Acta Scientiae Veterinariae, 2024. 52: 1950.

RESEARCH ARTICLE
Pub. 1950

ISSN 1679-9216

Management of Feline Corneal Sequestrum with Use of Third Eyelid Flap after Partial Keratectomy

Aynur Demír

ABSTRACT

***Background*:** Deep corneal sequestrum is a lesion that occurs in the middle layers of the cornea and typically leads to significant discomfort. This condition is a common and significant ophthalmologic issue in cats, which can significantly affect the cat's quality of life; if left untreated, it can lead to permanent vision loss. These findings underscore the importance of prompt and effective management strategies for deep corneal sequestrum in cats, with the third eyelid flap (TEF) application following partial keratectomy emerging as a potential treatment approach warranting further investigation. The study's objective was to evaluate the efficacy of the TEF application following partial keratectomy in managing deep corneal sequestrum in 50 cats (65 eyes) suffering from deep corneal sequestrum.

Materials, Methods & Results: Medical records, including the signalment, medical history, treatment procedures, and ocular status of 50 cats diagnosed with corneal sequestrum and treated with partial keratectomy followed by TEF, were retrospectively evaluated. The breed-wise distribution involved 26 Persians, 11 British Shorthairs, 6 Scottish Folds, 6 Domestic Shorthairs, and 1 Sphynx. Thirty-five cats were unilaterally, and 15 were bilaterally affected. The average age was 3.47 years (ranging between 5 months and 12 years). The average period for TEF application was 27.29 days (range =10-35 days), and the follow-up period varied from 2 to 50 months (Average = 14.1 months). The final follow-up revealed no change in 8 of 19 eyes regarding postoperative pale stromal pigment effusion, which disappeared in 9 and darkened in a 2 case. After complete resection in 3 eyes of 3 cases and incomplete resection in 2 eyes of 2 cases, recurrence rates were 6.52% and 10.52%, respectively, and corneal sequestrum was successfully treated with a 2nd surgical intervention in 3 eyes. 93.47% of patients (43 eyes) of 46 eyes whose feline corneal sequestrum (FCS) were totally removed by lamellar keratectomy were successfully treated with TEF.

***Discussion*:** In conclusion, 93.47% of patients (43 eyes) of 46 eyes whose feline corneal sequestrum (FCS) were totally removed by lamellar keratectomy were successfully treated with TEF. The results of this study demonstrate the effectiveness of TEF application in managing deep corneal sequestrum in cats. The high success rate and low recurrence rates support TEF as a reliable treatment option following partial keratectomy for deep corneal sequestrum cases. TEF was an effective treatment with highly satisfactory visual and cosmetic outcomes for deep and full-thickness feline corneal sequestrum. The TEF technique applied after partial keratectomy for the treatment of FCS can be considered an advantageous and practical method due to reasons such as providing rapid healing, being simpler, faster, and easier to apply compared to other aggressive interventional treatments, cost-effectiveness, not requiring specific tools and equipment or graft material, and showing no tissue rejection. However, careless application may pose certain risks; therefore, it is recommended under the guidance of a specialist. Similar to several other techniques, TEF application resulted in minimal corneal scarring along the visual axis. However, careless application may pose certain risks; therefore, it is recommended under the guidance of a specialist. Similarly, TEF application resulted in minimal corneal scarring along the visual axis, but recurrence may occur in some cases, necessitating a second surgical intervention. These findings provide significant contributions to clinical practice for the effective management of ophthalmic issues in cats.

Keywords: corneal sequestrum, feline, ophthalmology, partial keratectomy, third eyelid flap.

DOI: 10.22456/1679-9216.138776

Received: 18 January 2024 Accepted: 4 April 2024 Published: 27 April 2024

Department of Surgery, Faculty of Veterinary Medicine, Istanbul University-Cerrahpaşa, Istanbul, Turkey. CORRESPONDENCE: A. Demír [aynur.demir@iuc.edu.tr]. 34320 Avcılar, Istanbul, Turkey.

INTRODUCTION

Corneal sequestrum is a specific ocular disease observed in cats and is also known as corneal necrosis, corneal nigrum, necrotizing keratitis, and corneal mummification [12]. The most effective treatment for corneal sequestrum in cats is still controversial, but surgical intervention should generally be considered [17]. In the surgical treatment of corneal sequestrum in cats, lamellar keratectomy with or without secondary conjunctival pedicle graft is used as an option. This graft can reduce recurrence after keratectomy and provide tectonic support in case of deep keratectomy [11,18]. In the surgical treatment of corneal sequestrum in cats, lamellar keratectomy is performed alone or as an option using techniques such as secondary conjunctival and corneoconjunctival flaps, amniotic membrane, porcine small intestine submucosal transplants, and lamellar/penetrating keratoplasty [11,18].

TEF was applied to treat various corneal diseases, such as simple corneal ulcers, spontaneous chronic corneal epithelial defects, superficial corneal necrosis, and feline acute bullous keratopathy, and for the postoperative protection of corneal and conjunctival grafts after the removal of corneal foreign bodies [13]. Despite the technique's recognized success in superficial lesions, no comprehensive studies are yet to be available investigating its efficacy in treating deep corneal sequestrum in cat populations. The aim of this study is to evaluate the overall outcome of corneal surgery performed with the use of TEF after partial lamellar keratectomy of deep corneal sequestrum.

MATERIALS AND METHODS

Animals

Fifty cats diagnosed with deep corneal sequestrum (65 eyes) underwent TEF following partial lamellar keratectomy. The data collected for each patient comprised information, including breed, age, gender, affected eye, results of the ophthalmological exam, etiology, treatment, follow-up period, and findings (Table 1).

Anesthesia and analgesia

Ceftriaxone sodium[1] [Novosef®- 30 mg/kg IV, SID] and meloxicam[2] [Melox®- 0.2 mg/kg, SC, SID] were administered 15 min before the surgery. Anesthesia was induced by propofol[3] [Propofol-PF® - 6 mg/kg, IV] after the premedication by xylazine HCl[4] [Basilazin®- 1 mg/kg, IV]. Then, all patients were intubated by a endotracheal tube, and anesthesia was maintained by isoflurane[5] [Isoflurane®- 2%, inhalant route] in 100% oxygen.

Surgical procedure

The necrotizing tissue was excised by lamellar keratectomy with a 3.2 mm-angled crescent scalpel. Utmost care was taken to entirely remove the brownish-pigmented tissues in all stromal layers, allowing the transparent cornea's revealing. However, in the cases where the lesion progressed to the deepest corneal layer, incomplete excision was performed on the undermost layer to avoid corneal perforation (Figures 1 and 2).

Then, the TEF was placed by a slightly modified version, due to individual variations, of the relatively simple technique previously proposed by Hartley & Hendrix [6] to promote and accelerate the healing process of the ulcer. The flap was attached by mattress suturing (1-2 stitches) using a 3/0 or 2/0 polyglactin 910 suture material[6] (PGLA (Polyglyglactin 910®), and no stent was applied (Figure 3).

Postoperative treatment

Postoperatively, 2 drops of a combination of 0.3% ofloxacin[7] [Exocin®, QUID] + sodium hyaluronate[8] [Dryex®, QUID] + dexpanthenol[9] [Recuge®, QUID] were applied to the eye 4 times a day during the 1st 2 weeks and 3 times a day during the following 2 weeks. The flap was removed in the 3-4th postoperative weeks, and after the procedure, every patient underwent a complete ophthalmological examination. Once the corneal epithelization has been completed, moxifloxacin-dexamethasone phosphate[8] (Moxidexa®, QUID) + sodium hyaluronate[8] [Dryex®, QUID] + dexpanthenol[9] [Recugel®, QUID] combination was administered per day to alleviate corneal vascularization and scarring. The recurrence was defined as the patient's ongoing complaints and the necessity for repeating the surgical procedure, as was previously indicated by Featherstone *et al*. [4]. The vision was assessed by the presence of menace response, and corneal opacity due to scarring was subjectively evaluated on a 4-scale grading system as follows: clear (grade 0), mild opacity (grade 1), moderately dense opacity (grade 2), and dense opacity (grade 3).

Table 1. Signalment, surgical details, and outcomes in 50 cats (65 eyes) with feline corneal sequestrum treated with third eyelid flap (TEF).

Case No	Breed	Age	Sex	Eye	Etiology	Localisation	CDA	CPR		NMF duration		EHT	Outcome/ Opacity	Follow-up time (months)
								R	L	R	L			
1	P	6	M	L	Un	Pa	DST		-	-	26 days	26 days	0	10
2	P	2	M	B	E	Pa	DST	-	-	1 mth	1 mth	1 mth	0	16
3	BS	2.5	M	B	IU	Pa	DST	-	-	1 mth	1 mth	1 mth	0	19
4	SF	9 mth	M	L	E	Pa	DST		-	-	5 weeks	5 weeks	0	26
5	SF	1.5	M	R	Un	C	DST	-		1 mth	-	1 mth	0	8
6	DS	2	F	R	S	C	DST	-		2 weeks	-	6 weeks	Recurred	7
7	DS	2.5	F	B	S	C	DST	-	-	3 weeks	3 weeks	3 weeks	2	13
8	P	3	F	B	E	Pa	FT	FP	FP	1 mth	1 mth	1 mth	FP	42
9	BS	2	F	R	E	C	DST	-		1 mth	-	1 mth	0	13
10	DS	2	M	B	E	Not D	DST	-	-	1 mth	1 mth	1 mth	0	28
11	BS	1	F	L	Un	Pa	DST		FP	-	1 mth	1 mth	FPS+Recurred	9
12	P	8	F	R	Un	C	DST	-		20 days	-	35 days	2	6
13	BS	15 mth	M	B	E	Not D	DST	-	-	3 weeks	3 weeks	1 mth	R:1 L:0	6
14	P	2.5	M	B	IU	C	DST	-	-	1 mth	1 mth	1 mth	R:1 L:0	7
15	P	10 mth	F	L	Un	C	DST		-	-	10 days	23 days	Recurred	7
16	BS	11 mth	M	B	IU	Not D	DST	-	-	1 mth	1 mth	1 mth	0	9
17	DS	2	M	L	E	C	DST		-	-	1 mth	1 mth	1	8
18	BS	4	M	B	E	Pa	DST	-	-	1 mth	1mth	1 mth	1	14
19	P	10	M	L	IU	C	DST		-	-	1 mth	1 mth	1	7
20	SF	2	M	R	E	Pa	FH	FP		1 mth	-	1 mth	FP	10
21	BS	3.5	F	B	E	Pa	DST	-	-	25 days	25 days	28 days	0	5
22	DS	4	M	R	IU	C	DST	-		12 days	-	5 weeks	2	6
23	P	12	M	L	IU	C	DST		-	-	1 mth	1 mth	0	13
24	SF	3	M	R	IU	C	DST	FP		1 mth	-	1 mth	FPS	38
25	P	3	M	R	IU	C	DST	FP		24 days	-	27 days	FPS	3
26	P	5	F	R	Un	Pa	DST	FP		1 mth	-	1 mth	FP	7
27	P	3	F	B	Un	C	R:DST L:FT	-	FP	2 weeks	1 mth	5 weeks	R:0 L:FPS	R:12 L:10
28	P	4	F	L	Un	Pa	DST		-	-	1 mth	1 mth	2	10
29	P	6	M	L	E	Pa	FT		FP	-	25 days	1 mth	FPI	4
30	BS	9 mth	F	L	E	Not D	DST		-	-	1 mth	1 mth	0	7
31	P	5	F	B	Un	Pa	DST	-	-	1 mth	1 mth	1 mth	R:Recurred L:0	R:2 L:24
32	P	2	M	L	Un	C	FT		FP	-	1 mth	1 mth	FP	12
33	P	3	M	R	Un	C	FT	FP		1 mth	-	1 mth	Recurred	5
34	P	3	M	R	Un	Pa	DST			3 weeks	-	1mth	1	28
35	P	8	M	L	E	C	DST		FP	-	1 mth	35 days	FPS	4
36	P	3	M	B	Un	C	R: FT L:DST	FP	-	2 weeks	2 weeks	R:7 weeks L:4 weeks	R:FPS L:2	R:14 L:2
37	P	3	M	B	E	C	DST	FP	FP	1 mth	1 mth	1 mth	FPS	37
38	P	7	F	R	Un	C	DST	-		5 weeks	-	5 weeks	3	50
39	SF	1	M	R	E	Pa	DST	-		1 mth		1 mth	1	5
40	P	6	F	B	Un	C	DST	-	-	1 mth	1 mth	1 mth	2	12
41	P	4	M	R	Un	C	DST	-		1 mth	-	1 mth	1	21
42	BS	1.5	M	R	E	Pa	FT	FP		1 mth	-	1 mth	FP	9
43	SF	5 mth	M	R	E	Pa	DST	-		1 mth	-	1 mth	1	14
44	P	3	F	R	Un	C	FT	FP		1 mth	-	1 mth	FP	10
45	Sphinx	5 mth	M	L	S	C	DST		-	-	1 mth	1 mth	1	2
46	DS	5	F	L	Un	Pa	DST		-	-	1 mth	1 mth	0	8
47	P	6	M	L	Un	Pa	FT		FP	-	1 mth	1 mth	FP	11
48	BS	9	F	L	Un	Pa	DST		-	-	1 mth	1mth	0	25
49	P	13 mth	F	L	E	Pa	FT		FP	-	1 mth	5 weeks	FPS	11
50	BS	1.5	M	R	E	C	DST	-		-	1 mth	1 mth	1	36

P: Perisan; BS: British Shorthair; SF: Scottish Fold; DS: Domestic Shorthair; M: Male; F: female; Un: Unknown; E: Entropion; IU: Indolent Ulcer; S: Symblapheron; Pa: Paracentral; C: Central; Not D: Not described; EHT: Epitelial healing time; CDA: Corneal depth affected; CPR: Corneal pigment residue; FT: Full thickness; DST: Deep stroma; FPS: Faint pigment slougged; FP: Faint pigment; FPI: Faint pigment ıncreased.

Figure 1. *Case 19*. A- Photographic images of the eye of a 10-year-old male Persian cat with corneal sequestrum. B- Being submitted to lamellar keratectomy. C- The mummified corneal tissue excised. D- Correction of entropion accompanying corneal sequestrum with the modified Hotz-Celsus method. E- Upon removal of the 3rd eyelid membrane. F- After 2 months of the surgery. Good Clinical outcome with transparent cornea.

Figure 2. *Case 14*. Surgical procedure for corneal sequestrum in both eyes of a 2.5-year-old Persian cat. A- Performing parsial keratectomy with the corneal knife. B- Complete sequestrum excision with lamellar keratectomy and the removal of excess eyelid skin using the Holtz-Celcus method. C- Closure of the surgical wound with 3-0 simple interrupted non-absorbable sutures. D- Placement on both eyes with a 3rd eyelid flap (TEF) covering the cornea. E & F- The immediate appearance of the right and left cornea after the opening of the TEF. G- Six months after TEF. Good corneal clarity.

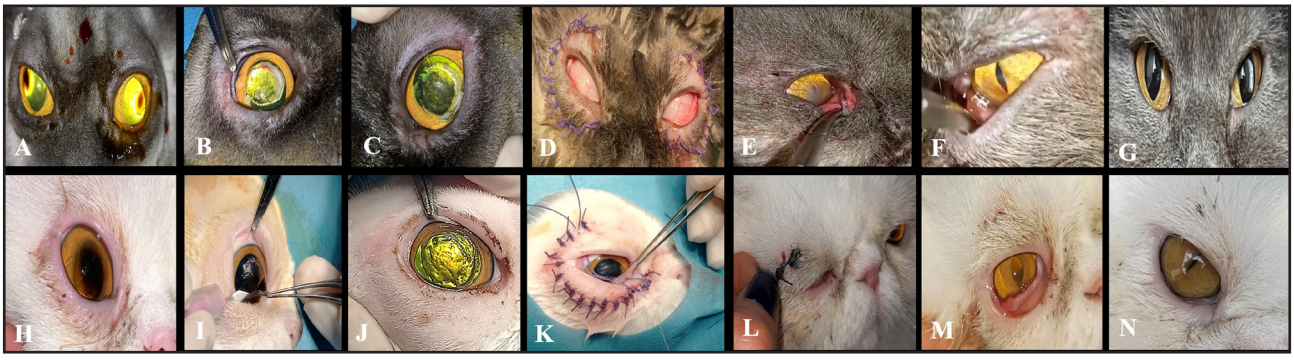

Figure 3. *Cases 21 and 33*. Photographs showing the clinical development of 2 cats with varying degrees of corneal sequestrum treated with keratectomy and TEF. A-G- Bilateral eyes of a 3.5-year-old female Persian cat. A- At presentation. B & C- After keratectomy. D- Placement of TEF. E & F- Immediately after removal of the TEF sutures. G- After 6 months of the surgery. H & N- Right eye of a 3-year-old male castrated Persian cat. H- At presentation. I- Performing a keratectomy during surgery. J- After keratectomy. K- Placing a TEF over keratectomy. L- On days 30 of surgical therapy, wound due to sutures in 2 areas on the upper eyelid. M- Immediately after TEF sutures are removed. N- After 3 months of the surgery.

RESULTS

Study population

Sixty-five eyes of 50 cats with FCS were included in the study. The results are listed in Table 1. The cat population comprises 5 breeds, predominantly brachycephalic, with Persian and British Shorthair being the most prevalent. The average age at referral is 3.4 years. Affection was observed in the left eye in 26.15% and in the right eye in 27.69% of cases. Bilateral involvement was found in 15 patients. The majority of corneal sequestra were centrally (47.69%) or paracentrally (41.53%) located.

Clinical outcomes

No stenting was performed, and no complications were recorded during the procedure. The pressure necrosis due to flap stitches noted on follow-ups entirely healed within 4-5 days after the flap's removal. The temporary protrusion, cartilage eversion of the 3rd eyelid and conjunctival hyperemia that developed after the flap's removal recovered within 5-7 days (Figure 4).

Postoperative evaluation, follow-ups, and epithelial healing period

The TEF remained in place for an average of 27.29 days (range = 10-35 days). No complications, such as corneal perforation, were noted when the flap was in place, regardless of the depth of the corneal ulcer formed by keratectomy. The TEF was (range =10-24 days) removed prematurely due to self-harm in 9 eyes of 8 cats. In these cases, the wound was left open, and topical medication was sustained until the epithelization was achieved (range =2 days to 5 weeks). The TEF was removed after 1 month in 46 eyes of 36 cases. Corneal epithelization was achieved in all cases (46 eyes out of 33 cases), except for 3 eyes out of 3 cases, in which the medical therapy was continued for a further week. The TEF was removed after 5 weeks in 2 eyes of 2 cases, and excessive granulation tissue was noted in the wound area of both cases (Figure 5). The adhesions between the 3rd eyelid and conjunctiva were easily removed by traction under local anesthesia during the opening of the TEF (Figure 6). Recovery was determined by vision recovery and the presence of satisfactory corneal transparency. The vision was restored in all eyes 1.5-2 months after surgery (Figure 7).

Figure 4. *Case 15*. A- Clinical aspect at initial examination: central area of necrosis, surrounded by edema and peripheral vascularization. B- Deep keratectomy to ensure complete removal of the sequestra. C- Placement of a lateral TEF that closes the left cornea using a horizontal suture pattern with 3-0 absorbable sutures. D- After 35 days of the 2nd keratectomy and TEF. Adhesion of the bulbar surface of the 3rd eyelid membrane from 1 point to the conjunctiva of the upper eyelid & E- Fracture of the free edge of the cartilage of the 3rd eyelid. F- After 50 days of the surgery. Transparent cornea with pale light pigment.

Figure 5. *Case 22*. A- A fairly large corneal sequestrum affecting almost the entire cornea of the right eye in a 4-year-old male Domestic shorthair cat. B- After 12 days of the surgery, the loosening of the TEF suture due to self-inflicted trauma, resulting in intense vascularization and granulation tissue on the cornea due to suture-related irritation. C- After 20 days of the surgery, the appearance of the cornea and granulation tissue. D- After 30 days, resolution of granulation tissue. E- After 42 days , moderate fibrosis and regressing vessels can be seen. F- After 75 days of complete remission, transparent cornea.

Figure 6. *Case 25.* A - Initial examination: 2/3 deep corneal sequestrum, with vascularization. B- After 24 days of the keratectomy and TEF. Thin adhesion of the 3rd eyelid conjunctiva from 1 point to the upper eyelid conjunctiva. C- Clinical aspect immediately after removal of the TEF sutures (24th days), good clinical outcome and cornea healed with thin corneal opacity. D- Recheck after 2 months. Complete remission, transparent cornea.

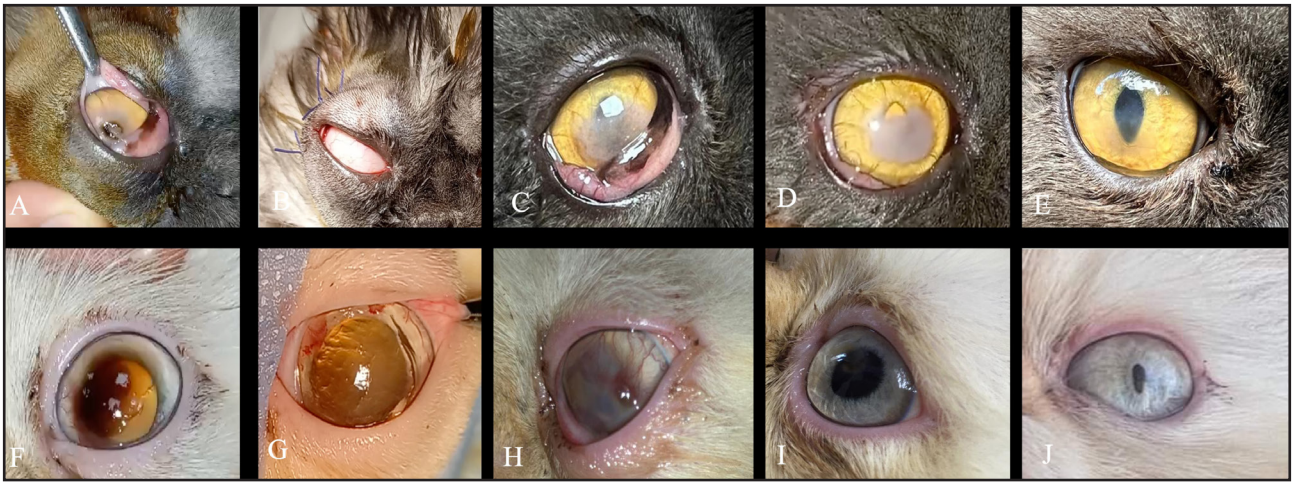

Figure 7. *Cases 12 and 32*. Photographs showing the clinical progression of 2 cats with corneal sequestrum treated with partial keratectomy followed by TEF. A-E- Right eye of a 8-year-old female Persian cat. A- At presentation. B- During operation. C- On days 50 and 62 (D) of medical therapy. E- After 6 months of the surgery. F & J- Left eye of a 2-year-old male castrated Persian cat. F- At presentation. G- After removal of necrotic tissue by lamellar keratectomy. H- Immediately after removal of the TEF sutures. I- On days 44 of medical therapy. J- After 14 months of the surgery.

Figure 8. *Cases 1, 5 and 29*. Photographs of 3 felines eyes with corneal sequestrum: A,B, C,D,E & F) at presentation (A,C,E), and 6 months after TEF (B,D,F).

Complications

A minor complication, such as pale pigmentation, had appearance after surgery in 19 eyes of 17 cases. Even though this pigmentation was noted to have slougged in 9 eyes of 8 cases in the final follow-up, it was noted to have sustained in 8 eyes of 7 cases and even darkened in 2 eyes of 2 cases.

Major complications, such as recurrence, were monitored in 5 eyes of 5 cases. Three of these cases were those with the TEF's premature removal due to self-harm, in which the cornea was left open to heal with adjuvant topical medication. The recurrence was noted in the border of the keratectomy zone in 3 cats (Cases n. 6,31,33) after 2 months, within the keratectomy zone, and in 2 separate areas ventrally in 1 cat (Case n. 15) after 3 months, and in a distanced location in another case (Case n. 15) after 3 months due to trauma which is non-associated with the surgery.

Widespread dark-colored pigmentation and marked ocular complaints were noted in cases 15, 31 and 33, where lamellar keratectomy was repeated, and a successful outcome was achieved after 1 month-long TEF application. The corneal sequestrum that recurred in the other 2 patients was managed by topical medication until the pigmentation faded and was stabilized, ceasing the patients' clinical complaints.

The overall evaluation revealed normal visual capacity and menace response in 65 eyes of 50 cases treated with partial keratectomy followed by the TEF application (Figure 8).

DISCUSSION

Few studies investigated its use in treating semi-deep and deep corneal sequestrum after lamellar keratectomy, and this retrospective study focused on its efficacy and outcomes in managing deep FCS. To our knowledge, this is the 1st comprehensive study documenting the TEF application in superficial and deep corneal sequestrum in cats, and it exerted favorable long-term results with only a 6.52% recurrence rate in the patients in which a total excision was performed.

There are many different methods used in the surgical treatment of corneal necrosis. Among these, conjunctival flap is a commonly used method in the surgical treatment of corneal necrosis. This flap is a technique that carries no risk of tissue rejection, is easy to apply, fills corneal defects, and accelerates healing, but complications such as permanent corneal fibrosis and varying degrees of visual impairment may arise over time as leukoma decreases [2,3,9]. Pena *et al*. [15] emphasize the potential of partial or full-thickness corneal transplants for treating deep corneal sequestrum post-keratectomy, despite limitations such as high risk of graft rejection and inadequate donors, with consideration of the reduced scarring in the central cornea but constraints related to healthy corneal injury in extensive lesions [7,9,10]. Third eyelid flap which includes superficial to medium 2/3 keratectomy followed by temporary transposition of the healthy 3rd eyelid to the keratectomy site, is a very successful treatment option for middle stromal ulcers. Despite the TEF's potential disadvantages in terms of providing permanent or combined tectonic support to the cornea, stimulation of vascularization or ingrowth of fibrovascular tissue, the wound zone's monitoring, the whole dispersion of the topical drugs into the defective area, removal of the inflammatory exudate accumulating adjacent to the lesion away from the corneal surface, unlike the other techniques [13], it generates efficient results in managing sequestrum, readily enabling the patient's comfort and a rapid course of healing, and reducing the potential risk of recurrence [16]. The TEF technique is effective particularly in protecting the cornea in ocular conditions, such as exophthalmos and tear film insufficiency, which expose the axial cornea to potential external trauma, alleviating pain [16]. In this study, the therapeutic approach involving the TEF application after keratectomy yielded favorable outcomes in the study population, including the cases of full-thickness corneal defects, and epithelization was achieved within 3-5 weeks.

Several veterinary ophthalmologists recommended using TEF after simple lamellar keratectomy [14]. Conflicting with the literature, no recurrence was monitored during 1-6 year-long follow-ups in a study where 15 eyes of 14 cases with corneal sequestrum of varying stromal depth were treated with the TEF application following keratectomy [16]. The documented recurrence rates vary due to the difference in the definition of recurrence [5]. Recurrence of corneal sequestration is defined as any postoperative corneal discoloration in one study [18] , while in another study, it is defined as the necessity of a 2nd surgical intervention [4]. The recurrence rate was reported as 17% in grafted eyes and 25% in non-grafted eyes [4]. In our study, according to the defined recurrence criteria [4], recurrence occurred in 5 out of 65 eyes, and patients experienced serious complaints during follow-ups lasting 2 months to 4 years due to the progression of faint pigment. Recurrence was noted in the cases with the flap's premature removal due to self-harm and whose subsequent treatments involved only medical therapy. Nevertheless, the low incidence of recurrence restricts evaluation of potential risk factors.

Postoperative corneal opacity vastly varies depending on the technique applied. While the conjunctival graft can create significant opacity; corneoconjunctival transposition, which restores corneal transparency, can simultaneously produce mild or moderate opacity in the healthy peripheral cornea [1,9]. Compared with the other techniques, the TEF procedure generates less central or axial corneal scarring, offering a more transparent cornea. Since most sequestration develops at the central cornea, a proce-

dure like the third eyelid flapping, allowing a healing process with more transparency on the corneal tissue over the pupil, reinforces vision. However, it was previously reported to be contraindicated in deep ulcers involving more than 3/4th of the corneal thickness since the flap's primary task is to protect and support the eye globe [8]. In contrast to the documented data, this study demonstrated the TEF's efficiency in the majority (43 eyes out of 33 cases) of more profound defects with favorable cosmetic results. Therefore, it might be an alternative to the other techniques regarding its success in recovering corneal transparency.

CONCLUSION

In conclusion, TEF technique following partial lamellar keratectomy in the surgical management of FCS offers several advantages, including rapid healing, more practicableness and feasibility compared to the invasive surgical interventions, cost efficiency, no necessity for specific tools, equipment, and grafts, and no tissue rejection. Like several other techniques, the TEF application generated minimal corneal scarring in the visual axis. The cosmetic outcome was satisfactory in 93.47% of eyes in totally excised cases in which the patient could be monitored by follow-ups. In conclusion, this technique offered favorable cosmetic results with low recurrence, enabling a clear visual axis in FCS. The respectively low recurrence rate hampered the evaluation of risk factors associated with recurrence.

MANUFACTURERS

[1]Sanofi İlaç Sanayi ve Ticaret A.Ş. Kırklareli, Turkey.

[2]Idol Dolum Sanayi ve Ticaret A.Ş. Istanbul, Turkey.

[3]Polifarma İlaç San.ve Tic. A.Ş. Tekirdağ, Turkey.

[4]Bavet İlaç San. ve Tic. A.Ş. Istanbul, Turkey.

[5]Piramal Critical Care, Inc. Bethlehem, PA, USA.

[6]Prima Medikal Gereçler İnşaat San.ve Tic. A.Ş. Istanbul, Turkey.

[7]AbbVie Tıbbi İlaçlar San. ve Tic. Ltd. Şti.Istanbul, Turkey.

[8]Abdi İbrahim İlaç San. ve Tic. A.Ş. Istanbul, Turkey.

[9]Bausch + Lomb Sağlık ve Optik Ürünleri Tic. A.Ş. Istanbul, Turkey.

***Acknowledgements*.** We would like to acknowledge that this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. The author thanks their colleagues at Istanbul University-Cerrahpaşa Veterinary Hospital for their support of this study and Nihan DİKBAŞ for her contribution to the material preparation.

***Ethical approval*.** This study was approved by the Ethics Committee of Animal Experiments of the Istanbul University-Cerrahpaşa (2022/55), and written consent was provided by the owners.

***Declaration of interest*.** The author declares no conflicts of interest, and is solely responsible for the content and writing of the paper.

REFERENCES

1 **Andrew S.E., Tou S. & Brooks D.E. 2001.** Corneoconjunctival transposition for the treatment of feline corneal sequestra: a retrospective study of 17 cases (1990-1998). *Veterinary Ophthalmology*. 4(2): 107-111. DOI:10.1046/j.1463-5224.2001.00181.x.

2 **Barachetti L., Giudice C. & Mortellaro C.M. 2010.** Amniotic membrane transplantation for the treatment of feline corneal sequestrum: pilot study. *Veterinary Ophthalmology*. 13(5): 326-330. DOI:10.1111/j.1463-5224.2010.00821.x.

3 **Ergin İ., Şenel O.O. & Koç B. 2016.** Kedi kornea nekrozlarının konjunktival flep ile sağaltımı. *Veteriner Hekimler Derneği* Dergisi. 87(1): 44-54.

4 **Featherstone H.J., Franklin V.J. & Sansom J. 2004.** Feline corneal sequestrum: laboratory analysis of ocular samples from 12 cats. Veterinary Ophthalmology. 7(4): 229-238. DOI:10.1111/j.1463-5224.2004.04029.x.

5 **Gómez A.P., Mazzucchelli S., Smith K. & Lacerda R.P.D. 2023.** Long-term treatment outcomes and risk factors for recurrence in feline corneal sequestrum: 72 cases (2009-2017). *Veterinary Record*. 193(3): e2783. DOI:10.1002/vetr.2783.

6 **Hartley C. & Hendrix D.V.H. 2021.** Diseases and surgery of the canine conjunctiva and nictitating membrane. In: Ben-Shomo G., Gilger B.C., Hendrix D.V.H., Kern T.J., Plummer C.E. & Gelatt K.N. (Eds). *Veterinary Ophthalmology*. 6th edn. Hoboken: John Wiley & Sons, pp.1045-1081.

7 **Laguna F., Leiva M., Costa D., Lacerda R. & Pena Gimenez T. 2015.** Corneal grafting for the treatment of feline corneal sequestrum: a retrospective study of 18 eyes (13 cats). *Veterinary Ophthalmology*. 18(4): 291-296. DOI:10.1111/vop.12228.

8 **Mcmullen R.J. & Passler T. 2021.** Diseases of the eye. In: Pugh D.G., Baird A.N., Edmondson M. & Passler T. (Eds). *Sheep, Goat, and Cervid Medicine*. 3rd edn. St Louis: Elsevier, pp.349-384. DOI:10.1016/b978-0-323-62463-3.00023-2.

9 **Mezzadri V., Crotti A., Nardi S. & Barsotti G. 2021.** Surgical treatment of canine and feline descemetoceles, deep and perforated corneal ulcers with autologous buccal mucous membrane grafts. *Veterinary Ophthalmology*. 24(6): 599-609. DOI:10.1111/vop.12907.

10 **Michel J., Vigan M. & Douet J.Y. 2021.** Autologous lamellar keratoplasty for the treatment of feline corneal sequestrum: A retrospective study of 35 eyes (2012-2020). *Veterinary Ophthalmology*. 24(5): 491-502. DOI:10.1111/vop.12930.

11 **Multari D., Perazzi A., Contiero B., Carobbi B., Bertoldi M. & Iacopetti I. 2021.** Corneal sequestra in cats: 175 eyes from 172 cases (2000-2016). *Journal of Small Animal Practice*. 62(2): 462-467. DOI: 10.1111/jsap.13303.

12 **Oriá A.P., Soares A.M.B., Laus J.L. & Dórea Neto F.D.A. 2001.** Feline corneal sequestration. *Ciência Rural*. 31(3): 553-556. DOI:10.1590/S0103-84782001000300032.

13 **Pederson S.L., Pizzirani S., Andrew S.E., Pate D.O., Stine J.M. & Michau T.M. 2016.** Use of a nictitating membrane flap for treatment of feline acute corneal hydrops-21 eyes. *Veterinary Ophthalmology*. 19(1): 61-68. DOI:10.1111/vop.12353.

14 **Peiffer R.L. & Gelatt K.N. 1976.** Superficial keratectomy for the treatment of chronic ulcerative keratitis and sequestrum in the domestic cat. *Feline Practice*. 6(2): 37-40.

15 **Peña Gimenez M.T.P. & Farina I.M. 1988.** Lamellar keratoplasty for the treatment of feline corneal sequestrum. *Veterinary Ophthalmology*. 1(2-3): 163-166. DOI:10.1046/j.1463-5224.1998.00031.x.

16 **Ragozzino M., Lamagna B., Guardascione A., Pasolini M.P., Auletta L. & Lamagna F. 2012.** Surgical treatment of feline corneal sequestration using focal keratectomy and third eyelid flap: a retrospective study and literature review. *Veterinaria* (*Cremona*). 26(1): 19-30.

17 **Sandmeyer L.S., Grahn B.H. & Breaux C.B. 2006.** Diagnostic ophthalmology. *The Canadian Veterinary Journal*. 47(1): 1131-1133.

18 **Yang V.Y., Labelle A.L. & Breaux C.B. 2019.** A bidirectional corneoconjunctival transposition for the treatment of feline corneal sequestrum. *Veterinary Ophthalmology*. 22(2): 192-195. DOI:10.1111/vop.12586.