ORIGINAL ARTICLE

# Incidence of Surgical Glove Perforations during Surgical Procedures at a Tertiary Care Hospital, Islamabad

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**ABSTRACT**

**Objective:** To determine the rate and patterns of surgical glove perforation during surgical procedures and to compare the rates between emergency and elective surgeries at PIMS, Islamabad.

**Study Design:** A cross-sectional study.

**Place and Duration of Study:** The study was conducted in the Department of General Surgery of Pakistan Institute of Medical Sciences (PIMS), Islamabad, Pakistan from January 2021 to June 2021.

**Materials and Methods:** Surgical gloves are worn in various major surgeries, elective and emergency, and were studied post-procedure, for six months' period. Gloves were examined by standardized visual and hydro-insufflation techniques to check for perforations. Glove quality was also noted. The type of procedure carried out, the number of perforations, the location of perforations, and the roles of the surgical team were all recorded along with other relevant information. Data were analyzed using SPSS version 22.

**Results:** A total of 120 gloves were tested perforated, 69/100 for elective and 51/80 for emergency procedures. Perforations in emergency procedures were 57.5% ±0.44, while 42.5% ±0.52 in elective surgeries. Glove perforations were extremely common among first assistants (26.67%) and second assistants (9.17%) during emergency surgeries as well as among first surgeons (30%) and scrub nurses (11.67%) during elective procedures. Only 1.2% of inner glove perforations were recorded. The most commonly perforated parts of the glove were the left hand, the left index finger and the thumb. Residents had a lower rate of glove perforation than consultant surgeons.

**Conclusion:** Calculated perforation rate is high, posing a clear threat to the surgical workforce. Preventive measures such as double gloving should be routinely adopted for all surgical procedures. Glove quality is also an important contributing element.

**Keywords:** *Perforation, Protective Clothing, Surgical Gloves*.

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## Introduction

In any surgical procedure, the only barrier separating the physician and the patient is a pair of surgical gloves and they have been playing a pivotal role in the surgeons' protection against pathogens for more than a century now. They were introduced with the intent of preventing contamination of the surgical wounds by the surgeons' hands and, thus, preventing surgical site infections. Surgical gloves are the mainstay of creating a sterile environment in the operation theatre.[1,2,3] Moreover, gloves are made to guard the surgical team against contracting diseases such as hepatitis B, hepatitis C, and the human immunodeficiency (HIV) virus when doing surgery.[1,2,3] Glove perforation means a breach in this sterile barrier and access of the patient's blood and body fluids to the surgeon's skin and blood. Glove perforation is not an uncommon experience and an operating team member does not discover the perforation until after the procedure is complete. A break in this barricade may pave way for the spread of pathogens and disease. Evidence proves that the

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incidence of intra-operative accidents to the operating team soar.[1,2]

Glove perforation is a common incident with glove punctures ≈61% have been reported.[2] It has been seen that glove perforation risk is related to the type of surgical procedure performed.[3-7] Moreover, perforation has been shown to be more during emergency surgical procedures. A challenging factor in this regard is that in about 70% of cases, the operating team member is unaware of the perforation until the end of the procedure.[1,4]

Double gloving instead of single glove usage is one of the recommended techniques to reduce the risk of glove perforation.[1,2,3] Also, it limits the level of contamination in perforations and tears in the gloves, especially from needle stick injuries. Studies demonstrate how the inner gloves had fewer perforations (as less as 2%), when double gloves are used, hence reducing cross infection.[1,2,3]

The objective of the study was to determine the rate and patterns of surgical glove perforation during surgical procedures and to compare the rates between emergency and elective surgeries at a tertiary care hospital in Islamabad, Pakistan. We presume this to fill important gaps in the literature and serve as a foundation for further study in this regard.

## Materials and Methods

This cross-sectional study was conducted at the Department of General Surgery, PIMS, Islamabad from January 2021 to June 2021. The study was started after receiving permission and ethical clearance from the ethical review board of the Pakistan Institute of Medical Sciences, Islamabad. All surgical gloves worn in various major surgeries, elective and emergency both, were studied post-procedure. Non-probability consecutive sampling was done. Perforated specimens were identified using standardized visual and hydro-insufflation techniques. Only the gloves of doctors who consented were collected and studied. The type of procedure carried out, the number of perforations, the location of perforations, and the roles of the surgical team were all noted along with other relevant information. Gloves were also labelled if they were obtained from the hospital or were of a purchased brand.

The gloves used by each scrubbed member of the surgical team for every procedure were put in a well-labeled separate collecting box immediately after surgery. For each operation, data was collected by using a pre-approved structured format. Postoperatively the gloves from all collecting boxes were retrieved for testing and standardized visual and hydro insufflation techniques were used to identify perforations.

The authors of this study performed the Testing and data collection themselves. (Figure 1) Initially, the visual assessment for perforations was performed by an examiner blinded to the relevant data of that glove otherwise. Later, the hydro insufflations method was performed on each specimen to identify still any missed perforation and to confirm smaller tears. A standardized water leak test was carried out. 1000 ml of diluted methylene blue solution were placed into the gloves. The glove's wrist was then manually compressed for a minute in order to reveal any damage. The leaking of blue water would point out a perforation.

After complete analysis, the data regarding perforations for each glove was recorded in terms of a number of perforations, the location of each perforation (in terms of Left or Right hand and the digit involved) and the layer of glove perforated. This data was related to the type of surgery and the surgeon/assistant surgeons/ scrub nurse. These comprised the study variables.


**Fig 1: Diagrammatic Prestructured Format of Data Collection**

The data were analyzed by using SPSS version 22. Percentages were calculated for all categories. The chi-square test was applied with $p<0.05$ having a statistical significance.

## Results

The study analyzed perforations in 120 gloves from two sets of gloves collected for testing. (Table 1)

**Table 1: Incidence of Perforation in Surgical Gloves from various Categories**

| Entity | | Rate of Perforation | | Cumulative Percentage |
|---|---|---|---|---|
| Type of Procedure | | Elective 51/80(63.75%) | Emergency 69/100(69%) | Emergency: 69 (57.5 ±0.44) Elective: 51(42.5% ±0.52) |
| Member of the Surgical Team | First Surgeon | 32 (26.67%) | 36 (30%) | 68 (56.67%) |
| | 1st Assistant | 02(1.67%) | 08 (6.67%) | 10 (8.33%) |
| | 2nd Assistant | 11 (9.17%) | 07 (5.83%) | 18 (15%) |
| | 3rd Assistant | 00 | 04 (3.33%) | 04 (3.33%) |
| | Scrub Nurse | 06 (5%) | 14 (11.67%) | 20 (16.67%) |

Set 1: Gloves from Emergency Procedures:

A total of 100 gloves were obtained from elective surgeries; amongst these 69(57.5%, $p$<0.05) were found to be perforated. Thirty-six (30%) gloves were worn by primary surgeons, 08(6.67%) by the first assistants, 07(5.83%) by the second assistants, 04(3.33%) by the third assistants and 14(11.67%) by the scrub nurses.

The gloves worn by primary surgeons 68(56.67%) and scrub nurses 20(16.67%) were more perforated. A lower rate was found in comparison when gloves used by the first assistant 10(8.33%), second assistant 18(15%) and third assistant 04(3.33%) were analyzed. It was determined that this difference was statistically significant ($p$<0.05).

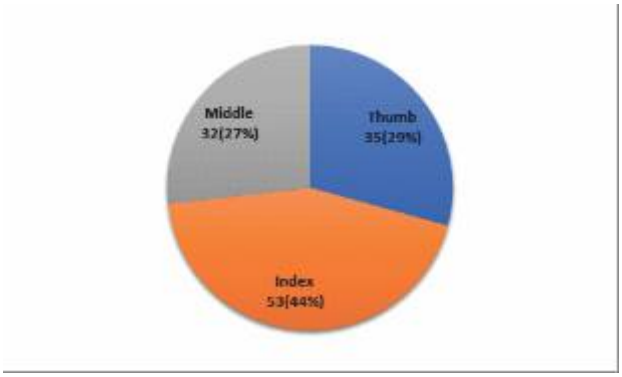


**Fig 2: Percentage of Digits Perforated**

Set 2: Gloves from Elective Procedures:

Altogether, 80 gloves were collected for testing from emergency surgeries; amongst these 51 (42.5%, $p$<0.05) were found to be perforated. Thirty-two (26.67%) were worn by primary surgeons, 02(1.67%) by first assistants, 11(9.17%) by second assistants, none by third assistants and 06(5%) by scrub nurses. This variance was statistically significant ($p$<0.05).

Frequency of digits perforations in surgical gloves is commonly localized in the index finger 53(44%), middle finger 32(27%) and thumb 35(29%) of the glove worn. (Figure 2) The scrubbed-in team wore double gloves in 97(81%) of cases. In only two cases (1.6%), perforations of both the inner and outer gloves were found. (Figure 3)

The overall perforation rate after emergency procedures remained at 57.5% ±0.44, while perforations in elective surgeries were 42.5% ±0.52. In emergency surgeries, the primary surgeon 68(56.67%) and scrub nurses 20(16.67%) sustained the maximum number of perforations in their gloves, while in elective surgeries, the primary surgeon 32(26.67%) and the second assistant 11(9.17%) had the highest rate of surgical glove perforation.

The right hand was involved in 26 (21.67%) and Left Hand was perforated in 94 (78.33%). Hospital provided gloves were 73 (60.8%) and Branded gloves were 47 (39.2%).

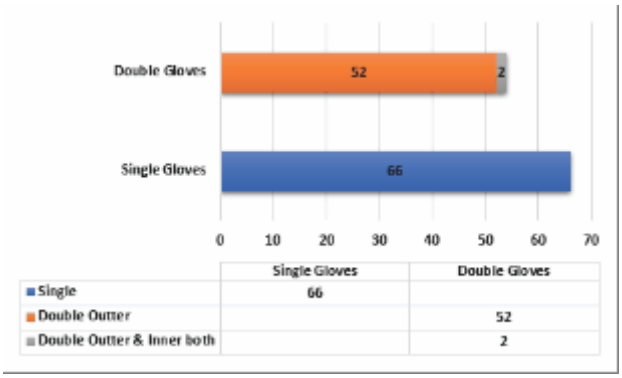


**Fig 3: Perforated Double Gloves 02(1.6%)**

## Discussion

Various risk factors are identified for surgical glove perforation during an operation. Commonly perforations occur during wound closure and are self-inflicted perforations. Other factors remain excessive fat and poor assistance by the scrubbed-in team. The operating surgeon suffers a glove perforation accident more frequently in major surgeries, especially during reconstruction and mass closure.[1,3] Lesser contributors to surgical glove perforation have been identified as glove indices including type, material, and brand. Latex is a superior material being more resistant to puncture than vinyl gloves.[1] Glove manufacturing defects may also contribute.[1]

This study has recognized a high rate (66.67%) of perforated gloves in both elective and emergency

procedures done at the Department of General Surgery, PIMS. Important factors that may significantly increase the rate of glove perforations seen are worth discussing. Higher rates of perforation are noted in emergency surgeries, owing to the fact that almost all of these surgeries are performed by surgical trainees who have limited surgical experience relative to their senior colleagues.[1] Furthermore, the results depict that, during our research, a variety of glove sizes was not always available. Several members of the surgical team employ gloves of extreme size or other due to the lack of options. So, using gloves of the wrong size may cause the higher rate of glove perforations in this study. Moreover, developing countries like Pakistan have been importing cheap and lower-quality products, giving rise to a more prevalent cause of surgical glove perforation in this part of the world. We suggest that further studies may be conducted to enlighten this correlation. On analysis of glove perforation locations, we found that the most commonly perforated were the left index finger and the middle finger. A possible explanation for the mechanism of this damage to the surgical glove comes from the point that perforations usually occur while suturing. During wound closure, the needle holder is often held with the dominant, usually, the right hand and the needle may accidentally perforate the glove of the non-dominant hand. Thus, effectively using forceps held by the non-dominant hand can reduce the risk of these perforations.[1] A study by Kevin and colleagues, however, found a major number of perforations in: the dominant thumb, non-dominant ring finger, and non-dominant little finger.[4]

While analyzing various glove layers, it was seen that the incidence of perforation for the inner glove was rare (0.4%). Thus, double gloving is a satisfactory protective measure against glove perforations in most operations. It is obvious that using two gloves during procedures reduces the danger of contaminating blood and other bodily fluids compared to using just one glove. Various studies second the fore mentioned.[1-4,8-14] As the surgical team often remains unaware of the perforation, various studies suggest double gloving and using indicator double gloves.[3,4,10,11] An important technique is changing gloves despite an evident perforation after 60 minutes to 90 minutes or up to 150 minutes in various procedures, during which the incidence of glove perforation is high.[3,4,9,10,12,13] The concept of reduced dexterity has though also been raised in the context of double gloving.[8]

We found that among surgical team members, surgeons experienced the highest prevalence of glove perforation during elective surgeries, followed by the scrub nurses bearing the second. The surgeons met the most glove perforation mishaps during both elective and emergency procedures, with even higher rates in emergency procedures. Many other studies have reported similar findings.[1,2,13] A unanimous justification is that rather than a first, second, and third assistant, the surgeon uses the surgical instruments directly and for longer periods of time in procedures, thus, increasing the risk of perforation. Both the scrub nurse and the surgeon are at a potentially high risk of surgical glove perforation owing to directly and repeatedly exchanging sharp surgical instruments in the scrubbed surgical team.[1]

Glove perforations are important determinants of a sterile barrier in the operation theatre and all measures must be adopted to reduce the risk of perforation.[1,2,3,13] Surgical site infections significantly determine morbidity and mortality during the postoperative period, around the globe. Wound infections have been linked with glove perforations in various studies.[1,2,11,15] Heidi at el. reported a statistically significant.[11] A study conducted in Hong Kong linked superficial SSI with glove perforation, independent of BMI and operating time.[15] Additionally, the surgical team is at risk of getting virus infections, and thus potential harm. A surgical team's top worries are the Human Immunodeficiency Virus (HIV), Hepatitis B, and Hepatitis C since they are blood-borne viruses that spread through intra-operative contact with the patient's blood and other bodily fluids.[1,2,3,13] Thus, it is vital to investigate incidents of glove perforations. Modified and recommended gloving techniques should be adopted to establish a safer environment in the Operating room for both the patient and the surgical team.

## Conclusion

In PIMS Islamabad, a high rate of surgical glove perforation has been observed, mostly during

emergency surgeries. Hence, it can be required to examine the quality and suitability of gloves before beginning any processes. Also, all gloves suspected of perforation should be checked post-procedure. This will facilitate infection control measures as per requirement. It is recommended that different color indicator gloves are used so that the penetration in the outer glove is detected earlier, highlighted by the inner glove. The gloves can be changed as soon as the perforation is detected.

Due to the widespread prevalence of glove perforations, surgeons and the surgical team are expected to follow the generally recognized guidelines for preventing occupational hazards. Studies that concentrate on the exposure to blood and infectious fluids brought on by glove holes in the future might increase our understanding of surgical hazards. Hepatitis B vaccination should also be mandated by legislation for both registration and accreditation processes and employment. All surgical practitioners should receive these essential vaccines without charge as a precaution. and

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