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Contact lens, case and solution related microbiological evaluation in health care workers and medical students

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ABSTRACT

Aim: To assess the microbial contamination in different types of contact lenses, their storage case, and lens case solutions of healthcare workers

Materials and Methods: This is a cross-sectional study, conducted over 2 months. 100 contact lenses, their cases, and case solutions were collected from 50 healthcare professionals and students. Individuals filled out a questionnaire on the duration of use, care, and compliance. The samples were subjected to gram staining, KOH mount, and culture with blood and potato dextrose agar.

Results: Out of the 300 collected samples, 30 lenses, 30 lens cases, and 6 lens care solutions showed positive growth. Among these 100 lenses and lens cases, 56 yielded bacterial growth and 4 fungal growth. Predominant bacteria isolated from lenses, lens cases, and their lens care solutions were *Pseudomonas aeruginosa* followed by *Klebsiella pneumonia*. 4 lenses and lens cases showed candida albicans. Polymicrobial growth was observed in 2 contact lenses. *Enterobacter species* were isolated from only lenses, and cases, and not solutions.

Conclusion: Most of the healthcare workers followed the recommended lens care regimen. The most common organism isolated was *Pseudomonas aeruginosa* followed by *Klebsiella pneumoniae, Enterobacter species*, and *Staphylococcus aureus* with few showing the presence of *Candida species*. A similar profile was also noted in the general population. From observations made in our study and similar studies, care on lens case and lens solution hygiene must be emphasized.

1. Introduction

The burden of ocular refractive disorders is increasing globally.[1] Contact lenses (CLs) have been prescribed for more than a century for correction of refractive errors and convenience, as a therapeutic modality for corneal pathologies and cosmetic purposes. The use of CLs has greatly increased, and a greater increase is expected. One of the serious complications associated with contact lens usage is microbial keratitis which has been significantly neglected in developing countries. There is an increased risk of developing this due to improper lens hygiene, extended wear, and poor lens fit. Infectious corneal ulcers are the fifth leading cause of blindness worldwide.[2,3]

The corneal surface has its own protective barriers formed by the metabolic products of the normal flora, tear film components, and bacteriocin production. The normal flora of the cornea consists of *staphylococcus epidermidis, corynebacterium species, micrococcus, bacillus, staphylococcus aureus,* and anaerobes like *propionibacterium*. All of the above-mentioned protective factors inhibit the growth of closely related bacteria and provide them with a competitive survival advantage .[4]

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CLs become an important media for the transfer of microorganisms to the ocular surface. The most common source of these is found to be the commensals present on the conjunctiva, lid margins, and the surrounding skin.[5] In some situations, the pathogenic organisms overwhelm the host defences and cause external ocular infections. One such situation is contact lens usage which creates an environment of hypoxia and hypercapnia. Its interaction with the corneal surfaces decreases the protective mechanisms of the cornea and increases the ability of the organisms to adhere and cause keratitis.[6] Handling of contact lenses is a major source of its contamination. These hand-transferred organisms usually do not survive if worn on healthy eyes. In studies done on the lens cases and lens solution, the burden has been found to be more than the lens itself. Here, along with bacteria, Acanthamoeba has also been found which is mostly due to biofilm formations on them which allows its adherence on smooth surfaces.[7–9] The biofilms are mostly resistant to the case solutions and hence allow the transfer of pathogenic organisms to the lens surface. The most common organisms responsible for biofilm formation are Serratia marcescens, Pseudomonas aeruginosa, and Staphylococcus aureus. Moreover, there is an association between the culture of contact lenses and corneal scrapings in contact lens-related microbial keratitis, they help to know the organism causing keratitis in cases of culture-negative corneal samples.[10] CLs are an important cause of the development of keratitis due to *Pseudomonas, Serratia*, and *Staphylococcus*.[11,12] Even after the presence of multiple defence mechanisms, healthcare workers are exposed to a vast array of microorganisms. Although colonization of pathogens is most commonly transient, it also depends upon the microbial load causing contamination.

This study aims to assess the microbial contamination in different types of contact lenses, their storage case, and lens case solutions and compare the outcomes with other studies on healthcare workers and the general population.

2. Materials and Methods

This is a cross-sectional study, conducted over a period of 2 months. 100 contact lenses, their cases, and lens case solutions were collected from 50 healthcare professionals and students. These included 32 medical students, 14 doctors, 2 dental students, 1 physiotherapy student, and 1 OT staff.

Individuals who had used lenses for at least 3 hours in the hospital were included in the study and given a questionnaire to enquire about the duration of use, hygiene, care, and compliance with the instructions for regular disposal.

Sterile cotton swabs were used to collect the samples from the surface of lens, lens cases and lens solutions. The collected samples were subjected to investigations which included gram staining, KOH mount and culture using blood and potato dextrose agar.

Table 1: Questionnaire (Annexure 1)

	Questionnaire:
1.	Age and gender :
2.	Type of lens and solution used (or the company name):
3.	Duration of use of the lens in a day:
4.	Number of years of using contact lenses:
5.	Power of the lens :
6.	Lens care regimen (in yes/no):
	a. Is the case replaced within the time instructed by the manufacturer?
	b. Are the lens case and lens washed with a multipurpose solution?
	c. Is water used to clean the case instead of a multi-purpose lens solution?
	d. Is the lens used while bathing?
	e. After cleaning the case, is it left to air dry, upside down?
	f. Is the lens worn during sleeping?
	g. Is hand washing a regular practice before inserting and removing the lens?
7.	Any previous complications due to the use of the lens:
8.	Amount of solution approximately used to store the lens after use:
9.	What was the reason for shifting from spectacles to lenses or the reason for preferring contact lenses:
10.	Are the lenses used colored?
11.	Any previous symptoms observed like redness, itching, discomfort, or watering while using the lenses?

2.1. Public and patient involvement

The study did not involve patients or members of public in the design, conduct or reporting or dessimination of plans.

3. Results

Our study included a total of 300 samples from 50 subjects, which included 100 contact lenses, 100 lens cases and 100 lens care solutions. Age group ranged between 20-30years years with 43 females and 7 males. Among these 5 subjects used coloured contact lenses.

Out of the total collected samples, 30 lenses, 30 lens cases, and 6 lens care solutions showed positive growth.

Out of 100 lenses and lens cases, 56 yielded bacterial growth and 4 fungal growth. Among the 56 showing bacterial growth, 44 showed growth with *pseudomonas aeruginosa* (44%), 8 showed *Klebsiella pneumonia* (8%),8 showed *Enterobacter* species (8%),4 showed *staphylococcus aureus* (4%). Among the fungal growth, 4 lenses and lens cases showed candida albicans.

A combined growth of *Pseudomonas aeruginosa* and *Enterobacter* was isolated from a single subject's contact lens. Another sample showed growth of *Pseudomonas* and *Klebsiella*.

Among 100 lens solutions, 6 showed bacterial growth with *Pseudomonas aeruginosa.* But 2 out of these 6 samples showed *staphylococcus aureus* growth in their corresponding lenses and lens cases culture and 1 showed *Candida albicans* growth from lens and lens cases.

Predominant bacteria isolated from lenses, lens cases, and their lens care solutions were *Pseudomonas aeruginosa* followed by *Klebsiella pneumonia*. *Enterobacter species* were isolated from only lenses, and cases, and not solutions.

4. Discussion

Our study collected 100 contact lenses from 50 subjects. There was a female predominance with 43(86%) females and 7(14%) males similar to other studies.[13,14] 30 subjects (60%) used monthly disposable lenses, 12 (24%) used daily disposable lenses, 7 (14%) used yearly disposable lenses and 1 (2%) used biweekly disposable lenses.[15] The average duration of contact lens usage was 12-18 hours per day in 35(70%) subjects. 37(74%) subjects used rigid gas permeable lenses and 13(26%) subjects used soft contact lenses.

The most common indication for using contact lenses was cosmetic and convenience purposes (84%), ease of using a microscope during a procedure (20%) and prevent fogging while wearing a mask (10%). Many studies also reported cosmetic purpose as the most common cause of contact lens usage.[13,14]

In our study, the most common complaint among the participants was acute red eye (35%), which was concordant with the findings reported from studies done in Brazil and the USA.[15,16] 26% had foreign body sensation, 10% had both redness and itching, 4% blurred vision and 2% complained of recurrent stye. These results were less compared to other studies. This may be because the majority of our subjects used daily or monthly disposable lenses.

Out of the 50 subjects 76% of subjects showed compliance with the instructions given by the manufacturer regarding its use and disposal. 64% washed their hands before the application and removal of contact lenses. 24% have worn their lenses for a duration more than indicated, seen in subjects using monthly disposable lenses. 50% subjects used lenses while bathing. These findings are similar to other studies.[17–21] However two of these studies mentioned contact lens usage while swimming, which was not observed in our study.[19,20] Good compliance was noted in lens hygiene practices due to a better understanding of the ill effects as the study subjects were mostly healthcare professionals and from allied sciences.

Negligence towards care of lens case and lens case solutions was found to be more common among contact lens users. Only 20% of our subjects have shown to replace the lens case within the recommended time. 26% wash their cases with the care solution and air dry the case before using them while 50% wash their cases with water and do not let them dry,60% of participants follow hand washing protocol before handling their lenses. Such negligence towards hygiene has also been seen in other studies.[19–21]

Key risk factors include overnight wear, failing to wash and dry hands before handling lenses, and poor storage case hygiene practices. The strong link between microbial keratitis and storage case hygiene and replacement suggests the relevance of microbial contamination in the storage case.[22] Failing to rub the contact lens prior to storage in the case has been found to be a risk factor for Acanthamoeba keratitis.[23] The 12 (24%) subjects who were using daily lenses disposed of their lenses on the same day after use. Daily disposable contact lenses if disposed off daily as recommended might have a lower risk of infection. Although few daily disposable contact lens wearers did not use a case, thereby avoiding potential contamination associated with the case. Moderate and severe microbial keratitis associated with daily use of lenses was independently associated with factors likely to cause contamination of CL storage cases (frequency of storage case replacement, hygiene, and solution type).[24]

80% subjects changed their lens solutions every night before storing the lens without using water to clean it. This was much better than the scenario seen in other studies.[19,20]

Napping with contact lenses on was seen in 36 (60%) of our participants and 4 (8%) of them have reported to have slept overnight wearing them. However, it is lower than the reports from the USA(87.1%) and Maldives (27%) where more students have napped with lenses which may be because some lenses have been approved for extended wear.[16,17] Microbial keratitis was shown to significantly increase by 9.2-20.9 per 10000 users(0.15%) in overnight soft contact lenses usage and 2.2-4.5 per 10000(0.03%) among daily contact lens users.[25] This has been shown to contribute to 0.5% of microbial keratitis among daily CL users.[26]

One of the most grave complications of contact lens usage is microbial keratitis. Microbial keratitis leading to corneal ulcers is among the top five leading causes of blindness worldwide.[27] A UK-based study found that contact lens user had 80 times higher risk of developing microbial keratitis than the general population.[28,29] Therefore eliminating or minimising the risk factors is desirable.

Table 2: Showing the microbiological profile of contact lenses, lens cases, and lens care solution

Age/sex	Designation	Duration of usage of contact lenses	Eye- right, left	Organism isolated from lenses and lens cases	Organism isolated from lens care solution	Direct Gram stain of lenses, lens cases and lens care solution	Direct KOH of lenses, lens cases and lens Care solution
23F	Student	14-16 hours	Both	Candida albicans	NG	No inflammatory cells, budding yeast cells seen (L and LC) No cells no organism(LS)	Budding yeast cells seen
22F	Student	4-6 hours	Both	Pseudomonas aeruginosa	NG	Occasional inflammatory cells, few gram-negative bacilli seen (L and LC), No cells no organism(LS)	No fungal elements seen
22F	Student	8 hours	Both	Pseudomonas aeruginosa	NG	Few epithelial cells no inflammatory cells, few gram-negative bacilli seen(L and LC), No cells no organism(LS)	No fungal elements seen
21F	Student	8-10 hours	Both	Pseudomonas aeruginosa	NG	Occasional inflammatory cells, gram-negative bacilli seen(L and LC), No cells no organism(LS)	No fungal elements seen
20F	Student	9 hours	Both	Pseudomonas aeruginosa	NG	No cells Occasional gram-negative bacilli seen(L and LC), No cells no organism(LS)	No fungal elements seen
24F	Intern	12 hours	Both	Pseudomonas aeruginosa	NG	Occasional epithelial cells, few gram-negative bacilli seen(L and LC), No cells no organism(LS)	No fungal elements seen
25F	Post graduate	12 hours	Both	NG	Pseudomonas aeruginosa	No cells no organism (L and LC), Occasional inflammatory cells, Occasional long gram-negative bacilli seen (LS)	No fungal elements seen
22F	Student	9 hours	Both	Enterobacter species	NG	Occasional inflammatory cells few short gram-negative bacilli seen(L and LC), No cells no organism(LS)	No fungal elements seen
22F	Student	12 hours	Both	Pseudomonas aeruginosa	NG	Few inflammatory cells thin long gram-negative bacilli were seen(L and LC), and No cells no organism(LS)	No fungal elements seen

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Table 2 continued

22F	Student	14 hours	Both	Staphylococcus aureus	Pseudomonas aeruginosa	Few inflammatory cells, few gram-positive cocci seen in singles(L and LC), occasional gram-negative bacilli seen (LS)	No fungal elements seen
25F	Post graduate	8-12 hours	Both	Pseudomonas aeruginosa	NG	In occasional epithelial cells, a few gram-negative bacilli were seen (L and LC) No cells no organism(LS)	No fungal elements seen
22F	Student	10 hours	Both	NG	Pseudomonas aeruginosa	No cells no organism (L and LC), Occasional epithelial cells Occasional gram-negative bacilli seen (LS)	No fungal elements seen
22F	Student	9 hours	Both	Pseudomonas aeruginosa	NG	No cells occasional gram-negative bacilli seen (L and LC), No cells no organism (LS)	No fungal elements seen
22F	Student	8 hours	Both	Klebsiella pneumoniae	NG	Few epithelial cells short gram-negative bacilli seen (L and LC) No cells no organism(LS)	No fungal elements seen
22F	Student	8 hours	Both	Enterobacter species & Pseudomonas aeruginosa	NG	Few inflammatory cells, gram-negative bacilli seen (L and LC), No cells no organism(LS)	No fungal elements seen
21F	Student	7 hours	Both	Pseudomonas aeruginosa	NG	Occasional epithelial cells no inflammatory cells, few gram-negative bacilli seen(L and LC) No cells no organism(LS)	No fungal elements seen
24F	Student	7 hours	Both	Klebsiella pneumoniae & Pseudomonas aeruginosa	NG	Few epithelial cells Occasional +++++++inflammatory cells short gram-negative bacilli thin long gram-negative bacilli seen (L and LC) No cells no organism(LS)	No fungal elements seen

All the participants in our study were asymptomatic and none showed any signs of infection. The most common organism was found to be *Pseudomonas aeruginosa* in 22(44%) lenses and lens cases followed by *Klebsiella pneumoniae* in 8 (8%), *Enterobacter species* in 8 (8%), *Staphylococcus aureus in 4 (4%)*, and *Candida albicans in 4 (4%). Both Pseudomonas aeruginosa and Enterobacter species* were isolated from 1 subject's contact lens and lens case, and *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* were isolated from 1 more subject's contact lens and lens case. Other studies have also found polymicrobial growth in lenses and their case.[29] In a South Indian study that included both asymptomatic and symptomatic patients, micrococci were the most offending microorganism followed by Bacillus, diphtheroids, and CONS, contrary to our study, and 1fungal growth of non-Albicans Candida was found in a symptomatic patient.[29] 6 lens care solution showed bacterial growth with *Pseudomonas aeruginosa*. Similar results were observed in other studies and *pseudomonas* was found when the solution was less frequently changed.[28] There was no growth of *Enterobacter* in the lens care solutions of our subjects.

5. Conclusion

Most of the healthcare workers have been following the recommended lens care regimen. The most common organism isolated was *Pseudomonas aeruginosa* followed by *Klebsiella pneumoniae, Enterobacter species*, and *Staphylococcus aureus* with few showing the presence of *Candida species*. A similar microbiological profile was also noted in the general population with *Pseudomonas* and *Staphylococcus* being the most common organisms. Our small sample size could be one of the limitations of this study. Despite being health care professionals, laxity towards contact lens hygiene was found to be common globally .Contact lens complications are of serious nature, hence awareness on care and hygiene must be created among the health care professionals given to the more virulent nature of the pathogens they are exposed to.

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None.

7. Conflict of Interest

None.

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