A prospective study on the risk of glove fingertip contamination during draping in joint replacement surgery

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ABSTRACT

INTRODUCTION The aim of this prospective study was to investigate the risk of contamination of surgical gloves during preparation and draping in joint replacement surgery.

METHODS During 46 hip and knee replacement procedures, the gloves of orthopaedic consultants ($n=5$) and registrars ($n=3$) were assessed for contamination immediately after draping by impression of gloved fingers on blood agar. Contamination was evaluated by the surgeon's grade, the type of procedure, the role of the assistant and the dominance of the hand.

RESULTS A total of 125 pairs of top gloves were examined (79 pairs from registrars and 46 pairs from consultants). Bacterial contamination was isolated on 19 pairs (15.2%) (16 pairs from registrars and 3 pairs from consultants, $p=0.04$). Coagulase negative staphylococci were the main isolates and contamination was considered low in all cases (1–5 colonies). Contamination was seen more on the dominant hand (16 gloves from dominant hands and 6 from non-dominant hands, $p=0.04$), on the index finger and thumb. More contaminated gloves were seen in hip arthroplasty procedures (16 pairs from total hip replacements vs 3 pairs from total knee replacements, $p=0.02$).

CONCLUSIONS Contamination of glove fingertips during draping in joint replacement procedures is more likely to occur among junior surgeons, in hip rather than knee arthroplasty procedures and on the dominant hand. It is therefore essential that surgeons of different grades replace gloves used in draping to avoid exposing patients to the risk of infection.

KEYWORDS

Joint arthroplasty – Draping – Glove contamination

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The majority of orthopaedic surgeons remove the gloves used in draping during joint arthroplasty procedures, and different gloving techniques are used after scrubbing and gowning. During orthopaedic surgery, the use of a double gloving technique is often recommended^{1,2} as it would reduce risk of blood contamination to hands of surgical staff.^{3,4} Double gloving does not have any impact on dexterity.⁵ Despite this, many surgeons prefer to remain single gloved.

Glove contamination during orthopaedic procedures has been investigated alongside perforation and both occur while draping as well as during the procedure.⁶ Frequent glove changing at regular intervals has been found to help minimise these two risks.⁷ The aim of this prospective study was to examine the risk of contamination on the outer gloves used in preparation and draping of patients undergoing primary joint replacement procedures, and whether this risk would vary with the grade of the surgeon and the dominance of the hand.

Methods

The study had the approval of our local ethics committee. Three orthopaedic consultants and five registrars participated in the study during primary hip and knee arthroplasty procedures. All procedures were carried out in laminar flow theatres and antibiotics (cefuroxime 1.5g) were administered intravenously on induction.

Patients' preparation was carried out uniformly in our hip and knee arthroplasty procedures. Initially, the foot is prepared while the leg is held by an unscrubbed member of the team. This is followed by the application of a stockinette by a scrubbed registrar, who holds the foot until the preparation and draping are completed. Any perceived touching of a contaminated area was reported and gloves were removed immediately but the newly replaced gloves in such a case were examined at the end of draping.

In the majority of procedures, one consultant was assisted by two registrars, one of whom held the prepared foot while the other helped with the preparation and draping. In some

procedures, the consultant was assisted by one registrar, who helped with the preparation and draping. All surgeons in our study used their routine gloving techniques and three groups were identified:

Group A wear double gloves and then renew the top pair after draping. In this group, the top gloves used in draping were examined for contamination as well as the new pair.

Group B wear three pairs of gloves, removing the top pair after draping. In this group, the top gloves used in draping were examined for contamination as well as the second pair underneath.

Group C wear two pairs of gloves. They remove the top pair after draping and start the procedure with a single pair of gloves. In this group, only the top pair used in draping was examined for contamination.

The tips of gloves were examined uniformly for contamination by impression of gloved fingers on blood agar. Samples were labelled to help identify the pair of gloves tested, the gloving technique used, the grade of surgeon, the type of procedure, the role of the assistant and the dominance of the hand. All specimens were sent immediately for a 48-hour incubation at 37°C and were processed by a single member of the microbiology team. The degree of contamination was categorised into 'no contamination' if there was no growth, 'low contamination' if there was between one and five colonies, and 'heavy contamination' if there were more than five colonies on the blood agar culture medium.

Fisher's exact test was used to calculate the statistical significance of the difference between variables. This difference was considered significant with a p -value of <0.05 using a two-tailed test.

Results

There were 25 total hip replacements (THRs) and 21 total knee replacements (TKRs). In 33 procedures, 1 consultant was assisted by 2 registrars and in the remaining 13 procedures, 1 consultant was assisted by 1 registrar (Fig 1). Further results are summarised in Table 1.

In total, 125 pairs of the top gloves used in preparation and draping were examined (46 pairs from consultants and 79 pairs from registrars). Overall, bacterial contamination was isolated on 19 pairs (15.2%). Of these, 16 pairs were from registrars while 3 were from consultants ($p=0.04$). Of the 19 contaminated pairs, 16 had only single glove contamination (13 gloves from dominant and 3 from non-dominant hands) and 3 pairs had both gloves contaminated.

The dominant hand showed more contamination than the non-dominant hand (16 gloves from dominant and 6 from non-dominant hands, $p=0.04$). There were more contaminated gloves from hip arthroplasty than knee arthroplasty procedures (16/75 pairs from THRs vs 3/50 pairs from TKRs, $p=0.02$). All of the contaminated gloves among registrars were from those who were involved in preparation and draping. None of the gloves from those who held the prepared foot showed any contamination. The individual digital impression on the agar plate revealed that the

Figure 1 Details of the tested gloves

index finger was the most commonly contaminated digit. This was followed by the thumb.

Regarding the gloving technique used, there was no contamination on the newly exchanged gloves in Group A (10 pairs from consultants and 49 pairs from registrars) or on the second pair of gloves in Group B (5 pairs from consultants and 30 pairs from registrars). Furthermore, of the 16 contaminated pairs from registrars, 7 pairs belonged to the 49 pairs from Group A and 9 pairs belonged to the 30 pairs from Group B ($p=0.14$, Fisher's exact test). This signifies that the risk of contamination did not necessarily increase when more than two pairs of gloves were worn at once.

All contaminated gloves showed a low degree of contamination (1–5 colonies). Coagulase negative staphylococci

Table 1 Details of the contaminated gloves by surgeons' grade, hand dominance and type of procedure

	Total top gloves	Contaminated gloves	p -value*
Consultants	46 pairs	3 pairs (7%)	0.04
Registrars	79 pairs	16 pairs (20%)	
Assisted in draping	46 pairs	16 pairs (35%)	0.0001
Held the prepared foot	33 pairs	0 pairs (0%)	
Total hip replacements	50 pairs	16 pairs (32%)	0.02
Total knee replacements	75 pairs	3 pairs (4%)	
Dominant hands	125 gloves	16 gloves (13%)	0.04
Non-dominant hands	125 gloves	6 gloves (5%)	

*Fisher's exact test

were the most common isolates. Others included *Micrococcus* and *Bacillus* spp. Two cases of coliforms were isolated from the THR group but none of the patients developed any clinical signs of infection.

Discussion

Bukhari *et al* reported that gloved fingertips became contaminated in 52% of general surgical procedures.⁸ They also found that bacterial counts increased over the duration of surgery. In joint replacement procedures, Davis *et al* reported that 28.7% of gloves used for preparation were contaminated⁹ whereas in the study by McCue *et al*, the incidence of outer glove contamination was 12%.¹⁰ In the latter study, however, gloves from only ten procedures were included.

In a study by Al-Maiyah *et al*, the overall incidence of glove contamination was significantly lower if outer gloves were changed at regular intervals compared with those changed only after draping and prior to cementing (4.8% and 13.9% respectively).⁷ On the other hand, there was no report on whether the outer gloves used in draping showed more contamination than those changed in the middle of the procedure and prior to cementing.

One of the weaknesses of our study is that glove perforation was not assessed. Several studies have demonstrated that the risk of glove perforation increases with the risk of accidental touching.^{1,6}

In our study, assessing for perforation in the top gloves would have had value when the different gloving techniques were compared. For instance, if perforation occurs in conjunction with contamination in the top gloves of surgeons who initially wear three pair of gloves (Group B) and in those who wear two pairs but simply remove the top pair without renewing the gloves (Group C), contamination might translate to the glove underneath that is going to be used during the surgery. In this case, the technique whereby surgeons exchange the top gloves used in draping (Group A) would be the safest. Although none of the gloves examined in the second sampling were contaminated, it is difficult to conclude that none of the outer gloves used in draping were perforated or, if perforation had occurred, that there was no difference in the gloving technique used.

A potential bias in our study is that contamination could have occurred during the gowning and glove donning rather than during patient preparation and draping. However, none of the registrars who only held the prepared

foot showed any contamination, in contrast to those who helped with patient draping. This leads to the conclusion that contamination occurred during draping, when there are more movements of the hand. It is also worth mentioning that more contamination was seen in the dominant hand, index finger and thumb.

Although we excluded those who reported accidental touching, it is not known whether some junior surgeons failed to report it. Moreover, it is also difficult to know whether a contact of fingertips with skin preparation could have rendered some cultures negative despite an initial touching of a contaminated area during draping. Furthermore, the fact that more contamination was seen in hip arthroplasty procedures could be explained by the higher risk of accidental touching during draping around the front and back supports used in hip positioning.

Conclusions

Glove tip contamination during draping in joint arthroplasty procedures is more likely to occur among less experienced surgeons, on the dominant hand, and the index finger and thumb.

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