

## DOUBLE GLOVING

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During an operative or invasive procedure, surgical gloves are worn as a protective barrier to reduce the risk of disease transmission for both members of the perioperative team as well as patients. Glove perforation during surgery has always been an area of concern, as it increases both the risk of transmission of bloodborne diseases and the infection rate.<sup>1</sup> For these reasons, prevention of barrier failure is the key to protection; the primary method of prevention for members of the surgical team is the practice of double gloving for operative procedures.

### ***Factors Contributing to Surgical Glove Failure***

While surgical gloves provide a protective barrier between surgical team members' hands and infectious blood and body fluids, the inherent nature of the operating room (OR) environment and other factors contribute to surgical glove failure across surgical specialties, as demonstrated by numerous studies.

- One study noted that three-quarters of injuries occurred during the use or passing of devices and that most sharp injuries are caused by suture needles (43.4%), scalpel blades (17%), and syringes (12%).<sup>2</sup>
- Procedures involving sharp instruments and exposure to boney surfaces have been associated with higher glove failure than soft-tissue surgery.<sup>3</sup>
- In a study of glove perforation rates in open lung surgery, rib resection and case duration of over 2 hours resulted in a significant increase in the glove perforation rate.<sup>4</sup>
- Ophthalmic surgery also presents a risk for glove perforation due to passing sharp, extremely fine instruments in a dimly lit environment. A case-controlled study conducted to determine the number and site of perforations in surgical gloves worn by scrub nurses during ophthalmic surgery reported a perforation rate of 8%.<sup>5</sup>
- Research has demonstrated that surgical gloves cannot always withstand the rigors of lengthy and strenuous procedures and also that perioperative personnel do not always change their gloves frequently enough during a long procedure. A study examining worn surgical gloves found that wearing gloves for 90 minutes or less resulted in microperforations in 46 of 299 pairs of gloves (15.4%), wearing gloves for 91 to 150 minutes resulted in perforation of 54 of 299 pairs of gloves (18.1%), and wearing gloves for over 150 minutes resulted in perforation of 71 of 300 pairs of gloves (23.7%).<sup>6</sup>

The issue that many glove perforations go unnoticed by members of the surgical team has also been well-documented in the literature.

- A recent randomized, controlled trial of tears in sterile surgical gloves used during thyroid surgery reported that about 90% of glove perforations go unnoticed during a surgical procedure.<sup>7</sup>
- A prospective study conducted to assess the rate of glove perforation in orthopaedic surgery, primarily caused by shearing injuries rather than perforation due to sharps, found that 61.5% of the perforations were unnoticed.<sup>8</sup>
- The case-controlled study on perforations in surgical gloves worn by scrub nurses during ophthalmic surgery noted above also reported that none of the perforations found were detected by the scrub nurses.<sup>9</sup>
- A prospective, randomized study assessing the effectiveness of double gloving compared with single gloving in reducing finger contamination during surgery found that the vast majority (83.3%) of glove perforations went unnoticed.<sup>10</sup>

### ***Healthcare Workers' Injury and Risks with Single Gloving***

It is imperative that healthcare workers understand the risks and potential injuries associated with single gloving. A study of the relative frequency in glove perforations comparing double gloving with single gloving reported a significantly greater potential for blood-skin exposure with single gloving.<sup>11</sup> The prospective study comparing the effectiveness of double gloving and single gloving in reducing finger contamination during surgery noted above also reported that the presence of visible skin contamination was higher in perforation with single gloving (42.1%) than with double gloving (22.7%).<sup>12</sup>

Percutaneous injuries to healthcare workers are associated with transmission of significant bloodborne pathogens (eg, hepatitis B virus, hepatitis C virus, and the human immunodeficiency virus); therefore, it is critical that members of the surgical team detect glove perforations before skin contact with pathogens occur in order to reduce the risk for infection.<sup>13</sup>

Bloodborne pathogen infection can have significant health implications for healthcare workers, as well as patients, such as<sup>14</sup>:

- Pain and physical injury;
- Emotional and psychological trauma;
- The potential for illness and possibly death;
- High costs of medical bills to treat any associated infection or disease; and
- Adverse effect on the healthcare worker's salary, if he or she is unable to work.

There have also been documented occurrences of surgical staff members who have experienced a percutaneous injury, contracted a bloodborne disease, and then transmitted the disease to patients.<sup>15</sup> An early report noted that a cardiac surgeon

with chronic hepatitis B transmitted the disease to five of his patients during open-heart surgery, despite investigations finding no deficiencies in the surgeon's infection control practices.<sup>16</sup>

### **Advantages of Double Gloving**

The literature also identifies numerous advantages associated with double gloving, as this practice has been shown to:

- Reduce the risk of exposure to patient blood by as much as 87% when the outer glove is punctured.<sup>17</sup>
- Reduce the volume of blood on a solid suture needle by as much as 95% when passing through two glove layers, thereby reducing viral load in the event of a contaminated percutaneous injury.<sup>18</sup>
- Prevent surgical site infection and also protect the hands of healthcare workers.<sup>19</sup>
- Provide an effective way to reduce the risk of percutaneous injuries.<sup>20</sup>
- Increase the wearer's awareness of a perforation, which may protect against exposure during surgery (for double gloving or double gloving with an indicator system).<sup>21,22,23</sup>
- Significantly decrease the amount of blood that is transferred to the healthcare worker's hands during a needlestick injury.<sup>24</sup>
- Reduce the risk of glove perforation during a lengthy procedure.<sup>25</sup>
- Reduce the risk of perforation of the inner-most glove.<sup>26</sup>
- Decrease the risk of blood contact exposure for perioperative personnel by 70%, when compared to wearing a single glove.<sup>27</sup>
- Reduce the risk for blood contamination; a study comparing single gloving and double gloving in orthopedic and trauma surgery suggested that the rate of contamination with blood was 13 times higher with single gloving as opposed to double gloving.<sup>28</sup>
- Provide greater than 90% protection to the surgeon, as well as the patient.<sup>29</sup>

### **Double Gloving Best Practices**

There are several best practices for double gloving to reduce the risk for occupational exposure. A color coded glove perforation indicator system (eg, a two-color glove system) is noted to be an effective risk reduction strategy. The inner-glove (ie, the indicator glove) is a brighter color (eg, bright green) and the outer-glove is a neutral color (eg, white). During surgery, if the glove is breached or fails in any way, the color of the inner glove will be visible. Wearing double indicator gloves has been shown to enable the wearer to detect perforations in the outermost glove more easily than when wearing double gloves without an indicator.<sup>30</sup> In addition, the frequency of changing gloves among wearers of double gloves has been reported as considerably higher when an indicator system is used.<sup>31</sup> Gloves should be monitored for punctures in order to help ensure barrier protection against transmission of microorganisms and bloodborne pathogens to the surgical field.<sup>32</sup>

Removing both pairs of gloves when a puncture occurs is another best practice. Regardless of whether a color coded glove indicator system is used, both the inner and outer pairs of gloves should be changed as soon as possible whenever a perforation is detected, since a perforation in the outer pair of gloves is an indication that the inner glove may be compromised as well.<sup>33</sup>

Changing gloves at certain intervals has also been shown to reduce the risk for exposure. For total hip arthroplasty procedures, more frequent changing of the outermost pair of gloves, particularly during certain phases of the procedure with a high risk of bacterial contamination (eg, prosthesis reduction) or perforation (eg, surgical incision, femoral cementing) was shown to reduce both contamination and perforation rates.<sup>34</sup> A recent study evaluating the integrity of surgical gloves after use reported the highest incidence of perforations occurred in the outer pair of gloves (76.9%) when double gloving was used, in open surgical procedures, and in surgeries of 150 minutes or more in duration; the authors concluded that these findings reinforce the significance of both double gloving with a perforation indicator system and changing gloves in operations of 150 minutes or more in length, especially in surgical procedures involving open incisions.<sup>35</sup>

### ***Professional Organizations which Endorse Double Gloving***

Several key professional organizations have endorsed the practice of double gloving to improve the protection and safety of both healthcare workers and patients, as outlined below.

- Association of periOperative Registered Nurses (AORN). The Guideline for Prevention of Transmissible Infections states:
  - “Perioperative team members should wear two pairs of surgical gloves, one over the other, during surgical and other invasive procedures with the potential for exposure to blood, body fluids, or other potentially infectious materials. When double gloves are worn, perforation indicator systems should be used.”<sup>36</sup>

- Australian College of Operating Room Nurses (ACORN).
  - In its 2014 updated standards, which represent the accepted standard of professional practice for Australian perioperative nurses, Standard 8 section 8.4 deals with glove use and sub-section 8.4.2 directly stipulates that nurses “comply with the recommended practice of double-gloving when scrubbed for surgical invasive procedures.”<sup>37</sup>
- American College of Surgeons (ACS). The Statement on Sharps Safety includes:
  - “The ACS recommends the universal adoption of the double glove (or underglove) technique in order to reduce body fluid exposure caused by glove tears and sharps injuries in surgeons and scrub personnel.”<sup>38</sup>
- American Academy of Orthopaedic Surgeons (AAOS). The Information Statement on Preventing the Transmission of Bloodborne Pathogens includes:
  - “Double gloving is recommended.
  - Double gloves may be worn during all surgical procedures. The outer pair should be changed at least every 2 hours to prevent skin exposure from perforations that may occur in the gloves with use over time. During procedures where sharp instruments and devices are used, or when bone fragments are likely to be encountered, the surgeon may consider the use of reinforced gloves that offer more protection.”<sup>39</sup>
- The International College of Surgeons (ICS). As part of ICS’s commitment to its vision of “improving the lives of patients through the development and education of its members, and advancing the field of surgery,” the college “urges all members to support and introduce whenever possible, standard double gloving with the additional benefit of a perforation indication system for all surgical intervention.”<sup>40</sup>
- The Centers for Disease Control and Prevention’s (CDC’s) 1999 Guideline for Prevention of Surgical Site Infection specified:
  - “Wearing two pairs of gloves (double-gloving) has been shown to reduce hand contact with patients’ blood and body fluids when compared to wearing only a single pair.”<sup>41</sup>
- The European Center for Disease Prevention and Control (ECDC) encourages the practice of double gloving to reduce hand contact with bodily fluids.<sup>42</sup>

- The World Health Organization (WHO). Information on medical glove use to prevent pathogen transmission notes:
  - Double gloving, in countries where there is a high prevalence of the hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV) for long surgical procedures (greater than 30 minutes); for procedures with contact with large amounts of blood or body fluids; and for some high-risk orthopaedic procedures, is considered an appropriate practice.<sup>43</sup>

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