Original Article

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Pattern of Bacterial Isolates in Patients with Nasolacrimal Passage Obstruction and their Antibiotic Sensitivity Pattern in a Tertiary Care Teaching Hospital, Pune, India

Ophthalmology Section

NILAY DHORE[1], SHASHI PRABHA PRASAD[2], KARISHMA TENDULKAR[3], AMOD AHUJA[4], MAYUR PATIL[5], KUNJ NAIK[6]

ABSTRACT

Introduction: An acquired Nasolacrimal Duct Obstruction (NLDO) can occur at any age, and is classified as either primary or secondary. The nasolacrimal obstruction occurring primarily also known as Primary Acquired Nasolacrimal Duct Obstruction (PANDO) is observed mainly in conditions occurring due to inflammation or fibrosis.

Aim: To study the current pattern of bacterial isolates with nasolacrimal passage obstruction and their antibiotic sensitivity patterns.

Materials and Methods: This was a cross-sectional study conducted in the Department of Ophthalmology at Dr. D.Y. Patil Medical College, Hospital and Research Centre, Pune, Maharashtra, India, over the period of two years from November 2019 to November 2021. A total of 100 patients were selected for the study. All the patients coming to Ophthalmology Out-patient Department (OPD) with the complaints of epiphora discharge, or both along with regurgitation on pressure over lacrimal sac and mucoid or mucopurulent or clear regurgitant material on sac syringing were taken. Before the beginning of the investigative procedure, informed consent was taken. The Clinical and Laboratory Standards Institute's (CLSI) standardised Kirby-Bauer disc diffusion test was used to determine antibiotic susceptibility.

Results: In the present study, the distribution of patients according to bacterial isolates was as follows, a maximum of 62% of patients were found with no growth, while 18% Methicillin-Sensitive *Staphylococcus aureus* (MSSA), 10% Coagulase-negative *Staphylococci* (CoNS), 6% *Streptococcus pneumoniae*, and 4% *Pseudomonas* were observed. In the present study, CoNS was observed as the predominant bacterial isolate in the diabetics with a female preponderance followed by MSSA (39%), *Pseudomonas* (75%), and *S. pneumoniae* (33%). This study found ciprofloxacin as a broad-spectrum antibiotic that worked against most bacterial isolates.

Conclusion: A higher female preponderance was observed in this study with the left side being affected in most of the patients. The pattern of antibiotic sensitivity varies from region to region and thus should be kept in mind while prescribing antimicrobial therapy to the patients.

Keywords: Antimicrobial agents, Dacryocystitis, Dacryostenosis, Microbial isolates

INTRODUCTION

Watering of the eye or epiphora is one of the most common presenting symptoms in an Ophthalmology clinic. Patients usually present with a chronic course of this ailment with no specific relieving factors and on an evaluation, a nasolacrimal passage block is revealed. The most common lacrimal system disorder is an obstruction in the nasolacrimal ducts or dacryostenosis [1]. Dacryocystitis is a condition in which the lacrimal sac becomes inflamed as a result of a blockage in the nasolacrimal duct. An acquired NLDO can occur at any age and is classified as either primary or secondary. In 1941, Henry Traquair termed it a 'primary' form of chronic dacryocystitis with strong female sex predilection and of unknown aetiology [2]. The term 'primary acquired nasolacrimal duct obstruction' or PANDO was coined by Linberg and McCormick in 1986 [3]. The NLDO occurrence is observed mainly in conditions occurring due to inflammation or fibrosis. Generally, the preponderance is more in women in the 40 to 60 years age range, as the nasolacrimal passage lumen is narrow in the female anatomy [4]. Inflammation or fibrosis accompanied by precipitating factors such as neoplastic, infectious, inflammatory, traumatic, or mechanical causes can lead to secondary acquired lacrimal duct obstruction (SALDO). It has been reported that bacteria, viruses, fungi, and parasites can cause SALDO [5]. An incidence rate of 30.47 per 100,000 has been observed for acquired NLDO [6].

Staphylococcus epidermidis is the most commonly isolated commensal of the lacrimal excretory system [7]. *Staphylococcus* spp., *Streptococcus* spp., *Pneumococcus* spp., and *Pseudomonas* spp. are the commonly prevalent bacteria isolated from the lacrimal sac, which is suggestive of the presence of both gram positive and gram negative bacteria [8].

Every year 16-19 lacs cataract surgeries are performed all over India. At most of these centres, preoperative sac syringing is a commonly used technique of irrigating the lacrimal drainage system with normal saline to determine the level of obstruction in patients with epiphora and rule out any possibility of infections in the lacrimal sac. Any infections present prior to cataract surgery can lead to vision-threatening postoperative conditions like endophthalmitis, which is an eye inflammation, involving the vitreous cavity and its surrounding tissues responsible for vision, which mostly occurs due to an infective pathology. The most common type is the postoperative endophthalmitis occurring due to the breaking up of ocular integrity and external eye surgeries [9,10].

In this study, the changing patterns of antibiotic sensitivity of the bacterial isolates causing NLDO in western Maharashtra were studied. Thus, with a better understanding of the bacteriological isolates observed in the lacrimal duct obstruction, a more efficacious antimicrobials agent can be selected, which will decrease unnecessary exposure to antimicrobials [11]. Bacteriological study of nasolacrimal passage obstruction is becoming more important

to avoid vision-threatening consequences such as endophthalmitis and hypopyon corneal ulcers following intraocular procedures such as cataract surgery and glaucoma filtration surgery.

MATERIALS AND METHODS

This was a cross-sectional study conducted in the Department of Ophthalmology at Dr. D.Y. Patil Medical College, Hospital and Research Centre, Pune, Maharashtra, India, over a period of two years from November 2019 to November 2021. Prior to the start of the study, the Institutional Ethics Committee (IEC) approval (Research protocol no. IESC/PGS/2019/113) was taken. Before beginning the study, all patients provided written and informed consent. All the procedures were in accordance with the tenets of the Declaration of Helsinki.

A sample size of 100 patients was taken calculated using WIN PEPI software.

Inclusion criteria: All clinically diagnosed cases of nasolacrimal passage obstruction testing positive for regurgitation on pressure over lacrimal sac test positive (ROPLAS positive) and discharge on lacrimal sac syringing were included. A total of 100 patients were included in the study.

Exclusion criteria: All patients with clinically diagnosed acute dacryocystitis, any ocular infection, and patients with nasal pathologies like nasal polyp, deviated nasal septum, rhinitis, and angiofibroma were excluded from the study.

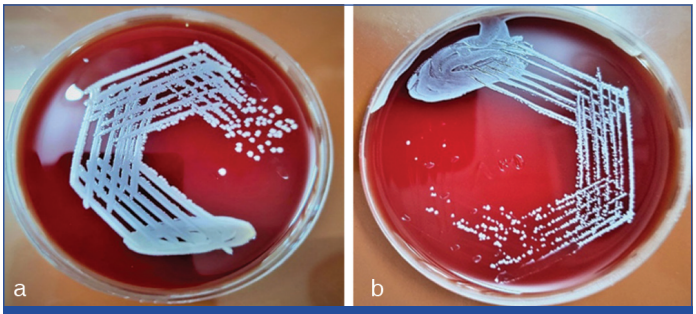
Study Procedure

All the patients coming to the Ophthalmology OPD with the complaints of epiphora, discharge, or both along with regurgitation on pressure over lacrimal sac and mucoid or mucopurulent or clear regurgitant material on sac syringing were included. Before the beginning of the investigative procedure, informed consent was taken. Demographic factors like age, sex, occupation, social status, and area of residence (Urban or Rural) were recorded on the patient information sheet. The social status of the patient was classified according to the modified Kuppuswamy scale in the Upper, Middle, and Lower-income groups [12].

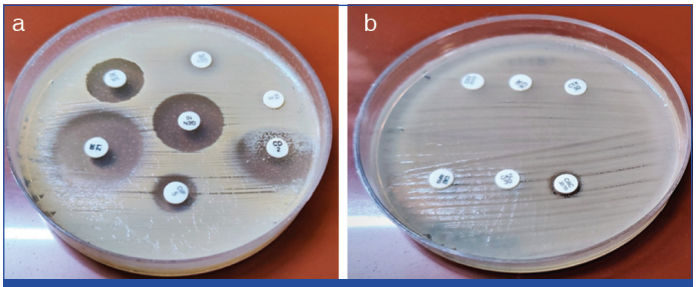
A complete ocular examination of the selected patients was performed with a focus being the lacrimal sac. Snellen's visual acuity chart was used to measure Uncorrected Visual Acuity (UCVA) at 6 meters distance and Best-Corrected Visual Acuity (BCVA) with refraction adjusted according to the subjects at the same distance was also measured. Detailed slit lamp evaluation was performed to rule out any other ocular pathology.

Clinical examination was performed for a total of 100 patients, which included the evaluation of the nature of discharge, lacrimal sac patency, presence of fullness in the lacrimal sac, and the nature of the regurgitant material on pressure over the lacrimal sac and during sac syringing was also examined. In the process of lacrimal sac syringing, the conjuctival sac was first anaesthetised using a topical agent, a lacrimal cannula is passed through the lower punctum, and normal saline is injected. In patients who sensed the saline in their nasal cavity with no reverse flow of saline through the punctum, the condition is regarded as a patent duct system. When regurgitation was experienced despite saline sensation, regurgitation occurred from the punctum. Lastly, the type of discharge of the regurgitate material was noted [13].

The regurgitant material was collected using a sterile conjunctival cotton wool swab stick ensuring the conjunctiva nor was the lid margin touched. Following the collection of the samples, they were immediately transferred to a microbiology laboratory for pathogen isolation and identification. The first swab was used for gram positive and gram negative staining, while the second was used immediately for inoculation into culture media such as Blood, Chocolate, and McConkey's agar. The swab was incubated at 37°C for 24-48 hours. After 24 and 48 hours of incubation, the Blood agar and Chocolate agar plates were examined [Table/Fig-1a,b]. CLSI standardised Kirby-Bauer disc diffusion test was used to determine antibiotic susceptibility [Table/Fig-2a,b] [14].



[Table/Fig-1]: Colony characteristics on MSSA: (a) shows, round, dome shaped greyish-white colonies, with small zones of haemolysis around it suggestive of MSSA were found. Colony characteristics on CoNS: (b) shows, smooth, circular low convex, glistening white in color colonies suggestive of CoNS were found. MSSA: Methicillin-sensitive staphylococcus aureus; CoNS: Coagulase-negative staphylococci



[Table/Fig-2]: a) The antibiotic sensitivity pattern of a Bacterium on Mueller Hinton agar; b) Image shows the resistance of a Bacterium on Mueller-Hinton agar.

STATISTICAL ANALYSIS

The data were entered on a Microsoft Excel spreadsheet and imported into Statistical Package for Social Sciences (SPSS) version 22.0 for statistical analysis. Data were presented in percentages.

RESULTS

This was a cross-sectional study that included 100 clinically diagnosed cases of nasolacrimal passage obstruction. According to the data recorded, there were 52 (52%) women and 48 (48%) men.

Majority of patients were over the age of 50 (n=61) 61% while just (n=2) 2% were under the age of 30, (n=12) 12 % were between the ages of 31 and 40, and (n=25) 25% were between the ages of 41-50. The number of patients and their occupations are summarised in [Table/Fig-3].

Variable	Classification	No. of cases (n=100)
Age (years)	≤30	2
	31-40	12
	41-50	25
	>50	61
Gender	Male	48
	Female	52
Occupation	Driver	5
	Factory worker	6
	Farmer	34
	Housewife	27
	Labourer	13
	Service holder	9
	Student	2
	Watchmen	4
Residence	Rural	64
	Urban	36

Socio-economic status	Lower	41
	Upper lower	36
	Lower middle	12
	Upper middle	11
	Upper	0
Diabetes mellitus	Present	40
	Absent	60
Gram staining (n=38)*	Positive	34 (89%)
	Negative	4 (11%)
Laterality	OD	41
	OS	59

[Table/Fig-3]: Distribution of patients according to socio-demographic profile (n=100).
*Gram staining was performed only for the positive culture samples with growth only (n=38);
OD: Oculus dexter (Right eye); OS: Oculus sinister (Left eye)

In this study, total positive cultures were 38, of which (n=34) 89% of patients were with gram staining positive while (n=4) 11% were gram-negative. In the present investigation, 59% of patients had the disease on the Left side (OS), while 41% of patients were affected on the right side (OD).

Out of the total cases in this study, diabetes mellitus was noted in (n=40) 40% of our patients, of which (n=20) 50% showed the following results, CoNS was observed as the predominant bacterial isolate in the diabetics with (n=8) 80% occurrence, followed by MSSA (n=7) 39%, *Pseudomonas* spp. (n=3) 75%, and *S. pneumoniae* (n=2) 33%. CoNS showed a female preponderance (n=6) 75%, while MSSA was isolated the most from males in this study (n=4) 57%. Although the other 20 patients were diabetics, bacteria was not isolated [Table/Fig-4].

Bacterial isolates (n=total no. of isolates)	No. of patients	Male	Female
MSSA (18)	7 (39%)	4 (57%)	3 (43%)
CoNS (10)	8 (80%)	2 (25%)	6 (75%)
S. pneumoniae (6)	2 (33%)	1 (50%)	1 (50%)
Pseudomonas spp. (4)	3 (75%)	2 (67%)	1 (33%)
Total	20	9	11

[Table/Fig-4]: Bacterial isolates wise distributions of diabetic patients.
MSSA: Methicillin sensitive staphylococcus aureus; CoNS: Coagulase-negative staphylococci

In this study the distribution of patients according to bacterial isolates was as follows, a maximum of (n=62) 62% of patients was found with no growth while (n=18) 18% MSSA, (n=10) 10% CoNS, (n=6) 6% *S. pneumoniae*, (n=4), and 4% *Pseudomonas* spp. were observed. Gender wise distribution is shown in [Table/Fig-5].

Bacterial isolates	Male (%)	Female (%)
MSSA	8 (17)	10 (19)
CoNS	4 (8)	6 (11)
S. pneumoniae	1 (2)	5 (10)
Pseudomonas spp.	1 (2)	3 (6)
No growth	34 (71)	28 (54)
Total	48 (100)	52 (100)

[Table/Fig-5]: Gender wise distribution of bacterial isolates.
MSSA: Methicillin sensitive staphylococcus aureus; CoNS: Coagulase-negative staphylococci

In this study, among the CoNS, highest sensitivity was observed towards vancomycin at (n=10) 100%, ciprofloxacin at (n=9) 90% whereas erythromycin showed only (n=2) 20% sensitivity. Among *S. pneumoniae*, the highest sensitivity was observed towards ciprofloxacin, and chloramphenicol (n=5,84% each) whereas ampicillin showed the least sensitivity. Among MSSA, the highest sensitivity was observed towards vancomycin (n=17) 94%, followed by ciprofloxacin (n=16) 89% and gentamicin (n=15) 84% whereas ampicillin (n=6) 34%, showed the least sensitivity [Table/Fig-6].

	CoNS (10)		*S. pneumoniae* (6)		MSSA (18)	
Antibiotic	NI/TI	SR (%)	NI/TI	SR (%)	NI/TI	SR (%)
Erythromycin (15 µg/disc)	2/10	20	3/6	50	14/18	78
Ciprofloxacin (5 µg/disc)	9/10	90	5/6	84	16/18	89
Vancomycin (30 µg/disc)	10/10	100	4/6	67	17/18	94
Ampicillin (10 µg/disc)	5/10	50	1/6	17	6/18	34
Chloramphenicol (30 µg/disc)	6/10	60	5/6	84	8/18	44
Gentamicin (10 µg/disc)	7/10	70	4/6	67	15/18	84
Linezolid (30 µg/disc)	6/10	60	3/6	50	10/18	56
Cotrimoxazole (25 µg/disc)	5/10	50	2/6	34	12/18	67
Clindamycin (2 µg/disc)	8/10	80	3/6	50	15/18	84
Oxacillin (1 µg/disc)	4/10	30	2/6	34	9/18	50

[Table/Fig-6]: Sensitivity pattern of antibiotics in gram-positive isolates.
+NI: No. of sensitive isolates; TI: Total isolates; SR: Sensitivity rate

Among *Pseudomonas* spp., the highest sensitivity was observed for TZP (Piperacillin+tazobactam) (n=4) 100% followed by ciprofloxacin (n=3) 75% and CAT (Ceftazidime+Tazobactam) (n=3) 75% and least sensitivity for CAC (Ceftazidime+clavulanic acid) (n=1) 25% [Table/Fig-7].

	Pseudomonas spp. (4)	
Antibiotic	NI/TI	SR (%)
Ciprofloxacin (5 µg/disc)	3/4	75
Gentamycin (10 µg/disc)	2/4	50
Amikacin (30 µg/disc)	2/4	50
CAT (30/10 µg/disc)	3/4	75
CAC (30/10/µg/disc)	1/4	25
Imipenem (10 µg/disc)	2/4	50
Carbenicillin (10 µg/disc)	2/4	50
TZP (100/10 µg/disc)	4/4	100

[Table/Fig-7]: Sensitivity pattern of antibiotics in gram-negative bacterial isolates.
NI: No. of sensitive isolates; TI: Total isolates; SR: Sensitivity rate
CAT (Ceftazidime+Tazobactum), CAC (Ceftazidime+clavulanic acid), TZP (Piperacillin/Tazobactam)

Present study found Ciprofloxacin as a broad-spectrum antibiotic, which works against most bacterial isolates.

DISCUSSION

The pattern of relative incidence varies in different studies. This study was at par with the other studies. In this study, the maximum number of patients were above 50 years (n=61) 61%, while only (n=2) 2% of patients were <30 years age group. In this study, (n=52) 52% were women, while (n=48) 48% were male patients. In a study done by Kinikar VP et al., in a total of 117 patients, 81 were women and 36 were men contributing to 69.2% and 30.7%, respectively. The highest incidence in females was in the age group of 40-49 and males it was above 70 years and above age group [15]. In the study done by Hanumantha S et al., among 60 patients, the highest number of study participants around (31.67%) was found between 45-50 years, with females being the most affected at 50 (83.3%) [16]. According to Bharathi MJ et al., gender-wise distribution ratios were noted male: female as 1:3.9 [17]. Similarly, Pornpanich K et al., [18] and Ahuja S et al., [19] reported that, with a 3:1 female preponderance, women are more typically affected than men and 41.9% of the participants were men and 58.1% were women.

In the present study, the maximum number of patients were farmers (34%) followed by housewives (27%). In the study by Hanumantha S et al., the majority i.e., 35 (58.33%) were farmers by occupation followed by homemakers (38.33%) [16]. Kinikar VP et al., reported that the majority of the patients were women and most of them were homemakers (41%) who are commonly affected. Farmers 21.3% and labourers 20.5% were next most commonly affected followed by students (6.8%). The least affected were professionals (1.7%) [15].

According to the area of residence, 64% of patients were from rural areas while 36% of patients were from urban areas. According to the socio-economic status, 77% of patients who formed the majority of the cases were from the lower-income group, while 23% were from the middle-income group, which was classified based on the Modified Kuppuswamy scale. This was attributed to a lack of hygiene and awareness among low socio-economic groups. Chayakul V et al., and Mandal R et al., reported similar findings in their studies [20,21].

In the present study, 40% of patients were with diabetes mellitus. Kinikar VP et al., reported of the 117 patients studied 17 patients had an associated systemic disease. Most of them had diabetes mellitus (14.5%), hypertension was observed in 11.9% and other systemic disorders were found in 10 patients (8.5%) [15].

In this study, 89% of patients with a positive culture growth were with gram staining positive while 11% were gram negative. A study done by Kinikar VP et al., revealed 126 samples were cultured, among them 74 (58.7%) samples showed growth of culture medium, and 52 (41.2%) were found with no growth [15]. While Hanumantha S et al., reported a gram-positive cocci (65.22%) as the principal cause of bacterial infection and gram-negative as 10.86% [16]. Patients with dacryocystitis had 65.4% and 69.7% of gram-positive cocci, according to Coden D et al., and Bharathi MJ et al., respectively [7,17]. In the study done by Kulkarni G and Dhananjaya KH bacterial growth was seen in 42 (84%) cases. Gram-positive organisms were isolated in 27 (54%) cases and gram-negative organisms in 13 (26%) cases. Two (4%) cases showed mixed growth patterns [22].

In the present study, most of the clinical samples collected showed no growth 62%, while the most commonly isolated organism was MSSA which was 18% followed by CoNS which was 10%, *S. pneumoniae* amounting to 6% and 4% *Pseudomonas aeruginosa*.

Kulkarni G and Dhananjaya KH study reported similar results with *S. aureus* and CoNS accounting for 22% each and *Streptococcus* in 10% cases. Among gram-negative organisms, klebsiella was isolated in 10% of cases. *Citrobacter* and *Pseudomonas* were isolated in 6%. This showed the predominantly present gram-positive organisms [22].

According to Chandra TJ et al., a very high number of culture-positive samples were reported. The method used was the inoculation of tissue samples on culture media directly instead of pus swabs, which might have been the cause for more culture-positive rates [23]. Thus, different sample collection strategies may have an impact on total culture-positive levels.

Patel K et al., reported that a total of 83% of 100 clinical samples were culture positive, with the remaining samples showing no growth (17%). Gram-positive and gram-negative organisms were both isolated. The most prevalent organism found was *S. aureus* (41%) amongst the gram-positive bacterial isolates, followed by *Streptococcus pneumoniae* (9%). Among the gram-negative organisms were *Escherichia coli* (17%), *Pseudomonas aeruginosa* (12%), *Klebsiella pneumoniae* (3%), and *Haemophilus* spp (1%) [24]. Shah CP and Santani D demonstrated that inoculated cultures involved an equivalent amount of gram-positive and gram-negative organisms [25].

In the present study, the data showed that the maximum sensitivity to vancomycin was observed in gram-positive organisms among the coagulase-negative *staphylococcus* (100%), and ciprofloxacin (90%). Among *S. pneumoniae*, the highest sensitivity was observed towards ciprofloxacin, and chloramphenicol (84% each). Thus, ciprofloxacin has proven to be a broad-spectrum antibiotic that works against most bacterial isolates. In Kinikar VP et al., study, they reported that the gram-positive isolates were more sensitive to vancomycin followed by erythromycin and clindamycin. The gram-negative isolates were most sensitive to ciprofloxacin and amikacin [15]. In contrast to this, a study done by Hanumantha S et al., investigated antibiotics such as gentamicin and vancomycin (93.33% each), which were the most effective antimicrobial agents for gram-positive cocci and ticarcillin/Clavulanic acid (87.25%), ticarcillin, imipenem and ceftazidime/Clavulanic acid (81.25% each) for gram-negative bacilli [16].

Patel K et al., reported ciprofloxacin (82.9%) was sensitive in the maximum number of isolates of *S. aureus* (82.9%). *S. pneumoniae* cultures were sensitive to gentamycin (88.9%). The sensitivity among *E. coli* was for ceftazidime-tazobactam (CAT) (70.6%). Most of the isolates of *P. aeruginosa* showed utmost sensitivity to CAT (83.3%). *K. pneumoniae* was sensitive to gentamycin (100%) and *Haemophilus* spp was sensitive to ciprofloxacin (100%). Streptococci were a prevalent cause of persistent dacryocystitis in the pre-antibiotic period. However, Streptococci have been replaced by Staphylococci with the discovery of potent antibiotics such as penicillin and cephalosporins [24].

Limitation(s)

Though the study was conducted over a longer period due to the pandemic the sample size was restricted and; therefore, the antibiotic sensitivity patterns could not be ascertained on a wider scale. It was a single-centre study and other aetiological factors of viral, fungal, and parasitic origin were not studied.

CONCLUSION(S)

A higher female preponderance was observed in this study with the left side being affected in most of the patients. Most of the patients hailed from rural areas and belonged to a lower socio-economic class. This can be attributed to a lack of hygiene and awareness among low socio-economic groups. In all the patients showing positive culture growth, gram-positive organisms were the dominant species. In this study, ciprofloxacin came out as a broad-spectrum antibiotic working against most bacterial isolates and thus can be used as a prophylactic antibiotic preoperatively.

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PARTICULARS OF CONTRIBUTORS:
1. Junior Resident, Department of Ophthalmology, Dr. D.Y. Patil Medical College Hospital and Research Centre, Pune, Maharashtra, India.
2. Professor and Head, Department of Ophthalmology, Dr. D.Y. Patil Medical College Hospital and Research Centre, Pune, Maharashtra, India.
3. Junior Resident, Department of Ophthalmology, Dr. D.Y. Patil Medical College Hospital and Research Centre, Pune, Maharashtra, India.
4. Junior Resident, Department of Ophthalmology, Dr. D.Y. Patil Medical College Hospital and Research Centre, Pune, Maharashtra, India.
5. Junior Resident, Department of Ophthalmology, Dr. D.Y. Patil Medical College Hospital and Research Centre, Pune, Maharashtra, India.
6. Junior Resident, Department of Ophthalmology, Dr. D.Y. Patil Medical College Hospital and Research Centre, Pune, Maharashtra, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Nilay Dhore,
Junior Resident, Department of Ophthalmology, Dr. D.Y. Patil Medical College Hospital and Research Centre, Pune, Maharashtra, India.
E-mail: nilay2niar@gmail.com

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