

# Case Report

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## Controlled Corticosteroid Introduction Using Superficial Therapeutic Pressure for the Treatment of Keloids

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*Abstract.* Keloids are benign fibrous growths that form as a result of an inherent defect in wound healing and appear mainly in scar tissue<sup>[1-2]</sup>. They are usually associated with the deposition of excessive collagen scar tissue in response to even minor trauma. Often keloids are mentioned in relation to altered concentrations of specific growth factors or levels of hyaluronan (HA) in the dermis<sup>[3]</sup>. Improving the appearance and elasticity of keloids is a challenge due to the limited number of available and effective solutions. The EnerJet treatment, a novel concept in skin rejuvenation, has been reported to be effective in the treatment

of facial rhytides, acne scars, striae and surgical scars, but its use in the treatment of keloids has not yet been evaluated.

This case report covers six cases which demonstrate the ability of the EnerJet procedure to provide a safe and effective alternative to the treatment of keloids in various anatomical locations. Evaluation was based on visual improvements, palpable improvements, and frequency and level of needle-like pain or itch often associated with keloids. Finally a clinical rationalization for the results is presented.

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### Introduction

Keloids result from a benign hyperproliferative disorder of dermal connective tissue resulting from an excessive response to cutaneous trauma in certain predisposed individuals. They are rigid, pruritic lesions that are mainly associated with an abnormal proliferation of fibroblasts and an overproduction of extracellular matrix and collagen [4]. In most cases, keloids occur as a result of a skin-trauma or an infection [5], yet in some cases these lesions may appear spontaneously. Although non-contagious, keloids often expand beyond the boundaries of a healed injury and very often agitate and itch – a type of discomfort usually referred to as sharp, needle-like pain. Keloids tumors present a serious aesthetic concern and the disfigurement caused

by the appearance of the keloids often leads to severe psychological distress and low self-esteem.

Early prognosis and treatment of keloids are significant factors in the success of any therapy. Lidocaine and intralesional steroid injections are the primary and most commonly suggested solution, followed by surgical excisions and cryosurgery. These methods report a recurrence rate of 45% to 100% at five years<sup>[6]</sup>. Surgical intervention may even result in a larger keloid scar. Pressure garments are often used in an attempt to reduce the keloid's size. Radiation therapy is becoming increasingly popular among practitioners, however it is only recommended for

the treatment of recalcitrant keloids that are resistant to formerly mentioned therapies<sup>[6]</sup>, due to radiation associated risks such as increased likelihood for cancer.

An additional predicament yet to be addressed is the discomfort associated with the keloids during and post-treatment. A series of steroid injections with triamcinolone acetonide or other corticosteroid attempt to reduce keloid size and temporarily minimize associated pain, yet these injections are similarly painful and difficult to perform, requiring local or even full anesthesia. Discomfort is reported to continue once the anesthetic wears off. An effective and convenient solution for the treatment of keloids may significantly contribute to the wellbeing of patients who seek a solution. An innovating solution is provided by the EnerJet device.

The EnerJet system is a novel skin-remodeling platform designed to introduce and laterally disperse a therapeutic substance into the dermis via pneumatic needle-less action that initiates a wound healing process in the dermis and mechanically augments collagen regeneration<sup>[7]</sup>. This is performed by introducing an accelerated solution which contains high molecular-mass particles under high focal pressure (e.g. hyaluronic acid; steroids)<sup>[8]</sup>. The delivered solution is uniformly distributed to generate

approximately 1cm<sup>2</sup> area of penetration effect in each application. In addition to the therapeutic effects associated with the injection of corticosteroid, the controlled, superficial delivery (ranging from 1-5 mm depth) operated by the system's pneumatic technology, spreads the substance, creating therapeutic pressure over the scarred tissue.

The EnerJet system's flexibility allows the introduction of different therapeutic substances with the mechanical effect that presses down on the scar and initiates natural wound-healing, illuminated the possibility of harnessing this mechanism for a safe and effective treatment of keloids.

*Materials and Methods*

Six patients with keloids on the breast, chest, back and behind the ear were enrolled in a preliminary study that was conducted in parallel in two centers. The most common complaints of the patients related to the aesthetic appearance of the overgrown scar tissue and the vexatious and unpredictably occurring pain.

Patients underwent a series of one to eight EnerJet treatments (Table 1) in two to three weeks intervals (larger scars were treated more frequently than smaller ones).

| Case No. | Gender | Patient Age | Location of the Scar | Cause of Scar | Estimated Scar Age | Number of treatments |
|----------|--------|-------------|----------------------|---------------|--------------------|----------------------|
| 1        | Female | 46          | Breast ( L )         | Operation     | 8 years            | 8                    |
| 2        | Female | 46          | Brest ( R )          | Operation     | 8 years            | 8                    |
| 3        | Female | 49          | Behind the Ear       | Facelift      | 5 years            | 6                    |
| 4        | Male   | 36          | Chest                | Operation     | 3 years            | 3                    |
| 5        | Female | 35          | Back                 | Operation     | 4 years            | 4                    |
| 6        | Male   | 47          | Chest                | Spontaneous   | 6 years            | 5                    |

**Table 1:** Patients demographics

A solution mixture comprising of Celestone chronodose (betamethasone disodium phosphate and betamethasone acetate in 1cc ampoules), Depomedrol (40 mg

methylprednisolone acetate in 1cc ampoules) or Diprosan (betamethasone dipropionate in 1 cc ampoules) mixed with Lidocaine 2%, filled into the EnerJet's disposable delivery kit. Treatments

consisted of consecutive applications, each covering an area of 100 mm<sup>2</sup>, extending up to 50 mm<sup>2</sup> beyond the keloid borderline. Evaluation criteria were based on visual improvements and palpable improvements assessed by the physician, and frequency and level of needle-like pain or itch often associated with keloids as reported by the patient.

### *Results*

Clinical response to treatment was evident in all subjects. A response was observed on all keloids in terms of size-reduction, flatness and appearance. Treatments on the abdomen and chest (relatively young scar tissue) showed significant fading and a considerable diminishing in size that continued improving 9 months following the last session. Both subjects reported an improvement in evenness and texture.

Pain-relief following treatment was reported in all patients as well as a reduction in pain and itching. Treatment tolerance in all patients was good and with no pain during the treatment sessions. There were no evident side effects except few spot bleedings at the entry points and a slight edema which resolved within 48 hours.

Palpable improvement evaluation demonstrated a significant improvement in texture and rigidity. An impressive palpable progress was achieved with a 36 year old male patient (Fig. 1), whose scar was the result of heart surgery three years prior to the treatment.

### *Discussion*

Keloids are the result of an aberrant wound healing process, expressed through abnormal cell migration and proliferation, inflammation, or increased secretion of cytokines and extra cellular matrix (ECM) proteins, all of which suggest high fibroblasts activity<sup>[9]</sup>. Factors affecting the rise of keloids may be excessive concentrations of specific growth factors and hyaluronan (HA) in the dermis. Principally, keloid tissue exhibits higher level of TGF- $\beta$ 1 (which its prolonged and excessive presence is known to

indicate a development of a keloid)<sup>[4]</sup>, lower rates of keloid fibroblasts<sup>[10]</sup> and elevated synthesis rates of proteoglycan<sup>[9]</sup>, water molecules and collagen compared with controls<sup>[11]</sup>. Available data on the introduction of different therapeutic substances and on the mechanical effect used to evoke healthier tissue construction indicate that the EnerJet system may present an appealing alternative for the treatment of keloids and hypertrophic scars.

In fetal wound-healing, which is scar-free, HA levels remain high much longer than in the adult wound-healing process, which is associated with scarring. Consequently, it is assumed that HA accumulation is a key factor in the process of scar-free healing<sup>[12]</sup>. Meyer et al. (2000) study's of reduced hyaluronan in keloid tissue, a "scratch" in vitro model of wound repair was used to show that HA stimulation occurred in response to scratches made on monolayer cultures. In fact, scratching increased HA secretion approximately 66% in the normal strain and 34% in the keloid strain<sup>[3]</sup>. These findings support the results observed in all six cases treated with the EnerJet, indicating a superficial remodeling process due to the mechanical trauma created by the device, resembling the scratching model and coinciding with HA accumulation and the creation of an environment that promotes healthier tissue structuring.

The treatment also appears to imitate the effect of an elastic garment fabricated to apply varying pressure gradients to a scar. The garments function as catalysts that speed up the natural process of scar softening and relieve patients from physical discomfort<sup>[14]</sup>. Further studies are required in order to test the implications of superficial, uniform injections of steroids at very high focal pressure to scars and the natural processes this type of treatment evokes.

Finally, solution mixtures comprising of Celestone chronodose/ Cepomedrol/ Diprosan with betamethasone as the active ingredient, are used to treat symptoms associated with inflammatory processes. These corticosteroids injections are

the most common of all treatments, reducing excessive scarring by decreasing collagen synthesis, altering glucosaminoglycan synthesis, and reducing production of inflammatory mediators and fibroblast proliferation during wound healing<sup>[5]</sup>. The effectiveness of the EnerJet treatment as observed in these subjects may imply that the use of the system uniformly spreads the solution mixture, creating increased contact and covering more efficiently the surface area. Future studies should consider adding hyaluronan (HA) to the solution mixture, fortifying the increased HA secretion in the scar tissue.

### *Conclusion*

The treatment of keloids using the EnerJet system appears to be an effective modality for reducing the unaesthetic disfigurement of keloids, improving their rigidity and texture, and minimizing the pain associated before, during and post-treatment. In all six cases reported, scar

tissue volume was reduced; the treated area appeared smoother and more balanced; borders were significantly blurred, with documentation showing continued improvement up to nine months following final treatment.

Every year, numerous types of pressure garments and drugs are investigated for the purpose of inhibiting excessive collagen synthesis in keloids and controlling fibrogenic growths. Until there is a complete mapping of factors contributing to aberrant wound-healing and not before research appreciates all aspects of keloid formation, it is unlikely there will be a complete therapeutic solution addressing all conditions. The EnerJet system's ability to combine the introduction of different therapeutic substances with the mechanical effect of initiating a healthier individual wound-healing process demonstrates a substantial potential for a novel keloid treatment.



**Fig. 1:** Chest. 36 year old male; before (left) and 17 days after (right) the 2<sup>nd</sup> treatment



**Fig. 2:** Chest. 47 year old male; before (left) and 4 months after (right) five treatments



**Fig. 3:** Breast. 46 year old female; before (left) and 9 months after (right) eight treatments

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