

# Are glove perforations equivalent to sharp injuries? Results from a study in maxillofacial surgery

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## Abstract

The objective of the present study was to remove the ambiguity in usage of terms Glove perforations (GP) and Sharp injuries (SI) equivalently. A 6 months prospective study was conducted involving the use of double gloving practice for the procedures needing medical sharps in maxillofacial surgery. Total of 270 procedures were performed. GP's and SI's were analysed. The data revealed total of 400 GP's including 290 outer GP and 110 inner GP and 80 SI. Out of 80 SI, 65 were superficial and 15 were deep injuries. Out of total 270 patients, 25 were high risk patients. Only 5 significant exposures were observed which were a part of high risk patient group. This study concludes:

Every GP is not always SI but every SI is a GP. Risk of SI increases with inner GP but it is also not necessary that every inner GP leads to SI. A modified surveillance and a new algorithm are also proposed which can be a part of guidelines for occupational safety and health.

## Key words

SI, Outer GP, Inner GP, Significant Exposure, Equivalency

## Introduction

In the daily practice of medicine and dentistry sharp instruments are needed. It is estimated that large number of contaminated medical sharp injuries occur each year in healthcare facilities. Sharp injury (SI) is an occupational hazard for surgeons and other health care workers engaged in surgical procedures because of the large amount of exposure to sharp

objects, like needles, syringes, IV catheters, cannulas, lancets, scissors, cautery tips, wires, drill bits, medical ampoules/vials and pointed segments of bone etc. In 1985, in order to increase awareness among health care workers of the dangers of sharp injuries and other types of disease transmission, the Centres for Disease Control (CDC) and the Occupational Safety and Health Administration (OSHA) in the United States

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introduced the “Universal Precaution Guidelines,” which have become the worldwide standard in both hospital and community care settings.

According to the World Health Organization (WHO), approximately three million individuals are injured annually due to needle stick or sharp injuries.<sup>1</sup>

A sharp injury (SI) is defined as “the par literal introduction into the body of a health-care worker, during the performance of his other duties, of blood or other potentially infectious material by a hollow-bore needle or sharp instrument, including but not limited to needles, lancets, scalpels and contaminated broken glass”.<sup>2</sup>

A glove perforation (GP) is defined as a “breach in the sterile barrier” and has been shown to be a risk-factor for infection.<sup>3</sup>

Department of Health and Human Services, USA, in March 2001, estimated that 0.6 to 0.8 million sharp injuries and other percutaneous injuries occur annually among healthcare workers.<sup>4</sup> A recent study in US reported as many as 700,000 SI occur per year.<sup>2</sup> SI may occur in up to 21% of the total operations in maxillofacial trauma surgery.<sup>5</sup> Health care workers incur 2 million sharp injuries (SI's) per year that result in infections like hepatitis B,C and HIV.<sup>6</sup> Data from the EPINet system also suggests that at an average, hospital workers incur approximately 30 sharp injuries per 100 beds per year and 69.3% were superficial with no or little bleeding, 27.3% were with moderate skin puncture and some bleeding while just 3.4% were deep cut associated with profuse bleeding. Various medical personnel show variable rates of SI according to their job category.<sup>7</sup>

According to Avery *et al.* the treatment of Maxillofacial fractures has a glove perforation incidence as high as 50%.<sup>8</sup> The incidence of perforations during the treatment of mandibular fractures is greater than 50%, with over 90% of perforations unnoticed at the time of surgery.<sup>9</sup> According to recent studies, glove perforations occur frequently which poses a risk of Hepatitis B, C or human immunodeficiency virus (HIV) infection for the surgeon but none of the studies mention anything about the association of GP to SI leading to exposure.<sup>10</sup>

Whether every glove perforation is transformed into SI is still an issue of concern, however to our knowledge there is no peer reviewed literature focussing on the non equivalency of GP and SI. When the needle punctures the glove, but not the skin, the result is not a sharp injury, but a glove perforation.

There are several studies about the incidence of SI and GP in different setups and surgical procedures but there is no study showing evaluation of how many glove perforations actually lead to SI and how many personnel had a significant exposure.

While working with sharps, a health care provider is always under stress, anxiety and under the fear of exposure making him unwilling to perform the procedure. A glove perforation received while working on high risk patient during the procedure may lead to post traumatic stress disorder increasing the economical burden involved in testing, follow up and disability payments. Detailed analysis of the GP and SI could help in reducing such problems.

Thus with the aim to remove the ambiguity in usage of terms glove perforation and sharp Injury equivalently, we conducted a randomized, prospective, blind study in the Department of Oral and Maxillofacial surgery, Dayanand Anglo Vedic (DAV) Dental College and Hospital, Yamunanagar, Haryana.

### Objectives

- To evaluate the number of glove perforations in the Dept. of Oral and Maxillofacial Surgery from September 2010 to Feb 2011.
- To evaluate the actual number of SI in the same study group in the same period.
- To evaluate the equivalency of GP with SI.

### Methods

Respondents were post graduate students in the Department of Oral and Maxillofacial surgery at DAV Dental college Yamunanagar, Haryana.

The study involved 9 residents of the department enrolled in Masters of dental Surgery (MDS) course. Study was carried out for 6 months from September 2010 to Feb 2011. All respondents were given a questionnaire after the completion of procedure

involving the use of medical sharps and an analysis of the perforated glove after the completion of the procedure was done. Double gloving was done during each procedure. The survey asked about:

- The duration of the operation.
- The number of glove perforations per procedure.
- The number of sharp injuries sustained.
- The details of the injury (superficial or deep and location).
- The details of the type of procedure/ surgery.

Glove perforation was evaluated by filling each glove with 500 ml of water, then applying slight pressure on the glove with the palm and fingers. The number of perforations, evidenced by water flow through the holes, was counted. All the evaluations were done by the same examiner. Questionnaire was deposited in a sealed envelope by every resident performing the procedure.

#### Definition of terms

**Significant exposure:** exposure which carries the potential for transmission of disease (it includes superficial and deep SI in high risk patients as well as deep SI in low risk patients)

**High risk patient:** patient with the history of infection with blood borne pathogens, intravenous drug use, multiple blood transfusions.

#### Observations and results

- Total procedures performed: 270
- Total number of GP {including inner (110) and outer glove perforation (290)}: 400 (Fig. 1, Table I)
- GP rate (outer and inner glove) per procedure is 1.48 (148.14%)
- GP rate of outer glove per procedure is 1.07 (107.4%)
- GP rate of inner glove per procedure is 0.40 (40.74%)

**Table I. Number of glove perforations**

Total number of procedures	Total number of Glove perforations	Outer glove perforations	Inner glove perforations
270	400	290	110

Inner glove perforations: 110 (27.5%)

Outer glove perforations: 290 (72.5%)

**Table II. Number of Sharp injuries and Type of injury**

Total number of procedures	Total number of SI	Type of injury
270	80	65 Superficial 15 Deep

\*Superficial with no or little bleeding

\*Deep cut associated with profuse bleeding

- Out of 110 inner glove perforations, 80 (72.72%) were SI's (Table II)

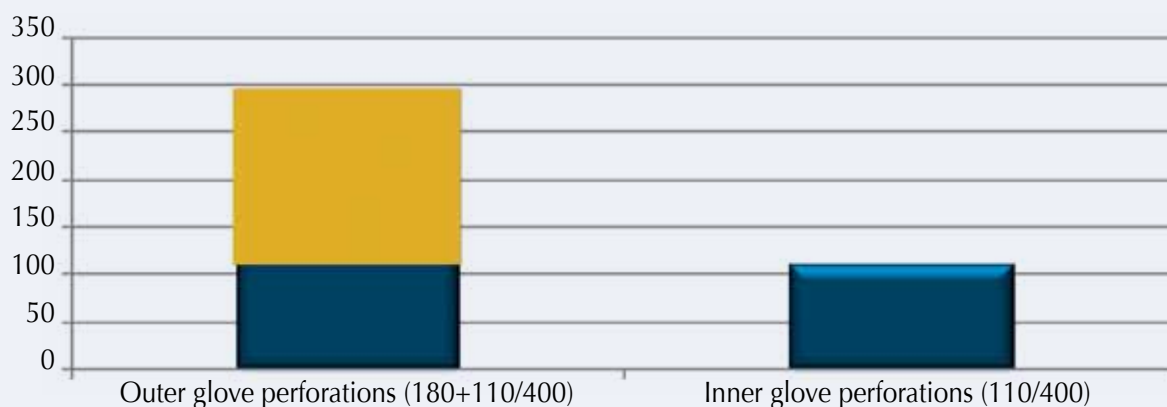
Out of 270 procedures, 25 (9.25%) were high risk patients and 5/270 (1.85%) was the total rate of significant exposures. The total rate of significant exposure (1.85%) was lower than total (148.14%) GP rate per procedure. The outer GP rate was 107.4% and inner GP rate was 40.74% per procedure. Thus it was inferred that the total rate of significant exposures (1.85%) was much lower than the outer GP rate and inner GP rate.

The rate of significant exposures was found to be 6.25%, 5 of the total 80 SI (Fig. 2).

SI rate per procedure was 0.29 (29.6%). Data about the duration of the operation, the details of the injury (superficial or deep and location) and the details of the type of procedure/ surgery are not presented here.

#### Discussion

Health care workers who are injured by sharp injury face the uncertainty of their infection status in the immediate period following the injury and once



Outer GP means only outer glove perforation without inner glove being perforated.

Inner GP denotes outer and inner both the gloves being perforated.

**Figure 1. Number of glove perforations**

the news is known face life-changing, long term consequences. A study in the year 2005 found that 29 out of 110 nurses who sustained a sharps-related injury sought emotional counselling in the year following the injury.<sup>2</sup> In a more recent 2006 detailed case study two nurses who received sharp injuries from an HIV-infected patient displayed symptoms consistent with post traumatic stress disorder (PTSD): insomnia, ongoing depression and anxiety, nightmares, and panic attacks upon returning to the work environment where the injuries were received, despite testing negative for HIV antibodies more than 22 months after their injuries.<sup>2</sup>

In our study we found that residents working on patients who had to undergo inter-maxillary fixation and other wiring techniques along with open reduction internal fixation (ORIF) were at maximum risk of receiving GP which is consistent with the study of Gaujac *et al.*<sup>11</sup> They showed that the use of an Erich arch bar for inter-maxillary fixation, a common procedure in oral and maxillofacial surgery, carries a significant risk of perforation and other accidents due to the rough edges of the bars and the stainless steel wires used for placement. Double gloving reduces the perforation risk of the inner glove on an average by 10-fold and the transmitted amount of blood by at least 6-fold.<sup>12</sup> Although double gloving may not prevent penetrating injury, it does increase the penetrating force required.

In our study we found total GP (400) rate per procedure to be 1.48 (148.14%) including outer and inner glove perforations per procedure. Out of total GP, outer GP (290) rate came out to be 1.07 (107.4%) and the inner GP (110) rate came out to be 0.40 (40.74%) whereas the SI (80) rate per procedure was found to be 0.29 (29.6%) clearly indicating that every GP did not lead to SI.

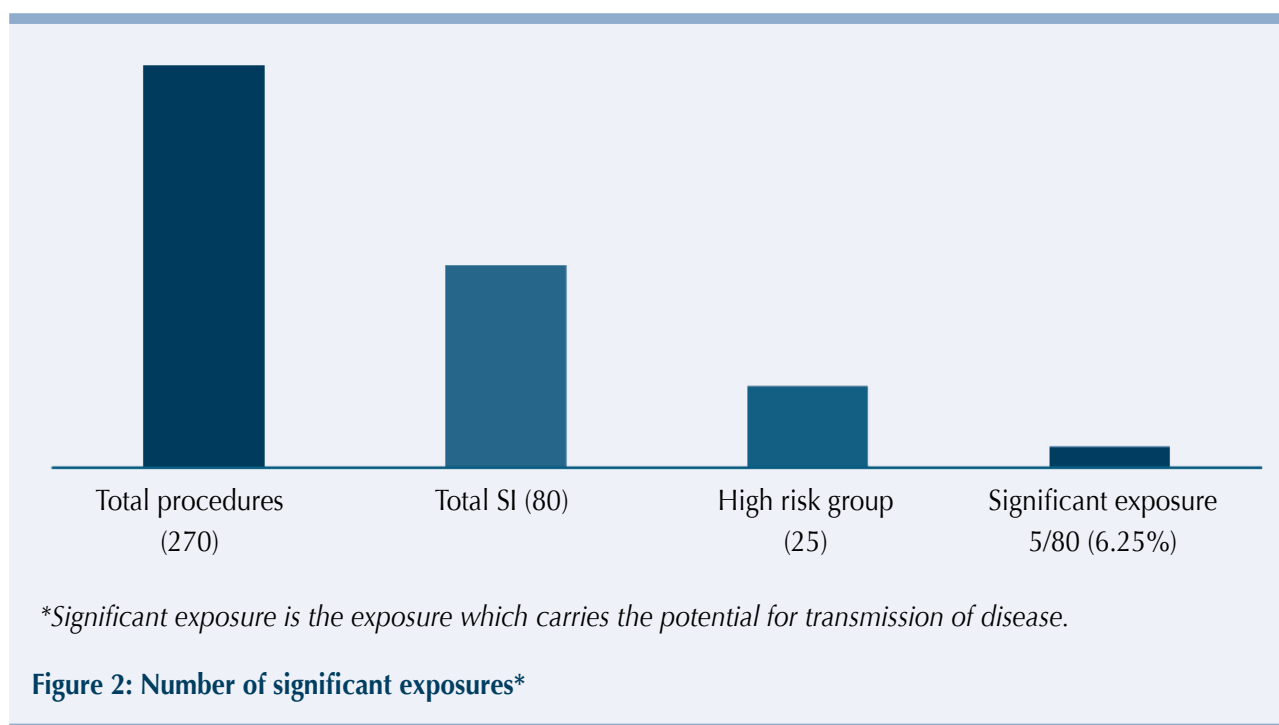
While evaluating total GP (400), outer GP came out to be 72.5% and inner GP was 27.5%. According to Avery *et al.*<sup>8</sup> the outer GP was as high as 79% and inner GP rate was 19% which are close to our study figures.

Out of total 80 (29.6%) SI, 65 (81.25%) were superficial having no or little bleeding and 15 (18.75%) were deep having profuse bleeding. Total of 5 (6.25%) significant exposures which occurred during our study were a

**Table III. Sharp injuries in high risk group**

Total procedures	Total high risk group patients	SI in high risk group
270	25	5/25

A high risk patient was defined as one with a history of infection with HIV, Hepatitis B or Hepatitis C or injectable drug use or multiple blood transfusions.



part of the deep SI group. However, the transmission of blood borne pathogens from the superficial injuries was not seen in our study, thus correlating with low possibility of transmission of blood borne pathogens from superficial injuries.<sup>13</sup>

Out of 25 high risk group patients, 5 significant exposures occurred (Table III). While working on rest of the 20 high risk patients, residents working on 7 patients had outer GP and those working on remaining 13 patients had neither GP nor SI. Thus making these 7 patients the main focus of our study. The residents working on these 7 patients were anxious, psychologically in stress and were in fear of exposure all the time.

A single sharp injury can cost anywhere from a few hundred thousand to a million dollars. More important than the economical factors of blood and body fluid exposure is the psychological trauma to the individual as well as the co-workers and family members. This includes delayed childbearing, altered sexual practices, and side effects of post exposure prophylactic treatment. These challenges are further complicated if potential chronic disability is developed leading to loss of employment and denial of compensation claims. The American Hospital Association reported that one case of serious occupational exposure to infection by bloodborne pathogens can add up to \$1 million or

more in expenditures for testing, follow-up, lost time, and disability payments. Whereas the cost of follow-up for a high-risk exposure per sharp injury without infection is generally in the range of \$3,000. Therefore the total cost of simply testing without subsequent seroconversion in the US approaches US \$2.4 billion.<sup>1</sup>

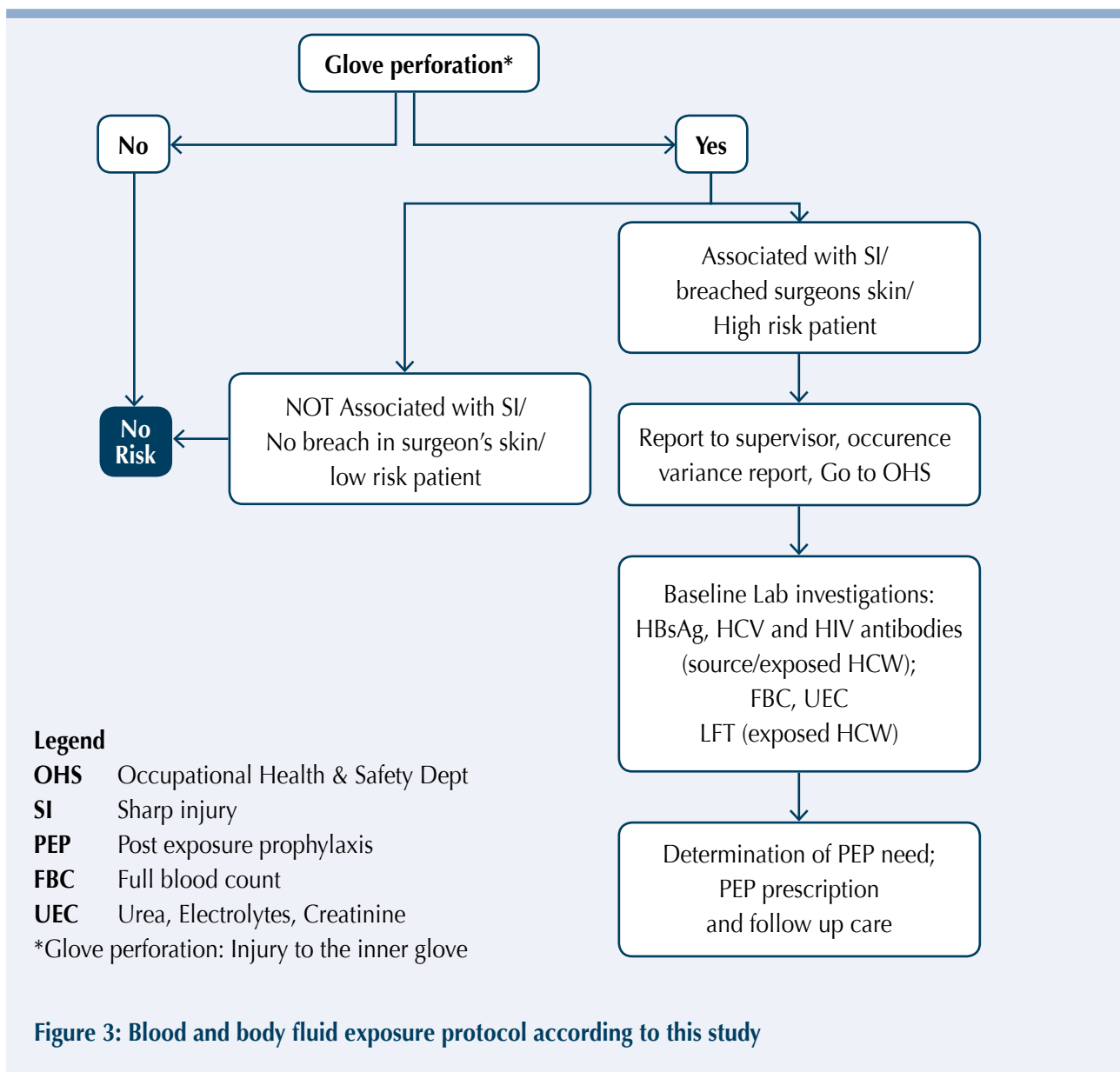
We have proposed a new algorithm based on the inferences from our study (Figure 3). These modifications in the surveillance and the new algorithm will be able to differentiate at first instance between a GP whether outer or inner and actual SI thereby making it easy to evaluate the chances of significant exposures and risks associated with it in treating high or low risk patients.

### Conclusion

Our study concluded:

1. Every GP is not always SI but every SI is a GP.
2. Risk of SI increases with inner GP but it is also not necessary that every inner GP leads to SI.

There is still a serious lack of information about the various factors that cause accidents with needles. Surveillance programs that provide in-depth analysis of sharp injury accidents are an important tool for obtaining this information. One such surveillance is given by Canadian Centre for Occupational Health and Safety in 2005.<sup>14</sup> We propose a modified surveillance as:



- Determining/ Differentiating between outer glove perforation, inner glove perforation and actual sharp injuries – **proposed point according to our study**
- Determining whether significant exposure is there or not – **proposed point according to our study**
- determining the rate of sharp injuries.
- investigating the factors that cause the injuries.
- ensuring that injured workers receive proper treatment.
- identifying areas in which the prevention program needs improvement.
- eventually providing practical strategies for dealing with the problem.

This study is to emphasise on the fact that there are very low chances of risk or significant exposure with every glove perforation a health care provider receives unless it is associated with an obvious SI or an inner glove perforation with breach in surgeon's skin and if the patient is a high risk patient. This mindset will ultimately lead to reduced psychological trauma to the individual, cost and expenditure, loss of time and also unwillingness to perform the procedure with the thought of risk in mind all the time.

Another important feature of the proposed new algorithm is its universal applicability for the analysis of GP in the procedures where either single or double gloving practice is being used. In single gloving practice GP denotes the GP to the worn single glove



while in double gloving GP denotes only the inner GP without considering outer GP to be a part of it.

The new algorithm clearly demonstrates that the residents working on seven high risk patients, who had outer GP but no inner GP and SI have no risk of any significant exposure. Thus the points we propose in the surveillance and the new algorithm should be analysed critically before labelling a health care worker as significantly exposed thereby reducing the post traumatic stress disorder, anxiety and economical burden.

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