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A Protocol for Managing Watery Eyes in Patients with Punctal Stenosis

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Abstract

Purpose

- To elucidate all factors resulting in watery eyes in patients with punctal stenosis.
- To treat these factors pre-operatively and post-operatively following a horizontal 3-snip punctoplasty to achieve surgical success.

Methods: 77 consecutive cases presenting to a tertiary care oculoplastics centre with watery eyes due to punctal stenosis/occlusion were included. The clinical type of stenois/occlusion was identified. Co-existing factors causing lacrimation and epiphora, besides punctal stenosis, were identified and treated preoperatively. All cases had a rectangular 3-snip punctoplasty followed by repeated punctal dilatation in clinic, weekly for one month, and then 2 monthly for 6 months. The anti-inflammatory therapy was continued post-operatively for 2-4 months.

Results: All cases had severe watery eyes (Munk grade 4-5). 69 cases (89.6 %) cases were on steroid-antibiotic topical therapy for recurrent blepharitis, while 12 cases (15.7%) were on anti-glaucoma therapy. 58 cases (75.3%) had previously failed punctoplasty. Ocular surface inflammatory disease (OSD) was present in all 77 cases (100%) causing lacrimation. It was notably severe in cases with pinpoint punctae. Membranous punctal occlusion was more common in the elderly patients with less severe OSD. Repeated punctal dilatation was necessary to maintain punctal patency post-operatively, achieving success rate of 97.4%, and 100% patient satisfaction.

Conclusion: Disturbed balance between tear production and its drainage exists in patients with watery eyes. A protocol is suggested to restore that balance in patients with punctal stenosis:

- Thorough clinical assessment, identifying factors causing lacrimation and treating them pre-operatively.
- Identifying lower lid margin pathology that may be contributing to epiphora besides punctal stenosis and correcting it simultaneously with punctoplasty.
- Rectangular 3-snip punctoplasty should be the preferred surgical procedure as it maintains the structure and function of the punctum.
- Repeated punctal dilatation post-operatively and continued topical anti-inflammatory therapy to avoid punctal re-stenosis.
- Patient education regarding recurrent nature of OSD and its early treatment to prevent punctal re-stenosis.

Keywords: Epiphora; Lacrimation; Punctal Stenosis; Horizontal 3-Snip Punctoplasty; Ocular Surface Inflammatory Diseases

Introduction

Watery eye is a common problem that presents to a general ophthalmologist. It is not an age-specific condition and can affect people of every age group (newborn to the elderly). To manage it correctly, one must understand the exact pathogenesis and the involved factors. Normally, a balance exists between the production of tears in an eye

and their exit/disposal by the lacrimal drainage system. This balance is disturbed in a patient with a watery eye, and restoring it is the key to proper management.

If tears are produced in excess it is called lacrimation. The over-production of tears exceeds the draining capacity of the lacrimal drainage system. Despite a normal-sized punctum and patent lower lacrimal drainage system, such a patient develops a watery eye. The causes of lacrimation are numerous and are related to an irritated/ inflamed ocular surface caused by infection (conjunctivitis, keratitis, corneal ulcer), ocular allergy, foreign body, misdirected eyelashes, and reflex tearing caused by superficial punctate keratitis in dry eyes. Eyelid infection/inflammation (blepharitis, meibomitis, or meibomian gland dysfunction) spreads to the adjacent ocular surface, produces tear-film disruption/ deficiency, and reflex tear production. In addition, topical medications have been known to cause ocular surface inflammation, especially the Anti-Glaucoma drugs.

On the other hand, a watery eye due to a problem in the lacrimal drainage system is called epiphora. To find out its exact cause, one must start an examination of the eyelids at the lateral canthal angle, where the ducts of the lacrimal and accessory lacrimal glands open. This is the most important part of clinical assessment for epiphora that is generally missed by ophthalmologists. If the lacrimal fluid is not transferred to the lacrimal lake, it will gather at the lateral canthal angle and overflow onto the cheeks.

For proper functioning of the lacrimal drainage system, the lateral canthal angle must be 1 mm higher than the medial canthal angle. The lower lid margin must be sharp and opposed to the globe. This allows the tear meniscus, normally 0.2 mm thickness, to form along the lower lid margin, extending from the lateral to the medial canthal angle. The fluid from the tear meniscus is picked up by the upper lid margin as it closes down over the lower lid margin at the end of each blink and spreads it over the cornea as the pre-corneal tear-film. The remaining fluid from the tear meniscus gathers into the depth of the medial canthal angle to form a lake, called the lacus lacrimalis or the lacrimal lake. The upper and lower punctae don't lie opposed to each other; the upper is 3 mm medial to the lower punctum, and both are located within an elevated structure called the lacrimal papilla.

Histologically, each punctum is 0.3 mm in diameter and is surrounded by a fibrous ring that forms the papilla [1]. The Riolan muscle (a narrow strip of the pre-tarsal orbicularis along the lid margin) and the dense fibrous tissue of the medial eyelid margin insert into the lacrimal punctum and pull it medially and posteriorly to open into the tear lake [2]. With each blink, the lacrimal fluid is sucked inwards through the punctae, into the cannaliculi, and then into the lacrimal sac by the contraction of the Horner's muscle (the deep head of pre-tarsal orbicularis muscle) and is referred to as the "Lacrimal Pump" [3,4]. Once the fluid builds up into the lacrimal sac, it is pushed downwards by gravity into the nasolacrimal duct which opens in the middle meatus of the lateral nasal wall. Investigation of epiphora, therefore, starts at the lateral canthal angle and ends by examining the nasal cavity. Any condition that alters the anatomical integrity of any of these structures can cause epiphora.

The true incidence of epiphora due to punctal stenosis or occlusion has not been determined in any large population-based studies. In a retrospective study in Canada [5], 8% of patients had epiphora either due to punctal stenosis or canalicular blocks. In a prospective study, 54.3% of the patients were diagnosed with punctal stenosis [6]. Punctal occlusion or agenesis can either occur congenitally due to embryological maldevelopment or can be acquired later in life.

The etiopathogenesis of acquired punctal stenosis is attributed to a common mechanism of chronic, recurrent inflammation [7]. This results in enhanced sub-mucosal fibrosis and constriction of the punctum, or the formation of a tight narrow slit. In addition, the Riolan muscle hypertrophies, surrounds the punctum and the vertical canaliculus, constricts the punctal opening by its continued spasm, and results in a pinpoint punctum. [8]. An inflammatory membrane may form over the narrowed punctum thus occluding it [9].

Therefore, ocular surface inflammation results in a watery eye in which the elements of lacrimation as well as epiphora co-exist (punctal stenosis ± blocked cannaliculi or the nasolacrimal duct). In addition, most of these patients are more than 50 years old. The involutional change in the structure and function of eyelids further adds to the problem. The loss of muscle tone, loss of elastin, and increased deposition of collagen in the subcutaneous tissue result in sagging of the lower lid and increased horizontal lid laxity [10]. This interferes with the function of the lacrimal pump mechanism with reduced transfer of tears to the lacrimal drainage system. Excess collagen deposition under the punctal mucosa and loss of elastin makes the punctal opening a tight narrow slit, while lid laxity causes punctal eversion resulting in epiphora. Another important factor resulting in a watery eye in the elderly population is the increased prevalence of dry eyes and reflex tearing/lacrimation [11,12]. The prevalence of severe MGD and meibomian gland loss also increases with age [13,14]. Therefore, identifying all factors that are causing lacrimation as well as epiphora and treating them is the key to proper patient management.

Though the reported rates of acquired punctal stenosis vary between 8-54.3%, it is a relatively simpler

problem to treat surgically than the obstruction in the distal lacrimal drainage system. Even then, there is a whole armamentarium of surgical procedures to treat it i.e. 1 snip to 4 snip punctoplasty, laser punctoplasty, punctum pucker procedure, punctum wall removal with Kelly's or Reiss punch, and electrocautery. Recurrent stenosis/occlusion is a common complication and to prevent that, adjunctive measures like stents are used to keep the punctal opening patent. These maybe perforated or fenestrated punctal plugs, mini-Monoka, or self-retaining bicanalicular stents. Despite all these measures, the surgical procedures have a variable success rates as most ophthalmic surgeons focus only on the stenosed, occluded punctum. The problem of a watery eye persists in many cases as all the causative factors are neither identified nor treated.

There are no uniform acceptable guidelines to manage the simple and common problem of punctal stenosis. In this study, we chose the rectangular 3-snip punctoplasty without using any stents. The aim of this study was to propose a protocol/suggest guidelines to maximise surgical success and achieve 100% patient satisfaction. To the best of our knowledge, no one has tried doing that before in the scientific literature.

Methodology

A prospective, interventional study was carried out at a tertiary care oculoplastics centre for a period of 7 years, from March 2016 till April 2023. 44 consecutive patients (77 eyes/cases) presenting with epiphora, ocular discomfort, and misty vision were included in the study. All aspects of this research protocol adhered to the tenets of the Declaration of Helsinki.

A detailed history was taken regarding visual fluctuation during visual tasks such as reading, driving, watching television, or staring at a computer/smartphone screen. Symptoms of ocular or eye lid discomfort, pain, redness, and irritation were noted in the clinical notes. The severity of their watery eye was inquired and graded according to the Munk score. A history was taken regarding previous ocular surgery, contact lens wear, topical antiglaucoma medications (prostaglandin analogs, beta blockers, carbonic anhydrase inhibitors), chemotherapy, irradiation, a fatty diet intake, and any systemic disease (rheumatoid arthritis, Sjögren's syndrome and systemic lupus erythematosus).

All cases had a complete ophthalmological assessment. The state of upper and lower lid margins (thickening, telangiectasia, foaming or frothing at the angles of the eyes, and crusting or keratinisation) was noted. Eyelashes were assessed regarding mis-direction, distichiasis, or the presence of scales at their bases. The meibomian duct orifices were examined and plugging by thick secretion, notching, and the type of meibum squeezed from them was noted. A co-existing Meibomian gland dysfunction (MGD) was graded accordingly.

The tear meniscus height (TMH) was measured, below the centre of the pupil along the lower lid margin, by using 1 mm slit lamp beam. The distance between the visible junction of the cornea with the tear meniscus and the upper edge of the lower eyelid was defined as the lower TMH. Normal TMH was taken as 0.2 mm.

Assessment of the Punctum

The state of conjunctiva around the upper and lower punctae was assessed. The direction of punctae with respect to the lid margin (whether everted or pointing into the lacus lacrimalis) was noted. The size of punctal opening was measured by a narrow (1 mm), horizontal slit-lamp beam and its shape was noted, whether it was pinpoint, a slit, covered by a membrane, or not visible at all. The size of a normal punctal opening was taken as 0.3 mm. The grading of punctal stenosis was done was according to the Kashkouli et al.'s scale with Grade 0: absent punctal opening over the ampulla (complete occlusion). Grade1: Punctal occlusion by a membrane. Grade 2: Lumen less than 0.3 mm. Grade 3: Normal size. Grade 4: Small slit < 0.2 mm. Grade 5: Large slit > 0.2 mm. Diagnosis of punctal stenosis was made on the basis of epiphora in a patient with punctal opening 0.2 mm or less.

Fluorescein staining of cornea and conjunctiva was performed in all cases to note SPE (superficial punctate erosions), the Tearfilm Break-up Time, and the Fluorescein Dye Disappearance Test. A drop of 2% diluted fluorescein was instilled into the inferior fornix. The conjunctiva and fornix were checked after five minutes for any remnant of the dye. The result was divided into five grades, where 0 denoted absence of the dye and 4 denoted a large amount of dye remaining in the tear meniscus after 5 minutes. This was also correlated with the TMH. Schirmer's 1 test was performed after instilling topical anaesthetic (amethocaine) to know the basal lacrimal secretion.

Diagnostic Probing & Syringing: The cases with a visible but narrow punctal opening had a diagnostic probing and syringing preoperatively in the clinic to assess the patency of the lacrimal drainage system. The cases with total occlusion or membranous occlusion had the syringing and probing at the time of surgery in the operation theatre. Only cases with punctal stenosis/occlusion with a patent lower lacrimal drainage system were included in the study. Cases which had a previously failed punctoplasty (performed elsewhere) were also included.

Exclusion Criteria

Moderate to severe dry eyes (Schirmer's test reading below 10 mm in 5 minutes, marked corneal and conjunctival fluorescein staining), lid malposition (ectropion, entropion, facial palsy), history of ocular or facial trauma in the medial canthal region, complete lower lacrimal drainage system obstruction (canaliculi, common canaliculus, or nasolacrimal duct) on diagnostic probing and syringing were excluded from the study. Cases with complete punctal agenesis due to chemical injury, congenital occlusion, or Steven's Johnson Syndrome were also excluded.

A written informed consent was taken from every patient after explaining to them the chronic and recurrent nature of the underlying disease, the need for pre- operative topical medication which must be continued post-operatively, and the need for regular follow-ups post-operatively for a minimum period of 6 months. Pre-operative topical therapy: Cases with a pre-existing MGD, posterior blepharitis, and tear-film deficiency or mild dry eyes were treated preoperatively for 2-3 months. They were prescribed topical lubricants, tetracycline eye ointment massaged into the lid margin at night, hot fomentation applied to the closed eyelids with a warm wet towel in the mornings, eyelid massage to improve meibum flow, and anti-inflammatory therapy (acetylcysteine 0.3% eyedrops ± Tacrolimus 0.03% skin cream applied into the lower conjunctival fornix). We avoided using topical antibiotic-steroid ointments or eyedrops.

Once the ocular and eyelid inflammation had cleared up, the patients were booked for surgery. This was assessed subjectively by the absence of symptoms of ocular irritation, grittiness, burning feeling, or itching of the eyelids and eyes, and by slight improvement in the severity of epiphora (though it was still troublesome).

Objectively, an improvement in inflammation was considered by the absence of ocular surface and eyelid redness, with no scales or froth at the lid margins, no corneal or conjunctival staining, a smooth conjunctival lining without papillary reaction, improved tearful BUT to 10 sec and Schirmer's reading to 15 mm.

All cases had a rectangular 3-snip punctoplasty. The cases with punctal eversion had a simultaneous diamond tarso-conjunctival excision. Those with horizontal lid laxity and scleral show had a lateral tarsal strip procedure. Excision of distichiasis with amniotic membrane graft at the excision site was performed in cases with large number of misdirected eyelashes. All cases had punctal dilatation, post-operatively, in the clinic weekly for one month and then 2 monthly for 6 months. The treatment of MGD and blepharitis was continued post-operatively.

Surgical Procedure

The goal of the treatment of punctal stenosis was to achieve a functioning lacrimal punctum, with an adequate size and a correct position pointing inwards into the tear lake. The surgery was performed by a single surgeon under local anaesthesia. 1.5 ml of a 2% lignocaine with 1: 1, 00,000 adrenaline was injected subcutaneously into the medial lid margin below the punctum. The stenosed punctal opening and the lumen of the inferior as well as the common cannaliculi was maximally dilated by the Bowman's puntum dilator. Cases in which a membrane was occluding the punctum, or no punctal opening was visible, it was perforated at the centre of the ampulla by either the sharp tip of the punctum dilator or the tip of a no 11 Bard Parker blade, and maximally dilated. Next, the 3-snip punctoplasty was performed in a rectangular shape. The posterior wall of the dilated punctum was grasped with a fine tooth- forceps. The blades of a curved Vanass scissors were introduced vertically downwards and outwards along the medial wall of the punctum and the adjacent part of the vertical canaliculus and incised for 2 mm. Similarly, the lateral wall was incised for 2 mm. The cut segment of the posterior punctal wall (facing the lacrimal lake/eyeball) was held taut with the tooth forceps and the intervening tissue was incised horizontally. A rectangular shaped segment of the posterior wall of the punctum and the vertical canaliculus was excised.

To ensure punctal/canalicular patency and to wash any debris, syringing was performed through the enlarged punctal opening. Bleeding was stopped by a cotton swab soaked in 1:100,000 adrenaline solution. Care was taken not to use any cautery to avoid scarring. Cases with bilateral punctual occlusion/stenosis had a simultaneous bilateral surgery. The cases with an everted punctum, also had a diamond tarso-conjuncival excision simultaneously. An antibiotic ointment was instilled into the eye and a pressure dressing applied for 24 hours. The dressing was removed the next day in clinic. They were advised to apply antibiotic-steroid ointment twice daily into the medial canthus for 1 week. At each follow-up, the severity of epiphora and the state of newly formed punctal opening was assessed. All cases had punctal dilation in the clinic whilst sitting on the slit-lamp under topical anaesthesia. This was done weekly for one month and then every 2 months for the next 6 months. Success was defined objectively by the resolution of epiphora and noted subjectively by the clearance of the dye from conjunctival cul de sac on fluorescein dye disappearance test.

Statistical analysis was performed using SPSS version 16. Paired t-test was used to detect the difference between pre-

and postoperative data. A p value of < 0.05 was considered significant.

Results

Patient Demographics

There were 44 patients included in the study, with 28 females (63.3%) and 16 males (36.7%). 11 patients had a unilateral involvement, while 33 patients had bilateral punctal stenosis. Therefore, in total, there were 77 consecutive cases (11+66) included in the study.

They were between the ages 41-79 years (median 61 years). 58 cases (75.3%) had a previously failed punctoplasty ± stenting performed elsewhere. Out of these, 6 cases had a failed 3-snip procedure, 9 cases had 3-snip + intubation; no surgical record was available for the remaining 43 cases. The duration of watery eyes was from 1.5-14 years with a mean of 3.5 years.

History of recurrent topical steroid+antibiotic ointment and eyedrops usage was present in 69 cases (89.6%). Blephamide eye ointment (Allergan Pharma: sulfacetamide sodium 100 mg and prednisolone acetate 2 mg) was the most commonly used drug. 12 cases (15.7%) had chronic open angle glaucoma for 4-11 years (mean 7 years) and were on anti-glaucoma therapy, mostly Timolol and Latanoprost.

Type of Punctal Stenosis

(Table 1): Out of the 77 cases, 28 cases (36.4%) had a pinpoint punctum (Kashkouli grade 2), 33 cases (42.9%) had a membranous punctal occlusion (Kashkouli grade 1), 7 cases (9%) had a tight slit-like punctum (Kashkouli grade 4), and 9 cases (11.7%) had a totally blocked punctum (Kashkouli grade 0).

Cases with membranous occlusion were more than 60 years old and had an associated MGD. Cases with a pinpoint pupil were of a younger age group, less than 60 years, with a recurrent history of allergic conjunctivitis or posterior blepharitis, and longterm use of topical anti-allergic medications. Cases with total punctal occlusion and those with slit-like punctae were on topical anti-glaucoma therapy for 5-7 years (multiple drugs in all cases: Timolol, latanoprost, naphazoline, lubricants).

Factors Aggravating Epiphora In Addition to Punctal Stenosis

27 cases had punctal evertion in addition to stenosis/occlusion, 16 cases had sagging of the lateral can thus, distichiasis was present in 7 cases, and ectropion of the lower lid in 5 cases. These 55 cases (27+16+7+5=55= 71.4%) had simultaneous surgical procedures in addition to the 3-snip horizontal punctoplasty to correct the lower lid deformities (Table 1).

Characteristics		Number	%
Age	Range: 41 - 79 years		
	Median: 61 years		
Gender	Males	16 patients	36.70%
	Females	28 patients	63.30%
Laterality	Unilateral	11 cases	14.30%
	Bilateral	66 cases	85.70%
Previous Topical Therapy	steroid-antibiotic combo	69 cases	89.60%
	AGT: Timolol, Latanoprost	12 cases	15.70%
Previous Punctoplasty	no record of type of surgery	43 cases	
	3-snip	6 cases	
	3-snip+intubation	9 cases	
	Total no with previously failed Punctoplasty	58 cases	75.30%
Duration of Watery eyes	Mean : 3.5 years Range: 1.5 - 14 years		
Type of Punctual Stenosis/ occlusion	Pinpoint = Grade 2	28 cases	36.40%
	Membranous= Grade 1	33 cases	42.90%
	Narrow tight slit=1.5-2mm (Grade4)	7 cases	9%
	Total occlusion, (Grade 0)	9 cases	11.70%

Table1: Demographics of 44 patients = 77 cases/eyes.

All cases had a high tear meniscus height (TMH) of 0.25-0.35 mm at presentation. The pre-operative Munk score, demonstrated in Table 2, was 4 in 28 cases (36.4%) who required dabbing of their eyes more than 10 times daily while 49 cases (63.6%) had constant epiphora with the Munk score of 5. A strong positive correlation between TMH and Munk score was noted which could be a quick objective assessment of the patency of lacrimal drainage system.

Grade	Severity of Epiphora	No of Cases	%
0	No epiphora	-	-
1	Occasional, requiring dabbing less than twice/ day	-	-
2	Epiphora requiring dabbing 2-4 times/day	-	-
3	Epiphora requiring dabbing 5-10 times/day	-	-
4	Epiphora requiring dabbing more than 10 times	28 cases	36.40%
5	Constant Epiphora	49	63.60%

Table 2: Munk Score in our 77 cases Pre-operatively.

Factors Causing Lacrimation in Addition to Punctal Stenosis/Occlusion

As demonstrated in Table 3, allergic conjunctivitis in 29 cases (37.7%), posterior blepharitis with scales and discharge on the bases of eyelashes in 39 cases (50.7%), mild-moderate dry eyes in 69 cases (89.6%), and spastic entropion due to severe lower lid and ocular surface inflammation was present in 21 cases (27.3%). Meibomian gland dysfunction of grade 2-4 was noted in all 77 cases (100%).

No	Lacrimation/ Epiphora	Cause	No of cases	% age of total
I	Lacrimation	Allergic conjunctivitis	29 cases	37.70%
		Posterior blepharitis	39 cases	50.70%
		MGD	All 77 cases	100%
		Dry eyes/Tear-film instability	69 cases	89.60%
		Spastic entropion	21 cases	27.30%
		Distichiasis	7 cases	9.09%
II	Epiphora	Sagging lateral canthus	16 cases	20.80%
		Ectropion lower lid	5 cases	6.70%
		Punctal Eversion	27 cases	35%
		Total no requiring additional surgery	7 + 16 + 5 + 27 = 55 cases	71.40%

Table3: Factors Causing Watery eyes in addition to Punctal Stenosis/ occlusion in the 77 cases.

Criteria of Surgical Success

Subjectively, Munk score was used to assess the severity of epiphora during the follow-up period.

Anatomically, a case was considered successful if the punctal opening maintained a Kashkouli score 3 post-operatively (fully patent, 0.3 mm size and not requiring further dilataion).

Functionally, complete success was considered when the patient had no epiphora (Munk score of 0 or 1) and the FDDT was grade 0 after 5 minutes of the dye instillation. Munk score of 2 with FDDT of grade 1 was considered partial success**.** Munk score of more than 2 and persistent or recurrent punctal stenosis (grades 0 or 1) within 6 months post-operatively was considered a failed procedure.

Munk score and Kashkoli score at each follow-up visit is demonstrated in Table 4. Epiphora with Munk score of grade 3-4 persisted in all cases for 2-3 post-operative weeks. It began reducing after the fourth week following repeated punctal dilation and became occasional (Munk score 1) after the 5-6 weeks post-operatively. Many cases missed their regular appointments. Those who attended regularly, the epiphora had improved to grade 0-1 after the 4th punctal dilatation. Those who missed appointments had to be called from home for the final visit at 6 months.

Post-operative	Munk Score	%	Kashkouli Grade
1 week	Grade 3-4: 77 cases	100%	Inflamed punctum, 2
2 weeks	Grade 3: 77 cases	100%	Inflamed punctum, 2
3 weeks	Grade 3: 69 cases	89.60%	Grade 2, with adhesions
	Grade 2: 8 cases	10.30%	
4 weeks	Grade 2: 53 cases	68.80%	Grade 2, with adhesions
	Grade 1: 24 cases	31%	
6 weeks	Grade 2: 59 cases	76.60%	Grade 3
	Grade 1: 18 cases	23.30%	Grade 2
8 weeks	Grade 0: 32 cases	41.50%	Grade 3
	Grade 1: 45 cases	58.40%	Grade 2
12 weeks	Grade 0: 47 cases	61%	Grade 3
	Grade 1: 18 cases	23.40%	
	12 cases didn't attend		
16 weeks	Grade 1: 57 cases	74%	Grade 3
	Grade 0: 11 cases	14.20%	
	9 cases did not attend		
20 weeks	Grade 0: 66 cases 11 cases did not attend	85.70%	Grade 3
24 weeks	Grade 0: 72 cases	97.40%	Grade 3
	Grade 1: 3 cases		
	2 cases did not attend		
26 weeks	Grade 0 : 75 cases	97.40%	Grade 3
	2 cases did not attend		

Table4: Improvement in Munk Score & Kashkouli grading after Punctoplasty.

Final result at six months after surgery: epiphora was totally absent (Munk grade 0) in 72 cases. It was present occasionally (grade 1) in 3 cases.Two cases did not attend the 6 month follow-up, but they informed verbally (over the telephone) that their epiphora had improved. Therefore an overall success was considered as 97.4%. The difference between preoperative and post-operative epiphora was statistically significant ($p < 0.001$). Patient satisfaction with the treatment was 100%.

Complications Following Punctoplasty

Punctal constriction was noted during the early follow-up period in all cases which was managed by maximal dilation at each visit. Fine membranous occlusion was noted in 2 cases with blepharitis who had stopped topical medication early. Frothing at the angles of the eye and at the lid margins was noted in 17 cases post-operatively for which the therapy for MGD was continued for the next 2-4 months.

Discussion

A correlation between age and the type of punctal stenosis has been suggested in various studies [11,13]. Our patients were on an average 61 years old. A definite female preponderance (63.3%) was noted in our cases similar to other studies. This has been proposed to be related to post-menopausal hormonal changes resulting in dry eyes, MGD, keratinised epithelium, and increased ocular surface inflammation [14].

Amongst our cases, pinpoint punctae were predominantly noted in relatively younger patients (between 41-60 years of age) with severe eyelid inflammation due to blepharitis and MGD. 21 of these cases also had spastic entropion of the lower lid which improved on its own as the eyelid inflammation subsided with topical therapy. Slit-like and membranous punctal occlusion was common in the elderly patients (more than 60 years old). This correlation has been made in other studies too [7,8,15].

In this study, we treated the cause of lacrimation in all our cases meticulously, pre-operatively, for 1-3 months. Once the ocular surface and lid margin inflammation was under control, As evident subjectively by improved symptoms of ocular irritation and objectively, only then punctoplasty was performed. Meibomian gland dysfunction, posterior blepharitis, and allergic conjunctivitis are recurrent conditions. They disrupt the pre corneal tearfilm, cause dryness of the cornea/conjunctiva (evident by Fluorescein staining), and reflex watering/lacrimation. In addition, the eyelid inflammation spreads to the punctum [16] and results in its re-stenosis/occlusion by Riolan muscle hypertrophy ± enhanced fibrosis in its submucosa, months or years later.

Therefore the treatment of OSD was continued post-operatively for 2-4 months. The patients were educated regarding the recurrent nature of the disease. Ensuring a meticulous control of ocular surface inflammation pre- and post-operatively was an important reason for achieving surgical success of 97.4% and a 100% patient satisfaction in our study. We refrained from using antibiotic-steroid combination ointment or eyedrops containing prednisolone acetate, dexamethasone, and moxifloxacin as they have been implicated in causing conjunctival fibrosis and worsening/recurrent punctual stenosis [17,18].

We chose the rectangular 3-snip punctoplasty as this is believed to maintain the normal anatomy and physiology of the canalicular system. It does not disturb the lacrimal pump mechanism [19,20]. In a study by Ali et al., complete resolution of symptoms was achieved in 82% cases following the horizontal 3-snip punctopasty; 10.3% of their cases had functional epiphora and 5.3% had restenosis. Even after placing perforated punctal plugs, they had a success rate of 85% [21]. Singh, et.al. also had similar results with anatomical success rate of 84% with restenosis in 16% cases at 6-month follow up [22]. Wong, et al. used Kelly's punch instead of 3-snip punctoplasty and achieved 92% functional success rate [23]. However, the vertical and the proximal segment of horizontal canaliculi were excised during punching which has been proposed to interfere with the lacrimal pump mechanism. The physiological role of the punctum to maintain positive pressure on lid closure during a blink and negative pressure within the horizontal canaliculus on lid opening at the end of a blink is lost [24].

The second important reason for achieving a surgical success of 97.4% in our study was the repeated punctal dilation post-operatively for 6 months. This was considered necessary in view of the underlying histological changes due to chronic inflammation, and is the main reason for punctual restenosis in the above mentioned studies. Following punctoplasty, the cut segment of the punctum and adjacent vertical canaliculus heal by scar tissue formation. As the scar tissue contracts, punctal opening narrows irrespective of the type of punctal stenosis. Secondly, in pinpoint punctae, as the cut Riolan muscle heals by scar tissue, it further constricts the punctal opening. A third factor is flaring up of the underlying eyelid inflammatory disease (MGD, posterior blepharitis) post-operatively that results in recurrent membrane formation over the punctum following punctoplasty. These changes were evident in all our cases in the first 4-6 weeks post-operatively as demonstrated by the gradual improvement in the Munk score and Kashkouli grade (Table 4). Therefore, repeated punctal dilation at each follow-up visit was necessary to break the inflammatory adhesions and stretch/relax the scar tissue as well as the encircling Riolan muscle.

This protocol was repeated at each follow-up visit for 6 months. By that time, the healing process had completed and the punctal opening remained patent without using any stents. In our study, 55 cases (71.4%) had additional lower eyelid deformities that contributed to epiphora in addition to punctal stenosis. The corrective surgery was performed simultaneously to the 3-snip punctoplasty. The correction of all contributory factors added to our surgical success and patient satisfaction.

The strengths of our study are its prospective nature, a detailed pre-operative clinical assessment of patients presenting with watery eyes, including cases with severe epiphora of long duration, 75% cases had previously failed punctplasty, a uniform surgical technique performed by a single surgeon, a careful assessment of the surgical outcome, and suggesting a guideline/protocol for managing such patients.

Possible Biases/Limitations of our Study

Perhaps not a large number of cases, a short follow-up, and conducted at a single centre.

Conclusion

A disturbed balance exists between tear production and their drainage in all cases presenting with watery eyes. Age-related involutional changes and OSD are the common underlying factors. A protocol is suggested to restore that balance, especially in patients with a simple but common problem like punctal stenosis, thus achieving a 100% patient satisfaction.

- A thorough clinical assessment to identify all factors causing lacrimation and treating them prior to performing lacrimal drainage surgery i.e. punctoplasty.
- Ocular surface diseases are chronic and recurrent in nature. Steroid-sparing topical anti-inflammatory therapy must be used to prevent steroid-related

complications.

- Identifying lower lid margin pathology that may also be contributing to epiphora besides punctal stenosis or obstruction in the lower lacrimal drainage system.
- Repeated punctal dilatation post-operatively at each follow-up visit and continued topical anti-inflammatory therapy is necessary to avoid recurrent punctal occlusion. Patient education regarding recurrent nature of ocular surface diseases. They should seek treatment early to prevent re-stenosis of the punctum.

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