Glove perforation in orthopaedic and trauma surgery

A COMPARISON BETWEEN SINGLE, DOUBLE INDICATOR GLOVING AND DOUBLE GLOVING WITH TWO REGULAR GLOVES

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The spread of viral diseases such as HIV has highlighted the importance of protecting medical personnel against contamination from blood. We have assessed the frequency of the perforation of surgical gloves during orthopaedic and trauma surgery and compared the efficiency of single and double gloving.

We examined all the gloves used by surgeons for a period of two months. There were 1769 gloves from 349 operations. Perforations occurred in 18.5% of conventional and 5.8% of arthroscopic procedures. The risk of contamination from blood was 13 times higher when using single compared with double gloves. Surprisingly, the combination of two regular gloves was much less efficient than double indicator gloves when comparing the rate of perforation of the inner glove when the outer had been damaged (24% vs 4.9%; p = 0.02).

We recommend double gloving in orthopaedic surgery in general and also in long arthroscopic procedures.
The use of indicator gloves significantly increased the detection of perforations during surgery, from 23% in the single glove group to 36% in the combination glove group and then to 90.2% in the indicator glove group (p ≤ 0.001, Table II).

When comparing the occurrence of perforations of the inner glove, the indicator gloves were markedly superior to the combination of two regular gloves. Perforations of the inner glove were observed in two of 41 (4.9%) of indicator gloves and in six of 25 (24%) of the regular combination gloves when the outer glove was perforated (p = 0.02).

The risk of blood contamination was 13-fold when using single gloves compared with double gloves.

The most common site of perforation was the index finger (32%) and the thumb (24%) of the non-dominant hand followed by the index finger of the dominant hand (18%). Over 70% of perforations occurred in the non-dominant hand.

Predictably, there were more perforations during emergency operations than during elective surgery with 44 of 324 (13.6%) being perforated during the former compared with 35 of 530 (6.6%) during elective surgery (p ≤ 0.001). Of the 44 perforations in emergency surgery 23 (52%) were detected during the surgery compared with 26 of the 35 perforations (74%) in elective surgery (p < 0.05).

The principal surgeon was more prone to have perforations (66/636; 10.4%) than the assistant (13/218; 6.0%).

The rate of perforation was only 3.6% (15/416) in minor orthopaedic procedures which lasted less than one hour. For operations longer than this, the rate rose to 14.6% (64/438, p ≤ 0.001). The rate of perforations detected during surgery did not differ significantly between the two groups (66.7% and 60.9% respectively).

Arthroscopic group. We examined 118 gloves and double gloving systems from 52 operations; 38 single gloves, 66 double gloving and 14 combination gloving systems. Perforations were detected in three operations (5.8%). The rate of perforation was 3.4% (4/118), one perforation being in the single glove group with three in the indicator group. This was not significant. No perforations of the inner glove were detected.

Only two arthroscopic operations lasted more than one hour and of the ten gloves used during these procedures, three were perforated (30%). No perforations occurred during the four emergency operations included in our study. Because of the small number of perforations no reliable statistical conclusions could be drawn.

**Discussion**

Although we cannot definitively prove that double gloving reduces the risk of infection to the surgeon, its use can be defended for several reasons.

The mean risk of transmission of HIV after percutaneous exposure is thought to be 0.3%, but this increases markedly with a larger volume of blood and a higher titre of HIV in the blood of the source patient. According to data from joint United Nations programme on HIV/AIDS at the end of 2002 the prevalence of HIV among adults in Western Europe was 0.3%. Among trauma patients the prevalence of HIV and HCV may be higher still, since the use of alcohol and drugs is a major aetiological factor in criminal and accidental trauma in an urban population. Orthopaedic injuries are also more severe with fractures which may demand emergency surgery.

The theoretical lifetime risk of HIV seroconversion for an orthopaedic surgeon can be estimated, based upon the prevalence of HIV in patients, the frequency of blood exposures and the rate of seroconversion after one exposure. The lifetime risk can vary between 0.01% and 12% so that the use of precautions to reduce exposure to blood is essential. The use of surgical gloves markedly reduces the volume of blood inoculum present on suture needles, and

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**Table I.** The distribution and number of single gloves and double gloving systems (actual number of gloves used) in conventional and arthroscopic surgery. Total does not include gloves changed during surgery

<table>
<thead>
<tr>
<th>Surgery</th>
<th>Single gloves</th>
<th>Indicator gloves</th>
<th>Combination gloves</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>186</td>
<td>426 (852)</td>
<td>242 (484)</td>
<td>854 (1522)</td>
</tr>
<tr>
<td>Arthroscopic</td>
<td>38</td>
<td>66 (132)</td>
<td>14 (28)</td>
<td>118 (198)</td>
</tr>
<tr>
<td>Total</td>
<td>224</td>
<td>492 (984)</td>
<td>256 (512)</td>
<td>972 (1720)</td>
</tr>
</tbody>
</table>

**Table II.** The number and rate of glove perforation (%) and perforations detected during surgery for the various glove subgroups in conventional surgery

<table>
<thead>
<tr>
<th>Perforations/Gloves</th>
<th>Perforations detected during surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single gloves</td>
<td>13/186 (7%)</td>
</tr>
<tr>
<td>Indicator gloves</td>
<td>41/426 (9.6%)</td>
</tr>
<tr>
<td>Combination gloves</td>
<td>25/242 (10.3%)</td>
</tr>
<tr>
<td>Total</td>
<td>79/854 (9.2%)</td>
</tr>
</tbody>
</table>

* p not significant  
† p ≤ 0.001  
‡ 49+1720=1769
double gloving is even more efficient than single gloving.\textsuperscript{11} Despite this, the use of double gloves has not been widely accepted. One reason may be the suggestion that double gloving can reduce sensation in the hand.

Although there does appear to be a significant difference in skin sensibility when using single or double gloves, most surgeons quickly adapt to double gloves, even in one day.\textsuperscript{12} In our study, perforations occurred in 18.5\% of conventional operations. This differs from other orthopaedic reviews in which perforations in 25\% to 48\% of operations have been described.\textsuperscript{13,14} One explanation may be that our series included a wider range of orthopaedic surgery, not just trauma operations, in which the risk of perforation is among the highest. In our study the rate of perforation rose to 31.4\% if an assistant was present, as is so often the case in longer and more demanding procedures.

Otherwise, our results confirm those of earlier studies in that most perforations remain undetected during surgery unless indicator gloves are used,\textsuperscript{14,15} when over 90\% may be detected. The risk of perforation increases with the duration of the procedure\textsuperscript{16} and the inner glove provides extra protection for the surgeon although the outer glove is perforated.\textsuperscript{14-17} Over 70\% of perforations occur in the non-dominant hand, primarily in the thumb and index finger.\textsuperscript{15,17}

When we compared the rate of perforation of the inner glove of the indicator glove system with that of the combination system, the rate of perforation of the inner glove was 4.9\% for indicator gloves and 24\% for regular gloves if the outer was perforated. The reason for this may be that in orthopaedic surgery many perforations are caused by sharp bone edges. In the indicator gloving system the inner glove is larger than the outer, allowing it to move if the outer glove is perforated. In the combination group, most surgeons used the same size of glove on top of each other. The fact that perforations of the outer glove were detected more swiftly with indicator gloves did not, in our view, affect the rate of puncture or the site of perforation of the inner glove.

With arthroscopic surgery, however, because of the small number of perforations in this group, we could draw no statistically significant conclusions from the data, although the trend shows that double gloving is to be recommended if the expected duration of an arthroscopic operation is long.

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References