



The risks of splash injury when using power tools during orthopaedic surgery : A prospective study

Asef ALANI, Cheaten MODI, Sami ALMEDGHIO, Ian MACKIE

From the Leicester Royal Infirmary, Leicester, United Kingdom

Transmissible blood-borne infection can occur at muco-cutaneous membranes. During trauma and orthopaedic surgery, the use of power tools increases spraying of bodily fluid, hence resulting in an increased risk of infectious splash injury to the face. This prospective study involved 25 patients. The visors worn by the operating team were examined postoperatively to identify any visible blood, fat and body tissue splashes. Eleven patients underwent knee arthroplasty. Splash counts to the surgeon's mouth/lip, nose/cheek and eye regions were 217, 105, and 62 respectively ; they were 258, 147, and 82 for the assistant. Fourteen patients had hip replacement ; splash counts to the surgeon's mouth/lip, nose/cheek and eye regions were 214, 90, and 53 respectively, and 137, 39 and 27 for the assistant.

To conclude, the face is vulnerable to material and fluid strikes during joint arthroplasty surgery. The visor is a reliable barrier to blood, fat and body tissue splashes and minimises the risk of exposure to blood-borne viruses. Therefore, a visor should be worn during all joint arthroplasty procedures and any procedure that involves the use of power tools.

Keywords : occupational exposure ; bloodborne viruses ; splash injury ; face ; eyes ; power tools.

INTRODUCTION

Blood transmissible infections are a major concern with regards to the well being of Health Care professionals especially within the operating theatre. There are a variety of methods by which

infections can be transmitted to the surgeon. These include contact with a pre-existing cut, damage to the glove and direct injury such as needle-stick and scalpel injury, and lacerations on bone spikes. It is often forgotten and underestimated, however, that considerable amounts of bodily fluids can come into contact with the surgeon when projected during the operation. This is particularly true for Trauma and Orthopaedic surgery where the use of power tools for drilling, reaming and sawing can project bodily fluids at high velocities, which come into contact with unprotected areas of the face, especially muco-cutaneous membranes where absorption is more likely to occur.

The main concerns when discussing blood transmissible infections in health-care workers are

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- Asef Alani, MBBS, MRCS, Trauma Registrar.
 - Cheaten Modi, MBBS, MRCS, Clinical fellow.
 - Sami Almedghio, MBBCh, MRCS, Clinical Fellow.
 - Ian G. Mackie, M.B.Ch.B, FRCS, FRCS Orth., Consultant Orthopaedic Surgeon.

Department of Trauma, Leicester General Hospital, Leicester, United Kingdom.

Correspondence : Asef Alani, Department of Trauma, Leicester Royal Infirmary, Infirmary Square, Leicester, Leicestershire, LE1 5WW, United Kingdom.

E-mail : asefmiqdad@gmail.com

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hepatitis B virus (HBV), hepatitis C virus (HCV) and Human Immunodeficiency Virus (HIV). The anti-HBV vaccine has greatly reduced the incidence of HBV infection in health-care workers (HCWs) since its introduction in 1981 (8) and there is almost no risk of infection in those who have completed the course and developed immunity (5). Despite this there is still a significant prevalence of chronic HBV infection in the general population with a 6-30% risk of transmission from a single blood exposure in susceptible persons (7). The risks of HCV and HIV transmission from single blood exposure are 1.8% and 0.3% respectively. The risk of HCV infection from muco-cutaneous contact is not known although transmission via blood splash to the eye has been reported (5). The HIV transmission rate from muco-cutaneous contact has been measured at 0.1% and occupational infection via mucous membrane exposure has been reported (8).

The most effective means of reduction in the risk of transmission of blood-borne viruses for HCWs is to prevent exposure. The Centre for Disease Control states that universal precautions should be taken when in contact with all patients to reduce exposure. These are in the form of barrier precautions including gloves, gowns, masks and protective eye-wear or face shields (4).

Several studies have shown that there are variable rates of compliance to universal precautions (34 to 89.1%) with failure to use masks and eye protection being the commonest areas of inadequacy (7). Megan *et al* (10) carried out a survey which captured the views of 768 surgeons and their thoughts and practice with respect to protection against blood-borne pathogens. They found that surgeons grossly underestimated the seroconversion rates for HBV, HCV and HIV with exposure to infected blood and 88% had only slight to moderate concern about blood transmissible infections during surgery. Only 92 of 768 surgeons regularly used double gloves even though evidence suggested that this reduced the exposure risk when a tear or glove failure occurred.

The aim of this study is to illustrate the level of risk of splash injury to the face during orthopaedic surgery. This is demonstrated for primary total hip and knee arthroplasty.



Fig. 1. – Template of face, the visor was removed and placed against a life-size template of the face. The areas of the face were divided into the following zones :
A – Mouth and lips ; B – Nose and cheeks ; C – Eyes ; D – Forehead ; E – Miss.

Primary Outcome

Number of contamination spots of blood, fat, tissue on the surgeon's visor at the end of the procedure.

MATERIALS AND METHODS

A prospective study was carried out at Nevill Hall Hospital, Abergavenny, UK over a three month period. The study involved 25 consecutive patients undergoing elective hip and knee arthroplasty by six different Consultant Orthopaedic Surgeons.

The surgeon, assistant and theatre nurse all wore protective space suits with visors (Smith & Nephew) during the procedure. At the end of the procedure, the visor was removed and placed against a life-size template of the face (fig 1). The areas of the face were divided into the following zones :

- A – Mouth and lips
- B – Nose and cheeks
- C – Eyes
- D – Forehead
- E – Miss

The numbers of visible blood, fat and body tissue splashes on the visor were counted manually in each zone of the face for each member of the surgical team.

RESULTS

Twenty five patients in the study underwent primary total hip or knee arthroplasty. Eleven of these patients underwent hip arthroplasty and 14 patients underwent knee arthroplasty. There were therefore 75 visors that were studied to look for areas of contamination (surgeon ; assistant ; scrub nurse). The results are shown in tables I and II.

Table I shows the splash injuries that occurred in each zone during total knee arthroplasty for 14 patients. There is a large range in the data set, and median values have therefore been used to show the splash injury rate. We can see that there are significant injuries to both the surgeon and the assistant during this procedure. There were 217 and 238 injuries to the mouth and lips region and 105 and 147 injuries to the nose and cheeks respectively. There were 62 and 82 eye splash injuries respectively. We can also see that there were small rates of injury to the theatre nurse.

Table II shows the splash injuries that occurred in each zone during total hip arthroplasty for 11 patients. Splash injuries to the surgeon and assistant were 214 and 137 to the mouth and lips region and 90 and 39 to the nose and cheeks respectively. There were 53 and 27 splash injuries to the eye region of the surgeon and assistant with low rates of injury to the theatre nurse. The tables show that the results are comparable for total hip and knee arthroplasty. They show that splash injuries occur frequently during these procedures. It is important to note that there were significant injuries to the mouth, lips and eyes which are areas where absorption of bodily fluids may take place with exposure. There were no masks in either group that had no splash contamination when examined post-operatively.

Table 1. — Total knee arthroplasty

Zones	Surgeon	Assistant	Theatre Nurse
A	(57-434), median 217	(49-553), median 238	(0-57), median 14
B	(12-362), median 105	(27-533), median 147	(0-17), median 3
C	(9-280), median 62	(7-261), median 82	(0-9), median 2
D	(4-97), median 32	(3-203), median 52	(0-11), median 2
E	(68-263), median 150	(35-608), median 262	(0-48), median 14

Table II. — Total hip arthroplasty

Zones	Surgeon	Assistant	Theatre Nurse
A	(67-413), median 214	(21-403), median 137	(0-97), median 24
B	(4-207), median 90	(15-123), median 39	(0-56), median 15
C	(8-142), median 53	(4-78), median 27	(0-32), median 4
D	(3-88), median 30	(2-66), median 16	(0-53), median 5
E	(78-213), median 137	(27-623), median 121	(0-120), median 25

DISCUSSION

Splash injury to the face is a common event during total hip and knee arthroplasty. It mainly affects the operating surgeon and the assistant. There are also minor injuries to the theatre nurse. These events pose a threat to the safety and well-being of the surgical team as there are risks of contracting blood-borne viral diseases through muco-cutaneous absorption.

The authors believe protection of the face using a shield or visor is therefore mandatory when undertaking orthopaedic procedures involving the use of power tools. This is also supported by several studies previously carried out. Bell and Clement (2) found that 65% of surgical goggles were contaminated during orthopaedic procedures with those involving the hip posing the highest risk. They also found that 5% were contaminated at the sides and

felt that ordinary spectacles therefore provided adequate protection with increased convenience and comfort. Prior *et al* (11) reported that 8% of contamination droplets occurred on the sides of the face during ear, nose and throat surgery. They felt that goggles rather than spectacles would be preferable to use in high risk group patients. Duthie *et al* (6) found that general surgical and soft tissue orthopaedic procedures, excluding vascular surgery, carried little risk of eye contamination. They found significant splash injuries in all scrubbed theatre personnel when cases involved bone cutting and intramedullary reaming. They stated that all scrubbed theatre personnel should wear eye protection during bone surgery.

Similar conclusions have also been drawn from several other studies looking at other surgical specialities. Morasco and Woods (9) looked at eye splashes for all types of surgery and found that 44% eye shields were contaminated. They also tested the shields with reagent strips to look for microscopic contamination. Interestingly, they found that the surgeons were aware that their eye shields were contaminated only in 8% of cases, with only 16% of splashes being macroscopically visible. Aisien *et al* (1) similarly found that 62% of surgeons' masks and 63% of goggles were contaminated during Caesarean section and advocated the routine use of protective masks and eye wear. Berridge *et al* (3) found that 51% of the surgeons' visors were contaminated during vascular procedures. They noted that the risks were increased for emergency and prolonged (longer than 2 hours) elective procedures.

Tokars *et al* (12) carried out a large study involving 1,382 surgical procedures which were observed. They found that the eye splash injury rate was considerably reduced with the use of ordinary spectacles but was actually zero for those surgeons wearing goggles or face shields. This suggests that goggles, face shields or the visor, as used in this study, are good methods of barrier protection for the eyes during all forms of surgery and will reliably prevent splash injury to the eyes.

This study shows that without face protection, the risk to the surgical team is high during joint arthroplasty. The authors believe that this can

probably be extended to any bone procedure that involves the use of power tools. Despite the extensive evidence in the literature to support this, the authors believe that surgeons across many specialities underestimate the risks of facial contamination during surgery and the possibilities of contracting blood-borne viral infections. Although it is useful to categorise patients in low, medium and high risk groups to estimate the risk, we believe that a safer approach would be to adopt universal policies to protect the faces and eyes of the surgical team during all operations. The HIV, HBV and HCV status of every patient operated upon is not always known and this therefore poses an unquantifiable risk. Although the use of face masks is common during surgery, eye protection is not always used and this puts the surgeon and the team at risk.

CONCLUSION

This study shows that the face is very vulnerable to material and fluid strikes during joint arthroplasty surgery. The visor used in this study was found to be a reliable barrier to blood, fat and body tissue splashes and therefore minimises the risk of exposure to blood-borne viruses. We believe that the visor should be used during all joint arthroplasty procedures and its use can be extended to any procedure that involves the use of power tools.

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