



Lumenis CO₂ Platforms

Bibliography of Studies & Peer Reviewed Papers

Energy to Healthcare

Lumenis is a global leader in the field of minimally-invasive clinical solutions for the Surgical, Ophthalmology and Aesthetic markets, and is a world-renowned expert in developing and commercializing innovative energy-based technologies, including Laser, Intense Pulsed Light (IPL) and Radio-Frequency (RF).

For years, **Lumenis**' ground-breaking products have redefined medical treatments and have set numerous technological and clinical gold-standards. **Lumenis** has successfully created solutions for previously untreatable conditions, as well as designed advanced technologies that have revolutionized existing treatment methods in each and every one of the verticals we operate in.

Our drive for innovation stems from an uncompromising commitment to improving the health and well-being of our patients; addressing new and growing needs of aging populations; and in offering medical professionals cutting-edge solutions that fit seamlessly into the health-economics environment of the 21st century.

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UltraPulse Testimonials

“With UltraPulse’s SCAAR FX, I am able to treat deep skin conditions, like hypertrophic scars, with the results of enhanced skin condition and improved quality of life for patients. SCAAR FX has the unique combination of short pulse durations and high energy which enables deep, precise and effective treatment.”

Dr. Matteo Tretti Clementoni, Plastic Surgeon

“I feel that I can safely treat my patients more aggressively with the UltraPulse, something I would not attempt with other CO₂ laser systems”

Dr. Girish Munavalli, Dermatologist

“UltraPulse gives me the extreme precision I desire from a fractional CO₂ laser. It gives me the possibility to tailor parameters to individual patient’s needs and the confidence to treat in a safe and efficient way.”

Dr. Christine Dierickx, Dermatologist

“I have been treating patients, primarily children, with scarring following burns and other types of trauma, for over 35 years. The use of the UltraPulse TotalFX active component has further enhanced our ability to rehabilitate scars both functionally and in their appearance.”

Matthias Donelan MD., Shriners Hospital Boston, MA

“I’ve had one version of the UltraPulse or another since 1994. It became my go to CO₂ laser. It’s very versatile, I can use it with different handpieces to accomplish many different things.... The UltraPulse laser is very safe. The safety typically is accentuated by the short pulse that allows for a very small zone of coagulation, which allows the wound to heal very quickly. The ability of this laser to cover a lot of ground quickly, safely and predictably, makes the procedure more enjoyable for the physician and the patient.”

E. Victor Ross, MD., Director, Laser and Cosmetic Unit Scripps Clinic, La Jolla, CA

“The CO₂ laser in my experience and belief is the first laser that should be incorporated into an aesthetic Dermatology practice. In my clinic it is the first Laser I turn on in the morning and the last laser I turn off. It is without a doubt the biggest profit generator among the many energy devices I own! Since my first CO₂ laser I purchased in 1979, I have treated over 85,000 patients with some type of energy device. I have now performed over 10,000 UltraPulse CO₂ laser Blepharoplasties since the launch of the UltraPulse 5000C laser in 1996. The UltraPulse in my hands is the Best in Class! I would highly recommend the Lumenis UltraPulse or AcuPulse to any physician looking to add a laser to their practice.”

B. Kent Remington, MD; Owner of Remington Aesthetic Dermatology Centre, Calgary, AB, Canada



STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
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Skin Treatments

1	Peer reviewed article	Tattoo removal	Combination of CO ₂ and Q-switched Nd:YAG lasers is more effective than Q-switched Nd:YAG laser alone for eyebrow tattoo removal	Mohammad Radmanesh, Zohreh Rafiei	Department of Dermatology, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran	Journal of Cosmetic and Laser Therapy, 2015; 17:65-68	2015	<p>BACKGROUND: The eyebrow tattoo removal using Q-switched lasers is usually prolonged. Other modalities may be required to enhance the efficacy and shorten the treatment course.</p> <p>OBJECTIVE: To compare the efficacy of Q-switched neodymium-doped yttrium aluminum garnet (Nd:YAG) laser alone versus combination of Q-switched Nd:YAG and Ultrapulse CO₂ lasers for eyebrow tattoo removal after a single session.</p> <p>PATIENTS AND METHODS: After local anesthesia, the right eyebrow of 20 patients was treated with Ultrapulse CO₂ laser with the parameters of 4 J/cm² and 3.2 J/cm² for the first and the second passes. Both eyebrows were then treated with 1064-nm and 532-nm Q-switched Nd:YAG laser. The spot size and pulse duration were 3 mm and 5 nanoseconds for both wavelengths, and the fluence was 7 J/cm² for 1064 nm and 3 J/cm² for 532 nm.</p> <p>RESULTS: The side treated with combination of Q-switched Nd:YAG and CO₂ lasers improved 75-100% in 6 of 20 patients versus only 1 of 20 in the side treated with Q-switched Nd:YAG alone. Similarly, the right side in 13 of 20 patients showed more than 50% improvement with combination therapy versus the left side (the monotherapy side), where only 6 of 20 cases showed more than 50% improvement. The Mann-Whitney test was 2.85 for the right side and 1.95 for the left side (P value = 0.007).</p> <p>CONCLUSION: Using Ultra pulse CO₂ laser enhances the efficacy of Q-switched Nd:YAG laser in eyebrow tattoo removal.</p>
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STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
2	Peer reviewed article	Xanthelasma Palpebrarum	Ultrapulse Carbon Dioxide Laser Ablation of Xanthelasma Palpebrarum: A Case Series	Vikas Pathania, Manas Chatterjee	Department of Dermatology, Military hospital, Bareilly, Uttar Pradesh, India	J Cutan Aesthet Surg. 2015 Jan-Mar; 8(1): 46-49	2015	<p>CONTEXT: Xanthelasma palpebrarum is the most common form of xanthomas. Albeit a benign entity, it is cosmetically disturbing and a frequently recurring dermatologic referral. Although the classical treatment option remains surgical excision, alternatively, chemical cauterization, cryosurgery and electrofulguration have all been tried in the past with mixed results. The use of laser systems such as carbon dioxide laser, Erb:YAG laser, Q-switched Nd:YAG laser, diode laser, pulsed dye laser and KTP laser have become popular in the treatment of these lesions. Recent literature suggests minimal pigmentary changes and scarring with the use of ultrapulse carbon dioxide laser treatment of these lesions.</p> <p>AIM: To study and evaluate the effectiveness of ultrapulse carbon dioxide laser ablation for treatment of xanthelasma palpebrarum.</p> <p>Materials and Methods: 10 patients presenting with bilateral xanthelasma palpebrarum, new and with recurrence were studied for results after a single treatment with ultrapulse carbon dioxide laser (10,600 nm; 100-200 Hz; 200-400 µsec). The follow-up time was 9 months.</p> <p>RESULTS: All lesions were treatable with a single-laser treatment session. Two patients (20%) developed recurrence during the follow-up period. Side effects included post inflammatory hyperpigmentation in two patients (20%), but no visible scarring was observed.</p> <p>CONCLUSIONS: The ultrapulse carbon dioxide laser is an effective and safe therapeutic alternative in treatment of xanthelasma palpebrarum.</p>
3	Peer reviewed article	Xanthelasma Palpebrarum	A prospective study comparing Ultrapulse CO ₂ laser and trichloroacetic acid in treatment of Xanthelasma palpebrarum	Khushbu Goel, MD, Kabir Sardana, MD, DNB, Vijay Kumar Garg, MD, DNB, MNAMS	Department of Dermatology, Venereology and Leprology, Maulana Azad Medical College & Associated Lok Nayak Hospital, New Delhi, India	Journal of Cosmetic Dermatology 2015, 14 (2): 130-9	2015	<p>BACKGROUND: Xanthelasma Palpebrarum is a type of xanthoma which presents as cosmetic concern.</p> <p>OBJECTIVE: To compare the efficacy of 30% TCA and UpCO₂ laser in XP.</p> <p>METHODS AND MATERIALS: Fifty patients with XP were categorized clinically into three groups. Patients in each group were alternately allocated to 30% TCA (Group A) and laser (Group B). TCA was applied weekly (maximum: 12 sessions), and laser sessions were given monthly (maximum: three sessions). The primary outcome measures were total patients cured, the number of sessions, and mean VAS at the end of treatment. The secondary outcome measures were total duration of treatment, side effects, and recurrence in follow-up (6 months) (P < 0.05 significant).</p> <p>RESULTS: In Group A, 14 of 25 and in Group B, 25 of 25 patients achieved complete cure (P < 0.05). The mean VAS was lower for Group A (patient: 4.56 vs. 5.36; physician: 4.64 vs. 5.44) [P < 0.05] with significant difference only for group III patients. Mean number of sessions was less with laser group (1.56 vs. 9.74), except in group I. There was no significant difference in pigmentary changes and recurrence.</p> <p>CONCLUSION: For clinically mild lesions, both TCA and laser are good options, but laser is a better option for severe lesions. Recurrence is a concern with both modalities.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
4	Peer reviewed article	Crow's Feet	Prospective randomized controlled study to determine the effect of topical application of botulinum toxin A for crow's feet after treatment with ablative fractional CO ₂ laser	Mahmoud BH, Burnett C, Ozog D	Department of Dermatology, Henry Ford Hospital, Detroit, MI, USA	Dermatol Surg Vol. 41 Suppl. pp. 75-81	2015	<p>BACKGROUND: Botulinum toxin Type A (BoNT A) for the treatment of facial wrinkles is delivered through local injection. We previously demonstrated that topical surface application of BoNT A has negligible cutaneous bioavailability and is not effective in treating wrinkles.</p> <p>OBJECTIVE: To determine the effect of BoNT A solution applied topically on the skin surface immediately after ablative fractional CO₂ laser treatment.</p> <p>METHODS: We conducted a randomized controlled trial for patients with periorbital wrinkles (crow's feet) (n = 10). Treatment was performed on both sides of the face with fractional ablative CO₂ laser followed by the application of topical solutions of BoNT A on one side and normal saline as control on the other side. Pretreatment assessment was performed, and at 1 and 4 weeks after treatment.</p> <p>RESULTS: There was a clinically significant greater degree of improvement in wrinkles after treatment with CO₂ laser, on the topically applied BoNT A side. Also, the difference between the 2 treatment types (laser followed by topical BoNT A vs laser followed by saline) at 1 week and at 1 month was statistically significant.</p> <p>CONCLUSION: Topically, noninjectable form of BoNT A applied on the surface of the skin after ablative fractional CO₂ laser is effective in the treatment of lateral periorbital wrinkles.</p>
5	Peer reviewed article	Photoaging	The use of the fractional CO ₂ laser resurfacing in the treatment of photoaging in Asians: five years long-term results	Jun Tan, MD ¹ ; Ying Lei, MD ¹ ; Hua-Wei Ouyang, MD ¹ ; Michael H. Gold, MD ^{2,3}	¹ The People's Hospital of Hunan Province, Department of Plastic & Laser Aesthetic Surgery, 1st Affiliated Hospital of Hunan Normal University, Chang-Sha, Hunan, P.R. China; ² Tennessee Clinical Research Center, Nashville, TN, USA; ³ Gold Skin Care Center, Department of Dermatology, Nashville, TN, USA	Laser Surg Med Vol. 46 No. 10, pp. 750-756	2014	<p>BACKGROUND AND OBJECTIVE: The purpose of this clinical paper is to explore the therapeutic effects, healing times, adverse effects, and maintenance periods of using a CO₂ fractional laser in the treatment of photoaging in Asian skin.</p> <p>STUDY DESIGN/MATERIALS AND METHODS: One fractional CO₂ laser procedure was performed on the full face in 56 patients with photoaging. Based on the Dover scoring system, we evaluated the degree of skin aging before treatment and at one-month post laser and at five years post laser therapy in 30 of the patients. Statistical analysis was performed by the Wilcoxon's method.</p> <p>RESULTS: Thirty of the treated patients have had follow-up for 5 years at this time. The photoaging scores in these thirty patients were significantly changed (P < 0.01) at one month, one year, and five years after the fractional laser treatment, as compared with their baseline. Adverse events seen during this analysis were found to be minimal and not of clinical significance.</p> <p>CONCLUSIONS: Fractional CO₂ laser resurfacing in the treatment of photoaging in Asians is a useful modality with results, for the first time, being shown to have continued efficacy for up to 5 years.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
6	Peer reviewed article	Acne scars	Comparison study of fractional carbon dioxide laser resurfacing using different fluences and densities for acne scars in Asians: a randomized split-face trial	Yuan XH, Zhong SX, Li SS	Department of Dermatology and Venereology, First Hospital of Jilin University, Changchun, China; Department of Dermatology and Venereology, Yanbian University Hospital, Yanji, China	Dermatol Surg Vol. 40 No. 5, pp. 545-552	2014	<p>BACKGROUND: Ablative 10,600-nm carbon dioxide (CO₂) fractional laser treatments have shown favorable outcomes for atrophic acne scars.</p> <p>OBJECTIVE: To compare the efficacy and complications of fractional CO₂ laser treatments with different fluences and densities for acne scars.</p> <p>METHODS: Twenty patients were treated using a single session of fractional CO₂ laser in Deep FX mode. In Group A (n = 10), half of the face was treated with 20 mJ, density 10% and the other half with 20 mJ, density 20%. In Group B (n = 10), half of the face was treated with 10 mJ, density 10% and the other half with 20 mJ, density 10%. Patients were evaluated at baseline and 3 days, 1 week, 1 month, and 3 months after the procedure.</p> <p>RESULTS: There was no significant difference in efficacy between different laser settings within the groups, although adverse effects were more evident in patients treated with higher densities or fluences.</p> <p>CONCLUSION: Fractional CO₂ laser treatment using the Deep FX mode may provide a significant efficacy with lower fluence and density with fewer complications than with higher energies for acne scars.</p>
7	Peer reviewed article	Resurfacing	Novel Post-treatment Care After Ablative and Fractional CO ₂ Laser Resurfacing	Duplechain JK, Rubin MG, Kim K	Department of Otolaryngology and Facial Plastic Surgery, Tulane University Medical Center, New Orleans, LA, USA	J Cosmet Laser Ther Vol. 16 No. 2, pp. 77-82	2014	<p>OBJECTIVE: This study evaluates a topical oxygen emulsion (TOE) to reduce adverse effects after skin rejuvenation with a fully ablative CO₂ laser alone and in combination with a fractional ablative CO₂ laser.</p> <p>MATERIALS AND METHODS: Patients (n = 100) seeking skin rejuvenation underwent CO₂ laser resurfacing. Group A patients (n = 34) received a single deep fractional laser treatment followed by application of Aquaphor immediately after treatment for 24 h and TOE every 6 h for the next 6 days. Group B patients (n = 66) underwent both deep fractional and fully ablative laser resurfacing followed by application of TOE every 6 h for 7 consecutive days.</p> <p>RESULTS: Patients in both groups showed clinical improvement and a 7.1% overall incidence of adverse effects which included milia (5.1% overall) and hyperpigmentation (3.1% overall). For milia, Group A and Group B individual adverse effect rates were 11.8% and 1.5%, respectively; for hyperpigmentation, individual rates were 0.0% and 3.1%, respectively.</p> <p>CONCLUSION: The elimination of petrolatum products in the post-skin care regimen has significantly reduced the incidence of post-procedure complications when compared with the use of TOE, resulting in the lowest incidence of complications in fully ablative or fractional resurfacing published thus far.</p>

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8	Peer reviewed article	Basal cell carcinomas	Combined carbon dioxide laser with photodynamic therapy for nodular and superficial basal cell carcinoma	Shokrollahi K, Javed M, Aeyung K, Ghattaura A, Whitaker IS, O'Leary B, James W, Murison M	Welsh Regional Burns and Plastic Surgery Unit, Morriston Hospital, Swansea, UK; Mersey Regional Burns and Plastic Surgery Unit, Whiston Hospital, Merseyside, UK	Annals of Plastic Surgery Vol.73 No. 5, pp. 552-558	2014	<p>BACKGROUND: Basal cell carcinomas (BCCs) are often seen by general practitioners, plastic surgeons, and dermatologists in the outpatient setting. Photodynamic therapy (PDT) and CO₂ laser when used as monotherapy have been successfully used to treat small BCC, with greatest success in the superficial histological subtype but have limitations compared to surgical excision due to a limited depth of penetration of PDT (2 mm absorption) limiting efficacy. We describe our experience of dual-modality treatment improving efficacy, cosmetic outcomes, and minimizing recurrence.</p> <p>METHODS: One hundred ten patients with a total of 177 lesions mainly on the head and neck were treated with combined therapy using an UltraPulse CO₂ laser and PDT using methyl aminolevulinate (METVIX) at the same sitting, with repeat PDT 1 week later. We evaluated recurrences, cosmetic outcomes, patient satisfaction, and costs.</p> <p>RESULTS: The mean age of patients was 67 years. The mean follow-up period was 32.2 months, with a range of 7.7 to 68.5 months. Eighty six lesions were followed up for more than 3 years. A total of 177 lesions were diagnosed and treated. Only biopsy-proven BCCs were included in this study. Histologically, 34 (19.2%) were superficial subtype, 50 (28.2%) nodular, 9 (5.08%) infiltrative, 7 (3.95%) morpheic, 3 (1.69%) mixed, and in 74 (41.8%) diagnosis was simply BCC. All lesions responded to treatment as assessed by clinical evaluation with regular follow-up. The total recurrence-free rate was 97.1%. In 88.1% lesions, a single cycle of treatment was required; 9.03% had 2 cycles and 0.56% underwent 3 cycles. In 3 of the patients, no data were available. Recurrences were noted in 5 (2.82%) cases. All recurrences were treated successfully, all but one using repeat laser-PDT. One patient underwent surgical excision. No significant complications were encountered, although mild hypopigmentation was occasionally seen and some discomfort is experienced with PDT.</p> <p>CONCLUSIONS: Combined CO₂ laser and PDT have equivalent cure rates to surgery for BCCs--notably of the nodular subtype--these modalities acting synergistically. This strategy provides cure often with scarless outcomes as illustrated. Laser with PDT is most appropriate for patients who value excellent cosmetic outcomes and where avoidance of an invasive procedure is an important factor. In addition, this modality comes into its own for specific groups of patients, such as those on Warfarin or those with diffuse or multiple lesions.</p>

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9	Peer reviewed article	Photoaging	Randomised Split-Face Study of Two Fractionalised Resurfacing Lasers to Treat Photo-ageing	Patrick Treacy, MD		Prime, Volume 3(7):46-60	2013	<p>INTERVENTIONS: UltraPulse® ActiveFX™ CO₂ laser (Lumenis Ltd., Yokneam, Israel) or DEKA SmartXide DOT™ CO₂ laser (DEKA S.r.l., Florence, Italy). All participants received regional anaesthetic of lignocaine 2% plus adrenaline, topical anaesthetic of ANESTop(R) 5mg statim and Valtrex (valacyclovir) 500mg twice daily for 8 days (i.e. herpetic prophylaxis mandatory for all patients). A post-procedural advice sheet was given to patients, and codeine with paracetamol as required.</p> <p>MAIN OUTCOME MEASURES: Participants' global assessment of improvement (five-point Dover scale) at 2, 4 and 12 weeks. Reduction of rhytides, tactile roughness, pigmentation and blood vessels were recorded along with the re-epithelialisation rate. The level of prolonged erythema and the presence of other side-effects such as infection were also recorded.</p> <p>RESULTS: Over 7 months, 23 subjects were randomised into a split-face study to compare the effects of two different fractionalised lasers on photoageing. Histological results initially showed that both lasers had a similar depth of penetration, but greater thermal penetration effect was noted with the ActiveFX compared with the SmartXide, with consequential formation of increased neocollagenesis. Twenty-three patients (92%) in the ActiveFX group felt that their split-face was completely better or improved compared with 21 (84%) in the SmartXide group (p<0.001). Fourteen patients (60.8%) said they preferred the SmartXide experience compared with nine patients (39.13%) in the ActiveFX group. One patient received full facial herpes. All patients received treatment to the neck.</p> <p>DISCUSSION: Although the two CO₂ lasers initially appeared to produce equivalent clinical improvement of lesions and rhytides, there was a marked difference noted at 3 months with the Lumenis ActiveFX showing superior new collagen formation.</p> <p>CONCLUSIONS: The Lumenis ActiveFX gives a superior aesthetic outcome of the two lasers when examined at 3 months. It appears to have a deeper dermal penetrative effect, superior neocollagenesis, and is more suitable for the removal of more difficult lesions, such as large congenital nevi. The DEKA SmartXide is an easy laser to use, but requires a separate plume extractor and re-do within a shorter period. Patients preferred the initial SmartXide effect.</p>

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10	Peer reviewed article	Skin rejuvenation	Random Fractional Ultrapulsed CO ₂ Resurfacing of Photodamaged Facial Skin: Long-Term Evaluation	Matteo Tretti Clementoni ¹ & Michela Galimberti ² & Athanasia Tourlaki ³ & Maximilian Catenacci ⁴ & Rosalina Lavagno ¹ & Pier Luca Bencini ²	¹ IDE (Istituto Dermatologico Europeo), Sezione di Laser e Chirurgia, Milan, Italy, ² ICLID (Istituto di Chirurgia e Laser-chirurgia in Dermatologia), ³ U.O. Dermatologia, Fondazione IRCCS Ca' Granda, Ospedale Maggiore Policlinico, Milan, Italy, ⁴ Skindermolaser, Rome, Italy	Lasers Med Sci. 2013 Feb;28(2):643-50	2013	Although numerous papers have recently been published on ablative fractional resurfacing, there is a lack of information in literature on very long-term results. The aim of this retrospective study is to evaluate the efficacy, adverse side effects, and long-term results of a random fractional ultrapulsed CO ₂ laser on a large population with photodamaged facial skin. Three hundred twelve patients with facial photodamaged skin were enrolled and underwent a single full-face treatment. Six aspects of photodamaged skin were recorded using a 5 point scale at 3, 6, and 24 months after the treatment. The results were compared with a non-parametric statistical test, the Wilcoxon's exact test. Three hundred one patients completed the study. All analyzed features showed a significant statistical improvement 3 months after the procedure. Three months later all features, except for pigmentations, once again showed a significant statistical improvement. Results after 24 months were similar to those assessed 18 months before. No long-term or other serious complications were observed. From the significant number of patients analyzed, long-term results demonstrate not only how fractional ultrapulsed CO ₂ resurfacing can achieve good results on photodamaged facial skin but also how these results can be considered stable 2 years after the procedure.
11	Peer reviewed article	Skin rejuvenation	Clinical Evaluation of the Safety and Efficacy of a Novel Superficial and Deep Carbon Dioxide Fractional System in the Treatment of Patients With Skin of Color	Michael H. Gold MD ^{a-d}	^a Gold Skin Care Center, Nashville, TN ^b Vanderbilt University School of Medicine, Vanderbilt University School of Nursing, Nashville, TN ^c Huashan Hospital of Fudan University, Shanghai, China ^d No 1 Hospital of China Medical University, Shenyang, China	J Drugs Dermatol. 2012;11(11):1331-1335.	2012	Fractional carbon dioxide (CO ₂) laser treatments have become a standard for treating a myriad of skin concerns. One of the biggest challenges facing us in this regard is treating the vast number of patients with skin of color who we encounter regularly in our practices. A novel superficial and deep CO ₂ ablative fractional device with both components coming from a single handpiece has been developed and is now being evaluated for patients with skin of color. In the 5 patients studied, side effects were not apparent and no postinflammatory hyperpigmentation was identified. This initial report suggests further evaluation is important to enhance our ablative fractional therapies.
12	Peer reviewed article	Skin cancer	Lesion Dimensions Following Ablative Fractional Laser Treatment in Non-Melanoma Skin Cancer and Premalignant Lesions	Katrine Togsverdbo ¹ & Uwe Paasch ² & Christina S. Haak ¹ & Merete Haed-erstaal ¹	¹ Department of Dermatology, Bispebjerg Hospital, University of Copenhagen, ² Department for Dermatology, Venerology and Allergology, University of Leipzig	Lasers Med Sci. 2012 May;27(3):675-9	2012	

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13	Peer reviewed article	Actinic keratosis	Intensified photodynamic therapy of actinic keratoses with fractional CO ₂ laser: a randomized clinical trial	K. Togsverd-Bo ¹ , C.S. Haak ¹ , D. Thaysen-Petersen ¹ , H.C. Wulf ¹ , R.R. Anderson ² , M. Hædesdal ^{1,2}	¹ Department of Dermatology, Bispebjerg Hospital, University of Copenhagen, Copenhagen, Denmark, ² Wellman Center for Photomedicine, Massachusetts General Hospital, Harvard Medical School, Boston, MA	British Journal of Dermatology Vol. 166, Issue 6, pp. 1262–1269	2012	<p>BACKGROUND: Photodynamic therapy (PDT) with methyl aminolaevulinate (MAL) is effective for thin actinic keratoses (AKs) in field-cancerized skin. Ablative fractional laser resurfacing (AFXL) creates vertical channels that facilitate MAL uptake and may improve PDT efficacy.</p> <p>OBJECTIVES: To evaluate efficacy and safety of AFXL-assisted PDT (AFXL-PDT) compared with conventional PDT in field-directed treatment of AK.</p> <p>METHODS: Fifteen patients with a total of 212 AKs (severity grade I–III) in field-cancerized skin of the face and scalp were randomized to one treatment with PDT and one treatment with AFXL-PDT in two symmetrical areas. Following curettage of both treatment areas, AFXL was applied to one area using 10 mJ per pulse, 0.12 mm spot, 5% density, single pulse (UltraPulse®, DeepFx handpiece; Lumenis Inc., Santa Clara, CA, U.S.A.). MAL cream was then applied under occlusion for 3 h and illuminated with red light-emitting diode light at 37 J cm⁻². Fluorescence photography quantified protoporphyrin IX (PpIX) before and after illumination.</p> <p>RESULTS: At 3-month follow-up, AFXL-PDT was significantly more effective than PDT for all AK grades. Complete lesion response of grade II–III AK was 88% after AFXL-PDT compared with 59% after PDT (P = 0.02). In grade I AK, 100% of lesions cleared after AFXL-PDT compared with 80% after PDT (P = 0.04). AFXL-PDT-treated skin responded with significantly fewer new AK lesions (AFXL-PDT n = 3, PDT n = 11; P = 0.04) and more improved photo-ageing (moderate vs. minor improvement, P = 0.007) than PDT-treated skin. Pain scores during illumination (6.5 vs. 5.4; P = 0.02), erythema and crusting were more intense, and long-term pigmentary changes more frequent from AFXL-PDT than PDT (P = not significant). PpIX fluorescence was higher in AFXL-pretreated skin [7528 vs. 12 816 arbitrary units (AU); P = 0.003] and photobleached to equal intensities after illumination (AFXL-PDT 595 AU, PDT 454 AU; P = 0.59).</p> <p>CONCLUSIONS: AFXL-PDT is more effective than conventional PDT for treatment of AK in field-cancerized skin.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
14	Peer reviewed article	Neocollagenesis	Immunohistological evaluation of skin responses after treatment using a fractional ultrapulse carbon dioxide laser on back skin	Xu XG, Luo YJ, Wu Y, Chen JZ, Xu TH, Gao XH, He CD, Geng L, Xiao T, Zhang YQ, Chen HD, Li YH	Department of Dermatology, No. 1 Hospital of China Medical University, Shenyang, China	Dermatologic Surgery Vol. 37 No. 8, pp. 1141-1149	2011	<p>BACKGROUND AND OBJECTIVE: Fractional photothermolysis (FP) lasers have been widely used in treating photo-aged skin, acne scars, and other skin conditions. Although plenty of clinical data have demonstrated the efficacy of the FP laser, only limited histologic studies have been available to observe serial short- to long-term skin responses.</p> <p>METHODS: Seven healthy Chinese women received one pass of fractional carbon dioxide laser treatment on the left upper back. Biopsies were taken at the baseline and 4 hours, 1 day, 5 days, 1 month, 3 months, 6 months, and 1 year after the procedure for hematoxylin and eosin stains, immunohistochemical evaluation (for heat shock proteins and elastin), and Verhoeff-iron-hematoxylin stains (for collagen and elastic fiber).</p> <p>RESULTS: Remarkably greater expression of heat shock protein (HSP)70 could be observed 4 hours after the procedure, which diminished significantly by 3 months, 6 months, and 1 year after the procedure. HSP47 reached its peak expression 1 month after the procedure, especially around microscopic thermal zones, and maintained its high level of expression 3 and 6 months after the procedure. Distinct new formation and remodeling of collagen and elastic fibers could be observed 3 and 6 months after procedure.</p> <p>CONCLUSION: FP-induced HSP expression and new formation of collagen and elastic fibers lasted as long as 6 months, longer than the previously acknowledged 3 months.</p>
15	Peer reviewed article	Striae	Treatment of Striae Distensae Using an Ablative 10,600-nm Carbon Dioxide Fractional Laser: A Retrospective Review of 27 Participants	Sang Eun Lee MD ¹ , Jong Hoon Kim MD ¹ , Sang Ju Lee MD, PhD ² , Jung Eun Lee MD ² , Jin Moon Kang MD ² , Young Koo Kim MD ² , Dongsik Bang MD, PhD ¹ , Sung Bin Cho MD ¹	¹ Department of Dermatology, Cutaneous Biology Research Institute, College of Medicine, Yonsei University, Seoul, Korea, ² Yonsei Star Skin and Laser Clinic, Seoul, Korea	Dermatol Surg 2010;36;1683-1690	2010	<p>BACKGROUND: Late-stage striae distensae is a type of scar characterized by a loss of collagen and elastic fibers in the dermis. Ablative 10,600-nm carbon dioxide fractional laser systems (CO₂ FS) have been used successfully for the treatment of various types of scars.</p> <p>OBJECTIVE: To investigate the therapeutic efficacy of using CO₂ FS for the treatment of striae distensae.</p> <p>METHODS: Twenty-seven women with striae distensae were treated in a single session with a CO₂ FS. Deep FX mode with a pulse energy of 10 mJ and a density of 2 (percent coverage of 10%) was used. Clinical improvement was assessed by comparing pre- and post-treatment clinical photographs and participant satisfaction rates.</p> <p>RESULTS: The evaluation of clinical results 3 months after treatment showed that two of the 27 participants (7.4%) had grade clinical 4 improvement, 14 (51.9%) had grade 3 improvement, nine (33.3%) had grade 2 improvement, and two (7.4%) had grade 1 improvement. None of the participants showed worsening of their striae distensae. Mean clinical improvement score was 2.6. Surveys evaluating overall participant satisfaction administered after the treatment was completed showed that six of the 27 participants (22.2%) were very satisfied, 14 (51.9%) were satisfied, five (18.1%) were slightly satisfied, and two (7.4%) were unsatisfied.</p> <p>CONCLUSION: Our observations demonstrated that the use of CO₂ FS can have a positive therapeutic effect on late-stage striae distensae.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
16	Peer reviewed article	Histopathological evaluation	TUNEL Assay to Characterize Acute Histopathological Injury Following Treatment With the Active and Deep FX Fractional Short-Pulse CO ₂ Devices	Jordan P. Farkas, MD; James A. Richardson, DVM, PhD; Spencer A. Brown, PhD; Becca Ticker; Evan Walgama; Clint F. Burrus, BA; John E. Hoopman; Fritz E. Barton, MD; Jeffrey M. Kenkel, MD	University of Texas Southwestern Medical Center, Dallas, TX, USA.	Aesthetic Surgery Journal. 30(4) 603-613.	2010	<p>BACKGROUND: This is a report of the histopathological evaluation of the acute damage profile in human skin following treatment with two novel short-pulsed fractional carbon dioxide resurfacing devices used independently and in combination <i>in vivo</i>.</p> <p>METHODS: The panni of eight abdominoplasty patients were treated with either the Active FX, the Deep FX (Lumenis Ltd., Yokneum, Israel), or a combination of the two (Total FX) prior to the start of the excisional surgical procedure. Multiple combinations of energies, pulse widths, and densities were evaluated for each device. After surgical removal (two to five hours), each pannus was immediately biopsied and samples were processed for histopathological evaluation.</p> <p>RESULTS: The Active FX system resulted in extensive epidermal injury with wide shallow ablation craters that, at higher fluences, extended through the basement membrane of the epidermis into the papillary dermis. The Deep FX fractional treatment caused deep microcolumns of ablation penetrating up to 3 to 4 mm from the epidermal surface into the deep reticular dermis with a variable rim of coagulated collagen surrounding each ablation column.</p> <p>CONCLUSIONS: The <i>in vivo</i> histopathological evaluation of these devices furthers our understanding of the fundamental laser/tissue interaction following treatment with each device independently and in combination.</p>
17	Poster	Skin furrows	Two-Years Treatment to Brazilian Patients With Dark Skin By Deep Fractional Carbon Dioxide Laser (TotalFX) Using Tridimensional Documentation	Elaine Marques, Guilherme Almeida, Leticia Almeida, Andrezza Facci, Marcia Paes, Thais Notarangi	Hospital Sirio Libanes, Sao Paulo, Brazil	ASLMS Poster Session	2010	<p>BACKGROUND: Dark skin type III to V Fitzpatrick, due to its melanocytic intolerance to heat and ablation, tends to present post-inflammatory hyperpigmentation (PIH) with any kind of American Society for Laser Medicine and Surgery Abstracts 27ablative procedure including standart fractional CO₂. The incidence of PIH in previous studies are bettween 37% to none. The objective of this work is to present two years of follow up of 45 brazilian dark skinned patients with acne scars and/or photoaging skin treated once with TOTAL FX (UltraPulse) with a specific factory protocol.</p> <p>STUDY: 45 patients with phototype III–V, with clinical indication of acne scar and/or photoaging skin were treated with TOTAL FX. Each one had been treated under the factory protocol with one pass of DEEP FX device exactly over the scars and rhytides, with energy level ranged from 5–25 mJ, pattern 1–4, size 2, and density 2–3, followed by full-face single pass with the ACTIVE FX with energy level used ranged from 70–125 mJ, 150 Hz, pattern 3, size 2–5, and density 2–3 in a vectorial fashion way over the lax skin. Patients were followed-up up to 2-years. Responses and side effects were recorded with VECTRA 3D, patient's and physicians' assessment.</p> <p>RESULTS: Significant improvement on the appearance is noticed. 100% of them had mild and transient PIH; one with intense and transient PIH; one with intense and long term PIH; one with late hypochromia; and one with mild hypertrophic scars on the neck. Post-inflammatory hyperpigmentation, delay onset hypopigmentation were observed and had resolved by 4 months post-treatment.</p> <p>CONCLUSION: This study indicates that in dark-skinned subjects, TOTAL FX is highly effective in the improvement of acne scars and photoaging appearance and is safe even tropical sunny country as Brazil. Using the regular factory protocol, the main temporary adverse effect is mild PIH. We suggest further studies, with lower energies and densities.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
18	Peer reviewed article	Melasma	The Treatment of Melasma with Topical Creams Alone, CO ₂ Fractional Ablative Resurfacing Alone, or a Combination of the Two: A Comparative Study	¹ Mario A. Trelles, M.D. Ph.D, ^{1,2} Mariano Velez, M.D., ³ Michael H. Gold, M.D.	¹ Instituto Médico Vilafortuny, Antoni de Gimbernat Foundation, Cambrils, Spain. ² Department of Dermatology, Hospital del Mar, Barcelona, Spain, ³ Gold Skin Care Center, Tennessee Clinical Research Center, Nashville, TN	Journal of Drugs in Dermatology 2010 Apr;9(4):315-22.	2010	<p>BACKGROUND: Melasma is a difficult entity to treat. Topical creams or chemical peels offer some success, and the newer fractional lasers have also been proposed to be useful. This three-armed study compares topical creams, CO₂ ablative fractional resurfacing and the combination of both modalities.</p> <p>PATIENTS AND METHODS: Thirty females with melasma, mean age of 38 years, skin types II-IV, were allocated to three groups: group A received treatment with Kligman's formula maintenance topical cream program; group B, CO₂ fractional resurfacing using high power, fixed pulse width and low frequency; and group C, both laser and maintenance topical cream treatment. Subjective patient and clinician assessments based on melasma area severity index (MASI) scores were made at baseline, one, two, six and 12 months, and the satisfaction index (SI) and overall efficacy calculated.</p> <p>RESULTS: All patients completed the study. The SI and overall efficacy in groups A, B and C were 100% at one month in all groups but progressively decreased in further assessments except for group C in which better scores were maintained throughout. MASI scores for group C were statistically significantly improved compared to A and B at six and 12 months (P < 0.001 for both).</p> <p>CONCLUSION: The fractional CO₂ laser and topical cream regimen produced good, well-maintained results in melasma treatment compared with the monotherapy groups.</p>
19	Peer reviewed article	Histological evaluation	Histological and Clinical Response to Varying Density Settings with Fractionally Scanned Carbon Dioxide Laser	Raminder Saluja, M.D., Jane Khoury, M.D., Susan Detwiler, M.D., Mitchel P. Goldman, MD.	American Academy of Cosmetic Surgery Fellow, Dermatology/ Cosmetic Laser Surgery Associates of La Jolla, Inc., CA, USA	Journal of Drugs in Dermatology 2009 Jan;8(1):17-20	2009	<p>OBJECTIVE: An evaluation of the histological and clinical response to varying density settings (-10%, 0, and 10% overlap) with a fractionally scanned CO₂ laser.</p> <p>STUDY DESIGN: Clinical and histological study evaluating abdominoplasty excised tissue for depth of penetration and width of tissue ablated with varying density and energy settings utilizing a scanned microsecond pulsed CO₂ laser. These parameters were correlated clinically with patients treated with similar density settings.</p> <p>PARTICIPANTS: Fifteen patients were enrolled with 5 patients in each group: group 1 (density 1 settings), group 2 (density 2 settings) and group 3 (density 3 settings).</p> <p>MAIN OUTCOME: Histological differences of width and depth of tissue ablated with varying density settings and correlation with photodamage improvement clinically.</p> <p>METHODS: Six samples of excised abdominoplasty tissue were treated with increased energy and density settings and were evaluated histologically. Clinically, 15 patients with photodamage to the face were randomized to receive a fractional CO₂ laser treatment with density levels ranging from 1 to 3.</p> <p>RESULTS: Microarrays of tissue injury were visualized with multiple areas of superficial to full-thickness epidermal thermal damage. As energy increased (90 W to 100 W), the width of basophilic coagulation of the subepidermal collagen increased. Increased density paralleled increased depth of penetration of subepidermal coagulation. Patient assessment of discomfort, erythema, edema, and satisfaction with the procedure was proportional to increasing densities.</p> <p>CONCLUSION: A fractional CO₂ laser produces photorejuvenation, erythema, edema and discomfort in proportion with the depth and extent of epidermal and subepidermal thermal damage.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
20	Peer reviewed article	Acne scars	Non-ablative 1550-nm erbium-glass and ablative 10 600-nm carbon dioxide fractional lasers for acne scars: a randomized split-face study with blinded response evaluation	¹ SB Cho, ² SJ Lee, ¹ S Cho, ¹ SH Oh, ² WS Chung, ² JM Kang, ² YK Kim, ³ DH Kim	¹ Department of Dermatology and Cutaneous Biology Research Institute, Yonsei University College of Medicine, Seoul, Korea, ² Yonsei Star Skin & Laser Clinic, Seoul, Korea, ³ Department of Dermatology, Pochon CHA University, College of Medicine, Seongnam, Korea	European Academy of Dermatology and Venereology, p1-5	2009	<p>BACKGROUND: Non-ablative 1550-nm erbium-doped fractional photothermolysis systems (FPS) and 10 600-nm carbon dioxide fractional laser systems (CO₂ FS) have been effectively used to treat scars.</p> <p>OBJECTIVE: We compared the efficacy and safety of single-session treatments of FPS and CO₂ FS for acne scars through a randomized, split-face, evaluator-blinded study.</p> <p>METHODS: Eight patients with acne scars were enrolled in this study. Half of each subject's face was treated with FPS and the other half was treated with CO₂ FS. We used a quartile grading scale for evaluations.</p> <p>RESULTS: At 3 months after the treatment, the mean grade of improvement based on clinical assessment was 2.0 ± 0.5 for FPS and 2.5 ± 0.8 for CO₂ FS. On each side treated by FPS and CO₂ FS, the mean duration of post-therapy crusting and scaling was 2.3 and 7.4 days respectively and that of post-therapy erythema was 7.5 and 11.5 days respectively. The mean VAS pain score was 3.9 ± 2.0 with the FPS and 7.0 ± 2.0 with the CO₂ FS.</p> <p>CONCLUSION: We demonstrated the efficacy and safety of single-session acne scar treatment using FPS and CO₂ FS in East Asian patients. We believe that our study could be used as an essential reference when choosing laser modalities for scar treatment.</p>
21	Peer reviewed article	Skin rejuvenation	Split-face comparison of fractional ablative CO ₂ and fractional nonablative laser devices for skin rejuvenation	James A. Heinrich, M.D., F.A.C.S.	Pacific Coast Cosmetic & Laser Medical Center, Inc. 26730 Crown Valley Parkway, Suite 250 Mission Viejo, CA 92691	Lumenis Inc.	2008	<p>BACKGROUND AND OBJECTIVE: Deep laser skin resurfacing is associated with prolonged downtime and healing time. Our objective was to compare the efficacy, downtime, and healing time of a fractional, ablative CO₂ and a fractional photothermolytic (FP) nonablative laser device.</p> <p>METHODS: Ten subjects (9 women) with visible cutaneous photodamage were randomized to receive a single treatment with a CO₂ device (UltraPulse® with ActiveFXTM, Lumenis Inc.) on one side of the face and five treatments with an FP device (Fraxel SRTM, Reliant Technologies) on the other side of the face. Efficacy and healing parameters were clinically and photographically evaluated before and after treatment. Collagen remodeling was assessed histologically on both sides of the face.</p> <p>RESULTS: Clinical benefits after a single treatment with the CO₂ device were equivalent to those after five treatments with the FP device. The treatment duration with the CO₂ device was 6.2 minutes compared to a mean of 24.3 minutes with the FP device, a statistically significant difference (p = 0.0002); the swelling after a single CO₂ treatment resolved within 4.3 days vs. a total of 13.0 days for the five FP treatments; posttreatment redness resolved in 5.3 days with the CO₂ device compared to a mean of 16.5 days (5 treatments) with the FP device; duration of posttreatment discomfort was 3.3 days with the CO₂ device compared to a mean of 6.0 days (5 treatments) with the FP device; and the downtime was 4.2 days with the CO₂ device compared to a mean of 6.5 days (5 treatments) with the FP device. Histological studies showed that collagen stimulation was 50% greater with the CO₂ device. Clinically, the investigator observed a 30% improvement in wrinkles on the CO₂-treated side and a 10% to 15% improvement on the side treated with the FP device.</p> <p>CONCLUSION: The efficacy and safety associated with fractional, ablative CO₂ laser treatment (ActiveFXTM) appears to be superior to that of the nonablative FP device (Fraxel SRTM).</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
22	Peer reviewed article	Basal Cell Carcinomas	Combined CO ₂ Laser With Photodynamic Therapy for the Treatment of Nodular Basal Cell Carcinomas	Iain S. Whitaker, BA(Hons), MBBCHIR, MA Cantab, MRCS, Kayvan Shokrollahi, BSC, MB, CHB, MSC, LL.M, MRCS(ENG), William James, BSC, ANUJ Mishra, MS, MRCS, Parkash Lohana, MRCS, Maxwell C. Murison, FRCS, FRCS PLAST	Welsh Centre for Burns and Plastic Surgery, Morriston Hospital.	Ann Plast Surg 2007;59: 484 - 488	2007	<p>BACKGROUND: Basal cell carcinomas (BCC) are often seen by plastic surgeons and dermatologists in the outpatient setting. Treatment usually necessitates excision of these lesions with an appropriate margin guided by published recommendations, often resulting in less than ideal cosmetic outcomes, especially if local flaps or skin grafts are required for reconstruction. Photodynamic therapy (PDT) and CO₂ laser when used as monotherapy have been successfully used to treat BCCs, with greatest success in the superficial histologic subtype. These modalities when used alone have a number of limitations when compared with surgical excision, including a limited depth of penetration of PDT (2-mm absorption), which potentially limits the efficacy of treatment of nodular BCCs greater than this thickness or which are deeply invasive. We describe our positive experiences of combination therapy with both modalities in 12 patients, with the aim of improving treatment efficacy.</p> <p>METHODS: Twelve patients with 13 biopsy-proven nodular BCCs on the head and neck were treated with combined therapy using an Ultra Pulse CO₂ and PDT using Methyl Aminolevulinate (METVIX) and the Aktillite 16 LED lamp.</p> <p>RESULTS: A total of 12 patients (13 lesions) were treated using combined CO₂ laser/PDT. Nine were male and 2 female; 1 had gender reassignment. The mean age was 67, with a range of 54 to 85. The mean follow-up period was 18.1 months, with a range of 7 to 26 months. All lesions responded to treatment as assessed by clinical evaluation, with regular follow-up on a 3-month basis. There were no recurrences during this time period. The only complications encountered were mild hypopigmentation in 2 cases and mild discomfort experienced with PDT.</p> <p>CONCLUSION: In this study, CO₂ laser and PDT appear to play a synergistic role in the treatment of nodular basal cell carcinomas. Both the surgical team and the patients have been pleased with the results. The mean recurrence-free follow-up was 18.1 months. This apparently synergistic treatment appears most appropriate for patients who value excellent cosmetic outcome over the inconvenience of making additional visits to the clinic or where avoidance of an invasive procedure is an important factor.</p>
23	Peer reviewed article	Laser Skin Resurfacing	Safe and Effective Carbon Dioxide Laser Skin Resurfacing of the Neck	Suzanne L. Kilmer M.D., Vera A. Chotzen M.D., Susan K. Silma M.D., Marla L. McClaren M.D.	Laser & Skin Surgery Center of Northern California, Sacramento, California	Lasers Surg. Med. 38:653-657, 2006	2006	<p>CO₂ laser skin resurfacing remains the gold standard for treatment of photoaged facial skin. It can be used onto the neck to further blend in the treated area with non-treated, adjacent photodamaged skin as well as improve the superficial textural quality of the neck skin. This article provides an overview of laser skin resurfacing of the neck, including pre-operative evaluation, patient education and selection, laser settings and technique used, post-operative care, and identification and treatment of possible complications.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
24	Peer reviewed article	Perioral Rhytides	Ablative Versus Non-Ablative Treatment of Perioral Rhytides. A Randomized Controlled Trial With Long-Term Blinded Clinical Evaluations and Non-Invasive Measurements	Lene Hede-lund M.D., Peter Bjer-ring, M.D., Ph.D., Henrik Egekvist, Ph.D., Merete Haedersdal, M.D., Ph.D	Department of Derma-tology, Copenhagen University Hospital, Bispebjerg Hospital, Denmark.	Lasers in Surgery and Medicine, 38:129-136, 2006.	2006	<p>BACKGROUND AND OBJECTIVE: To compare efficacy and side effects of CO₂ laser resurfacing and intense pulsed light (IPL) rejuvenation for treatment of perioral rhytides.</p> <p>METHODS: Twenty-seven female subjects with perioral rhytides (class I-III) were randomly treated with either CO₂ laser or IPL (three monthly treatments). Efficacy was evaluated by patient self-assessments and blinded photographs up to 12 months postoperatively. Side effects were assessed clinically. Non-invasive measurements included: trans epidermal water loss (TEWL), skin reflectance, skin elasticity, and ultrasound.</p> <p>RESULTS: CO₂ laser resurfacing resulted in higher degrees of patient satisfaction and clinical rhytide reduction compared to IPL rejuvenation up to 12 months postoperatively (patient evaluations, P < 0.05) (observer evaluations, P < 0.008). Laser-induced side effects included erythema, dyspigmentation, and milia whereas no side effects were observed after IPL rejuvenation. Non-invasive measurements showed a significant higher reduction of the subepidermal low-echogenic band in CO₂ laser treated areas versus IPL treated areas (12 months postoperatively, P < 0.001). Skin elasticity (expressed as Young's modulus) increased in both groups (P = ns). One month postoperatively a significant increase in TEWL values (P < 0.009) and skin redness% (P < 0.02) was found in CO₂ laser treated patients versus IPL treated patients. No significant differences were seen in skin pigmentation% during the observation period.</p> <p>CONCLUSION: CO₂ laser resurfacing induces a significantly higher degree of clinical rhytide reduction followed by considerably more side effects compared to IPL rejuvenation in a homogeneous group of patients</p>
25	Peer reviewed article	Photoaging	Ablative Treatment of Photoaging	Divya Railan, Suzanne Kilmer	Laser and Skin Surgery Center of Northern Cali-fornia, Sacramento	Dermatologic Therapy, Vol 18, 2005	2005	Despite the burgeoning options available for skin rejuvenation, the benefits of laser skin resurfacing in trained hands remains unequalled. This article will review the preoperative evaluation, lasers and techniques used, postoperative course, and possible complications.
26	Peer reviewed article	Facial Rhytides	Facial Rhytides - Sub-surfacing or Resurfacing? A Review	Hortensia Grema M.D. ¹ , Bärbel Greve M.D. ² , Christian Raulin M.D. ¹	¹ Laserklinik Karlsruhe, Karlsruhe, Germany, ² Department of Der-matology, University Hospital of Heidelberg, Heidelberg, Germany	Lasers Surg. Med. 32:405-412, 2003.	2003	<p>STUDY DESIGN/ BACKGROUND AND OBJECTIVES: Currently, ablative laser therapy (with CO₂/Er:YAG lasers) is considered an effective and promising method of skin rejuvenation. The induction of collagen synthesis was observed after treatments with the CO₂ laser and with the long-pulsed Er:Yag laser. In past years, the undesirable side effects and risks of these methods have led to intensified research efforts in the fields of non-ablative facial rejuvenation as well as subsurfacing by means of non-ablative laser systems and intense pulsed light systems. The objective is to achieve selective, heat-induced denaturalization of dermal collagen that leads to subsequent reactive synthesis of neocollagen but does not damage the epidermis. This article reviews the use of different types of lasers and intense pulsed light sources for the non-ablative treatment of facial rhytides.</p> <p>RESULTS: The results of numerous clinical and histological investigations have recently indicated that these new technologies are successful. Some studies demonstrated remarkable effects with non-ablative systems; others, however, showed only limited cosmetic improvement or none at all.</p> <p>CONCLUSIONS: After critical review and assessment of current literature on the treatment of rhytides, we have found that non-ablative methods do not appear to be a comparable alternative to ablative skin resurfacing in terms of their efficacy and side effects.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
27	Peer reviewed article	Simultaneous Rhytidectomy and Full-Face Carbon Dioxide Laser Resurfacing	Simultaneous Rhytidectomy and Full-Face Carbon Dioxide Laser Resurfacing: A Case Series and Meta-Analysis	Brenton B. Koch, Stephen W. Perkins	Carithers and Koch Facial Plastic Surgery	Arch Facial Plast Surg. 2002 Oct-Dec;4(4):227-33.	2002	<p>BACKGROUND: The combination of facial rhytidectomy and full-face carbon dioxide laser resurfacing would theoretically provide for superior aesthetic rejuvenation of the face, but some reports have advised against this combination (particularly using chemical peel). However, significant differences exist between previous studies of combination therapy.</p> <p>OBJECTIVE: To evaluate these differences and determine protocol for care and carbon dioxide laser settings for resurfacing when done in combination with full-face rhytidectomy.</p> <p>DESIGN: (1) A case series of 30 patients treated in a private practice over 26 months with simultaneous rhytidectomy and full-face laser resurfacing; (2) a meta-analysis of 3 and 1/2 years of literature reporting the same combination procedure (453 patients). Variables evaluated include rhytidectomy technique, laser type and settings, postoperative care, complications, and outcome analyses.</p> <p>OUTCOME MEASURES: Rate of postoperative complications, premorbidity, previous surgery, concurrent procedures, postoperative dressings, and follow-up status.</p> <p>SELECTION: Referred sample patients were determined by the single operating surgeon who performed all procedures. For literature meta-analysis, only peer-reviewed studies of simultaneous rhytidectomy and full-face laser resurfacing from January 1997 through May 2000 were included.</p> <p>RESULTS: Among the 30 patients treated over our 26-month case series accession period, there was no evidence of flap loss, skin slough, infection (viral or cellullitic), or hypopigmentation. Settings for laser resurfacing were determined. Of the 453 patients included in our meta-analysis, 1 (a smoker) sustained a 2-cm full-thickness flap necrosis, and 4 sustained varying degrees of skin slough in the postauricular area without full-thickness necrosis. The complication rate did not differ from that of rhytidectomy alone.</p> <p>CONCLUSION: Simultaneous rhytidectomy and full-face carbon dioxide laser resurfacing can safely provide a dual cosmetic benefit option for aesthetic rejuvenation of the face.</p>
28	Peer reviewed article	Rhytidectomy and Full-Face Carbon Dioxide Laser Resurfacing	The Importance of Blood Supply in Combination Rhytidectomy and Full-Face Carbon Dioxide Laser Resurfacing	Paul J. Carniol, M.D.		Arch Facial Plast Surg 4(4):234-234 (2002)	2002	

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
29	Peer reviewed article	Rhinophyma	Excision of Rhinophyma with a Laser Scanner Handpiece- A Modified Technique	Charalambos E. Skoulakis, Chariton E. Papadakis, Dimitrios G. Papadakis, John G. Bizakis, Dionysios E. Kyrmizakis, Emmanuel S. Helidonis	Department of Otolaryngology, University of Thessaly School of Medicine, Larissa, Greece.	Rhinology, 40:83-87, 2002.	2002	Rhinophyma is a slowly progressive, benign dermatological disorder of the tip of the nose. The most widely accepted theory is that rhinophyma is the end stage result of chronic acne rosacea. The primary reason for excision of rhinophyma is cosmetic deformity. However, nasal obstruction may present, as rhinophyma may obstruct nasal vestibules. Surgery is the treatment of choice for rhinophyma. Medical therapy has not given satisfactory results. The surgical treatment modalities are divided into two main groups. The first is complete excision, with primary closure for small lesions, or skin grafting for large lesions. The second group includes incomplete excision followed by re-epithelialization from the remaining glandular epithelium. The carbon dioxide (CO ₂) laser has been advocated for excision of rhinophyma. Newer instrumentation, such as Swiftlase and SurgiTouch (ESC Sharplan) or Ultrapulse (Coherent) is more effective in vaporization and carbonization resulting in better hemostasis (Ries and Speyer, 1996). In this report, 7 patients with rhinophyma treated with the Swiftlase are reviewed. The surgical technique, the complications and the follow-up are discussed.
30	Peer reviewed article	Periungual Fibromas	Use of CO ₂ Laser in the Treatment of Periungual Fibromas associated with Tuberous Sclerosis	Berlin AL, Billick RC.	Department of Dermatology, University of Illinois College of Medicine, Chicago, Illinois, USA.	Dermatol. Surg., 28:434-436, 2002.	2002	BACKGROUND: Tuberous sclerosis complex is an autosomal dominant disorder with variable clinical expression. In severe forms it may involve almost any organ system. Periungual fibromas are a common cutaneous manifestation and a frequent source of cosmetic and functional concern. Current treatment involves surgical excision of the lesions. OBJECTIVE: To evaluate laser vaporization of periungual fibromas and to compare results to the standard surgical treatment. METHODS: A patient with tuberous sclerosis and recurrent periungual fibromas was treated with a continuous wave CO ₂ laser in sequential focused and defocused modes at 10-15 W. RESULTS: Laser treatment required approximately 10 seconds per lesion and produced no intraoperative bleeding. The wounds healed well with good cosmetic results. CONCLUSION: Though similar to conventional surgery in terms of cosmetic satisfaction, CO ₂ laser presents a viable alternative to surgery through significantly reduced treatment time and amount of bleeding.

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
31	Peer reviewed article	Pyogenic Granuloma	The Combined Continuous-Wave/Pulsed Carbon Dioxide Laser for Treatment of Pyogenic Granuloma	Christian Raulin, M.D.; Baerbel Greve, M.D.; Stefan Hammes, M.D.	Laserklinik Karlsruhe, Karlsruhe, Germany.	Arch. Dermatol., 138:33-37, 2002.	2002	<p>BACKGROUND: Pyogenic granuloma is a frequently diagnosed, benign vascular lesion. Objectives: To present the use of the combined continuous-wave/pulsed carbon dioxide (CO₂) laser as an innovative therapeutic method, to compare it with established methods, and to assess its results.</p> <p>DESIGN: Prospective observational study between March 1998 and July 2000, comprising 1 treatment session with 6- week and 6-month follow-up examinations and evaluations.</p> <p>SETTING: Private or institutional practices as well as ambulatory or hospitalized care. Patients: One hundred patients with pyogenic granuloma selected from a population-based sample.</p> <p>INTERVENTIONS: Treatment with CO₂ laser. The laser was first used in continuous mode (power, 15 W) and then in pulsed mode (pulse length, 0.6-0.9 milliseconds; energy fluence, 500 mJ/pulse).</p> <p>MAIN OUTCOME MEASURE: Complete resolution of treated granuloma pyogenicum.</p> <p>RESULTS: Pyogenic granuloma was removed completely in 1 treatment session in 98 patients without recurrence. In 88 cases there were no visible scars; in 10 cases slight textural changes of the skin were observed. Hypertrophic scars or keloids did not occur. Sixty-three patients were very satisfied with the result of the treatment, 37 were satisfied (ie, 100% patient satisfaction), and none indicated that they were not satisfied. No permanent hypopigmentation, hyperpigmentation, or erythema was observed.</p> <p>CONCLUSIONS: The combined continuous-wave/pulsed CO₂ laser is our treatment of choice for pyogenic granuloma because this kind of laser is widely available, produces excellent results with few adverse effects, is easy to use, yields low recurrence rates, and is well tolerated by most patients.</p>
32	Peer reviewed article	Facial Rejuvenation	Minimally Invasive Facial Rejuvenation Endolaser Mid-Face Lift	¹ Ana Zulmira Diniz Badin, M.D., ² Carlos Casagrande, M.D., ³ Thomas Roberts III, M.D., ⁴ Renato Saltz, M.D., ¹ Lea Mara Moraes, M.D., ⁵ Mariângela Santiago, M.D., ¹ Marlon Gouveia Chiratti, M.D.	¹ Curitiba, Brazil, ² Florianópolis, Brazil, ³ Spartanburg, SC, USA, ⁴ Salt Lake City, UT, USA, ⁵ São Paulo, Brazil	Aesthetic Plast Surg. 25:447-53, 2001.	2001	<p>Endolaser mid-face lift was performed on patients in a multi-center study over a 36-month period (Feb. 1998 to Feb. 2001). It permits significant facial rejuvenation through small incisions. This technique achieves aesthetic results and wider rejuvenation while being less traumatic and creating minimal morbidity. Combined with other procedures, it rejuvenates the face by three strategic methods: soft tissue suspension, reversal of photo aging, and correction of the depletion of volume. To achieve this triple result, the mid-face lift is performed by endoscopic approach, and in every case is combined with the endoscopic lift of the frontal area. Laser resurfacing was used to reverse skin photo damage. The Ultrapulse CO₂ laser and/or the Ultrafine Erbium YAG(Coherent, Inc, Palo Alto, CA) were used. The third combined procedure was the introduction of fat graft to compensate the atrophy/ptosis of fat and the depletion of bone mass (other filling materials besides fat may be used, depending on the preference of the surgeon). Our method of fixation using the Casagrande Needle (an evolution of Reverdin Needle) makes the mechanical purchase on the tissues to be suspended much easier, permitting the intra-oral and/or infra-orbital incisions to be eliminated. The present study of the technical evolution of the endolaser mid-face lift method allows us to conclude that a very satisfactory outcome has been reached, offering patients a minimally invasive procedure, which can be performed under local anesthesia, with low morbidity, imperceptible incisions, and an excellent long-term result.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
33	Peer reviewed article	Resurfacing of Photodamaged Skin	Resurfacing of Photodamaged Skin on the Neck with an UltraPulse® Carbon Dioxide Laser	^{1,2} Richard E. Fitzpatrick, M.D., ^{1,2} Mitchel P. Goldman, M.D., ³ Suchai Sriprachya-Anunt, M.D.	¹ Division of Dermatology, Department of Medicine, University of California at San Diego, San Diego, California. ² Dermatology Associates of San Diego County, Inc., San Diego, California. ³ Pornkasem Skin and Laser Center, Bangkok, Thailand	Lasers in Surgery and Medicine 28:145-149 (2001)	2001	<p>BACKGROUND AND OBJECTIVE: Successful treatment of facial wrinkles with carbon dioxide or erbium laser resurfacing brings about a more youthful appearance of the skin on the face. A variable degree of contrast with the untreated skin on the neck prompts many patients to request treatment for photodamaged skin on the neck. The objective is to investigate the feasibility of resurfacing photodamaged skin on the neck with the UltraPulse((R)) carbon dioxide laser.</p> <p>STUDY DESIGN/ MATERIALS AND METHODS: The study was carried out in two phases. During the first phase, a small area on the upper neck was tested with three different parameters. The best parameter was then used to treat the neck area in a single pass in 10 cases in the second phase. Patients were then evaluated at 3-6 months.</p> <p>RESULTS: The three parameters tested were 200 mJ at CPG settings of pattern 3, size 9, density 6, 300 mJ at CPG 3-9- 5, and 300 mJ at CPG 3-9-6. The latter seemed to achieve the best results, and there were no complications at any test sites. This setting was used to treat the whole anterior and anterolateral part of the neck with a single pass, wiping away the resultant epidermal debris. Moderate improvement in color and texture, but no improvement in wrinkling, were observed at 3-6 months. However, a mild degree of patchy hypopigmented scarring in the lower neck was encountered in three cases, as well as one other case of patchy hypopigmentation without textural changes.</p> <p>CONCLUSIONS: Despite some obvious improvements, the risk of scarring and hypopigmentation with the tested parameters out-weighs the potential benefits. The lower part of the neck responded very differently from the upper part. Alternative strategies to achieve better results are discussed.</p>
34	Peer reviewed article	Vitiligo	Treatment of Vitiligo with Suction Epidermal Grafting by the Use of an UltraPulse CO ₂ Laser with a Computerized Pattern Generator	Chang-Keun Oh M.D., Ph.D, Jung-Hoon Cha M.D., Jae-Young Lim M.D., Ju- Hyeon Jo M.D., Sung-Jun Kim M.D., HO-Sun Jang M.D., Ph.D, Kyung-Sool Kwon M.D., Ph.D	Department of Dermatology, Pusan National University College of Medicine, Pusan, Korea	Dermatologic Surgery, 27: 565-568	2001	<p>BACKGROUND: Laser ablation is used to remove the recipient epidermis in the suction epidermal grafting in vitiligo surgery.</p> <p>OBJECTIVE: To evaluate the effectiveness and safety of a suction epidermal grafting method after the removal of the epidermis by the use of the Ultrapulse CO₂ laser with a computerized pattern generator.</p> <p>METHODS: Eleven patients with 34 lesions of refractory stable vitiligo were studied.</p> <p>RESULTS: Of the 34 lesion sites, excellent repigmentation was seen in 30 and the other 4 had good repigmentation. No complications occurred.</p> <p>CONCLUSION: The Ultrapulse CO₂ laser is particularly well suited for deepithelialization in vitiligo surgery.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
35	Peer reviewed article	Acne Scars	Laser Punch-Out for Acne Scars	Sang Hwan Koo, Eul Sik Yoon, Duck Sun Ahn, Seung Hapark	Department of Plastic and Reconstructive Surgery, Korea University Hospital, Seoul.	Aesthetic Plast Surg. 2001 Jan-Feb;25(1):46-51.	2001	<p>Patients with acne scars want smooth facial skin. However, achieving this is difficult with dermabrasion or chemical peeling. Nor can acne scars be covered with cosmetics, due to their ice-picked or cobblestone appearance. Laser resurfacing is more effective and safer than other conventional methods due to its precision with depth control and variable methods of surface cutting. Even depth resurfacing with a laser shows unsatisfactory results, therefore, for the deep-sited acne scar the cutting methods have to be changed according to the depth and pattern of the scar. For 2 years, starting in January 1996, we treated 71 patients with a high-powered CO₂ laser (Ultrapulse). Different resurfacing methods were applied according to the depth and pattern of the scars. For mild depressed scars, even depth resurfacing was done. For moderate-depth acne scars, the shoulder technique was also used. For the deepest and ice-picked scars, the laser punch-out was combined. Laser resurfacing was carried out at 300–500 mJ, with two to five passes. Laser punch-out was done at 500 mJ, with three to seven continuous passes on the ice-picked scar. From the pathologic findings of acne scars showing that there was thick intradermal scar, we knew that laser punch-out was necessary for improvement of acne scars. Depth-wide, the ice-picked scars improved by over 80% and the sharp demarcated margin of the acne scar faded out. Most of the patients with acne scars were satisfied with laser resurfacing. Only six patients had a second laser treatment, with an interval of 12 months. There were no hypertrophic scars after laser resurfacing, but erythema lasted for 3–12 months. Patients taking oral retinoic acid were not contraindicated for laser resurfacing but required special caution because they had atrophic skin and delayed wound healing. Laser resurfacing is the most versatile method for acne scars, with a high-powered CO₂ punch-out method is better than even depth resurfacing for improving deep acne scars and can be combined with the shoulder technique or even depth resurfacing according to the type of acne scar.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
36	Peer reviewed article	Laser Resurfacing	Laser Resurfacing with a Long Pulse Erbium:YAG Laser Compared to the 950 ms Pulsed CO ₂ Laser	Elizabeth F. Rostan M.D. ¹ , Richard E. Fitzpatrick M.D. ² , Mitchel P. Goldman M.D. ²	¹ Dermatology Associates of San Diego County, Inc., Encinitas, California ² Associate Clinical Professor, Division of Dermatology, Department of Medicine, University of California at San Diego, San Diego, California	Lasers Surg. Med. 29:136-141, 2001.	2001	<p>BACKGROUND AND OBJECTIVE: Laser resurfacing with the 950 μs pulsed CO₂ laser is an effective treatment for photodamage and acne scarring; however, the potential for prolonged erythema and delayed re-epithelialization dissuade many patients from the procedure. With the use of erbium lasers alone, there is a decrease in the incidence and severity of these adverse sequelae; however, it is difficult to achieve the same degree of improvement as with the CO₂ laser because of the more superficial depth of resurfacing. Thus, new erbium lasers have been developed with longer pulse durations to deliver increased thermal effects to tissue. It is hypothesized that with the use of these lasers, diminished erythema and faster wound healing will be observed as well as enhanced clinical outcomes.</p> <p>STUDY DESIGN/MATERIALS AND METHODS: Sixteen patients were randomized to receive laser resurfacing on one-half of the face with the 950 μs pulsed CO₂ laser (UPCO₂) followed by short pulse erbium:YAG ablation, and to the other half with a variable pulsed erbium laser (VP Er:YAG) followed by traditional short pulse erbium laser. Patients were evaluated clinically before resurfacing and at 1, 2, 4, 8, and 12 weeks post-operatively. Histologic samples taken at various time periods before and after resurfacing were also evaluated.</p> <p>RESULTS: Overall clinical improvement was equal for both UPCO₂ and VP Er:YAG treated sides with an average improvement in photoaging scores of 57%. Decreased erythema, less edema, and faster healing were observed on the VP Er:YAG treated side.</p> <p>CONCLUSION: The VP Er:YAG laser can achieve a similar degree of improvement as seen with short pulse CO₂ laser resurfacing with decreased thermal tissue effects and decreased risk for adverse sequelae.</p>
37	Peer reviewed article	Plastic Surgery	Clinical Uses of CO ₂ Laser in Plastic Surgery	Giorgio Bronz, M.D., F.M.H.	Viale Castagnola 21, Lugano, Switzerland.	Aesthetic Plast Surg. 2001 Sep-Oct;25(5):313-25.	2001	The author demonstrates what can be done with the CO ₂ laser in the ultrapulse mode and in the continuous wave mode. In his four and a half years of experience he has seen that the result one gets after six months lasts for a longer time. If, after this time, the result is not satisfactory for the patient and for the surgeon, he offers a new laser treatment free of charge.
38	Peer reviewed article	Skin Deepithelialization	Expanding the Scope of the UltraPulse Carbon Dioxide Laser for Skin Deepithelialization	Geoffrey G. Hallock, M.D.	Division of Plastic Surgery, The Lehigh Valley Hospital, Allentown, PA 18103, USA.	Plast Reconstr Surg. 2001 Nov;108(6):1707-12.	2001	

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
39	Peer reviewed article	Bowen Disease	Bowen Disease Treated with Scanned Pulsed High Energy CO ₂ Laser. Follow-up of 6 Cases	Vaïsse V, Clerici T, Fusade T.	Unité de Dermatologie, Hôpital Tenon, 4, rue de la Chine, Paris.	Ann Dermatol Venereol. 2001 Nov;128(11): 1220-4.	2001	<p>INTRODUCTION: Cutaneous Bowen's disease is an intra-epidermal squamous cell carcinoma.</p> <p>PATIENTS AND METHOD: Ten cases of cutaneous Bowen's disease diagnosed among 8 patients were treated by scanned high energy carbon dioxide laser between November 1996, and March 1998. A biopsy was performed in all patients before treatment.</p> <p>RESULTS: The post-treatment follow-up extended from 1 to 4 years with an average follow-up of 2 years and 11 months. Only one patient, whose lesion was located on the auricle, presented a recurrence after one year. The remaining patients did not present any recurrence during their last control: six patients were followed for two years or more and one patient for one year. We demonstrate a histological and clinical correlation between the number of carbon dioxide laser passes before a clinical endpoint and the thickness of the epidermal carcinoma treated.</p> <p>DISCUSSION: This new treatment has comparable efficacy to other treatments. It can be applied to extensive lesions without sequelae except for the risk of residual hypopigmentation.</p>
40	Peer reviewed article	Laser Skin Resurfacing	Laser Skin Resurfacing: Perspectives at the Millennium	Arielle N. B. Kauver M.D.	Laser and Skin Surgery Center of New York, New York, New York	Dermatol Surg., 26:174-177, Feb 2000.	2000	
41	Peer reviewed article	Resurfacing with Lasers	Resurfacing with Lasers: CO ₂ , Er:YAG, and Combination Systems	Michael H. Gold	Gold Skin Care Center, Nashville, Tennessee	Dermatologic Therapy, 13: 206-214, 2000.	2000	The advent of lasers into the armamentarium of dermatologic surgeons has provided our patients the most advanced technological medical devices for the treatment of a variety of skin disorders. Laser skin resurfacing has helped to revolutionize the treatment of photoaging and scarring. The purpose of this article is to review where we have been (CO ₂ lasers), where we are now (new and improved CO ₂ lasers and Er:YAG lasers) and where we might be headed (combination CO ₂ /Er:YAG lasers).

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
42	Peer reviewed article	Collagen Tightening	Collagen Tightening Induced by Carbon Dioxide Laser versus Erbium:YAG Laser	^{1,2} Richard E. Fitzpatrick, M.D., ² Elizabeth F. Rostan, M.D., ³ Nancy Marchell, M.D.	¹ Division of Dermatology, Department of Medicine, University of California at San Diego, San Diego, California, ² Dermatology Associates of San Diego County, Inc., San Diego, California, ³ Laguna Hills Dermatology, Inc., Laguna Hills, California	Lasers in Surgery and Medicine 27:395–403 (2000)	2000	<p>BACKGROUND AND OBJECTIVE: Pulsed CO₂ laser resurfacing improves photodamage and acne scarring by ablation of abnormal tissue with subsequent regeneration and remodeling of collagen and through heat induced collagen contraction. Whether collagen contraction persists long-term and helps maintain the skin tightening observed after resurfacing is debated. One possible mechanism of long-term clinical tightening is that of wound contracture that occurs as part of normal wound healing. If normal wound contracture, and not heat induced collagen contraction, is responsible for maintaining the initial skin tightening seen in CO₂ laser resurfacing, then equal results would be expected from resurfacing with either CO₂ or erbium lasers. The study was performed to determine whether there is a difference in skin tightening secondary to thermally mediated collagen contraction versus that which occurs secondary to tissue contraction of wound healing. The persistence of these changes over 6 months and the histologic characteristics were studied as well.</p> <p>STUDY DESIGN/ MATERIALS AND METHODS: Nine patients had four tattoo dots applied to the upper eyelids, with horizontal axis measuring 18-20 mm and the vertical axis 6-10 mm. One month later, one eyelid was treated with three passes of the UltraPulse CO₂ laser and the other eyelid with an erbium laser to the end point of early pinpoint bleeding. Three patients were treated with additional passes after pinpoint bleeding was encountered. The total number of pulses used per patient was recorded. Measurements of the vertical and horizontal distances were made after each pass and monthly for 6 months. The treated skin was then excised in performance of an upper lid blepharoplasty and the tissue submitted for histologic analysis.</p> <p>RESULTS: In the vertical plane, the UltraPulse CO₂ laser induced an average of 43% tightening intraoperatively and this gradually diminished to an average of 34% by 6 months, whereas the wound contracture of erbium resurfacing was not seen until 1 month postoperatively, at which time 42% tightening was seen, gradually diminishing to 36% at 6 months. Three patients with erbium resurfacing had scarring present. These were the three patients treated most aggressively and also the three patients with the most significant wound contracture. Scarring was not seen on the CO₂ treated side in any patients. In the horizontal plane, the CO₂ laser caused 31% intraoperative tightening, decreasing to 19% at 6 months. In this plane, the erbium laser induced wound contracture was 12% at 1 month which remained stable and unchanged.</p> <p>CONCLUSIONS: Although wound contraction secondary to tissue healing may result in nearly the same tissue tightening as heat-induced collagen contraction, the two processes are very different and variable, with increased risk of scarring seen with wound contracture, compared with heat-induced collagen tightening. The tissue tightening seen with thermally induced collagen contraction is long-lasting, if not "permanent."</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
43	Peer reviewed article	Treatment of Perioral Wrinkles	A Controlled Evaluation of Dermabrasion versus CO ₂ Laser Resurfacing for the Treatment of Perioral Wrinkles	W. John Kitzmiller, M.D., Marty Visscher, Ph.D., Dean A. Page, M.D., Randall Wicket, Ph.D., K. William Kitzmiller, M.D., Leonard J. Singer, M.D	Department of Dermatology, University of Cincinnati College of Medicine, Ohio, USA.	Plast. Reconstr. Surg., 106:1366-1372, discussion 1373-1374, 2000	2000	Facial skin treatments with laser resurfacing, dermabrasion, and chemical peels were responsible for a significant portion of the 2.7 million cosmetic procedures performed in 1998. Perioral wrinkles are a common problem for which plastic surgical consultation is obtained. The aim of this study was to compare and quantify the advantages and disadvantages of laser resurfacing versus dermabrasion in the treatment of perioral wrinkles. Twenty female patients provided informed consent and participated in the study. Half of the perioral area was treated with dermabrasion and half was treated with the UltraPulse CO ₂ laser. The two procedures were compared using high-quality photographs; a biophysical evaluation of skin color, hydration, and mechanical properties; and patient evaluation of outcomes. Photographs were evaluated by 10 board-certified plastic surgeons who were blinded to the treatment methods. The laser treatment had a significantly higher erythema score at 1 month and a small but significantly greater improvement in perioral wrinkles at 6 months. Thirteen subjects selected the laser treatment as producing the best result, despite the greater intraoperative pain for this procedure. Biomechanical measurements suggest that the laser treatment produced a skin state more similar to skin in younger patients, presumably with higher levels and/or greater organization of the collagen and elastin. Patient preference was inferred from the resurfacing method that they would recommend to a friend. Although the laser was selected as the best result in a majority of cases, patient preference was equally distributed between the two treatments. The authors think that by studying and quantifying the biophysical changes that occur as a result of CO ₂ laser resurfacing, greater improvements in restoring actinic damage (e.g., wrinkles) can be achieved. Patients consider more than the objective skin changes from a resurfacing technique when making a recommendation to a friend.
44	Peer reviewed article	Pigment Darkening of a Cosmetic Tattoo	Successful Treatment of Treatment-Resistant Laser-Induced Pigment Darkening of a Cosmetic Tattoo	Richard E. Fitzpatrick M.D. ¹ , Jason R. Lupton M.D. ²	¹ Clinical Dermatology Associate of San Diego County, Inc., Encinitas, California ² Department of Dermatology, The George Washington University Medical Center, Washington, D.C.	Lasers Surg Med. 2000;27(4):358-61.	2000	BACKGROUND AND OBJECTIVE: Cosmetic tattoo removal has a reported risk of immediate pigment darkening when treated with a high energy, nanosecond pulsed-laser system. Surgical treatment options for this reaction are limited and carry significant risk of scarring and permanent pigment alterations. This report describes the response of a resistant Q-switched ruby laser-induced cosmetic tattoo ink darkening to multiple treatments with the Q-switched alexandrite laser and Q-switch Nd:YAG laser and textural improvement with the UltraPulse CO ₂ laser. STUDY DESIGN/MATERIALS AND METHODS: A woman with Q-switched ruby laser-induced pigment darkening of a cosmetic tattoo of the upper lip resistant to four further treatments with the ruby laser and two chemical peels received a total of 26 treatments with the Q-switched alexandrite and Nd:YAG lasers and a single treatment with the UltraPulse CO ₂ laser, most treatments being done at monthly intervals. RESULTS: Treatment of the affected areas with the Q-switched alexandrite and Nd:YAG lasers resulted in complete clearing of the pigment without scarring, but revealed some preexisting textural changes. Use of the UltraPulse CO ₂ laser smoothed the surface irregularities. CONCLUSION: The Q-switched pigment lasers are a useful modality for treating this pigment darkening reaction. As in this case, multiple treatment sessions with the laser may be necessary but the pigment can be expected to clear eventually without scarring. Any textural changes may be blended with the UltraPulse CO ₂ laser with further improvement.

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
45	Peer reviewed article	Skin Resurfacing	Comparison of Carbon Laser, Erbium:YAG Laser, Dermabrasion, and Dermatome: A Study of Thermal Damage, Wound Contraction, and Wound Healing in a Live Pig Model: Implications for Skin Resurfacing	E. Victor Ross, M.D. ^{1,2} , George S. Nas-eef, M.D. ¹ , Joeseeph R. Mckinlay, M.D. ² , David J. Barnette, M.D. ² , Miroslav Skrobal, M.D. ¹ , Joop Grevelink, M.D., Ph.D. ¹ , R. Rox Anderson, M.D. ¹	Boston, Massachusetts, and San Diego, California From the Wellman Laboratories of Photomedicine, Department of Dermatology, Massachusetts General Hospital, Boston, ¹ and the Naval Hospital San Diego, Department of Dermatology, San Diego. ²	J Am Acad Dermatol 2000;42:92-105	2000	<p>BACKGROUND: Advances in laser technology allow for precise tissue removal and minimal thermal damage. However, mechanisms for cosmetic improvement have not been determined. Investigators have suggested that ablation, collagen shrinkage, and new collagen deposition all contribute to the clinical outcome.</p> <p>OBJECTIVE: In a live farm pig, we examined gross and microscopic effects of thermal and mechanical ablation devices to characterize immediate and long-term mechanisms in skin rejuvenation.</p> <p>METHODS: Two CO₂ lasers, an erbium:YAG laser, a dermabrader, and a dermatome were used to treat flank skin in a farm pig. There were 14 different treatment groups based on device type and working parameters. One to five sites were treated for each group. Wound surface areas were measured before treatment, immediately after treatment, and 7, 17, 23, 30, and 60 days thereafter. Biopsies were performed immediately after irradiation and 2, 7, 17, and 60 days after treatment.</p> <p>RESULTS: For the CO₂ laser-induced wounds, surface area measurements showed that immediate and final wound contraction tended to increase with initial residual thermal damage (RTD) for a range of values, above which immediate contraction remained relatively constant. Although there was no immediate wound contraction with mechanical ablation devices, long-term wound contraction in the dermatome and dermabrasion sites increased with depth of ablation. The erbium:YAG laser sites healed in a manner similar to that of mechanically induced wounds. Wound contraction profiles over time were dependent on depth of RTD and depth of ablation. Sixty days postoperatively, histologic examination showed varying degrees of fibroplasia. Overall, there was greater compaction and horizontal orientation of collagen fibers in those wounds with more than 70 microm of dermal RTD. Grossly, all wounds were similar after 60 days, with the exception of the deep dermabrasion sites, at which clinical scarring was observed.</p> <p>CONCLUSION: Our results show that CO₂ laser resurfacing produces short- and long-term wound contraction that is greater than that induced by purely ablative methods for the same total depth of injury. The erbium laser produced wound contraction profiles similar to those produced by mechanical wounding. The data suggest that initial collagen contraction and thermal damage modulate wound healing.</p>
46	Peer reviewed article	Serpiginosa	Localized Idiopathic Elastosis Perforans Serpiginosa Effectively Treated by the Coherent UltraPulse 5000C Aesthetic Laser	Anthony Abdullah, MRCP, Peter S. Colloby, MRCPATH, Iain S. Foulds, FRCP, Ian Whitcroft, MD, FRCP	Birmingham, United Kingdom	Int J Dermatol. 2000 Sep;39(9):719-20.	2000	

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
47	Peer reviewed article	Rapid Skin Deepithelialization	Value in Microsurgery of the UltraPulse Carbon Dioxide Laser for Rapid Skin Deepithelialization	Geoffrey G. Hallock, M.D.	Division of Plastic Surgery, The Lehigh Valley Hospital, Allentown, PA, USA.	Microsurgery, 20:47-51, 2000.	2000	Although laser technology continues to evolve, its role in microsurgery is limited to minor adjunctive applications including skin deepithelialization. In the past, continuous-wave carbon dioxide (CO ₂) lasers were the best for performing skin deepithelialization. The newer ultrapulse CO ₂ lasers also show promise in this regard. They have become readily available and are very popular for aesthetic skin resurfacing. Their use for skin deepithelialization is an essential part of microsurgical procedures for free flap contouring, flap onlay at the recipient site, and revision of skin grafted free flap donor sites. Complications are essentially nonexistent and competency in using this modality is straightforward for any microsurgeon.
48	Peer reviewed article	Laser Resurfacing	Variable-Pulse Width Er:YAG Laser Resurfacing	Pozner JN, Roberts TL 3RD.	Medical University of South Carolina at Spartanburg, South Carolina, USA.	Clin. Plast. Surg., 27:263-271, 2000.	2000	New resurfacing laser systems have been introduced that offer the ablative capacity of Er:YAG lasers with the ability to add controlled degrees of thermal effect to provide collagen tightening and hemostasis. This article discusses the current systems available and offers comparisons to short-pulse Er:YAG and carbon dioxide lasers. A histologic study and initial clinical results are presented and discussed
49	Peer reviewed article	Laser Resurfacing of the Neck	Short-pulse Carbon Dioxide Laser Resurfacing of the Neck	Daniel S. Behroozan, BS, Mary M. Christian, MD, Ronald L. Moy, MD	Los Angeles, California	J Am Acad Dermatol 2000;43:72-6.	2000	<p>BACKGROUND: Carbon dioxide (CO₂) laser resurfacing of the face has become an increasingly popular procedure. However, laser resurfacing of the neck has been largely avoided because of fears of scarring or pigmentation changes.</p> <p>OBJECTIVE: Our purpose was to evaluate the efficacy of treatment and incidence of complications after short-pulse CO₂ laser resurfacing of the neck.</p> <p>Methods: A total of 308 patients received concomitant face and neck CO₂ laser resurfacing. A 90-µs pulse duration CO₂ laser without a scanner was used in all cases for 2 passes on the neck (10.6-µm wavelength, 500-mJ pulse energy, 90-µs duration, 3-mm spot size) and a continuous CO₂ laser with a computergenerated scanner (396-µs dwell time, 18 W) was used for 3 passes over the face except for the perioral area, which received 4 passes. The incidence of scarring or permanent pigmentation changes was determined. Forty patients who had been treated at least 6 months but no longer than 18 months earlier were randomly surveyed by phone to assess the degree of improvement.</p> <p>RESULTS: Of the 308 patients treated, there were no cases of scarring or permanent pigmentation changes. Surveyed patients reported a 39% improvement in rhytides and tightening on the neck.</p> <p>CONCLUSION: Resurfacing of the neck can be performed safely in conjunction with resurfacing of the face. Patients may be offered improvement in the neck with little chance of scarring or permanent pigmentary changes when resurfacing on the neck is performed by means of a short-pulse duration laser for a limited number of passes instead of the more aggressive laser parameters previously used such as continuous longpulse duration treatments.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
50	Peer reviewed article	Actinic Cheilitis	Comparison of Electro-desiccation with CO ₂ Laser for the Treatment of Actinic Cheilitis	Richard A. Laws, M.D. ¹ , Joseph L. Wilde, M.D. ² , William J. Grabski, M.D. ³	¹ Dermatology Service, Ft. Stewart, Georgia, ² Dermatology Service, Ft. Riley, Kansas, ³ Dermatology Associates, Tyler, Texas	Dermatol Surg. 2000 Apr;26(4):349-53.	2000	<p>BACKGROUND: Actinic cheilitis is a common premalignant condition that is most often treated with destructive therapy. The most effective technique is usually considered to be CO₂ laser resurfacing. Little has been written on the use of electrodesiccation for this condition.</p> <p>OBJECTIVE: We designed a study to compare these two treatment modalities for the treatment of biopsy-confirmed actinic cheilitis.</p> <p>METHODS: A random half of the lower lip was treated with electrodesiccation. The contralateral half was then treated with CO₂ laser. Healing time, subjective pain during healing, and clinical outcome at 3 months was compared.</p> <p>Results: The side treated with electrodesiccation took significantly longer to heal than the side treated with the CO₂ laser (23 versus 14 days, P <.001). There was no difference in subjective pain or clinical appearance at 3 months.</p> <p>CONCLUSION: Although the healing time is longer with electrodesiccation, this modality represents an inexpensive practical ablative treatment method for actinic cheilitis.</p>
51	Peer reviewed article	Deepithelialization of TRAM Flaps in Breast Reconstruction	Successful Use of the UltraPulse CO ₂ Laser for the Deepithelialization of TRAM Flaps in Breast Reconstruction	Kanter, William R. M.D.; Kanter, Mitchel A. M.D.		Plast. Reconstr. Surg., 105:808-809, 2000.	2000	
52	Peer reviewed article	Resurfacing	Why Does Carbon Dioxide Laser Resurfacing Work?	¹ E. Victor Ross, M.D., ¹ Joseph R. McKinlay, M.D., ² R. Rox Anderson, M.D.	¹ Department of Dermatology, Naval Medical Center San Diego, Calif, ² Wellman Laboratories of Photomedicine, Massachusetts General Hospital, Boston	Arch Dermatol. 1999 Apr;135(4):444-54.	1999	<p>Despite the unquestionable efficacy of carbon dioxide laser skin resurfacing, mechanisms for cosmetic enhancement remain poorly characterized. Histological studies have provided some insight into the cascade of events from initial laser impact to final skin rejuvenation. However, there are few comprehensive studies of gross and microscopic wound healing. Additionally, the literature is fragmented; excellent individual articles appear in journals from widely disparate disciplines. For example, some reports relevant to laser skin resurfacing are "sequestered" in the engineering literature. This article is intended to update the physician on laser skin resurfacing based on the broadest review of the current literature. It proceeds from a discussion of initial laser-tissue interactions, such as collagen denaturation, to examination of long-term biological sequelae. At some cost to scientific rigor, mathematical models describing laser-tissue interactions are not presented.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
53	Peer reviewed article	Laser Resurfacing	Cutaneous Laser Resurfacing	¹ Désirée Ratner, M.D., ² Yardy Tse, M.D., ² Nancy Marchell, M.D., ² Mitchel P. Goldman, M.D., ² Richard E. Fitzpatrick, M.D., ³ Darrell J. Fader, M.D.	¹ Departments of Dermatology, College of Physicians and Surgeons of Columbia University, New York, ² University of California at San Diego, ³ Departments of Dermatology and Otolaryngology, University of Michigan Medical Center, Ann Arbor.	J Am Acad Dermatol. 1999 Sep;41(3 Pt 1):365-89	1999	Cutaneous resurfacing with the new generation of carbon dioxide and erbium lasers has recently come into favor for the treatment of facial rhytides, photodamage, and scarring. The precise control of these resurfacing lasers over the extent of tissue vaporization minimizes thermal damage to the skin while maximizing therapeutic efficacy. Proper use of resurfacing lasers is contingent upon a complete understanding of their clinical, histologic, and ultrastructural effects, as well as an appreciation of the principles of laser safety. An organized approach to the preoperative, intraoperative, and postoperative management of the patient undergoing laser resurfacing will be provided, including a discussion of prevention and treatment of postoperative side effects and complications. LEARNING OBJECTIVE: At the conclusion of this learning activity, participants should be familiar with the clinical, histologic, and ultrastructural effects of resurfacing lasers and be able to discuss the preoperative, intraoperative, and postoperative management of patients undergoing laser resurfacing.
54	Peer reviewed article	Photoaged Skin	A Clinical and Histologic Comparison of Low Fluence Pulsed Carbon Dioxide and Erbium-YAG Lasers in the Treatment of Photoaged Skin	Adrian RM		Lasers Med. and Surg., 108:28, (Coherent Medical 1999 unpublished data is also included),	1999	
55	Peer reviewed article	Laser Skin Resurfacing	Effects of Overlap and Pass Number in CO ₂ Laser Skin Resurfacing: A Study of Residual Thermal Damage, Cell Death, and Wound Healing	^{1,2} E. Victor Ross, M.D., CDR, MC, USN, ² David J. Barnette, M.D., CAPT, MC, USN, ¹ Robert D. Glatter, M.D., ¹ Joop M. Grevelink, M.D., Ph.D	¹ Dermatology Laser Center and Wellman Laboratories of Photomedicine, Massachusetts General Hospital, Boston, Massachusetts, ² Department of Dermatology, Naval Medical Center San Diego, San Diego, California	Lasers Surg Med. 1999;24(2):103-12.	1999	BACKGROUND: Newer CO ₂ laser systems incorporating short pulse and scanning technology have been used effectively to resurface the skin. As the number of resurfacing cases has increased, hypertrophic scarring has been reported more commonly. Previous dermabrasion and continuous wave CO ₂ studies have suggested that depth of injury and thermal damage are important predictors of scarring for a given anatomic region. To determine whether rapid overlapping of laser pulses/scans significantly altered wound healing, we examined residual thermal damage, cell death, and histologic and clinical wound healing in a farm pig. METHODS AND MATERIALS: Two popular CO ₂ systems were used, with a range of radiant exposures, degrees of overlap, and numbers of passes. Thermal damage was assessed by histology, and dermal cell viability was measured with nitroterazolium blue staining. Presence or absence of clinical scarring was determined by textural change and loss of skin markings. RESULTS: We observed that dermal thermal damage did not increase significantly with pass number when performed as in the normal clinical setting (for 2-4 passes); however, by delivering rapidly overlapping pulses and scans, residual thermal damage and cell death depth were increased as much as 100% over areas without immediate overlap of laser impacts. CONCLUSIONS: Immediate overlapping of CO ₂ laser pulses and scans is a significant risk factor in increasing thermal damage, cell death, and possibly scarring.

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
56	Peer reviewed article	Laser Skin Resurfacing	Quantification of Skin Elasticity Changes Associated With Pulsed Carbon Dioxide Laser Skin Resurfacing	R. James Koch, M.D.; Elbert T. Cheng, M.D.	Wound Healing and Tissue Engineering Laboratory, Division of Otolaryngology-Head and Neck Surgery, Stanford University, Calif., USA.	Arch Facial Plast Surg. 1999;1:272-275	1999	<p>BACKGROUND: While skin resurfacing using pulsed carbon dioxide lasers appears to have a skin-tightening effect clinically, the debate continues over its actual effects on dermal collagen.</p> <p>OBJECTIVES: To provide quantitative measures of skin elasticity changes associated with pulsed carbon dioxide laser skin resurfacing and to introduce to the facial plastic surgery community the Cutometer SEM 575 skin elasticity meter, an instrument that is useful in the measurement of skin elasticity.</p> <p>SETTING: University-based facial plastic surgery clinic and wound healing laboratory.</p> <p>DESIGN: Intervention.</p> <p>MAIN OUTCOME MEASURES: Measurements taken prior to and 6 months after procedure.</p> <p>SUBJECTS AND INTERVENTION: Thirty-two patients undergoing pulsed carbon dioxide full-face laser skin resurfacing participated. There were 12 test sites measured in 6 aesthetic units per participant. The Cutometer SEM 575 skin elasticity meter was used to measure skin elasticity changes accompanying this procedure. This device measures skin deformation with an accuracy of 10 microns.</p> <p>RESULTS: The change in elastic recovery (U_r/U_e) was determined. At all 6 of the facial sites, there was a statistically significant increase in skin elasticity ($P < .001$). Overall, there was an 18.2% improvement in skin elasticity. Site-specific changes ranged from 9% (forehead) to 22% (prejowl and periorbital).</p> <p>CONCLUSIONS: Skin resurfacing with the pulsed carbon dioxide laser produces a true skin-tightening effect. The Cutometer is a valuable instrument that permits accurate quantification of skin elasticity and may be useful in the evaluation of other facial plastic procedure results.</p>
57	Peer reviewed article	Actinic Cheilitis	CO ₂ Laser Vaporization of Actinic Cheilitis	Silvia Hohenleutner, Michael Landthaler, Ulrich Hohenleutner	Klinik und Poliklinik für Dermatologie der Universität Regensburg	Hautarzt, 5:562-565, 1999.	1999	<p>As a premalignant condition, actinic cheilitis requires therapy, and multiple treatment modalities have been described. Although frequently reported in Angloamerican literature, CO₂ laser vaporization for the treatment of actinic cheilitis is scarcely mentioned in German journals. We report 19 cases of CO₂ laser treatment of actinic cheilitis. In only one case, the ablation proved to be too superficial after the first treatment. Except in this case we did not see any recurrences and only one case with minor scarring within a median follow up period of 16 months. In comparison with other treatment modalities, we consider the CO₂ laser ablation to be a safe and cost-saving method with excellent cosmetic results.</p>
58	Peer reviewed article	Skin Deepithelialization	Consideration of the Ultra-Pulse Carbon Dioxide Laser as a Tool for Skin Deepithelialization	Geoffrey G Hallock, M.D., David C. Rice, B.S.	Division of Plastic Surgery, The Lehigh Valley Hospital, Allentown, PA, USA.	Ann. Plast. Surg., 42:608-612, 1999.	1999	<p>Laserabrasion is essentially skin deepithelialization. The continuous-wave carbon dioxide (CO₂) laser has a long history during which this capability to ablate the epidermis has been used in multiple clinical applications. The "improved" UltraPulse CO₂ laser has been advocated as a safer method, primarily for skin resurfacing. The authors show in Sprague-Dawley rats by gross and histological examination that the UltraPulse CO₂ laser can also be used effectively to achieve skin deepithelialization, with efficacy in clinical simulations without untoward effects on wound healing. The advantage of the UltraPulse CO₂ laser appears to be less destruction to surrounding tissues.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
59	Peer reviewed article	Xanthelasma Palpebrarum	Xanthelasma Palpebrarum: Treatment With the Ultrapulsed CO ₂ Laser	Christian Raulin, M.D. ¹ , Matthias P. Schoener Mark, M.D. ² , Saskia Werner, M.D. ¹ , Baerbel Greve, M.D. ¹	¹ Center for Dermatologic Laser Therapy, Karlsruhe, Germany, ² Department of Otolaryngology / Head and Neck Surgery, Medical School, Hannover, Germany	Lasers Surg Med. 1999;24(2):122-7.	1999	<p>BACKGROUND AND OBJECTIVE: Due to its delicate location near the eye and the high recurrence rate, the therapy of xanthelasma palpebrarum is a difficult surgical task. Besides chemical, physical, and surgical procedures, various laser systems have been used to treat these lesions (argon laser, pulsed dye laser, and CO₂ laser). This study was designed to critically evaluate the use of the ultrapulsed CO₂ laser for the treatment of xanthelasma palpebrarum.</p> <p>STUDY DESIGN/MATERIALS AND METHODS: We report about the standardized treatment of 23 patients (52 periorbital xanthelasmas) and the results obtained after one treatment with a new generation, ultrapulsed CO₂ laser (COHERENT Ultrapulse 5000C, Palo Alto, CA; 250-500 mJ; 600-900 microsec; 10,600 nm). The followup time was 10 months.</p> <p>RESULTS: All lesions could be removed completely with a single laser treatment. As for side effects, only transient pigmental changes (4% hyperpigmentations, 13% hypopigmentations) and no visible scarring was observed. Three patients (13%) developed a recurrence of xanthelasma.</p> <p>CONCLUSIONS: The ultrapulsed CO₂ laser is an effective and safe therapeutic alternative to the hitherto described approaches.</p>
60	Peer reviewed article	Tissue Interactions in Skin	CO ₂ Laser Physics and Tissue Interactions in Skin	James E. Fulton, M.D., Ph.D, Paul K. Shitabata, M.D.	Fulton Skin Institute, Newport Beach, California	Lasers Surg. Med. 24:113-121, 1999.	1999	<p>BACKGROUND AND OBJECTIVES: The theoretical model of CO₂ laser tissue interaction appeared to be too simplistic. To explain the reactions seen in skin, a more complex model was needed. We hoped to correlate the clinical-histologic patterns of CO₂ laser tissue interactions.</p> <p>STUDY DESIGN/MATERIALS AND METHODS: The Ultrapulse CO₂ laser was used on normal and pathologic skin conditions. Clinical observations were correlated with histologic examinations of biopsies.</p> <p>RESULTS: It was possible to demonstrate cavitation at the dermal-epidermal junction 2-3 diameters beyond the actual spot of CO₂ laser contact with the skin. Dermal heat damage was seen as homogenization of collagen 1-2 diameters beyond the spot of laser contact. This flow of energy laterally at the dermal-epidermal junction and vertically down the skin follicles was both clinically beneficial and detrimental. Beneficially, superficial skin lesions separated at this junction and were easily removed. The heat coagulation of the dermis facilitated lesion removal without bleeding. The clinician had a better view of the pathology and could find focal zones of deeper pathology that could be easily re-treated. Detrimentally, this extended damage delayed wound healing and led to persistent erythema.</p> <p>CONCLUSION: These clinical-histologic correlations have provided a better understanding of CO₂ laser tissue interactions in skin. It has been possible to take advantage of these findings to remove pathologic skin conditions more efficiently.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
61	Peer reviewed article	Resurfacing	Comparative clinical trial of 2 carbon dioxide resurfacing lasers with varying pulse durations. 100 microseconds vs 1 millisecond	Daniella Duke, M.D., M.P.H., Khalil A. Khatri, M.D., Joop M. Grevelink, M.D., Ph.D, R. Rox Anderson, M.D. Levy JL. M.D.	Massachusetts General Hospital Dermatology Laser Center, Boston, Mass., USA.	Arch Dermatol. 1998 Oct;134(10): 1240-6.	1998	<p>OBJECTIVES: To compare the clinical and histological effects of 2 carbon dioxide lasers with different pulse durations and to evaluate the effect of carbon dioxide laser pulse duration on postprocedure erythema, wound healing, and efficacy of wrinkle treatment.</p> <p>DESIGN: Prospective, randomized, comparative clinical trial.</p> <p>SETTING: A university-affiliated hospital-based laser center.</p> <p>PATIENTS: Thirty-five patients with facial wrinkles were enrolled in the study. Treatment sites included 15 perioral, 14 periorbital areas, and 6 full face.</p> <p>INTERVENTION: A 2-sided comparison was performed. One side of the study site was treated with the TruPulse laser (Tissue Technologies, Palomar Medical Products Inc, Lexington, Mass). The other side of the study site was treated with the UltraPulse 5000 laser (Coherent Medical Inc, Palo Alto, Calif). The 2 sides were treated to equivalent tissue effects rather than maintaining the number of passes.</p> <p>MAIN OUTCOME MEASURES: Photographs of the treatment areas at baseline, week 1, week 2, month 2, and month 6 were evaluated by a 5-member panel for degree of erythema, amount of edema, and percentage of wrinkle improvement. Silicon skin casts for profilometry measurements before and after the treatment were compared. To evaluate skin shrinkage, surface area before and after treatment of square tattoos on both cheeks of the full-face patients were computed using a digital imaging system. Histological sections before and after the procedure were analyzed.</p> <p>RESULTS: At week 1, 75% of the patients had more erythema on the UltraPulse than TruPulse sides. The difference in erythema (TruPulse less than UltraPulse) between the 2 treatment sides was clinically mild yet statistically significant for weeks 1 (P = .05) and 2 (P = .05). Although observed results favored the UltraPulse over the TruPulse, the difference in efficacy between the 2 lasers did not reach statistical significance.</p> <p>CONCLUSIONS: Compared with the longer pulse-duration carbon dioxide laser, the shorter pulse-duration carbon dioxide laser, used with higher energy and more passes, caused slightly less erythema while maintaining efficacy. The longer pulse-duration laser required lower energy and fewer number of passes to achieve an equivalent depth of ablation, level of residual thermal damage, and degree of efficacy. The shorter TruPulse allows for more superficial tissue damage per pass and therefore is best suited for situations requiring superficial or more controlled ablation. The longer UltraPulse achieves a desirable depth of tissue damage with fewer passes. The data did not support the long-term presence of tissue collagen shrinkage in the treated areas.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
62	Peer reviewed article	Resistant Verrucae Vulgaris	Carbon Dioxide Laser Treatment of Resistant Verrucae Vulgaris: Retrospective Analysis	Sloan K, Haberman H, Lynde CW.	Resident Department of Dermatology, Dalhousie University, Halifax, NS, Canada.	J. Cutan. Med. Surg., 2:142-145, 1998.	1998	<p>BACKGROUND: Verrucae are a very common dermatological problem that can be both painful and bothersome to the individual as well as costly to the health care system. In some cases verrucae can be notoriously resistant to therapy.</p> <p>OBJECTIVE: To determine the cure rate, side effect profile, and overall satisfaction with CO₂ laser treatment of recalcitrant verrucae vulgaris.</p> <p>METHODS: A retrospective survey was sent to over 200 patients who had resistant verrucae vulgaris treated with the carbon dioxide laser at The Toronto Hospital (Western Division) from 1989 to 1994. Results: Ninety-two complete responses were received. The overall cure rate was 64.1% at 12 months. There was no significant difference in cure rates between single compared to multiple warts (p = .824 Fisher's exact test). The duration of the wart being present showed no difference in cure rate (p = .801 Fisher's exact test). The location of the wart also had no influence on the cure rate (p = .433 Fisher's exact test). Overall, 71.7% of the patients were happy with the laser treatment and 85.7% would have it done again.</p> <p>CONCLUSION: The carbon dioxide laser is an effective treatment of resistant verrucae vulgaris.</p>
63	Peer reviewed article	Laser Resurfacing	Histological Perspective of Laser Resurfacing	William Gregory Chernoff, BSC, MD	Chernoff Plastic Surgery and Laser Laser Center, Indianapolis, IN.	Operative Techniques in Otolaryngology–Head and Neck Surgery,8:2-8, 1997.	1997	<p>Cutaneous laser exfoliation has gained widespread acceptance among multispecialties involved with skin care. The evolution of this acceptance has surrounded improved delivery systems, allowing for the delivery of a selective and precision controlled means of tissue exfoliation. Acquiring a working knowledge of the histological aspects of the skin as well as the clinical correlates of laser tissue biophysics is essential for the surgeon considering using this technology. Histological studies have revealed correlations between clinical treatment endpoints, histological depths of exfoliation, postoperative erythema, and rhytid resolution. Failure to respect these correlates can yield tragic scarring in this patient population. The past few years have seen an increasing number of carbon dioxide laser systems entering the market as it pertains to cutaneous laser exfoliation. These systems encompass two main varieties, either surrounding a time energy modulation delivering high peak powers in short exposure times, or a special energy modulation that moves sharply focused beams over short exposure times. Regardless of what system is used by the physician, a working knowledge of both laser physics as well as tissue biophysics is essential for the proper treatment of patients.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
64	Peer reviewed article	Laser Skin Resurfacing	Full Face and Neck Laser Skin Resurfacing	Rosenberg GJ.	Division of Plastic Surgery, University of Miami, Delray Beach, Fla., USA.	Plast Reconstr Surg. 1997 Dec;100(7):1846-54.	1997	Since the inception of laser skin resurfacing for the removal of facial rhytides, laser surgeons have avoided laser resurfacing of the neck. The purpose of this paper is to demonstrate that the accuracy and precision of the Ultrapulse carbon dioxide laser allows the laser surgeon to safely laser skin resurface the neck as well as the full face. This series includes 40 patients who have undergone laser skin resurfacing of the neck at the time of full-face laser skin resurfacing. Three subgroups are defined. Thick-skinned patients, thin-skinned patients, and patients who otherwise would have medical contraindications to face and neck lift are included in this study group. Patients between the ages of 40 and 60 who do not have a lot of excessive neck skin or prominent platysma bands are candidates for full face and neck laser skin resurfacing. Successful tightening for thick-skinned patients occurs by using 300 mJ at 60 W, a density of 6, and one pass. For thinner-skinned patients, the upper half of the neck is treated with 300 mJ, 60 W, a density of 6, and one pass. The lower half of the neck in these patients is treated with 125 mJ and 20 W, a density of 6, and one pass. In some patients who otherwise have medical contraindications for face and neck lift, the laser may be an indicated procedure because there is minimal bruising, lack of bleeding, minimal edema, minimal to absent use of adrenaline, and nonincisional surgery with a speedy recovery. The Ultrapulse laser delivers high energy with high speed, precision, and control. Therefore, the laser surgeon can successfully laser skin resurface the neck at the time of full face laser skin resurfacing. Immediate tightening of the face and neck, from the photothermal effect, and the neocollagenesis effectively tighten the neck in the properly selected patient.
65	Peer reviewed article	Granuloma Pyogenicum	Granuloma Pyogenicum—Removal with the CO ₂ Laser	Christian Raulin, M.D., Detlef Petzoldt, M.D., Saskia Werner, M.D.	Praxis für Dermatologie, Phlebologie und Allergologie Dr. C. Raulin, Karlsruhe.	Hautarzt, 48:402-405, 1997.	1997	13 patients with pyogenic granuloma were treated with a CO ₂ laser using the continuous wave laser in all cases and using additionally the ultrapulsed laser in 7 patients. The pyogenic granuloma was removed in all patients in one session. Side effects included transient erythema in 8 patients and scars in 2 cases. There was no hypo- or hyperpigmentation. The use of the CO ₂ laser is a fast and bloodless way to treat pyogenic granuloma with slight side effects and is an elegant alternative to standard approaches.
66	Peer reviewed article	Dermatologic Surgery	Lasers in Dermatologic Surgery	Takac S, Stojanović S, Muhi B	Zavod za sudsku medicinu, Medicinski fakultet, Novi Sad.	Med. Pregl., 50:215-219, 1997.	1997	The authors review their experiences with the use of carbon-dioxide (CO ₂) lasers in dermatological surgery in a group of 3000 patients, with a total number of 3920 tumorous skin lesions, during a three-year period. The word LASER is an acronym for L-ight A-mplification by S-timulated E-mission of R-adiation. It must be pointed out that it is electromagnetic radiation, not X-irradiation. In regard to the spectrum laser light is between infrared and ultraviolet light, mainly in the visible spectrum, so its application does not produce new generations of iatrogenic malignancies as in the case of ionizing radiation. The laser is a new scalpel which differs from the metal surgical scalpel (also called "optical knife" and "light scalpel"). In the conclusion authors state that using (CO ₂) complete success was achieved in treatment of the following skin lesions: common viral warts, senile keratosis, seborrheic keratosis, plantar viral warts, papillomas, capillary telangiectasias of the face, hemangiomas, juvenile viral warts of the face, ingrown nails, condyloma acuminata, pendular fibromas, xanthelasmas, atheromas, pyogenic granulomas, keratoacanthomas, tattooed skin and basocellular epitheliomas.

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
67	Peer reviewed article	Deepithelialization	UltraPulse Carbon Dioxide Laser with CPG Scanner for Deepithelialization: Clinical and Histologic Study	David B. Apfelberg, MD, Bruce Smoller, MD.	Atherton Plastic Surgery Center, Calif., USA.	Plast Reconstr Surg. 1997 Jun;99(7):2089-94.	1997	The UltraPulse carbon dioxide laser with CPG scanner was utilized to deepithelialize dermal pedicles in breast reduction inferior pedicle flaps. Clinical advantages include lack of bleeding, markedly shortened time of dissection, and excellent wound healing. Histologic studies confirm that the laser removes epidermis and papillary dermis but leaves undamaged the superficial vascular plexus and reticular dermis.
68	Peer reviewed article	Cutaneous Resurfacing	Pulsed Carbon Dioxide Laser, Trichloroacetic Acid, Baker- Gordon Phenol, and Dermabrasion: A Comparative Clinical and Histologic Study of Cutaneous Resurfacing in a Porcine Model	Richard E. Fitzpatrick, M.D.; Whitney D. Tope, MPHIL, M.D.; Mitchel P. Goldman, M.D.; Nancy M. Satur, M.D.		Arch Dermatol. 1996;132(4):469-471.	1996	Recent advancements in carbon dioxide laser technology have allowed the development of microsecond-domain pulses with a high pulse energy (up to 500 mJ), enabling precise and complete tissue vaporization while minimizing residual thermal damage and its potential adverse effects on wound healing. ¹ For appropriate clinical application, one should know the depth of vaporization and residual thermal damage after successive laser passes over the same area, the depth of vaporization and residual thermal damage caused by different pulse energies, and how these in turn compare with the depth of tissue removal afforded by currently used resurfacing modalities: dermabrasion, 35% trichloroacetic acid peel, and Baker-Gordon (50%) phenol peel. To evaluate these immediate tissue effects and postoperative wound healing for all of these modalities, a clinical and histologic animal study was performed.
69	Peer reviewed article	Xanthelasma	Ultrapulse CO ₂ laser ablation of xanthelasma	Alster TS, West TB	Washington Institute of Dermatologic Laser Surgery, Washington, DC, USA	Journal of the American Academy of Dermatology Vol. 34 No. 5, pp. 848-849	1996	

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
70	Peer reviewed article	Skin Resurfacing of Fine to Deep Rhytides	Skin Resurfacing of Fine to Deep Rhytides Using a Carbon-free Carbon Dioxide Laser in 47 Patients	Heidi A. Waldorf, M.D., Kauvar, Arielle N B, M.D., Roy G. Geronemus, M.D.	Laser and Skin Surgery Center of New York, NY, USA.	Dermatol Surg. 1995 Nov;21(11):940-6.	1995	<p>BACKGROUND: Recent advances in carbon dioxide (CO₂) laser technology have resulted in the development of lasers that can precisely remove thin layers of skin with minimal thermal damage to the surrounding tissue. These lasers rely on rapid pulsing or scanning of the laser beam. The effects of these lasers are predictable and reproducible, making them ideal for skin resurfacing. Clinical results have been promising, however, to date, no published series exist.</p> <p>OBJECTIVE: To evaluate the effectiveness and side effect profile of laser resurfacing utilizing a CO₂ laser with a scanning device, and make recommendations for patient selection and treatment protocol.</p> <p>METHODS: Patients with perioral, periorbital, and glabellar rhytides were treated with a CO₂ laser with a scanning device. Utilizing chart review and photographic evaluation, patients treated between November 1994 and April 1995 were retrospectively evaluated for effectiveness of therapy, healing time, and complication rates.</p> <p>RESULTS: A total of 47 patients were evaluated. Photographic evaluation or chart review revealed good to excellent cosmetic results in all anatomic areas studied. All patients experienced posttreatment erythema lasting 1-6 months. Other minor complications were limited to contact dermatitis to topical preparations, transient postinflammatory hyperpigmentation, and milia formation. One patient experienced a primary herpes simplex virus infection during reepithelialization and required intravenous therapy. Minor focal atrophy was seen in one patient. No hypertrophic scarring or permanent pigmentation changes were seen.</p> <p>CONCLUSIONS: A CO₂ laser system with a scanning beam can effectively and safely improve or remove glabellar, perioral, and periorbital rhytides.</p>
71	Peer reviewed article	Dermatologic Surgery	Use of the Carbon Dioxide Laser in Dermatologic Surgery: A Clinically Relevant Update for 1993	Suzanne M. Olbricht, MD	Department of Dermatology, Beth Israel Hospital, Boston, Massachusetts.	J. Dermatol., Surg. Oncol., 19:364-369, 1993.	1993	<p>BACKGROUND: The effective and safe use of the carbon dioxide (CO₂) laser in the 1990s has been facilitated by technologic advances and widespread clinical use producing a better understanding of laser-tissue interactions, refinements in technique, and modifications of the list of indications. Safety guidelines have evolved from identification of complications.</p> <p>OBJECTIVE: To discuss the basic principles and applications of CO₂ laser surgery. Methods: Types of CO₂ lasers and their applications are discussed.</p> <p>CONCLUSION: Today, use of the carbon dioxide laser simplifies many procedures, is reasonably safe, is effective for its intended usages, and is the preferred treatment of several cutaneous disorders.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
72	Peer reviewed article	Periungual and Subungual Viral Warts	Carbon Dioxide Laser Treatment of Periungual and Subungual Viral Warts	J.T.E. Lim, MBBS(MAL), MRCP (IRE) ¹ , C.L. Goh, FAMS, MMED (Singapore), MRCP (UK) ²	¹ Senior Registrar, National Skin Centre, Singapore, ² Senior Consultant and Medical Director, National Skin Centre, Singapore.	Australas J. Dermatol., 33:87-91, 1992.	1992	This is a retrospective study of the cure rates of forty patients with subungual and periungual viral warts treated with carbon dioxide laser vapourisation (total of 69 lesions). 70.6% (48/68) lesions had failed treatment with cryotherapy and/or electrocautery treatment previously. 20/68 were treated with CO ₂ laser vapourisation as a first line treatment. The overall cure rate over 10 months follow-up period was 57.4% (39/68). Most recurrences (24/25) occurred within the first 3 months of vapourisation. The carbon dioxide laser vapourisation cure rate for warts in which previous cryotherapy and/or electrocautery had failed was 47.9% whereas those treated with carbon dioxide laser vapourisation as a first line treatment had a cure rate of 80% (p = 0.043). Subungual warts responded slightly better with a cure rate of 64.7% compared with periungual warts (54.9%) (n.s.). The carbon dioxide laser vapourisation cure rate for recurrent subungual and periungual warts (which failed previous carbon dioxide laser vapourisation) was 73.3% (11/15). Our findings appeared to indicate that periungual and subungual warts can be eradicated by CO ₂ laser vapourisation. Recurrent warts can be effectively eradicated by further vapourisation. Recalcitrant periungual and subungual warts which have previously failed to respond to cryotherapy and/or electrocautery can be effectively eradicated with CO ₂ laser vapourisation.
73	Peer reviewed article	Chondrodermatitis Nodularis Chronica Helicis	Chondrodermatitis Nodularis Chronica Helicis: Successful Treatment with the Carbon Dioxide Laser	Taylor MB.	University of Utah Division of Dermatology, Salt Lake City.	J. Dermatol. Surg. Oncol., 17:862-864, 1991.	1991	Chondrodermatitis nodularis chronica helicis is a painful, persistent, or recurrent inflammatory lesion involving the cartilage and skin of the external ear. These lesions are resistant to many therapeutic modalities and often recur even after surgical excision. The CO ₂ laser was used to vaporize the cutaneous nodules and involved cartilage. The wounds were allowed to heal with only minimal care using hydrogen peroxide cleansing and applications of topical antibiotic ointment. Twelve lesions have been treated with no recurrences after 2 to 15 months. There have been no complications or infections following laser surgery. The pain from these lesions is gone immediately following laser surgery. Healing with excellent cosmetic results is complete usually within 3 to 4 weeks.
74	Peer reviewed article	Actinic Cheilitis	Actinic Cheilitis: Treatment with the Carbon Dioxide Laser	Brian D. Zelickson, M.D., Randall K Roenigk, M.D.	Department of Dermatology, Mayo Clinic, Rochester, Minnesota	Cancer, 65:1307-1311, 1990.	1990	Actinic cheilitis is a premalignant condition that can be treated in several ways. A total of 43 patients with biopsy-proven actinic cheilitis were treated with the carbon dioxide (CO ₂) laser. After follow-up of at least 10 months, 26 patients thought that the lip was cosmetically improved, and 40 thought that the function of the lip was improved or had not changed. Complications were few and included only mild hypertrophic scarring, which resulted most often from the diagnostic biopsy and was corrected with topical or intralesional steroids or no therapy except simple massage. The CO ₂ laser is a simple, inexpensive, effective therapy for actinic cheilitis.

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
75	Peer reviewed article	Recalcitrant Periungual Verrucae	Recalcitrant Periungual Verrucae: The Role of Carbon Dioxide Laser Vaporization	Marcy L. Street, M.D., Randall K. Roenigk, M.D.	Department of Dermatology, Mayo Clinic and Mayo Foundation, Rochester, Minnesota, USA	J. Am. Acad. Dermatol., 23:115-120, 1990.	1990	Recalcitrant periungual Verrucae (24 lesions) in 17 patients were vaporized with the carbon dioxide laser. The lesions had been present for 1 to 15 years and treated an average of nine times previously. Vaporization of these warts, in combination with partial or complete nail avulsion, resulted in complete cures in 71% of patients who had one or two treatments. The cure rate was 94% when the patients who had clearing after one or two laser treatments in combination with other therapies are included. Further follow-up indicates that infection and significant onychodystrophy are uncommon. Pain occurs, but in most cases it is short lived and manageable.
76	Peer reviewed article	Skin Deepithelialization	Extended Applications of the Carbon Dioxide Laser for Skin Deepithelialization	Geoffrey G. Hallock, M.D.	Division of Plastic Surgery, Allentown Hospital.	Plast Reconstr Surg. 1989 Apr;83(4):717-21	1989	The efficacy of the carbon dioxide laser for skin deepithelialization in humans was initially demonstrated using reduction mammoplasty as a clinical model. Twenty-two additional successful cases including use of this technique as an adjunct for other flap transpositions and overgrafting of skin grafts are described. These results document a role for the carbon dioxide laser in skin deepithelialization, where it provides an advantage when rigid skin immobilization is impossible or if there would be a risk to underlying structures if more conventional approaches were used.
77	Peer reviewed article	Actinic Cheilitis	Microscopically Proven Cure of Actinic Cheilitis by CO ₂ Laser	Duane C. Whitaker M.D.	Director of Dermatologic Surgery, Department of Dermatology, University of Iowa Hospitals and Clinics, Iowa City	Lasers Surg. Med., 7:520-523, 1987.	1987	Actinic cheilitis is a premalignant condition of the lip frequently seen in individuals with chronic sun exposure. Various surgical and ablative therapies have been employed, but microscopic outcome has not been well documented. In this study CO ₂ laser ablation was performed on 16 patients with actinic cheilitis that involved 50% or greater of the lower lip. Pre- and post-treatment biopsies were performed to assess results of therapy. After treatment all 16 patients showed microscopic clearing of atypical cells and disorderly maturation characteristic of actinic cheilitis. One patient had clinical recurrence at 14 months, which was retreated with laser.
78	Peer reviewed article	Acne Keloidalis Nuchae	Treatment of Acne Keloidalis Nuchae with Carbon Dioxide Laser	Gary R. Kantor, M.D., John L. Ratz, M.D., Ronald G. Wheeland, M.D.	Department of Dermatology, Cleveland Clinic Foundation	J. Am. Acad. Dermatol., 14:263-267, 1986.	1986	The chronic stage of acne keloidalis nuchae is characterized by symptomatic keloidal papules and plaques on the occipital scalp and posterior neck. We describe our results with the use of the carbon dioxide laser in eight patients with treatment-refractory acne keloidalis nuchae.
79	Peer reviewed article	Bowenoid Papulosis and Bowen's Disease	Laser Therapy of Bowenoid Papulosis and Bowen's Disease	Michael Landthaler, Dieter Haina, Reinhold Brunner, Wilhelm Waidelich, Otto Braun-Falco		J. Dermatol. Surg. Oncol., 12:1253-1257, 1986.	1986	Six patients with bowenoid papulosis and two patients with Bowen's disease of the genital area were treated by means of an argon, Nd:YAG, and CO ₂ laser. In all of the patients, complete resolution of the lesions was achieved. Due to a superficial coagulating effect, application of the argon laser should be restricted to macular and papular pigmented lesions. In contrast, Nd:YAG and CO ₂ lasers could be used even for treatment of extensive leukoplakia-like and verrucous lesions. Advantages and disadvantages of these two lasers are discussed.

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
80	Peer reviewed article	Actinic Cheilitis	Laser Vermilion Ablation for Actinic Cheilitis	Laurence M. David, M.D.		J Dermatol Surg Oncol. 1985 Jun;11(6):605-8.	1985	A new surgical procedure employing a carbon dioxide laser for treating actinic cheilitis is described. Eight patients having biopsy-proven actinic cheilitis and one patient having clinically evident actinic cheilitis but biopsy-proven superficial basal cell carcinoma were treated by vermilion ablation using the carbon dioxide laser. After an average follow-up period of 34 months (27 to 38 months), no patient has had a recurrence of cheilitis. Normal contour of the treated lip has been preserved in all patients, while none has had significant post-treatment scarring.

Scar Treatments

81	Peer reviewed article	Scar Treatments	Laser treatment of traumatic scars with an emphasis on ablative fractional laser resurfacing: consensus report	Anderson RR ¹ , Donelan MB ² , Hivnor C ³ , Greeson E ³ , Ross EV ⁴ , Shumaker PR ⁵ , Uebelhoer NS ⁵ , Waibel JS ⁶	¹ Wellman Center for Photomedicine, Massachusetts General Hospital, Boston, MA, ² Department of Plastic Surgery, Shriners' Hospital for Children, Boston, MA, ³ San Antonio Uniformed Health Education Consortium, Lackland Air Force Base, TX, ⁴ Scripps Clinic Laser and Cosmetic Dermatology Center, San Diego, CA, ⁵ Department of Dermatology, Naval Medical Center, San Diego, CA, ⁶ Miami Dermatology and Laser Institute, Miami, FL	JAMA Dermatology Vol. 150 No. 2, pp. 187-193	2014	<p>IMPORTANCE: Despite expert wound care and assiduous management with traditional therapy, poor cosmetic outcomes, restricted motion, and symptoms such as pain and itch are a pervasive problem of disfiguring and debilitating scars. The advent of ablative fractional photothermolysis within the past decade and its application to the treatment of traumatic scars represents a breakthrough in the restoration of function and cosmetic appearance for injured patients, but the procedure is not widely used.</p> <p>OBJECTIVE: To provide a synthesis of our current clinical experience and available literature regarding the laser treatment of traumatic scars with an emphasis on fractional resurfacing.</p> <p>EVIDENCE REVIEW: Eight independent, self-selected academic and military dermatology and plastic surgery physicians with extensive experience in the use of lasers for scar treatment assembled for a 2-day ad hoc meeting on January 19 and 20, 2012. Consensus was based largely on expert opinion, but relevant literature was cited where it exists.</p> <p>FINDINGS: After consensus was appraised, we drafted the manuscript in sections during the course of several months. The draft was then circulated among all panel members for final review and comment. Our consensus is that laser treatment, particularly ablative fractional resurfacing, deserves a prominent role in future scar treatment paradigms, with the possible inclusion of early intervention for contracture avoidance and assistance with wound healing.</p> <p>CONCLUSIONS AND RELEVANCE: Laser scar therapy, particularly fractional ablative laser resurfacing, represents a promising and vastly underused tool in the multidisciplinary treatment of traumatic scars. Changes to existing scar treatment paradigms should include extensive integration of fractional resurfacing and other combination therapies guided by future research.</p>
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STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
82	Peer reviewed article	Scar treatments	Residual Scarring From Hidradenitis Suppurativa: Fractionated CO ₂ Laser as a Novel and Noninvasive Approach	Andrew C. Krakowski, MD ^{a,b} , Shehla Admani, MD ^{a,b} , Nathan S. Uebelhoer, DO ^c , Lawrence F. Eichenfield, MD ^{a,b} , and Peter R. Shumaker, MD ^c	^a University of California, San Diego, La Jolla, California; ^b Rady Children's Hospital, San Diego, California; and ^c Naval Medical Center, San Diego, California	Pediatrics Vol. 133 No. 1, pp. e248-e251	2014	Hidradenitis suppurativa (HS) is a chronic, relapsing, inflammatory skin condition that can have a significant psychosocial impact, both with the active disease and with residual scarring. Although a wide variety of treatment options exist for HS, to our knowledge there are no reported modalities aimed specifically at treating HS scarring. We describe the case of an adolescent female who received medical management of intramammary HS followed by successful treatment with fractionated 10 600-nm carbon dioxide laser for her residual cribriform scarring. We believe there is great potential for the use of fractionated carbon dioxide laser to improve short- and long-term psychosocial outcomes of HS, promote physical scar remodeling, and possibly alter the disease process itself.
83	Peer reviewed article	Scar treatments	Treatment of Atrophic Scars With Fractionated CO ₂ Laser Facilitating Delivery of Topically Applied Poly-L-lactic Acid	Ali Rkein, MD ¹ ; David Ozog, MD ¹ ; Jill S. Waibel, MD ²	¹ Department of Dermatology, Henry Ford Hospital, Detroit, MI, USA; ² Miami Dermatology and Laser Institute, Miami, FL, USA	Dermatologic Surgery Vol. 40 No. 6, pp. 624-631	2014	BACKGROUND Atrophic scars represent a loss of collagen and a challenging reconstructive dilemma with disappointing traditional treatments. OBJECTIVE To study the safety and efficacy of the treatment of atrophic scars using an ablative fractionated CO ₂ laser and topical poly-L-lactic acid (PLLA) immediately after to improve atrophic scars. MATERIALS AND METHODS This was an uncontrolled, institutional review board-approved, prospective study evaluating the treatment of atrophic scars. Four blinded dermatologists evaluated a total of 20 photographs taken at baseline and 3 months after the laser and PLLA treatments using the Modified Manchester Scar Scale. Four criteria were evaluated: (1) overall improvement, (2) improvement in scar atrophy, (3) improvement in scar color/dyschromia mismatch, and (4) improvement in scar contour. RESULTS All 4 observers accurately identified 76 of the 80 "before" and "after" photographs. Therefore, the blinded evaluating physicians agreed that at the 3-month follow-up visit, 95% of the scars had improved. Each criterion demonstrated an average improvement of at least 33%. CONCLUSION The combination of using an ablative fractional CO ₂ laser and PLLA in the treatment of atrophic scars has a synergistic effect on their inherent properties in up-regulating new collagen synthesis to improve atrophic scars.
84	Peer reviewed article	Scar treatments	Ablative fractional photothermolysis in the treatment of scar contractures of the wrists and forearms: a retrospective data analysis	Perry A ¹ , Elston J ² , Reynolds H ³ , Hawley L ³ , Kroonen L ² , Uebelhoer NS ³ , Shumaker PR ³	¹ Department of Dermatology and Dermatologic Surgery, Naval Medical Center, San Diego, CA, ² Department of Orthopedics, Naval Medical Center, San Diego, CA, ³ Department of Dermatology and Dermatologic Surgery, Naval Medical Center, San Diego, CA	JAMA Dermatology Vol. 71 No. 4, pp. 841-842	2014	Since its introduction in 2007, ablative fractional photothermolysis (AFP) has been reported to be effective in improving appearance and texture in a broad array of skin conditions, including surgical, acne, and traumatic scars. ^{1,2} A growing number of anecdotal reports have suggested that this laser modality can safely and effectively improve function in patients with debilitating scar contractures. ³⁻⁵ However, to our knowledge there has not previously been a systematic evaluation of efficacy specifically related to function.

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
85	Peer reviewed article	Scar treatments	Vascular Patterns in Mature Hypertrophic Burn Scars Treated with Fractional CO ₂ Laser	Karen L. Connolly, MD; Marsha Chaffins, MD; David Ozog, MD	Department of Dermatology, Henry Ford Hospital, Detroit, MI, USA	Lasers in Surgery and Medicine Vol. 46 No. 8, pp.597-600	2014	<p>Background and Objective: Fractional CO₂ laser has recently emerged as a promising therapeutic modality to improve the texture and appearance of burn scars. An issue in many burn scars is persistent erythema, which traditionally has been treated with vascular lasers. Interestingly, fractional CO₂ lasers have been shown to improve the appearance of burn scars, including erythema, but no mechanism has been proposed for this change. Our objective is to evaluate the histopathologic changes in vasculature in burn scars treated with fractionated CO₂ laser, and to attempt to describe the mechanism behind reduced erythema following treatment.</p> <p>Study Design/Materials and Methods: Uncontrolled, prospective study of ten patients with mature burn scars, from a clinical and histological perspective. Biopsy specimens were obtained before and 2 months after 3 treatment sessions. Anti-CD31 immunostaining was performed to highlight vascular patterns in biopsy specimens.</p> <p>Results: In histological analysis, an increase in vascular density, particularly of small caliber vessels, was seen following treatment, with an 82.6% average increase in vasculature (P=0.028). This increase in vascularity correlated with a decrease in clinical erythema and vascularity scores, measured using the Vancouver Scar Scale.</p> <p>Conclusion: Mature hypertrophic burn scars treated with a fractional CO₂ laser showed a statistically significant increase in vascular density in the superficial dermis. A non-statistical decrease in clinically perceived erythema and improvement of overall appearance was seen. To our knowledge, this is the first report of increased vascular density in burn scars treated with fractional CO₂ laser and suggests our prior assumptions on causes of erythema in mature hypertrophic scars may need to be challenged.</p>
86	Peer reviewed article	Scar treatments	Ablative fractional laser resurfacing helps treat restrictive pediatric scar contractures	Krakovski AC ¹ , Goldenberg A ² , Eichenfield LF ¹ , Murray JP ³ , Shumaker PR ⁴	¹ Division of Pediatric and Adolescent Dermatology, Rady Children's Hospital, San Diego, CA, ² University of California San Diego School of Medicine, San Diego, CA, ³ Occupational Therapy, Rady Children's Hospital, San Diego, CA, ⁴ Department of Dermatology, Naval Medical Center, San Diego, CA	Pediatrics Vol. 134 No. 6, pp. e1700-1705	2014	<p>Conventional management of debilitating pediatric scar contractures, including hand therapy and surgery, may often be beset by delayed treatment, suboptimal results, and additional surgical morbidity. Ablative fractional laser resurfacing is an emerging adjunctive procedural option for scar contractures because of its promising efficacy and safety profile. However, its use to improve function has not been studied in the pediatric population. Herein we report 2 pediatric patients with recalcitrant scar contractures, causing persistent functional deficits, treated with an ablative fractional laser protocol. Both patients experienced rapid and cumulative subjective and objective improvements in range of motion and function as measured by an independent occupational therapist without reported complications. We highlight ablative fractional laser resurfacing as a novel and promising tool in the management of function-limiting scar contractures in children and propose that the technique be incorporated into existing scar treatment paradigms, guided by future research.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
87	Peer reviewed article	Scar treatments	Laser resurfacing and remodeling of hypertrophic burn scars: the results of a large, prospective, before-after cohort study, with long-term follow-up	Hultman CS, Friedstat JS, Edkins RE, Cairns BA, Meyer AA	Division of Plastic Surgery and The NC Jaycee Burn Center, University of North Carolina Health Care System, Chapel Hill, NC, USA	Ann Surg Vol. 260 No. 3, pp. 519-529	2014	<p>OBJECTIVES: Hypertrophic burn scars produce significant morbidity, including itching, pain, stiffness, and contracture, but best management practices remain unclear. We present the largest study to date that examines long-term impact of laser therapies, a potentially transformative technology, on scar remodeling.</p> <p>METHODS: We conducted a prospective, before-after cohort study in burn patients with hypertrophic scars. Pulsed-dye laser was used for pruritus and erythema; fractional CO₂ laser was used for stiffness and abnormal texture. Outcomes included (1) Vancouver Scar Scale (VSS), which documents pigmentation, erythema, pliability, and height, and (2) University of North Carolina "4P" Scar Scale (UNC4P), which rates pain, pruritus, paresthesias, and pliability.</p> <p>RESULTS: A total of 147 burn patients (mean age, 26.9 years; total body surface area, 16.1%) received 415 laser sessions (2.8 sessions/patient), 16 months (median) after injury, including pulsed dye laser (n = 327) and CO₂ (n = 139). Laser treatments produced rapid, significant, and lasting improvements in hypertrophic scar. Provider-rated VSS dropped from 10.43 [standard deviation (SD) 2.37] to 5.16 (SD 1.92), by the end of treatments, and subsequently decreased to 3.29 (SD 1.24), at a follow-up of 25 months. Patient-reported UNC4P fell from 5.40 (SD 2.54) to 2.05 (SD 1.67), after the first year, and further decreased to 1.74 (SD 1.72), by the end of the study period.</p> <p>CONCLUSIONS: For the first time, ever, in a large prospective study, laser therapies have been shown to dramatically improve both the signs and symptoms of hypertrophic burn scars, as measured by objective and subjective instruments. Laser treatment of burn scars represents a disruptive innovation that can yield results not previously possible and may displace traditional methods of operative intervention.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
88	Peer reviewed article	Scar treatments	Evaluation of Clinical Results, Histological Architecture, and Collagen Expression Following Treatment of Mature Burn Scars With a Fractional Carbon Dioxide Laser	David M. Ozog, M.D. ¹ ; Austin Liu, M.D. ¹ ; Marsha L. Chaffins, M.D. ² ; Adrian H. Ormsby, M.D. ² ; Edgar F. Fincher, M.D., Ph.D. ⁴ ; Lisa K. Chipps, M.D. ⁴ ; Qing-Sheng Mi, M.D., Ph.D. ³ ; Peter H. Grossman, M.D. ⁵ ; John C. Pui, M.D. ⁶ ; Ronald L. Moy, M.D. ⁴	Department of Dermatology ¹ , Department of Dermatology and Pathology ² , and Dermatology Research and Immunology ³ , Henry Ford Hospital, Detroit, Michigan; Moy-Fincher Medical Group, Los Angeles, California ⁴ ; Grossman Burn Centers, Sherman Oaks, California ⁵ ; and Hilbrich Labs, Garden City, Michigan ⁶ .	JAMA Dermatol. 2013 Jan;149(1):50-7	2013	<p>OBJECTIVE: To assess mature burn scars treated with a fractional carbon dioxide laser for changes in histological architecture, type I to III collagen ratios, density of elastic tissue, and subjective measures of clinical improvements.</p> <p>DESIGN: Uncontrolled, prospective study of patients with mature burn scars, from a clinical and histological perspective. Biopsy specimens were obtained before and 2 months after 3 treatment sessions. The tissue was prepared with Verhoff von Giesen (VVG) stain to discern elastic tissue and Herovici stain to differentiate types I and III collagen.</p> <p>SETTING: Subjects were recruited from the Grossman Burn Centers.</p> <p>PARTICIPANTS: Of 18 patients with mature burn scars, 10 completed the entire treatment protocol. Intervention: Participants received 3 treatments with a fractional carbon dioxide laser.</p> <p>MAIN OUTCOME MEASURES: Vancouver Scar Scale and Patient and Observer Scar Assessment Scale survey scores. In histological analysis, imaging software was used to measure changes in collagen subtype and elastic tissue. A rating scale was developed to assess normal vs scar architecture.</p> <p>RESULTS: The first hypothesis that significant histological improvement would occur and the second hypothesis of a statistically significant increase in type III collagen expression or a decrease in type I collagen expression were confirmed. There were no significant changes in elastic tissue. Statistically significant improvements were seen in all survey data.</p> <p>CONCLUSIONS: Treatment with a fractional carbon dioxide laser improved the appearance of mature burn scars and resulted in a significant improvement in collagen architecture following treatment. Furthermore, in treated skin specimens, a collagen subtype (types I and III collagen) profile resembling that of nonwounded skin was found.</p>
89	Peer reviewed article	Scar treatments	Rapid healing of scar-associated chronic wounds after ablative fractional resurfacing	Shumaker PR, Kwan JM, Badiavas EV, Waibel J, Davis S, Uebelhoer NS		Archives of Dermatology Vol. 148 No. 11, pp. 1289-1293	2012	<p>BACKGROUND: Skin compromised by traumatic scars and contractures can manifest decreased resistance to shearing and other forces, while increased tension and skin fragility contribute to chronic erosions and ulcerations. Chronic wounds possess inflammatory mediator profiles and other characteristics, such as the presence of biofilms, that can inhibit healing.</p> <p>OBSERVATIONS: Three patients with multiple traumatic scars related to blast injuries initiated a course of ablative fractional laser therapy for potential mitigation of contractures, poor pliability, and textural irregularity. Patients also had chronic focal erosions or ulcerations despite professional wound care. All patients experienced incidental rapid healing of their chronic wounds within 2 weeks of their initial ablative fractional laser treatment. Healing was sustained throughout the treatment course and beyond and was associated with gradual enhancements in scar pliability, texture, durability, and range of motion.</p> <p>CONCLUSIONS: The unique pattern of injury associated with ablative fractional laser treatment may have various potential wound-healing advantages. These advantages include the novel concept of photomicrodebridement, including biofilm disruption and the stimulation of de novo growth factor secretion and collagen remodeling. If confirmed, ablative fractional resurfacing could be a potent new addition to traditional wound and scar treatment paradigms.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
90	Peer reviewed article	Scar Treatments	Ablative Fractional Resurfacing for the Treatment of Traumatic Scars and Contractures	Nathan S. Uebelhoer, DO ¹ , E. Victor Ross, MD ^{1,2} , Peter R. Shumaker, MD ¹	¹ Department of Dermatology, Naval Medical Center San Diego, San Diego, CA. ² Department of Dermatology, Scripps Clinic, La Jolla, CA.	Semin Cutan Med Surg 31:110-120	2012	After a decade of military conflict, thousands of wounded warriors have suffered debilitating and cosmetically disfiguring scars and scar contractures. Clearly, there is a need for effective scar treatment regimens to assist in the functional and cosmetic rehabilitation of these patients. Traditional treatments, including aggressive physical and occupational therapy and dedicated wound care, are essential. Adjunctive treatments with established laser technologies, such as vascular lasers and full-field ablative lasers, have had a somewhat limited role in scar contractures due to modest efficacy and/or an unacceptable side effect profile in compromised skin. Refractory scar contractures often require surgical revision, which can be effective, but is associated with additional surgical morbidity and a significant risk of recurrence. Furthermore, current scar treatment paradigms often dictate scar maturation for approximately a year to allow for spontaneous improvement before surgical intervention. Since 2009, the Dermatology Clinic at the Naval Medical Center San Diego has been treating scars and scar contractures in wounded warriors and others using ablative fractionated laser technology. Although traditionally associated with the rejuvenation of aged and photo-damaged skin, our clinical experience and a handful of early reports indicate that laser ablative fractional resurfacing demonstrates promising efficacy and an excellent side effect profile when applied to the functional and cosmetic enhancement of traumatic scars and contractures. This article discusses our clinical experience with ablative fractional resurfacing and its potential prominent role in rehabilitation from traumatic injuries, including a possible shift in scar treatment paradigms toward earlier procedural intervention. Potential benefits include the optimization of scar trajectory and higher levels of full or adapted function in a more favorable time course.
91	Peer reviewed article	Scar Treatments	Functional Improvements in Traumatic Scars and Scar Contractures Using an Ablative Fractional Laser Protocol	Peter R. Shumaker, MD, Julia M. Kwan, MD, John T. Landers, MD, Nathan S. Uebelhoer, DO	Department of Dermatology, Naval Medical Center, San Diego, California	J Trauma Acute Care Surg. 2012;73: S116YS121.	2012	BACKGROUND: Reports describing the use of ablative fractional resurfacing (AFR) for cosmetic improvements in skin dyschromia, rhytides, and textural irregularities are becoming increasingly common in the literature. However, there is little mention of its functional impact on patients with traumatic scars and scar contractures. We present our experience treating scars with AFR, highlighting four illustrative cases and providing a review on possible mechanisms. METHODS: Up to three ablative fractional carbon dioxide laser treatments were performed at 1-month to 2-month intervals on four patients with functional deficits related to refractory scar contractures. Treatments were individualized and began as early as 2 months after injury or final reconstructive surgery. Cases were performed in the outpatient clinic using topical anesthetic supplemented by forced air cooling. Postprocedure care included diluted-vinegar compresses two to three times daily and application of ointment over the treatment area for approximately 3 days after the procedure. Postprocedure pain was minimal, and all patients were allowed to resume physical therapy as early as the day of treatment. RESULTS: AFR was well tolerated without serious complications. Durable and cumulative improvements in range of motion or overall skin functionality were noted in all patients. AFR can be surgery sparing and facilitated earlier return to full or modified activities based on associated injuries. CONCLUSION: AFR is a novel, well tolerated, and effective complement to traditional rehabilitative management for patients with traumatic scars and scar contractures. Potential paradigm shifts include earlier initiation of treatment and a focus on functional improvements.

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
92	Peer reviewed article	Scar Treatments	Clinical and Molecular Effects on Mature Burn Scars After Treatment With a Fractional CO ₂ Laser	Le Qu, M.D., ^{1,2,4} Austin Liu, M.D., ² Li Zhou, M.D., ^{1,2,3} Chundi He, M.D., Ph.D., ⁴ Peter H. Grossman, M.D., ⁵ Ronald L. Moy, M.D., ⁶ Qing-Sheng Mi, M.D., Ph.D., ^{1,2,3} David Ozog, M.D. ²	¹ Henry Ford Immunology Program, Henry Ford Hospital, Detroit, Michigan, ² Department of Dermatology, Henry Ford Hospital, Detroit, Michigan, ³ Department of Internal Medicine, Henry Ford Hospital, Detroit, Michigan, ⁴ Department of Dermatology, No. 1 Hospital of China Medical University, Shenyang, PR China, ⁵ Grossman Burn Center, West Hills, California, ⁶ David Geffen School of Medicine at the University of California at Los Angeles, Los Angeles, California	Lasers Surg. Med.44:517-524, 2012	2012	<p>BACKGROUND AND OBJECTIVE: There have been several case reports of improvement in the appearance of mature burn scars following treatment with fractional CO₂ lasers. However, the biochemical mechanisms responsible for these improvements have not been elucidated.</p> <p>MATERIALS AND METHODS: Ten patients with mature, full thickness, hypertrophic burn scars received initial treatment with a fractional CO₂ laser. Clinical improvement was measured with Vancouver Scar Scale as well as Patient and Observer Scar Assessment Scale. Fresh tissue samples were obtained before the initial treatment and 48 hours after the first treatment for TaqMan Real-time RT-PCR analyses. Expressions of several scar-related biological markers, including types I and III procollagen, matrix metalloproteinase (MMP)-1, -13, transforming growth factor (TGF)-b1, b2, b3, and basic fibroblast growth factor (bFGF), as well as microRNA miR-17-92 cluster, were investigated.</p> <p>RESULTS: There were significant improvements in both observer and subject ratings in all scales. Both types I and III procollagen mRNA levels were dramatically down-regulated after treatment, but the ratio of types I/III procollagen mRNA was not different. The expression of MMP-1 was significantly up-regulated after treatment, while TGF-b2, -b3, and bFGF levels were significantly down-regulated. Expression of miR-18a and miR-19a were dramatically up-regulated (P < 0.05) after treatment.</p> <p>CONCLUSIONS: Our study indicated that fractional CO₂ resulted in clinical improvement of mature burn scar. Alteration of types I and III procollagen, MMP-1, TGF-b2, -b3, bFGF, as well as miRNAs miR-18a and miR-19a expression may be responsible for the clinical improvement after treatment. Our finding may have implications for novel treatments and further our understanding of fractional CO₂ laser treatment.</p>
93	Peer reviewed article	Scar Treatments	Induction of De Novo Hair Regeneration in Scars after Fractionated Carbon Dioxide Laser Therapy in Three Patients	¹ Thomas M. Beachkofsky, MD, ² J. Scott Henning, DO, ² Chad M. Hivnor, MD	¹ U.S. Air Force, Kunsan Air Base, Republic of Korea. ² Department of Dermatology, Wilford Hall Medical Center, Lackland Air Force Base, Texas	Dermatol Surg. 2011 Sep;37(9):1365-8	2011	<p>For many years, the human hair follicle was thought to form only during primary development and to be unable to be regenerated if destroyed or lost. Although its complex development has been intensely studied, the morphologic stages and numerous biochemical cascades characteristic of human hair follicle growth and development are poorly understood. Consequently, it is a source of intense research.</p> <p>More than 50 years ago, Kligman and Strauss described the regeneration of vellus hair follicles and sebaceous glands on the face after dermabrasion. Gillman and Penn showed similar findings during healing of incised wounds. Although the validity of these findings has been questioned, numerous researchers have shown post-traumatic de novo hair follicle regeneration in many nonhuman mammalian species, including mice, rats, rabbits, and guinea pigs, although there continues to be a paucity of human studies, and published case reports are rare and offer incomplete detail.</p> <p>Here we present original case reports of three patients with scarring of distinct etiologies. All experienced new hair growth within fractionated carbon dioxide (CO₂) laser treatment areas. We believe these incidental findings may represent de novo hair follicle regeneration inside the borders of post-traumatic hypertrophic scarring or grafting.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
94	Peer reviewed article	Scar treatments	A Randomized Split-Scar Study of Intraoperative Treatment of Surgical Wound Edges to Minimize Scarring	David M. Ozog, MD ¹ ; Ronald L. Moy, MD ²	¹ Department of Dermatology, Henry Ford Hospital, Detroit, MI, USA; ² Moy-Fincher Medical Group, Beverly Hills, CA, USA; ³ David Geffen School of Medicine at University of California, Los Angeles, CA, USA	JAMA Dermatology Vol. 147 No. 9, pp. 1108-1110	2011	For ablative resurfacing of surgical scars, the recommended time frame for treatment has remained relatively constant at 8 weeks postoperatively. ¹ However, Strauss and Kligman ² were aware as early as 1956 that dermabrasion to the wound edges at time of closure would improve the final appearance of sutured wounds. In 1980, Caver ³ reported that dermabrasion to wound edges at the time of surgery had been used successfully in his practice for over 20 years. In recent years, 2 studies using ablative laser resurfacing of wounds at the time of closure have shown promising trends. ^{4,5} Ablative fractional resurfacing has been shown to quantitatively improve atrophic surgical and traumatic scars. ⁶ The improved safety profile of fractional carbon dioxide lasers vs their fully ablative counterparts and the ability to treat nonfacial sites makes them well suited for scar treatments. Our study aims to quantify the improvements resulting from intraoperative fractional carbon dioxide laser treatment. To our knowledge, this is the first prospective fractional laser study for this indication and the first to evaluate nonfacial sites.
95	Peer reviewed article	Scar Treatments	Use of a Fractional Ablative 10.6 μm Carbon Dioxide Laser in the Treatment of a Morphea-Related Contracture	Donald Kineston, MD, Julia M. Kwan, MD, Nathan S. Uebelhoer, DO, Peter R. Shumaker, MD	Department of Dermatology, Naval Medical Center San Diego, California	Arch Dermatol. 2011 Oct; 147(10):1148-50	2011	
96	Peer reviewed article	Scar Treatments	Functional improvement after ablative fractional laser treatment of a scar contracture	Julia M Kwan, Marilynn Wyatt, Nathan S Uebelhoer, Jay Pyo, Peter R Shumaker	Department of Dermatology, Naval Medical Center San Diego, California	PM R. 2011 Oct;3(10):986-7	2011	
97	News article	Scar Treatments	Laser Helps Heal Wounded Warriors	Wendy Rigby/Kens 5	San Antonio's Wilford Hall Medical Center	http://www.kens5.com/news/Laser-helps-heal-wounded-warriors-84956337.html	2010	An interview with Dr. Chad Hivnor and wounded soldiers.

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
98	Peer reviewed article	Scar Treatments	Ultrapulsed fractional CO ₂ laser for the treatment of post-traumatic and pathological scars	Cervelli V, Gentile P, Spallone D, Nicoli F, Verardi S, Petrocelli M, Balzani A.	Plastic and Reconstructive Surgery Department, University of Tor Vergata, Rome, Italy.	J Drugs Dermatol. Nov 2010;9(11): 1328-31	2010	<p>BACKGROUND AND OBJECTIVE: Scar management is a long-term process. A variety of modalities have been employed and, depending on scar type, treatment may be invasive and/or conservative. The purpose of this study was to evaluate a new CO₂ laser resurfacing for post-traumatic and pathological scars and to compare this device with classic dermabrasion. The new fractionated ultrapulsed CO₂ laser (Ultrapulse Encore, Lumenis Ltd., Santa Clara, CA) is equipped with two types of scanners: the first, ActiveFX, is non-sequential while the second, DeepFX, is sequential and produces microspot.</p> <p>MATERIALS AND METHODS: From September 2008 to November 2008, a study on 60 patients was performed. The patients (average age 47.3 years) enrolled in this study had severely scarred skin and were divided into two groups of 30 people. All patients were Caucasian with skin type II or III. Each scar was photographed and scored by the authors using the Manchester Scar Scale (MSS). Follow-up ranged from 12-15 months.</p> <p>RESULTS: Sixty patients were analyzed in two homogeneous groups. Significant improvement in skin tone, texture and appearance of skin was noted in all patients treated with CO₂ laser, lower improvement resulted with dermabrasion. Both subjects and investigators noted similar aesthetic improvement. No major complications were found for both groups and minor complications included transient erythema and edema.</p> <p>CONCLUSION: Fractional ultrapulsed CO₂ laser resurfacing has proven to be both safe and effective. The efficacy and favorable side effects profile for this technology, with low incidence of pigmentary changes, make it a viable alternative for the treatment of moderate-to-severe scars.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
99	Peer reviewed article	Scar Treatments	Successful Treatment of Atrophic Post-operative and Traumatic Scarring With Carbon Dioxide Ablative Fractional Resurfacing Quantitative Volumetric Scar Improvement	Elliot T. Weiss, MD; Anne Chapas, MD; Lori Brightman, MD; Christopher Hunzeker, MD; Elizabeth K. Hale, MD; Julie K. Karen, MD; Leonard Bernstein, MD; Roy G. Geronemus, MD	Laser & Skin Surgery Center of New York, New York, New York.	Arch Dermatol. 2010;146(2):133-140	2010	<p>OBJECTIVE: To assess the safety and efficacy of ablative fractional resurfacing (AFR) for nonacne atrophic scarring.</p> <p>DESIGN: In this before-and-after trial, each scar received 3 AFR treatments and 6 months of follow-up.</p> <p>SETTING: Private academic practice.</p> <p>PATIENTS: Fifteen women with Fitzpatrick skin types I to IV, aged 21 to 66 years, presented with 22 nonacne atrophic scars between June 1 and November 30, 2007. Three patients (3 scars) were excluded from the study after receiving 1 AFR treatment and not returning for follow-up visits. The remaining 12 patients (19 scars) completed all 3 treatments and 6 months of follow-up.</p> <p>INTERVENTIONS: Each scar received 3 AFR treatments at 1- to 4-month intervals.</p> <p>MAIN OUTCOME MEASURES: Erythema, edema, petechiae, scarring, crusting, and dyschromia were graded after treatment and through 6 months of follow-up. Skin texture, pigmentation, atrophy, and overall appearance were evaluated after treatment and through 6 months of follow-up by the patient and a nonblinded investigator. A 3-dimensional optical profiling system generated high-resolution topographic representations of atrophic scars for objective measurement of changes in scar volume and depth.</p> <p>RESULTS: Adverse effects of treatment were mild to moderate, and no scarring or delayed-onset hypopigmentation was observed. At the 6-month follow-up visit, patient and investigator scores demonstrated improvements in skin texture for all scars (patient range, 1-4 [mean, 2.79]; investigator range, 2-4 [mean, 2.95]), pigmentation for all scars (patient range, 1-4 [mean, 2.32]; investigator range, 1-4 [mean, 2.21]), atrophy for all scars (patient range, 1-4 [mean, 2.26]; investigator range, 2-4 [mean, 2.95]), and overall scar appearance for all scars (patient range, 2-4 [mean, 2.89]; investigator range, 2-4 [mean, 3.05]). Image analysis revealed a 38.0% mean reduction of volume and 35.6% mean reduction of maximum scar depth.</p> <p>CONCLUSION: The AFR treatments represent a safe, effective treatment modality for improving atrophic scarring due to surgery or trauma.</p>
100	Peer reviewed article	Scar Treatments	Treatment of Burn Scar Using Carbon Dioxide Fractional Laser	¹ Sung Bin Cho MD, ² Sang JU Lee MD PhD, ³ Won Soon Chung MD, ² Jin Moon Kang MD, ² Young Koo Kim MD	¹ Department of Dermatology and Cutaneous Biology Research Institute, Yonsei University College of Medicine, ² Yonsei Star Skin & Laser Clinic, Seoul, Korea	J Drugs Dermatol. 2010 Feb;9(2):173-5.	2009	<p>In Asian patients, ablative laser therapies are seldom used to treat burn scars due to posttreatment dyschromia, especially when nonfacial areas are treated. The non-ablative 1550-nm erbium-doped fractional photothermolysis system, although effective, requires multiple treatment sessions. In the authors hands, a 34-year-old Korean woman achieved improved atrophy, contracture, texture and color of a burn scar on her chest after two treatments spaced six weeks apart with an ablative 10,600 nm CO₂ fractional laser system (Ultrapulse Encore Laser, Lumenis Inc., Santa Clara, CA).</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
101	Peer reviewed article	Scar Treatments	Ablative Fractional Laser Resurfacing for the Treatment of a Third-degree Burn	¹ Jill Waibel MD, ² Kenneth Beer, MD	¹ Palm Beach Aesthetic Dermatology and Laser Center, West Palm Beach, FL. ² Jupiter, FL	J Drugs Dermatol. 2009 Mar;8(3): 294-7.	2009	Burn scars are the result of wound healing following a partial-thickness or full-thickness thermal injury. Thermal injury can frequently result in extensive scarring, which may have profound psychologic impact on the victim, serving as a visible and palpable reminder of a traumatic event. Standard treatments for scars include the use of skin grafts, intralesional steroid injections, and pulsed-dye laser treatments. The authors have previously described successful treatment of a burn scar with nonablative fractional resurfacing. Ablative fractional lasers may offer burn patients advantages over nonablative techniques, including improved function and cosmetic outcomes. In addition, ablative fractional laser may require fewer treatments, and therefore, be a more cost-effective treatment option for patients. The authors report the use of fractional ablative laser for the treatment of a disfiguring scar that was more than 50-years-old. To our knowledge, this is the first report of this technology for the treatment of a scar resulting from a third-degree burn in the literature. The demonstrated successful outcome in this case patient may indicate a progressive treatment option for many patients who have been disfigured by these types of thermal injuries.
102	News article	Scar Treatments	Warriors' wounds: Fractional CO ₂ scars shines when treating soldiers' scars	Lisette Hilton		http://www.testmart.com/webdata/mfr_promo/Derm_Times_-_Dr_Hivnor_Wounded_Warriors_Article.pdf	2009	An interview done with Air Force Maj. Chad Hivnor, M.D
103	Peer reviewed article	Scar Treatments	Burn Scars Treated by Pinhole Method Using a Carbon Dioxide Laser	Sung Won Whang ¹ , Kyu-Yeop Lee ¹ , Sung Bin Cho ¹ , Sang Joo Lee ² , Jin Moon Kang ² , Young Koo Kim ² , In Hwan Nam ³ , Kee Yang Chung ¹	¹ Department of Dermatology and Cutaneous Biology Research Institute, Yonsei University College of Medicine, ² Yonsei Star Skin and Laser Clinic, Seoul, ³ Daejeon Severance Skin Clinic, Daejeon, Korea	J Dermatol. 2006 Dec;33(12):869-72.	2006	Many patients with burn injuries have various complications and emotional problems due to scars. Although various modalities to improve burn scars have been attempted, such as excision of scars, skin grafts, laser abrasion and silicone product usage, the cosmetic outcomes have not been satisfactory for a large portion of patients. Herein, we describe two cases which showed satisfactory cosmetic results after treatment of burns scars with the pinhole method using a carbon dioxide (CO ₂) laser that allowed us to make deep, closely set holes reaching down to the upper dermis. A 20-year-old female patient with a scar on her neck and a 25-year-old female patient with a scar on her right forearm after burn injuries are presented. As early as only a few weeks after the treatment, the scars showed relaxation of contracture, reduction of wrinkles and improvement of texture and color compared to before the treatment. Treatment of burn scars with the pinhole method can be easily performed and results in dramatic improvement in scar quality with only a few side-effects.

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
104	ASLMS abstract	Scar Treatments	Successful treatment of Post Burn Scars with Fractional CO ₂ laser in Indian skin	DR N Dhepe, DR Ashok Naik, DR Sahil Dhavan	Dr Dhepe's Skin City, PG Institute of Dermatology, Pune, Maharashtra, India			OBJECTIVES: There are no reports from India of treatment of post burn scars with lasers. We present a report of successful treatment of post burn scars with a novel fractional CO ₂ laser delivery system.
105	Peer reviewed article	Scar Treatments	Dramatic Improvement on Variable Scars Clinical Notes on Asian Skin	Sang Ju Lee, MD, Woon Soon Chung, MD	S. Korea			

AcuPulse Testimonials

“AcuPulse with MultiMode allows me to be much more efficient in the delivery of both deep and superficial fractional laser treatments, enabling me to quickly deliver both modalities using the same handpiece. Initial results show a high level of patient satisfaction and efficacy for the treatment of photodamage, dyschromias and scars.”

Dr. Michael H. Gold, Medical Director of Gold Skin Care Center, Nashville, TN

“I have found that FineTouch mode on AcuPulse has the precision that I need to treat fine pigmented lesions. I have also found that FineTouch has the capability to ablate layers evenly into deep nevus cells with visual contact. The FineTouch mode is very easy to control and easy to operate with minimum damage to normal tissue that is unrivalled by any other products.”

Dr. Nariaki Miyata, Director of Miyata Plastic Surgery and Dermatology Clinic, Japan

“AcuPulse™ Combo mode is a MultiMode™ CO₂ laser with both SuperPulse and continuous wave CO₂ technologies for a concomitant deep and superficial impact. It enables treatment of common and challenging skin disorders characterised by textural and pigmented lesions. In the author’s experience, for patients having mild to moderate acne scarring, one single, combined, Deep and Superficial treatment using the Combo mode enables a high rate of improvement in scarring, as well as in skin tone, with no complications and with a short downtime.”

Dr. Francesca De Angelis, Specialist in Plastic Surgery in DE.A. Center and Head of Plastic Surgery Dept. in Clinica Mediterranea, Italy

“I have used the AcuPulse to perform over 500 CO₂ laser procedures. The most impressive features are its small footprint, mobility, and wide range of applications. The two scanners can be interchanged easily. One can perform conventional resurfacing and deeper fractional procedures. The scanner technology allows for a wide range of injury patterns on the skin, so one can customize the treatment type for a particular pathology. We have used it for skin conditions as varied as warts to syringomas to photo-damage. The Combo mode is especially helpful as the unique injury patterns allow for deeper fractional treatments (e.g. for acne scarring), while still allowing for lighter conventional superficial resurfacing for pigment and fine lines (all in one pass). Its SuperPulse technology allows me to be more aggressive when I need to, while maintaining a wide patient safety margin, which ensures my patients are satisfied with the results of their treatments after a single session.”

E. Victor Ross, MD; Director, Laser and Cosmetic Unit, Scripps Clinic, La Jolla, CA



Bibliography

AcuPulse

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
1	White paper	Soft tissue (mole) removal	AcuPulse™ FineTouch™: High Quality CO ₂ Laser Assisted Mole Removal	Nariaki Miyata, MD	Miyata Plastic Surgery and Dermatology Clinic, Japan	Lumenis	2014	A report of clinical case studies, the methods used therein and the respective characteristics and advantages of the AcuPulse CO ₂ laser
2	White paper	Syringomas, acne scars, perioral wrinkles, blepharoplasty, warts, photoaging	AcuPulse™ Versatility: Guidelines and Uses	Girish (Gilly) Munavalli ¹ , MD; E. Victor Ross, MD ² ; Matteo Tretti Clementoni, MD ³	¹ Dermatology, Laser and Vein Specialists of the Carolinas, Charlotte, NC, USA; ² Laser and Cosmetic Unit, Scripps Clinic, La Jolla, CA, USA; ³ Laserplast, Milano, Italy	Lumenis	2014	A report of clinical case studies, the methods used therein and the respective characteristics and advantages of the AcuPulse CO ₂ laser
3	Journal article	Acne scars	Fractional CO ₂ Laser on Acne Scarring Treatment	Fabiola Kettenhuber Kleinert, MD	MedSpa Clinic, Santa Maria, Brazil	Journal of the American Academy of Aesthetic Medicine Issue 4, pp. 14-17	2013	A report of clinical experience with fractional CO ₂ laser resurfacing for acne scars.
4	Magazine article	AcuPulse MultiMode versatility	AcuPulse MultiModes: Multiple Applications Offer Broad Appeal	Girish (Gilly) Munavalli, MD	Dermatology, Laser, and Vein Specialists of the Carolinas, Charlotte, NC, USA	Practical Dermatology	2013	The versatility of the AcuPulse MultiMode can benefit a range of dermatology practices. Importantly, the system offers the ability to effectively treat a number of the most common patient concerns—and to do so efficiently. Most notably, the available applications appeal to a broad patient demographic, addressing concerns across various ages and skin types. From its multiple potential applications to its intuitive and practice-friendly features, the MultiMode system is quickly becoming a workhorse tool in my practice.

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
5	Peer reviewed article	Cosmetic tattoo removal	Treatment of Cosmetic Tattoos Using Carbon Dioxide Ablative Fractional Resurfacing in an Animal Model: A Novel Method Confirmed Histopathologically	Chia-Chen Wang, MD ^{1,2} , Chuen-Lin Huang, PhD ^{3,4} , Yuh-Mou Sue, MD ⁵ , Shao-Chen Lee, PhD ² , Fur-Jiang Leu, MD, PhD ^{2,6}	¹ Department of Dermatology, Cardinal Tien Hospital, New Taipei City, Taiwan, ² School of Medicine, Fu-Jen Catholic University, New Taipei City, Taiwan, ³ Department of Medical Research, Cardinal Tien Hospital, New Taipei City, Taiwan, ⁴ Department of Physiology and Biophysics, Graduate Institute of Physiology, National Defense Medical Center, Taipei, Taiwan, ⁵ School of Medicine, Taipei Medical University, Taipei, Taiwan, ⁶ Department of Pathology, Cardinal Tien Hospital, New Taipei City, Taiwan	Dermatol Surg. 2013 Apr;39(4):571-7	2013	<p>BACKGROUND: Treating cosmetic tattoos using quality-switched lasers is difficult.</p> <p>Objective: We used carbon dioxide ablative fractional resurfacing (CO₂ AFR) to remove cosmetic tattoos and examined the pathophysiologic mechanisms involved in this technique in an animal model.</p> <p>METHODS AND MATERIALS: Twelve rats were tattooed on their backs with white and flesh-colored pigments. Half of each tattoo was treated with CO₂ AFR (5 sessions at 1-month intervals), and the other half was the untreated control. An independent observer reviewed photographic documentation of clinical response. Serial skin samples obtained at baseline and at various times after laser treatment were evaluated using histologic and immunohistochemical methods.</p> <p>RESULTS: Four rats had excellent responses to laser treatment and eight had good responses. White and flesh-colored tattoos had similar clearance rates and tissue reactions. Histologic analysis showed immediate ablation of tattoo pigments in the microscopic ablation zones. Tattoo pigments in the microscopic coagulation zones migrated to the epidermis and became part of the microscopic exudative necrotic debris appearing on day 2 that was exfoliated after 5 days. Increased fibronectin expression around the microscopic treatment zones during the extrusion of tattoo pigments indicated that wound healing facilitates this action.</p> <p>CONCLUSION: CO₂ AFR successfully removes cosmetic tattoos.</p>
6	Peer reviewed article	Treating darker skin types	Clinical Evaluation of the Safety and Efficacy of a Novel Superficial and Deep Carbon Dioxide Fractional System in the Treatment of Patients With Skin of Color	Michael H. Gold, MD ^{a,d}	^a Gold Skin Care Center, Nashville, TN ^b Vanderbilt University School of Medicine, Vanderbilt University School of Nursing, Nashville, TN ^c Huashan Hospital of Fudan University, Shanghai, China ^d No 1 Hospital of China Medical University, Shenyang, China	J Drugs Dermatol. 2012;11(11):1331-1335.	2012	<p>Fractional carbon dioxide (CO₂) laser treatments have become a standard for treating a myriad of skin concerns. One of the biggest challenges facing us in this regard is treating the vast number of patients with skin of color who we encounter regularly in our practices. A novel superficial and deep CO₂ ablative fractional device with both components coming from a single handpiece has been developed and is now being evaluated for patients with skin of color. In the 5 patients studied, side effects were not apparent and no postinflammatory hyperpigmentation was identified. This initial report suggests further evaluation is important to enhance our ablative fractional therapies.</p>
7	Magazine article	Acne scars	Treating Acne Scars: AcuPulse™ MultiMode™	Francesca De Angelis, MD	DE.A. CENTER, Laser & Plastic Surgery Clinic; Plastic Surgery Department at Clinica Mediterranea, Naples, Italy	www.prime-journal.com	2012	<p>Facial scarring resulting from severe acne is a common skin condition that affects individuals of all skin types. Acne scars have multiple morphologies, including ice-pick scars, boxcar scars and rolling scars, and are occasionally accompanied by pigment alterations¹. Therefore, acne scars often require different technical treatment approaches to achieve an optimal cosmetic outcome, at both textural and pigment level. Treatments such as dermabrasion, chemical peels, punch excision, subcision and others have been used. Yet for the past 15 years, with different levels of performance, the mainstays of acne scar therapy have been non-ablative and ablative lasers. The latter achieves significant results but patients will experience a prolonged healing period and occasional complications, while the former has a lack of sufficient efficacy²⁻⁵.</p>

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
8	Peer reviewed article	Photodamaged skin	Combined superficial & deep fractional skin treatment for photodamaged skin - a prospective clinical trial	Michael H. Gold ^{1,2,3,4} & Julie A. Biron ¹	¹ Tennessee Clinical Research Center, Nashville, TN, ² Gold Skin Care Center, Nashville, TN, ³ Vanderbilt University School of Medicine, Vanderbilt University School of Nursing, Nashville, TN, and ⁴ Huashan Hospital of Fudan University, Shanghai China; No 1 Hospital of China Medical University, Shenyang China	J Cosmet Laser Ther. 2012 Jun;14(3):124-32.	2012	<p>BACKGROUND AND OBJECTIVES: Deep microthermal zones targeted by Fractional CO₂ lasers stimulate fibroblast activity, whereas superficial microthermal zones target the epidermal layer pigment. The new combination modality enables targeting both deep and superficial disorders. The study is designed to evaluate the improvement in photodamage and determine downtime.</p> <p>MATERIALS AND METHODS: This IRB approved study was aimed to evaluate histology phenotype of combined deep and superficial skin resurfacing. A 120-micron, focused CO₂ laser beam was used to create both deep and superficial fractional skin resurfacing using ultrapulse and continuous wave laser modes, respectively. Fifteen patients (skin types II–V) underwent combined treatment and returned for assessment at 1 week, 1 and 3 months to evaluate the clinical outcome. Additional histological analysis of human tissue was performed to elucidate the combined impact on tissue.</p> <p>RESULTS: Pre-clinical histologies demonstrated the ability to achieve fractional discrete 1.3-mm-diameter spots of superficial ablation with a uniform shallow and narrow area of coagulation while maintaining the deep, fractional 120-micron-ablation spot capabilities. Histologies of the human tissue confirmed the ability to control both superficial and deep fractional treatment using a single handpiece. Pigmentation was greatly reduced at the 1 month follow-up with significant textural improvement. No unexpected AEs or SAEs were reported.</p> <p>CONCLUSION: The new modality enables combined superficial and deep fractional impact and improvements that are demonstrated at both the phenotype and tissue level.</p>
9	White paper	Treating darker skin types	AcuPulse™ with Combo Treatment Modality: Clinical Study of Patients with Skin of Color	Michael H. Gold, MD	Gold Skin Care Center and Tennessee Clinical Research Center Inc., TN, USA	Lumenis	2012	An account of a clinical study on using fractional ablative laser treatments on patients with skin of color.

STUDY	TYPE	TOPIC	TITLE	AUTHORS	RESEARCH SITES	PUBLICATION	YEAR	ABSTRACT
10	Peer reviewed article	Skin resurfacing	A new multi-modal fractional ablative CO ₂ laser for wrinkle reduction and skin resurfacing	Matteo Tretti Clementoni ¹ , Rosalia Lavagno ¹ , Girish Munavalli ²	¹ Istituto Dermatologico Europeo – Laser and Surgery Department, Milano, Italy, and ² Dermatology, Laser & Vein Specialists of the Carolinas, Charlotte, North Carolina, USA and Department of Dermatology, Wake Forest University School of Medicine, Winston Salem, NC, USA	J Cosmet Laser Ther. 2012 Dec;14(6):244-52.	2012	<p>BACKGROUND: The concept of fractional delivery modality of the energy with both ablative and non-ablative devices is now well known and accepted as an effective method to attain significant aesthetic improvements on facial aging skin. A new, multi-modal, fractional, ablative CO₂ laser that can create, using same scanner/handpiece, deep columns in addition to superficial ablation has been recently proposed and therefore investigated.</p> <p>METHOD: Twenty-four patients were enrolled in this evaluation. Each of them received one multi-modal, fractional ablative treatment. Patients were clinically and photo-graphically evaluated at baseline and 6 months after the procedure. The degree of photoaging and the efficacy of treatment were evaluated using a VAS five-point scale of some skin features. A 3D images comparison was furthermore performed to objectify the improvements.</p> <p>RESULTS: For all of the analysed skin features of photodamage a significant, statistical improvement was obtained. The data collected with the 3D system demonstrated an average improvement of 42% of the wrinkles and an average improvement of the melanin variation of 40.1%.</p> <p>CONCLUSIONS: The multi-modal approach with a single handpiece allows obtaining good outcomes with a very low incidence of adverse effects and a short downtime.</p>

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Warnings and risks

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