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## Lower eyelid ectropion as a sequela of different underlying diseases in maxillo-facial surgery: Diagnostics and treatment approaches

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## ABSTRACT

**Purpose:** This study investigated the outcome of lower eyelid ectropion (LEE) treatment in patients with another primary periorbital or mid-facial pathology.**Materials and methods:** This 18-year monocentric retrospective cohort study included patients admitted for various leading mid-facial pathologies and presenting with a LEE. The primary diagnosis, surgical pretreatment, ectropion type, ectropion severity score (ESS), and surgical techniques were recorded. The primary endpoint was the postoperative ESS score.**Results:** Overall, 40 patients (female n = 16, male n = 24, average age 70.8 years), primarily with periorbital skin cancer (n = 21, 52.5%), facial palsy (n = 7, 17%), trauma (n = 6, 15%), or other pathologies (n = 6, 15%), were included. Surgical procedures mostly addressed a correction of anterior and posterior lamellae (n = 22, 55%), with isolated anterior lamellae in only a few cases (n = 10, 25%). The ESS score significantly decreased from  $4.8 \pm 1.8$  to  $1.3 \pm 1.3$  (paired t-test,  $p < 0.001$ ) after a mean follow-up of 23.8 months.**Conclusion:** LEE constitutes a relevant problem. Due to preexisting canthal ligament laxity in patients undergoing oncologic or traumatic midface surgery, the risk of ectropion has so far been underestimated. Bilamellar approaches in elderly patients are likely to be obligatory in any case.

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## 1. Introduction

Eyelid malpositions are one of the most common pathologies of the eyelid (Sommer, 2010). Although eyelid pathologies and malpositions are predominantly treated by oculoplastic surgeons, the lower eyelid ectropion is an interdisciplinary challenge, particularly relevant in the field of maxillofacial plastic surgery (Reich et al., 2013). Depending on etiopathological factors, several forms of lower eyelid ectropions are known, such as congenital, involutive, paralytic, cicatricial, and mechanical (Sommer, 2010) ones. These conditions commonly present as the eversion of the eyelid margin, lagophthalmos, impaired lubrication and cornea protection, as well

as possible inflammatory signs, and epiphora. Surrounding abnormalities, along with the complexity of the eyelid anatomy, severity of the mentioned pathology, and underlying pathomechanisms, should determine the appropriate surgical treatment. Surgical corrections of the lower eyelid ectropion are indicated in cases of disturbed lid function and inflammation (Sommer, 2010). For corrections of aging eyelids, the surgeon must not only consider the malposition of the lower eyelid, but also take into account the ptosis of the eyebrow, dermatochalasis, blepharoptosis of the upper eyelid, as well as the prolapse of intraorbital fat tissues (involuntional syndrome) (Press, 2010).

## 1.1. Study purposes

Within the cranio-maxillo-facial surgery domain, the risks of lower eyelid ectropion and of other eyelid malpositions are particularly relevant in the context of dermato-oncology, traumatology, maxillofacial oncology, and reconstructive surgery. This study aimed to analyze the underlying pathologies and treatment

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results of lower eyelid ectropion requiring correction following maxillofacial surgery. Another study purpose was to develop, early in each treatment course, an integrative and interdisciplinary refined surgical perspective based on our experiences, and to elaborate appropriate surgical techniques. Consideration of these issues would lower repeated surgery and improve safety and treatment outcomes.

## 2. Material and methods

### 2.1. Patients and procedures

In a single-center Oral and Plastic Maxillofacial Surgery Department at an academic hospital, a retrospective longitudinal cohort study was conducted from January 2000 to July 2019. All consecutively included in-patients diagnosed with a lower eyelid ectropion were initially treated at the same department for another acquired major mid-facial pathology (e.g., trauma, malignancy). Data acquisition was performed as summarized in [Table 1](#). Patients with manifest unilateral lower eyelid ectropion and without any history of eyelid surgery were included, based on their medical records. The recorded data were collected following the PICOST (population, intervention, comparison, outcome, study design, and time limitations) format ([Coroneos et al., 2011](#)). Outpatients, patients with any history of former eyelid surgery and patients treated only conservatively were excluded from this analysis. The general data collected were demographic parameters, primary acquired mid-facial pathology, type of incision during primary surgery, date (year), and corresponding surgical pretreatment. For each patient, the collected local data were the ectropion type, severity, surgical correction technique focusing on three subgroups (1. Consideration of the anterior or 2. Posterior eyelid lamella, and 3. Correction of the anterior and posterior lamellae, with or without additional measures), and outcome. Clinical signs of lower eyelid ectropion were observed, along with functional and physical impairments, such as eversion of the inferior lacrimal punctum, epiphora, lacking cornea wetting, predisposition for inflammation, epithelial metaplasia, or even dysplasia. The chosen primary outcome measure was the ectropion severity score (ESS), according to Korteweg et al. ([Korteweg et al., 2014](#)). The ESS is a validated, photograph-based, cumulative numeric score that follows a standard metric format, with a maximum score of 8 points. The scoring takes into account the 1) lateral and 2) medial marginal eyelid position, 3) scleral and 4) conjunctival show, 5) redness of the eye, 6) roundness of the canthus, 7) excess of tear film, and 8) eversion of the lacrimal punctum. Standardized preoperative and postoperative digital colored frontal-view photography (open eyes, patient at rest) taken at the time of treatment planning and at minimum 6-month

follow-ups were used to assess the preoperative and postoperative ESS for each patient. The first author (W.R.) was the outcome assessor. To ensure valid comparison, the unaffected contralateral eyelids each served as comparators. Also, the time horizon for the postoperative follow-up  $\geq 6$  months was chosen to ensure outcome stability of the corrected eyelid position [Raschke et al. \(2012\)](#). All patients were pseudonymized and parameters were added to a Microsoft Excel (Microsoft Corp., Redmond, WA) database.

### 2.2. Statistical analysis

Statistical analyses for the effect of surgery were performed using statistics software (IBM SPSS statistics, version 25; IBM SPSS, Chicago, IL). Descriptive statistics were applied, using frequency and distribution of several occurrences, as well as combinations of certain features. Analytical statistics were applied depending on the scale using the paired t-test for differences in mean ranges. A p value of  $p \leq 0.05$  was considered statistically significant.

All patients provided their informed consent prior to study participation. The research was performed according to the principles of the Declaration of Helsinki (approval by the institutional research committee 2014). The manuscript was written in line with the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) statement checklist.

## 3. Results

### 3.1. General factors

Over an 18-year period, a total of 40 inpatients from 11 to 97 years of age (average age 70.8 years) with a manifest lower eyelid ectropion met the inclusion criteria and were analyzed. Of these patients, only three were not available for the 6-month follow-up examination. The mean follow-up period for the 16 female and 24 male patients was 23.8 months (minimum 1 month, maximum 81).

The underlying diseases were as follows: periorbital skin cancer in 21 (52.5%) patients, facial nerve palsy of several etiologies in seven (17.5%), open mid-facial fractures in six (15%), and miscellaneous (carcinoma of the maxillary sinus, traumatic infraorbital ulcer, etc.) in six (15%). In line with the primary treatment of the underlying mid-facial pathology, in 9 oncological cases patients received adjuvant radiotherapy in the head and neck region. These data have been summarized in [Tables 2 and 3](#). Where applicable, the type of incision during primary surgery has been specified. The common findings were infraorbital ( $n = 19$ ), subciliary ( $n = 2$ ), and Weber-Ferguson incisions ( $n = 2$ ). Otherwise, soft tissue lacerations

**Table 1**  
Patient selection and recorded parameters following the PICOST format ([Coroneos et al., 2011](#)).

Domain	Population	Intervention	Control	Outcome	Setting	Time horizon
Maxillofacial surgery	In-patients presenting unilateral LEE, who had no history of eyelid surgery and were initially treated at the same department due to another leading acquired mid-facial pathology (i.e. trauma, malignancy).	Surgical techniques for LEE correction: type of incision/access, intervention for anterior lamella reconstruction, horizontal shortening of the posterior lamella, and additional measures (Frost sutures, ciliary electro-epilaton, tarsorrhaphy sutures).	Unaffected contralateral lower eyelids each served as comparators.	Primary outcome measure: ESS ( <a href="#">Korteweg et al., 2014</a> ). Preoperative and postoperative digital photography taken at the time of treatment planning and follow-ups was employed to assess the pre-/ postoperative ESS.	A group of consecutive patients retrospectively collected (from January 2000 to July 2019) at a single-center Oral and Plastic Maxillofacial Surgery Department (academic hospital).	The time horizon for the postoperative follow-up $\geq 6$ months was chosen to ensure outcome-stability of the corrected eyelid position. The clinical findings of the latest recall-examination were determinant.

LEE, lower eyelid ectropion; ESS, ectropion severity score.

**Table 2**  
 Characterization of successfully treated patients depending on underlying pathology, primary surgery, and ectropion treatment.

Patient	Age (years)	Entity	Underlying pathology	Primary surgery (Year)	Type of incision during primary surgery	Ectropion case	Surgical techniques for ectropion correction	Preoperative ESS	Postoperative ESS	Year of ectropion correction	Overall follow-up (months)
1	M 60	Oncology	Myoepithelial carcinoma of the parotid gland, facial palsy	Parotidectomy (2000)	(Not applicable)	Paralytic	Facia lata sling, medial and lateral tarsorrhaphia	7	1	2000	75
2	M 58	Oncology	Squamous cell carcinoma (larynx) osteoradionecrosis of the mandible, facial palsy	Partial mandibulectomy (2003, 2009) <sup>b</sup>	(Not applicable)	Paralytic	Facia lata sling, browlift, Z-plasty	5	3	2009	66
3	M 55	Traumatology	Missing bony support and torn canthal ligaments due to midfacial fractures in childhood (horse kick)	Enucleatio bulbi (unknown)	(Infraorbital soft tissue laceration)	Medial and lateral, combined cicatricial, mechanical and paralytic	Z-plasty medial, full thickness skin graft and facia lata sling	8	0	2009	81
4	M 44	Traumatology	Central midfacial fracture, unilateral laceration of the eyelids and periorbital soft tissue	Reconstruction of soft tissues, anterior cheek rotation flap (2009)	(Palpabral and periorbital soft tissue laceration)	Medial, cicatricial	Multiple Z-plasties, levator refixation and upper lid blepharoplasty, full thickness skin graft	3	0	2009	10
5	M 74	Dermato-oncology	Squamous cell carcinoma, lower eyelid (irradiated hemangioma)	Anterior cheek rotation flap (2010) <sup>b</sup>	Infraorbital	Medial and lateral, cicatricial	Full thickness skin graft	4	2	2010	31
6	F 80	Dermato-oncology	Basal cell carcinoma, cheek (relapse)	Posterior cheek rotation flap and Bichat flap, radiotherapy (2011) <sup>b</sup>	Infraorbital	Lateral, cicatricial	Finger flap and lateral tarsorrhaphia (Elschnigk)	4	0	2011	32
7	F 85	Dermato-oncology	Basal cell carcinoma, cheek	Transposition flap (2011)	Infraorbital	Lateral, cicatricial	V-Y sliding flap, revision by finger flap and temporary tarsorrhaphia	3	1	2011	8
8	M 68	Dermato-oncology	Isolated cutaneous B-cell lymphoma, actinic keratosis	Anterior cheek rotation flap (2012)	Infraorbital	Lateral, cicatricial	Finger flap, lateral tarsorrhaphia (McLaughlin)	5	1	2012	49
9	F 75	Dermato-oncology	Malignant melanoma (superficial spreading), cheek	Anterior cheek rotation flap (2012)	Infraorbital	Lateral, cicatricial	Full thickness skin graft, lateral tarsorrhaphia (McLaughlin). Revision lateral tarsal strip	3	0	2012	13
10	M 73	Miscellaneous, otology	Otitis media, facial palsy (childhood)	Mastoidectomy, orthognatic surgery (unknown)	(Not applicable)	Paralytic	Facia lata sling (several times), lateral tarsorrhaphia (Elschnigk)	7	0	2012	59
11	M 73	Dermato-oncology	Basal cell carcinoma (relapse), retroauricular, facial palsy	Lateral mastoidectomy, latissimus dorsi flap, radiotherapy, implant anchored auricular episthesis (2009, 2012) <sup>b</sup>	(Not applicable)	Paralytic	Facia lata sling, browlift, upper eyelid loading	7	2	2012	60
12	M 62	Miscellaneous, oncology	Acoustic neurinoma, facial palsy	Tumor resection (2005)	(Not applicable)	Paralytic	Medial canthoplasty, muscular neurotisation (Rosenthal)/browlift, lateral tarsal strip	7	0	2012/2017	55

13	M	78	Oncology	Adenocarcinoma of the parotid gland, facial palsy, recurrent	Parotidectomy, radiotherapy (2013) <sup>b</sup>	(Not applicable)	Paralytic	Upper eyelid loading, lateral tarsorrhaphia (McLaughlin)	7	0	2013	39
14	M	77	Dermatology	Basal cell carcinoma, paranasal	Bilobed flap (2014)	Infraorbital, medial	Medial, cicatricial	Full thickness skin graft, V-Y sliding flap	4	1	2014	20
15	F	76	Dermatology	Basal cell carcinoma, infraorbital	Anterior cheek rotation flap (2014)	Infraorbital	Medial, cicatricial	Finger flap	3	1	2014	4 <sup>c</sup>
16	M	88	Miscellaneous, geriatrics	Cataracta senilis	Complicated lens implantation (unknown)	(Not applicable)	Lateral and medial, involutive	Horizontal shortening and blepharoplasty (Kuhnt-Szymanowski), medial rhomboid conjunctiva excision	7	0	2014	25
17	M	51	Traumatology	Comminuted open centro-lateral midfacial fracture, severe ocular contusion, and laceration of the medial canthus	Open reduction, osteosynthesis, reconstruction of soft tissues, pars plana vitrectomy, lens implantation, retinotomy and retinectomy (2014)	(Palpebral soft tissue laceration)	Medial, cicatricial, lagophthalmus, symblepharon	Local transposition flaps, full thickness skin graft (upper eyelid), oral mucosa graft, canthopexia, Bifurcated forehead/ glabella flap	5	2	2014	28
18	F	54	Oncology	Adenoid cystic carcinoma of left maxillary sinus	Hemimaxillectomy, radiotherapy, secondary microsurgical reconstruction by osteomyocutaneous scapula flap (2015) <sup>b</sup>	Weber-Ferguson	Medial and lateral, combined cicatricial and mechanical	Forehead flap, medial canthoplasty, augmented tarsorrhaphia (Chang and Olver, 2006), upper eyelid loading	7	1	2015	22
19	M	78	Traumatology	Laceration of the left lower eyelid and severe orbital contusion with retrobulbar hemorrhage	Anterior orbitotomy without osteotomy and hemorrhage release (2015)	(Palpebral soft tissue laceration)	Medial, cicatricial	Medial canthopexia, rhomboid tarsoconjunctival excision, temporary tarsorrhaphia <sup>a</sup>	5	2	2015	7
20	M	77	Dermatology	Basal cell carcinoma, infraorbital	Anterior cheek rotation flap (2016)	Infraorbital	Medial, cicatricial	Lateral tarsal strip and full thickness skin graft from retroauricular region, Z-plasty	3	1	2016	8
21	F	84	Dermatology	Squamous cell carcinoma, cheek, dementia	Extended posterior cheek rotation flap (2016)	Infraorbital	Lateral, mechanical and cicatricial	Lateral tarsal strip and finger flap, suspension of the cheek	5	3	2016	10
22	F	76	Oncology	Squamous cell carcinoma (oropharynx), bilateral osteoradionecrosis of the mandible, facial palsy	Secondary microsurgical reconstruction by osteomyocutaneous fibula flap (1996, 2016) <sup>b</sup>	(Not applicable)	Paralytic	Lateral tarsal strip and brow lift (patient rejected upper eyelid loading)	5	0	2016	9
23	M	56	Traumatology	Comminuted open lateral midfacial fracture, laceration of lower eyelid and periorbital soft tissue	Open reduction, osteosynthesis and soft tissue reconstruction (2016)	(Palpebral and periorbital soft tissue laceration)	Lateral, cicatricial and paralytic, lagophthalmus, stenosis of lacrimal canaliculi	Scar excision, lateral canthoplasty, levator re-fixation, intubation of lacrimal canaliculi with silicon stent <sup>a</sup>	3	1	2016	6
24	F	73	Dermatology	Merkel cell carcinoma, cheek	Extended cheek advancement flap, radiotherapy (2016) <sup>b</sup>	Infraorbital	Lateral, cicatricial	Finger flap, autologous fat grafting, lateral tarsorrhaphia (Elschnig) <sup>a</sup>	3	1	2016	11
25	M	60	Traumatology	Comminuted open centro-lateral midfacial fracture, laceration of the lateroorbital soft tissue	Open reduction and osteosynthesis, reconstruction of soft tissues (2015)	(Latero-orbital soft tissue laceration)	Lateral, cicatricial	Scar excision, lateral tarsal strip, V-Y sliding flap	1	0	2017	1 <sup>c</sup>

(continued on next page)

Table 2 (continued)

Patient	Age (years)	Entity	Underlying pathology	Primary surgery (Year)	Type of incision during primary surgery	Ectropion case	Surgical techniques for ectropion correction	Preoperative ESS	Postoperative ESS	Year of ectropion correction	Overall follow-up (months)	
26	M	62	Dermato-oncology	Basal cell carcinoma, infraorbital	Tumor resection (2016)	Infraorbital	Lateral, cicatricial	Lateral tarsal strip and Tenzel rotation flap	3	1	2017	12
27	F	97	Dermato-oncology	Basal cell carcinoma, cheek	Tumor resection, full thickness skin graft (2016)	Infraorbital	Medial and lateral, combined involutive and paralytic	Lateral tarsorrhaphia (Elschnigk)	5	2	2017	12
28	F	52	Oncology	Squamous cell carcinoma maxillary sinus	Tumor radiotherapy, resection, microsurgical reconstruction, patient specific orbital implant and scapula flap (2016) <sup>b</sup>	Weber-Ferguson	Paralytic, partially cicatricial (secondary)	Lateral tarsal strip and tarsorrhaphia, paramedian forehead flap (secondary)	3	0	2017	22
29	F	83	Miscellaneous, geriatrics	Chronic cheek ulcer, manipulation	Extended cheek advancement flap (2017)	Infraorbital	Lateral, combined involutive and cicatricial	Lateral tarsorrhaphia (McLaughlin)	3	1	2017	1 <sup>c</sup>
30	M	63	Dermato-oncology	Basal cell carcinoma lower eyelid	None (2018)	(Not applicable)	Medial and lateral, tumor-associated	Tumor resection, oral mucosa graft, temporal fascia sling, fronto-temporal island flap <sup>a</sup>	7	0	2018	24
31	M	69	Oncology	Squamous cell carcinoma oropharynx, facial palsy	Partial mandiblectomy, microsurgical complicated reconstruction by osteomyocutaneous fibula flap (2018)	(Not applicable)	Paralytic	Lateral tarsorrhaphia Elschnigk, only (palliation)	6	2	2018	12
32	F	74	Dermato-oncology	Cutaneous adnexcarcinoma cheek	Anterior cheek rotation and glabella flap (2018)	Infraorbital	Medial cicatricial	Tarsoconjunctival excision, combined with horizontal shortening medially (lazy-T), finger flap	4	1	2018	12
33	M	11	Traumatology	Traumatic infraorbital ulcer (dog bite)	Conservative (2018)	(Infraorbital soft tissue laceration, lateral)	Medial and lateral, cicatricial	Full thickness skin graft	5	1	2018	10
34	M	80	Dermato-oncology	Recurrent basal cell carcinoma lower eyelid	Primary resection and reconstruction alio loco (2019)	Subciliary	Medial and lateral, tumor-associated	Tumor resection, oral mucosa, temporal fascia sling, fronto-temporal island flap	3	1	2019	6
35	F	84	Dermato-oncology	Recurrent infraorbital squamous cell carcinoma, dementia	Cheek advancement flap (2019)	Infraorbital	Medial and lateral, combined involutive, cicatricial and tumor-associated	Tumor resection, lateral tarsal strip and extended Mustardé flap	3	0	2019	6

M, male; F, female.

<sup>a</sup> Additional measures: Frost sutures, ciliary electro-epilation, tarsorrhaphy sutures, protection contact lens, suture lifting, contralateral upper eyelid blepharoplasty, intubation of lacrimal canaliculi, combinations.<sup>b</sup> Radiotherapy in head and neck region.<sup>c</sup> Patients were not available for the 6-month follow-up.

**Table 3**  
Characterization of patients, for whom, in spite of ectropion correction, no stable result was achieved.

Patient	Age (years)	Indication for primary surgery	Primary surgery (Year)	Type of incision during primary surgery	Ectropion case	Surgical techniques for ectropion correction	Preoperative ESS	Postoperative ESS	Year of ectropion correction	Follow-up (months)
1	M 72	Basal cell carcinoma, lower eyelid	Full thickness skin graft, temporary tarsorrhaphia (2011)	Subciliary	Lateral, cicatricial	Posterior cheek rotation flap	5	5	2011	19
2	M 86	Syringocystadenoma, infraorbital	Lateral advancement flap (2013)	Infraorbital	Lateral, cicatricial	Lateral tarsorrhaphia (Elschnig)	4	4	2013	6
3	F 84	Squamous cell carcinoma, infraorbital	Lateral advancement flap (2013)	Infraorbital	Lateral cicatricial	V-Y sliding flap	4	4	2013	6
4	F 88	Basal cell carcinoma, paranasal	Rhomboid Limberg flap (2016)	Infraorbital	Medial, cicatricial	Glabella flap	3	3	2016	7
5	F 90	Merkel cell carcinoma, infraorbital	Posterior cheek rotation and Limberg flap (2019)	Infraorbital	Medial and lateral, cicatricial	Glabella flap	3	3	2019	6

Ectropion correction solely considered the anterior lamellae and failed to improve the eyelid position (ESS<sub>base line</sub> ≈ ESS<sub>follow-up</sub>). ESS, ectropion severity score.

as a direct consequence of trauma were found in the periorbital (n = 3), infraorbital (n = 2), and palpebral regions (n = 2).

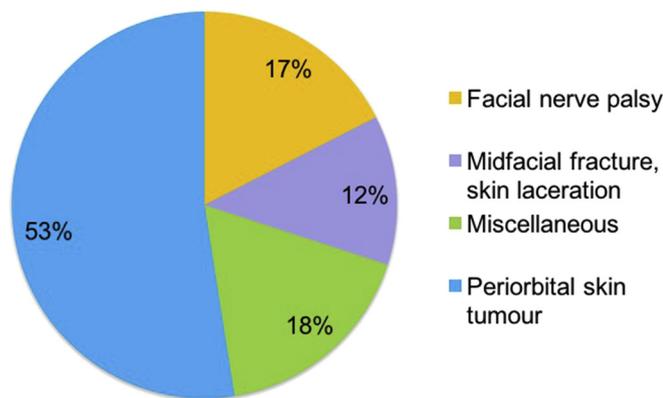
3.2. Clinical presentation of lower eyelid ectropion

Depending on the etiology, severity, and duration of eyelid ectropion, a broad variety of clinical presentations were observed, including medial and lateral manifestations in 19 (47.5%) cases, lateral in 13 (32.5%), and medial in eight (20%). Cicatricial ectropion in 27 cases (skin cancer and trauma 67.5%) was more dominant than paralytic in seven (17.5%), and tumor-associated in three (7.5%) (Tables 2 and 3; Fig. 1).

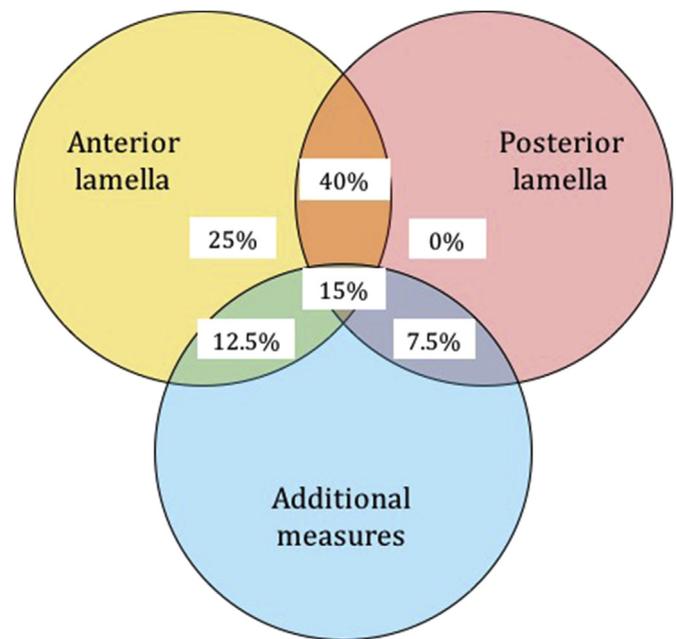
3.3. Treatment and outcome

Surgical techniques for ectropion correction focusing on three subgroups (consideration of the anterior or posterior eyelid lamella, correction of the anterior and posterior lamellae, with or without additional measures) are presented in Tables 2 and 3 and Fig. 2. The surgical procedures focused in 40% (n = 16) of cases on the anterior and posterior lamellae, in 25% (n = 10) on the anterior lamella only, in 15% (n = 6) on the anterior and posterior lamellae including additional measures, and in 7.5% (n = 3) on the posterior lamella including additional measures. None of the included patients received a correction of only the posterior lamella.

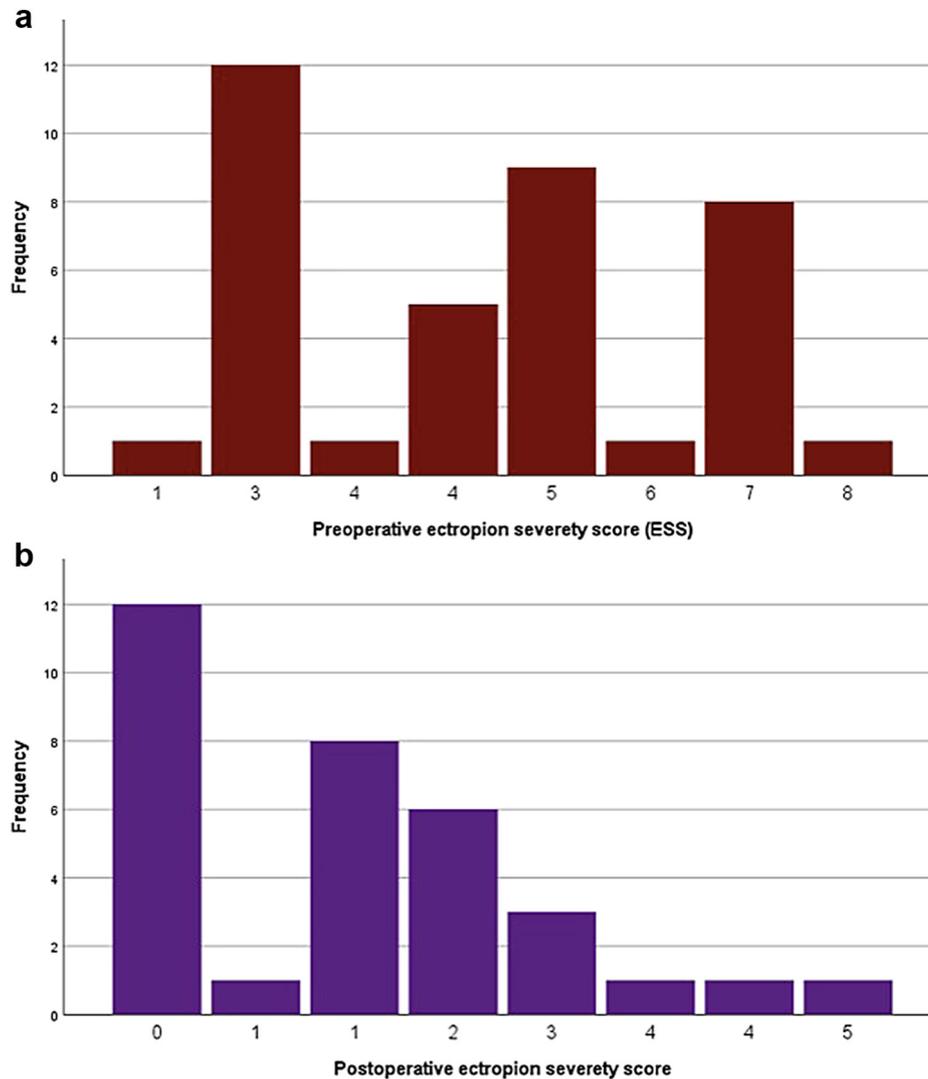
in 15% (n = 6) on the anterior and posterior lamellae including additional measures (upper eyelid loading, temporary tarsorrhaphia sutures, Frost sutures, muscular neurotisation, intubation of lacrimal canaliculi), in 12.5% (n = 5) on the anterior lamella including additional measures, and only in 7.5% (n = 3) on the posterior lamella including additional measures. Patients were treated by five experienced senior physicians. The mean ESS score and median ESS score decreased from 4.8 ± 1.8, 95% CI (4.2; 5.4), and 5.0 units at baseline to 1.3 ± 1.3, 95% CI (0.8; 1.8), and 1.0 unit at follow-up (Fig. 3a, b). Statistical analysis for differences in mean



**Fig. 1.** Ectropion causes in the presented study cohort (n = 40 patient). The underlying diseases were periorbital skin cancer in 53% of patients, facial nerve palsy of several etiologies in 17%, open midfacial fractures in 12%, and miscellaneous (i.e., carcinoma of the maxillary sinus, traumatic infraorbital ulcer etc.) in 18%.



**Fig. 2.** Applied surgical techniques for ectropion correction. The surgical procedures focused in 40% (n = 16) of cases on the anterior and posterior lamellae, in 25% (n = 10) on the anterior lamella only, in 15% (n = 6) on the anterior and posterior lamellae including additional measures (upper eyelid loading, temporary tarsorrhaphia sutures, Frost sutures, muscular neurotisation, intubation of lacrimal canaliculi, etc.), in 12.5% (n = 5) on the anterior lamella including additional measures, and in 7.5% (n = 3) on the posterior lamella including additional measures. None of the included patients received a correction of only the posterior lamella.



**Fig. 3.** Quantitative assessment of lower eyelid ectropion severity. (3a) Histogram of the *preoperative* ectropion severity score (ESS). The mean value was  $4.8 \pm 1.8$  units (median: 5.0). (3b) Histogram of the *postoperative* ectropion severity score. The mean value was  $1.3 \pm 1.3$  units (median: 1.0), and the mean postoperative follow-up period 23.8 months. The statistical examination for differences of mean ranges (paired *t*-test,  $p < 0.001$ ) yielded a significant improvement in the lower eyelid position. The unaffected contralateral eyelids each served as comparators and displayed the values of ESS = 0.

ranges (paired *t*-test,  $p < 0.001$ ) yielded a significant improvement in lower eyelid position over the mean follow-up of 23.8 months. Nevertheless, there were five patients identified, for whom, in spite of ectropion correction, no stable improvement was achieved (Table 3). This demonstrates the under-treatment of the preexisting laxity of the canthal ligament. All five elderly patients ( $\geq 72$  years) suffered primarily from a cutaneous tumor in the palpebral, infraorbital and paranasal region. In these cases, only the anterior lamellae were considered upon ectropion surgery (Fig. 2), and repeat surgical treatment was not required by the patients.

A representative interdisciplinary treatment course of a complicated, trauma-associated right eyelid ectropion has been presented in Fig. 4a–h.

## 4. Discussion

### 4.1. General factors

Iatrogenic malpositions of the lower eyelid associated with orbital trauma or skin cancer treatment have previously (Salgarelli et al., 2009; Salgarelli et al., 2012) been described. Depending on

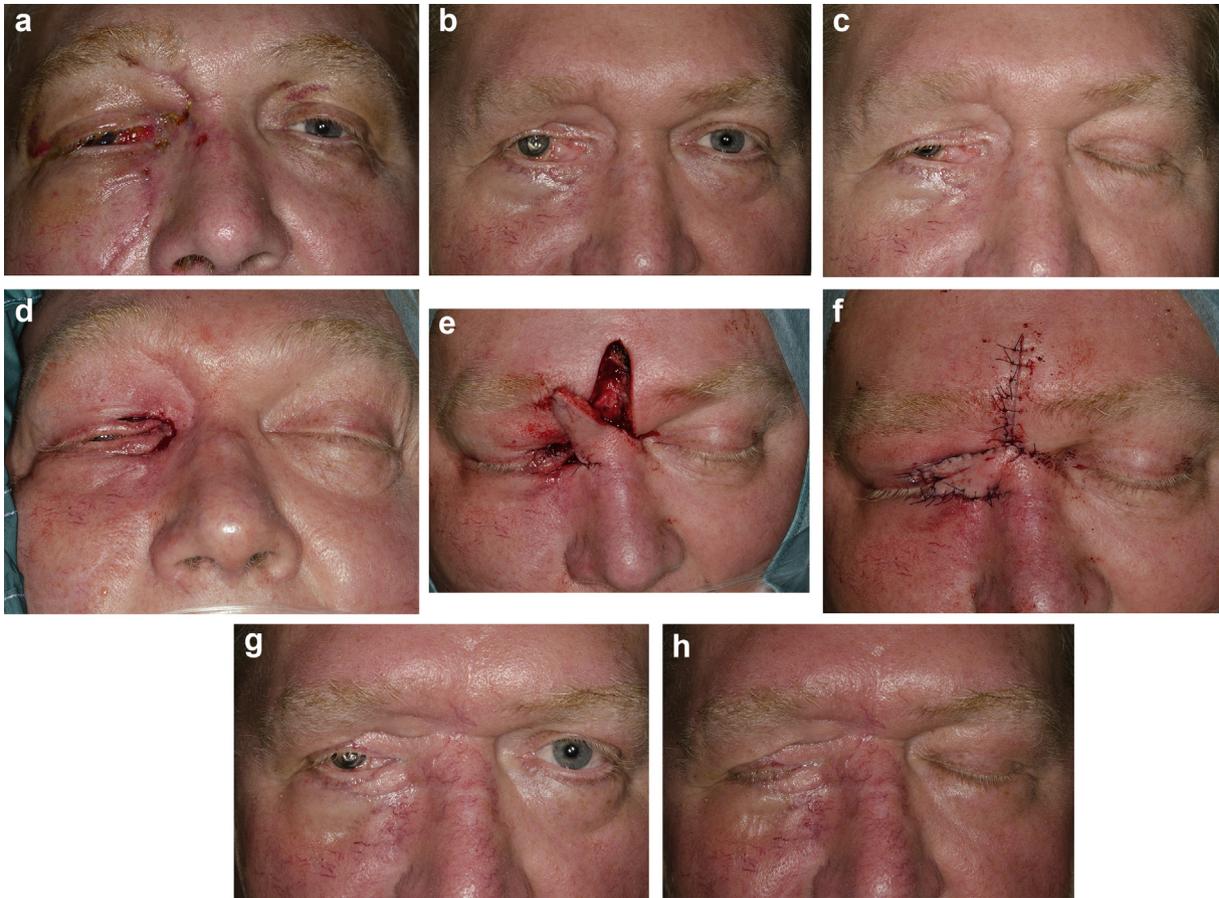
the lower eyelid connective tissues' resistance to downward tension, underlying pathology, and resulting vector of scar tension within the periorbital area, this malposition requires thoroughly planned surgical correction.

This can be compromised by several systemic and local pathological conditions, such as secondary skin malignancy, or radiotherapy. The eyelids are scarcely adaptable to persistent mechanical tension under physiological conditions. This is more evident in elderly patients with preexisting tissue laxity or major periorbital surgery with potential risk of tension. Considering the wide range of etiological factors, especially in elderly patients, the actinic damage of the anterior lamella actively contributes to the development of involuntal eyelid changes (Marshall et al., 2006).

### 4.2. Local factors

#### 4.2.1. Histopathological changes

The histological pattern of the exposed lid margin using light microscopy include collagen degeneration, and elastosis of the tarsal plate, increasing amount of adipose tissue in the distal tarsal portion and fascia, subacute inflammation as well as metaplasia of



**Fig. 4.** Correction of the unilateral cicatricial lower eyelid ectropion as a result of an extensive medial periorbital soft-tissue laceration combined with a comminuted centro-lateral mid-facial fracture. (4a) Clinical aspect of a 51-year old patient 2.5 weeks following osteosynthesis and primary soft tissue reconstruction in the medial canthal and periorbital region (case 17 in Table 2). (4b–4c) At the 1-year follow-up post trauma the medial symblepharon has been already corrected by a buccal mucosal graft and local skin flap. Other sequelae of the severe ocular trauma were phthisis bulbi, vision loss and deep corneal vascularization. However, tear drainage has not yet been considered. Insufficient eyelid closure and cicatricial lower eyelid ectropion are more evident when trying to close the eyes (ESS 5: affected medial marginal eyelid position, scleral and conjunctival show, excess of tear film, eversion of the lacrimal punctum). (4d–4f) Intraoperative aspect of the bilamellar ectropion correction: medial canthopexy and canthoplasty by a bifurcated glabella transposition flap (compensation of the short anterior lamella), which was later additionally thinned out. (4g–4h) Final structural and functional results 6 months following ectropion correction (postoperative ESS 2: scleral show, excess of tear film). In view of the persistent trauma-associated vision loss (nulla lux), the vertically reduced eyelid aperture (upper eyelid ptosis) was acceptable. ESS, ectropion severity score.

the tarsal conjunctiva (Kocaoglu et al., 2009). Additionally, focal degeneration, fibrosis and elastosis of the orbicularis oculi muscle combined with arteriosclerosis of the marginal artery are evident (Stefanyszyn et al., 1985). In involutional ectropion, a significant negative correlation between horizontal eyelid laxity and extracellular matrix content (reduction of collagen and elastic fibers) in the eyelid skin, the orbicularis oculi muscle and stroma was observed (Damasceno et al., 2011).

#### 4.2.2. Ectropion grading

Besides the quantitative assessment for scientific reasons (0–8) (Korteweg et al., 2014), other authors use a descriptive grading scale (I–V) (Moe and Linder, 2000), which is especially practicable in daily routine, or a semiquantitative grading implement treatment planning (I–IV) (Gundisch-Thomas and Pfeiffer, 2010). The two scales are not comparable, but they consider lateral and medial aspects, the eyelid margin itself, and complications. Another option to quantitatively evaluate the correction of the lower eyelid distortion/ectropion was described in detail by Raschke (Raschke et al., 2012). The authors used a comprehensive photo-assisted anthropometric approach employing standardized measurements of intercanthal width, binocular width, eye fissure width and eye fissure height (eye fissure index), lower and upper iris coverage, the

distance from cornea to palpebrale inferior, canthal tilt, etc. This assessment considers also the upper eyelid position, which is an advantage.

#### 4.3. Management of lower eyelid ectropion

In view of several ectropion causes, localizations, and severity reported in literature, there are a variety of surgical techniques proposed, with some of them considered to be equivalent (Tables 2–4). Depending on the underlying eyelid pathology, unilamellar or (more appropriate) bilamellar approaches are indicated. According to Pfeiffer (2004) and Gundisch-Thomas and Pfeiffer (Gundisch-Thomas and Pfeiffer, 2010), mild lower eyelid ectropion should initially be managed by focusing on the posterior lamella (laterally, then medially), then the anterior lamella. In the current study, it is evident that the initial consideration of the posterior lamella was underpart (see distribution of surgical corrections regarding the anterior lamella in Fig. 2, and postoperative ESS of cases 5, 7, 11, 14, 15, 21, 27 and 31 in Table 2). This demonstrates a certain undertreatment of the canthal ligament laxity, which seems to explain why, in five cases, the ectropion correction failed (Table 3). A basal surgical principle of full-thickness eyelid reconstructions is the consideration of sufficient blood supply of both lamellae. This

**Table 4**  
Surgical correction of the lower eyelid ectropion depending on the underlying pathology.

Pathology	Diagnostics	Surgical treatment
Horizontal lower eyelid laxity	Snapback test (horizontal, vertical)	Lateral canthopexia, horizontal shortening laterally with lateral tarsal strip or lateral periosteal flap or blepharoplasty (Kuhnt-Szymanowski)
Medial canthal tendon laxity	Lateral traction test	Medial canthal tendon stabilization or plication (and thermoplasty)
Eversion of the inferior lacrimal punctum	Eversio puncti lacrimalis (missing pipette phenomenon)	Tarsconjunktival diamond excision, combined with horizontal shortening medially (lazy-T and modifications), punctumplasty <sup>a</sup>
Desinsertion of the lower lid retractors	Visibility of the caudal tarsal border	Refixation of the lower lid retractors combined with inverting sutures <sup>a</sup>
Shortening of the anterior lamella	Scarification of the skin	Scar excision, full-thickness skin graft, local flaps, midface lifting with periorbital anchoring
Facial palsy	Lagophthalmus etc.	Augmented lateral tarsorrhaphia (tarsorrhaphia combined with und lateral tarsal strip), medial cantoplasty, upper eyelid loading

Overview modified according to [Chang and Olver \(2006\)](#); [Gundisch-Thomas and Pfeiffer \(2010\)](#); [Korteweg et al. \(2014\)](#); [Pascali et al., 2017](#); [Vahdani and Thaller, 2017](#).

<sup>a</sup> Not applied in this study cohort.

means the combination of 1) an anterior flap with a posterior graft, 2) an anterior graft with a posterior flap, or 3) an anterior and a posterior flap in the same session ([Tyers and Collin, 2008](#)). Furthermore, in oncological as well as in trauma patients, medial and lateral canthopexy (medially, posterior lacrimal crest; laterally, Whitnall's tubercle) along with lateral stabilization, fornix-forming sutures as well as lengthening of the anterior lamella, are considered to be guiding principles ([Perry and Allen, 2016](#)). These principles were realized as presented in [Fig. 4](#). Regarding the lower eyelid lengthening, additionally an interponate between the lower tarsal margin and retractor is of value for cicatricial lower eyelid ectropion (e.g., bovine pericardium membrane, porcine acellular dermal matrix, sclera allograft ([Eckstein and Esser, 2011](#))).

The unipedicled or bipedicled myocutaneous (Tripiet) flap is proposed for anterior lower eyelid reconstruction, sometimes in combination with a mucochondral graft from the nasal septum, while it can similarly be used for ectropion correction ([Maghsodnia](#)

[et al., 2011](#); [Park et al., 2018](#)). Some techniques may be usefully combined ([McKelvie et al., 2018](#); [McVeigh et al., 2018](#); [Goddard and Chesnut, 2019](#)).

Of note, for a paralyzed eyelid retraction, the supporting mid-cheek lift showed superiority over a suspension sling using autologous tendon sling or Mitek anchor ([Min et al., 2019](#)).

Moreover, some authors describe non-surgical/minimally invasive corrections using hyaluronic acid ([Mitchell et al., 2018](#)) and autologous fat grafting ([Lupo et al., 2016](#)), which, however, seem to be (repeatedly) applicable only in mild ectropion cases.

#### 4.4. Preventive measures regarding lower eyelid ectropion

Based on our experience, there is a need for preventive and supportive surgical procedures in dermatologic, trauma, oculoplastic, esthetic, and oncologic (maxillectomy) patients. The risk of lower eyelid malpositions, along with preventive techniques

**Table 5**  
Adjuvant procedures in the periorbital region with a potency to reduce the risk of lower eyelid ectropion development.

Complexity (setting)	Suspension procedure	Intended effect	Authors
Low (outpatient)	Manual eyelid massage	Gentle postoperative eyelid manual massage. Is recommended. Nevertheless, patients should be instructed about the risk of rubbing- and massage-associated corneal deformation	<a href="#">McMonnies et al. (2012)</a>
	Lateral canthopexy	Additional procedure in esthetic lower blepharoplasty to prevent postoperative ectropion in moderate presurgical eyelid laxity	<a href="#">Green et al. (2015)</a>
	Orbitomalar suspension	Complemental procedure adding a medial and superior vector of elevation to the cheek	<a href="#">Cohen et al. (2010)</a>
Moderate (inpatient)	Temporary suspension suture (Frost), combined with temporary suture tarsorrhaphy	A temporary suspension suture (Frost) is helpful to oppose the downward tension and to stabilize the physiological lower eyelid position. Temporary suture tarsorrhaphy reduces edema and increases stability. In some cases (skin cancer) a combination with Frost suture might be indicated.	<a href="#">Salgarelli et al., 2012</a> ; <a href="#">Connolly et al., 2015</a> ; <a href="#">McGrath and McNab, 2018</a> )
	Barbed sutures	Bidirectional barbed sutures allow specific gradients of tension depending on placement (linear, arcuate, u-shaped). This technique proved to be a good alternative to other static facial reanimation techniques.	<a href="#">(Paul, 2013; Costan et al., 2018)</a>
High (special center)	Bony suspension (Mitek Anchor System or other non-resorbable suture screw anchors)	For the purpose of durable bony suspension (e.g., to the zygomatic bone) of cervicofacial rotation-advancement flaps or free vascularized flaps is a reliable method	<a href="#">(Okazaki et al., 1998)</a> ; <a href="#">(Alfano et al., 2011; Visscher et al., 2019)</a>
	Preserving anatomical structures through modifications of the standard approaches (e. g., Weber-Ferguson, lateral rhinotomy)	Transconjunctival approach instead of subciliary incision, infraorbital rim osteotomy or Midfacial degloving with extended transconjunctival-retrocaruncular approach in patients requiring maxillectomy. Modifications of lateral rhinotomy approach to improve functional and esthetic results.	<a href="#">(Thankappan et al., 2009; Andi et al., 2010; Goyal et al., 2011; Muscat et al., 2017)</a>

in esthetic and reconstructive surgery of cutaneous or maxillectomy defects on and near the lower eyelid, are summarized in Table 5. Considering this, surgical procedures in the midface of increasing complexity and elevated risk of tension require equally appropriate measures of tissue support.

In esthetic lower blepharoplasty, an additional lateral cantho-pexy constitutes a simple and effective procedure to prevent postoperative ectropion in moderate pre-surgical eyelid laxity (Green et al., 2015). A temporary suspension suture (Frost) is likely to be helpful to oppose the downward tension and to stabilize the physiological lower eyelid position (Salgarelli et al., 2012; Connolly et al., 2015). Additionally, in case of temporary tarsorrhaphy, sutures may similarly be applied upwards according to the Frost suspension suture. Jothi and Moe have previously reported on the temporary splinting and benefits of the Frost suture (Jothi and Moe, 2007).

Another approach is to take into consideration procedures for ectropion correction (e.g., Kuhnt-Szymanowski) as a reconstructive procedure for marginal eyelid defects (Dryden and Edelstein, 1988; Edelstein and Dryden, 1990).

The modified suture technique (diagonal instead of vertical) of the tarsal strip improves the stability of the margin position in involutive ectropion correction (Lopez-Garcia et al., 2017). Moreover, in case of a paralytic ectropion, it is suitable to augment the tarsal strip technique, as previously described (Chang and Olver, 2006).

For the purpose of durable bony suspension (e.g., to the zygomatic bone) of large cervicofacial rotation-advancement flaps or free vascularized flaps, screw anchor systems are a reliable method when adequate periosteum or soft tissue for standard suture techniques or suspensions is not available (Okazaki et al., 1998; Harris and Perez, 2003; Alfano et al., 2011; Visscher et al., 2019).

For persistent facial palsy, dynamic free neuromuscular flaps or neural anastomoses are standard treatment options, whereas there are still indications for transposition of temporal or masseter muscles (Exner and Kuhn, 2010). In our study, one patient required additional lateral canthoplasty 5 years following temporal and masseter muscle transposition.

Patients undergoing maxillectomy via a standard approach may be at risk for developing lower eyelid malposition due to scarification and lymphostasis, potentially enhanced by adjuvant radiotherapy (Sweeney et al., 2019). Therefore, modifications of the Weber-Ferguson approach are advisable, as follows: transconjunctival, instead of subciliar incisions (Goyal et al., 2011), mid-facial degloving with transconjunctival-retrocaruncular approach (Muscat et al., 2017), and infraorbital rim osteotomy (Andi et al., 2010). To improve functional and esthetic results in the medial canthal region, another helpful modification of a standard incision consists in a modified lateral rhinotomy approach (Thankappan et al., 2009).

In general, postoperative manual eyelid massage is recommended to reduce lymphostasis, whereas patients should be instructed about the risk of rubbing and massage-associated corneal deformation (McMonnies et al., 2012).

#### 4.5. Future perspectives<<?

Despite the ideal reconstructive approach of moderate-sized and large cutaneous defects in the cheek, paranasal, and zygomatic areas, there remains a certain risk of lower eyelid ectropion when considering long-term results (Salgarelli et al., 2012; Sugg et al., 2013; Sweeney et al., 2019).

In accordance with our results, other authors also found in cases of open mid-facial fractures with severe soft tissue laceration, lower eyelid complications as a result of trauma per se or due to

surgical access (Neovius et al., 2017). Therefore, there is a need to better understand, anticipate early, and compensate for the vector of tissue contraction regarding the inferior palpebral region. Additionally, in the medial canthal region, ideally primary surgical reconstruction of affected lacrimal ducts by suturing and intubation using tubes is desirable (Heichel et al., 2019).

## 5. Conclusion

Due to the pre-existing laxity of canthal ligaments in patients undergoing oncologic or traumatic surgery in the midface, the risk of ectropion development is a relevant issue in the maxillofacial surgery domain. Upon ectropion correction bilamellar approaches in elderly patients appear to be most accurate and likely obligatory in all cases in order to avoid repeated surgery.

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## Consent for publication

Written informed consent for the publication of clinical images had been obtained from the patients. A copy of the consent form is available for review by this journal's Editor.

## Declaration of Competing Interest

All authors confirm no conflict of interest.

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