

# Occult Glove Perforation During Adult Elective Orthopaedic Surgery

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## Abstract

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**Key words:** Gloves; Perforations; Occult; orthopaedic operations; Double gloving.

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**Competing Interests:** The author have declared that no competing interests exist.

**Aim:** This prospective study was conducted in Rustaq Regional referral hospital, Oman from 01-3-2004 to 31-2-2007 to study the frequency of occult glove perforation in adult elective orthopaedic operations and to determine the efficacy of double gloving.

**Material and Methods:** A total of 404 gloves (369 double and 35 single ) used in 175 adult orthopaedic operations were examined. All gloves were tested by standardized water leak method – EN 455-1. Glove perforation rate, incidence among surgical team members, location of perforation and duration of surgery were analysed and compared.

**Results:** The overall perforation rate was found to be 15% with 11.6% blood contamination in our study. Surgeons had higher perforation rate (11.1%) compared to other operating team members. The index finger and thumb of the non-dominant hand had more perforations than the dominant hand. More perforations were observed in bony operations compared to other surgeries. Perforation rate was more in operations lasting for more than 90 min. The perforation rate of unused gloves was 1%.

**Conclusion:** Routine use of double gloves during elective orthopaedic surgery is advocated. Occult perforations are unrecognized during surgery and pose greater risk. Double gloves confers additional protection especially in high risk patients and significantly reduces blood contamination. Also regular glove changing in high risk surgeries and surgeries lasting more than 2 hours is recommended.

## Introduction

There is increasing concern about the transmission of infection between the patients and healthcare workers. Surgical gloves prevent the exposure of surgical team hands to patients blood and act as protective barrier against blood-borne pathogens such as human immunodeficiency virus (HIV), hepatitis B virus (HBV) and hepatitis C virus (HCV) [1]. Occult (derived from Latin word Occultus ) perforation denotes that is hidden or concealed, not visible to naked eye and which can be detected only indirectly. Occult glove

perforations often go unrecognized by the surgical team members. Most underestimate the risk of blood-borne pathogens and rarely report needle stick injuries, despite there being strong recommendation to use of double gloves [2]. Glove perforations occur in operations in all surgical branches with incidence varying from 10% in ophthalmic surgery to 45% in general surgery [3]. The incidence of glove perforation in orthopaedic surgery ranges from 14% in pediatric orthopaedic surgery to 50% in hip fracture surgery [4, 5]. The reason for this high incidence is due to needle injuries, sharp bony

fragments and use of sharp and complex orthopaedic instruments [6].

In Oman and in other gulf countries there is high prevalence of sickle cell disease (SCD). These patients receive frequent blood transfusions which increases the risk of blood borne infections.

The aim of this study was to study the occult glove perforations in elective orthopaedic surgery, determine the usefulness of double gloving and evaluate the risk of glove perforation among participating surgical team members.

### Materials and Methods

This prospective study was conducted in Rustaq Regional Referral Hospital, Oman over a period of three years from 01-3-2004 to 31-2-2007. A total of 404 pair gloves (369 double and 35 single pair) used in 175 adult orthopaedic operations were studied for occult perforations and related issues. Total of 212 surgeons, 132 assistants and 60 scrub nurses participated in this study. All team members were right handed and if any glove was found to be visible punctured it was immediately replaced with a similar glove. 100 unused gloves were tested as control group. Gloves type, single or double and sizes were determined by personal preference of surgical team members.

Gloves used in surgery were from single company which supplies gloves for all the Ministry of Health hospitals in Oman. After surgery all gloves were collected examined and tested for any occult perforations by standardised water leak test method (EN 455-1) by inflating each glove with 1000 ± 50 ml of water and then observed for 2-3 min to detect any leak [7]. Patients data base was recorded as per the Inpatient No. type of operation (bony or soft tissue) along with the glove sizes, number of gloves – single or double used by surgeon, assistant, scrub nurse, perforations in non or dominant hand, site and number of perforations in the gloves was noted.

Single glove and ipsilateral simultaneous perforations of both inner and outer gloves in the same hand leading to blood contamination of glove was termed significant. Any blood contamination with skin was termed exposure.

Data was analyzed by SAS statistical package. Chi-square test and Fischer exact test was used to compare the groups and individuals involved. A p- value

of less than 0.05 was termed significant.

### Results

Sixty one perforations from 76 operations were identified in 404 gloves after 175 elective orthopaedic surgeries. The overall glove perforation rate of 15% (61/404) and operative perforation rate of 43.2% (76/175) was found. Two hundred and four (204) surgeons, 115 assistants and 50 scrub nurses used double pair of gloves while 8 surgeons, 16 assistants and 10 scrub nurses used single pair of gloves (Table 1).

**Table 1: Types of gloves used by operating team members.**

No. of gloves used	Surgeon	Assistant	Scrub Nurse	Total
Double Pair	204	115	50	369
Single Pair	8	17	10	35
Total	212 (52.5%)	132 (32.7%)	60 (14.8%)	404

The operative perforation rate was higher in bony procedures 65.3% (55/64) than in other soft tissue procedures 38% (6/12) (Table 2), which was significant (p <0.02). The glove perforation rate in control group was 1% (1/100) possibly from manufacturing defect. There was no marked variation in glove perforation rate with duration of surgery except slight increase in incidence of glove perforation rate in surgeries lasting more than 120 min (29.6%) (Table 2). The mean operating time for bony procedures was 93.6 min (45-300) min while for other soft tissue procedures it was 60.2 min (30-120) min.

**Table 2: Glove perforation related to type and duration of operation.**

Type of operation	No. of operations	No. of perforations
Bony	64	65.3% (55)
Soft tissue	12	38% (6)
Duration (in min)		
30-60	46	26.2% (16)
60-90	15	18% (11)
90-120	6	26.2% (16)
>120	9	29.6% (18)

The incidence of glove perforation was found high in Surgeon 11.1% (45/61) followed by assistants 3.4% (14/61) and scrub nurses 0.4% (2/61) respectively (p<0.05) (Table 3). Blood contamination was seen in 11.6% (significant and single glove) cases which shows that exposure to blood was reduced by double glove use to the tune of 86.8% which is significant statistically (p<0.02).

**Table 3: Pattern of glove perforation.**

Pattern glove perforation	Surgeon	Assistant	Scrub nurse	Total
Inner glove	1	0	0	1
Outer glove	25	10	2	37
Inner/outer glove	12	3	0	15
Significant glove perforation	4	0	0	4
Single glove perforation	3	1	0	4
Total/percentage	45 (11.1%)	14 (3.4%)	2 (0.4%)	61 (15%)

In 85.2% (52/61) gloves the perforation was in non-dominant left hand and remaining 14.8% (9/61) in the dominant right hand. Majority of perforations were seen in the Index finger, followed by thumb and other fingers as shown in (Fig. 1). No significant impairment of hand sensibility or dexterity was recorded.

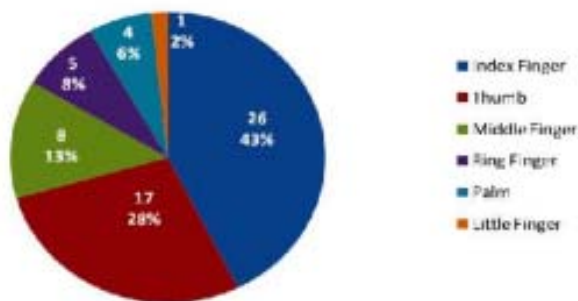


Figure 1: Pattern of glove perforation.

## Discussion

In orthopaedics as in other Surgical branches glove perforation is a common problem and if the integrity of the surgical gloves is compromised it puts the surgeon and other surgical team members at risk of contracting infectious diseases from patients and vice versa. The emergence of deadly viral diseases as human immunodeficiency virus (HIV), hepatitis B virus (HBV) and hepatitis C virus (HCV) has put the surgeon and other healthcare workers to occupational risk of contracting these infections [8]. In Oman as is in other gulf countries there is high prevalence of SCD and hepatitis disease especially Hepatitis B. This can be explained by the fact that SCD patients receive frequent blood transfusions with increase chances of blood borne infections [9]. The incidence of glove perforation in our study was 15% which is comparable to other studies which have reported perforation rate of 8.7% to 28.4% (6, 8, 10, 11, 12). Surgeons had the highest rate of perforation in their gloves as they use knives, needles and other instruments more than assistants and scrub

nurses. This is comparable to other studies (10, 11, 12). The perforation rate of outer gloves was highest in our series when using double gloves. Only one perforation of the inner glove was noticed when using double gloves without associated perforation of corresponding outer glove. Manufacturing defect can be the only explanation for it.

Glove perforation reported in other surgical specialities varies. In Gynaecology and obstetrics procedures it varies from 24.4% to 20.8% [13], general surgery 45%, plastic surgery 21.4% and thoracic surgery 26% (14, 15). In orthopaedic surgery with use of metallic instruments, oscillating saw, sharp implants and wires may be responsible for higher risk of glove perforation [6]. The risk of blood contamination is 13 fold when using single gloves compared to double gloves [8]. Naver [16] have reported six fold reduction in exposure when using double gloves. Majority of the perforations occurred in Index finger and thumb followed by in other parts of hand. This observation is consistent with most of the other studies (6, 11, 14). Non dominant left hand was found to have more perforations as compared to dominant right hand. This is explained by the fact that dominant hand is used for more elegant manoeuvres and non-dominant hand for more coarse and awkward manipulations during surgery [6]. In our study there was not marked variation in glove perforation with duration in contrast to other studies where higher rate of perforation was noted with increasing surgical time [8, 10-12]. The nature of surgery also influences the incidence of glove perforation. Bony procedures due to sharp nature of bone and more use of instrumentation are associated with more perforation rate compared to other soft tissue surgery. Moreover the mean operating time for bony procedures is more and contributes to higher glove perforation rate as is seen in our study and other studies [4, 6, 17].

Lemaire and Masson [18] have reported the lifetime risk for HIV seroconversion following percutaneous exposure between 0.01% to 12% but this risk is much higher for Hepatitis B and C viruses. The mean risk of transmission of HIV infection after one major percutaneous exposure was reported as 0.3% and this increases markedly with larger inoculums of blood and higher titre of HIV in the blood of source patient. Further in a study by Thomas et al [19] 40 pairs of unused gloves were examined and a 3.75% (3/80) rate of perforation was detected implying that in 3 out of 40 cases (7.5%) a surgeon using single gloves was more likely to have blood contamination of his hands

from patients blood or body fluids.

Therefore use of double gloves is highly recommended to reduce risk of contamination from perforation during surgery or otherwise from pre-existing perforations in gloves. Change of outer gloves every 02 hours in long surgeries is recommended by some authors [6, 14].

## Conclusion

1. Glove perforations are common in orthopaedic operations. Occult perforations are unrecognized during surgery and pose greater risk. Double gloves confers additional protection especially in high risk patients.

2. Careful handling of bone and sharp instrumentation especially while drilling and reaming in orthopaedic surgery can help reduce infection in many cases.

3. In case of any visible glove perforation during surgery immediate change of glove is advocated and in case of any finger perforation screening of both patient and operating personnel is warranted to rule out any cross infection so that proper remedial measures can be taken.

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