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Research Articles

Does Having a Beard Matter? An Analysis of Orthopaedic Surgical Site Infection Rates in Outpatient Orthopaedic Surgery

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Objectives

Post-operative infections cause significant morbidity and mortality in outpatient orthopaedic surgery. Orthopaedic surgical site infections have been estimated to occur in up to 5.6% of patients. Prior research has evaluated infection prevention related to operating room attire and hygiene, but no study has evaluated the effect on postoperative infection rates from surgeons having a beard.

Methods

Two fellowship-trained orthopaedic surgeons operated on a total of 940 patients during a consecutive 12-month period. During the first six months, surgeons were clean-shaven, and in the last six months, surgeons maintained a beard. A standard mask was worn at all times. Infectious complication data were collected retrospectively. Major infection was defined as hospitalization and/or return to the operating room, and minor infection was classified using the Centers for Disease Control and Prevention (CDC) Surveillance Criteria for surgical site infections (SSI).

Results

Three (0.31%) patients developed a major infection, and 57 (6.05%) patients developed a minor infection. Of 471 patients operated on when surgeons were clean-shaven, two (0.42%) and 30 (6.62%) developed a major or minor infection, respectively. Of the 469 patients operated on when surgeons had beards, one (0.21%) and 27 (5.75%) patients developed a major or minor infection. The difference in major (*P=1.00*) and minor (*P=0.80*) infection rates between the 6-month periods was insignificant.

Conclusions

Similar infection rates for outpatient surgery were found when the surgeons did and did not have a beard. These findings indicate that while wearing a standard surgical mask, a surgeon having a beard at the time of surgery does not affect the postoperative infection rate.

Level of Evidence

Level 3

INTRODUCTION

Post-operative infections are a significant cause of morbidity and mortality in orthopaedic surgery and have been estimated to account for over 10 billion dollars in associated costs per year.[1,2] A systematic literature review on the management of surgical site infections adopted by the American Association of Orthopaedic Surgeons (AAOS) estimates the overall incidence of surgical site infections in

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patients undergoing orthopaedic procedures to be 1%.[3,4] The range of surgical site infection incidence reported in the literature varies by orthopaedic sub-specialty, as the incidence in spine surgery (1-9%), trauma (2-50%), shoulder and elbow surgery (0.11-.47%) and joint replacement surgery (1-2.5%) all differ greatly.[5–12] Specific to hand and upper extremity surgery, surgical site infections have been estimated to occur in .05% to 5.6% of cases.[13,14] In lower extremity surgery, surgical site infections have been estimated to occur in 1.0% to 5.3% of cases.[15] Even when comparing inpatient orthopaedic surgery to outpatient surgery, rates of surgical site infections differ based on the surgical site as well.[10]

Infection sources during orthopaedic surgery include operating room staff, contaminated equipment, hematogenous seeding, and post-operative contamination.[16] Significant research has been performed regarding surgical infection prevention related to proper operating room attire and hygiene. Multiple guidelines have been published that address proper operative techniques to minimize infection.[17,18] To our knowledge, there has been limited research aimed directly at evaluating the effect on surgical infections that might occur from a surgeon having a beard. Moreover, a recent collaborative position of the American College of Surgeons (ACS), American Surgical Association, and other surgical societies, including The Joint Commission, identified a lack of scientific evidence of coverage of the hair, beard, or ears and SSI rates.[19]

Beards are well known for acting as a reservoir for bacteria, and the impact a beard has on bacterial shedding during surgery has been debated.[20,21] Previously, the ACS recommended that hair on the face and skull should be covered during all operations to avoid potential wound contamination.[22] However, there are no specific guidelines or recommendations from regulatory or advisory bodies on how to cover hair on the face during surgery best. Today, surgeons practice the protocol determined by their hospital or surgical center, utilizing surgical masks or hoods to cover facial hair. To better inform best practices to minimize surgical site infections, a retrospective study was undertaken to determine infection rates and risk factors for surgeons with a beard. The study hypothesis was that a surgeon wearing a beard and a standard surgical mask makes no difference in outpatient orthopaedic surgery infection rates.

METHODS

Institutional review board approval was obtained before the start of this study, and consent was obtained or waived by all patients who participated. Over the twelve months spanning July 2018 to June 2019, two orthopedic surgeons maintained standard operative protocols. Each surgeon was fellowship trained, and board certified, one in hand and upper extremity and the other in foot and ankle surgery. The surgeons were blinded to the specific surgical data collected for the study. Both surgeons were clean-shaven for the first six months, and for the second 6-month period, both had a beard. Beard length between the two surgeons was not measured, but both beards appeared to be the same thickness, were trimmed regularly, and shaved around the upper neck area, extending to the lower jaw and chin daily. Each surgeon wore the same standard surgical mask type during the study period **[Figure 1]**.

Figure 1. Image of the standard surgical mask worn by the surgeons throughout the study.

Data on postoperative complications were collected retrospectively by a neutral individual not involved with any surgeries performed. Major complications were reported from data collected by the outpatient surgical center, and minor complications were collected through medical record review. Major infections were defined as hospitalization and/or return to the operating room following surgery. Minor infections were classified using the CDC/National nosocomial Infection Surveillance Criteria for SSI **[Figure 2]**.[23] The CDC criteria classify a surgical site infection as an infection occurring within 30 days of initial surgery that fulfills at least one of four criteria; purulent drainage, organisms isolated from an aseptically obtained culture from the incision, one or more signs and symptoms of infection such as pain or redness, or diagnosis of an infection by the surgeon or attending physician. Minor infections were diagnosed in the office from the clinical exam performed by the surgeon and were managed with oral antibiotics.

Differences between major and minor infection rates were statistically evaluated using Pearson's Chi-Squared or Fisher's exact test. Statistical significance was defined as p = 0.05.

RESULTS

This study aimed to determine if a surgeon's beard affected postoperative infection rates. There were 940 patients included in this analysis, 395 of whom were male. The average age of the cohort was 51.9 (8-98 range) years, and the

Superficial Incisional SSI

Infection occurs within 30 days after the operation *and* infection involves only skin or subcutaneous tissue of the incision *and* at least *one* of the following:

1. Purulent drainage, with or without laboratory confirmation, from the superficial incision.
2. Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.
3. At least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat *and* superficial incision is deliberately opened by surgeon, *unless* incision is culture-negative.
4. Diagnosis of superficial incisional SSI by the surgeon or attending physician.

Do *not* report the following conditions as SSI:

1. Stitch abscess (minimal inflammation and discharge confined to the points of suture penetration).
2. Infection of an episiotomy or newborn circumcision site.
3. Infected burn wound.
4. Incisional SSI that extends into the fascial and muscle layers (see deep incisional SSI).

Note: Specific criteria are used for identifying infected episiotomy and circumcision sites and burn wounds.

Deep incisional SSI

Infection occurs within 30 days after the operation if no implant† is left in place or within 1 year if implant is in place and the infection appears to be related to the operation *and* infection involves deep soft tissues (e.g., fascial and muscle layers) of the incision *and* at least *one* of the following:

1. Purulent drainage from the deep incision but not from the organ/space component of the surgical site.
2. A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (>38°C), localized pain, or tenderness, unless site is culture-negative.
3. An abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination.
4. Diagnosis of a deep incisional SSI by a surgeon or attending physician.

Notes:

1. Report infection that involves both superficial and deep incision sites as deep incisional SSI.
2. Report an organ/space SSI that drains through the incision as a deep incisional SSI.

Organ/space SSI

Infection occurs within 30 days after the operation if no implant† is left in place or within 1 year if implant is in place and the infection appears to be related to the operation *and* infection involves any part of the anatomy (e.g., organs or spaces), other than the incision, which was opened or manipulated during an operation *and* at least *one* of the following:

1. Purulent drainage from a drain that is placed through a stab wound‡ into the organ/space.
2. Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space.
3. An abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination.
4. Diagnosis of an organ/space SSI by a surgeon or attending physician.

†National Nosocomial Infection Surveillance definition: a nonhuman-derived implantable foreign body (e.g., prosthetic heart valve, nonhuman vascular graft, mechanical heart, or hip prosthesis) that is permanently placed in a patient during surgery.
‡If the area around a stab wound becomes infected, it is not an SSI. It is considered a skin or soft tissue infection, depending on its depth.

Figure 2. CDC/National nosocomial Infection Surveillance Criteria for SSI

Table 1. Procedures by type and location.

Location of Procedure		No Beard	Beard	Total
	Foot	118	102	220
	Ankle	63	74	137
	Leg	18	17	35
	Hand/wrist	229	230	459
	Elbow/forearm	43	46	89
Type of Procedure				
	Bone	237	230	467
	Soft tissue	234	239	473

average BMI was 24.6 (16.88-64.01). The description of the procedures by type and location is shown in Table 1 [Table 1].

A total of three (0.31%) of the patients included in the study developed a major infection, and 57 (6.05%) developed a minor infection. Of the 471 patients operated on during the six months when surgeons did not have a beard, two (0.42%) developed a major infection, and 30 (6.35%) developed a minor infection. In contrast, one (0.21%) developed a major infection, and 27 (5.75%) developed a minor infection among the 469 patients operated on during the six months when surgeons had a beard. The difference in postoperative major *(P=1.00*) and minor (*P=0.804*) infections between the two periods was insignificant.

A breakdown of postoperative infections in upper and lower extremity surgery is shown in Table 2 [Table 2]. A case description for the patients who developed major infection complications can be found in the discussion.

DISCUSSION

The study findings demonstrate that a surgeon having a beard during outpatient orthopaedic surgery while wearing a standard surgical mask does not affect the postoperative infection rate. Surgical site infections are a major cause of morbidity following outpatient orthopaedic surgery and can lead to prolonged recovery and lower quality of life.[1,24,25] As the utilization of outpatient surgical centers for orthopaedic procedures continues to increase, there is a strong emphasis on preventing surgical site infections as-

Table 2. Major and minor postoperative infections broken down by location of surgery

		Major		P Value	Minor		P Value	Total Patients
Upper Extremity	No Beard	0	0%		18	6.62%	0.912	272
Upper Extremity	Beard	0	0%		20	7.22%		277
Lower Extremity	No Beard	2	1%	1	12	6%	0.395	200
Lower Extremity	Beard	1	0.52%		7	3.65%		192

sociated with these ambulatory settings.[26–28] Previous research on surgical site infections has focused mainly on major infections, particularly in the inpatient setting, and the data that evaluates surgeon-derived causes of infection is limited.[29,30]

Since the publication of the Association for Perioperative Registered Nurses (AORN) recommendations on operating room attire, strict policies have been implemented in operating rooms intending to decrease exposed areas of skin and hair.[31] However, to date, there is little evidence to suggest that wearing a surgical mask effectively reduces the surgical site infection rate in the operating room, regardless of whether the team member has a beard or not. Tunevall *et al.* demonstrated no difference in surgical site infection rates between masked and unmasked groups in the operating room.[32] Subsequent reviews and meta-analyses supported these findings.[33,34]

This stance was ultimately modified in a statement following a summit meeting of the American College of Surgeons, AORN, and the Joint Commission stating that "the scientific evidence fails to demonstrate any association between the type of surgical hat or extent of ear and hair coverage and SSI rates."[35] Nevertheless, current OSHA regulations require all scrubbed personnel to utilize face masks as part of personal protective equipment during surgery, regardless of their contribution to the procedure or surgical site infections.[36]

In their 2016 update of Surgical Site Infection Guidelines, the American College of Surgeons and Surgical Infection Society recommended that the surgeon's face be protected during all procedures and that all facial hair be covered.[22,37] This recommendation was based on prior research investigating the infectious capabilities of a surgeon's beard, which focused on bacterial shedding. However, the literature does not consider the contribution of eyelashes or eyebrows, which often remain uncovered. The tendency for facial hair to act as a reservoir for bacteria and retain more bacteria than a clean-shaven individual is well known, and the rate of bacterial shedding has been demonstrated to be significantly higher in surgeons with beards when undergoing a series of facial movements while masked.[20,38] However, recent studies have shown that bearded orthopaedic surgeons and other operating room personnel do not have an increased likelihood of bacterial shedding compared to clean-shaven surgeons while unmasked or wearing surgical masks in the operating room.[21] Therefore, given the lack of literature-supported guidelines for specific methods of facial hair coverage and the little evidence supporting facial hair coverage to prevent surgical site infections, the use of standard surgical masks for bearded and non-bearded surgeons should be adequate to prevent infections effectively.

Our study evaluated how a surgeon's beard affects postoperative infections following orthopaedic surgery in an outpatient setting. Similar infection rates for both upper and lower extremity surgery were found, and the rates of major and minor infection were not significantly different when comparing the two time periods. Our rate of major infectious complications (0.31%) is consistent with previously published rates of major complications of orthopaedic surgery performed at ambulatory surgical centers.[39] The rates of minor infections were also comparable to the literature and were found to be similar whether the surgeon had a beard or not.[13]

In our study, three cases of major infectious complications arose. Of note, all patients were admitted for intravenous antibiotic treatment. Details of each case include:

- The first major complication was in a 45-year-old male with a positive smoking history who was diagnosed with an *Enterobacter cloacae* infection and received multiple surgical debridement procedures following an open reduction internal fixation of a distal tibia fracture.
- The second major complication occurred in a 70-year-old female with a past medical history of hypertension and peripheral vascular disease who was diagnosed with a *Staphylococcus aureus* infection following a revision Akin osteotomy for recurrent hallux valgus and hammer toe corrections of the second and third toe. The patient was treated with hardware removal and two surgical debridement and wound closure procedures.
- The third complication developed in a 50-year-old female with a significant smoking history who experienced full wound dehiscence and drainage with cultures revealing *Staphylococcus aureus* infection after an Achilles insertional revision and repair. Treatment required three surgical debridement procedures.

It should be noted that all complications occurred in patients undergoing lower extremity surgery. In addition, it has been well documented that the lower extremity has higher baseline colonization of skin flora, and surgical site infection rates as high as 9.4% have been recorded in some studies.[40] This study's higher postoperative infection rate in the lower extremity group compared to the upper extremity group is consistent with this notion.

The importance of preventing surgical site infections should not be understated. Menendez *et al.* found that surgical site infections comprise 5.2% of all postoperative visits, 53% of which were visits to the emergency department.[13] Similarly, studies have surfaced revealing a decreased adherence to hand hygiene and use of personal protective equipment among surgically scrubbed staff.[28,41] Although an infrequent occurrence in upper and lower extremity outpatient orthopaedic surgery, surgical site infections can lead to significant patient complications and associated costs.

Based on the results of our study, we believe that a surgeon having facial hair does not play a role in contributing to the development of surgical site infections.

Our study had several limitations. Due to the study's retrospective nature and data collection, any infections not documented by the surgical center or recorded in the patient charts may have been missed. Similarly, our records cannot account for patients who may have developed an infection and sought care elsewhere. Another limitation includes the study's lack of a control group to help account for seasonal changes affecting beard growth and infections. Surgeons' beard lengths, shaving routine, and use of mask or hood in the operating room were also not standardized, which may have introduced bias into our study. Another limitation includes the lack of standardization of procedures performed, individual patient characteristics, such as BMI and age, and other operating room personnel throughout the study.

Additionally, there was no gap in the 6-month study sections to allow for beard growth before beginning the bearded study section. This may have introduced inconsistency in beard length during this study phase. Lastly, our findings can only be applied to outpatient upper and lower extremity surgery and may not apply to inpatient or joint arthroplasty surgeries.

Overall, the findings of our study demonstrate that a surgeon having a beard at the time of outpatient orthopaedic surgery while wearing a standard surgical mask does not affect the postoperative infection rate. It is important to continue following previously published guidelines to prevent surgical site infections and to cover facial hair appropriately in the operating room.

CONCLUSIONS

Similar infection rates for outpatient surgery were found when the surgeons did and did not have a beard. The findings indicate that while wearing a standard surgical mask, a surgeon having a beard at the time of surgery does not affect the postoperative infection rate. Appropriate facial hair covering during surgical procedures and adherence to guidelines for preventing surgical site infections should be maintained.

CONFLICT OF INTEREST

The authors do NOT have any potential conflicts of interest in the information and production of this manuscript.

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ETHICAL APPROVAL FOR STUDY

This study was approved by the Thomas Jefferson University Institutional Review Board; Control #: 19D.646; Board #: 2504

INFORMED CONSENT

The authors declare that there is no information in the manuscript that can be used to identify patients

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