

Patient Footwear Contamination in Ophthalmic Day Surgery: A Prospective Observational Study

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Abstract

Introduction: Surgical site infections (SSIs) remain significant healthcare challenges. This study investigates the cleanliness of patient footwear in an ophthalmic day surgery setting. **Methods:** An observational study was conducted over a period of 8 weeks. A total of 94 patients were included. Shoe cleanliness was graded according to an in-house standardized system. Other data included shoe type, contamination, weather conditions, and demographics. Logistic regression analyses were used to identify trends. **Results:** Poor shoe hygiene (contamination) was more common in males (OR = 2.89, 95% CI: 1.18 - 7.09) and surprisingly during sunny weather conditions (OR = 1.31, 95% CI: 0.57 - 3.03). Smart shoes were the most frequently worn type (n = 19), primarily by females in sunny conditions, while sneakers were more common among males in rainy conditions. No complications/infections were identified during follow-up. **Conclusions:** This study highlights an area of infection control that has received relatively little attention. The study demonstrates that shoes entering an operating environment are not infrequently soiled particularly in poor weather and in men. It is suggested that simple interventions such as overshoes or disposable slippers could enhance cleanliness and potentially improve patient safety with relatively little cost.

Keywords

Shoe Contamination, Hygiene, Surgical Practice, Infection Rates, Ophthalmology

1. Introduction

Surgical site infections (SSIs) are a significant healthcare challenge, leading to increased patient morbidity, extended hospitalizations, and elevated healthcare expenditures. Among the myriad factors influencing the risk of SSIs one which has

attracted relatively little attention to date is the cleanliness of patient footwear in the operating room (OR) environment.

The potential for footwear to act as a conduit for microbial dissemination has been previously reported in medical personnel by Treacle *et al.* (2009) who found that 55% of shoes are to be contaminated with methicillin-resistant *Staphylococcus aureus** (MRSA) [1]. Similarly, another study demonstrated that disposable shoe covers, when in contact with the surgical floor, accumulated significant bacterial loads, including live pathogens [2]. Tateiwa *et al.* (2020) investigated the impact of surgical clothing and footwear upon OR contamination, and the role of intraoperative movements in elevating airborne particle concentrations, finding a 20-fold increase in particle generation induced by movements [3]. Similarly, Brohus, Balling and Jeppesen (2006) reported a 10-fold increase in particle concentration due to personnel activity [4].

This study endeavours to document the cleanliness of patient footwear in an ophthalmic day surgery setting and to highlight the potential impact.

2. Methods

2.1. Study Design and Setting

This quantitative, observational study was conducted in the day surgery unit at Singleton Hospital (Swansea, Wales). Data was collected from March 7, 2024, to April 25, 2024. Included were patients undergoing operations that did not require removal of shoes.

2.2. Participants

94 patients scheduled for ophthalmological surgery.

2.3. Data Collection

Shoes were inspected and graded according to a standardized grading system (**Table 1**) at the time of entering the OR. Grading was performed by two trained graders.

Table 1. Grading system for shoe hygiene.

Grade	Description of shoe	Criteria
A	Clean—No foreign material present	Shoes are visibly clean and free from dirt. Soles and treads are free from visible debris. Laces and insoles are clean.
B	Trace of foreign material present	Traces of foreign material present upon close inspection of any of soles, uppers, laces
C	Foreign material obviously present	Obvious foreign material present without close inspection of any of soles, uppers, laces.
D	Heavy contamination with foreign material	Obvious and excessive foreign material present.
E	Very heavy contamination with foreign material	Obvious and excessive foreign material present—leaves trails on floor

In addition, the type of shoe and type of foreign material present was recorded; rainwater/puddle mess, mud, sand/stones/grit, animal waste, or undetermined. Other data collected included; patient demographics, weather conditions and time of day.

2.4. Post-Operative Infection Follow-Up

Possible post-operative infections were detected/excluded by review of the eye service triage records at six weeks.

2.5. Data Analysis

Descriptive statistics were used to summarize the distribution of shoe hygiene grades and types of contaminants. Chi-square tests were performed to examine associations between shoe hygiene grades and potential influencing factors such as weather conditions, time of day, or patient demographics. A multivariate logistic regression analysis was conducted to identify significant predictors of poor shoe hygiene (defined as grades C, D, or E). Variables included in the model were patient age, gender, weather conditions, and day of the week. The reference categories were female gender and sunny weather. Inter-rater reliability between the two shoe graders was assessed using Cohen’s kappa coefficient. Statistical significance was set at $p < 0.05$ for all analyses.

2.6. Ethical Considerations

As this was an observational study that did not involve any interventions or changes to standard patient care, formal ethical approval was not required.

3. Results

Table 2 summarizes key findings and presents age distribution data for the overall patient population and by gender, along with logistic regression results analysing the relationship between shoe hygiene where grades A and B were compared to C, D and E and factors such as weather conditions and patient gender. The data provides insights into potential risk factors for poor shoe hygiene among ophthalmology patients, which may have implications for infection control practices in clinical settings.

Table 2. Shoe hygiene patient demographics and logistic regression of parameters.

Age Distribution	
Overall Range	29 - 91 years
Overall Mean	72.5 years
Age Distribution by Gender	
Males (n = 29)	Mean: 71.17 years (SD: 10.76)
Females (n = 66)	Mean: 72.95 years (SD: 11.03)

Continued

Logistic Regression Results	
Predictor	Odds Ratio (95% CI)
Rainy/wet weather	0.76 (0.33 - 1.76)
Sunny weather	1.31 (0.57 - 3.03)
Male gender	2.89 (1.18 - 7.09)

Furthermore, the Cohen kappa score of 0.76 indicates that there was good agreement between the two reviewers.

The most common types of shoes observed among the 94 patients were smart shoes (n = 19), sneakers (n = 17), boots (n = 16) leather slip-ons (n = 10), runners (n = 10), sandals (n = 8), sliders (n = 3), pumps (n = 5), and trainers (n = 7). Smart shoes were more commonly worn by females (n = 12) and sneakers more commonly by males (n = 10). Smart shoes were predominantly worn in sunny and dry conditions (n = 14), while sneakers were more common in rainy/wet conditions (n = 10). Furthermore, leather smart shoes were found to be more prone to retaining dirt and mud compared to mesh or fabric uppers of sneakers, and shoes with textured soles were more likely to have embedded debris than those with smooth soles. Older/worn-out shoes also showed greater signs of contamination.

Table 3 provides a detailed analysis of shoe hygiene categorized by weather conditions and gender. The data highlights that Grade B is the most common across all categories, indicating generally clean shoes. There is a suggestion that rainy conditions were associated with slightly more debris. In contrast to the visual summary of the table, the logistic regression analysis revealed that male gender was significantly associated with poorer shoe cleanliness.

Table 3. Shoe hygiene grades by gender and weather conditions.

Weather	Gender	Grade A	Grade B	Grade C	Grade D	Grade E
Sunny	Female	1	19	7	1	0
	Male	1	13	9	3	0
Sunny with Intermittent Showers	Female	0	11	6	0	0
	Male	0	8	8	1	0
Rainy/wet	Female	0	27	9	0	0
	Male	0	9	5	1	0

3.1. Most Common Shoe Contaminants

The most common contaminants found were mud, stones, and dirt. Other contaminants included chewing-gum, rocks, and indeterminate waste.

3.2. Post-Operative Patient Contacts

A total of 15 patients contacted the eye services with post-operative complaints

within six weeks of their surgery date. Complaints reported included; slight pain and swelling, inflammation and redness, photophobia, headaches, vision changes (such as floaters and flashing lights), and minor trauma-related issues. No post-operative infections were identified.

4. Discussions

This study is the first to report upon the patterns in shoe hygiene among patients entering an ophthalmic operating room (OR). Most shoes in this study were in good condition but as expected gender differences were observed, with females more likely to wear smart shoes and males more likely to wear sneakers [5] [6]. Weather conditions affected shoe cleanliness, though the finding that poor hygiene was less likely in rainy conditions was not statistically significant identified in other work [7] [8]. These findings also suggest that the choice of shoe materials and design can significantly influence their hygiene [9] [10]. In addition, the study also demonstrated that male gender was associated with poorer shoe cleanliness.

Given the study's relatively small sample size and an expected post-operative endophthalmitis rate of between 0.04% to 0.2% following cataract surgery [11]-[13], conclusions related to infection rates were unrealistic; however, for completeness, screening for post-operative infections was performed, yielding no infections.

This study highlights an important and probably largely overlooked aspect of day-case surgery, in that patients, their clothing and hygiene, including the state of their shoes, probably constitute what has become an "acceptable" infection risk for which there currently appears little mitigation. Whilst we appreciate that even a very large study may fail to identify a causal link between the state of shoe contamination and post-operative outcomes, it is proven beyond doubt that cleanliness matters in the operating room environment. It takes no great leap of faith to extend this cleanliness to the patient. How far this is taken is the question, but from our observations, it is clear that improvements could be made, for example, removing outdoor shoes and providing disposable slippers or more simply by providing clean overshoes. These measures are supported by guidelines from the Centres for Disease Control and Prevention (2017) and the World Health Organization (2016) [14] [15]. Of course, these suggestions do nothing for other aspects of patient cleanliness/hygiene which are also probably worthy of investigation in their own right.

This study had several limitations, including its observational design and the relatively small sample size, but it serves very simply to highlight a potential problem which is right under our patients' feet and for which simple measures are likely to be in every patient's best interests.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] Treackle, A.M., Thom, K.A., Furuno, J.P., Strauss, S.M., Harris, A.D. and Perencevich, E.N. (2009) Bacterial Contamination of Health Care Workers' White Coats. *American Journal of Infection Control*, **37**, 101-105.
<https://doi.org/10.1016/j.ajic.2008.03.009>
- [2] Carling, P.C. (2021) Health Care Environmental Hygiene: New Insights and Centers for Disease Control and Prevention Guidance. *Infectious Disease Clinics of North America*, **35**, 609-629. <https://doi.org/10.1016/j.idc.2021.04.005>
- [3] Tateiwa, T., Masaoka, T., Ishida, T., Shishido, T., Takahashi, Y. and Yamamoto, K. (2020) Impact of Surgical Clothing and Footwear on Operating Room Contamination during Standstill and Intraoperative Stepping Motion. *Journal of Orthopaedic Surgery*, **28**, 1-6. <https://doi.org/10.1177/2309499020976232>
- [4] Brohus, H., Balling, K.D. and Jeppesen, D. (2006) Influence of Movements on Contaminant Transport in an Operating Room. *Indoor Air*, **16**, 356-372.
<https://doi.org/10.1111/j.1600-0668.2006.00454.x>
- [5] Ayode, D., Tora, A., Farrell, D., et al. (2016) Association between Causal Beliefs and Shoe Wearing to Prevent Podoconiosis: A Baseline Study. *American Journal of Tropical Medicine and Hygiene*, **94**, 1123-1128.
<https://pmc.ncbi.nlm.nih.gov/articles/PMC4856613/>
- [6] Nursilowati, R.D. and Mayangsari, L. (2020) Women Footwears of Choice: A Correlation Analysis of Customer Attitudes toward Purchase Intention of Local Footwear Products. *KnE Social Sciences*, **4**, 574-589.
- [7] Carling, P.C. (2016) Optimizing Health Care Environmental Hygiene. *Infectious Disease Clinics*, **30**, 639-660 <https://doi.org/10.1016/j.idc.2016.04.010>
- [8] Gill, N., McKiernan, S., Lewis, A., Cherry, H. and Annunziato, D. (2020) Biosecurity Hygiene in the Australian High Country: Footwear Cleaning Practices, Motivations, and Barriers among Visitors to Kosciuszko National Park. *Australasian Journal of Environmental Management*, **27**, 378-395.
<https://doi.org/10.1080/14486563.2020.1838352>
- [9] ProQuest (2024) An Analysis of Us Hospital Healthcare Worker Occupational Footwear: An Ergonomics Footwear Design Imperative.
<https://www.proquest.com/docview/2778643131?pq-origsite=gscholar&fromopen-view=true&sourcetype=Dissertations%20&%20Theses>
- [10] Deb, A.K., Shaikh, M.A.A., Sarker, M.R. and Hossain, M.I. (2018) Assessment of Influential Factors for Purchasing Gent's Shoes-Understanding the Basic Comfort Properties. *Leather and Footwear Journal*, **18**, 13-24.
<https://doi.org/10.24264/lfj.18.1.2>
- [11] Taban, M., Behrens, A., Newcomb, R.L., Nobe, M.Y., Saedi, G., Sweet, P.M., et al. (2005) Acute Endophthalmitis Following Cataract Surgery. *Archives of Ophthalmology*, **123**, 613-620. <https://doi.org/10.1001/archophth.123.5.613>
- [12] Friling, E., Bro, T., Lundström, M. and Montan, P. (2024) Endophthalmitis after Cataract Surgery and Effect of Different Intracameral Antibiotic Regimes in Sweden 2011-2017: National Registry Study. *Journal of Cataract & Refractive Surgery*, **50**, 828-835. <https://doi.org/10.1097/j.jcrs.0000000000001464>
- [13] Royal College of Ophthalmologists' National Ophthalmology Database (2024) Report 10: Risk Factors for Post-Cataract Surgery Endophthalmitis-Ophthalmology.
[https://www.aaojournal.org/article/S0161-6420\(23\)00517-1/fulltext](https://www.aaojournal.org/article/S0161-6420(23)00517-1/fulltext)
- [14] Rutala, W.A. and Weber, D.J. (2024) Guideline for Disinfection and Sterilization in

Healthcare Facilities, 2008. Update: May 2019.

<https://stacks.cdc.gov/view/cdc/134910>

- [15] Leaper, D.J. and Edmiston, C.E. (2017) World Health Organization: Global Guidelines for the Prevention of Surgical Site Infection. *Journal of Hospital Infection*, **95**, 135-136.

[https://www.journalofhospitalinfection.com/article/S0195-6701\(16\)30587-4/abstract](https://www.journalofhospitalinfection.com/article/S0195-6701(16)30587-4/abstract)