioMed Photomed Laser Surg. 2021, 39, 137–140. [CrossRef] [PubMed]
9. Bennardo, L.; Cannarozzo, G.; Tamburi, F.; Patruno, C.; Provenzano, E.; Nisticò, S.P. Picosecond Q-Switched 1064/532 nm Laser in Tattoo Removal: Our Single Center Experience. Appl. Sci. 2021, 11, 9712. [CrossRef]
10. Silvestri, M.; Bennardo, L.; Zappia, E.; Tamburi, F.; Cameli, N.; Cannarozzo, G.; Nisticò, S.P. Q-Switched 1064/532 nm Laser with Picosecond Pulse to Treat Benign Hypermelanosis: A Single-Center Retropective Study. Appl. Sci. 2021, 11, 7478. [CrossRef]
11. Akerman, L.; Solomon-Cohen, E.; Rozenblat, M.; Hodak, E.; Lapidoth, M.; Levi, A. 1064-nm Q-switched fractional Nd:YAG laser is safe and effective for the treatment of post-surgical facial scars. Lasers Med. Sci. 2020, 36, 871–874. [CrossRef] [PubMed]
12. Goodman, G.J.; Baron, J.A. Postacne scarring—A quantitative global scarring grading system. J. Cosmet. Dermatol. 2006, 5, 48–52. [CrossRef] [PubMed]
13. Lee, H.J.; Jang, Y.J. Recent Understandings of Biology, Prophylaxis and Treatment Strategies for Hypertrophic Scars and Keloids. Int. J. Mol. Sci. 2018, 19, 711. [CrossRef]
14. Berman, B.; Maderal, A.; Raphael, B. Keloids and Hypertrophic Scars: Pathophysiology, Classification, and Treatment. Derm. Surg. 2017, 43 (Suppl. 1), S3–S18. [CrossRef] [PubMed]
15. Ogawa, R. Keloid and Hypertrophic Scars Are the Result of Chronic Inflammation in the Reticular Dermis. Int. J. Mol. Sci. 2017, 18, 606, Published 10 March 2017. [CrossRef] [PubMed]
16. Bs, R.S.C.; Borovikova, A.A.; Bs, K.K.; Banyard, D.A.; Bs, S.L.; Toranto, J.D.; Paydar, K.Z.; Wirth, G.A.; Evans, G.R.D.; Widgerow, A.D.; et al. Current concepts related to hypertrophic scarring in burn injuries. Wound Repair Regen. 2016, 24, 466–477. [CrossRef] [PubMed]
17. Jacob, C.I.; Dover, J.S.; Kaminer, M.S. Acne scarring—a classification system and review of treatment options. J. Am. Acad. Dermatol. 2001, 45, 109–117. [CrossRef]
18. Manstein, D.; Herron, G.S.; Sink, R.K.; Tanner, H.; Anderson, R.R. Fractional photothermolysis: A new concept for cutaneous remodeling using microscopic patterns of thermal injury. Lasers Surg. Med. 2004, 34, 426–438. [CrossRef] [PubMed]
19. Sobanko, J.F.; Alster, T.S. Management of acne scarring, part I: A comparative review of laser surgical approaches. Am. J. Clin. Dermatol. 2012, 1, 319–330. [CrossRef] [PubMed]
20. Walia, S.; Alster, T.S. Prolonged clinical and histologic effects from CO₂ laser resurfacing of atrophic acne scars. Dermatol. Surg. 1999, 25, 926–930. [CrossRef] [PubMed]
21. Nisticò, S.P.; Tolone, M.; Zingoni, T.; Tamburi, F.; Scali, E.; Bennardo, L.; Cannarozzo, G. A New 675 nm Laser Device in the Treatment of Melasma: Results of a Prospective Observational Study. Photobiomodul Photomed Laser Surg. 2020, 38, 560–564. [CrossRef] [PubMed]
22. Cannarozzo, G.; Fazia, G.; Bennardo, L.; Tamburi, F.; Amoruso, G.F.; Del Duca, E.; Nisticò, S.P. A New 675 nm Laser Device in the Treatment of Facial Aging: A Prospective Observational Study. Photobiomodul Photomed Laser Surg. 2021, 39, 118–122. [CrossRef]
23. Sannino, M.; Ambrosio, A.G.; Lodi, G.; Cannarozzo, G.; Bennardo, L.; Nisticò, S.P. A giant epidermal nevus of the face treated with a CO₂ and dye laser combination: A case report and literature review. J. Cosmet. Laser Ther. 2021, 23, 59–64. [CrossRef] [PubMed]
24. Viviano, M.T.; Provini, A.; Mazzanti, C.; Nisticò, S.P.; Patruno, C.; Cannarozzo, G.; Bennardo, S.; Fusco, I.; Bennardo, L. Clinical Evaluation on the Performance and Safety of a Non-Ablative Fractional 1340 nm Laser for the Treatment of Stretch Marks in Adolescents and Young Adults: A Case Series. Bioengineering 2022, 9, 139, Published on 25 March 2022. [CrossRef]
25. Anderson, R.R.; Parrish, J.A. Selective photothermolysis: Precise microsurgery by selective absorption of pulsed radiation. *Science* 1983, 220, 524–527. [CrossRef] [PubMed]

26. Sardana, K.; Manjhi, M.; Garg, V.K.; Sagar, V. Which type of atrophic acne scar (icepick, boxcar, or rolling) responds to non-ablative fractional laser therapy? *Dermatol. Surg.* 2014, 40, 288–300. [CrossRef]

27. Wong, T.S.; Li, J.Z.-H.; Chen, S.; Chan, J.Y.-W.; Gao, W. The Efficacy of Triamcinolone Acetonide in Keloid Treatment: A Systematic Review and Meta-analysis. *Front. Med.* 2016, 3, 71, Published on 27 December 2016. [CrossRef]

28. Ogawa, R.; Akaishi, S.; Huang, C.; Dohi, T.; Aoki, M.; Omori, Y.; Koike, S.; Kobe, K.; Akimoto, M.; Hyakusoku, H. Clinical applications of basic research that shows reducing skin tension could prevent and treat abnormal scarring: The importance of fascial/subcutaneous tensile reduction sutures and flap surgery for keloid and hypertrophic scar reconstruction. *J. Nippon Med. Sch.* 2011, 78, 68–76. [CrossRef]

29. Leventhal, D.; Furr, M.; Reiter, D. Treatment of keloids and hypertrophic scars: A meta-analysis and review of the literature. *Arch. Facial. Plast. Surg.* 2006, 8, 362–368. [CrossRef]

30. Muir, I.F. On the nature of keloid and hypertrophic scars. *Br. J. Plast. Surg.* 1998, 177–184.

31. Har-Shai, Y.; Zouboulis, C.C. Intraleisional Cryotherapy for the Treatment of Keloid Scars: A Prospective Study. *Plast Reconstr. Surg.* 2015, 136, 397e–398e. [CrossRef] [PubMed]

32. Nistico, S.; Campolmi, P.; Moretti, S.; Del Duca, E.; Bruscino, N.; Conti, R.; Bassi, A.; Cannarozzo, G. Nonconventional Use of Flash-Lamp Pulsed-Dye Laser in Dermatology. *Bio. Med. Res. Inf.* 2016, 2016, 7981640. [CrossRef] [PubMed]

33. Guida, S.; Galimberti, M.G.; Bencini, M.; Pellecani, G.; Bencini, P.L. Treatment of striae distensae with non-ablative fractional laser: Clinical and in vivo microscopic documentation of treatment efficacy. *Lasers Med. Sci.* 2017, 33, 75–82. [CrossRef]

34. Koike, S.; Akaishi, S.; Nagashima, Y.; Dohi, T.; Hyakusoku, H.; Ogawa, R. Nd: YAG Laser Treatment for Keloids and Hypertrophic Scars: An Analysis of 102 Cases. *Plast Reconstr. Surg. Glob. Open.* 2015, 2, e272, Published on 8 January 2015. [CrossRef] [PubMed]

35. Hermans, J.F.; Petit, L.; Hermans-Le, T.; Pierard, G.E. Analytic quantification of phototype-related regional skin complexion. *Skin. Res. Technol.* 2019, 25, 168–171. [CrossRef]

36. Chiwo, F.S.; Guevara, E.; Ramirez-Elias, M.G.; Castillo-Martínez, C.C.; Osornio-Martínez, C.E.; Cabrera-Alonso, R.; Pérez-Atamoros, R. Use of Raman spectroscopy in the assessment of skin after CO₂ ablative fractional laser surgery on acne scars. *Skin. Res. Technol.* 2020, 26, 805–809. [CrossRef]

37. Naouri, M.; Atlan, S.; Campolmi, P.; Moretti, S.; Del Duca, E.; Bruscino, N.; Conti, R.; Bassi, A.; Cannarozzo, G. Nonconventional Use of Flash-Lamp Pulsed-Dye Laser in Dermatology. *Bio. Med. Res. Inf.* 2016, 2016, 7981640. [CrossRef] [PubMed]

38. Alster, T.; Hirsch, R. Single-pass CO₂ laser skin resurfacing of light and dark skin: Extended experience with 52 patients. *J. Cosmet. Derm.* 2003, 48 (Suppl. 6), S139–S142. [CrossRef]

39. Berardesca, E.; Maibach, H. Ethnic skin: Overview of structure and function. *J. Am. Acad. Dermatol.* 2003, 48 (Suppl. 6), S139–S142. [CrossRef]

40. Alalu, S.; Atkins, D.; Barrett, K.; Blount, M.; Carter, N.; Heath, A. Ethnic variation in melanin content and composition in photoexposed and photoprotected human skin. *Pigment. Cell Res.* 2002, 15, 112–118. [CrossRef]

41. Taylor, S.C. Skin of color: Biology, structure, function, and implications for dermatologic disease. *J. Am. Acad. Dermatol.* 2002, 46 (Suppl. 2), S41–S62. [CrossRef]

42. Yeung, C.K.; Teo, L.H.Y.; Xiang, L.H.; Chan, H.H. A community-based epidemiological study of acne vulgaris in Hong Kong adolescents. *Acta Derm Venerol.* 2002, 82, 104–107. [CrossRef] [PubMed]

43. Chung, J.H. Photoaging in Asians. *Photodermatol Photoimmunol Photomed.* 2003, 19, 109–121. [CrossRef] [PubMed]

44. Battie, E.F., Jr.; Soden, C.E., Jr. The use of lasers in darker skin types. *Semin. Cutan. Med. Surg.* 2009, 28, 130–140. [CrossRef] [PubMed]

45. Chan, H.H.; Wong, D.S.; Ho, W.S.; Lam, L.K.; Wei, W. The use of pulsed dye laser for the prevention and treatment of hypertrophic scars in Chinese persons. *Derm. Surg.* 2004, 30, 987–994. [CrossRef]

46. Alster, T.S.; Williams, C.M. Treatment of keloid sternotomy scars with 585 nm flashlamp-pumped pulsed-dye laser. *Lancet* 1995, 345, 1198–1200. [CrossRef]

47. Bernstein, L.J.; Kauvar, A.N.B.; Grossman, M.C.; Geronemus, R.G. The short- and long-term side effects of carbon dioxide laser resurfacing. *Derm. Surg.* 1997, 23, 519–525. [CrossRef] [PubMed]

48. Nanni, C.A.; Alster, T.S. Complications of carbon dioxide laser resurfacing. An evaluation of 500 patients. *Derm. Surg.* 1998, 24, 315–320. [CrossRef]

49. Manaloto, R.M.P.; Alster, T. Laser resurfacing for refractory melasma. *Dermatol. Surg.* 1999, 25, 121–123. [CrossRef]

50. Polnikorn, N.; Goldberg, D.J.; Suwanchinda, A.; Ng, S.W. Erbium:YAG laser resurfacing in Asians. *Derm. Surg.* 1998, 24, 1303–1307. [CrossRef]

51. Cho, S.I.; Kim, Y.C. Treatment of facial wrinkles with char-free carbon dioxide laser and erbium: YAG laser. *Kor. J. Derm.* 1999, 37, 177–184.

52. Alster, T.; Hirsch, R. Single-pass CO₂ laser skin resurfacing of light and dark skin: Extended experience with 52 patients. *J. Cosmet. Laser.* 2003, 5, 39–42. [CrossRef] [PubMed]
53. Brauer, J.A.; Kazlouskaya, V.; Alabdulrazzaq, H.; Bae, Y.S.; Bernstein, L.J.; Anolik, R.; Heller, P.A.; Geronemus, R.G. Use of a picosecond pulse duration laser with specialized optic for treatment of facial acne scarring. *JAMA Dermatol.* 2015, 151, 278–284. [CrossRef] [PubMed]

54. Tsai, P.S.; Blinder, P.; Migliori, B.J.; Neev, J.; Jin, Y.; Squier, J.A.; Kleinfeld, D. Plasma-mediated ablation: An optical tool for submicrometer surgery on neuronal and vascular systems. *Curr. Opin. Biotechnol.* 2009, 20, 90–99. [CrossRef] [PubMed]

55. Haedersdal, M.; Bech-Thomsen, N.; Poulsen, T.; Wulf, C.H. Ultraviolet exposure influences laser-induced wounds, scars, and hyperpigmentation: A murine study. *Plast Reconstr Surg.* 1998, 101, 1315–1322. [CrossRef]