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Glove perforation time and frequency in total hip arthroplasty procedures

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Objective: The aim of the present study was to investigate glove perforation rate and time and evaluate the factors affecting glove perforation in total hip arthroplasty (THA).

Methods: Nine hundred seventy-nine gloves used in 57 THA procedures were assessed according to the perforation. Forty-four (77.2%) procedures were primary THA and 13 (22.8%) were revision THA. Gloves were changed when perforated, become dirty with blood or blood products, and before bone cementing. All gloves were filled with water at the end of the operation and controlled for perforation. Two hundred and one surgical gloves used during scrubbing and removed after draping the patient were examined as the control group. The location (which finger), number and time of the perforation, surgery type and duration, and distribution of the perforation location according to the surgical team were assessed.

Results: Patients' mean age was 62.9±14.6 (range: 33 to 97) years and the mean surgery duration was 162.9±32.0 minutes. Thirty-two glove perforations were noted in 19 of the operations. Of these perforations, 28 belonged to the surgeons and first assistants. There was no significant difference between the dominant or non-dominant hand according to the location of perforations. Perforations in the first and second fingers of the gloves accounted for 81.3% of all perforations. There was no significant difference in terms of number of gloves used, perforation numbers and operation duration between the primary and revision THA procedures. Two perforated gloves (0.99%) were found in the control group and the difference between the number of perforations in the control and study groups was significant (p=0.048).

Conclusion: We recommend the use of two pairs of gloves to avoid the risk of contamination and protect the surgical team from infectious disease in major surgeries like THA. Surgical gloves should be changed when they are excessively contaminated with surgical fluids and the surgeon and first assistant should also change their outer gloves at an average of every 90 minutes.

Key words: Contamination; glove perforation; total hip arthroplasty.

Surgical gloves were first used by Dr. William S. Halsted's nurse to protect herself against dermatitis.[1-4] They were first used to protect the surgical team from infections, and later gained importance in protecting the patient as well against infection.

Perioperative surgical glove perforation increases patient risk of contamination with infective agents and leaves the surgical team vulnerable against blood-borne diseases. HIV and Hepatitis-B especially can be easily transmitted through a perforated surgical glove.[5] One

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Table 1. Distribution of glove perforations among the members of the surgical team.

	Number of glove perforations			
	Dominant hand	Non-dominant hand	Total	Time to the detection of perforation (min.)*
Surgeon	10	9	19 (59.4%)	87.1±58.2 (30-260)
Nurse	1	0	1 (3.1%)	58
1st assistant	1	8	9 (28.1%)	92.4±41.3 (30-150)
2nd assistant	1	2	3 (9.4%)	91.7±32.5 (60-125)
3rd assistant	0	0	0 (0%)	0
Total	13 (40.6%)	19 (59.4%)	32 (100%)	92.7±50.2 (30-260)

*Data are presented as mean±SD (range).

study revealed positive results in cultures obtained from the periphery of the perforation site in 10% of perforated surgical gloves.[6] Moreover, skin integration disrupting lesions were detected in 13% of surgical teams prior to surgery, increasing infection risk.[7] The frequent use of penetrating devices, such as wires, saws or needles during orthopedic procedures increases the risk for transmission of blood-borne infections, such as AIDS and hepatitis.[8]

The aim of this study was to investigate glove perforation rate, time and distribution amongst members of the surgical team during total hip arthroplasty (THA) surgery.

Materials and method

This study included a total of 979 gloves used in the THA surgeries of 57 patients at our clinic between January 2008 and August 2009. Forty-four primary THA surgeries and 13 revision THA surgeries were performed. The control group consisted of 201 surgical gloves which were used during scrubbing and draping of the patient and then removed.

The surgical team wore two pairs of gloves of the same brand (Beybi®; Beybi Plastik, Istanbul, Turkey) in all surgeries. All surgical procedures were performed by one surgeon, a first and second assistant and one nurse. Thirty-two surgeries were performed with an additional third assistant. All surgical gloves, including those removed because of surgical fluid contamination, perforation, or before cementing, were filled with water and examined for perforation. The team performing the surgery, the dominant hand of the surgical team, the location and number of perforations in each glove, and the time of detection of perforation were recorded.

Data were analyzed using the SPSS program (SPSS Inc., Chicago, IL, USA). The Mann-Whitney U test was used for the comparison of non-parametric data and the Spearman's correlation test was used for the correlation analysis. The control and study groups were compared using chi-square test. P values below 0.05 were considered significant.

Results

Mean patient age was 62.9±14.6 (range: 33 to 97) years and the mean duration of the surgical procedure was 162.9±32.0 minutes. All surgeons were right-handed. Glove perforation was detected in 32 gloves (3.3%) used in 19 surgical procedures (33.3%). The control group had two perforated gloves (0.99%). There was a significant difference between the control and the study groups (p=0.048).

The glove perforation was detected at a mean time of 92.7±50.2 minutes (Table 1). Perforation was mostly detected in the outer gloves; one perforation was detected both in the internal and outer gloves of a surgeon. There was no significant difference between the dominant and non-dominant hands in terms of the presence of perforation (Table 1). However, 87.5% of perforations occurred in the gloves of the surgeons and first assistants. Perforations in the first and second fingers accounted for 81.3% of all perforations (Table 2).

There was a moderate positive correlation between revision and primary THA surgeries and the in terms of number of glove perforations (r=0.237) and a significant difference in patient age between the primary and revision THA surgeries (p=0.027). However, there were no significant differences in the number of gloves used, number of perforations or duration of surgical procedure (Table 3). Moreover, there was a weak positive correlation between the number of glove perforations and the duration of the surgical procedure (r= 0.131).

Discussion

In the present study, we found a 3.6% rate of glove perforation. In the literature, the frequency of glove perforation has been reported between 3.3% and 57% in elective orthopedic surgeries.[9-11] While the frequency of glove perforation decreases during arthroscopy or minor surgical procedures, it increases during trauma surgery in which the surgeon is exposed to sharp bony ends, or during Ilizarov surgery in which penetrating instruments are frequently used.[5,9-11]

Wearing two pairs of surgical gloves can decrease the frequency of glove perforation. Yinusa et al. reported a frequency of glove perforation of 0.8% during orthopedic surgery performed wearing two pairs of gloves and of 8.7% with one pair of gloves.[5] Moreover, Laine et al. determined contamination rates 13 times higher with the use of one pair of gloves as compared to two.[11] In their study, Çetinus et al. compared the use of one and two pairs of gloves and found a lower rate of contamination with the use of two pairs of gloves and recommended surgeons use special-production gloves, if possible.[12]

Our clinic's policy in routine elective orthopedic procedures is to change gloves when excessively contaminated with surgical fluids. Al-Maiyah et al.[13] conducted a study on the use of two pairs of surgical gloves during THA surgery and found that the frequency of glove perforation was significantly lower in the group that changed gloves at 20 minute intervals (4.8%) than those who did not (13.9%). In the present study, glove perforation occurred at the 90th minute of the surgical procedure on average and most commonly occurred in surgeons and first assistants. It appears that even when changed at frequent intervals glove perforation is inevitable both for the surgeon and first assistant. Studies in the literature have suggested that glove perforation risk increases during operations of over 90 minutes and that gloves should be changed.[14,15] Demirçay et al. stated that the risk for glove perforation was higher in the second hour of arthroplasty surgery, especially during the closure stage, due to needle prick injuries.[8]

Of note, there is a consensus in the literature that glove perforation occurs most commonly in the thumb and index finger of the non-dominant hand.[5,8] Such perforations result from the use of the non-dominant hand to directly hold the needle, the reduced bone, tissue or extremity leaving the dominant hand to hold instruments that require fine motor coordination.[5,8]

Although using surgical gloves protects the surgical team against blood-borne diseases, such as Hepatitis-B and HIV, prolonged operation duration in conjunction with a perforated glove increases the contamination risk.[1,5] In addition, disrupted skin integrity of the surgical team increases the risk for contamination through a perforated glove. Palmer and Rickett determined that skin integrity was disrupted prior to surgery in 13% of the surgical teams.[6] Using indicator surgical gloves may be protective for the surgical team, especially during surgical procedures in risky cases.[15] Micro-perforations on these gloves are easily recognizable and can thus be changed when perforated.[15] Moreover, strengthened gloves are also protective in specific surgeries using penetrating instruments such as Ilizarov surgery.

Limitations of our study was that the contamination of the perforated gloves was not evaluated and the study was not double-blind.

In conclusion, we recommend wearing two pairs of surgical gloves to avoid both the risk of contamination of the surgical wound and protect the surgical team against infectious diseases during major surgeries, such as THA. The surgical team should change gloves when excessively contaminated with surgical fluids; the surgeon and the first assistant in particular should change their outer gloves at a minimum of an average of every 90 minutes.

Conflicts of Interest: No conflicts declared.

Table 2. Distribution of perforations among the fingers of the gloves.

Location of the perforations	Number of perforations
1st finger	16 (50%)
2nd finger	10 (31.34%)
3rd finger	3 (9.37%)
4th finger	2 (6.24%)
5th finger	1 (3.12%)
Total	32

Table 3. Comparison of primary THA cases and revision THA surgeries in terms of the number of gloves used, number of glove perforations and the duration of the surgical procedure.

	Primary THA surgery	Revision THA surgery	P value
N	44 (77.2%)	13 (22.8%)	
Age (mean±SD)	60.9±14.6	69.7±9.7	0.027*
Number of gloves	745 (76.1%)	234 (23.9)	0.340
Number of perforations	13 (40.6%)	19 (59.4)	0.077
Surgery time minutes (mean±SD)	162.4±31.1	164.6±36.3	0.605

*p<0.05. **THA:** Total hip arthroplasty; **SD:** Standard deviation

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