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Original Article

Incidence of Microbial Contamination of Lenses in Long-term Soft Contact Lens Wearers

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Abstract

Introduction: Microbial keratitis is the most visually devastating complication associated with contact lens (CL) wear CL wear disrupts these protective mechanisms through breakdown of normal homeostatic surface renewal as well as damaging the corneal surface.

Materials and Methods: A study of 50 eyes in 30 patients was conducted at a tertiary care ophthalmic center. There was a check on microbial contamination of lenses in long-term soft CL wearers. Patients who wanted to change their lenses after 1 year use or who wanted to discard their lenses due to redness, pain, watering, or blurring of vision were requested to give their lenses for smear culture antibiotic sensitivity and microbial culture.

Results: The cultures were evaluated for bacterial, fungal, or *Acanthamoeba* growth. These were tabulated in a master chart and results documented.

Conclusion: This study was conducted to impress the need to stop dispensing CLs at the optometrist counters where proper advice as to care of the lenses and their maintenance is not given. It also creates awareness about CL hygiene.

Key words: Contact lens, Lens contamination, Microbial infection, Smear culture antibiotic sensitivity

INTRODUCTION

Microbial keratitis (MK) is the most visually devastating complication associated with contact lens (CL) wear CL wear disrupts these protective mechanisms through breakdown of normal homeostatic surface renewal as well as damaging the corneal surface.

Trauma, pre-existing ocular surface disease, and CL wear have been earmarked as the most common etiologies of microbial infection.

CLs share an intimate relationship with the epithelial surface; all forms of CL wear, regardless of lens material, and modality of wear have a profound effect on the physiology of this tissue. Studies have shown that the physical presence of a CL, irrespective of oxygen transmissibility, disrupts corneal epithelial renewal mechanisms, producing a thinned, and stagnant epithelium.

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MATERIALS AND METHODS

A study of 50 eyes in 30 patients was conducted at a tertiary care ophthalmic center for evaluating the incidence of microbial contamination of lenses in long-term soft CL wearers.

On screening, a patient who fitted into the inclusion criteria (Table 1) were impressed on to hand over the lenses for the study to enable collection of data. These patients underwent a detailed eye examination as shown in Table 2. A thorough anterior segment examination was done to differentiate between corneal and conjunctival infection.

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CLs documenting growth or eye lesions were photographed for prognosis (Figures 1-6). The lenses collected and were transported to the laboratory in a sterile autoclaved lens cleaning solution to avoid cross contamination.

At the laboratory, the lens were transferred to glucose broth and incubated at 37° for 2 h. This broth was further cultured on blood agar, McConkey's agar overnight at 37° and sabouraud's at room temperature and 37° for 3 weeks. The growth observed was documented as bacterial, fungal and *Acanthamoeba* growth. Digital pictures were taken (Figures 7-12).

Results were tabulated and inference drawn (Tables 3 and 4).

Table 1: Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Age group: 15-35 years	Age group: <15 or >35
Lenses	Lenses: RGP, bandage soft CL
Soft, yearly wear in power range of+5-−20 which were discarded after the yearly use or prior to that due to redness pain watering or blurring of vision not permitting the wearer to use them	Conjunctivitis causing redness pain watering
Asymptomatic patient wearing CL for duration more than the prescribed schedule	Iridocyclitis causing redness pain watering
Asymptomatic patient wearing CL and never having got them cleaned for >3 months in yearly wear schedule	Patient not willing for any eye procedure
Symptomatic patient wearing CL with redness pain watering	Patient not willing to come for regular follow-up

RGP: Rigid gas permeable, CL: Contact lens

The wear and tear of soft CL as it is creates microcracks. If handled roughly with nails then this forms earlier. Once the integrity of surface is lost, normal commensals or opportunist which will grow into the CL. During the wear of CL, if there is an inadvertent eye injury, these organisms will latch on the cornea causing corneal ulcer and subsequent loss of vision.

The cultures gave us a mixed basket of organisms with almost 1/3rd as no growth. Only those patients who had redness/conjunctival congestion or corneal defects were treated with antibiotics.

All were counseled as to CL hygiene (Table 5). They were reinforced on the corrective measures to be taken. In the case of a problem visit to the eye doctor was mandatory. Better to be safe than sorry.

DISCUSSION

The potential role of CL care solutions in MK has recently gained significant interest due to increased reports of fungal and *Acanthamoeba* keratitis. More recent reports support the view that corneal staining may be directly related to inflammation. This compromise includes the inhibition of apoptotic desquamation and a slowed renewal mechanism, producing a thinned, stagnant epithelial sheet. It appears that it is the cumulative breakdown of these collective processes that results in CL related MK and further illustrates the multifactorial nature of the disease process.[1]

Table 2: Detailed eye examination and investigations

CL history	Clinical examination	Investigation
CL usage at what age	Visual acuity on logmar chart	CL sent for SCABS and KOH
Duration of CL usage in a day	BCVA: Spectacle power/CL power	BUT/Schirmers
Type of CL	Slit lamp examination	Sac syringing
Cleaning procedure for the CL	CL details	IOP measurement by a non contact tonometer
Any faulting in the usage	Soft/RGP	If corneal lesion present corneal scrape for SCABS and KOH
Sleeping with the lenses in the eye	CL fit tight or loose	CBC/ESR
Cleaning lenses with tap water	Lack of lustre on CL indicating over-usage	Urine: (Routine & Microscopy)
Washing the eye with tap water with the lenses in the eye	Deposits on CL	ENT/Dental focus of infection
Using OTC drugs - Pyrimon for any redness of the eye with the lenses on	Cornea	
Continuing the usage of lenses in spite of getting a FB sensation redness watering or discharge in the eye	Corneal lesion	
Not visiting a doctor but an optician for CL dispensing	Fluorescent staining	
Improper cleaning schedule for the lenses	Photo of the lesion	
	Corneal sensation	
	Sac status to r/o chronic dacryocystitis	
	IOP to r/o glaucoma	
	BUT to r/o dry eyes	

Increased risk of bacterial infection is a reality with which all CL wearers must live. Unfortunately, the most CLs wearers suffer from the "it-cannot-happen-to-me" syndrome. Those who have had a contact-lens-related bacterial infection now know better than to tempt fate.

Bacterial eye infections affecting the cornea are known as MK. MK is the most severe complication associated with CL wear. *Pseudomonas aeruginosa* is the most common bacteria involved in MK. It is also one of the most damaging. *P. aeruginosa* eats away at the cornea (causing

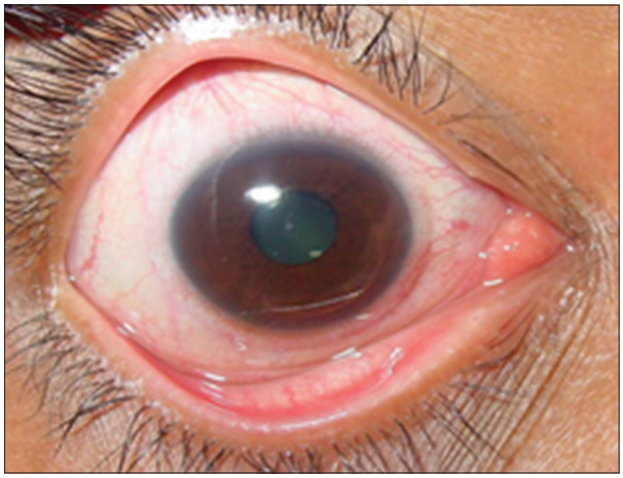

Figure 1: Tight fit lens causing hypoxia with ciliary congestion with corneal edema

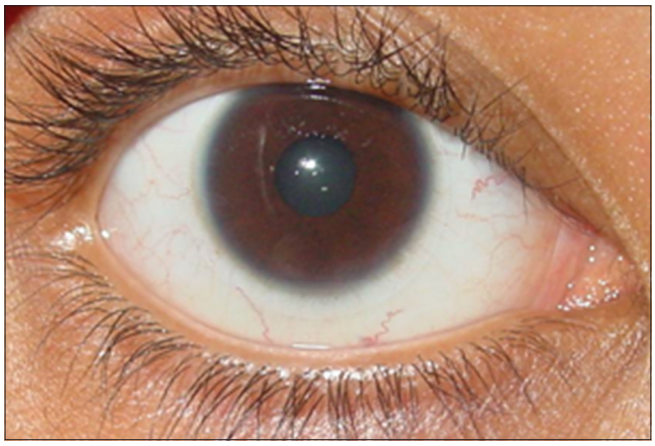

Figure 2: Lack of luster depicting an aged lens

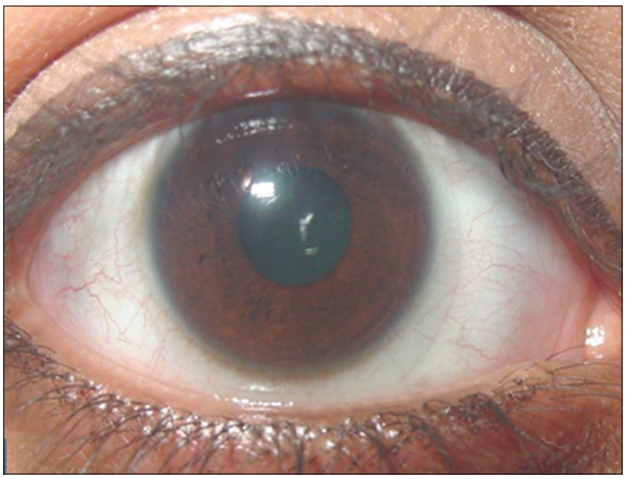

Figure 3: Lens deposit eroding into the lens

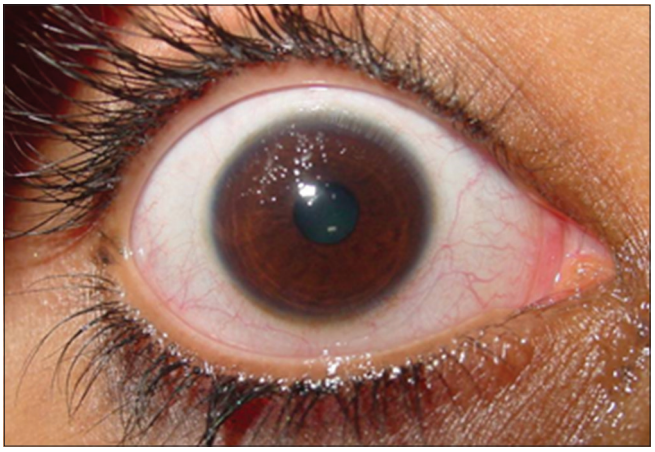

Figure 4: Multiple deposits on the contact lens causing FB sensation

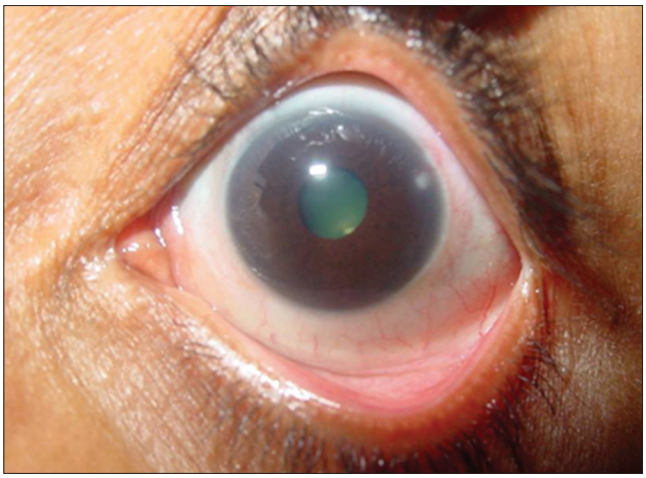

Figure 5: Peripheral corneal infiltrate with vascularization

Figure 6: Corneal infiltrate with circumcorneal congestion following contact lens deposit

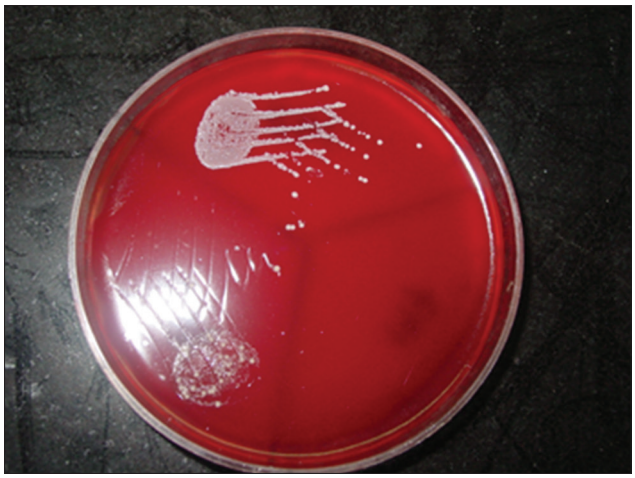

Figure 7: *Staphylococci*

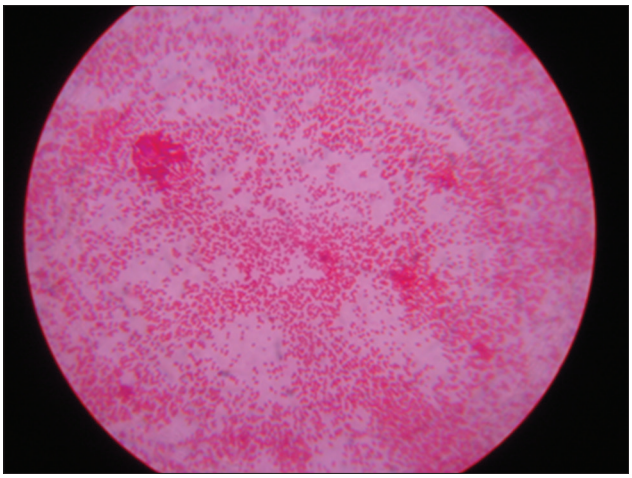

Figure 10: Gram-negative diplococci - *Neisseria* spp.

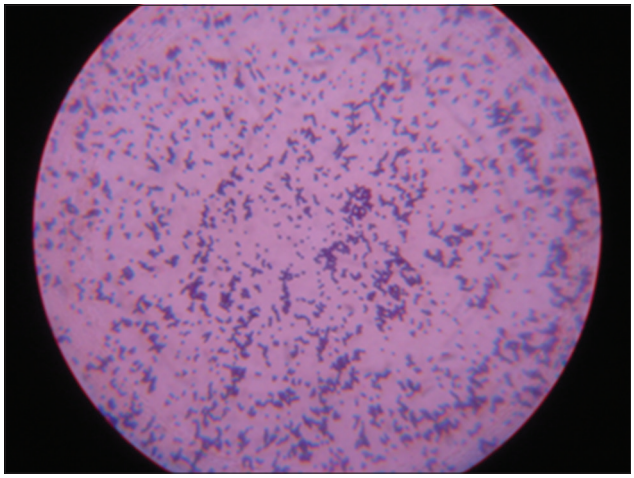

Figure 8: Gram-positive cocci in pairs and chains

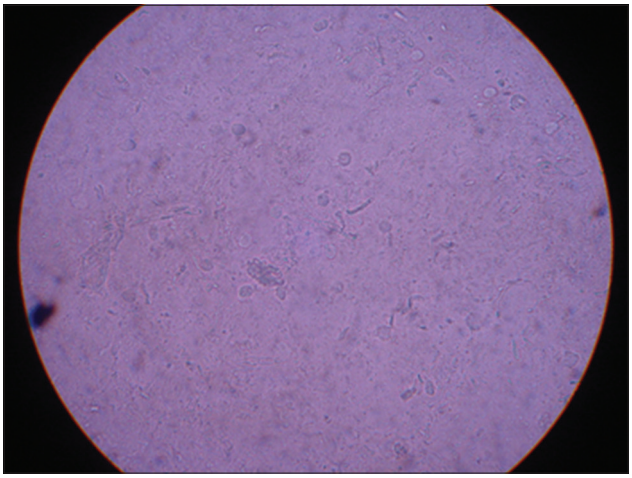

Figure 11: Fungal hyphae

Figure 9: Pink colonies of *Klebsiella* or *Enterobacter*

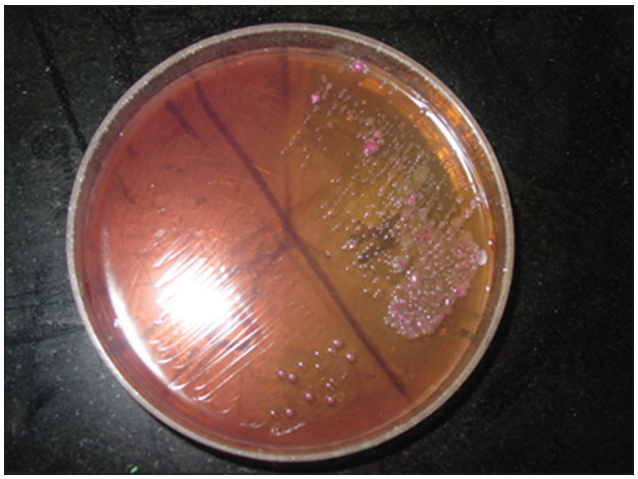

Figure 12: Non-lactose fermenting and lactose fermenting colonies

corneal ulceration), which could eventually lead to vision loss and blindness. Fungus and *Acanthamoeba* follow suit.

Overnight wear of daily CLs which are only meant for short-term wear is the biggest risk factor for eye infections. Others being dry eyes, smoking, chronic blepharitis, and allergic conjunctivitis.[2]

Soft CLs helps in surface disorders by preventing recurrent surface breakdowns and by restoration of the optical

Table 3: Results master chart

Subject	Age	Sex	Age of CL (in months)	Duration of symptoms (in days)	Pathogen isolated from CL
Case 1	15	F	11	5	*Escherichia coli*
Case 2	23	F	5	7	*Citrobacter*
Case 3	29	F	9	3	Non fermenter spp
Case 4	27	F	12	6	No growth
Case 5	33	M	17	4	*Serratia marcescens*
Case 6	22	F	7	3	*Morexilla* spp
Case 7	30	M	10	3	*Serratia marcescens*
Case 8	24	F	10	6	*Escherichia coli*
Case 9	18	F	12	3	*Acinetobacter*
Case 10	25	F	6	7	Proteus spp
Case 11	15	F	16	5	No growth
Case 12	29	F	10	5	No growth
Case 13	18	M	7	4	*Moraxella* spp
Case 14	35	F	9	7	No growth
Case 15	22	F	11	3	*Aspergillus*
Case 16	16	F	6	2	No growth
Case 17	28	F	18	4	No growth
Case 18	25	M	14	5	Streptococcus spp
Case 19	16	F	15	4	Streptococcus spp
Case 20	23	F	9	4	*Pseudomonas aeruginosa*
Case 21	19	F	6	5	*Escherichia coli*
Case 22	32	F	11	3	*Klebsiella* spp
Case 23	26	F	10	3	*Klebsiella* spp
Case 24	17	F	14	5	No growth
Case 25	31	M	11	2	*Fusarium*
Case 26	19	M	9	7	No growth
Case 27	16	F	13	5	*Acinetobacter* spp
Case 28	30	F	8	4	No growth
Case 29	31	F	18	5	No growth
Case 30	25	F	10	5	No growth
Case 31	28	F	6	6	*Fusarium*
Case 32	33	M	15	3	No growth
Case 33	21	F	12	5	No growth
Case 34	18	F	11	4	No growth
Case 35	30	F	17	4	No growth
Case 36	21	F	6	7	No growth
Case 37	29	M	11	6	*Pseudomonas aeurginosa*
Case 38	27	F	10	6	*Pseudomonas aeurginosa*
Case 39	21	F	7	3	*Citrobacter* spp
Case 40	25	F	15	5	*Citrobacter* spp
Case 41	24	F	18	6	No growth
Case 42	30	M	14	4	*Aspergillus*
Case 43	26	F	11	3	No growth
Case 44	19	M	13	6	No growth
Case 45	33	F	10	5	*Klebsiella* spp
Case 46	25	F	9	5	*Klebsiella* spp
Case 47	18	F	15	3	*Pseudomonas* spp
Case 48	22	F	11	4	*Pseudomonas* spp
Case 49	28	F	18	4	No growth
Case 50	24	F	13	4	No growth

integrity of the surface. However in a tight lens syndrome, it might cause corneal edema with subsequent rupture of corneal bullae secondary infection can lead to MK.[3]

Table 4: Micro-organisms grown with antibiotic sensitivity

Gram-positive sensitivity	Gram-negative sensitivity
Ox-Oxacillin	Cac-Ceftazidime-Clavulanic acid
Va-Vancomycin	Ce-Cephotaxime
Lz-Linezolid	Ci-Ceftriaxone
E-Erythromycin	G-Gentamicin
P-Penicillin A-Ampicillin	Pt-Piperacillin-Tazobactum
Co-Trimaxazole	I-Imepenem
Ca-Ceftazidime	Ao-Aztreonam
Cf-Ciprofloxacin	Tb-Tobramycin
Pseudomonas	Ci-Ceftriaxone
Pt-Piperacillin-Tazobactum	Ak-Amikacin
I-Imepenem	Cpm-Cefepime
Ao-Aztreonam	Ca-Ceftazidime
Tb-Tobramycin	
Ci-Ceftriaxone	
Ak-Amikacin	
Cpm-Cefepime	
Ca-Ceftazidime	

With the growth of soft CL wear, the incidence of CL-associated MK has increased up to 30% of all keratitis in developed countries. The microbes responsible for CL-associated keratitis include Gram-negative bacteria and rarely, Gram-positive bacteria and fungi, whereas *Acanthamoeba* predominated in the developed countries. Several CL-related and non-CL-related factors were attributed to the higher incidence of *Acanthamoeba* keratitis among CL wearers in developed nations. In contrast, bacteria were found to be the only pathogen for all CL-associated keratitis in this study. *P. aeruginosa* was reported to be the most common organism isolated from CL wearers in the developing world and similarly.

In developing countries like India, commonly used water is contaminated by gut commensals, especially *Pseudomonas*. A contact of CLs and CL storage cases with water can cause contamination by *Pseudomonas*, which survives well in the moist environment offered by CLs, CL storage cases, and lens care solutions. Contaminated CLs which were used by the patients, acted as a vector for transmitting the microbes from the CL storage cases to the patients' conjunctiva and cornea by forming polysaccharide-containing bio-film on the posterior surface of soft CLs by bacterial adherence. Bacterial adherence to artificial surface is also thought to be mediated by hydrophobic bonding and relatively hydrophobic strains adhere very readily to CLs.[4]

A CL can act as a vector for micro-organisms to adhere to and transfer to the ocular surface. Commensal micro-organisms that uneventfully cohabitate on lid margins and conjunctivae and potential pathogens that are found transiently on the ocular surface can inoculate CLs *in vivo*. In the presence of reduced tissue resistance, these

Table 5: CL hygiene and corrective measures to be taken

Factors-lens hygiene	Corrective measures
• No nail growth • No cracks/rough pulp of index finger • Rub the CL with cleaning solution while inserting and after removing • CL • Not to rub eyes immediately after CL removal. Least corneal abrasion happens in case of post CL corneal edema • Storage of CL • Change solution every 2nd day • Make sure CL borders are within well of CL storage box so that cap not put over CL • Ultrasonic/enzyme cleaning of CL every 2 months • CL cleaning solution to be kept in fridge/not to be replaced by tap water/use a transparent bottle so deposits can be cleaned • Do not wear CL in case of: Redness of eyes Watering of eyes Dropped vision Discharge	• When prescribing CL counsel on preventing injury to the lens • Do not use lens in case of redness pain watering and if worn then discard those lenses • Do not use any unpreserved solution to clean or store lenses in c/o emergency use a tear substitute • Clean the lenses ultrasonically every 2 months as the rubbing action is insufficient to remove accumulated deposits • Clean the lens case with betadaine 5% solution when the patient comes for CL cleaning at the clinic • Visit eye doctor every 3 months to r/o tight lens syndrome or CL deposits on the lens • Always get lenses from eye doctors and not optometrists

CL: Contact lens

resident micro-organisms or transient pathogens can invade and colonize the cornea or conjunctiva to produce inflammation or infection.[5]

Lens handling greatly increases the incidence of lens contamination, and the ocular surface has a tremendous ability to destroy organisms. Even when lenses are removed aseptically from the eye, 50% are found to harbor micro-organisms, almost exclusively bacteria. Coagulase-negative *Staphylococci* being most common and Gram-negative about 10%. In storage cases, the incidence of positive microbial bioburden is also typically >50%. All types of care solutions can become contaminated including up to 30% of preserved products. Thus, this detailed understanding of lens-related bioburden is important in the understanding of factors associated with infectious and inflammatory complications.[5]

Many complications arise when lenses are worn not as prescribed (improper wear schedule or lens replacement). Sleeping in lenses not designed or approved for extended wear is a common cause of complications. Many people go too long before replacing their lenses, wearing lenses designed for 1, 14, or 30 days of wear for multiple months or years. While this does save on the cost of lenses, it risks permanent damage to the eye and loss of sight. CL wear is the most important risk factor. The role of initial therapy for MK remains important.[6]

Severe MK with vision loss in CL wearers is more likely to be caused by an environmental pathogen, and to occur in tropical regions in association with high daytime temperatures.[6]

One of the major factors that cause CL complications are that the lens is a barrier to oxygen. The cornea needs a supply of oxygen to function and it normally gets that oxygen from the surrounding air while awake and from the blood vessels in the back of the eyelid while asleep. The most prominent risks associated with long-term, chronic low oxygen to the cornea include corneal neovascularization increased epithelial permeability, bacterial adherence, micro cysts, corneal edema, endothelial polymegethism, and potential increase in myopia.

Mishandling of CLs can also cause problems. Corneal abrasions can increase the chances of infection. When combined with improper cleaning and disinfection of the lens, the risk of infection further increases. Decreased corneal sensitivity following extended CL wear may cause a patient to miss some of the earliest symptoms of such complications.[7]

Genetic mutations in the innate immune system may be involved in individual susceptibility to MK.[8]

Cytokine gene expression is tightly regulated, and aberrant expression from environmental and genetic polymorphism has been implicated in a range of diseases, susceptibility to infections, and responses to treatment. This review concentrates on the functionality of cytokine and cytokine receptor gene polymorphisms; it is through these variants that genuine disease-associations are based. Several mechanisms for single nucleotide polymorphism (SNP) functionality are present within cytokine genes.[9]

CONCLUSION

The trend to use lenses is more in the pre-presbyopic age group hence it formed our sample base. 90% of the sample was contributed by the female gender. Cosmesis as well as reduced corneal sensation compared to the male population was the basis of this rigid gas permeable (RGP) lenses are safer but soft lenses are user-friendly hence the increase in demand and shift from RGP lenses in recent years. The younger generation is careless about the hygiene of wearing, cleaning and maintenance of the lens. There seems to be no gender bias. The duration of wear seems to have a bearing on the incidence of infection. This may be due to the micro-cracks in the CL due to wear and tear. The presence of clinical symptoms like redness pain watering and blurring of vision seems to herald the onset of microbial infection in the lenses. Hence, continuing to use the CL in the presence of these symptoms may be a contributing factor in people developing corneal infections following CL wear. The presence of infiltrates is a sure shot marker for isolating pathogens in the lenses. Hence, a complete slit lamp examination at every follow-up should be mandatory. Seeing an infiltrate should be an absolute indication to discard usage of the lenses.

Deposit on the lens was the hallmark of finding pathogens as they grow into it. It highlights the need for ultrasonic cleaning of lenses and frequent change of CL solution in the lens case. Disinfecting the lens case once a fortnight with betadine 5% solution would prevent deposit formation on the lenses. Storing the solution in the refrigerator and handling the bottle cap aseptically would go a long way in preventing CL solution contamination.

Pathogens were isolated in 60% of cases. They came in a mixed basket of Gram-positive specially staphylococcus, Gram-negative especially *Pseudomonas* and *Klebsiella*, Fungal hyphae in 10% as listed in Table 3. We could not isolate *Acanthameoba* in spite of literature reporting it as the most common organism in CL wearers.

The study emphasizes the need to clean hands with glycerine soap with clean water and dry them prior to handling lenses. Disinfecting sanitizer would definitely help. The need to emphasize cleaning of the CL case every week and rinsing them in betadiane solution 5% every fortnight before reuse. It is necessary to refrigerate the CL cleaning solution to prevent the growth of organism in them.

Immediate ophthalmic consultation in case of redness pain watering with blurred vision and refrain from wearing these lenses in these situations must be a compulsory mandate to prevent transfer of this infection to the cornea heralding the onset of infectious keratitis with significant loss of vision.

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