

## Efficacy of periorbital region rejuvenation with a single session of Erbium:YAG 2940nm fractional laser in dual mode

*Eficácia do rejuvenescimento da região periorbital com uma sessão de laser fracionado Erbium: YAG 2940nm no modo duplo*

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### ABSTRACT

**BACKGROUND:** Wrinkles and flaccidity in the periocular region are frequent complaints. Ablative fractional lasers (AFL) CO<sub>2</sub> 10600nm and Erbium:YAG 2940nm can induce neocollagenesis and contraction of collagen fibers.

**OBJECTIVE:** Our study aimed to observe the effectiveness of one session of dual mode Erbium:YAG 2940nm fractional laser to treat sagging, rhytids, and fat bags of the upper and lower eyelids.

**METHODS:** Seventeen patients with sagging, rhytids, and fat bags of the upper and lower eyelids underwent one session of Ablative fractional laser (AFL) 2940nm from the Etherea platform in dual mode. Photographic records were taken in the same environment before treatment and one month after the end of the protocol, and five dermatologists and plastic surgeons independent of the study assessed them objectively.

**RESULTS:** The improvements in the evaluation of rhytids, fine lines, and flaccidity were clinically and statistically significant with few adverse events such as edema, erythema, and desquamation. However, eyelid bags did not improve significantly.

**CONCLUSION:** A single session with the dual mode AFL Erbium:YAG tip 2940 can contribute to a significant improvement in rhytids, fine lines, and flaccidity of the periorbital area.

**Keywords:** Lasers; Rejuvenation; Blepharoplasty; Erbium

### RESUMO

**INTRODUÇÃO:** rugas e flacidez na região periorbital são queixas frequentes. O laser fracionado ablativo (LFA) CO<sub>2</sub> 10600nm e o Erbium:YAG 2940nm têm a capacidade de induzir a neocolagênese e a contração das fibras de colágeno.

**OBJETIVOS:** o objetivo do nosso estudo foi observar a eficácia de uma única sessão de laser fracionado Erbium:YAG 2940nm dual mode no tratamento de flacidez, ríntides e bolsas de gordura das pálpebras superiores e inferiores.

**MÉTODOS:** 17 pacientes com flacidez, ríntides e bolsas de gordura das pálpebras superiores e inferiores foram submetidos a uma sessão de laser fracionado ablativo Erbium:YAG 2940nm da plataforma Etherea em modo duplo. Os registros fotográficos foram realizados no mesmo ambiente antes do tratamento e um mês após o término do protocolo. A avaliação foi realizada objetivamente por cinco dermatologistas e cirurgiões plásticos independentes ao estudo.

**RESULTADOS:** as melhorias na avaliação de ríntides, linhas de expressão e flacidez foram clínica e estatisticamente significativas, com poucos efeitos adversos, como edema, eritema e descamação. No entanto, as bolsas de gordura não melhoraram significativamente.

**CONCLUSÃO:** uma única sessão com o modo duplo LFA Erbium:YAG 2940nm pode contribuir para uma melhoria significativa de ríntides, linhas finas e flacidez da área periorbital.

**Palavras-chave:** Lasers; Rejuvenescimento; Blefaroplastia; Érbio

## Original Article

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## INTRODUCTION

The periorbital region is one of the first facial areas to show signs of aging, such as rhytids and sagging skin.<sup>1</sup> The skin around the eyes has special characteristics that must be considered when treating this region, such as thin dermis and low density of sebaceous glands.<sup>2</sup> Also, it has a thin subcutaneous tissue, with skin folds resulting from hyperactivity of the orbicularis oculi muscle. Thus, the periorbital skin is characterized by low elasticity and is prone to the formation of rhytids, discoloration, and pads visualization in the lower eyelids.<sup>3</sup> Fractional ablative lasers (FALs) CO<sub>2</sub> 10600nm and Erbium:YAG 2940nm can induce neocollagenesis and tissue contraction.<sup>4</sup> It is due to the heat generation within the tissue, which vaporizes the intracellular water in its upper layer, denaturing the underlying portion and inducing collagen retraction in the lower layers.<sup>1</sup> This study aims to observe the effectiveness of a single session of Erbium:YAG 2940nm fractional laser in dual mode to treat flaccidity, rhytids, and fat pads of the upper and lower eyelids.

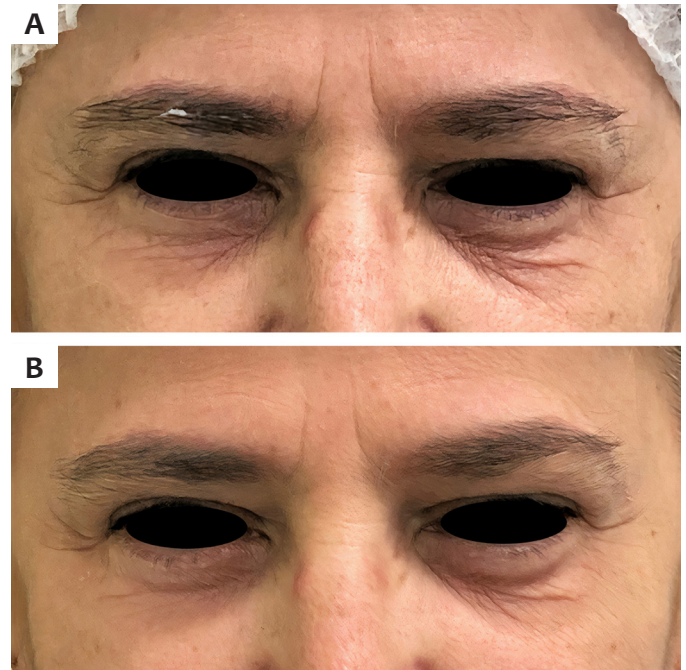
## MATERIAL AND METHODS

It is a prospective, interventional, and open study. We selected 17 patients at the Laser and Technologies Outpatient Clinic of the Professor Rubem David Azulay Institute of Dermatology at Santa Casa de Misericórdia do Rio de Janeiro, from July 2020 to November 2020, according to this study's inclusion and exclusion criteria.

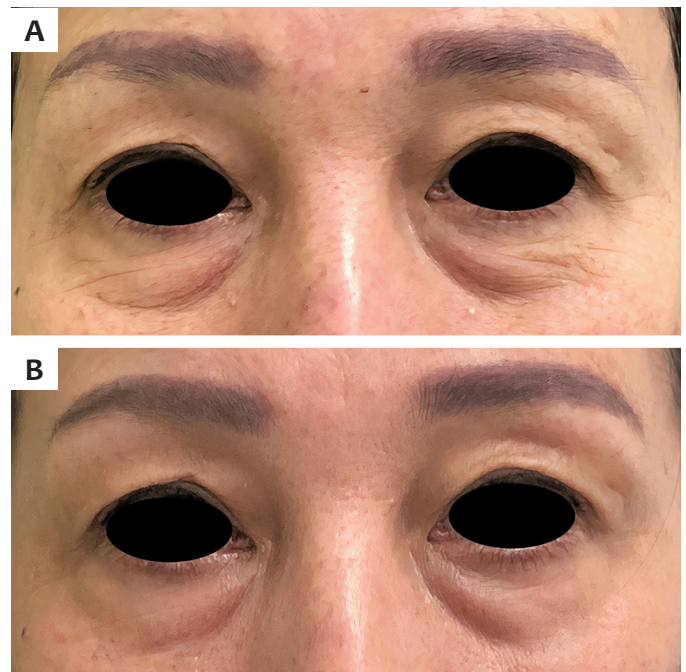
The inclusion criteria were patients with rhytids or flaccidity in the periorbital region, aged over 18 years, of both sexes, with skin phototypes I-III. The exclusion criteria were pregnancy, lactation, history of hypersensitivity to topical anesthetics, use of oral retinoid up to six months before the beginning of the study, active infection at the site, dermatological lesion in activity and/or lesion suspected of malignancy in the region to be treated, previous surgical treatments in the periorbital area, ectropion, or eyelid retractions.

All patients underwent fractional ablative laser (FAL) 2940nm tip, Etherea platform (Vydence Medical, Anvisa 80058580015). First, we applied topical anesthesia with lidocaine 4% for at least 30 minutes before the session. Then, asepsis and antisepsis were performed at the site with degerming chlorhexidine 2% and alcoholic chlorhexidine solution 0.5% to ensure adequate skin cleansing, freeing it of residues. Lastly, we applied the FAL 2940 nm from the Etherea platform, in dual mode, using the parameters 17.5 mj, 300  $\mu$ s/52.5 mj, and 5 ms, 100 MTZ/cm<sup>2</sup>. Patients underwent one session with two passes in perpendicular directions (horizontal and vertical).

Photographic records were taken in the same environment before treatment and one month after the end of the protocol. Five independent examiners, dermatologists, and plastic surgeons conducted the evaluation objectively. We used the parameters rhytids, fat pads, and flaccidity to evaluate separately the "before" and "after" photos, each graded on a scale from 1 (absence) to 10 (very intense). We used the parameters skin



**Figure 1:** Before and after 30 days of the Erbium: YAG 2940nm ablative laser session in dual mode



**Figure 2:** Before and after 30 days of the Erbium: YAG 2940nm ablative laser session in dual mode

texture, eyelid retraction, and global improvement to assess the "before" and "after" treatment photos together, graded on a scale with measures separated by quartiles: Grade 1, 0–25% (no improvement/ slight improvement); Grade 2, 26%–50% (moderate im-

provement); Grade 3, 51%-75% (significant improvement); and Grade 4, 76%-100% (improvement close to resolution) (Figure 1 and 2).

All patients were informed about the research objectives and their benefits and risks. The Ethics Committee of Faculdade de Medicina Souza Marques - Fundação Técnica Educacional Souza Marques/Rio de Janeiro approved the project through Plataforma Brasil, CAAE 5239. For data analysis, the R Core Team 2019 software was used. Categorical variables were described using absolute and relative percentage frequency and continuous variables using the mean, median, interquartile range, and standard deviation. We tested the differences in scales between time points and groups using the Aligned Rank Transformed ANOVA (ART-ANOVA) (Wobbrock *et al.*, 2011) with repeated measures. The significance level adopted was 5% ( $p$ -value < 0.05).

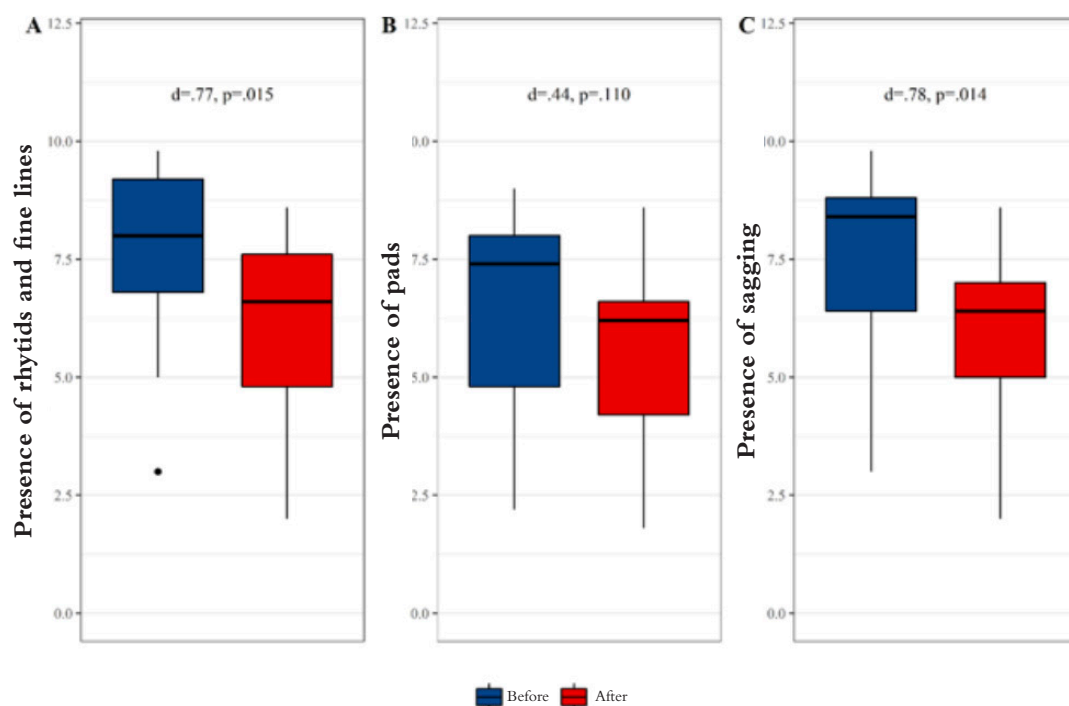
## RESULTS

Seventeen patients completed the study. Table 1 shows the mean scores given by the five evaluators before and after treatment. The improvements in the evaluation of rhytids, fine lines, and sagging were clinically and statistically significant (Graph 1). There was an improvement in the parameters analyzed separately, especially in the evaluation of flaccidity, with an average of 7.48 before treatment and 6.4 after 30 days, using a scale from 1 (absence) to 10 (very intense). On the other hand, regarding fat pads, despite the positive result, the difference observed in the patients was not statistically significant.

The comparative photos, analyzing skin texture, eyelid retraction, and global improvement, also showed a reduced perception of severity. More than half of the patients showed an improvement between 26% and 75% in the overall appearance

**TABLE 1: Analysis of the parameters (rightness, fat pads and flaccidity) separately**

	Before		After		<i>p</i> -value
	Mean (DP)	Median (IIQ)	Mean (DP)	Median (IIQ)	
Presence of rhytids and fine lines	7.65±1.94	8.0 (6.8-9.2)	6.14±1.94	6.6 (4.8-7.6)	0.015
Presence of fat pads	6.48±2.03	7.4 (4.8-8.0)	5.62±1.83	6.2 (4.2-6.6)	0.110
Presence of sagging	7.48±1.98	8.4 (6.4-8.8)	5.92±2.03	6.4 (5.0-7.0)	0.014



**Graph 1:** Analysis of the parameters (rightness, pads and flaccidity) separately

and texture of the skin. Also, in these two categories, almost 30% of the patients analyzed showed an improvement of up to 75%.

Among the three criteria of this step, eyelid retraction had a less impactful result, showing 10 patients (58.8%) with an improvement below 26%. However, approximately 30% of the patients evaluated according to this criterion had significant eyelid retraction, considered greater than 50% (Table 2). Adverse events were limited to edema, erythema, and desquamation.

## DISCUSSION

Rejuvenation of the periorbital region presents unique features and challenges related to eye function and safety. Surgical or invasive blepharoplasty has always been the gold standard for rejuvenating the periorbital area. However, patients routinely experience bleeding, bruising, edema, scarring, and prolonged recovery time, and also a risk of serious complications such as ectropion, diplopia, scleral show, retrobulbar hemorrhage, and xerophthalmia, causing temporary or permanent vision loss, among others.<sup>5</sup> The postoperative healing period is usually six to 12 weeks. Scars are a feature of all surgeries and can be cosmetically undesirable.

Lasers are one of the options for surgery to rejuvenate this region. They can be applied in the doctor's office, reducing costs for patients and physicians. Among the available alternatives are ablative lasers. They are considered the gold standard for laser rejuvenation,<sup>6</sup> and include the CO<sub>2</sub> and Erbium:YAG lasers. Its mechanism of action is based on the destruction of abnormal tissue, collagen remodeling, and epidermal regeneration.

Several studies using the CO<sub>2</sub> laser have shown a reduction in fine lines and wrinkles and elevation of the eyebrows.<sup>7,8</sup> Garcia *et al.* suggest it as a substitute for transcutaneous lower eyelid blepharoplasty since skin contraction makes surgical resection unnecessary.<sup>9</sup>

The 2940 nm Erbium:YAG laser (with a shorter wavelength than the CO<sub>2</sub> laser) targets water. It can deliver energy more accurately than the CO<sub>2</sub> laser without extensive thermal damage to the surrounding tissue, allowing faster healing and recovery of the dermis, with a lower incidence of hypopigmentation, although it exerts less of a hemostatic and tissue contraction effect than the CO<sub>2</sub> laser when purely ablative.<sup>10</sup> Recently, new Erbium:YAG systems have been developed, providing a dual mode that combines short and long pulses in the same tip.<sup>11</sup> The longer pulse delivers thermal energy with a coagulation capacity comparable to CO<sub>2</sub> lasers.<sup>12</sup> These technical advantages translate into results comparable to those of the CO<sub>2</sub> laser but with faster recovery and fewer adverse events.

Several studies have shown the clinical efficacy of the Erbium:YAG laser for rejuvenation, especially on superficial rhytids. In 1997, Teikemeier and Goldberg showed improvement in superficial rhytids in all 20 patients studied.<sup>13</sup> Later studies demonstrated its efficacy in treating moderate and deep rhytids.<sup>14,15</sup>

Our study showed clinically and statistically significant improvements in assessing rhytids, fine lines, and sagging, with limited adverse events such as edema, erythema, and scaling. However, fat pads did not improve significantly. These findings are in line with the literature.

**TABLE 2: Comparative analysis between before and after photos**

	<b>n</b>	<b>%</b>	<b>Agreement</b>	<b>%</b>
<b>Improved skin texture</b>				
(0-25%)	18	21.2	7	41.2
(26-50%)	25	29.4	6	35.3
(51-75%)	30	35.3	4	23.5
(76-100%)	12	14.1	0	0.0
<b>Improved eyelid retraction</b>				
(0-25%)	32	37.6	10	58.8
(26-50%)	15	17.6	2	11.8
(51-75%)	29	34.1	5	29.4
(76-100%)	9	10.6	0	0.0
<b>Overall improvement</b>				
(0-25%)	21	24.7	8	47.1
(26-50%)	22	25.9	4	23.5
(51-75%)	32	37.6	5	29.4
(76-100%)	10	11.8	0	0.0

*Caption: n - absolute frequency; % - percentage relative frequency*

The Erbium:YAG laser has the main advantages of minimal thermal injury and rapid healing and recovery. The disadvantages include the need for multiple passes and the lack of immediate tissue contraction induced by thermal injury.<sup>6</sup>

FAL Erbium:YAG 2940nm in dual mode provides decreased recovery time, increased safety profile than traditional blepharoplasty and CO<sub>2</sub> laser, and effective cosmetic results for rhytids and fine wrinkles and sagging of the periorbital region.<sup>16-19</sup>

Surgical blepharoplasty is classically considered the gold standard in periorbital rejuvenation. However, there is the possibility of complications, from mild to severe. In our study, the 2940nm fractional ablative laser in dual mode was ineffective in improving eyelids pads, which is a classic indication of a surgical blepharoplasty. Thus, the laser procedure would be indicated for the treatment of fine wrinkles and sagging, showing a statistically significant improvement, in agreement with the literature.<sup>20,21</sup>

This study presents some limitations. Despite being prospective, it is not randomized; it has a small number of patients and evaluators; also, all patients received laser treatment. In addition,

we used the 2940nm Erbium:YAG laser in dual mode on the Etherea platform, but we believe that other machines with dual mode (ablative/coagulative) may have similar results. Thus, further studies are necessary.

## CONCLUSION

The periorbital region is one of the first to undergo the skin aging process. Thus, therapies for its rejuvenation are highly desirable. Although the gold standard to treat this region is surgical blepharoplasty, it is a more invasive procedure with possible mild to severe complications, requiring a longer recovery time. Thus, alternative therapies are being increasingly sought, including the laser.


In this study, we can conclude that a single session with the FAL Erbium:YAG 2940nm in dual mode can contribute to a significant improvement in rhytids, fine lines, and flaccidity of the periorbital area. However, fat pads, a classic indication for surgical blepharoplasty, did not improve significantly.

Therefore, laser resurfacing of the periorbital area with FAL Erbium:YAG may be an option in those patients with rhytids, fine lines, and sagging who want less downtime and lower complication rates. ●

## REFERENCES:

- Bowen R. Periorbital rejuvenation: ablative full field Er:Yagvs. Fractional Er:Yag laser resurfacing. *J Clin Cosmet Dermatol.* 2017;(1):1-4.
- Tamatsu Y, Tsukahara K, Sugawara Y, Shimada K. New finding that might explain why the skin wrinkles more on various parts of the face. *Clin Anat.* 2015;28(6):745-52.
- Kołodziejczak AM, Rotsztejn H. Mexametric and cutometric assessment of the signs of aging of the skin area around the eyes after the use of non-ablative fractional laser, non-ablative radiofrequency and intense pulsed light. *Dermatol Ther.* 2017;30(2):e12470.
- Fitzpatrick RE, Goldman MP, Satur NM, Tope WD. Pulsed carbon dioxide laser resurfacing of photo-aged facial skin. *Arch Dermatol.* 1996;132(4):395-402.
- Mack WP. Blepharoplasty complications. *Facial Plast Surg.* 2012;28(3):273-87.
- Hook BA, Hruza GJ. Periorbital ablative and nonablative resurfacing. *Facial Plast Surg Clin North Am.* 2005;13(4):571-82.
- Bonan P, Campolmi P, Cannarozzo G, Bruscinio N, Bassi A, Betti S, et al. Eyelid skin tightening: a novel 'Niche' for fractional CO<sub>2</sub> rejuvenation. *J Eur Acad Dermatol Venereol.* 2012;26(2):186-93.
- Balzani A, Chilgar RM, Nicoli M, Sapountzis S, Lazzari D, Cervelli V, et al. Novel approach with fractional ultrapulse CO<sub>2</sub> laser for the treatment of upper eyelid dermatochalasis and periorbital rejuvenation. *Lasers Med Sci.* 2013;28(6):1483-7.
- Garcia CP, Badin AZD. Treating Excess Lower Eyelid Skin Without Incisions. *Aesthetic Plast Surg.* 2019;43(5):1320-5.
- Jung KE, Jung KH, Park YM, Lee JY, Kim TY, Kim HO, et al. A split-face comparison of ablative fractional lasers (CO<sub>2</sub>) and Er:YAG) in Asian patients; postprocedure erythema, pain and patient's satisfaction. *J Cosmet Laser Ther.* 2013;15(2):70-3.
- Zachary CB. Modulating the Er:YAG laser. *Lasers Surg Med.* 2000;26(2):223-6.
- Fincher EF, Gladstone HB. Use of a dual-mode erbium:YAG laser for the surgical correction of rhinophyma. *Arch Facial Plast Surg.* 2004;6(4):267-71.
- Teikemeier G, Goldberg DJ. Skin resurfacing with the erbium:YAG laser. *Dermatol Surg.* 1997;23(8):685-7.
- Perez MI, Bank DE, Silvers D. Skin resurfacing of the face with the Erbium:YAG laser. *Dermatol Surg.* 1998;24(6):653-8.
- Goldberg DJ, Cutler KB. The use of the erbium:YAG laser for the treatment of class III rhytids. *Dermatol Surg.* 1999;25(9):713-5.
- Drolet BC, Sullivan PK. Evidence-based medicine: Blepharoplasty. *Plast Reconstr Surg.* 2014;133(5):1195-205.
- Rostan EF, Fitzpatrick RE, Goldman MP. Laser resurfacing with a long pulse erbium:YAG laser compared to the 950 ms pulsed CO<sub>2</sub> laser. *Lasers Surg Med.* 2001;29(2):136-41.
- Khatri KA, Ross V, Grevelink JM, Magro CM, Anderson RR. Comparison of erbium:YAG and carbon dioxide lasers in resurfacing of facial rhytides. *Arch Dermatol.* 1999;135(4):391-7.
- Hobart James L, Negus Daniel K, Andersen Dan E. Dual mode laser delivery system providing controllable depth of tissue ablation and corresponding controllable depth of coagulation.
- Bae-Harboe YS, Geronemus RG. Eyelid tightening by CO<sub>2</sub> fractional laser, alternative to blepharoplasty. *Dermatol Surg.* 2014;40(Suppl 12):S137-41.
- Roberts TL, Yokoo KM. In pursuit of optimal periorbital rejuvenation: laser resurfacing with or without blepharoplasty and brow lift. *Aesthet Surg J.* 1998;18(5):321-32.

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Statistical analysis; approval of the final version of the manuscript; study design and planning; preparation and writing of the manuscript; data collection, analysis, and interpretation; active participation in research orientation; intellectual participation in propaedeutic and/or therapeutic conduct of studied cases; critical literature review; critical revision of the manuscript.

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