



Correction of nasolabial folds wrinkle using intraoral non-ablative Er:YAG laser

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ABSTRACT

Background: The accentuated nasolabial folds (NLFs) is the most pronounced sign of aging. Non-ablative erbium:yttrium aluminum garnet laser (Er:YAG), Smooth mode was used for the treatment of mucosal tissue. It was reported that it is effective in facial rejuvenation.

Aim: To assess the safety and the effectiveness of intraoral Er:YAG Smooth mode laser in the treatment of NLFs wrinkle. **Materials and methods:** A total of 20 patients with different grades of NLFs wrinkle treated with 2940 nm Er:YAG laser intraorally. Six sessions were done every 2 weeks. The efficacy was assessed by two blinded dermatologists. Photographs were taken at the baseline, end of treatment and 6 months after the final session to document visible changes in NLFs wrinkle. The assessment was based on Modified Fitzpatrick Wrinkle Scale (MFWS) and by comparing the photographs. Patient's self-assessment and patient's satisfaction were used for assessment of final results and any side effects associated to treatment were observed. **Results:** There was significant reduction of the NLFs wrinkle. The MFWS was significantly improved 6 months after treatment compared to before treatment ($p < 0.001$). At the end of the follow-up period, there was improvement in overall appearance of the wrinkles. Patient's self-assessment and satisfaction demonstrated better cosmetic outcomes. **Conclusion:** Intraoral Er:YAG laser is safe, painless, and effective treatment option for NLFs wrinkle.

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Wrinkles reduction; intraoral non-ablative Er:YAG; smooth mode laser

Introduction

As we age, the production of collagen is decreased causing skin rhytides. The aging process is natural but it has been accelerated by other factors such as sun exposure and environmental pollution. These factors lead to progressive structural and physiological changes in skin via reducing collagen and elastic fibers with subsequent loss of the skin elasticity (1,2). Laser skin resurfacing such as CO₂ or erbium:yttrium aluminum garnet laser (Er:YAG) has still been considered the gold standard for skin rejuvenation. The Er:YAG laser produces less thermal injury and tissue necrosis, resulting in epidermal ablation with rapid healing and less down time compared with CO₂ laser (3,4). Fractional laser induces thermal alteration of fraction or columns of the skin, leads to stimulation of new collagen formation (5). Smooth mode is a new non-ablative, non-invasive Er:YAG laser used for the treatment of mucosal tissues (6). Previous studies have demonstrated that the smooth mode modality has been used in treatment of vaginal relaxation syndrome, stress urinary incontinence, and in onychomycosis (7–12). The promising results of this laser on vaginal mucosal tissue help in using it intraoral for treatment for nasolabial folds (NLFs) wrinkle and also the oral and maxillofacial surgeons have noticed improvement of perioral and facial rhytides on repeated usage of intraoral (13) Er:YAG laser. It has been reported that Smooth mode technique was applied inside the mouth inducing controlled

thermal damage to deep mucosal tissue, stimulating intraoral collagen deposition. This will lead to reducing the NLFs wrinkle and tightening the skin in the lower face (14,15).

Materials & methods

This study was conducted at the Department of Dermatology and Venereology and Andrology, Zagazig University Hospitals during the period from June 2016 to March 2017. The study was approved by the Institutional Review Board at Zagazig University Hospital. All cases were informed of the purpose, risks, and expectations of the study, and a written consent was obtained from all cases who like to correct NLFs wrinkles.

Participants

A total of 20 patients (18 females and 2 males) aged 35–55 years with different Fitzpatrick skin types were included in this study. The participants were presented with different grades of NLFs wrinkles and have instructed to avoid weight gain or loss during the study.

Patients with facial soft tissue augmentation, peeling, laser, or cosmetic facial surgery of the lower face in the previous 6 months or during the follow-up period, a history of keloid or skin infection were excluded from the study.

Laser technique

Each patient received six sequential sessions at 2-week intervals over 3-month period. Fractional non-ablative 2940 nm Er:YAG laser (Fotona, SP Dynamis, Slovenia) using special Smooth mode technique was applied. Handpiece PS03 was used with 7 mm spot size and 12 J/cm² fluence, six passes were done at a repetition rate of 1.8 Hz applied at each session with superlong pulse of 300 ms. The laser beam was delivered to intraorally cover the NLFs and cheeks. The handpiece is inserted inside the mouth and the laser light emits pulses of laser to the surface of the oral cavity without damaging the surface of the skin. The six passes that parallel to nasolabial line were applied to cover the NLFs intraorally.

Assessment

Digital photographs were taken using identical camera settings (Canon, Japan) at baseline, weeks no. 4, 8, and 12 as well as 6 months after the final session. The clinical outcome was evaluated by objective and subjective methods. The objective method included blinded evaluations of photographs before and after laser treatment by two dermatologists. The subjective method comprised patient's satisfaction (Grade 1: Very Unsatisfied; Grade 2: Unsatisfied; Grade 3: Satisfied; and Grade 4: Very satisfied) and the patient's self-assessment (Grade 0: Worse; Grade 1: No Change; Grade 2: Slightly Improved; Grade 3: Improved; Grade 4: Much Improved).

Modified Fitzpatrick Wrinkle Scale (MFWS) was used to assess wrinkle severity before and after treatment (16). It comprises three main classes ranged from 1 (fine) to 3 (severe) and three inter classes as follows:

- Class 0: No wrinkle. No visible wrinkle; continuous skin line.
- Class 0.5: Very shallow yet visible wrinkle.
- Class 1: Fine wrinkle. Visible wrinkle and slight indentation.
- Class 1.5: Visible wrinkle and clear indentation <0.1-mm wrinkle depth.
- Class 2: Moderate wrinkle. Clearly visible wrinkle, 1- to 2-mm wrinkle depth
- Class 2.5: Prominent and visible wrinkle. More than 2-mm and less than 3-mm wrinkle depth.

- Class 3: Severe wrinkles. Wrinkle depth is based on assessors' estimation rather than physical measurement.

Follow-up assessment

Patients were followed up at 6 months after the last session to detect the final cosmetic outcome and to record any complication.

Laser safety

Patients tolerability for the intraoral laser were evaluated both objectively (erythema and edema) and subjectively (burning and pain).

Statistical analyses

All analyses were performed using the Statistical Package for the Social Sciences; SPSS, version 18 (SPSS Inc., Chicago, IL, USA). Data were expressed as mean \pm SD and range. Friedman, Mcnemmar test and two-way ANOVA test were used. The *p* value of <0.05 was considered to be significant.

Results

The demographic data and types of wrinkles for all cases are presented in Table 1. All patients completed the study and the 6-month follow-up period. The mean value of MFWS at baseline was 1.85 which was reduced to 0.95 at the end of treatment, then to 0.70 and to 0.65 after 3 and 6 months of treatment, respectively *p* < 0.001 (Table 2).

Among all cases, the total improvement was found in 16 patients (80%). Clinical improvement was found in 6 (85.71%) of 7 patients with fine wrinkles, 8 (88.8%) of 9 cases with moderate type and 2 (50%) of 4 patients with severe wrinkles (Table 2; Figures 1 and 2).

Table 1. Demographic data of the studied group.

	Variable	(n = 20)
Age	Mean \pm SD	43.5 \pm 6.35
	Range	35–55
Sex	Female N (%)	16 (80%)
	Male N (%)	4 (20%)
Wrinkles	Fine N (%)	7 (35%)
	Moderate N (%)	9 (45%)
	Severe N (%)	4 (20%)

Table 2. MFWS of the studied groups at different times.

Variable	Base line (n = 20)	4 weeks (n = 20)	8 weeks (n = 20)	12 weeks (n = 20)	3 month After ttt (n = 20)	6 months After ttt (n = 20)	<i>P</i>	% of Change
MFWS (Modified Fitzpatrick Wrinkle Scale)							0.32 NS ^{1a}	
No N (%)	0 (0%)	1 (5%)	4 (20%)	11 (55%)	13 (65%)	14 (80%)	0.04* ^{2a}	
Fine N (%)	7 (35%)	6 (30%)	4 (20%)	2 (10%)	2 (10%)	1 (5%)	0.002** ^{3a}	85.7%
Moderate N (%)	9 (45%)	9 (45%)	8 (40%)	4 (20%)	3 (15%)	3 (5%)	0.03* ^{4a}	77.8%
Severe N (%)	4 (20%)	4 (20%)	4 (20%)	3 (15%)	2 (10%)	2 (10%)	0.04* ^{5a}	50%
Mean	1.85	1.8	1.6	0.95	0.70	0.65	<0.001** ^{6a}	64.9%
							<0.001** ^b	

^aFriedman test. ^bTwo-way ANOVA test.

P1: Base line versus 4 weeks, P2: 4 weeks versus 8 weeks, P3: 8 weeks versus 12 weeks, P4: 12 weeks versus 3 months, P5: 3 months versus 6 months, and P6: Base line versus 6 months, *Significant, **Highly significant, ttt: Treatment



Figure 1. (a) Female patient, aged 44 years old has moderate NLFs wrinkle before treatment, (b) same patient at the end of follow-up treatment by fractional Smooth mode laser showing much improvement.



Figure 2. Illustration of intraoral fractional laser technique.

Regarding patient’s self-assessment at the end of follow-up period, there was much improvement in 6 patients (30%) while 10 patients (50%) showed improvement and one patient (5%) had slight improvement. Five patients (25%) were very satisfied, 12 patients (60%) were satisfied, and 3 (15%) were unsatisfied (Table 3). Patients were tolerable to the treatment as the study was safe with no pain or any associated side effects.

Table 3. Patient’s satisfaction and patient’s self assessment of the studied groups at different times.

Variable		12 weeks End of ttt (n = 10)	6 months After ttt (n = 10)	P ^a
Satisfaction	Unsatisfied N (%)	6 (30%)	3 (15%)	0.04*
	Satisfied N (%)	10 (50%)	12 (60%)	
Self-assessment	Very satisfied N (%)	4 (20%)	5 (25%)	0.03*
	No change N (%)	5 (25%)	3 (15%)	
	Slightly improved (%)	3 (15%)	1 (5%)	
	Improved N (%)	8 (40%)	10 (50%)	
	Much improved N (%)	4 (20%)	6 (30%)	

^aMcnemmar test, *Significant, ttt: Treatment

Discussion

Over the last decades, there are progressive demands for skin rejuvenation to gain youthful looking skin. NLFs are only one sign of aging which depend on many facts as aging, smoking, and sun exposure. NLFs and perioral wrinkles are the most prominent sign of aging in lower face moreover, they are highly common and they appear early at the age of 30 or before (17). Most of patients would like NLFs to be less prominent. The advances in modern technology of medical field have witnessed the development of Intraoral Er:YAG laser as a novel method for skin rejuvenation resulting in dermal remodeling (10,13,14). Smooth mode Er:YAG laser is a modality of the conventional non-ablative Er:YAG being studied to improve signs of skin aging. It has been reported that non-ablative fractional Er:YAG laser induces thermal damage to the papillary and reticular dermis without epidermal ablation. It initiates wound-healing like effects that enhances fibroblast activation, neocollagenesis, expression of heat shock proteins and activation of the extracellular matrix that results in increased proteoglycans which act as mechanical support. The collagen is responsible for improvement of skin thickness, elasticity, and fill in wrinkles (18–23). Conventional Fractional Er:YAG emits 2940 nm with pulse duration 250 ms and it selectively targets water-containing tissue in the dermis resulting in controlled dermal thermal injury resulting in rapid healing and less side effects as mild erythema and scaling (18,19,24). Previous published data have demonstrated that smooth mode is a technique delivers repetitive laser pulses in a fast sequence of low fluence with super long pulse of 350 ms, it is just a new parameter that derived from the conventional Er:YAG laser machine emitted. The smooth mode has low fluence that applied to avoid epidermal damage. It is designed to prevent temperature build-up on the surface and to achieve heating of the deep mucosal layer that reaches 100 micron thickness (10,12).

Er:YAG laser smooth mode induces photothermal interaction by tissue heating from 55 to 70°C that reach mucosal depth of 200–500 um. Thermo mechanical effect; the upper mucosal layer undergo shrinkage meanwhile the deep layer pulled by the mechanical tension between the two layer. Finally, these effects are leading to contraction and shrinkage of tissue that resulting in

collagen remodeling and new collagen formation which increases tissue tightness with mild to moderate improvement of NLFs wrinkles (5,10,18). Conventional Er:YAG laser has limited ability to induce more thermal injury so its effect on collagen shrinkage is significantly lower.

About six passes of laser beam parallel to NLFs are needed to reach controlled heating of the deeper layer of mucosa without affection of the skin surface (10,14,15).

Er:YAG laser Smooth mode has been used in treatment of mucosal tissues as in stress urinary incontinence and for increasing vaginal tightening and recently in treatment of onychomycosis as heat build-up is higher at the site of the fungal infection in comparison to Nd:YAG laser (12).

The objective of this study was to assess the safety and effectiveness of intraoral non-ablative Er:YAG laser, Smooth mode in treatment of NLFs wrinkle. No consensus is reached about the optimal laser parameters, but the physicians depend on their experience to determine the suitable parameters to achieve the best clinical response. In this study, repeated modeling sessions with different fluences of 10, 11, and 12 J/cm² were performed to achieve the best results and to determine the appropriate laser parameters. The laser parameter of 12 J/cm² has better clinical outcomes. The choice of hand piece PS03 in smooth mode was relied on that fractional laser delivers pulses inducing columns of thermal damage distributed in a pixilation pattern within the treated area leaving surrounding area remain intact. This help in supplying the treated area with new cells with subsequent fibroblast stimulation and extracellular remodeling.

The present study showed an improvement in fine and moderate grades of NLFs wrinkle after intraoral Er:YAG laser. The results were very satisfactory in most of patients presenting with fine and moderate wrinkles but severe wrinkles appeared to less benefit. Statistically significant improvements were seen in most patients with (85.7%) reduction in fine wrinkles, (77.8%) in moderate type and no improvement in patients of severe wrinkle except that two patients were upgrade into moderate type. The results at 6-month follow-up period revealed better score than the first 3 months after the final session (0.65) with $p < 0.001$. This might be explained by that the effect of laser becomes more obvious with time. The effect of intraoral fractional Smooth mode in the present study was consistent with previous study (14) in which nine patients were received intra oral fractional laser for facial rejuvenation, one session every month for five sessions, they used the same laser parameter except in the fluence 8 J/cm² compared to 12 J/cm² that was used in this study.

In the current study, there was significant reduction of the MFWS before treatment from 1.85 to 0.65 at the end of follow-up period. Another study (15) used combination therapy of Er:YAG fractional laser extra (on the skin surface) and intraorally for NLF and perioral skin rejuvenation. The intraoral parameter was the same as in the present study except in the fluence was 9.5 J/cm².

The Er:YAG laser is applied inside the mouth. This causes intraoral neocollagenesis inside and outside. It gives a plumping and tightening effect in patients, especially those who did

not prefer surgery or filler. The technique was non-invasive requiring no anesthesia, no recovery time, no adverse effects, will tolerated by the patients and it was effective in patients with fine or moderate wrinkles.

Further studies are advised to evaluate more numbers of patients and longer follow-up periods to find if further sessions are required as maintenance for the results. It would be interesting to investigate the influence of smooth mode Er:YAG laser on various aspects of skin photoaging.

Conclusion

Intraoral Er:YAG, Smooth mode laser is safe, effective, and tolerable method for tightening of NLFs skin in patients with fine and moderate wrinkles.

Disclosure statement

The authors declared that there was no any conflict of interest.

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