

## Lagophthalmos: An etiological lookout to frame the decision for management

Rani H Rita M, Deepa M, Gitanjali V C, Tinu S R, Subbulakshmi B, Sujitha D, Gopinayik Palthya, Saradha M, Vedhavalli T, Sowmiya B, Akalya R, Mathivadhani L S, Uma M, Bhavani R<sup>1</sup>, Joy R Violet<sup>1</sup>

**Purpose:** To describe the etiology, clinical profile, duration of lagophthalmos cases and thereby, framing a decision for the management based on the severity of Exposure keratitis (EK), Facial palsy (FP) with each etiology and to describe the outcome of the management options. **Methods:** The method was a prospective review of 120 lagophthalmos cases treated at a single tertiary center from January 2018 to January 2019. The main outcome measures were analysing the association between age, etiology, duration and management of lagophthalmos. **Results:** Of the 120 patients studied, paralytic etiology was noted in 86 and eyelid etiology in 34 patients. The percentage of various lagophthalmos etiology documented were Bell's palsy (35.83%), lagophthalmos in ICU patients (15%), traumatic facial palsy (FP) (10.80%), stroke associated FP (6.67%), infection associated FP (6.67%), iatrogenic FP, cicatricial lagophthalmos (5%), lagophthalmos post eyelid surgeries (5%), neoplastic FP (3.33%), congenital FP (1.67%), proptosis induced lagophthalmos (1.67%), floppy eyelid syndrome induced lagophthalmos (0.83%) and lid coloboma associated lagophthalmos (0.83%). A statistically significant correlation was noted between exposure keratitis and age, with an increased prevalence age advances. The management showed significant variation with individual etiology, with some etiologies unquestionably requiring surgical management. Surgical management is crucial as the duration of lagophthalmos increases more than 6 weeks, EK involving pupillary axis and poor FP recovery. **Conclusion:** This study concludes that the conservative management was sufficient in all cases when the duration is less than 1 week, Exposure keratitis not involving the pupillary axis (EK < Grade II) and FP with good functional recovery (FP < Grade III). The predominant causes being Bell's palsy, lagophthalmos in ICU patients and vascular FP. Whereas, cases with poor functional recovery of facial palsy (FP) and permanent eyelid deformation require definitive surgical management like Traumatic FP & cicatricial lagophthalmos.

**Key words:** Exposure keratitis, facial palsy, lagophthalmos, lateral tarsorrhaphy

The term lagophthalmos is used to denote the partial or aberrant closure of the eyelids. Eyelid closure is facilitated by orbicularis oculi muscle supplied by facial nerve (FN). So, for a proper eyelid closure, an intact facial nerve and eyelid architecture is crucial. Conditions causing derangement of one of these two components results in lagophthalmos.<sup>[1,2]</sup>

A Korean study reported the overall prevalence of facial palsy as 0.12%.<sup>[3]</sup> Facial nerve paralysis (FP) occurs in 30 to 40 people per 100,000 annually in the United States.<sup>[3,4]</sup> Out of these, per 100,000 cases annually, Bell's palsy accounts for 25 cases, infectious FP 7.7 cases, neoplastic FP 6.8 cases, and traumatic FP 4.1 cases.<sup>[3]</sup> The incidence of lagophthalmos in intensive care unit (ICU) patients is quite high (21%–75%), sedative and neuromuscular blocking agents used for ICU patients attribute to lagophthalmos.<sup>[5–7]</sup> Lagophthalmos resulting from eyelid surgeries do contribute to significant numbers, with one study citing post-op lagophthalmos as high as 47%.<sup>[8]</sup>

Lagophthalmos results in exposure keratitis which ultimately results in corneal blindness. Though lagophthalmos results from several causes, the ultimate goal in the management

of lagophthalmos resides in the treatment of exposure keratitis and in providing an acceptable cosmetic appearance. Several studies comparing the different treatment strategies for a specific etiology like facial palsy, cicatricial lagophthalmos, and postoperative lagophthalmos are available. But there is lack of information regarding a holistic approach to a case of lagophthalmos. Proper recommendations to approach a case of lagophthalmos and to prevent corneal blindness is diversified among literature. Thus, this study was carried out to describe the etiology, clinical profile of lagophthalmos cases, and to frame management options based on the etiology.

## Methods

This hospital-based, cross-sectional, analytical study was carried out between January 2018 and January 2019. Out of 135 patients reported during the study period, 120 who consented were enrolled in the study by consecutive sampling method. The study was conducted at a tertiary level medical college hospital in Tirunelveli, Tamil Nadu, India.

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Department of Ophthalmology, Tirunelveli Medical College Hospital, Tirunelveli, <sup>1</sup>Research Analyst, Queen Mary's College, Tamil Nadu, India

**Correspondence to:** Dr. Rani H Rita M, Govt Quarters, Tirunelveli Medical College Hospital, Tirunelveli, Tamil Nadu, India. E-mail: doctor.rita28@gmail.com

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Institutional ethical board clearance and informed consent were obtained prior to commencement of the study. The selected patients were categorized based on the etiology as those with paralytic causes and eyelid causes, based on the classification dictated in a previous journal of *American Academy of Ophthalmology*.<sup>[2]</sup>

The operational definition for enrolling the subjects of lagophthalmos in the study was the presence of gap between the eyelids in millimeters on attempted closure of eyes.<sup>[9]</sup> The inclusion criteria were the diagnosis of lagophthalmos caused by various etiologies. They were considered to be eligible for participation in the study. The exclusion criterion was facial paralysis associated with other cranial nerve palsies like oculomotor nerve resulting in ptosis.

### Study instrument and procedure of data collection

A semi-structured questionnaire was framed. The first part included demographic details of the subject; the second part consisted of history pertaining to the identification of etiology; and the third part retrieved findings of ophthalmic examination. Each study subject was photographed before and periodically after surgery. Visual acuity was assessed using the Snellen chart. Severity of exposure keratitis was assessed using a slit lamp with fluorescein staining. Keratopathy was graded on a scale of 1–6 [Table 1].<sup>[10]</sup> The paralytic group was graded based on House–Brackmann scoring system for facial palsy (FP). The scoring was done by asking the patient to lift the eyebrow, following which the measure of upward movement of the middle portion of the top of the eyebrow was noted in centimeters. Then, by asking the patient to clench their teeth, the outward movement of the angle of the mouth was noted. Each anatomical landmark carried 1 point for every 0.25 cm of movement, up to a maximum value of 1 cm; thus, altogether, a maximum score of 8. Based on this scoring system, the functional recovery was graded [Table 2].

**Table 1: Grading of exposure keratitis<sup>[10]</sup>**

Grade	Corneal Findings
Grade I	Punctate epithelial erosions (PEEs) involving inferior third of cornea.
Grade II	PEEs involving more than the inferior third of corneal surface.
Grade III	Macroepithelial defect (MED)
Grade IV	Stromal whitening in the presence of epithelial defect (SWED)
Grade V	Stromal scar.
Grade VI	Microbial keratitis.

**Table 2: House–Brackmann scoring of facial palsy**

Grade	Description	Measurement	Function %	Estimated Function %
I	Normal	8/8	100	100
II	Slight	7/8	76-99	80
III	Moderate	5/8-6/8	51-75	60
IV	Moderately severe	3/8-4/8	26-50	40
V	Severe	1/8-2/8	1-25	20
VI	Total	0/8	0	0

Based on the above scoring, the severity of lagophthalmos was assessed, tabulated and statistically analyzed using Statistical Package for the Social Sciences (SPSS) version 25. Descriptive analysis was done, and demographic and clinical characteristics were expressed in frequency and percentages. Chi-squared test or Fischer's exact test was used to explore the association of various categorical variables.

## Results

The study comprised of 120 lagophthalmos patients of varying etiologies. The subjects were grouped based on their etiology. Eighty-six patients had lagophthalmos due to FP, such as traumatic FP, vascular FP (following stroke or diabetes), Bell's palsy, FP due to tumors of the ear and parotid, FP due to infections of the ear and parotid, iatrogenic FP, and congenital FP. Thirty-four patients had lagophthalmos due to eyelid causes like cicatricial lagophthalmos, lagophthalmos after eyelid surgery, lagophthalmos in proptosis, floppy eyelid syndrome, lid coloboma, and lagophthalmos in sedated patients in ICU. The distribution of patients based on the mean age, sex, exposure keratitis, treatment management (conservative/surgical), and outcomes are provided in Table 3. The mean age of the study was 42 years. A statistically significant correlation was noted via the Chi-squared test (99.95% probability) between occurrence of exposure keratitis and age, with an increased prevalence with advancing age. The percentage of various lagophthalmos etiology documented were Bell's palsy (35.83%), lagophthalmos in ICU patients (15%), traumatic FP (10.80%), stroke-associated FP (6.67%), infection-associated FP (6.67%), iatrogenic FP, cicatricial eyelid causing lagophthalmos (5%), lagophthalmos following eyelid surgeries (5%), tumor-induced FP (3.33%), congenital FP (1.67%), proptosis-induced lagophthalmos (1.67%), floppy eyelid syndrome-induced lagophthalmos (0.83%), and lid coloboma-associated lagophthalmos (0.83%) [Fig. 1].

The severity of exposure keratitis and severity of facial palsy dictate their management. Surgical management was employed for only those cases that presented with exposure keratitis of grade II and above (threatening the visual axis), and FP of grade III and above (estimated functional recovery of FN less than 50%), as increased prevalence of visual loss was reported in this category.<sup>[3]</sup> Remaining cases were treated with conservative measures like tear supplements, eyelid taping, punctal plugs, eyelid stretch exercises, and physiotherapy. The surgical management primarily employed was tarsorrhaphy. Temporary tarsorrhaphy was performed in all patients with lagophthalmos more than six weeks duration, and also in those with grade II and above exposure keratopathy irrespective of the duration of lagophthalmos [Fig. 2]. Permanent tarsorrhaphy was performed in cases with grade III and above House–Brackmann scoring of fp and for persistent lagophthalmos more than 24 months owing to the evidence of poor FP recovery noted. If significant upper eye lid retraction was noted in those scheduled for permanent tarsorrhaphy, additional levator recession was also performed.<sup>[11]</sup> For patients with significant lower lid malposition, a lateral tarsal strip or medial canthoplasty procedure was done<sup>[12]</sup> [Fig. 2c and 2d]. Based on the aforementioned criteria for conservative and surgical management, this study was undertaken and the results analyzed to determine the distribution of lagophthalmos among different etiologies; its chronicity was also evaluated. The outcome of this protocol of management involves downstaging of exposure keratitis severity, acceptable

**Table 3: Distribution of lagophthalmos based on age, sex, exposure keratitis, management and outcome variables**

	120 study subjects												
	Paralytic causes						Eyelid causes						
	Trauma (n=13)	Stroke (n=8)	Bell's Palsy (n=43)	Tumor (n=4)	Infection (n=8)	Iatrogenic (n=8)	Congenital (n=2)	Cicatricial (n=6)	Post Eyelid Surgery (n=6)	Proptosis (n=2)	Floppy Eyelid (n=1)	Lid Coloboma (n=1)	ICU Patients (n=18)
Mean Age	42	52	41	49	39	47	13	42	38	51	52	22	48
Sex Male	10	4	23	1	4	2	1	5	3	1	1	1	11
Sex Female	3	4	20	3	4	6	1	1	3	1	0	0	7
Exposure Keratitis Present	13	6	12	4	7	2	2	6	3	2	1	1	11
Exposure Keratitis Absent	0	2	31	0	1	6	0	0	3	0	0	0	7
Conservative Management	0	6	41	1	5	3	0	0	3	0	0	0	14
Surgical Management	13	2	2	3	3	5	2	6	3	2	1	1	4
Outcome Improved	12	7	40	2	5	8	2	4	6	1	1	0	17
No Improvement	1	1	3	2	3	0	0	2	0	1	0	1	1

eyelid closure (only lower sclera visible and cornea protected by Bell's phenomenon) and minimal ptosis (1 mm or less) in open position.<sup>[13]</sup> Patients were followed up, those without resolution of exposure keratitis and significant epiphora, dry eye and poor cosmetic appearance required further interventions like botox injection to induce ptosis, mid facial suspensions, sub-orbicularis oculi fat (SOOF) lift or middle lamellae spacer. The outcome following these procedures need long-term follow up and are not discussed in this study.<sup>[12]</sup>

The main outcome measures were analyzing the association between etiology, duration, and management of lagophthalmos patients. To facilitate analysis duration of lagophthalmos was subdivided into <1 week, 1–6 weeks, 6–12 weeks, and >12 weeks. On analyzing the duration of lagophthalmos with the etiology and management methods, the Chi-squared significance was high for less than one week (18.6) at 99.95 confidence interval. Its mean difference with *t* test was also comparatively less than other duration interval frequencies. This categorically established that medical line of management is sufficient for lagophthalmos of less than 1 week. Comparing the Chi-squared significance at 99.95 confidence interval for duration interval of 1–6 weeks (Chi-squared significance: 2.38), and 6–12 weeks (Chi-squared significance: 8), it could be established that surgical management is crucial as the duration of lagophthalmos increases to more than 6 weeks [Fig. 3].

The occurrence of exposure keratitis also varies with different etiologies. Exposure keratitis is absent only in certain etiologies in the descending order of Bell's palsy, lagophthalmos in ICU patients, post eyelid surgery, stroke-associated FP, iatrogenic FP, and infection-associated FP. The remaining etiologies invariably present with exposure keratitis [Fig. 4].

The management of lagophthalmos differed with each etiology, with some etiologies unquestionably requiring surgical management [Table 4]. As per the *t* test, the mean difference of management does not vary with broad subdivisions of paralytic and eyelid etiology, but it significantly varies with individual etiology. The surgical ratio was high with traumatic FP (ratio 1), congenital FP (ratio 1), cicatricial eyelid (ratio 1), proptosis-associated lagophthalmos (ratio 1), floppy eyelid syndrome (ratio 1), and lid coloboma-associated exposure keratitis (ratio 1). The other etiologies have a surgical ratio of less than 1, with the lowest surgical ratio being for Bell's palsy (ratio 0.046) followed by lagophthalmos in ICU patients (ratio 0.22) and stroke-associated FP (ratio 0.25), [Fig. 5].

The outcome following the treatment was assessed based on the factors mentioned above and improvements were noted. Bell's palsy and patients in the ICU showed favorable prognoses of 93% and 94%, respectively. Conditions which had worsening of disease like tumors of the parotid and ear, infections of parotid and ear, and cicatricial eyelid causes showed prognoses of 50%, 62.5%, and 50%, respectively. Conditions which showed resolution of FP like stroke- and trauma-associated FP showed a prognosis of 92% and 87.5%, respectively. All other causes showed 100% recovery.

### Discussion

The primary goal of treating lagophthalmos is to prevent exposure keratitis and to restore eyelid function.<sup>[14]</sup> The

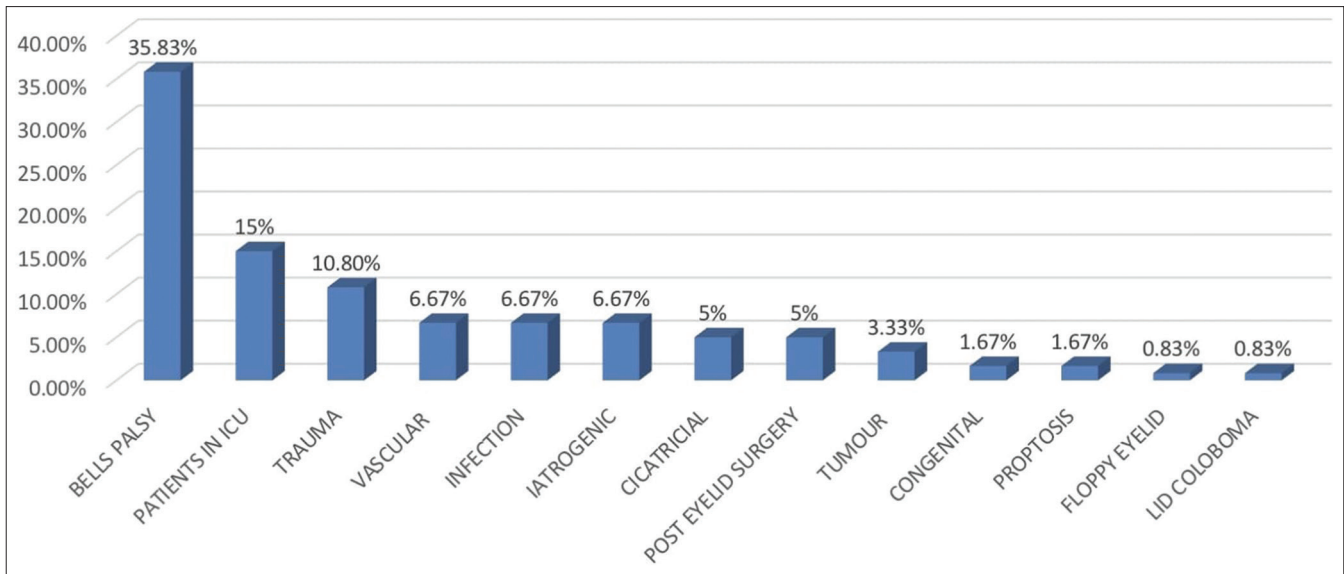


Figure 1: Proportionate prevalence of lagophthalmos among various etiologies



Figure 2: Clinical pictures of patients who underwent surgical management -- preoperative picture (a), post-operative picture of lateral tarsorrhaphy with lateral tarsal strip procedure (b); preoperative picture of lagophthalmos with medial canthal tendon laxity (c), postoperative picture following medial canthoplasty (d)

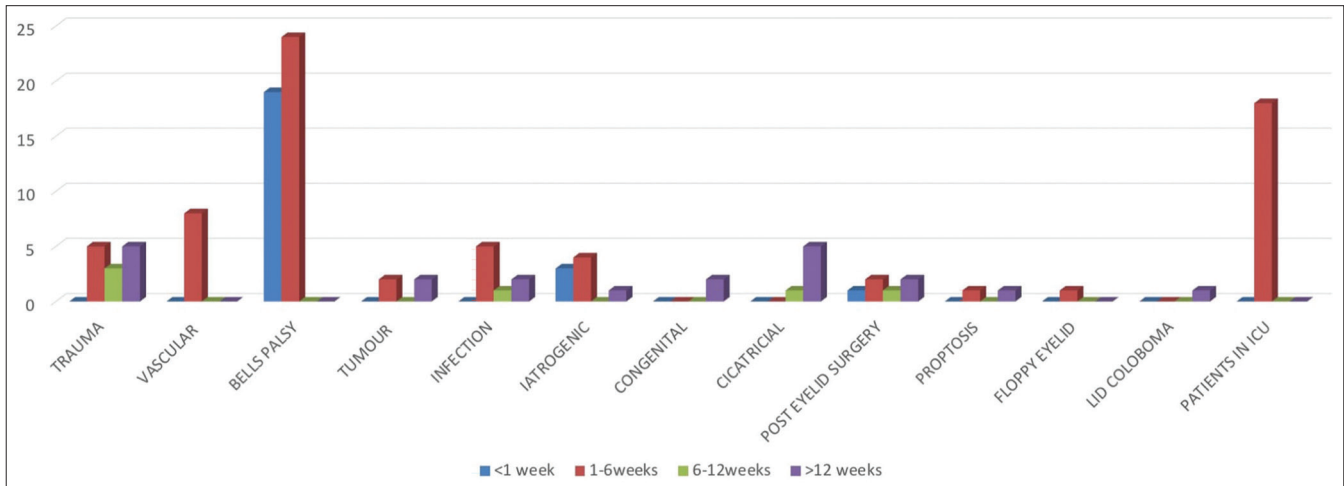


Figure 3: Analysis of duration of lagophthalmos with various etiologies

severity of the aberration varies with different etiological variants of lagophthalmos. Hence, this first of its kind study intended to frame an individualized, case-based approach by aiming to establish a correlation between etiology and management. Based on the above-mentioned data, the study demonstrated that the occurrence of lagophthalmos in a tertiary setup, multi-specialty hospital is highest in Bell's palsy (35.83%) followed by lagophthalmos in ICU patients (15%). It was also observed that both of these

conditions had less duration of the disease and respond better for conservative management with 95.4% recovery in Bell's palsy and 78% recovery in lagophthalmos present in ICU patients. Subsequently, higher occurrence was noted among traumatic FP (10.8%) which required a higher threshold for surgical intervention (100%). This was followed by infection of the ear and parotid-associated FP (7%), and iatrogenic FP (7%), both of which have median range of threshold for surgical management (40%–60%). The lower incident causes

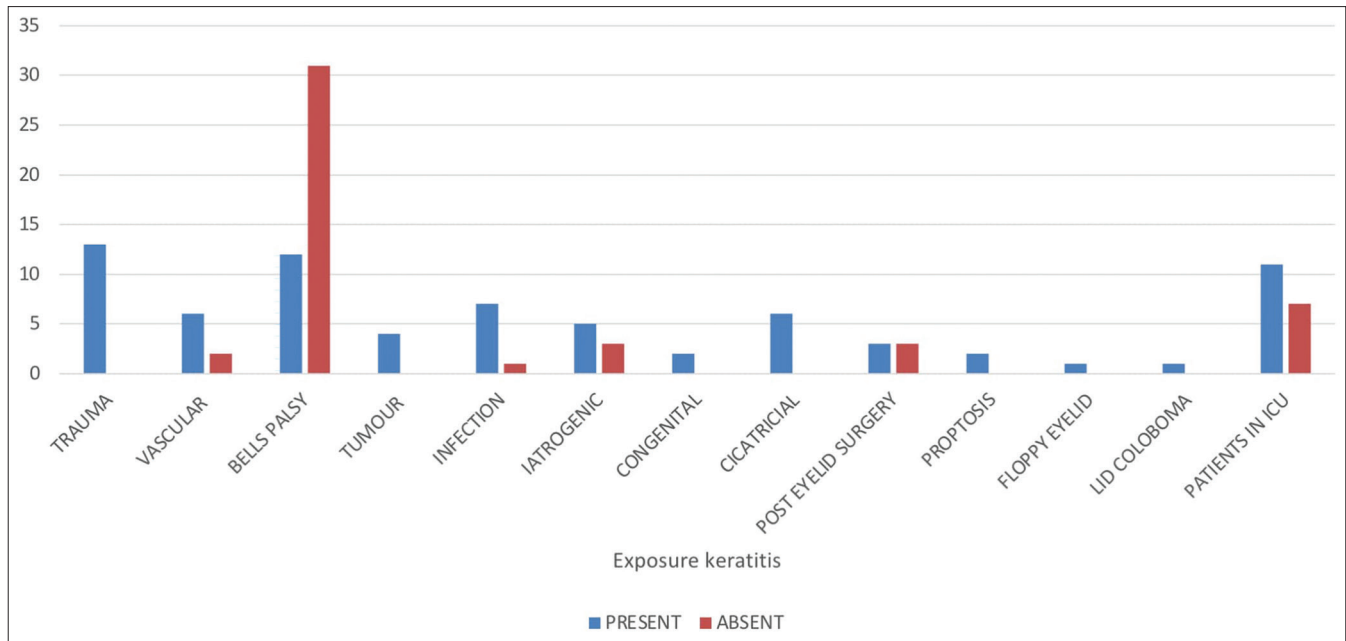


Figure 4: Analysis of exposure keratitis with etiology

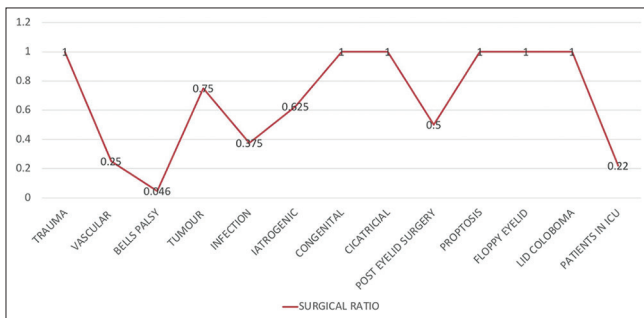


Figure 5: Analysis of surgical ratio with various etiologies

of the eyelid group, namely cicatricial lagophthalmos, floppy eyelid syndrome, lid coloboma and proptosis associated exposure keratitis, had a definitive need for surgical intervention (100%). The duration of lagophthalmos had a strong influence on the decision-making regarding the surgical intervention. As the duration of lagophthalmos crossed 1 week, the need for surgical management was higher and it was the highest as the disease existence crossed 6 weeks (Chi-squared significance: 8).

A retrospective study evaluated 96 consecutive individuals with FP who received ophthalmologic evaluation at a tertiary care center. The study measured multiple parameters like the time interval from the diagnosis of FP to commencement of ocular symptoms, to the initial ophthalmologic evaluation (IOE), and the severity of exposure keratopathy and eyelid malposition on IOE. The study discovered that the most common etiology of FP was subsequent to surgery, while Bell’s palsy (25%) came second. Punctate epithelial erosions (PEEs) were observed in 75 patients. The study concluded that exposure keratopathy was highly prevalent and stressed on the significance of ophthalmologic evaluation of FP patients.<sup>[15]</sup> In contrast, in the present study, Bell’s palsy was the major cause and 57.5% patients exhibited exposure keratitis.

Table 4: Depicting the etiology and the management method adopted

Paralytic Causes	Surgical Management	Conservative Management	Surgical Ratio
Trauma	13	0	1
Stroke	2	6	0.25
Bell’s palsy	2	41	0.046
Tumor	3	1	0.75
Infection	3	5	0.375
Iatrogenic	5	3	0.625
Congenital	2	0	1
Total	30	56	0.348

Eyelid Causes	Surgical Management	Conservative Management	Surgical Ratio
Cicatricial	6	0	1
Post eyelid surgery	3	3	0.5
Proptosis	2	0	1
Floppy eyelid	1	0	1
Lid coloboma	1	0	1
Patients in ICU	4	14	0.22
Total	17	17	0.5

Another retrospective descriptive study in 99 eyes of LMN facial palsy identified Bell’s palsy as the most common etiology (70.5%) and that it responded well to medical management if the duration was less than a week’s duration. Surgical management was employed as the duration crossed 6 months.<sup>[16]</sup> Similar to that, our study also identified that conservative management was sufficient in lagophthalmos of less than 1 week (Chi-squared significance: 18.6; *P* value <0.05). Temporary surgical management was needed in our patients for 6 weeks to 24 months. Permanent surgical procedures were performed for all cases beyond 24 months.

An observational, longitudinal study in Manchester Royal Infirmary examined the eyelid position, conjunctival edema, and keratopathy of 26 patients in the ICU. Seventy-five percent of patients under heavy sedation or muscle relaxants were found to have lagophthalmos and 42% some degree of keratopathy. The investigators also noted that punctate epithelial erosions in the inferior portion of the cornea progressed to macroepithelial abnormalities if not addressed. The study documented a direct relationship between ocular surface disease to the degree of lagophthalmos to the level of drowsiness or paralysis.<sup>[17]</sup> In our study, exposure keratitis increased with advancing age, and lagophthalmos in ICU patients was observed in 15% of cases, with most of them occurring in 1–6 weeks.

Nemet and Vinker, in a retrospective and population-based investigation, analyzed the electronic medical records of 4,463 patients diagnosed with Bell's palsy from 1 January 2003 to 31 December 2012. This study measured two main ophthalmic complications that resulted from Bell's palsy, lagophthalmos, and keratitis. The researchers found that the rate of post-Bell's palsy lagophthalmos was 3.45% and keratitis was 0.63% at 1–3 months, and both showed a tendency to develop in older patients. Similar age and duration relation were noted in the present study as well.<sup>[18]</sup>

## Conclusion

This study concludes that early intervention in the management of lagophthalmos could provide better results. Conservative management was sufficient in all cases when the duration was less than 1 week, exposure keratitis not involving the pupillary axis (EK < Grade II) and FP with good functional recovery (FP < Grade III). The predominant causes were Bell's palsy, lagophthalmos in ICU patients, and vascular causes of FP. Surgical management can be planned as temporary or permanent procedures based on the clinical profile of etiology causing lagophthalmos. Etiologies with prolonged duration of recovery like traumatic FP and cicatricial lagophthalmos could be planned for permanent surgical procedures at the early stages rather than awaiting improvement with conservative measures. Based on this study, treating a case of lagophthalmos based on the clinical profile of various etiology could provide a better outcome. A long-term comparative study will be able to further corroborate the findings of this study.

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## Conflicts of interest

There are no conflicts of interest.

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