Case Report

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A multimodal approach to the treatment of extensive burn scars: a modified subcision technique for intralesional delivery of corticosteroid and 5-fluorouracil in combination with several procedural laser therapies; a case report

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Abstract

Introduction: Hypertrophic scars and keloids are challenging to manage due to recurrence and often suboptimal response to treatment. There is a lack of both definitive treatment standards and randomised controlled trials comparing therapeutic options. While a wide array of procedures has been utilised to improve traumatic burn scars, such interventions have been used with varying degrees of success. Some reported methods include intralesional injections of anti-inflammatory and anti-mitotic medications, laser-based therapy, topical therapies, cryotherapy, silicone gel sheeting, pressure therapy, radiotherapy and reconstructive surgery.

Case: We report a case of extensive traumatic burn scarring on the head and neck successfully treated with a multimodal approach comprised of an infrequently used modified subcision technique to deliver alternating intralesional injections of anti-inflammatory (high-dose steroid) and anti-metabolite (5-flurouracil) concurrently with a series of laser (epilatory, vascular and fractional) treatments.

Methods: Our treatment modality utilised a subcisional technique to deliver intralesional steroid and anti-metabolite medications directly into scar tissue to downregulate inflammation and inhibit collagen synthesis. Alexandrite, fractional and pulsed dye laser therapy was employed to improve skin texture, reduce dyschromia and reduce tissue burden of hypertrophic scar and keloid tissue, resulting in improved mobility and skin elasticity.

Conclusion: Our case supports a combined medical and procedural, subcisional, approach to successfully treat a patient with extensive hypertrophic scarring and keloid formation with associated hair entrapment after a head and neck burn.

Keywords
Burn, scar, corticosteroid, laser, 5-fluorouracil, subcision

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Lay Summary

Head and neck scarring can result in significant psychological and physical impairments that may interfere with a patient's daily life activities and self-esteem. Burn injuries can result in hypertrophic scars and keloids that are large in size, out of proportion to the initial area of injury, thought to be due to inflammation that increases collagen production in the skin. In our case report, we utilise a combined, non-surgical method of steroid and anti-metabolite injections as well as laser technology to successfully reduce the symptoms and appearance of large head and neck scars. Treatments consisted of a non-invasive combination of injections into the scar tissue delivering medication to reduce inflammation, pulsed dye laser to aid in decreasing scar thickness and Alexandrite laser to reduce inflammation associated with trapped hair follicles. One session of erbium fractional laser therapy was performed with local anaesthesia, creating microscopic wounds to stimulate collagen remodelling in the skin and facilitate resurfacing and healing of the scar. These treatment sessions were performed outpatient and occurred at eight-week intervals for 10 months. Results included decreased associated itching, increased mobility of the head and neck, and improved skin texture and colour. Our patient also reported an overall improvement in his mental wellbeing.

Introduction

Hypertrophic and keloidal scarring secondary to thermal injury frequently causes significant functional, cosmetic and psychosocial morbidity. Patients commonly complain of pain, itching, impaired mobility, depression and poor self-esteem. While there is no uniform treatment algorithm, a wide range of therapeutic procedures have been employed with variable degrees of success. The exact mechanism of keloid and hypertrophic scar formation is not fully defined, yet studies have shown that excess collagen production, which is due to abnormal fibroblast activity in response to transforming growth factor-ß stimulation and increased vascularity are typically seen in involved tissue.[1,2] Treatments include, but are not limited to, intralesional injections, topical agents, pressure therapy, silicone gel sheeting, cryotherapy, laser treatments and reconstructive surgery. Our case report reflects a multimodal approach to treating hypertrophic facial and neck scarring complicated by hair entrapment in a patient with significant associated pain, discomfort and psychosocial impairment.

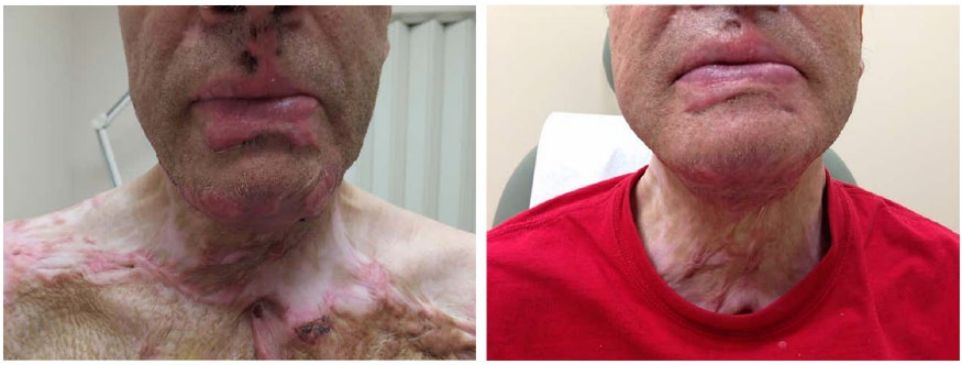
Case

A 55-year-old Hispanic man, with a history of generalised seizure disorder, presented with complaints of extensive scarring involving the entire trunk, neck and face (35% body surface area) following a burn injury three years before presentation. He was interested in pursuing treatment for disfiguring symptomatic scarring on his face and neck, which was causing him significant psychological distress. The burns were a result of water heater explosion that ensued after the patient experienced a grand mal seizure while fixing the stated appliance. The patient's initial injuries were treated at an outside hospital burn unit where he received aggressive wound care and extensive skin grafting procedures. He complained of persistent and, often, incapacitating pruritus, pain, tightness and progressive immobility of his skin. Emotionally, the patient displayed an altered sense of self, lack of self-esteem and had a documented history of depression due to the injuries he had sustained.

On physical examination, extensive pink to brown firm, hypertrophic rope-like plaques and associated contractures were noted on the upper and lower cutaneous lip, chin, lower mandible, neck, trunk and bilateral upper extremities, including the hands. All scars were tender on palpation (Figure 1a; Figure 2a). Amputation of the distal digits on the left hand was also appreciated.

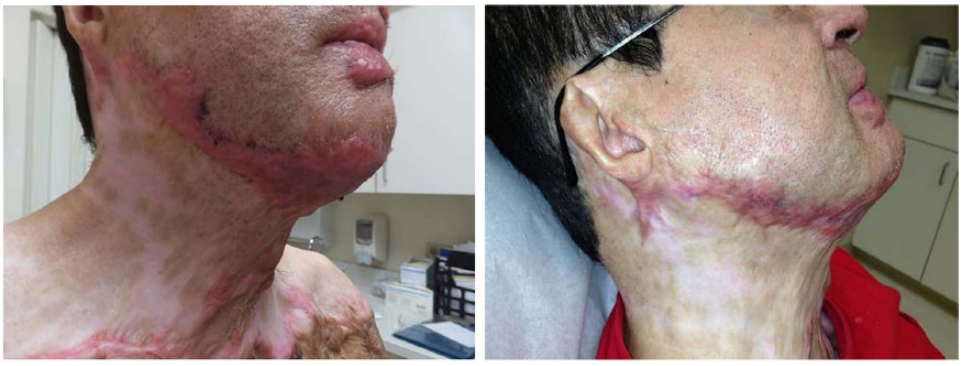
One firm tender nodule containing numerous terminal hairs on the left submental chin was biopsied. Histopathologic examination of the tissue revealed cicatricial fibrosis and a dilated follicular cyst with associated keratin. Granuloma formation was noted to be consistent with a ruptured follicle. No foreign body was seen on polarisation.

To ameliorate symptoms and improve the appearance and functional status of his extensive hypertrophic and keloidal burn scars on his face



(a) (b)

Figure 1. (a) Pink to brown firm rope-like plaques and associated contractures are seen on the upper cutaneous lip, chin, lower mandible and neck before treatment was initiated. (b) Skin-coloured thin plaques with significantly decreased contractures are seen on the upper cutaneous lip, chin, lower mandible and neck after 9 months of aggressive, multimodal treatment.



(a) (b)

Figure 2. (a) Pink to erythematous firm rope-like plaques and associated contractures are seen on the lower mandible and neck before treatment was initiated. (b) Skin-coloured thin plaques with significantly decreased contractures are seen on the lower mandible and neck after 9 months of aggressive, multimodal treatment.

Table 1. Treatment regimen.

Intralesional injections	Treatments (n)	Time interval	Notes
Triamcinolone (40 mg/mL)	5	8-week intervals	Injected with aggressive modified subcision technique
5-FU (50 mg/mL)	5	8-week intervals	Injected with aggressive modified subcision technique
Laser treatments	Treatments (n)	Time interval	Laser settings
Pulsed dye laser	4	8-week intervals	Spot size: 5 mm Energy: 10 J Pulse duration: 5 ms Cooling: 2
Alexandrite laser hair removal	4	8-week intervals	Spot size: 8 mm Energy: 35 J Cooling: 30/20/0
Non-ablative fractional laser	1	Once at month 3	Energy: 50 mJ Treatment level: 5 Passes: 6

and neck, an aggressive, non-surgical course of treatment consisting of nine monthly interventions was developed. In effort to maximise patient comfort, medical modalities (intralesional injections) were alternated with procedural laser therapies (epilatory, vascular and fractional laser treatments).

At eight-week intervals, five concurrent sessions of high-dose intralesional triamcinolone acetonide (40 mg/mL, total 6 cc) injections and 5-fluorouracil (5-FU; 50 mg/mL, total 2 cc) injections were administered via a modified subcisional technique. All injections were delivered using a 25-gauge needle (1.5-in. length) into the deep dermis as to avoid inducing superficial atrophy. After an initial linear 'tunnel' was established within the scar by advancement of the needle, medication was injected in retrograde fashion. From single points of entry, the needle was reintroduced several times in a fanning pattern to maximize the total treated area using the fewest number of access sites.

Additionally, he underwent four combination laser sessions with the pulsed dye laser (PDL) (595 nm [VBeam Perfecta, Syneron-Candela Inc, Irvine, CA, USA], spot size 5 mm, energy 10J, pulse duration 5 ms, cooling setting 2) and Alexandrite laser (755 nm [GentleLase, Syneron-Candela Inc, Irvine, CA, USA], spot size 8 mm, energy 35 J, cooling setting 30/20/0) to the upper cutaneous lip, chin, jawline and neck. One fractional laser (1550 nm [Fraxel Dual, Solta Medical Inc, Hayward, CA, USA], energy 50 mJ, treatment level 5, passes 8) treatment was performed after topical (topical lidocaine and prilocaine 2.5% cream) and local anaesthetic (1% lidocaine with 1:100,000 epinephrine, total 3 cc) administration at month 3. While he reported improvement in the appearance of his scar after fractional resurfacing, he complained of temporary isolated altered mental status, which he attributed to the administration of the anaesthetics. In accordance with his preference to eschew further usage of topical or local anaesthetics, only PDL and Alexandrite lasers were continued.

Following two sets of injections and one laser session, the hypertrophic scars became more supple and scattered, allowing entrapped, horizontally growing terminal hairs (~1 cm in length) to be visualised within the scars located on the neck. In order to decrease the suspected inflammation stimulated by this hair trapping, the Alexandrite laser was added to the patient's therapy regimen. At the completion of treatment, the patient reported significant improvement in pain, itch, physical mobility and self-esteem. Clinically, he displayed a remarkable decrease in scar thickness and improvement in the parameters of erythema, dyschromia, texture and range of motion (Figure 1b; Figure 2b). Results were maintained at 15 months after presentation.

Discussion

Anti-inflammatory and anti-metabolite therapies such as intralesional steroid and 5-FU injections, respectively, have been shown to improve symptoms and cosmesis in both hypertrophic scars and keloids.[3] Steroid injections are proposed to work via inhibition of the mitotic activity of fibroblasts and keratinocytes, inflammatory blockade and vasoconstriction.[4] While steroid injections have been recommended as first-line therapy for treating hypertrophic and keloidal scars, there is a relatively high recurrence rate, especially for large and chronic scars. Furthermore, many treatment sessions are often required.[3,5] Fluorouracil is a pyrimidine analogue and chemotherapeutic agent that has been shown to inhibit myofibroblast and fibroblast activity and collagen synthesis.[4,6] Flurouracil injections have typically been combined with low concentrations of corticosteroid (9:1 ratio of 5-FU to triamcinolone) to decrease the adverse effect of erythema. This small concentration of steroid, however, does not seem to contribute an additive therapeutic effect.[7,8]

A recent study by Lee et al. retrospectively examined the safety and efficacy of combination therapy involving three monthly sessions of subcision followed by low-dose intralesional corticosteroid (triamcinolone acetonide 5 mg/mL) injection for treatment of postoperative adherent linear thyroidectomy scars. Significant clinical improvement was seen in 15 of the 16 patients reviewed. Another recent study found excision and intralesional 5-FU and corticosteroid treatment (triamcinolone acetonide 5 mg/mL) to be superior to excision and radiation therapy in reducing size and recurrence of ear keloids.[9] Additionally, when compared with intralesional verapamil injections, triamcinolone remains superior in reducing size, pigmentation, height, pliability and vascularity of keloids and hypertrophic scars.[10] Subcision is a technique introduced by Orentreich,[11] in which a sharp needle (usually 16 or 18 gauge) is introduced into the skin beneath a depressed scar and is able to act like a scalpel to incise and release tethered fibrous attachments causing the scar to lift. This dermal injury response and subsequent connective tissue generation following subcision can be modified by intralesional corticosteroid injection.[11,12]

Laser therapy is another effective means of treating hypertrophic scars. PDL has been shown to improve burn scar texture and pliability as well as to decrease erythema and associated symptoms from burn scars resulting from chemical peels, carbon dioxide laser procedures and accidental thermal injury.[13] In 2012, a systematic review of eight randomised controlled trials found that three or more treatment sessions with PDL led to significant improvement in Vancouver scar scale scores (objective changes in pigmentation, vascularity, pliability, scar height) and global assessment as compared to no treatment or conventional treatments including varied combinations of intralesional triamcinolone acetonide, intralesional 5-FU, pressure garments and silicone gel sheeting or other laser treatments.[14] PDL was found to be superior to conventional treatment modalities in improving the associated symptoms and overall appearance of the scar.[14]

Burn scars have also been variably responsive to non-ablative, fractional and ablative laser therapies. While fractional resurfacing with a 1550-nm erbium laser has been traditionally used in the management of photodamaged facial skin, producing significant improvement in rhytides, skin texture, dyschromia and acne scarring, it has also been shown to improve dyschromia,[15,16] skin texture, hypertrophy or atrophy, and self-reported self-esteem in patients with burn scars.[16]

A recent consensus report suggests that fractional ablative laser resurfacing therapy deserves a prominent role in future scar treatment paradigms based on evidence of improvement of scar contractures and function (ambulation, improved grip and earlier more aggressive implementation of prosthetic devices). Scar texture and colour as well as symptomatic relief of burning and itching have also been consistently demonstrated with fractional laser.[17] However, recovery time with fractional and ablative lasers is somewhat longer than that of non-ablative lasers. Similarly, fractional and ablative procedures also require either topical or local anaesthesia application beforehand and can pose potential risks, especially when treating widespread surface areas. Such after-effects of fractional and ablative lasers include erythema (persisting up to four months after treatment) and dyspigmentation.[18]

A recent case series by McGoldrick et al. utilised fractional ablative CO2 laser therapy in treating burn scars in sensitive and functionally mobile areas including the breast, face, finger and elbow.[19] While three patients were treated with multiple sessions of variable-depth CO2 fractional ablative therapy (10,600 nm), one patient with a hypertrophic burn scar of the left elbow underwent a combined approach of intralesional 5-FU and corticosteroids with one session of medium-depth (1.5 mm) CO2 fractional laser treatment.[19] Monotherapy with any one procedure is often ineffective and a combination approach of injections and laser treatments such as that utilised by McGoldrick et al. as well as to treat our patient, may provide a more satisfactory outcome. Additionally, in the treatment of our patient, a subcision technique for dermal release was utilised.

Many recent reports have found combination treatments to be superior to monotherapy. Intralesional 5-FU in combination with low dose-intralesional triamcinolone (mixture ratio 9:1) for the treatment of keloids and hypertrophic scars was found to be superior to intralesional triamcinolone (10 mg/mL) treatment alone in more than one series.[20,21] Likewise, PDL and fractional lasers may have synergistic roles in the treatment of burn scars. Erythematous and more acutely inflamed scars are most amenable to PDL, while pigmentary and textural alterations respond better to fractional laser treatments.[17] A prospective, before and after, single cohort study of 147 burn patients with hypertrophic scars found that a 12-month treatment course with a combination of PDL and fractional CO2 laser caused significant improvement in scars.[22]

Further improvement may be demonstrated with the addition of intralesional medications such as corticosteroids and 5-FU as an adjuvant to laser therapy.[7,8] One blinded clinical trial found that intralesional 5-FU combined with low-dose triamcinolone (3:1) plus PDL was more efficacious in treating keloids and hypertrophic scars when compared to 5-FU combined with triamcinolone or any of these treatments alone.[7] Steroid tape may also prove an effective adjunct therapy to treating hypertrophic scars, though safety and absorption data must be further researched, especially with use on the face and neck.[23]

A recent case of hypertrophic scarring after deep chemical peel was improved as a result of multimodal therapy. This 75-year-old woman with a four-month history of scarring following a phenol peel for perioral rhytides underwent 10 treatments with a 595-nm PDL followed immediately by the 1450-nm diode laser in combination with intralesional triamcinolone and 5-FU. She showed significant overall improvement.[4] A recent pilot study found that adjuvant intralesional autologous platelet-rich plasma injections may also hold promise as keloid therapy for patients who fail conventional treatments.[24]

Our case is unusual in that the patient had notable trapping of hair where skin grafting was previously performed. We suspect that this complication added to the patient's persistent pain and itching. Review of the literature found a single report of a painful facial burn scar, which was found to have internal hair growth within previously skin grafted sites on excision. These 'non-emergent' hairs were successfully removed with Alexandrite laser, which produced temporary symptomatic relief.[25]

Our selection of targeted, multimodal, minimally invasive therapies focused on removing the stimulus for continued scar production and inflammation (laser hair removal of entrapped hairs) while also aggressively normalising dermal thickness (intralesional high-dose steroid and antimetabolite administration delivered via a modified subcision technique) and improving colour and texture (PDL and non-ablative fractional laser therapy).

Conclusion

Our case highlights the success of combination medical and procedural treatment (triamcinolone and 5-FU intralesional injections with a series of vascular, fractional and hair removal lasers) for extensive hypertrophic head and neck burn scars. Triamcinolone and 5-FU intralesional injections normalised dermal thickness, while minimally invasive vascular, fractional and hair removal laser therapy targeted underlying inflammation via laser hair removal of entrapped hairs and PDL and non-ablative fractional laser therapy improved skin colour and texture. Our conclusions are limited by small sample size in this case report. Future research should investigate the role of hair entrapment in inflammatory keloid and scar formation and opportunities for multimodal, minimally invasive treatment.

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Ethical approval

The authors confirm that the necessary written, informed consent was obtained from patients for this article.

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References

1. Tuan TL and Nichter LS. The molecular basis of keloid and hypertrophic scar formation. *Mol Med Today* 1998; 4(1): 19–24.
2. Lee TY, Chin GS, Kim WJ, et al. Expression of transforming growth factor beta 1, 2, and 3 proteins in keloids. *Ann Plast Surg* 1999; 43(2): 179–184.
3. Wang XQ, Liu YK, Qing C, et al. A review of the effectiveness of antimitotic drug injections for hypertrophic scars and keloids. *Ann Plast Surg* 2009; 63(6): 688–692.
4. Katz TM, Glaich AS, Goldberg LH, et al. 595-nm long pulsed dye laser and 1450-nm diode laser in combination with intralesional triamcinolone/5-fluorouracil for hypertrophic scarring following a phenol peel. *J Am Acad Dermatol* 2010; 62(6): 1045–1049.
5. Ledon JA, Savas J, Franca K, et al. Intralesional treatment for keloids and hypertrophic scars: a review. *Dermatol Surg* 2013; 39(12): 1745–1757.
6. Huang L, Wong YP, Cai YJ, et al. Low-dose 5-fluorouracil induces cell cycle G2 arrest and apoptosis in keloid fibroblasts. *Br J Dermatol* 2010; 163(6): 1181–1185.
7. Asilian A, Darougheh A and Shariati F. New combination of triamcinolone, 5-Fluorouracil, and pulsed-dye laser for treatment of keloid and hypertrophic scars. *Dermatol Surg* 2006; 32(7): 907–915.
8. Fitzpatrick RE. Treatment of inflamed hypertrophic scars using intralesional 5-FU. *Dermatol Surg* 1999; 25(3): 224–232.
9. Khalid FA, Farooq UK, Saleem M, et al. The efficacy of excision followed by intralesional 5-fluorouracil and triamcinolone acetonide versus excision followed by radiotherapy in the treatment of ear keloids: A randomized control trial. *Burns* 2018; 44: 1489–1495.
10. Abedini R, Sasani P, Mahmoudi HR, et al. Comparison of intralesional verapamil versus intralesional corticosteroids in treatment of keloids and hypertrophic scars: A randomized controlled trial. *Burns* 2018; 44: 1482–1488.
11. Orentreich DS and Orentreich N. Subcutaneous incisionless (subcision) surgery for the correction of depressed scars and wrinkles. *Dermatol Surg* 1995; 21(6): 543–549.
12. Lee JH, Kim TH, Lee YS, et al. Combination of surgical subcision and intralesional corticosteroid injection as a cost-effective and minimally invasive treatment for postoperative adhesive thyroidectomy scars. *Dermatol Surg* 2013; 39(12): 1822–1826.
13. Alster TS and Nanni CA. Pulsed dye laser treatment of hypertrophic burn scars. *Plast Reconstr Surg* 1998; 102(6): 2190–2195.
14. de las Alas JM, Siripunvarapon AH and Dofitas BL. Pulsed dye laser for the treatment of keloid and hypertrophic scars: a systematic review. *Expert Rev Med Devices* 2012; 9(6): 641–650.
15. Bach DQ, Garcia MS and Eisen DB. Hyperpigmented burn scar improved with a fractionated 1550 nm non-ablative laser. *Dermatol Online J* 2012; 18(7): 12.
16. Waibel J, Wulkan AJ, Lupo M, et al. Treatment of burn scars with the 1,550 nm nonablative fractional Erbium Laser. *Lasers Surg Med* 2012; 44(6): 441–446.
17. Anderson RR, Donelan MB, Hivnor C, et al. Laser treatment of traumatic scars with an emphasis on ablative fractional laser

resurfacing: consensus report. *JAMA Dermatol* 2014; 150(2): 187–193.
18. Alexiades-Armenakas MR, Dover JS and Arndt KA. The spectrum of laser skin resurfacing: nonablative, fractional, and ablative laser resurfacing. *J Am Acad Dermatol* 2008; 58(5): 719–737; quiz 738–740.
19. McGoldrick RB, Sawyer A, Davis CR, et al. Lasers and ancillary treatments for scar management: personal experience over two decades and contextual review of the literature. Part I: Burn scars. *Scars Burn Heal* 2016; 2: 2059513116642090.
20. Darougheh A, Asilian A and Shariati F. Intralesional triamcinolone alone or in combination with 5-fluorouracil for the treatment of keloid and hypertrophic scars. *Clin Exp Dermatol* 2009; 34(2): 219–223.
21. Davison SP, Dayan JH, Clemens MW, et al. Efficacy of intralesional 5-fluorouracil and triamcinolone in the treatment of keloids. *Aesthet Surg J* 2009; 29(1): 40–46.
22. Hultman CS, Edkins RE, Wu C, et al. Prospective, before-after cohort study to assess the efficacy of laser therapy on hypertrophic burn scars. *Ann Plast Surg* 2013; 70(5): 521–526.
23. Goutos I and Ogawa R. Steroid tape: A promising adjunct to scar management. *Scars Burn Heal* 2017; 3: 2059513117690937.
24. Hersant B, SidAhmed-Mezi M, Picard F, et al. Efficacy of autologous platelet concentrates as adjuvant therapy to surgical excision in the treatment of keloid scars refractory to conventional treatments: a pilot prospective study. *Ann Plast Surg* 2018; 81: 170–175.
25. Royston S, Tiernan E and Wright P. Post-burn non-emergent hair in the male moustache area. *Burns* 2012; 38(4): 615–616.

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