ORIGINAL ARTICLE

Acta Orthop Traumatol Turc 2015;49(4):421–425
doi: 10.3944/AOTT.2015.14.0401

# Surgical light handles: a source of contamination in the surgical field

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**Objective:** Total hip arthroplasty (THA) is a common and generally safe procedure; however, among the most devastating complications associated with THA is periprosthetic infection (PPI). The origin of bacteria causing PPI is not completely understood. The aims of the present study were to identify bacterial contamination of light handles with up-to-date culture methods and to determine the safety in using these handles in hip arthroplasty surgery.

**Methods:** A total of 36 surgical handles randomly selected from primary hip arthroplasty procedures were screened for bacterial contamination using 2 different culture methods, including 1 with high sensitivity. Two types of controls were used. Cultures were kept for up to 10 days, and retrieved bacteria were identified.

**Results:** Fifty percent of the light handles yielded positive cultures, demonstrating a bacterial presence on surgical light handles during hip arthroplasty. The most frequently identified bacteria were Staphylococcus epidermidis and Staphylococcus aureus.

**Conclusion:** A large number of positive bacterial cultures were found in manipulated light handles during hip replacement surgery, representing a potential contamination source that could eventually lead to infection in hip arthroplasty.

**Keywords:** Adverse effects; arthroplasty; bacterial diagnosis; bacteria isolation; bacterial infection; bacteria purification; hip; knee; microbiology; replacement; surgical field contamination; surgical light handles.

Total hip arthroplasty (THA) is a common and safe procedure which is regularly performed for treatment of hip osteoarthritis. Although THA is a generally safe procedure, there are potential complications. Among the most devastating complications associated with THA are surgical site infection (SSI) and periprosthetic infection (PPI). Efforts toward decreasing the incidence of PPI in hip replacement surgery have resulted in a series of strict guidelines to ensure sterility.

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**Submitted:** November 9, 2014 **Accepted:** February 6, 2015



Available online at
www.aott.org.tr
doi: 10.3944/AOTT.2015.14.0401
QR (Quick Response) Code

As with any surgery, light from surgical lamps—generally 2 lamps in an operating room (OR)—is directed toward the surgical field. During orthopedic surgery, including hip replacement, the surgical field can change in location. The surgical team usually relocates the surgical lamps by handling specially designed sterile light handles. There are 2 basic types of light handles, sterile disposable and resterilizable adapters, both of which are designed to be securely fitted in surgical lamps and managed during surgery. These handles are managed according to sterile criteria during surgery, and they constitute a part of the sterile surgical field. During surgery, unnoticed contact of the sterile hood with the nonsterile part of the lamp and subsequent contact with the handle can possibly contaminate light handles (Figure 1). Additionally, surgical gloves can become contaminated by handling the nonsterile parts of the handles or their locking devices (Figure 2).

Several contamination sources have been identified and theorized, with the patient's skin being the primary identified source of bacterial contamination of the surgical field. Airborne bacteria are also known to be possible contamination sources. Thus far, no evidence has proven that surgical light handles constitute a possible source of surgical site contamination. Nevertheless, some surgeons have recommended discontinuing their use during joint replacement surgery due to the possible risk of contamination.

The aims of the present study were to identify bacterial contamination of light handles with up-to-date culture methods and to determine the safety of using these handles in hip arthroplasty surgery.

## Materials and methods

This study was approved by the Institutional Ethics Committee of the School of Medicine, Pontificia Universidad Católica de Chile.

Samples were obtained from 36 randomly selected primary hip arthroplasties performed between April 2013–January 2014. All surgeries were performed in a positive pressure, clean air OR without laminar airflow. All surgeries were performed by 1 attending orthopedic surgeon and 3 orthopedic residents; in total, a team of 4 surgeons and 1 surgical technician with filtered exhaust helmets scrubbed in for every surgery, and the surgical site was covered with Ioban™ (3M, St Paul, Minnesota, USA). An average of 130 minutes (range: 70–210 minutes) was required for hip arthroplasty.

Samples were obtained upon completion of the surgery by 1 of the scrubbed surgeons. The surface of the handle was swabbed twice with 2 sterile swabs (Stuart-Copan, Brescia, Italy). One of the swabs was placed in brain-heart infusion (BHI) agar supplemented with 5% sheep blood, and the second swab was seeded in thioglycollate broth (THIO), a high sensitivity culture broth.[1] Both cultures were incubated at 35±1°C for 10 days or until growth.[2] Controls were not considered initially for the study, but due to the high incidence of positive cultures in the first 19 cases, the authors decided to test the validity of the results with 2 types of controls. Therefore, 17 of the 36 surgeries had 2 control cultures: 1 closed control (THIO broth), a broth container brought to the OR and back to the microbiology laboratory for incubation, and which was never opened; and 1 table control, which was obtained after swabbing a light handle,

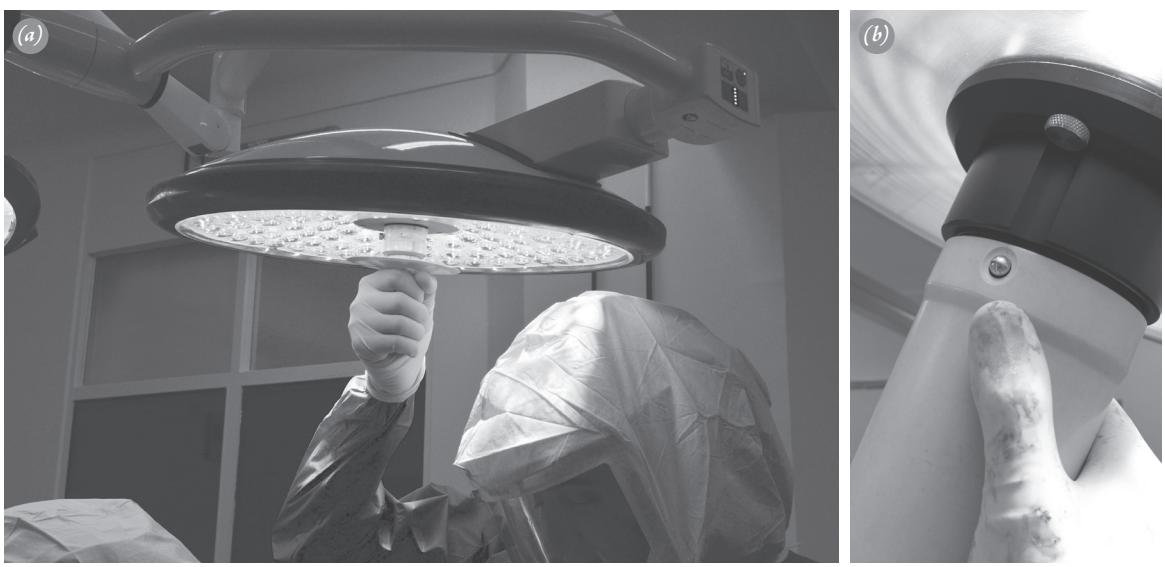


**Fig. 1.** **(a)** Surgeon handling light handle. **(b)** Resterilizable light handle, unsterile locking device.

opened at the same time as used handles and located on the surgical technician's table, which was never manipulated and was placed in THIO broth.

After swabbing the light handles, samples were immediately taken to the microbiology laboratory for incubation. Positive cultures were further studied for bacterial identification with matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS) using MALDI Biotyper® software, version 2.0 (Bruker Daltonics, Freemont, California, USA). All identified bacteria were stored at -80°C for later molecular identification in case SSI or PPI was reported in these patients.

The sample size estimation of 36 cases was performed using confidence level (CI) of 95% and a power of 80% for detecting at least 15% positive cultures in used light handles.

The differences between the samples and table controls were tested using Fisher's exact test. The surgical time was documented, the normal distribution of surgical time was tested with the Kolmogorov-Smirnov test and not normally distributed, and the difference between means was tested with a 2-tailed Mann-Whitney test using SPSS software version 18 (IBM, Somers, NY, USA)

## Results

Thirty-six culture sets were obtained. Eighteen of the 36 THIO cultures were positive, representing 50% of the light handles; the most frequently identified bacterium was *S. epidermidis* (63% of positive cultures). All bacteria identified are reported in Table 1. Three of the 18 positive THIO cultures retrieved 2 bacterial species, whereas the remainder retrieved only 1 bacterial species. No sample retrieved more than 2 bacterial species.

BHI agar cultures were reported to be positive in 3 patients; identified bacteria are shown in Table 1. The positive BHI with *S. epidermidis* matched a positive THIO broth culture with *S. epidermidis* for the same light handle. The remaining 2 positive BHI agar cultures matched a negative THIO broth culture.

Three technician's table controls retrieved positive cultures; two for *Propionibacterium acnes* and 1 for *S. epi-*

**Table 1**. Positive cultures.

| No. | Surgery time (min) | BHI | THIO | Time to positivity of THIO (h) | Table control | Closed control |
|---|---|---|---|---|---|---|
| 1 | 90 | Negative | Bacillus spp | 24 | ND | ND |
| 2 | 150 | Negative | Staphylococcus haemolyticus | 96 | ND | ND |
| 3 | 120 | Negative | Staphylococcus epidermidis | 48 | ND | ND |
| 4 | 80 | Negative | Staphylococcus epidermidis | 96 | ND | ND |
| 5 | 120 | Negative | Staphylococcus epidermidis | 72 | ND | ND |
| 6 | 210 | Negative | Staphylococcus epidermidis | 48 | ND | ND |
| 7 | 180 | Negative | Staphylococcus epidermidis | 72 | ND | ND |
| 8 | 100 | Negative | Staphylococcus hominis | 24 | ND | ND |
| 9 | 150 | Negative | CNS | 96 | ND | ND |
| 10 | 125 | Negative | Staphylococcus epidermidis/ Staphylococcus aureus | 72 | ND | ND |
| 11 | 90 | Negative | Staphylococcus epidermidis | 72 | ND | ND |
| 13 | 135 | Negative | Staphylococcus epidermidis | 148 | Propionibacterium acnes | ND |
| 14 | 140 | Negative | Staphylococcus capitis/ Staphylococcus pasteurii | 148 | Propionibacterium acnes | ND |
| 16 | 140 | Negative | Staphylococcus epidermidis | 48 | Negative | ND |
| 18 | 130 | Staphylococcus haemolyticus | Negative | NR | Negative | ND |
| 21 | 120 | Negative | Staphylococcus hominis | 48 | Negative | Negative |
| 26 | 120 | Staphylococcus epidermidis | Staphylococcus epidermidis | 24 | Negative | Negative |
| 31 | 150 | Negative | Staphylococcus epidermidis | 48 | Negative | Negative |
| 34 | 120 | Negative | Staphylococcus epidermidis/ Streptococcus viridans group | 48 | Negative | Negative |
| 36 | 120 | Acinetobacter spp/ Staphylococcus haemolyticus | Negative | NR | Negative | Negative |

BHI: Brain heart infusion broth; THIO: Thioglycollate broth; CNS: Coagulase-negative Staphylococcus; NR: Not reported; ND: Not determined.

*dermidis*. There was a statistically significant difference in the positive rate when comparing the light handles with the technician's table controls ($p<0.05$).

No closed control cultures retrieved positive results (Table 2).

There was no difference in surgical time between the negative and positive culture groups ($p=0.5157$).

As of the date of article submission, no cases of SSI or PPI were reported in these patients.

## Discussion

Our results, using high-sensitivity culture techniques (THIO broth), demonstrated a high rate of bacterial contamination in the surgical light handles, which are considered a part of the sterile and safe surgical field. However, primarily high sensitivity cultures were positive (18 of 36 *vs*. 3 of 17 in BHI), most likely indicating a low bacterial load in the handles. The most likely source of contamination was lamp manipulation after unnoticed contact of the hood with the unsterile part of the lamp. Patients' skin and airborne bacteria cannot be discarded as a possible source in some samples, but they seem unlikely considering that no patients developed SSI or PPI 1 year after obtaining the last sample. Therefore, contamination could have been easily prevented by avoiding manipulation of the handles by the scrubbed surgical team. While Whyte et al. reported that in exceedingly clean linear air flow ORs, the air could be a source of bacteria[3] and no certainty of the source of contamination of the light handles can be ascertained, the likely origin is preventable.

There is paucity in the literature regarding the safety of using light handles as an extension of the surgical field and the associated risk of contamination. Cultures of surgical light handles have been described in only 2 previously published articles. The former reported 14.5% positive cultures, but no negative controls were used in that study, and moreover, it did not make solid recommendations for maintaining sterile handles.[4] The latter article reported 0% positive cultures, concluding that there was no need to discontinue the use of light handles.[5] The lack of positive cultures might be attributed to the use of only standard cultures. We used THIO broth because it was previously reported to have high sensitivity and because there have been recommendations for using it to assure sterility.[1] Cultures were kept for at least 10 days, the minimum time recommended for PPI cultures,[2] but it is unlikely that a longer culture period would have retrieved more bacteria.

The average time for primary arthroplasty in the present study was longer than that reported by others, which may be a source of concern and contribute to the high percentage of positive cultures in used and ambient exposed light handles.[5,6] All surgeries were performed in a teaching hospital, which may explain the longer surgical time; however, all 3 surgeons that contributed to the study perform more than 50 arthroplasties/year and have been performing them for more than 5 years, so learning curve was not an issue.[6]

Incidence of SSI and PPI have increased in recent

**Table 2**. Negative cultures.

| Sample no. | Surgery time (min) | Brain heart infusion broth | Thioglycollate broth | Table control | Closed control |
|---|---|---|---|---|---|
| 12 | 140 | Negative | Negative | Not determined | Not determined |
| 15 | 160 | Negative | Negative | Negative | Not determined |
| 17 | 120 | Negative | Negative | Negative | Not determined |
| 19 | 210 | Negative | Negative | Not determined | Not determined |
| 20 | 90 | Negative | Negative | Negative | Negative |
| 22 | 150 | Negative | Negative | Negative | Negative |
| 23 | 70 | Negative | Negative | Negative | Not determined |
| 24 | 150 | Negative | Negative | Negative | Negative |
| 25 | 120 | Negative | Negative | Negative | Negative |
| 27 | 130 | Negative | Negative | Negative | Negative |
| 28 | 180 | Negative | Negative | Negative | Negative |
| 29 | 90 | Negative | Negative | Negative | Negative |
| 30 | 170 | Negative | Negative | Negative | Negative |
| 32 | 150 | Negative | Negative | Negative | Negative |
| 33 | 120 | Negative | Negative | Staphylococcus epidermidis | Negative |
| 35 | 120 | Negative | Negative | Negative | Negative |

years, despite growing efforts to prevent this complication.[7] The purpose of this study was not to correlate bacterial presence on surgical light handles with increased incidence of SSI and/or PPI. Current to the date of this article's submission, there has been no report of SSI and/or PPI 1 year after obtaining the last sample. As PPI incidence is approximately 2%, it would be challenging to design a study aiming to demonstrate that light handles are the source of infection. The bacteria identified in our cultures are the most frequently identified pathogens in SSI and PPI,[2] representing an actual risk of infection if transferred by the surgical team from the handles to the surgical wound. Although it is impossible to completely eliminate risk of contamination during surgery, even in exceedingly clean linear air flow ORs as reported by Whyte et al.,[3] since air and patients' skin are nonsterile, all efforts should be made to avoid other preventable sources of contamination.

Even though the present article has limitations such as the limited number of controls, a relatively small sample size, and samples lacking controls, surgeons in our institution have ceased using light handles for arthroplasty surgery, making it impractical to continue obtaining samples. The results of the present study should lead to careful consideration of using light handles.

Light handles have a high risk of bacterial contamination and represent a possible source of surgical site contamination and infection. Due to the results of the present study, the authors no longer use light handles in hip arthroplasty procedures and strongly recommend that others adopt the same behavior.

**Conflics of Interest:** No conflicts declared.

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