

## ORIGINAL RESEARCH

# The Incidence and Nature of Fingernail Flora after Routine Pre-operative Hand Scrubbing

Rohan Sohoni<sup>1</sup>, Ajit V Koshy<sup>2</sup>, Amrita Manish Bhatia<sup>3</sup>, Ameera Mulla<sup>4</sup>, Anagha Kochar<sup>5</sup>, Sana Shaikh<sup>6</sup>

## ABSTRACT

**Background:** Nail folds and subungual are areas where bacteria can remain even after effective washing. The presence of the pathogenic bacteria will cause contamination through the fingernails. Infected hand of the health-care personnel is the main cause of spread of these infections. These can be passed from the hospital employees to the patients resulting in nosocomial infections. Gram-positive and some Gram-negative bacteria are found which remain stable.

**Aim and Objectives:** The study was to investigate the incidence and nature of fingernail flora after routine pre-operative hand scrubbing.

**Materials and Methods:** Fifteen consecutive patients were studied. After scrubbing with betadine/soap solution for 10 min, the patients' nails of all digits were trimmed. Gram staining of the isolates was performed. Fungal cultures were done by plating the suspension onto Sabouraud's agar slants and incubating at 30°C for up to 4 weeks with weekly observations.

**Results:** Fingernail isolates from the 15 patients varied. Some patients had more than one type of microorganism (i.e. bacterial, mold, and yeast) and others had several different species of the same type. Microscopic observations revealed the presence of fungi: *Mucor* sp., *Aspergillus* sp., *Penicillium* sp., and yeast *Candida*.

**Conclusions:** The study has shown the presence of bacteria in high frequency in and around fingernail. In spite of adequate pre-operative hand scrubbing, the fingernails were heavily contaminated.

**Keywords:** Contamination, Fingernail flora, Hand hygiene, Health-care personnel, Pre-operative hand scrubbing.

**How to cite this article:** Sohoni R, Koshy AV, Bhatia AM, Mulla A, Kochar A, Sohoni SS. The Incidence and Nature of Fingernail Flora after Routine Pre-operative Hand Scrubbing. *Int J Prev Clin Dent Res* 2018;5(2):56-58.

<sup>1,5,6</sup>Post Graduate Student, <sup>2</sup>Professor, <sup>3</sup>Assistant Professor, <sup>4</sup>Senior Lecturer

<sup>1,2,4-6</sup>Department of oral Pathology and Microbiology, M.A Rangoonwala College of Dental Sciences and Research Centre, Pune, Maharashtra, India

<sup>3</sup>Department of Microbiology, Abeda Inamdar Senior College, Pune, Maharashtra, India

**Corresponding Author:** Dr. Rohan Sohoni, Post Graduate Student, Department of oral Pathology and Microbiology, M.A Rangoonwala College of Dental Sciences and Research Centre, Pune, Maharashtra, India. e-mail: id sohnirohan77@gmail.com

**Source of support:** Nil

**Conflict of interest:** None

## INTRODUCTION

The human body surface is constantly in contact with environmental microorganisms and becomes readily colonized by certain microbial species, Gram-negative and Gram-positive pathogens in clinical specimens.<sup>[1-4]</sup> It can cause a variety of community- or hospital-acquired infections, including those of the urinary tract, respiratory tract, wounds and burns, bacteremia, neonatal meningoencephalitis, empyema, and osteomyelitis.<sup>[5]</sup> The hand serves as a major vehicle of transmission of various microbes, including the enteric species. About 5% of all patients admitted to hospitals develop a nosocomial infection. Contaminated hands of health-care personnel are reported as a major route for the spread of nosocomial infections.<sup>[6]</sup> Nevertheless, little importance has been given to relevant factors which control the survival of microorganisms on the hands. The degree of hydration of the epidermis is one of the most significant factors in the control of bacterial flora on the skin.<sup>[7-10]</sup> Gram-negative bacteria such as *Pseudomonas* spp. or Enterobacteriaceae are more sensitive to drying than Gram-positive *Streptococcus pyogenes* or *Staphylococcus aureus*.<sup>[11]</sup> There are few reports on the survival of these organisms when artificially applied to hands.<sup>[12]</sup> The objective of the present study was to investigate the incidence and nature of fingernail flora after routine pre-operative hand scrubbing of the patients.

## MATERIALS AND METHODS

Fifteen consecutive patients were studied. There were 10 females and 5 males. Their ages ranged from 19 to 22 years. The doctors who scrubbed the patients' hands were not aware of the study and did not specifically instruct them to trim and cleanse the nails. After scrubbing with betadine/soap solution for 10 min, the patients' nails of all digits were trimmed. The nails were placed on a sterile moist gauze pad in a plastic container and delivered to the microbiology laboratory for culture within 30 min after collection.

In the laboratory, the nails were observed macroscopically for dirt and other materials. Then, they were placed in a sterile 13 mm × 100 mm glass, screw-cap test

tube that contained 1.0 ml of sterile deionized water. The nails and water were vortexed for 30 s to loosen and suspend debris. Bacterial cultures were quantitated as follows: Serial dilutions of the suspension were prepared and 0.1 ml sample of each dilution was plated on nutrient agar plate. The plates were then incubated at 37°C and observed daily for growth. Microorganisms were identified by conventional methods, and colony counts were taken (range 30–300 colony-forming unit /ml) as cultures became positive [Table 1]. The colonies were streaked on nutrient agar medium for isolation. [Figures 1 and 2]. Gram staining of the isolates was performed [Table 2]. Fungal cultures were done by plating the suspension onto Sabouraud's agar slants and incubating at 30°C for up to 4 weeks with weekly observations.

## RESULTS

Fingernail isolates from the 15 patients varied. There were 10 females and 5 males. Their ages ranged from 19 to 22 years. Some patients had more than one type of microorganism (i.e. bacterial, mold, yeast) and others had several different species of the same type. Microscopic

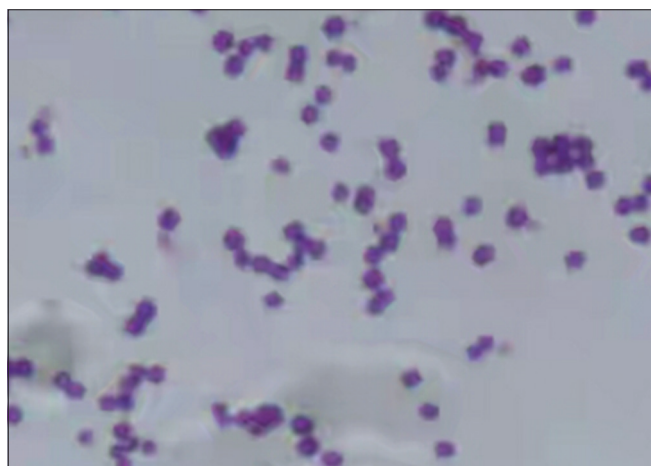


Figure 1: Gram staining of isolate 1

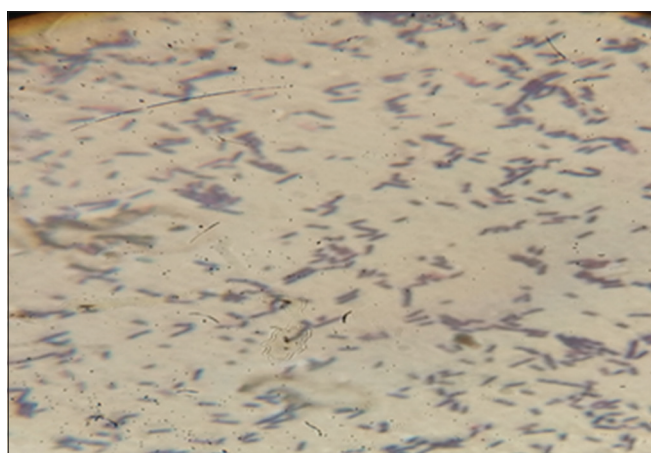


Figure 2: Gram staining of isolate 2

observations revealed the presence of fungi: *Mucor* sp., *Aspergillus* sp., *Penicillium* sp., and yeast *Candida*.

## DISCUSSION

Transient and resident bacterial flora can be passed from hospital employees to patients, resulting in nosocomial infections. Contaminated hands of health-care personnel are major vehicles for the spread of nosocomial infection.<sup>[13]</sup> Some Gram-positive microorganisms (e.g., *Staphylococcus*) are resistant to drying and can survive a long time on the hands of hospital personnel. Attempts have been made by some to reduce the number of bacteria residing on the hands, but the Gram-positive flora remains stable, regardless of changes in the external and physiologic environment.<sup>[14,15]</sup>

Rayan and Flournoy had reported heavy bacterial growth under fingernails that were more than 1 mm in length and showed that students with short fingernails (properly cut) had 64% bacterial contamination (bacterial count) and students with long fingernails showed more (67%) contamination of bacterial count on their hands.<sup>[16]</sup>

Lau *et al.* reported that long fingernail tends to harbor more microorganisms than short nails. Visibly clean nails were observed merely by the appearance of fingernails of students, showed the presence of 62% bacterial contamination on their hands.<sup>[17]</sup> Ray *et al.* observed a decrease in colony count following hand washing with soap in 60% of the samples.<sup>[18]</sup>

Tambekar *et al.* also observed that highest bacterial contamination (70%) was observed on the hands of the KG

Table 1: Microorganism colony count

Sample No.	10 <sup>-2</sup>	10 <sup>-4</sup>	10 <sup>-6</sup>	10 <sup>-8</sup>	CFU/ml
A	UC	UC	83	9	83×10 <sup>7</sup>
B	UC	UC	240	11	240×10 <sup>7</sup>
C	UC	UC	258	10	258×10 <sup>7</sup>
D	UC	UC	32	12	32×10 <sup>7</sup>
E	UC	8	7	5	-
F	UC	UC	43	27	43×10 <sup>7</sup>
G	UC	UC	233	33	233×10 <sup>7</sup>
H	UC	212	39	13	39×10 <sup>7</sup>
I	UC	UC	256	16	256×10 <sup>7</sup>
J	UC	22	13	7	-
K	UC	UC	234	43	234×10 <sup>7</sup>
L	UC	UC	157	39	157×10 <sup>7</sup>
M	UC	UC	47	21	47×10 <sup>7</sup>
N	UC	267	163	32	163×10 <sup>7</sup>
O	UC	UC	247	25	247×10 <sup>7</sup>

UC: Uncountable, CFU: Colony-forming unit

Table 2: Gram staining of isolates

Organism	Gram nature	Motility
<i>Staphylococcus</i> sps.	Gram-positive cocci	Non-motile
<i>Bacillus</i> sps.	Gram-positive bacilli	Motile

students followed by 67% on hands of primary students, 66% on secondary students, 64% on PG students, and least (57%) on the hands of undergraduate students.<sup>[19]</sup>

Ray *et al.* found that hand swab samples of 61% children harbor potential pathogens before taking food and also reported the presence of pathogenic microbes on the hands of the students which included *S. aureus*, *Escherichia coli*, *Enterococcus faecalis*, and *Klebsiella* spp.<sup>[20]</sup> Tambekar and Shirsat reported the presence of *E. coli*, *Pseudomonas* spp., *Proteus* spp., *Citrobacter* spp., *Klebsiella* spp., *Salmonella* spp., *Enterobacter* spp., and *S. aureus* from the hand swabs of students.<sup>[21]</sup> Chinakwe *et al.* also isolated *E. coli*, *S. aureus*, *Enterobacter* spp., *Klebsiella* spp., *Enterococcus* spp., *Pseudomonas* spp., *Shigella* spp., and *Corynebacterium* spp. from the handwash water samples.<sup>[22]</sup> Oniya *et al.* isolated microorganisms transmissible through handshake and also reported that the prevalence of microorganisms was higher in primary and secondary school students than in the undergraduate students.<sup>[23]</sup> The reduction in the number of pathogens after handwashing was also reported by Tambekar *et al.*<sup>[19]</sup>

Isolation of microorganisms from the fingernails of all the patients in our study indicates that fingernails can be a source of contamination and emphasizes the importance of nail hygiene in health care personnel to prevent nosocomial infections. The predominant bacteria residing on the fingernails were *Staphylococcus* and *Bacillus*; several molds and yeasts were also present.

These and other normally saprophytic organisms may become pathogens in the right environment (i.e., immunocompromised patients) and therefore should not be considered merely contaminants. In our study, *Staphylococcus* and *Bacillus* species appeared to be major inhabitants of the fingernails. Our report suggests that the patient's own nail flora might be responsible for some infections.

## CONCLUSIONS

The study has shown the presence of bacteria in high frequency in and around fingernail. In spite of adequate pre-operative hand scrubbing, the fingernails were heavily contaminated. Such organisms may become pathogens and should not always be considered contaminants. This study also confirmed the importance of pre-operative fingernail trimming and cleaning.

## REFERENCES

1. Boyce JM, Pittet D. Healthcare infection control practices advisory committee, HICPAC/SHEA/APIC/IDSA hand hygiene task force. Guideline for hand hygiene in healthcare settings. MMWR Morb Mortal Wkly Rep 2002;51:1-48.
2. Wycklicky H, Skopec M. Ignaz philipp semmelweis, the prophet of bacteriology. Infect Control 1983;4:367-70.
3. Classic Articles in Colonic and Rectal Surgery. On the antiseptic principle in the practice of surgery by joseph lister 1867. Dis Colon Rectum 1982;25:173-8.
4. Gröschel DH, Pruett TL. Surgical antisepsis. In: Block SS, editor. Disinfection, sterilization and preservation. 4<sup>th</sup> ed. Philadelphia, PA: Lea and Febiger; 1991.
5. Garner JS, Favero MS. CDC guideline for hand washing and hospital environmental control, 1985. Infect Control 1986;7:231-43.
6. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for prevention of surgical site infection, 1999. Hospital infection control practices advisory committee. Infect Control Hosp Epidemiol 1999;20:250-78.
7. Larson EL, Aiello AE, Heilman JM, Lyle CT, Cronquist A, Stahl JB, *et al.* Comparison of different regimens for surgical hand preparation. AORN J 2001;73:412-4, 417-8, 420.
8. Hajipour L, Longstaff L, Cleeve V, Brewster N, Bint D, Henman P. Hand washing rituals in trauma theatre: Clean or dirty? Ann R Coll Surg Engl 2006;88:13-5.
9. Guthery E, Seal LA, Anderson EL. Zinc pyrithione in alcohol-based products for skin antisepsis: Persistence of antimicrobial effects. Am J Infect Control 2005;33:15-22.
10. Seal LA, Rizer RL, Maas-Irslinger R. A unique water optional healthcare personnel handwash provides antimicrobial persistence and residual effects while decreasing the need for additional products. Am J Infect Control 2005;33:207-16.
11. Eickhoff TC. Nosocomial infections-a 1980 view: Progress, priorities and prognosis. Am. J. Med 1981;70:381-8.
12. Hart CA, Gibson MF, Buckles AM. Variation in skin and environmental survival of hospital gentamicin-resistant *Enterobacteria*. J Hyg 1981;87:277-85.
13. Knittle MA, Eitzman DV, Baer H. Role of hand contamination of personnel in the epidemiology of gram-negative nosocomial infections. J Pediatr 1975;86:433-7.
14. Lilly HA, Lowbury EJ. Transient skin flora. Their removal by cleansing or disinfection in relation to their mode of deposition. J Clin Pathol 1978;31:919-22.
15. Lowbury EJ, Fox J. The influence of atmospheric drying on the survival of wound flora. J Hyg 1953;51:203-14.
16. Rayan G, Flournoy D. Microbiologic flora of human fingernails. J Hand Surg 1987;12A:605-7.
17. Lau CH, Springston EE, Sohn M, Mason I, Gadola E, Damitz M, *et al.* Removal of *Escherichia coli* on hands with natural or artificial fingernails. Int J Epidemiol 2002;21:1157-64.
18. Ray SK, Dobe M, Lahiri A, Basu SS. Hand washing practices in urban and rural communities in and around Kolkata, West Bengal. Indian J Public Health 2009;53:1192-5.
19. Tambekar DH, Shirsat SD, Kakde SR, Ambekar KB. Hand hygiene and health: An epidemiological study of students in Amravati. Afr J Infect Dis 2009;3:26-30.
20. Ray SK, Amarchand R, Srikanth J, Majumdar KK. A study on prevalence of bacteria in the hands of children and their perception on hand washing in two schools of Bangalore and Kolkata. Indian J Public Health 2011;55:293-7.
21. Tambekar DH, Shirsat SD. Minimization of illness absenteeism in primary students using low-cost hygiene interventions. J Health Allied Sci 2012;11:1-4.
22. Chinakwe EC, Nwogwugwu NU, Nwachukwu IN, Okorundu SI, Onyemekara NN, Ndubuisi-Nnaji UU. Microbial quality and public health implications of handwash water samples of public adults in Owerri, South-East Nigeria. Int Res J Microbiol 2012;3:144-6.
23. Oniya MO, Obajuluwa SE, Alade ET, Oyewole OA. Evaluation of microorganisms transmissible through handshake. Afr J Biotechnol 2006;5:1118-21.