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Tightening of Facial Skin Using Intraoral 2940 nm Er:YAG SMOOTH Mode

Adrian Gaspar[1], Gustavo Alfaro Gasti[2]
1 Prima Piel Clinic of Aesthetics, Antiaging and Gynecology, Mendoza, Argentina
2 Rejuvemed Clinic of Plastic Surgery, Aesthetic Medicine and Gynecology, Santiago de Chile, Chile

ABSTRACT

Facial skin rejuvenation has long been the most highly desired aesthetic procedure. The demand for no-downtime procedures in skin rejuvenation has guided researchers to develop newer non-invasive procedures based on thermal effects that result in collagen remodeling.

The purpose of this prospective pilot study was to assess the effectiveness and safety of intraoral treatment with Er:YAG laser using a non-ablative mode. Nine patients were treated with an 2940 nm Er:YAG laser using the intra-oral technique. Up to five sessions were needed for efficient reduction of the nasolabial folds, depending on the severity of the perioral wrinkles. Wrinkle severity was assessed by three independent evaluators before and after each treatment using the Modified Fitzpatrick Wrinkle Scale.

A significant reduction of perioral wrinkles was observed after the treatment. The therapy was also very well tolerated by all patients, with no discomfort described.

In this pilot study we describe a new non-invasive intraoral method using Er:YAG in a non-ablative mode for efficient reduction of perioral wrinkles, with no down time and no adverse effects observed.

Key words: Wrinkle reduction, intraoral treatment, Er:YAG laser, non-ablative mode, skin rejuvenation.

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I. INTRODUCTION

Increasingly deep nasolabial folds and perioral wrinkles are the most significant signs of facial skin aging. Facial rejuvenation has long been the most highly desired aesthetic improvement, and the increased interest in skin rejuvenation has promoted rapid evolution of different methods to treat aged skin.

Ablative laser skin resurfacing treatments using lasers such as CO_2 or Er:YAG have long been considered the gold standard for skin rejuvenation. Er:YAG lasers produce less residual thermal injury and hence less total depth of tissue necrosis, with faster healing and less down time in comparison with CO_2 lasers [1]. However, ablative laser treatments have become less popular due to prolonged downtime and an increased risk of complications with long-lasting side effects [2].

Methods that combine high efficacy with minimal downtime and minimal chance of side effects have become more desirable. For this reason a number of non-ablative treatments using different wavelengths were developed [3–6]. With ablative techniques, a reduction of superficial imperfections such as photodamaged skin can be achieved, but with non-ablative methods, a thermal effect produces a wound healing response and the stimulation of collagen remodeling, leading to tissue tightening.

A novel noninvasive method was introduced using the Er:YAG laser in a non-ablative SMOOTH mode for the treatment of mucosa tissue, which enabled the development of several new applications based on collagen remodeling and neo-collagenesis, such as laser vaginal tightening, stress urinary incontinence, treatment of snoring and apnea reduction [7–9]. Recently one case study demonstrated promising results using a combination of intraoral and extraoral Er:YAG in SMOOTH mode for the reduction of nasolabial folds [10].

The latest promising results of Er:YAG use on mucosal tissue, combined with high patient interest for novel non-invasive methods for skin rejuvenation, prompted us to evaluate the efficacy and safety of intraoral treatment with the Er:YAG laser using the non-ablative SMOOTH mode for perioral wrinkle reduction.

II. MATERIALS AND METHODS

A prospective, multi-centered pilot study was conducted at the Piel Clinic of Aesthetics, Antiaging and Gynecology in Mendoza, Argentina and at the

Rejuvemed Clinic of Plastic Surgery, Aesthetic Medicine and Gynecology in Santiago de Chile, Chile.

Nine subjects with average age of 46.8 years (ranging between 35 to 58) with different grades of perioral wrinkle severity were treated in our clinic. All 9 patients (8 female and 1 male) participating in this study were evaluated as Fitzpatrick skin types II–III. The exclusion criteria were injury or/and active infection in the treatment area or administration of drugs which could cause photosensitivity.

Each patient underwent up to five sessions at one-month intervals with a fractional non-ablative 2940 nm Er:YAG laser (SP Dynamis, Fotona, Slovenia) using the intra-oral technique. A fractional non-ablative PS03 handpiece with 7 mm spot size, 8 J/cm^2 fluence and a frequency of 1.8 Hz was applied at each session.

The treatment was done in two steps as shown in Fig.1. The first step included the tightening of the cheeks, diminishing of the nasolabial fold and lifting of the labial commissure. The second step involved a raising of the philtrum and cupid bow lip augmentation. An additional third step could be done to achieve augmentation of the bottom lip volume. Six passes were delivered to the intraoral area using SMOOTH mode pulses. Each shot was delivered in one spot at a time with no overlapping (Fig. 2). The treatment is non-invasive and no special patient preparation is needed. No anesthesia or cooling were applied before or after the treatment.

Fig. 1: Overview of the two-step procedure showing the treated area inside the mouth.


Fig. 2: Demonstration of the intra-oral technique using the fractional non-ablative PS03 handpiece.

Wrinkle severity was evaluated before and after each treatment based on comparisons of photographs using the Modified Fitzpatrick Wrinkle Scale (MFWS) by three independent observers [11]. To calculate the statistical significance of the treatment, the Student's t-test was used. Patient tolerability of the treatment was also evaluated by self-assessment of pain and discomfort on a 10-point scale.

III. RESULTS

A significant reduction of perioral wrinkles was observed in all treated patients. The average wrinkle score before the treatment, evaluated at 2.22, was improved by 69% to 0.69 (Table 1). The results of wrinkle reduction as evaluated by three independent observers using the Modified Fitzpatrick Wrinkle Scale are displayed in Fig. 3.

Table 1: Assessment of average MFWS values by three independent evaluators before and after the treatment and the patients' evaluation of pain during the treatment.

Patients No.	Age	MFWS Before	MFWS After	MFWS Change	Pain
1	39	2.00	0.00	2.00	1
2	48	3.00	1.33	1.67	0
3	41	1.33	0.17	1.17	1
4	52	2.50	1.00	1.50	0
5	35	2.00	0.00	2.00	0
6	53	2.33	0.67	1.67	1
7	58	2.33	1.50	0.83	2
8	47	1.67	0.33	1.33	0
9	48	2.83	1.17	1.67	1
Average	**46.78**	**2.22**	**0.69**	**1.54**	**0.67**

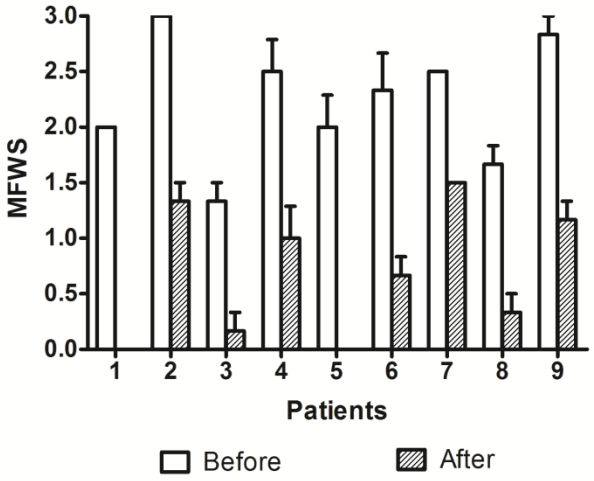

Fig. 3: Evaluation of MFWS values of nine treated patients before and after the intraoral treatment by three independent clinical observers. A significant ($p<0.0001$) reduction of wrinkles was observed after the treatment.

The reduction of wrinkles was detected immediately after the intraoral treatment (a result of the immediate collagen remodeling), with no adverse effect such as additional erythema or edema (shown in Figs. 4 and 5*)*.

Fig. 4: Reduction of nasolabial folds in a 39-year-old woman after treatment with Er:YAG in non-ablative SMOOTH mode.

Fig. 5: Intraoral treatment of perioral wrinkles with Er:YAG in non-ablative mode resulting in a significant diminishing of the nasolabial furrow. Pictures were taken before (left) and immediately after (right) the treatment.

Although there were no long-term follow ups, the preliminary results show a long lasting effect. As shown in Fig. 6, a significant reduction of perioral wrinkles was observed 60 days after the final treatment session.

Fig. 6: Significant reduction of perioral wrinkles achieved with five sessions of intraoral Er:YAG treatment. Before (left) and 60 days after (right) the treatment.

The treatment is non-invasive and no special patient preparation or anesthesia was needed. No adverse effects were observed after the treatment which was very well tolerated by all patients. Patient discomfort during the treatment was minimal and there was no pain or any other adverse effects after the treatment. The average pain evaluated by the patients on a 10-point scale was 0.67, and the maximal pain reported by one patient was 2.

IV. DISCUSSION

In this pilot study we demonstrated the effective and safe use of an intraoral non-ablative Er:YAG technique for the reduction of perioral wrinkles. The intraoral treatment, using SMOOTH mode Er:YAG, is a novel method for skin rejuvenation resulting in collagen remodeling via the induction of a controlled thermal effect.

Non-ablative laser skin remodeling is based on controlled induction of thermal injury of the collagen while preserving the epidermis. A temperature increase up to 70°C leads to subsequent collagen remodeling [12, 13]. In addition to an immediate effect resulting in the shrinkage of collagen fibers, the initiation of neo-collagenesis (lasting up to 6 months) occurs causing the generation of new collagen. Both the short-term as well as the long-term effects result in an overall improvement of laxity and elasticity in the treated tissue [14–16].

The intraoral treatment with Er:YAG enables tissue heating to well-controlled temperature levels of between 45°C and 65°C in the upper layers of the dermis (around 500 μm deep), resulting in immediate shrinkage of the tissue, which can be as large as 30% of the tissue volume. An additional effect is achieved by the mechanical pull of deeper tissue layers following the shrinkage of upper, photo-thermally processed tissue layers. The long-lasting tightening effect can be described with neo-collagenesis initiated with the expression of heat shock proteins (HSP) resulting in the generation of new collagen fibers, which further contributes to the improvement of thickness and elasticity in the facial skin [17, 18].

As demonstrated in Fig. 4 to Fig. 6, this treatment is very effective for mild-to-moderate wrinkles. The unique histological features of intraoral mucosa enable us to achieve skin tightening, resulting in a lifting of the labial commissure and an augmentation of rythides and nasolabial folds.

V. CONCLUSIONS

In this prospective pilot study we demonstrated the use of a new non-invasive intraoral method with Er:YAG in the non-ablative SMOOTH mode for the reduction of perioral wrinkles.

The method was proven to be very effective, showing an excellent immediate as well as medium-term effect. The safety and non-invasiveness of the method is another advantage, with no down time and no adverse effects, which explains why it was so well accepted by the patients.

This non-ablative 2940 nm Er:YAG laser treatment using the intra-oral technique represents one of the safest and most effective treatments, however, additional follow-up studies should be performed to evaluate the long-term effect on wrinkle reduction.

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