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Research Article

Surgical Treatment of Non-Traumatic Corneal Perforations

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Summary

Introduction: The treatment of non-traumatic perforations of the cornea is a real challenge for the choice of surgical technique as well as for management of the causal pathology. The aim of our study is to determine the anatomical and functional results of the management of non-traumatic perforation of the cornea in the absence of ready access to a corneal graft.

Materials and methods: This is a retrospective, non-comparative mono centric study of23 consecutive cases diagnosed and treated between January 2011 and January 2013. We included 23 eyes with non-traumatic corneal perforation. Various surgical techniques were used depending on the size and location of the corneal perforation.

Results: The predominant etiology of the corneal perforations in our series was corneal abscess, found in 30.4% of cases (7 eyes). A conjunctival flap was performed in 43.5% of cases (10eyes) followed by tarsorrhaphy in 21.7% of cases (5 eyes), auto logo us corneal patch in 17.4% of cases (4 eyes), amniotic membrane in 13% of cases (3 eyes) and finally cyanoacrylate glue in one case. Mean follow-up was 12.4 ± 2.1 months. Anatomical closure of the corneal perforation was achieved in 91.3% of cases (21 eyes), while the final visual acuity was not improved due to secondary opacities.

Discussion: The choice of surgical technique depends on the size of the corneal perforation, its location, its etiology and the resources available for emergencies. When amniotic membrane and corneal donor tissue are unavailable, conjunctival flap is an easy and effective technique, which is a good alternative to close corneal perforations less than 3 mm. It improves ocular surface quality and prepares the eye for later penetrating keratoplasty.

Conclusion: Conjunctival flap is a good technique that is still relevant today, especially in the absence of corneal donor tissue or amniotic membrane. The anatomical success rate is very sat is factory, but sometimes several interventions are needed to improve the visual prognosis.

Keywords: *Corneal perforation; Non-traumatic; Corneal abscess; Conjunctival flap; Autologous corneal patch*

Introduction

Corneal perforations are an important cause of ocular morbidity and blindness [1,2]. They represent the last step of evolution of the infectious process and immune disorders [3]. They require surgical treatment in emergency in the order to restore the sealing of eyeball and prevent end ophthalmitis. Several surgical techniques may be used. Some are temporary; others are permanent as penetrating keratoplasty [4]. The choice of the appropriate technique is guided by the size, the seat, the etiology of the perforation and the means available

at emergencies. The objectives of this study are to report and describe easeries of cases of non-traumatic corneal perforations, to define the causes and the treatment modalities in a center where emergency access to amniotic membrane transplantation and corneal grafts is limited. Finally, we report the anatomical and functional results of interventions carried out.

Patients and methods

We conducted a non-comparative retrospective study of a series of 23 consecutive cases treated in our department between January 2011 and January 2013. All patients signed a written consent before starting treatment in accordance with the Declaration of Helsinki. The study was approved by the institutional review board of the faculty of medicine and pharmacy of Casablanca (Morocco). We included only non-traumatic corneal perforations. A total of 23 eyes (23 patients, 13 men and 10 women) were collected in this study. The average age was 56.2 years, ranging between 17 years old and 75 years old. For each patient we identified the age, sex, pre-operative visual acuity, characteristics of the perforation, its etiology, the surgical technique used as well as anatomical and functional outcome. The mean follow-up was 12.4 ± 2.1 months. For the measurement of visual acuitya Snellen chart was used. Regarding the visual acuity less than 1/20 (0.05), a decimal equivalence scale was used. Negative LP = 0, positive LP = 0.0001, HM = 0.001, CF at 30 cm = 0.01 and CF at 1 m = 0.02. The size of the perforation was measured by the millimeter ruler of the slit lamp. Concerning localization of the perforation, corneal surface has been divided into four zones: a central zone of 4 mm, a par central area between 4 and 7 mm, a peripheral area between 7 and 11 mm and alimbal area. All our patients were operated urgently to close the corneal perforation. Then, symptomatic treatment (antalgic, artificial tears) and etiological treatment (antibiotic, antiviral, corticosteroids and non steroidal anti-inflammatory drugs) was adapted for each patient. The etiological diagnosis was made in collaboration with the department of internal medicine, the microbiology parasitology and mycology department. Surgical techniques used in emergency are: partial conjunctival flap, total tarsorrhaphy, tectonic lamellar graft using auto logo us corneal patch, the amniotic membrane and the cyanoacrylate glue.

The partial conjunctival flap requires careful dissection of the conjunctiva from the limbus. The Tenon's capsule is respected to the maximum. The conjunctiva is released to be able to slide on the corneal perforation without tension. Then it's sutured to the cornea and the sclera by separated monofilament 10/0 sutures (Figure 1 and 2). For corneal patch, the removal of the autologous lamellar graft is performed at a safe area of peripheral cornea of the same eye, using a crescent knife. Its dimensions must be equivalent to the perforation. Sutures are made by 10/0 monofilament (Figure 3). The cyanoacrylate glue was used in central perforations of a diameter less than 1 mm. we deposita drop of glue using a 27 G cannula on the perforation before placing a therapeutic lens. An air bubble is used to form the anterior chamber (Figure 4).

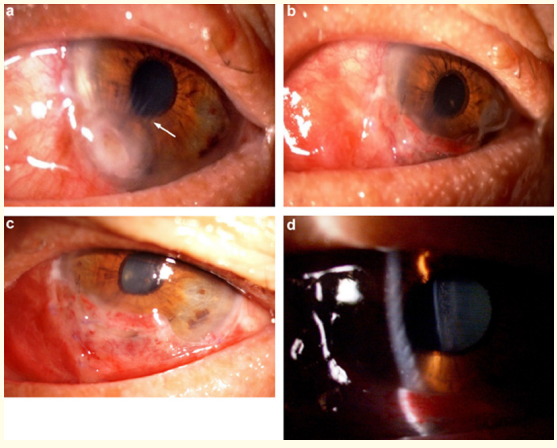

Figure 1: *Conjunctival flap. Patient with rheumatoid arthritis.*
a) Peripheralcorneal perforation: corneal leukoma, athalamy, Descemet membranefolds (arrow)
b) and c):partialoverlying after sliding conjunctivalflap
d) Postoperative aspect showing deep anterior chamber

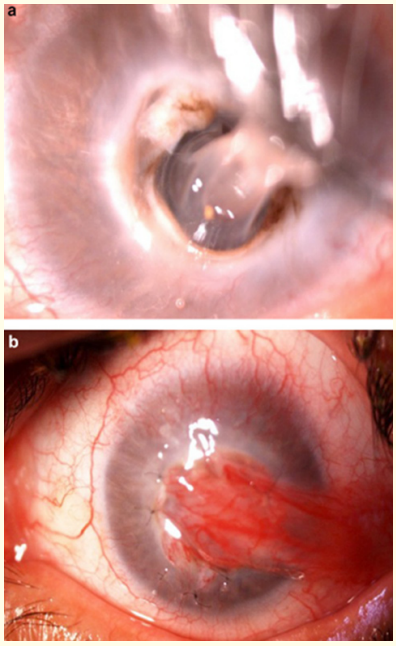

Figure 2: *Conjunctival flap. Central corneal perforation on corneal abscess.*

a) Central corneal perforation, vitreous loss

b) Slidingconjunctivalflap.

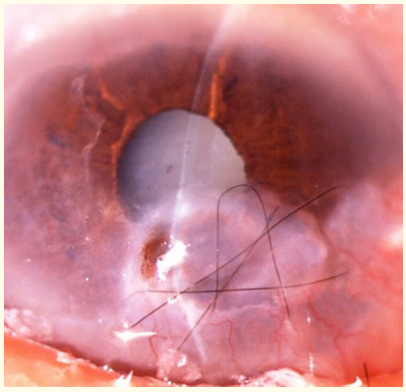

Figure 3: *Autologous corneal graft. Patient withtrachomatous trichiasis complication. Star-shapedmonofilament 10/0 sutures.*

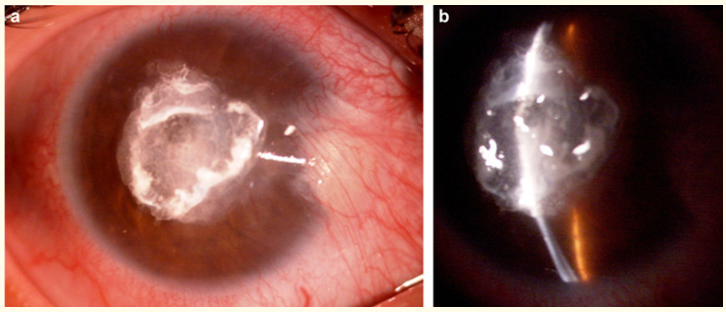

Figure 4: *Cyanoacrylate glue. Central corneal perforation of 1,5 mm in diameter.*

Regarding the multilayer amniotic membrane transplantation, we used a dried amniotic membrane cut according to the size of the perforation. It was sutured to the cornea by the 10/0 monofilament and the perforation has been filled by another fragment folded in several layers. Finally the graft is covered with a therapeutic lens.

Perforating keratoplasty was performed secondarily after the closure of the perforation when the local condition allows. The number of patients who underwent perforating keratoplasty and their follow-up were evaluated.

Statistical analysis was performed using Epi info 7.To compare the differences between the visual acuity before and after treatment, we used Student test, considering $P < 0.05$ as statistically significant.

Results

The most common etiology of corneal perforation in our study is the corneal abscesses, it was found in 30.4% of cases (7 eyes), followed by immune mediated ulcers in 26.1% of cases (6 eyes), dry eye syndrome in 21.7% of cases (5 eyes), neurotrophic keratopathy in 13.1% of cases (3 eyes), then exposure kerat it is in 8.7% of cases (2 eyes) (Table 1). Preoperative initial visual acuity was ranged between light perception and 2/10. The average was 0.28 and the standard deviation was 0.53 (Figure 5). The localization of the perforation was central in 47.8% of cases, paracentral in 17,4 % of cases, peripheral in 8.7% of cases and limbic in 26% of cases. The average size of the perforations was 2.61 ± 0.77 mm. In our study, the partial conjunctival flap is the most commonly used technique, it was performed in 10 patients (43.5% of cases), and it has been indicated especially in the peripheral perforations. The complete tarsorrhaphy was performed in 5 patients (21.7% of cases) presenting active stromal suppuration not allowing corneal sutures achievement. Autologous corneal patch was achieved in 4 patients (17.4% of cases), it was indicated in peripheral perforations ranging from 2 mm to 3 mm in diameter. Amniotic membrane was used in 3 patients (13% of cases) for corneal perforation on inflammatory ulcer less than 2 mm in diameter. The cyanoacrylate glue was used in a single patient (4% of cases), who presenting a central hole of 1 mm in diameter.

In the immediate postoperative period, the closure of the perforation was achieved in 91.3% of cases (21 eyes) and we noted two cases with failure of closing the perforation at postoperative day 1. The first patient treated with cyanoacrylate glue required reapplication of the glue. The second patient treated with conjunctival flap presented a 10/0 monofilament sutures dehiscence and required new sutures. Closing the perforation was obtained in both cases.

The average of the final visual acuity at the end of follow-up was 0,24 with a standard deviation of 0,41. Comparing the initial and final visual acuity, we found a non significant difference (p = 0.329), therefore visual acuity was not improved in spite of the closing of the perforation due to corneal scar opacities which persisted (Figure 5). In our series, 4 patients underwent penetrating keratoplasty programmed in a second intervention. The average time between initial surgery and penetrating keratoplasty was 12.5 ± 3.5 months. The localization of the corneal perforation was central in the 4 cases and penetrating keratoplasty was performed after the initial conjunctival flap in 3 cases and after the initial application of cyanoacrylate glue in one case.

Etiology	Number	Value (%)
Corneal abscess - Bacterial - Mycotic - unidentified	7	30,4
	4	17,4
	1	4,3
	2	8,7
Immune ulcer - Moorenulcer - Rheumatoidarthritis	6	26,1
	4	17,4
	2	8,7
Dry eye syndrome - Gougerot -Sjögren - Ocularrosacea	5	21,7
	3	13
	2	8,7
Neurotrophickeratitis	3	13,1
Exposurekeratitis		
-Facial paralysis	2	8,7
	2	8,7
	Solomon., et al. [5] (USA)	Vasseinex., *et al.* [4] (France)
Number of cases (duration of the study)	33 (8,1 +/- 5,7 months)	56 (8 years)
Averageage	-	69
Main etiology	Inflammatorydisease (69,7%)	Neurotrophiculcer (42%)
Most used technique	Amniotic membrane	Amniotic membrane
Anatomicalsuccess	82,3%	91%

Table 1: *corneal perforation etiology in our series.*

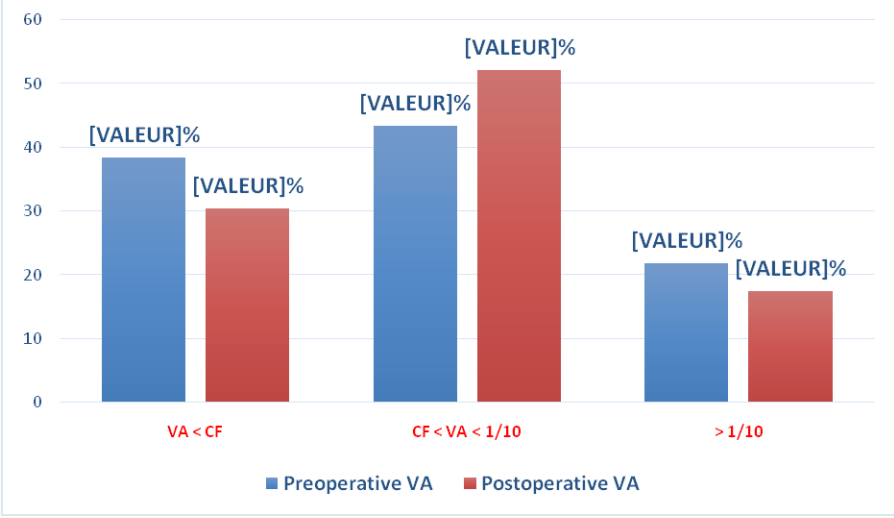

Figure 5: *Preoperative and postoperative visual acuity.*

Discussion

Non-traumatic corneal perforations are rare and serious situations that engage the anatomical and functional prognosis of the eye. They result from a tissue degradation process caused by inflammatory or infectious etiology. [5] In our series, we reported 23 cases of non-traumatic corneal perforation in 2 years, this low incidence is found in studies of Lekskul., *et al*. (40 cases in 8 years) [6], Vasseinex., *et al*. (56 cases in 8 years) [4], Xie., *et al*. (365 cases in 10 years) [7]. The average age of our patients was 56.2 years, which is similar to the literature [4,6,7]. The dominant etiology of non-traumatic corneal perforations varies depending on the study (Table 2). In our study, infectious etiology was dominant. It was found in 30.4% of the perforations, while in the series of Xie., *et al*. [7] it was found in 80.5% of cases. In the series of Lekskul., *et al*. [6], kerato conjunctivitis sicca was the dominant etiology in 30% of cases, while in the series of Vasseinex., *et al*. [4], trophic ulcers have been reported in 42% of cases. In our series, the incidence of infectious perforations could be explained by the delay in the management of corneal abscesses and by the virulence of offending germs. The aim of treatment of non-traumatic corneal perforations is to ensure the sealing the eyeball. In our series, this objective was achieved in 91.3% of cases. This good result was found in several studies with nearly 90% of anatomic success (Table 2) [4,6,8]. There are different surgical techniques for closing non-traumatic corneal perforations. The indications will depend on the size and localization of the perforation [3].

	Our series (Morocco)	**Xie., *et al*. [7] (China)**	**Lekskul., *et al*. [6] (USA)**	**Marcus., *et al*. [8] (Malaisya)**	**Sharma., et al. (India) [20]**
Number of cases (duration of the study)	23 (3 years)	341 (10 years)	40 (8 years)	296 (20 years)	41 (1 year)
Averageage (years)	56,8	-	65,4	51,5	-
Main etiology	Infection (30,4%)	Infection (80,5%)	Kerato-conjunctivitissicca (30%)	Inflammatorydisease (23%)	Infection (53,7%)
Most used technique	Conjunctival flap	keratoplasty	Cyanoacrylate glue	keratoplasty	Cyanoacrylate glue
Anatomicalsuccess	91,3%	-	92%	-	86%

Table 2: *Main corneal perforation etiology and most used surgical technique in different studies.*

In our series, the conjunctival flap was the most used technique. This technique is still relevant as it is effective, easy to perform and provides a quality ocular surface despite the significant alterations of the cornea sometimes observed [9 -11]. However, this technique is not very suitable in corneal perforations complicating corneal abscess since active suppuration persists under the conjunctival flap [12]. In the infectious or inflammatory process, the conjunctival flap is sometimes the only treatment that reduces inflammation by providing anti-inflammatory cells [10,11,13] and anti-collagenolytic enzymes [13-15]. This technique requires the use of a secondary keratoplasty to restore corneal transparency [16-18]. The cyanoacrylate glue is indicated in small perforations [19,20]. According to Sharma., *et al*.[20], the success rate is 100% when the size of the corneal perforation is less than 2 mm. Saini., *et al.* [21] reported a success rate of 92.5% .

The amniotic membrane transplantation has proven effective in the repair of corneal perforations in several studies [22,23]. Rodriguez-Ares., *et al*. [22] reported a success rate of the multilayer amniotic membrane transplantation in 73% of cases for the perforations less than 1.5 mm in diameter. Amniotic membrane transplantation may be combined with the biological glue with a success rate of 80% according Hick *et al*. [23].

The therapeutic effect of the amniotic membrane is due to its double synergistic action. Indeed, it remove the inflammation mediators and facilitate a rapid epithettialization of the corneal surface with good functional and anatomical recovery and thereby prepare a subsequent keratoplasty if necessary [5].

In our context, we do not have the amniotic membrane in the eye bank of our country and in our series we used dry amniotic membranes imported from abroad. Autologous corneal patch is used in the peripheral perforations of less than 3 mm in diameter

when other techniques are impossible. However, when the etiology of the perforation is immune, there is a high risk of failure [24,25]. It is therefore against indicated to use autologous corneal graft in the immune keratitis because of the high risk of inducing corneal graft necrosis. In our series, the anatomical results of autologous corneal patches were very satisfactory and no complications were observed.

Other new techniques are being evaluated. Turner., *et al*. [26] reported the use of an autologous scleral graft in 9 patients to close peripheral corneal holes with a success rate of 75%. Hurtado-Sarrio., *et al*. [27] reported the use of TachoSil® (Nycomed, France) (collagen sponge combinedwith human fibrin) in non-traumatic perforations of the cornea of less than 3 mm in diameter. It is a collagen sponge associated with human fibrinogen (5.5 mg) and human thrombin (2 UI) that is applied to corneal perforation, under topical anesthesia directly to the slit lamp. In contact with the cornea the TachoSil components dissolve and form a stable and tight support. This technique is being evaluated.

The weaknesses of our study are the small number of patients, the diversity of techniques used and the absence of control group.

Conclusion

The corneal perforations are due to several infectious and inflammatory diseases. It require an urgent treatment in the aim to close the corneal tissue loss and control the etiology. The choice of the surgical technique depends on the size, localization and etiology of the perforation as well as means available at emergencies. Small perforations respond well to cyanoacrylate glue, the peripheral perforations can be closed by a conjunctival flap or partial autologous corneal graft. The wide perforations and the relapses may require a penetrating keratoplasty in the first intention. Sometimes several interventions are necessary to obtain an anatomical success and improve functional outcomes, especially for immune-perforations.

Disclosure of interest

The authors declare that no conflict of interest in connection with this article

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