OPEN AIMJ ORIGINAL ARTICLE

Three_ Snip Punctoplasty versus Perforated Plug for Management of Lacrimal Punctal Stenosis

Ophthalmology

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Received *for publication December 17, 2021;* ***Accepted*** *May 27, 2022;* ***Published online*** *May 27,2022.*

doi: *10.21608/aimj.2022.111689.1727*

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ABSTRACT

Background: Punctal stenosis is a common cause of epiphora, and several treatment options are available for this disease.
Aim of The Work: To compare TSP and PPP for management of epiphora due to stenoses of the lacrimal puncta.
Patients and Methods: this is a non-randomized, interventional, prospective, comparative investigation that included 20 eyes having punctal stenosis divided into 2 groups. Group A (10 eyes) has been managed via rectangular three-snip punctoplasty and Group B (10 eyes) has been managed via insertion of polyvinylpyrrolidone PPP in the inferior punctum. The study was performed in Al-Azhar University Hospitals' ophthalmology department.
Results: The mean age was 54.30±13.85 years they were 13 males and 7 females. Epiphora Grade 4 or 5, improved post-operatively to Grade 0 or 1 in 70% of Group A eyes compared with 80% of Group B eyes. Fluorecein dye disappearance test grade 2 or 3,improved post-operatively to grade 1 in (80%) of Group A eyes compared with (90%)of Group B eyes. Restenosis was occurred in 20% of Group A eyes versus 10% of Group B eyes after falling during follow up at one month. Regarding safety, the two procedures were well-tolerated without intra-operative or post-operative complications Group B and apart occurred in 30% of Group A eyes with three-snip as canaliculitis, eyelid swelling and bleeding in the early post-operative period.
Conclusion: Both TSP and PPP have shown safety and effectiveness in treating acquired punctal stenosis. But, PPP insertion is less-invasive, better-tolerated, with superior and stable outcomes in comparison to TSP.

Keywords: *Punctal stenosis; Epiphora; Perforated plug; Three-snip punctoplasty.*

Disclosure: *The authors have no financial interest to declare in relation to the content of this article. The Article Processing Charge was paid for by the authors.*
Authorship: *All authors have a substantial contribution to the article.*

INTRODUCTION

The lacrimal punctum is a 0.3-mm opening on the medial side of the eyelid. It is rounded or ovoid in young persons and usually collapses into fish-mouth with aging. The punctum sits on a raised mound called "papilla lacrimalis" and is encircled with a fibrous ring [1].

Punctal stenosis is frequently associated with epiphora. This condition is either congenital or acquired. The plugs was first introduced by [2] with a 0.6 mm central perforation to allow tear drainage. Because of the hydrophilic nature, the punctum either undergoes narrowing or stenosis. It is defined as a punctal diameter <0.3 mm or failure of punctal intubation using a 26-G cannula with no dilation [3].

Management includes frequent mechanical and balloon dilation, punctum snip surgeries, and various stenting techniques [4].

Silicon material, collected secretions might occlude punctal lumen. Coating of PPP with polyvinylpyrrolidone (PVP) increases their hydrophobicity and permits the drainage of tears and debris through the perforation [5].

A variety of punctoplasty procedures have been used in treating punctal stenosis including one-snip procedure, two-snip procedure, and TSP. The latter could be further divided into a rectangular and triangular surgeries [6].

In the current work, polyvinylpyrrolidone PPP and TSP were compared in terms of anatomic and functional outcomes as a treatment for epiphora linked with punctal stenosis.

PATIENTS AND METHODS

This study is a non-randomized, interventional, prospective, comparative investigation, carried out on 20 eyes of 10 cases complaining of bilateral punctal stenosis and epiphora, divided into 2 groups. Group A was managed by rectangular TSP of the inferior punctum while group B was managed by PVP-coated PPP inserted in the inferior punctum. The study was performed in Egypt's Al-Azhar University Hospitals'

ophthalmology department. Inclusion criteria: All patients have epiphora caused by punctal stenosis.

Exclusion criteria: Include congenital and allergic punctal stenoses, canalicular, lacrimal sac or naso-lacrimal duct occlusion, malpositions and inflammation of the eyelid, ocular surface diseases, and keratoconjunctivitis sicca. Furthermore, cases with a history of irradiation therapy, prior lid or lacrimal surgeries was also ruled out.

Grade 0	No epiphora
Grade 1	Epiphora requiring dabbing less than twice a day
Grade 2	Epiphora requiring dabbing 2–4 times a day
Grade 3	Epiphora requiring dabbing 5–10 times a day
Grade 4	Epiphora requiring dabbing more than 10 times a day
Grade 5	Constant epiphora

Table 1: Munk classification for epiphora 7.

Pre-procedural assessment: Patients were selected randomly from those coming to Al-Azhar University hospitals. All participants in this study were subjected to the following:

History taking in terms of age, sex, main symptoms, onset of epiphora and its grade based on Munk scale (Table 1) (Dudeja et al., 2015)7, history of any topical or systemic medications and history of any surgeries or trauma.

0	**Absent punctum (agenesis)**
1	A membrane covers the papilla (difficult recognition)
2	Less than average size, however can be recognized
3	Normal
4	Small slit (<2 mm)
5	Large slit (≥2 mm)

Tear meniscus height measured (according to munk score).

Table 2: Punctal stenosis grading based on Kashkouli et al.'s score8 (Kashkouli et al., 2018)9.

Ophthalmological evaluation: Best corrected visual acuity, slit lamp examination to determine any ocular disease and punctal occlusion grade based on Kashkouli scale8 (Kashkouli et al., 20189) (Table 2).

Grade Clinical findings

2% fluorescein dye disappearance (FDD) test was performed and scored. The test underwent grading based on 5. scale that rely on with time needed for dye clearance where Grade 1 is <3 min, Grade 2 is 3–5 min, and Grade 3 is >5 min.

Syringing and probing to rule out any lacrimal pathway obstruction.

Procedures: Operations were done under local or general anesthesia according to the patient cooperativity and age.

As regard the first procedure;

Perforated punctal plug: The plug consists of silicone and coated with a polyvinylpyrrolidone layer to make the surface smooth; thus avoiding collection of debris on surface and to increase drainage with a 0.6 mm central hole. The plug underwent preloading on a disposable plug inserter to promote the insertion. Insertion procedure: Benoxinate HCL 0.4% was utilized to achieve surface anaesthesia. Nettle ship dilator was utilized to perforate any membrane that covers the inferior punctum, then underwent vertical introduction for punctal dilatation. Further dilation was achieved by utilizing the insertor's dilator end. Plugs were then placed in the proper plane (the high end of the collar is directed towards the punctum's lateral side). The plug was introduced gently in a vertical and gradual way. After that, it was released from the inserter by pressing its lever until its entire end passed into the punctum. Patients applied moxifloxacin 0.5% and fluorometholone 0.1% eye drops 4 times a day for 7 days. Removal of the plug was performed with topical anaesthesia by fine-toothed forceps while the case was on slit lamp

As regard the second procedure:

3-Snip Operation: Punctoplasty was performed with 2% lignocaine and 1:200 000 adrenaline under general or local anesthesia. The punctal sites were found with a punctum seeker and marked. A 25/27-G needle was used to perforate the membranes protecting the punctum location as needed. The punctum was sufficiently dilated to enable toothed microforceps to grab the ampulla's posterior wall. Throughout the operation, the microforceps must keep their grasp on the posterior wall. With three snips, the posterior wall of the ampulla was excised with Vannas scissors, the first two downward on every side of the forceps and the third across the bottom. Remove any punctal tissue that extends 2–3 mm behind the canaliculus's vertical component. To reduce inflammation and potential scarring, cautery has been avoided during the operation. Compression and cold saline alone were sufficient to establish hemostasis in the majority of patients; the usage of a cotton tip applicator dipped in 2.5 % phenylephrine eye drops may further minimize hemorrhage. At the end of the operation, syringing and probing have been conducted to verify the lacrimal drainage system's patency and to look for any related common canaliculus or nasolacrimal duct blockage. For two weeks after surgery, all patients were given a combination of steroid and antibiotic eye drops.

Postoperative follow up:

Recording data from 5 follow up visits within 6 months after the procedure in days 1,7 and after 1,3,6 months. Follow up assessment included the following: Assessment of symptoms (recurrence of epiphora, redness, vision), asking if there is improvement or not. Improvements in subjective epiphora symptoms as measured by the Munk score, the fluorescein disappearing test, the preservation of recently produced punctal openings, and the occurrence of complications. Slit-lamp biomicroscopic examination was done to assess the punctum. The best corrected visual acuity.

Informed consent: All patients were informed about the details and were asked to provide a written informed consent. Also, any unanticipated dangers that arose over the course of the study were promptly communicated to the participants as well as the ethics committee.

Medical ethical committee: Ethical aspects of this study were checked by medical ethical committee.

Statistical analysis and data interpretation:

Data has been entered into the computer and evaluated by IBM SPSS Corp., which was released in

2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp. Numbers and percentages have been employed to describe qualitative data. After confirming normality with the Shapiro–Wilk test, quantitative data has been presented employing mean and standard deviation for parametric data. The significance of the obtained findings has been determined at the (0.05) level. Qualitative data: The Chi-Square test is performed to compare two or more groups. When more than 25% of cells in tables (>2*2) contain a count of < 5, the Monte Carlo test is employed as a correction for the Chi-Square test. When > 25% of cells in 2*2 tables had a count of < 5, the Fischer Exact test has been performed to correct the Chi-Square test. Marginal Homogeneity is used to compare more than 2 periods in same group. Quantitative data between groups: parametric tests: A student t-test has been employed to compare two independent groups.

RESULTS

Our study included 20 eyes of 10 cases having bilateral punctal stenosis with epiphora. The patients were classified in 2 groups. Group A underwent rectangular three-snip punctoplasty of the inferior punctum while Group B was managed by PVP coated PPP in the inferior punctum, aiming at comparison of Three_ Snip Punctoplasty and Perforated Plug for treatment of epiphora due to lacrimal punctal stenosis. Twenty-Six cases were examined for involvement in the study with exclusion of 6 patients (not met inclusion criteria) then 20 cases were divided into 2 groups (10 in each group).

Groups	Group A	Group B	Test of significance
Parameters	n=10(%)	n=10(%)	
Age/years	54.30±13.85	60.60±8.15	t=1.23
Mean ± SD			p=0.231
Sex			
Male	6(60)	7(70)	FET
Female	4(40)	3(30)	P=1.0

t:Student t test, FET: Fischer exact test

Table 3: Comparison of socio-demographic features of the groups tested.

There are no statistically significant differences in age and sex between the tested groups, with the mean ±SD age of group A versus Group B (54.30±13.85 & 60.60±8.15, respectively). Among group A; 60% males versus 70% among group B (Table 3).

Groups	Group A	Group B	Test of significance
Patient satisfaction	n=10(%)	n=10(%)	
Not satisfied			
Satisfied	2(20.0)	0	FET
	8(80.0)	10(100)	p=0.474

FET: Fischer exact test

Table 4: Comparison of Patient satisfaction of the groups tested.

There is no statistically significant difference of patient satisfaction between studied groups with 100% of patients at group B versus 80% of group A are satisfied (Table 4).

Groups	Group A	Group B	test of significance
Epiphora grade	n=10(%)	n=10(%)	
Pre-operative			
Grade3	2(20.0%)	1(10.0%)	MC
Grade 4	4(40.0%)	3(30.0%)	P=0.645
Grade 5	4(40.0%)	6(60.0%)	
After 1 day			
No epiphora	8(80.0)	10(100)	FET
Grade 1	2(20.0)	0	P=0.474
After 1 week			
No epiphora	7(70.0)	10(100)	FET
Grade 1	3(30.0)	0	P=0.211
After 1 month			
No epiphora	7(70.0)	9(90.0)	MC
Grade 1	2(20.0)	1(10.0)	P=0.453
Grade 2	1(10.0)	0	
After 3 months			
No epiphora	7(70.0)	8(80.0)	MC
Grade 1	1(10.0)	1(10.0)	P=0.819
Grade 2	2(20.0)	1(10.0)	
After 6 months			
No epiphora	7(70.0)	8(80.0)	MC
Grade 1	1(10.0)	1(10.0)	P=0.785
Grade 2	1(10.0)	0	
Grade 3	1(10.0)	1(10.0)	

Comparison of FU (marginal homogeneity)	P1=0.004* P2=0.005* P3=0.005* P4=0.005* P5=0.005*	P1=0.004* P2=0.004* P3=0.004* P4=0.004* P5=0.005*

Table 5: Comparison of epiphora incidence of the groups tested.

There were no statistically significant differences in epiphora grade before and after surgery between the groups tested. In group A, there is a statistically significant enhancement of epiphora during follow-up; changed from 40% grade 4, grade 5 pre-operative to 80% no epiphora after 1 day, 70% no epiphora after 1 week, 1 month, 3 months and 6 months. Among group B, better improvement is detected as there is no epiphora is detected after 1 day & 1 week and after 1 month, 3 months and 6 months (90%, 80% &80% no epiphora) (Table 5).

MC: Monte Carlo test, FET: Fischer exact test,*Statistically significant

p1: difference between before and one day after surgery; p2: difference between before and one week after surgery; p3: difference between before and one month after surgery; p4: difference between before and three months after surgery; p5: difference between before and six months after surgery.

Grade 0=No epiphora, Grade 1: epiphora require dabbing <2 times/days, Grade 2: epiphora require dabbing 2-4 times/days, Grade 3: epiphora require dabbing 5-10 times/days, Grade4: epiphora require dabbing >10 times/days, Grade5: constant epiphora

Groups **FDDT grade**	**Group A**	**Group B**	**test of significance**
	n=10(%)	n=10(%)	
Pre-operative			
Grade 2	2(20.0)	1(10.0)	FET
Grade 3	8(80.0)	9(90.0)	P=1.0
After 1 day			
Grade 1	9(90.0)	10(100)	FET
Grade 2	1(10.0)	0	P=1.0
After 1 week			
Grade 1	8(80.0)	10(100)	FET
Grade 2	2(20.0)	0	P=0.474
After 1 month			
Grade 1	8(80.0)	9(90.0)	FET
Grade 2	2(20.0)	1(10.0)	P=1.0
After 3 months			
Grade 1	8(80.0)	9(90.0)	FET
Grade 2	2(20.0)	1(10.0)	P=1.0
After 6 months			
Grade 1	8(80.0)	9(90.0)	MC
Grade 2	1(10.0)	1(10.0)	P=0.589
Grade 3	1(10.0)	0	
Comparison of FU	P1=0.004* P2=0.004* P3=0.004* P4=0.004* P5=0.006*	P1=0.002* P2=0.003* P3=0.003* P4=0.002* P5=0.003*	

MC:Monte Carlo test,FDDT: Fluorescein dye disappearance test, FET: Fischer exact test,*Statistically significant

Table 6: Comparison of fluorescein dye disappearance test grading of the groups tested.

As detected by the fluorescein dye disappearance test, there are no statistically significant differences in grade before and after surgery between the studied groups. There is statistically significant improvement in grade among group A during follow-up; it changed from 20% grade 2, 80% grade 3 pre-operative to 90% grade after 1 day, 80% grade 1 after one week, one month, three months, and six months. Among group B, better improvement is detected as FDD grade 1 is detected after 1 day and 1 week. FDD grade 1 after one month, three months and six months (90% Each) (Table 6).

p1: difference between before and one day after surgery; p2: difference between before and one week after surgery; p3: difference between before and one month after surgery; p4: difference between before and three months after surgery; p5: difference between before and six months after surgery.

Groups	Group A	Group B	test of significance
Punctum Opening			
	n=10(%)	n=10(%)	
After 1 day open	10(100.0)	10(100.0)	
After 1 week			
Closed	3(30)	0	FET
Open	7(70)	10(100)	P=0.211
After 1 month			
Closed	2(20.0)	1(10.0)	FET
Open	8(80.0)	9(90.0)	P=1.0
After 3 months			
Closed	2(20.0)	1(10.0)	FET
Open	8(80.0)	9(90.0)	P=1.0
After 6 months			
Closed	2(20.0)	1(10.0)	FET
Open	8(80.0)	9(90.0)	P=1.0
Comparison of FU	P1=0.083 P2=0.157 P3=0.157 P4=0.157	P1=1.0 P2=0.317 P3=0.317 P4=0.317	

FET: Fischer exact test,*Statistically significant

p1: difference between 1 day &1 week post-operative, p2: difference between 1 day &1 month post-operative, p3: difference between 1day &3 months post-operative, p4: difference between 3&6 months post-operative

Table 7: Comparison of the new punctum opening of the groups tested

There are no statistically significant differences in new punctum opening between the groups tested. Among group A; 30% of cases have closed punctum after 1 week and 20% closed after 1, 3 & 6 months. Among group B; 10% closed after 1, 3 & 6 months. No statistically significant change of new punctum opening during follow up is detected for either groups (Table 7).

Groups	Group A	Group B	test of significance
Complications	n=10(%)	n=10(%)	
No			
Yes	7(70.0)	10(100)	FET
	3(30.0)	0	P=0.211

FET: Fischer exact test,*Statistically significant

Table 8: Comparison of complications of the groups tested.

3 cases (30%) of group A shows complications without any complications detected for group B (Table 8).

DISCUSSION

Punctal stenosis is a common cause of epiphora, and several treatment options are available for this condition [10]. The current work comprised 20 eyes having punctal stenosis divided in 2 groups. Group (10 eyes) was managed by implanting of PVP-coated PPP in the inferior punctum while Group (10 eyes) underwent rectangular TSP. The inferior punctum is the major drainage site accounting for 70% of tears drainage and all techniques that aiming at treating punctal stenosis often carried out through this punctum. Ruling out of patients having allergic punctal stenosis was done since it is often reversible and congenital stenosis, since it might be accompanied by distal obstruction. Furthermore, any patients with lid malposition, canalicular, nasolacrimal duct obstruction, prior lid or lacrimal drainage operation, and untreated conjunctivitis or blepharitis were ruled out, because such conditions might ingluence the outcome of the surgery and might necessitate special therapy.

In Group with perforated plug it was inserted in the inferior punctum with a 6 months follow-up. Soiberman et al. (2012)[10] removed the PPP following 60 days with an average follow-up of nine months. Additionally, Chang et al. (2013)[11] removed the PPP following 60 days. In contrast, PPP's removal was earlier in our study in comparison to El Ghafar et al. (2017)[12] study in which 30 eyes complaining of acquired punctal stenosis were enrolled along with co-administration of mitomycin-C, and the PPP was inserted for 6 months with a 6 months follow-up period following plugs' removal.

Moreover, Ozgur et al. (2015)[5] implanted PPP and removed following 6 months with a follow-up 6 and -24 months. In patients with three-snip punctoplasty, the follow-up period was up to 6 months post-operatively. The majority of earlier studies of rectangular TSP, however, showed 6 months follow-up period (Kim et al., 2012[13]; Ali et al [6]. 2015; Singh et al., 2018[14]). The eyes that showed epiphora Grade 3 or 4 based on Munk scale, (Munk et al., 1990[15]) underwent post-operative improvement to Grade 0 or 1 in 90% of eyes with PPP inserted compared with 80% of eyes with three-snip punctoplasty by the end of follow-up.

The outcomes of patients with plug inserted are consistent with that of Ozgur et al. (2015)[5] study that reported improved epiphora score to 0% and 1 in about 91% of eyes, six months following PPP

removal. On the contrary, they were better compared with El Ghafar et al. (2017)[12] study that revealed epiphora improvement in about 83% of eyes. Such difference might be because of enrollment of Grade 0 punctal stenosis cases by El Ghafar[12] and colleagues. Furthermore, Chang et al. (2013)[11] reported low success rate of 85%. Regarding the anatomic outcomes, in our study, plugs were observed to be appropriately positioned in the majority of eyes (90%).

Early rotation was observed in10% of eyes and reposition was performed on slit lamp. Only one eye was droped off early within the first 30 days. Restenosis following PPP removal occurred in one eye in the follow-up period. This agreed with Ozgur [5]and co-workers study in which one PPP underwent spontaneous loss within 14 days. Ozgur et al.[5] reported that only two puncta (18.18%) underwent restenosis during in the follow-up period of 24 months (Ozgur et al., 2015)[5]. Soiberman et al. (2012)[10] reported that 3 eyes had restenosis. Chang et al.'s (2013)[11] revealed that PPP was droped off spontaneously in 4 eyes in the first and second month followup. El Ghafar et al.'s (2017)[12] reported that 2 patients had PPP extrusion. One patient had granuloma which extruded from PPP lumen 2 months post-operative. Granuloma did not occur in our study.

In patients with three-snip, improvements of epiphora score were better compared with the improvement of Chalvatzis and colleagues[16] who compared TSP in 16 eyes vs. 16 eyes underwent modified TSP with bicanalicular self-retaining stent. Epiphora was improved completely in 2 eyes with TSP compared with 8 eyes with the other surgical technique [16].

Kim and co-workers[13] assessed the results of rectangular TSP in 45 eyes having punctal stenosis. They measured TMH via OCT. The functional success was 88.9% based on Munk score while anatomic success was 93.3% with a remarkable decrease of tear height at 6 months post-operative [13].

In general, the wide variations in TSP success rates might be linked to differences in follow-up period because restenosis incidence frequently increases over time. Furthermore, there might be some modifications in operative procedures from a surgeon to another. In our study, restenosis after TSP occurred in 2 eyes (20%) because of fibrosis of surgical edge following a 6 months follow-up period. This is in agreement with Singh and colleagues[14] who compared TSP and mono-canalicular intubation in punctal stenosis. They observed restenosis in 9 eyes that underwent TSP and in only 3 eyes with intubation [14].

In our study, anatomic improvement was better compared with functional one. Comparable findings were reported by Ali and co-workers[6] who carried out rectangular TSP in 56 cases with punctal stenosis related epiphora with a follow-up of six months. Recurrent stenosis happened in 5.7% of the eyes, while 10.3% of eyes showed post-operative functional epiphora. Additionally, Chak and Irvine evaluated rectangular TSP (49 eyes) versus triangular TSP (59 eyes). Authors found that post-operative symptoms occurred in spite punctal patency in 16.9% of eyes that had triangular TSP compared with 10.2% of eyes with rectangular TSP with this a non-significant difference (Ali et al., 2015)[6]. The less favorable functional results in spite of punctal patency might be due to the invasive techniques of ampullectomy and canaliculus incision causing disruption of the physiologic mechanism [14].

The lacrimal punctum's physiological involvement in tear drainage includes maintaining positive pressure in the horizontal canaliculus during lid closure and negative pressure during lid opening. Invasive techniques such as TSP make the system exposed to atmospheric pressure, thus causing disruption of such physiologic process [14]. In contrast, PVP-perforated PPP maintains both the physiologic mechanism as well as the anatomic structures uninterrupted.

On comparing PPP with TSP, the former showed better functional and anatomic outcomes. With the plug inserted, the subjective advancement of epiphora based on the Munk score was better. In addition, FDD revealed objective progress. (90%) among Group with plugs versus (80%) in Group with three-snip improved regarding FDDT grade.

The advantage of PPP over TSP is the fibrous ring preservation around the punctum during PPP's implantation causing minor trauma and reduces fibrous wound healing. This partially explains the significantly decreased functional success of TSP in comparison to PPP insertion despite anatomically patent puncta [10].

Regarding the safety, the TSP and PPP were well-tolerated with no intra-operative or post-operative adverse events was felt in Group with plug inserted and apart was felt in 30% of eyes in Group with three-snip as canaliculitis, eyelid swelling and bleeding in the early post-operative period and improved 7 days and 30 days, respectively. The insertion of PPP was performed with topical anaesthesia whereas infiltration anaesthesia was utilized for TSP. Lastly; extra cost was required for PPP in comparison to TSP. The current study's limitations include the small sample size and short follow-up period, as well as the absence of a long-term assessment.

CONCLUSION

Both TSP and PPP have shown safety and effectiveness in treating acquired punctal stenosis. But, PPP insertion is less-invasive, better-tolerated, with superior and stable outcomes in comparison to TSP.

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