

# Refinements in Tear Trough Deformity Correction: Intraoral Release of Tear Trough Ligaments: Anatomical Consideration and Clinical Approach



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## Abstract

**Background** Correction of tear trough (TT) deformity is a crucial aspect of facial rejuvenation. Because the anatomical origins of TT deformity lie in the TT ligaments, which firmly attach the dermis to the periosteum, the release of TT ligaments should be considered when performing an etiological correction. The aim of this paper is to propose an alternative method for TT deformity correction, comprising use of filler together with the release of TT ligaments. This technique was compared to the procedure of only percutaneous filler.

**Methods** From January 2014 to December 2015, 10 patients were enrolled in the study for recurrence of TT deformity. All the patients underwent TT ligament release and filler injections; all had been previously treated with percutaneous hyaluronic acid injection without ligament release. Under local anesthesia, the TT ligaments were detached using a blunt cannula introduced directly in the supra periosteal plane through an intraoral access. Once the ligament was released, the TT depression was evenly recontoured with a very small amount of filler. The clinical data, digital images, evaluations of outcomes, including patient satisfaction rates were collected and compared.

**Results** Adding the procedure of TT ligament release to filler injections showed satisfactory results, avoiding an unnatural puffy appearance. The comparison between the

two different methods showed improved outcomes and increased patient satisfaction with minor patient discomfort among those who underwent TT ligament release.

**Conclusion** Because TT ligaments are among the etiologic factors of TT deformity, they have a strong impact on procedures that are designed to improve TT deformity; therefore, TT ligament release should always be considered to obtain satisfactory, natural results.

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**Keywords** Tear trough · Tear trough deformity · Tear trough correction · Facial rejuvenation · Facial beauty

## Introduction

The periorbital region is of vital significance to the perception of facial beauty, as it portrays youth, health and well-being. Because of its high visibility, the malar area is an extremely critical zone, and tear trough (TT) deformity is one of the most common signs of the aging process. Since it is in a very sensitive area, even when not particularly evident it gives the skin an unhealthy, aged and tired appearance. On the other hand, a small improvement in TT deformity greatly enhances the overall facial appearance, changing how other people perceive one's state of being. Therefore, TT treatment should be seriously considered as an integral component of facial rejuvenation [1].

An esthetically pleasing face with a youthful appearance is characterized by a full, convex, and well-defined profile, with smooth and taut skin. With the aging process, the

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fullness of the face contour flattens out, and very efficient anchorage ligaments affect the chronological repositioning of the soft facial tissues, interrupting the regularity of the mid-face profile and splitting it into an alternation of concavities and depressions.

Although TT correction should account for the individual needs of each patient, it is not merely a question of volume restoration, but should deliver esthetically pleasant results without a puffy and unnatural appearance [2]. Although filling the hollow is one of the most common methods used to correct TT deformity, the authors maintain that filler injections alone cannot always correct the disorder adequately because of the TT ligaments; they firmly connect the dermis to the periosteum, which may cause an irregular, puffiness to the malar area. This unnatural appearance could even worsen over time, due to the osmotic activity of the filler itself.

The aim of this paper is to propose an alternative method for TT correction, including the release of TT ligaments, using an intraoral approach as an outpatient procedure. In addition, a comparison has been made between patients who underwent TT correction only with percutaneous filler injection, and subjects treated with TT ligament release plus filler.

## Materials and Methods

From January 2014 to December 2015, 10 patients underwent TT correction with release of TT ligaments and filler injection, using an intraoral access under local anesthesia. They were selected out of a cohort of patients who had previously undergone a procedure by the same surgeon: TT correction only with percutaneous injections of hyaluronic acid without the release of ligaments.

*Inclusion criteria* Patients with recurrence of TT deformity requiring secondary correction, and possessing pre- and post-treatment digital images for each procedure. All the selected patients had undergone primary correction with percutaneous injections of hyaluronic acid at least 18 months beforehand.

*Exclusion criteria* Presence of lower eyelid fat pads, dermatochalasis, festoons and local or general disorders, and absence of standard photographic documentation.

The clinical purposes and medical information regarding the treatments were discussed with the patients before the procedure; all the patients signed a written informed consent form. Minimum follow-up was carried out after 2 months, and maximum follow-up was carried out after 12 months. Clinical data and digital images were collected from all the patients before the initial procedure, and 2 months after the primary and secondary TT corrections.

Patient satisfaction with the result was evaluated 2 months after each treatment; the patients were asked to evaluate the esthetic result and their level of discomfort with the procedure, rating overall satisfaction on a scale of 1–10 (1 = the worst score). The evaluation of the discomfort included the presence and persistence of edema, bruising, and social embarrassment.

The outcomes were evaluated 2 months after each procedure by three residents who were unaware of the treatment and post-treatment care; they were asked to compare the result with the patients' pre-op-images and to evaluate the presence of irregularities during visual and palpatory examinations by rating the outcomes on a scale of 1–10 (1 = the worst score).

## Patient Evaluation and Surgical Technique

Examination of TT deformity should be performed with the patient in the upright position, in neutral gaze with optimal light conditions avoiding shadow interferences; it should include an assessment of skin texture and thickness.

Infraorbital nerve block injection of lidocaine 2% with a 30-gauge 25-mm needle connected to a 2.5 cc Luer-lock syringe is performed using an intraoral approach. A small incision in the mucosa is performed bilaterally in the buccal fornix at the level of tooth 13 and 23 using a Nokor<sup>TM</sup> needle. Through the access, a 1 mm blunt cannula, 7.5 cm in length, is introduced directly into the supra periosteal plane and the TT area is reached, respecting the infraorbital nerve. With a delicate detaching movement, the TT ligaments are gently separated from their deep-seated location, and the TT depression is evenly recontoured with a very small amount of non-animal stabilized biphasic hyaluronic acid filler using the same cannula. Since filler injection with the cannula wastes a larger amount of product than with a needle, the amount of injected filler is measured after filling the cannula. Once injected, the filler is gently massaged in the TT area to ensure it is evenly distributed, and a cool medical dressing is applied; no antibiotics or pain medications are administered (see Video, Supplemental Digital Content).

## Results

Eight women and two men were enrolled in the study. The average age was 36.6 years, ranging from 27 to 49. The average quantity of hyaluronic acid used in the transcutaneous approach was 0.395 ml, ranging from 0.3 to 0.45 ml. The average quantity of hyaluronic acid used in the intraoral approach was 0.185 ml, ranging from 0.1 to 0.5 ml (see Table 1).

Hematomas were observed only in four subjects who underwent percutaneous filler injections. Neither pain nor paresthesia was observed in patients who underwent TT release; minimal bruising, which did not need covering with makeup, was reported unilaterally in four patients. Minimal edema was also observed in patients treated with TT ligament release when they were discharged; however, no patients said this had caused them social embarrassment. The clinical data are reported in Table 1.

As can be seen in Table 2, satisfaction on the part of both patients and clinicians was higher with the TT ligament release procedure compared to that performed only with percutaneous filler injections.

## Discussion

TT deformity is a critical component of the orbital-malar area. It is typically unsightly, and shows an aged, unhealthy and tired appearance; moreover, the effects of animation, gravity and sun damage cause it to appear prematurely in extrinsic aging. It appears as a concave deformity in the lower eyelid, running in a medial–lateral direction, extending obliquely from the medial canthus to the midpupillary line. Laterally to the midpupillary line, it continues up and outwards at the lid-cheek junction up to the external canthus; over time, these two grooves connect to become one continuous groove. With more advanced aging, TT deformity becomes progressively more evident, and the bulging orbital fat above is sharply demarcated from the retruded mid-cheek below. Although TT deformity becomes more pronounced with age, it is not exclusively a feature of aging, since it can be seen in some young people, where it is usually most noticeable when the face is animated rather than at rest. It has a triangular shape, with the apex pointing superomedially and the base inferolaterally. It is bordered by the inferomedial part of the orbicularis oculi muscle, the superior levator of the ala nasalis muscle, and the medial edge of the superior levator of the lip (Fig. 1). Skin atrophy and a dark shadow may worsen its appearance, increasing its visibility [3–6]. TT etiology includes intrinsic and extrinsic aging processes, and genetic factors [7]. The main characteristics of TT deformity are: the hollow itself, and the difference in the quality, color, and thickness of the skin between the lid and the cheek. Furthermore, the prolapse of orbital fat pads, firmly retained by the orbital septum, renders its appearance more evident. Duke Elder and Wyber first described the nasojugal fold in 1961, but the term ‘TT deformity’ was put forward by Flower in 1993 because it corresponds to the skin projection of the tear sac [8, 9].

TT retaining ligaments, first described by Wong in 2012, are strong, fibrous anchorage structures that arise

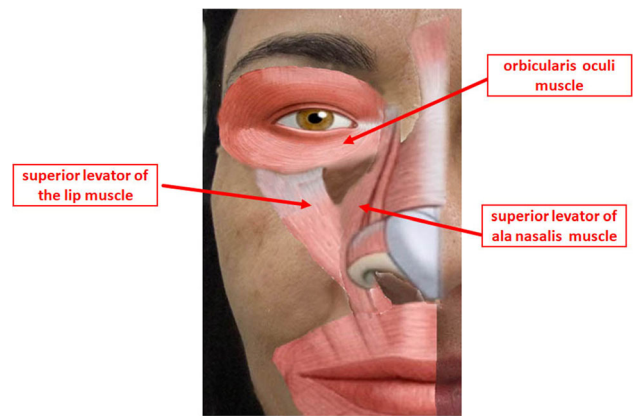
**Table 1** Clinical data

Age	Sex	Amount of filler ml <sup>a</sup>		Patient overall satisfaction				Complications					
		Percutaneous	Intraoral	Percutaneous	Intraoral	Bruising or hematomas	Edema	Social embarrassment					
31	Female	0.3	0.1	3	10	1	8	2	1	7	9	1	9
45	Female	0.35	0.1	5	7	4	8	5	6	7	9	6	9
49	Female	0.25	0.05	7	9	5	9	7	6	8	8	6	8
27	Male	0.4	0.15	6	10	1	10	2	1	9	7	1	7
29	Female	0.45	0.2	5	8	1	6	3	2	7	8	2	8
33	Female	0.4	0.2	6	10	6	6	6	6	7	7	6	7
31	MALE	0.45	0.2	7	8	5	10	5	6	8	10	6	10
39	Female	0.35	0.15	4	8	1	7	4	1	8	9	1	9
42	Female	0.5	0.5	7	9	4	8	4	4	7	8	5	8
40	Female	0.5	0.2	7	10	4	9	8	6	8	9	6	9

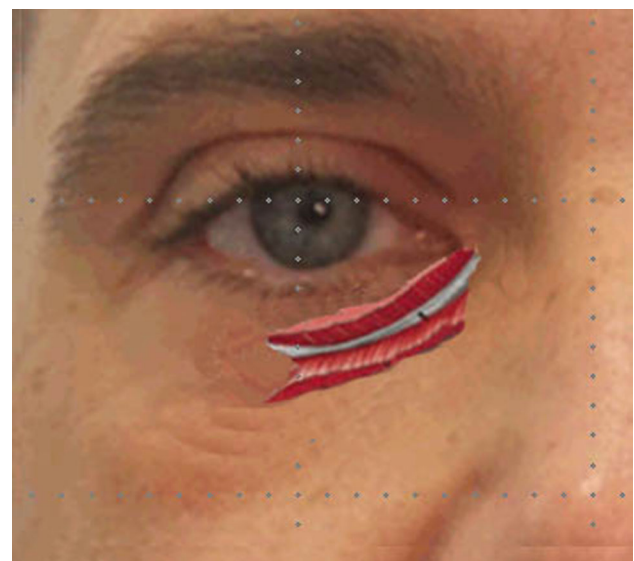
<sup>a</sup>Total amount of filler injected for each patient

**Table 2** Evaluation of residents' outcomes comparing pre-op images with digital pictures of follow-up after 2 months

Age	Sex	Irregularities											
		Surgeon 1				Surgeon 2				Surgeon 3			
		Outcomes		Irregularities		Outcomes		Irregularities		Outcomes		Irregularities	
		Percutaneous	Intraoral	Percutaneous	Intraoral	Percutaneous	Intraoral	Percutaneous	Intraoral	Percutaneous	Intraoral		
31	Female	6	10	6	10	6	10	6	10	6	10		
45	Female	5	8	6	8	6	8	7	10	7	9		
49	Female	6	10	6	10	8	10	8	10	8	10		
27	Male	7	9	6	9	7	9	7	9	8	9		
29	Female	7	9	6	8	7	8	8	9	8	9		
33	Female	6	9	5	10	6	9	6	10	6	10		
31	Male	6	9	5	8	5	8	5	9	6	9		
39	Female	5	7	5	8	2	9	3	10	2	9		
42	Female	6	8	7	9	6	10	6	9	7	9		
40	Female	4	10	4	10	4	9	4	10	3	10		



**Fig. 1** The triangular shape of TT deformity, pointing superomedially with its apex and inferolaterally with the base, bordered superiorly by the inferomedial part of the orbicularis oculi muscle, inferomedially by the superior levator of the ala nasalis muscle and inferolaterally by the medial edge of the superior levator of the lip



**Fig. 2** The extension of the TT ligament from the medial canthal tendon, to the medial pupil line, connecting the periosteum of the medial part of the orbital region to the dermis of the overlying skin

from the maxilla and are inserted firmly into the skin [10]. They are sandwiched between the origins of the palpebral and the orbital parts of the orbicularis oculi muscle, and extend from the level of the medial canthal tendon, just inferior to the anterior lacrimal crest, to approximately the medial pupil line (Fig. 2). Despite being very slight—less than 0.5 mm in width—they are extremely strong. Their ligamentous nature has been histologically confirmed [11].

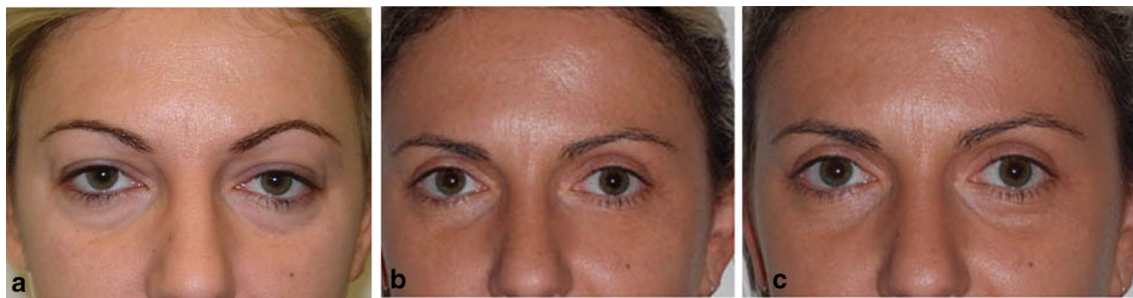
During the aging process, the soft tissue in the malar area loses its volume, becomes thinner, flattens its prominent aspect, and assumes a ptotic appearance. The presence of the TT ligaments affects the chronological



**Fig. 3** **a** 31-year-old man pre-treatment view; **b** tear trough release showing natural and satisfactory result; **c** hyaluronic acid transcutaneous injection showing partial correction and tyndall effect



**Fig. 4** **a** 27-year-old female pre-treatment view; **b** tear trough release showing satisfactory and natural result; **c** hyaluronic acid transcutaneous injection showing partial correction and tyndall effect on the left side



**Fig. 5** **a** 31-year-old female pre-treatment view; **b** tear trough release showing natural and satisfactory result; **c** hyaluronic acid transcutaneous injection and upper blepharoplasty

repositioning of the skin, imprinting on the mid-face contour an alternation of depressions and concavities. In this process, TT ligaments play an important role in demarcating the orbital from the malar region and therefore should be taken into consideration (Figs. 3, 4 and 5).

Even if the loss in thickness of soft tissues is certainly present in TT deformity, smoothing the TT hollow by filling the deformity could recontour an unnatural and puffy profile, giving the mid-face a swollen appearance that might worsen over time in the case of osmotic activity of the filler itself. On the other hand, fat injection could produce unpredictable results and require multiple surgical steps. Since TT deformity is in a very sensitive area, it might require minimal modifications, which may be difficult to manage with injections, and neither fillers nor fat can guarantee long-lasting, stable results. Correction of TT deformity should restore a regular and smooth profile, minimizing the visibility of the transition zone between the orbital and the malar

region, and avoiding an unnatural appearance. Since TT ligaments are involved in the deformity, their release should be considered in TT correction to allow an even distribution of the skin with a natural result. To remove one of the main components of the defect, a small amount of filler is necessary, reducing the risk of irregularities, puffy appearance, and unstable results. However, the quality of the skin should be taken into consideration.

The intraoral access places the cannula directly in the supra periosteal plane and allows the filler to be injected deeply, with minor risk of filler visibility or the Tyndall effect. By avoiding transcutaneous injection, the vascular network of the orbicularis muscle is spared, with consequent low incidence of bruising or hematomas. Moreover, due to the high visibility of the orbital area, signs of transcutaneous injections are very unpleasant for patients as they could be difficult to cover, even with makeup, thus causing social embarrassment.

Although the study enrolled a small number of patients, the data reported in Tables 1 and 2 compare the outcomes of the different techniques, including the amount of filler injected, complications, and patient and clinician satisfaction.

## Conclusion

TT deformity is a critical component of any facial rejuvenation procedure. The outpatient method, proposed by the authors, provides a reliable procedure that does not cause discomfort to patients; it achieves satisfactory correction of the deformity with a natural result, uses minimal amount of filler, and has only a minor risk of irregularities and complications. Furthermore, the release of TT ligaments improves the natural smoothness of the TT skin cover, avoiding unnatural results. Although the procedure could seem more invasive than the transcutaneous filler injection, it requires a short learning curve and minimal manual dexterity; the result of this is that it is painless and simple to perform, and does not cause discomfort for patients (not even in the post-operative period).

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## Compliance with Ethical Standards

**Ethical Approval** All the procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964

Helsinki declaration and its later amendments or comparable ethical standards.

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