

Earrings: an obscured source of cross- contamination in Dental Clinics of

India

Commented [MM1]: You must be consistent throughout the entire document about how you spell earrings: You have earrings, ear rings, and ear-rings...pick one spelling and stick with it for consistency.

ABSTRACT:

Purpose: This study aimed to check for the bacterial contamination of ear-rings worn by female dentists involved in direct patient care. **Method:** This cross-sectional microbiological study was carried out among female dentists working in clinical departments of a tertiary care dental hospital. A questionnaire concerning awareness regarding the donning of ornaments as possible source of contamination was administered. It also included questions on measures taken to prevent cross contamination through earrings and methods for disinfection of earrings used if any. Two swabs from each participant were taken, one from the ear-ring and other from the underlying skin site using a sterile microbial swab moistened in saline. The samples were then dispensed into 1 ml of sterile water by vortexing for 45s. The vortexed sample was then inoculated onto Blood Agar. The inoculated plates were incubated for 24 hours at 37°C aerobically. Further examination was done for the count of bacteria, type of bacteria and antibiotic sensitivity. **Result:** In total 90 swabs, 45 each from earring and underlying skin were cultured for microorganisms. All the (100%) samples were positive for bacterial contamination. The swabs obtained from underlying skin sites were found to have significantly higher microbial load. (p-value = 0.008). Sixty two percent (62%) of the participants were aware of earrings being a possible source of contamination and 55% had the knowledge that ornaments are supposed to be removed while working in patient clinics. Only 5% practiced removing the ornaments which included bangles/bracelets, rings and watches. None reported to have removed earrings while working in clinics.

Conclusion: The results of this study show that earrings are potential source of cross contamination in dental setting. This can act as nidus for colonization of bacteria and possible source for nosocomial infections and pathogenic transmission.

Keywords: Bacterial contamination, Earring, Female Dentists, Dental Clinic, Cross-Contamination

Commented [MM2]: Insert "a" before dental.

UNDER PEER REVIEW

INTRODUCTION

Body piercing has been practiced by many for religious and other purposes across the globe. Piercing has become increasingly popular in recent years. Navel, the nipples and ears are the most common site of piercing.[1] Most commonly adorned ornaments are rings, necklaces, earrings and bangles. It may be made from any material, precious and semi-precious metals, gems etc. Factors that decide the choice of materials include cultural differences, availability and affordability.[2]

Commented [MM3]: Change to "The navel, nipples,..."

Commented [MM4]: Change to "sites"

Ornaments are used differently in different sections of society. The reasons vary from way of showing wealth to functionality of the ornament like keeping hair in place. These have been designed to adorn every part of body.[3] Thus, making intimate contact with the skin or body of the person. As a result, they serve as site of easy colonization by bacteria and fungi thereby serving as fomites. These organisms get settled on jewelry using glycocalyx and develop into a bio film on or around the jewelry.[4]

Commented [MM5]: Add "the" before functionality

Commented [MM6]: Insert "a" before site

Disparate suggestions have been made that jewelry items could be colonized by nosocomial pathogens and can serve as a nidus of microbial contamination.[5] Hence sanitization of jewelry gains considerable importance.

Commented [MM7]: Change to "Different"?

Jewelry and Indian women are inherently connected. It is customary to gift jewelry to women during wedding and other festivals.[6] However, infection control in dentistry has remained majorly confined to adherence to hand hygiene practices. The National Association of Theatre Nurses (NATN) suggests that all jewelry should be removed before any surgical procedure.[6] Although rings and watches are removed by most dental surgeons, many females those who are working in hospitals do not remove their ear-rings or necklaces.

There are very few studies that report bacterial contamination of ornaments worn by females working in the hospital. Moreover, despite some evidence that ear-rings when worn in hospitals may get colonized by microbes, there is great dearth of literature to suggest that viable

bacteria develop a bio film around the skin surface with potential of causing infections. This establishes the need to conduct study substantiating the role of earrings worn by female dentists in direct patient care as potential source of contamination.

MATERIALS AND METHODS

The present cross-sectional study was conducted from January 2018 to July 2018. Ethical approval was obtained from University Ethics Committee (IEC no SVIEC/ON/DENT/SRP/17124). Ninety samples (forty-five each from ear ring and underlying skin) were taken from female dentists working in clinical departments of a tertiary care dental hospital, Vadodara. The sample included swabs from under graduate students, dental interneees and post graduate trainees involved in direct patient care. A questionnaire was administered to assess the knowledge regarding infection control practices with respect to wearing ornaments in clinics. The questionnaire was pretested on 5 subjects who were not a part of final sample. The test-retest reliability was found to be 0.78. The Cronbach's α for internal consistency was 0.76.

Two swabs from each participant were taken from the consenting participants using a sterile microbial swab moistened in saline. One swab was taken from ear-ring adorned in the right side ear lobe to maintain consistency and other from its underlying skin site. The investigator wore a new pair of sterile gloves when taking the swab from each participant. All the participants were assigned a number to maintain anonymity. The collected swabs were placed into separate sterile self- lock clear plastic poly bags and numbered according to the numbers allocated to the participants. After collection, the poly bags were transferred to the department of Microbiology. The samples were then dispensed into 1 ml of sterile water by vortexing for 45s. The vortexed sample was then inoculated onto Blood Agar. The inoculated plates were incubated for 24 hours at 37°C aerobically. Examination was carried out for

estimation of total bacteria count and the presence of pathogenic and non-pathogenic bacteria. The resultant colonies and also the number of bacteria present in colony forming units per ml (CFU/ml) was then counted. Several microbiological tests were performed for the identification of different types of bacteria such as Coagulase test, biochemical test, Antibiotic sensitivity test, Methicillin resistance staphylococcus aureus. Data from returned questionnaires were analyzed with SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp. Comparisons of data sets were performed using the student's t-test and the chi-square test; $p \leq 0.05$ was considered statistically significant.

RESULTS

Two swabs were collected from each participant (45), one each from ear-ring and underlying skin site. All the swabs (90) were found positive for bacterial contamination. The swabs obtained from underlying skin sites were found to have significantly higher microbial load. (Table 1).

Table 1: - Bacterial Contamination rate and Bacterial Load from earrings and skin sites:

		Ornaments [n (%)]	Skin [n (%)]	p- value
Bacterial Contamination	Yes	45 (100%)	45 (100%)	
	No	0 (0%)	0 (0%)	
Mean CFU*		193.53	2076.40	0.008*

*student's t -test, $p < 0.05$: statistically significant

The post graduate students presented with significantly higher mean CFU of micro-organisms when compared to the undergraduate trainees. Only 62% participants were aware of the ornaments being a possible source of contamination in clinics and 55% knew that the

ornaments should be removed before starting clinical procedures. Only 6% of the subjects practiced removing the ornaments (bangles and finger rings) before starting clinical procedures. However, none reported to having removed the earrings while working in clinics. (Table 2)

Table 2: Knowledge of dental trainees with regards to Contamination of Ornaments:

Questions	Responses Yes [n (%)]		Total	
	Undergraduate	Interns/ Post-Graduate		
1. Do you know that ornaments can be a potential source of contamination	Undergraduate	11(24.4%)	28(62.2%)	
	Interns/ Post-Graduate	17(37.7%)		
2. Do you know you should remove your ornaments before starting your clinical procedures	Undergraduate	9(20%)	25(55.5%)	
	Interns/ Post-Graduate	16(35.5%)		
3. Do you remove your ornaments before starting your clinical procedures	Undergraduate	0	3(6.66%)	
	Interns/ Post-Graduate	3(6.66%)		
		Bangles		Rings
		1(33.3%)	2(66.6%)	

Bacillus species was the most common bacterial isolate obtained from the swabs, 31% and 26% respectively from earring and skin. Diptheroids was isolated from 2 earring (4.4%) and 4 skin swabs (8.8%). Total of 11 samples were found to be contaminated with coagulase negative Staphylococcus (CoNS) and 20 swabs with Methicillin Resistant S. aureus. Enterococci was the contaminant in 5(11.1%) of the samples from earrings and 6 (13.33%) from skin.

Two swabs from earrings and 3 from skin were found positive for Pseudomonas.

Commented [MM8]: Spell out "Three" to be consistent with the Two?

Enterobacteriaceae was isolated only from earrings (4.4%) and E. coli only from skin (2.2%). It has been observed that all the samples were positive for contamination. But there was no statistically significant difference in the type of bacterial contamination of earrings and underlying skin sites. (p value= 0.79) (Table 3)

Table 3: Contamination of skin and earring with potentially pathogenic bacteria:

Bacteria	Ornaments	Skin sites	Total	p-value
Bacillus species	14 (31.1%)	12 (26.6%)	26 (57.7%)	0.79
Diphtheroids	2 (4.44%)	4 (8.88%)	6 (13.3%)	NS
Coagulase negative	6 (13.3%)	5 (11.1%)	11 (24.4%)	NS
<i>S. aureus</i>	9 (42.2%)	11(24.4%)	20 (44.4%)	NS
Enterococcus sp	5 (11.1%)	6 (13.33%)	11 (24.4%)	NS
Pseudomonas sp.	2 (4.44%)	3 (6.66%)	5 (11.1%)	NS
<i>E. Coli-</i>	0	1 (2.22%)	1 (2.22%)	NS
Enterobacteriaceae	2 (4.44%)	0	2 (4.44%)	NS
Non Enterobacteriaceae	5 (11.1%)	3 (6.66%)	8 (17.7%)	NS

DISCUSSION

Healthcare associated infections (HAIs) are of considerable public health significance. Micro-organisms that cause HAIs can get transmitted from patients, healthcare professionals or the hospital environment. The mode of transmission of microorganisms can be direct or indirect contact and health care workers are invariably the most common channel for transmission. The World Health Organization, Centre for Disease Control considers hand

Commented [MM9]: Change to "be"

Commented [MM10]: Change to "to"

hygiene to be very important for prevention of transmission of microorganism through contact. The relevance of hand hygiene has only become even more important since the emergence of SARS- Cov.[7] There have been discrete and isolated guidelines that recommend removal of jewelry. But, the evidence supporting these recommendations may remain to be inconclusive.

Commented [MM11]: Need a reference for these sentences.

Increased atmospheric contamination during routine dental activity with various microorganisms has been scientifically established for some time.[8] Researches conducted to assess this s environmental hazard have emphasized on the gravity of this potential source of cross-contamination.[9] The bacteria associate with and settle on surfaces available, when they remain suspended in atmosphere. This in dental set up is mostly due to aerosol generation. Thus, in these settings, especially aerosol generating dental clinics, the source of contamination is not just the hands of the healthcare personnel as reported by Brady et al. but also the atmospheric contamination.[10]

Commented [MM12]: Remove "es"

Commented [MM13]: Change to "these"

Commented [MM14]: Remove "on"

Commented [MM15]: particularly?

Commented [MM16]: Remove extra space

The present study was done to check for probable bacterial contamination of ear-rings worn by female dentists working in dental clinics. The study revealed that ear-rings worn by female dentists involved in direct patient care harbour variety of pathogenic and non-pathogenic bacteria. The mean bacterial count recorded from ear-rings was 3.59×10^5 CFU/ml. The common bacteria identified from ear-rings and underlying skin sites were *Bacillus species*, *Diphtheroids*, *Staphylococci*, *Enterococcus sp*, *Pseudomonas sp*, *E. Coli*, *Enterobacteriaceae*, *Non Enterobacteriaceae*. Studies in past have been majorly conducted on contamination of necklaces and hand ornaments.

Commented [MM17]: Insert reference

Staphylococcus aureus was the most common type of organisms in samples from ear-rings. The second most common organism was *Bacillus species*. The occurrence of bacteria on jewelries suggests a plausible relationship with sites with greater moisture and inaccessibility to routine hygiene practices. The presence of the *Staphylococci*, *S. pyogenes*, *Pseudomonas sp*, *Corynebacterium sp.*, can be attributed to colonization of the jewelry by microorganisms

commonly found on skin, while source of the Bacilli, *E. coli*, *MRSA* is likely to be from the environment.

There was no statistically significant difference observed in the type of pathogenic bacteria isolated from ornaments and underlying skin sites. However, significant difference was found in bacterial load of ornaments and underlying skin sites and between the samples obtained from undergraduates and postgraduates. Post Graduate students had significantly higher microbial load compared to the undergraduate trainees possibly because of greater exposure to patient care and longer duration of work.

There have been recommendations on removal of all hand and facial jewelry for the health care team working in surgical units. It has been suggested that surgical team members should remove all jewelry prior to entering the Operating Room. Considering the threat of cross contaminating the patient by microbes which could have colonized under the ornaments, the health care personnel should remove all forms of ornaments.[11],[12],[13] It has also been stressed upon removal of ant jewelry before entering the operatory to avoid skin desquamation and preventing from falling in sterile field. [12] Moreover, the jewelry that is not removed and remains exposed acts as a surface for the microbes to engage on. It also poses the risk of getting contaminated with blood, or other potentially infectious materials, and serve as a source of cross-contamination. There are however, no guidelines on removal of ornaments other than associated with hand while working in dental clinics. Despite evidences on bacterial atmospheric contamination in dental clinics, posing to be an environmental hazard, the infection control protocols have largely remained confined to hand hygiene only.

The following recommendations may be made considering the significance of infection control in healthcare settings. The dental institutions should take initiative to develop a standard operating protocol for infection control practices. Sensitization and training of students towards the best practices for infection control to safeguard the health of doctors and patients. Dental

Commented [MM18]: Change to
"The removal of any jewelry before entering the operatory has been stressed..."

education can be used as a conduit for training and helping students conform to the guidelines laid down. Principles of occupational and safety can be introduced at entry level as it applies to dentistry before the students come in contact with patients. The wearers of ornaments should be encouraged to **sanitize** their ear-rings and other ornaments regularly. Thirdly, guidelines to be drawn and implemented stringently making it mandatory to remove all jewelry before proceeding to the surgical procedure in dental clinics to avoid any cross contamination. Health Care Providers should remain adept with the changing guidelines and good practices on hand hygiene. [14]

Commented [MM19]: sanitize

Limitations of the study are, firstly the small sample size due to which significant differences in bacterial contamination of skin sites and ear-rings possibly could not established. Secondly, the sweep plate method could have been better method of obtaining samples. However, irrespective of the method of swab collection, it has been established that the ornaments were contaminated with potentially pathogenic organisms. And these could possibly serve as fomites for cross contamination.

The study reinstates the significance of transmission of microorganisms from skin as a potential source of cross-contamination in the hospital based environment. Jewelry and underlying skin can be a site of microbial colonization that could possibly be a source of hospital acquired infection. Hand hygiene is the most stressed upon preventive measure in current era.[15] This hand hygiene practice should be expanded to include awareness on the consequences of wearing jewelry in the clinical workplace and acting as a potential source of cross contamination. Studies on UV-light sanitizers and other methods to sanitize jewelry made of metals are also suggested.

Conclusion:

It can be concluded from the findings of the study that earrings like any other hand and face ornament can act as source of possible cross contamination. The awareness on removal or disinfection of earrings among female dentists is very low. Considering the emergence of newer infectious diseases especially post the SARS-CoV 2 pandemic, importance of infection control in hospital settings has gained highest priority. Dental clinics are high risk zones for spread of infections through aerosols. Therefore, it becomes imperative to practice best preventive measures to prevent the spread of infection and cross contamination. A uniform operating procedure regarding the removal of all the ornaments from hands and face before entering the dental operatory is recommended. There is also a need to sensitize the health care workers on possible risks posed by wearing of ornaments in dental clinics.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

REFERENCES:

1. Ziebolz D, Hornecker E, Mausberg RF. Microbiological findings at tongue piercing sites: implications to oral health. *Int J Dent Hyg.* 2009 Nov;7(4):256-62. doi: 10.1111/j.1601-5037.2009.00369.x. PMID: 19832912.

2. Isitua C.C., Igbini O.F., Imariabe O.J. Microorganisms associated with Gold Jewellery Worn by Students in the University of Benin, Ugbowo Campus, Nigeria. *Res. J. Recent Sci.*, 2012 May; 1,(5): Pages 46-50.
3. Yildirim I, Ceyhan M, Cengiz AB, Bagdat A, Barin C, Kutluk T, Gur D. A prospective comparative study of the relationship between different types of ring and microbial hand colonization among pediatric intensive care unit nurses. *Int J Nurs Stud.* 2008 Nov;45(11):1572-6. doi: 10.1016/j.ijnurstu.2008.02.010. Epub 2008 May 13. PMID: 18479684.
4. Cogen AL, Nizet V, Gallo RL. Skin microbiota: a source of disease or defence? *Br J Dermatol.* 2008 Mar;158(3):442-55. doi: 10.1111/j.1365-2133.2008.08437.x. PMID: 18275522; PMCID: PMC2746716.
5. Syeed I.B., *Islamic Medicine: 1000 Years Ahead of its Times*, Journal of International Society. 2002; 12(2): 2 – 9
6. Muniraj.S. Significance of jewellery in India: a study. *Asia Pacific Journal of Research.* 2015; 1(30):177-183.
7. Evidence for hand hygiene guidelines. Geneva (CH): World Health Organization; 2017. Available from: http://www.who.int/gpsc/tools/faqs/evidence_hand_hygiene/en/
8. Williams HN, Singh R, Romberg E. Surface contamination in the dental operator: a comparison over two decades. *J Am Dent Assoc.* 2003 Mar;134(3):325-30; quiz 339. doi: 10.14219/jada.archive.2003.0161. PMID: 12699046.
9. Brady RR, Verran J, Damani NN, Gibb AP. Review of mobile communication devices as potential reservoirs of nosocomial pathogens. *J Hosp Infect.* 2009 Apr;71(4):295-300. doi: 10.1016/j.jhin.2008.12.009. Epub 2009 Jan 24. PMID: 19168261.

Commented [MM20]: defense

Commented [MM21]: correct spelling

10. Singh S, Acharya S, Bhat M, Rao SK, Pentapati KC. Mobile phone hygiene: potential risks posed by use in the clinics of an Indian dental school. *J Dent Educ.* 2010 Oct;74(10):1153-8. PMID: 20930247.
11. Kelsall NK, Griggs RK, Bowker KE, Bannister GC. Should finger rings be removed prior to scrubbing for theatre? *J Hosp Infect.* 2006 Apr;62(4):450-2. doi: 10.1016/j.jhin.2005.09.002. Epub 2006 Feb 17. PMID: 16487627.
12. Linkin DR, Lautenbach. Environmental safety in the OR. 2004. <https://psnet.ahrq.gov/webmm/case/47/environmental-safety-in-the-or-#references>.
13. Association of Surgical Technologists. AST Guidelines for Best Practices for Surgical Attire, Surgical Scrub, Hand Hygiene, and Hand Washing. 2008.
14. Association of Surgical Technologists. AST continuing education policies for the CST and CSFA. 2005.
15. Pittet D. Improving adherence to hand hygiene practice: a multidisciplinary approach. *Emerg Infect Dis.* 2001 Mar-Apr;7(2):234-40. doi: 10.3201/eid0702.010217. PMID: 11294714; PMCID: PMC2631736.