



Fractionated CO₂ Laser Treatment to Reduce Fibro-Fatty Tissue Bulk of Involved Infantile Hemangiomas: A Case Series

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Abstract

Importance: Involution of Infantile Hemangiomas (IH) may result in unsightly fibro-fatty bulky residuum that is difficult to treat effectively.

Objective: To present the outcome of fractionated CO₂ laser treatments to improve skin texture and reduce fibro-fatty tissue of involved IH in a pilot study of 3 pediatric patients.

Design, settings and participants: Case series in which the medical records of 3 patients undergoing fractionated CO₂ laser treatments for cosmetically disfiguring involved IH between January 2015 and March 2017 at a tertiary care pediatric hospital were reviewed to collect demographics, lesion characteristics, prior and concomitant therapies, number of treatments, complications, pre and post treatment photos and perceived outcome.

Results: Patients were 4 years of age with a 2:1 female ratio and stable involved IH. Bulky lesions were located on the upper arm (14 × 16.5 cm² and 5 × 4 cm²), cheek (2 × 1 cm²), and upper lip (2.5 × 1.5 cm²). Patients underwent a mean of 3.3 treatments (2 to 5) over 2 to 23 months. All sessions were combined with pulsed dye laser treatment to concurrently address vascular discoloration. Parents reported a mean 70% reduction (50% to 80%) in size of residual involved IH bulk and one parent also reported resolution of oral incompetence following lip treatment. Minor adverse events of focal crusting, erythema, mild hyperpigmentation and mild discomfort all resolved within 1 to 2 weeks.

Conclusion: The fractionated CO₂ laser shows a promising novel role in the treatment of cosmetically disfiguring, bulky, fibro-fatty tissue and textural changes of involved IH and can be combined with pulsed dye laser therapy to concomitantly reduce erythema and telangiectasias. Further studies with objective evaluation of reduction in lesion volume following fractionated CO₂ laser treatments are warranted.

Keywords: Infantile hemangiomas; Fractionated CO₂ laser treatment; Fibro-fatty tissue

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Introduction

Infantile Hemangiomas (IH), the most common tumors of infancy tumor [1], have a natural history of proliferation, plateaued growth, and subsequent involution the latter usually spanning from 1 to 7 years of age [2]. During involution, the lesion becomes softer and fibro-fatty tissue replaces the original tumor endothelium. In about half of cases, normal skin is restored, but in the other half telangiectasias, hyperemic spots, scarring, bulky fibro-fatty tissue with textural change often resembling an orange peel may remain causing cosmetic, social, and sometimes functional concerns [3-5]. Pulsed Dye Laser (PDL) can improve the erythema and telangiectasias of involved IH but does not address their bulk. We present three cases of problematic involved IH residuum in which fractionated CO₂ laser was added to PDL treatments to improve texture and reduce fibro-fatty tissue bulk.

The fractionated CO₂ laser energy (10,700 nm) is absorbed by water and the resultant heat denatures collagen and creates fractionated holes in the target tissue matrix. Contraction of collagen in the ablative phase lessens the extent of fibro-fatty tissue. Collagenases degrade the

damaged collagen matrix during wound healing and replace it with new collagen that has a higher and more favorable ratio of finer type III collagen to thicker type I collagen [6].

Methods

Subjects' medical records were reviewed for demographics, lesion characteristics, treatments, clinical results, adverse effects and outcome. Pre and post treatment images were compared.

The Candela Vbeam Perfecta PDL (Syneron Candela, Wayland, Massachusetts USA) was used on residual erythema and telangiectasias with a 10 mm treatment diameter, 10% overlap of pulses and, depending on skin type, a fluence of 5.5 to 6.5 Joules/cm², pulse duration of 1.5 to 3 milliseconds, and cooling of 2 or 3. Purpura was the endpoint.

The Lumenis UltraPulse fractionated CO₂ laser (Lumenis Ultra Pulse, Lumenis LTD, Yokneam, Israel) was used to improve texture and reduce fibro-fatty residuum. Using the Deep FX mode, the delivered energy was set to 17.5 Millijoules, density to 10%, and frequency to 250 to 300 Hertz with no overlap of pulses.

All patients were treated under general anesthesia. Ice was applied post-operatively over a dressing of petroleum jelly, gauze, and Telfa. Parents were instructed to remove the dressing in 24 h, wash the area twice daily for 5 days and reapply petroleum jelly and Telfa. The wound was then permitted to remain uncovered if dressings were uncomfortable and parents were instructed to keep the area moist with petroleum jelly until fully healed and avoid sun exposure.

Patient characteristics

Patient 1: A 4-year-old girl, skin type V, presented with a bulky, involuted IH residuum on the right upper arm, shoulder, and axilla (14 × 16.5 cm²) and mid arm (5 × 4 cm²) despite receiving systemic corticosteroids during infancy (Figure 1A). Four prior PDL treatments lessened residual erythema but did not address the bulk. The lesions remained unchanged for 6 months and their size and psychosocial impact prompted parents to seek additional treatment (Table 1).

The fractionated CO₂ laser was added to PDL therapy and 5 combined laser treatments were administered between January 2015 to November 2016.

The color, texture, and thickness improved with each treatment. Her parents were very pleased with the outcome and after the 5th treatment reported an 80% reduction in fibro-fatty tissue bulk verified clinically (IKR) with no residual hyperpigmentation and an overall significant improvement in the color of the original lesion (Figure 1B).

Adverse effects of mild focal crusting, hyperpigmentation and discomfort were seen after first two treatments but were minimal and self-limited and not seen at the 3rd and subsequent treatments.

Patient 2: A 4-year-old girl, skin type II, presented with a history of an upper lip IH that involuted to a 2.5 × 1.5 cm² bulky lesion remaining unchanged for the prior 6 months (Figure 2). She had received systemic Propranolol and Kenalog injections during infancy. Her mother expressed emotional concerns about cosmetic disfigurement and also oral incompetence when drinking liquids.

Physical examination showed the left upper lip skin to be crepe-like with patchy erythema and telangiectasias with marked overhang of the lesion below the natural lip contour (Figure 2). To improve



Figure 1: Patient #1 with involuted IH of the right upper arm and axilla (A) Raised bulky lesion with length and width measurements of 14 cm × 16.5 cm superiorly and 5 cm × 4 cm inferiorly. (B) Reduction in bulk noted after 5 fractionated CO₂ laser and PDL combined treatments.



Figure 2: Upper panel, Patient #2, with an IH of the left upper lip in infancy (upper left). On presentation for laser treatment the lesion measured 2.5 cm × 1.5 cm with irregular skin surface (upper middle). After 3 fractionated CO₂ laser treatments parents reported flattening of lesion and resolution of drooling when swallowing liquids (upper, right). Lower panel, Patient #3, with an involuted 2 cm × 1 cm raised irregular IH of the right cheek pre-treatment (lower left). After 2 fractionated CO₂ laser treatments, parents reported a 50% reduction in elevation (lower middle and lower right).

the crepe-like texture and to reduce the fibro-fatty tissue, fractionated CO₂ laser treatment was added to PDL therapy in 3 combined laser treatments over 6 months. Her mother noted a 50% decrease in fibro-fatty tissue, with improvement of the lip overhang evident in school pictures after the first treatment and a 75% to 80% improvement in bulk and resolution of lip overhang after the second treatment. After her third treatment, there was near-resolution of erythema, and complete restoration of oral competence.

Expected purpura resolved spontaneously 5 to 14 days after each treatment. There were no adverse effects.

Patient 3: A 4-year-old boy, skin type IV, presented with a bulky 2 cm × 1 cm involuted IH on his right cheek that was unchanged in prior 6 months (Figure 2). He had not received prior treatment for his IH. His mother related emotional concerns regarding the prominent lesion and its conspicuous location. The skin had a peau d'orange texture, mild overlying erythema and telangiectasias. To improve the texture and to reduce the fibro-fatty tissue, fractionated CO₂ laser treatment was added to PDL therapy. He underwent 3 combined PDL and fractionated CO₂ laser treatments in a 3 month span. There was mild erythema after the first treatment and a 50% reduction in fibro-

Table 1: Patient characteristics.

Case #	Age of Patient	Gender	Skin Type	Presentation date	Date of first treatment	# of Combined treatments	Initial size of lesion	Prior treatment	Parents assessment % reduction fibro-fatty tissue
1	4 year old	F	V	1/18/2013	1/15/2015	5 treatments; 01/15/15 05/20/15 03/02/16 06/01/16 11/18/16	Right upper arm: 14 cm x 16.5 cm; Right upper arm, inferior aspect: 5 cm x 4 cm.	Systemic steroid therapy; 4 PDL treatments alone before 5 combined CO ₂ and PDL treatments	80%
2	4 year old	F	II	1/10/2013	7/15/2016	3 treatments; 07/15/16 11/02/16 01/04/17	2.5 cm x 1.5 cm involuting hemangioma of the left upper lip.	Kenalog injection and propranolol therapy	75% to 80%
3	4 year old	M	IV	10/3/2013	1/4/2017	2 treatments; 01/04/17 03/01/17	Right cheek 2 cm x 1 cm	None	50%

fatty tissue. After the second and final treatment parental report of 75% to 80% reduction in fibro-fatty tissue bulk was verified clinically (IKR). Mild erythema persisted after the second treatment and significantly improved after a single PDL treatment in April, 2017.

Discussion

We present 3 patients in whom the fractionated CO₂ laser was used to reduce bulky involuted IH residuum by 50% to 80%, a reduction not seen in these patients during prior PDL treatments alone. The CO₂ fractionated laser is effective for a variety of cosmetic concerns including skin resurfacing [7], facial rhytids [8] and burn scars [9], but little has been reported regarding its use in IH residuum. Prior reports include a series of 5 patients lacking pre and post treatment imaging [10] and single case reports of a teen treated with a midbrow lesion [11] and another with a cheek lesion [12].

Treatment of problematic involuted IH residuum can be difficult particularly as the lesion size and location often limits the option of surgical excision. Traditional laser treatment addresses pigment changes but not bulk. Unless lesions are still clinically changing in appearance, our vascular anomaly clinic addresses cosmetically concerning involuted IH just prior to kindergarten since 5 years of age generally heralds an increase in self-awareness. It was at this point that the addition of CO₂ laser was recommended to parents. The pre and post-treatment images in this series clearly show substantial improvement in bulky disease and, although subjective, parental satisfaction was high.

As often is true of a new surgical application, case reports like this preliminary one lack objective outcome measures but stimulate interest as the medical community ponders the relevance of the treatment to their clinical practice. Such interest sparks more rigorous outcome measures to support the clinical application. Future investigative studies in this area might employ ultrasound imaging to assess volume changes and perhaps use a validated measure such as the Vancouver Scar Scale to more objectively assess this application of the fractionated CO₂ laser [13].

Conclusion

This report suggests that the fractionated CO₂ laser plays a promising role in treating fibro-fatty tissue and textural changes of cosmetically disturbing involuted, IH residuum in pediatric patients, a condition that can be otherwise difficult to treat. When combined with simultaneous PDL treatment, residual erythema and cosmetically disfiguring tissue bulk are both reduced.

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