Advanced Diode Laser Technology Using Low Fluence, High Average Power and High Repetition Rate for Virtually Painless, Permanent Hair Reduction

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Introduction

Laser hair removal technology emerged and proliferated in the past decade to become the "gold standard" for the treatment of unwanted/ excessive hair. Laser devices (alexandrite, diode, neodymium:YAG and ruby lasers) with high fluence, high peak power and low average power are commonly in use but can be accompanied by high incidents of patient discomfort and low performance-cost ratio. In addition pain, erythema, swelling, pigmentary changes and burned hairs are reported adverse effects. While clinically proven, laser technology for permanent hair reduction has yet to achieve good safety and efficacy standards. There is a widely recognized need for an effective hair removal method which is not accompanied by patient discomfort. We postulate that a hair removal system which heats the hair follicle to a sufficient temperature for hair removal while delivering a minimal amount of thermal energy to the epidermis will be virtually painless and deliver effective results. The purpose of this preliminary study is to summarize the clinical experience gained in the past four months using an advanced diode laser system (Soprano XL, Alma Lasers Ltd, Caesarea, Israel).

Methods

Fourteen patients (8 female; 6 male; 18-37 year-old; Fitzpatrick skin type II-IV; hair color black [n=9]; brown [n=5]; hair type coarse [n=8]; vellus [n=6]) were treated with the Soprano XL diode laser system using the following specifications: wavelength 810nm, fluence 10J/cm^2, spot size 1.2 cm^2, repetition rate of 10 Hz. The system handpiece has a sapphire contact cooling tip. Parameters were kept constant for each and every treatment/patient. Group I (n=10) received a laser treatment every 4-6 weeks (number of treatments range 2-5), and Group II (n=4) is in the process of receiving 6 laser treatments on a weekly basis with 1, 3 and 6 months follow-up.

Patients were treated in the following areas: axilla (n=8); stomach (n=3); back (n=2); chest (n=3); arm (n=1). Before the treatment, high resolution photography was taken to document each area (Nikon D70, Japan). All areas were shaved and wiped cleaned. No local anesthesia was used. The treatment technique employed multiple, in-motion, repetitive passes (6-10; average 8 passes) on a pre-marked grid (10 x 10 cm for smaller area and 15 x 15 cm for larger areas). A single grid was used on small areas (axilla, bikini) whereas multiple grids were used on large areas (chest, back, arm). Before the treatment, the grid area was covered with a thin coat of ultrasonic gel. The handpiece (in contact with the skin) was moved within the grid boundaries at a speed of 5 cm/sec employing "paint-brush"-like strokes to cover the entire grid area. This was done repetitively and sequentially 8 times (range 6-10). Clinical end-points were considered as epidermal and perifollicular erythema and edema.

Results

All patients reported virtually no pain (minimal heat sensation) during all treatments. No adverse side effects were recorded during, after or during the follow-up. Group I (n=10) received on average 3.2 treatments. One month after the last treatment, Group I hair clearance score was >75-<100% in the axilla, >50-<75% in the chest, >75%<100%, on the back and arm >50-75%. Group II (n=4) received on average 5.4 treatments. Similarly, one month after the last treatment, Group II clearance score in the axilla was >75% <100%.

Discussion

In the past decade, many laser and pulsed light based devices for removing unwanted hair based on the principle of selective photothermolysis have been introduced to the market, and to date, this hair removal method is in wide-spread clinical use.

During treatment, the skin of the treatment region is locally irradiated by a high fluence and high peak power laser beam, and the melanin-containing hair follicle absorbs the delivered electromagnetic radiation, resulting

in an abrupt temperature rise in both the hair follicle and the epidermis. Unfortunately, with this treatment method, the energy delivered to the treatment region concomitantly heats the nerve-containing melanin-rich epidermis of the patient. Thus, in many clinical situations, laser hair removal is considered a painful procedure with noticeable risks for adverse side effects. This may explain why many laser hair removal systems incorporate expensive cooling means.

The Soprano XL technology employs low fluence, high average power, with super fast pulses (10 Hz). With the Soprano XL system, epidermal protection is achieved by the handpiece's sapphire contact cooling. The system does not target melanin as the principle target chromophore. Instead, the Soprano XL focuses on raising the temperature of the sub-dermal layer of the skin, progressively, to at least 45°C and to less than the thermal destruction temperature of the hair follicle, without heating the epidermis of the skin region. Although the fluence of each pulse delivered to the skin is relatively low, the rapidly-delivered pulses effectively heat the dermis.

It is postulated that because the dermis is a good heat conductor, during treatment the temperature of the hair follicle does not drop below the temperature of the heated dermis. Since the hair follicle is in thermal equilibrium with surrounding tissue, and the hair follicle is sensitive to heat, under prolonged laser exposure conditions the hair follicle is thermally affected. Thus, once the sub-dermal layer is sufficiently heated, individual pulses only need to provide enough energy to the hair follicle to raise its temperature from a temperature at or above the heated-dermis temperature, to a temperature effective to impair the function of the stem cells which are responsible for hair growth. All of our patients experienced virtually pain-free laser hair removal treatment without any adverse side effects.

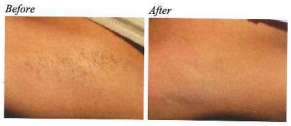
Conclusion

The Soprano XL system provides state-of-the-art advanced diode technology for virtually painless, permanent hair reduction for all hair and skin types.

Clinical Evidence

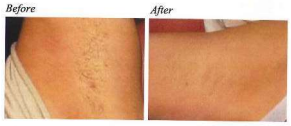
Right Axilla

Before *After*



Left Axilla

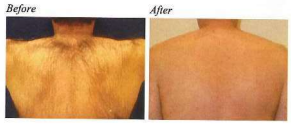
Before *After*



Case 1: Before and One Month After Six Weekly Treatments (Skin Type IV)

Man's Back

Before *After*



Case 2: Before and Three Weeks After Three Treatments (Skin Type III)

Photographs are courtesy of David J. Friedman, MD.

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