Camera Cover Perforation after Arthroscopic Surgery

Dear Editor,

To maintain sterility during arthroscopic surgery, arthroscopic cameras may be used either sterilised or enveloped in a sterile cover. Before the development of autoclavable arthroscopic cameras, sterilising arthroscopic cameras in glutaraldehyde had been the acceptable method of practice in many centres around the globe. However, case reports of suspected gas gangrene cases following arthroscopic surgery[1-2] had raised concern regarding the effectiveness and safety of this disinfection method. We use the word 'disinfection' here because it had been shown that soaking instruments in glutaraldehyde solution for 15 to 20 minutes could eliminate all types of bacteria and viruses, but not spores.[3]

In the report by Ketterl[2] the patient presented with compartment syndrome and was presumptively treated for gas gangrene based on radiological findings. Although the gram stain revealed gram positive bacilli, no positive cultures were obtained. Therefore, the infection may not necessarily have been due to a clostridial infection.

Standard arthroscopic cameras are temperature-sensitive and thus not amenable to autoclave sterilisation due to the high temperature. The use of autoclavable arthroscopic cameras seems like an attractive option, but given the high frequency at which arthroscopic surgeries are performed, duplication of these expensive modern cameras are required to allow adequate turnover between cases, resulting in escalating costs.

Other options include ethylene oxide and plasma sterilisation. However, while they are effective and do not require a long sterilisation processes, they are also relatively costly.

Therefore, most centres still utilise standard arthroscopic cameras, either disinfected with glutaraldehyde or covered with sterile plastic arthroscopic camera covers. Although convenient and relatively cheap, the reliability of these covers is unproven.

Glutaraldehyde soaking of arthroscopic cameras was the sterilisation/disinfection method-of-choice at our institution until 2005, when concerns regarding the potential of postoperative infection by spore-forming bacteria was raised.[1-2] Despite its many advantages, glutaraldehyde had limitations due to its ineffectiveness against spore-forming bacterium. Sterile arthroscopic camera covers had replaced our standard of practice since then, believed to be offering a safe, relatively cheap and reliable alternative to glutaraldehyde. A prospective randomised study conducted by Werner et al reported a staggering leakage rate of 74% out of the 90 sterile covers analysed in their study.[4] We aimed to determine the integrity of sterile arthroscopic camera covers used at our institution.

Materials and Methods

Forty-three sterile arthroscopic camera covers (Fairmont Medical, Australia) were analysed in a prospective study at our institution's Ambulatory Surgery Centre. Data recorded include the performing surgeon, type and duration of surgery. The type of surgery included both knee and shoulder arthroscopies. The average duration was 61 minutes, with a range from 20 to 150 minutes.

Covers were immediately removed from the camera postarthroscopy and filled with water to a level of about 70 cm. The junction between the built-in camera adapter and plastic sleeve was labelled as Zone C. Zone B and A marked the level from the adapter-plastic junction to 25 cm and from 25 to 50 cm, respectively. The area above the 50 cm mark was labelled as the pre-zone (Figs. 1 and 2).

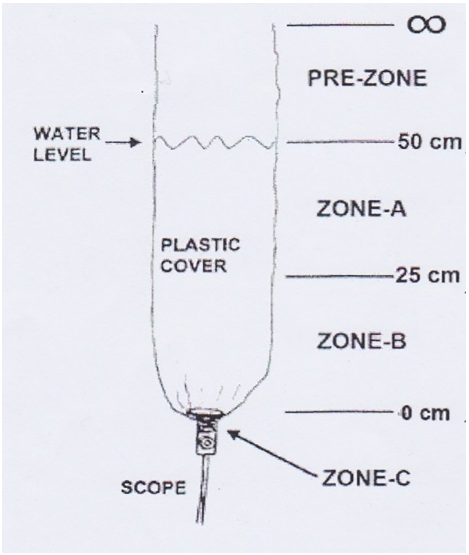

Fig. 1. Diagram of testing setup.

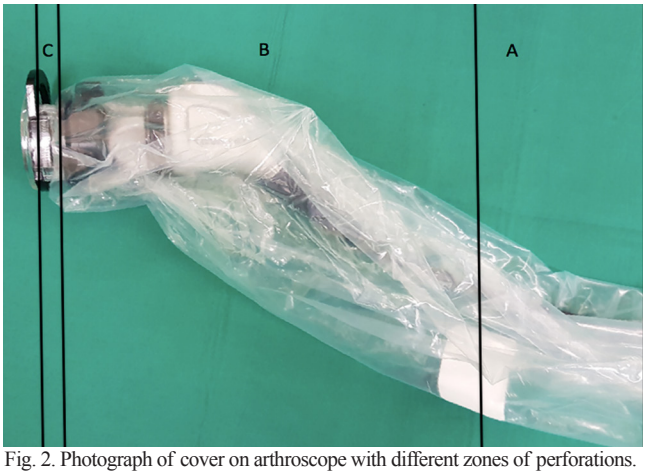

Fig. 2. Photograph of cover on arthroscope with different zones of perforations.

Perforations were documented as 'small' where leakage was detected with no visible perforation, 'medium' for perforations up to 1 mm and 'large' for perforations larger than 41 mm. All testing were conducted by the same personnel to maintain consistency and standardisation. In addition, 15 unused covers were analysed as controls. Testing of the control unused covers was carried out in a similar manner to the covers used during arthroscopy.

The statistical analysis was performed using 1-way analysis of variance (ANOVA) with posthoc Dennett pairwise comparison. Statistical software SPSS v17.0 was utilised.

Results

A total of 81% (35 out of 43) of covers analysed postarthroscopy had 1 to 3 perforations. A total of 49 perforations were recorded in our study (Zone A = 14%, Zone B = 41%, Zone C = 43%). One cover was found to have 1 perforation in the pre-zone (Table 1).

Most small and medium sized perforations were found in Zone C and most large perforations were found in Zone B. Only the difference in percentage of leakage rate between Zone A and Zone B was found to be statistically significant ($P = 0.026$) (Table 2).

No correlation was found between the duration and type of surgery with the number or size of perforations. The number and size of perforations was also found to be independent of the performing surgeon. None of the 15 new covers in the control group had perforations. At 3 months follow-up, there were no cases of postoperative infection.

Table 2. Comparison between Zones of Perforation

Comparisons	*P* Value
Zone A vs zone B	0.026
Zone A vs zone C	0.054
Zone B vs zone C	0.998

Discussion

Sterile plastic arthroscopic camera covers, thought to be a cost-effective and reliable alternative to glutaraldehyde, may not be the perfect solution after all. The high rate of perforation found by Werner et al[4] and our study is indeed of concern.

Our analysis had shown that most perforations occurred at Zones C and B (area from junction of camera adaptor to 25 cm proximal along the plastic sleeve). This could perhaps be because the 2 zones were the areas under most mechanical stress from manipulation by the operator. Furthermore, majority of the large sized perforations occurred in Zone B where the operator's hand made direct contact with the plastic drape.

Manufacturers of sterile arthroscopic camera covers should re-evaluate their design to address the issue of perforations at the junction between the built-in camera adapter and plastic sleeve (Zone C), and consider reinforcing the initial 25 cm from the adapter-plastic junction (Zone B) to reduce the perforation rate.

While standard glutaraldehyde disinfection may not sufficiently sterilise the arthroscopic equipment, the published infection rates were still low. The incidence of infection postarthroscopy is reported to be around 1% or less.[5-11] Staphylococcal and streptococcal infections were still the most common pathogens involved in infection, and thus glutaraldehyde disinfection may be sufficient to prevent most infections. While glutaraldehyde disinfection may not be proven to result in higher infection rates, the discerning surgeon may have to consider other methods of maintaining sterility, be it with ethylene oxide, plasma sterilisation, or with sterile plastic arthroscopic camera covers.

The question remains as to why there was such a low incidence of infection despite the high leakage rate found in sterile arthroscopic camera covers used in arthroscopic surgery. The use of copious and continuous irrigation during arthroscopic surgery may perhaps minimise or eliminate

Table 1. Table of Perforations by Zones

	Pre-Zone	Zone A (S)	Zone A (M)	Zone A (L)	Zone B (S)	Zone B (M)	Zone B (L)	Zone C (S)	Zone C (M)	Zone C (L)
	1	3	2	2	7	1	12	10	4	7
Total by region	1 (2%)		7 (14%)			20 (41%)			21 (43%)	

L: Large; M: Medium; S: Small

joint contamination. Another explanation may be due to the fact that arthroscopic surgery is minimally invasive, utilising small incisions for access, thus minimising outside contamination and at the same time minimising tissue trauma and necrosis.

In between cases, it was the standard practice for the camera heads and cables to be wiped with a solution containing detergent and disinfectant. This helped in removing gross contaminant and in reducing bacterial load on the equipment, potentially minimising the risk of infection despite the perforations, even though the equipment was not handled in a sterile manner.

Currently, there are no direct studies comparing the incidence of postoperative infection between the use of glutaraldehyde disinfection and the use of sterile arthroscopic camera covers. However, given the low incidence of postarthroscopy infections, large numbers are required to prove any differences in postoperative infection rates.

As we strive to improve on current standards and practices, there is still a need to provide better sterilisation instead of mere disinfection for elective surgical procedures, and hence there is a need for surgeons, operating theatres and hospitals to consider different methods of maintaining sterility.

Conclusion

The alarmingly high rate of perforations found in sterile plastic arthroscopic camera covers postarthroscopy raises concern regarding its reliability in the maintenance of sterility in clinical practice. Although the rate on infection is low, surgeons and their hospitals may want to consider other options to maintain sterility, since the perforation rate, and hence potential for infection, is high.

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