identified by computer, the visual and computer measurements were significantly different (p = 0.0009). There was, however, no significant difference (p = 0.48) in the results for lucent zones of 2.5 mm and above (2.5 to 7.5) although there were very significant differences (p = 0.000) for lucent zones of 2 mm or less.

Discussion. At a radiographic interface there may be physiological edge enhancement known as a Mach band, which gives the appearance of a lucent line. This occurs at retinal level and varies between observers (Lane et al 1976). Such interface borders are never distinct; they pass through shades of grey. These two effects combine to make the subjective determination of an exact border very difficult, since it depends on the distinction between various grey levels. In addition, when repeated measurements are performed, visual fatigue is an important factor.

The production of Mach bands was probably responsible for the visually apparent lucent zones on four occasions when none was found by computer. We have found that visual measurements are reliable only at 2.5 mm and above, and we call this level the ‘reliability threshold’. For lucent zones narrower than this we recommend that measurements of width be confirmed by image digitisation with grey-scale representation.

We would like to thank Dr D. W. L. Hukins, Department of Medical Biophysics, University of Manchester for his advice on the hardware and Dr L. Hunt, Department of Computational Science, Manchester Royal Infirmary for her help with the statistical analysis.

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Infection and Interposition between Ultraclean Air Source and Wound

G. J. S. Taylor, G. C. Bannister

Most deep infections after joint replacement result from airborne contaminants shed by operating theatre personnel. Lidwell et al (1982) showed that ultraclean air reduced the incidence by 50%, but Marotte et al (1987) reported no benefit and Salvati et al (1982) found that infection rates in total knee replacement doubled when horizontal laminar flow was used. The use of body-exhaust suits reduces infection rates by a further 50% (Lidwell et al 1982), which suggests that preventable airborne contamination may occur from theatre personnel.

One reason for the failure of ultraclean air systems may be the interposition of personnel (Salvati et al 1982), which depends on the relative positions of the surgeon, patient and air source. Interposition is common under vertically directed laminar downflow when a surgeon or assistant leans over a wound. Our study aimed to quantify this effect.

Methods. Tests were made during six clean orthopaedic operations performed in a partially walled, vertical, exponential laminar-downflow ultraclean air system (Howorth Exflow; Howorth Airttech Ltd, Bolton, UK). Five sedimentation plates were laid out on a surface 80 cm above the floor, and a surgeon, not in the operating team, but wearing conventional theatre clothing, interposed his head and shoulders between the air source and the plates, occasionally standing straight then leaning forward again. Five other plates were placed at head height within the clean air enclosure, with no interposition and another five were placed on a trolley at 70 cm height outside the clean zone. On three occasions an additional five plates were placed on a trolley next to the instruments and scrub nurse.

We used 9 cm Petri dishes with DST agar (Oxoid; Unipath Ltd, Basingstoke, UK) exposed for a mean of 34.2 minutes. The plates were incubated at 37°C for 48 hours before colony counting. Statistical analysis was by the Mann-Whitney U test.

Results. There was no significant difference between the colony counts from the ultraclean zone without an interposed surgeon (0.27 colonies per plate) and those next to the scrub nurse and instruments (0.33 colonies).

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The plates outside the ultraclean zone had a mean count of 3.43 colonies per plate, ten times more than in the ultraclean zone (p < 0.001). The plates in the ultraclean zone with intermittent interposition had a mean count of 7.23 colonies per plate, 27 times more than those without interposition (p < 0.001) and twice as many as those outside the ultraclean zone (p = 0.009; Table I).

**Discussion.** Sedimentation plates offer a better assessment of direct bacterial fallout into a wound than volumetric analysis of air contamination. The sedimentation rate outside the ultraclean zone was similar to that reported for conventionally ventilated theatres (Scheibel, Jensen and Pedersen 1991) but the interposition of head and shoulders into an ultraclean air flow produced double that rate. The size of the increase produced by interposition may explain some of the contradictory results for infection rates in ultraclean air. Our study suggests that a surgeon who leans over a wound in vertical-downflow ultraclean air can expect a 27-fold increase in direct wound contamination. In operating positions in which interposition is frequent, body-exhaust suits may be especially advantageous.

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**REFERENCES**


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**A MOBILITY PROGRESS CHART**

G. M. SLOWIK, C. L. COLTON

There is no simple way of recording and displaying the progress or the lack of it of a patient who is mobilising after an operation or a period of bed-rest. We have designed a chart which provides such a graphic display.

**Method.** We grade mobility as follows:

- 00 - confined to bed,
- 0 - able to sit out on a chair,
- 1 - uses a frame for support,
- 2 - uses either 2 crutches or 2 sticks,
- 3 - uses a single crutch or cane,
- 4 - independent with no aids.

The letters 'A' and 'I' are used to denote Assisted or Independent mobilisation, and the amount of weight-bearing is recorded by the standard notation: NWB (non-weight-bearing), PWB (partial), and FWB (full).

This information can be noted on a 'MOBILITY CHART' (Fig. 1) which can be included in the standard bedside charts. We used this chart for 100 consecutive patients after lower-limb surgery, and found it to be extremely valuable in the postoperative period.

**Discussion.** The chart gives an instant impression of postoperative walking ability, and lack of progress is apparent. The grading system allows for ease of communication between medical staff, nurses and physiotherapists, and the chart provides a permanent record of progress. It also helps to motivate the patient towards higher levels of recovery.

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**Table I. Colony-forming units on sedimentation plates**

<table>
<thead>
<tr>
<th></th>
<th>Ultraclean zone (n=30)</th>
<th>Instrument trolley (n=15)</th>
<th>Periphery (n=30)</th>
<th>Interposed person (n=30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colonies per plate Median</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Range</td>
<td>0 to 2</td>
<td>0 to 2</td>
<td>0 to 7</td>
<td>0 to 22</td>
</tr>
<tr>
<td>Mean</td>
<td>0.27</td>
<td>0.33</td>
<td>3.43</td>
<td>7.23</td>
</tr>
<tr>
<td>Colonies per m²/hour Mean</td>
<td>74</td>
<td>91</td>
<td>947</td>
<td>1994</td>
</tr>
</tbody>
</table>

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