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Contamination Relative to the Activation Timing of Filtered-Exhaust Helmets

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ABSTRACT

Background: Filtered-exhaust helmet systems are commonplace during total joint arthroplasty, but their ability to limit intraoperative contamination has been questioned. We hypothesized that activation of the airflow system after complete gowning would lead to decreased contamination of the surgical environment.
Methods: Using a fluorescent particle model, the maximal particle spread from a filtered-exhaust helmet and contamination of the surgical environment based on timing of airflow activation through simulated surgical gowning procedures were evaluated.
Results: Helmet airflow analysis revealed particle spread greater than 5 feet in all trials. Activation before gowning resulted in a significantly greater contamination in the control group compared with the experimental group ($P = .014$).
Conclusions: We recommend complete surgical gowning before activation of the airflow system.

Surgical site infections and periprosthetic joint infections are devastating complications of elective total joint arthroplasty. Despite infection rates of 1%-2%, a substantial burden is placed on both the patient and the health care system when these infections do occur [1,2]. Additional medical treatments, readmissions, and return to the operating room are all potential consequences that cost both time and money [3,4]. As a result, continued efforts have been pursued toward prevention of periprosthetic joint infections.

Contamination in the operating room is a known cause for periprosthetic infections. Investigations into surgical attire, sterile techniques, operating room traffic, and room airflow have proven successful in limiting infection and decreasing infection rates [5-7]. The use of filtered-exhaust surgical helmets and their respective personal protection hoods and/or suits were developed for this purpose and have become commonplace in many operating rooms during arthroplasty surgery. Often referred to as "space suits," these devices have an intake valve on top of the helmet that filters air through a disposable hood cover. The air then circulates within the helmet and disperses down toward the surgeon's face and/or neck and into the gown. Unfortunately, infection prevention while using these filtered-exhaust systems has not yet been supported by the orthopedic literature and these systems are, therefore, more commonly regarded as personal protective equipment [8-10].

A common practice of the orthopedic surgeon and operating room staff is to plug in the helmet battery pack and activate the helmet's airflow system before the preoperative hand wash. The surgeon then enters the operative suite and proceeds with the sterile gowning process while the helmet continues to circulate air from inside the helmet and out into the surrounding surgical environment. Because the helmets themselves are not part of the sterile processing system and they are often stored in nonsterile locations, there is potential for contaminate spread from within the helmet to the surrounding surgical field, equipment, and staff. As a result, the aim of this study was to evaluate the timing of airflow activation with the use of these helmets in an attempt to use these systems in a more appropriate manner and limit potential contamination. Our first hypothesis was that airflow from the filtered-exhaust helmet would lead to widespread dispersion of fluorescent particles in a surgical draping scenario. Our second hypothesis was that activation of the airflow system on a filtered-exhaust helmet before complete surgical gowning would lead to increased contamination of the surrounding surgical environment. To our knowledge, no prior study in the orthopedic literature has investigated a relationship between helmet airflow timing and contamination.

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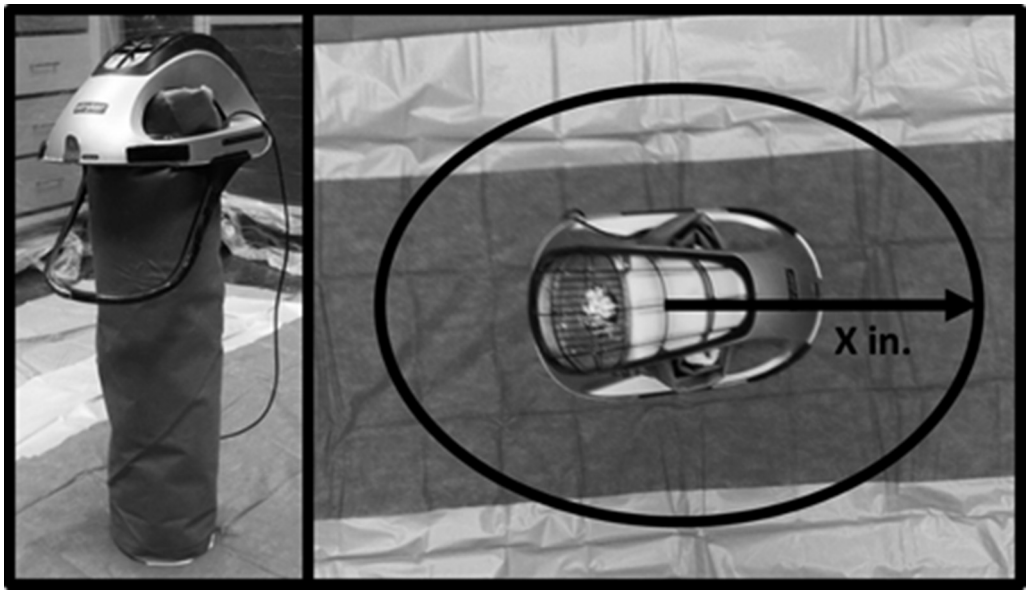

Fig. 1. Particle spread measurement.

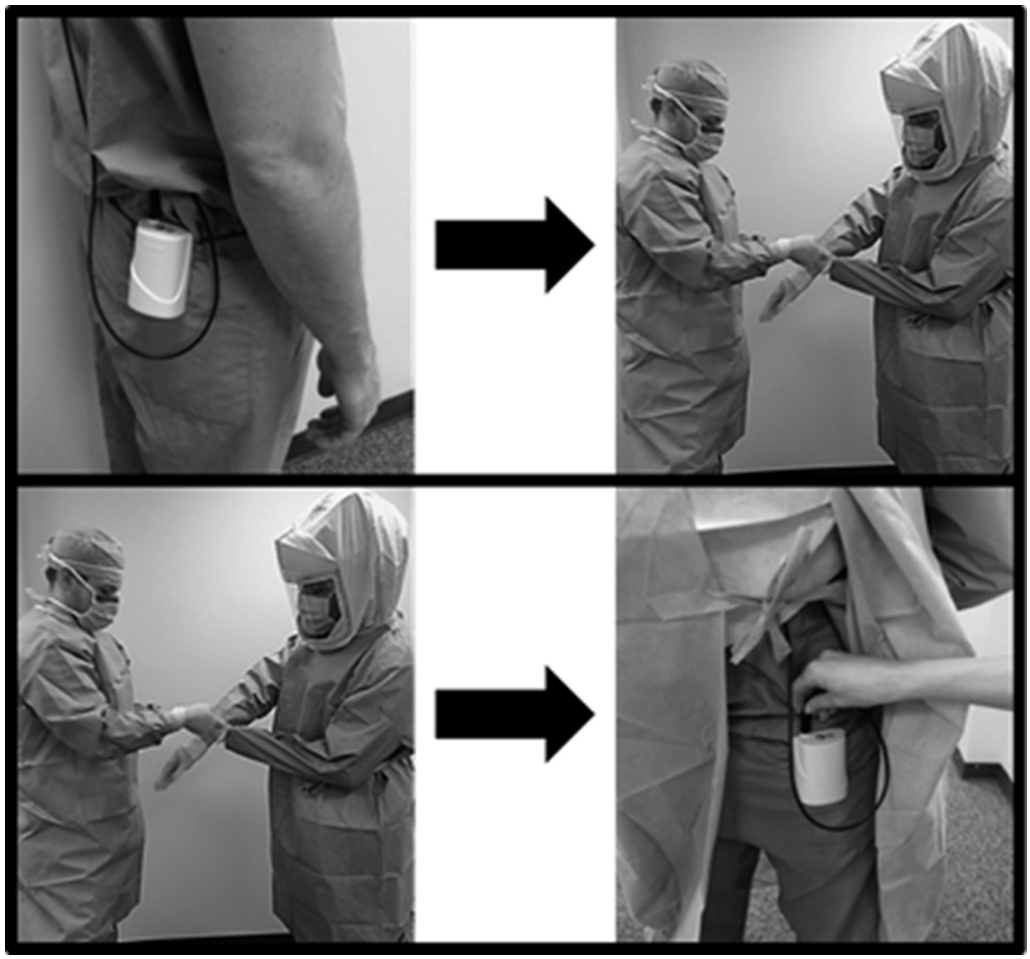

Fig. 2. Airflow timing activation during surgical gowning procedure.