

Permanently Avoiding Steam on Camera for Arthroscopy by a Simple Device



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Abstract: Steam on the camera may happen in any arthroscopic procedure, especially in shoulder arthroscopy. Although multiple techniques and devices have been applied to avoid steam, it still cannot be prevented completely. We designed a simple device to terminate this problem by protecting against the ingress of water.

A clear view is the first requirement to perform an arthroscopy. Steam on the camera is a common obstacle to this procedure. It happens unpredictably in any arthroscopic procedure, especially in shoulder arthroscopy. Although multiple techniques and devices have been applied to avoid steam, it still cannot be prevented completely.¹ Because of fogging during surgery, the surgeons may remove the camera and wipe the lens—even change the arthroscope. We designed a simple device to terminate this annoying problem by persistently preventing steam and protecting against the ingress of water during the hours of arthroscopic procedures.

Materials

The following materials were used: surgical gloves, size 6½ or 7 (Heng Sheng Medical Products, Jiangxi, China), an incise drape (Jiangxi 3L Medical Products Group, Jiangxi, China), and an arthroscope (4-mm diameter, rigid; Smith & Nephew, Andover, MA).

Construction Steps

The following constructions steps were taken (Fig 1, Video 1):

Step 1: First, using scissors, a thin, oval-shaped hole between 8 and 13 mm in length is cut in the fingertip of the glove (Fig 1A). The hole and the piece of removed glove material are measured by a ruler to ensure that the diameter of the hole is suitable for the following procedure. The selection of the glove finger affects the prevention against the ingress of water. The little finger and index finger are better than the middle finger or ring finger. Then, the glove is turned inside-out, and only the finger with the hole is left out so that the other fingers are packed inside the palm of the glove. It will maintain a tidy shape after the camera is enclosed by the glove.

Step 2: Enclose the arthroscope and camera within the glove. First, the light post adaptor (the yellow arrow in Fig 1B) is removed, and the proximal portion of the arthroscope shaft is passed through the palm of the glove, the protruding finger, and the small hole in the fingertip. Considering that the light post is much wider than the other part of the arthroscope shaft, it is difficult to pass through the small hole. Pick up the edge of the small hole carefully with 2 fingers to expand the hole slowly, and let the rubber edge of the hole slip over the light post smoothly (Fig 1C). After the light post passes through the hole, the rubber finger of the glove is tightly wrapped around the thick distal part of the arthroscope shaft (Fig 1B). Leaving some folds of plicate rubber wrapped around the shaft under the light post will help prevent the ingress of water. Then, the light post adaptor is reloaded.

Step 3: Pack the distal part of the arthroscope and camera head into the palm of the glove. After the fingers and the edge of the glove are tidied into a neat

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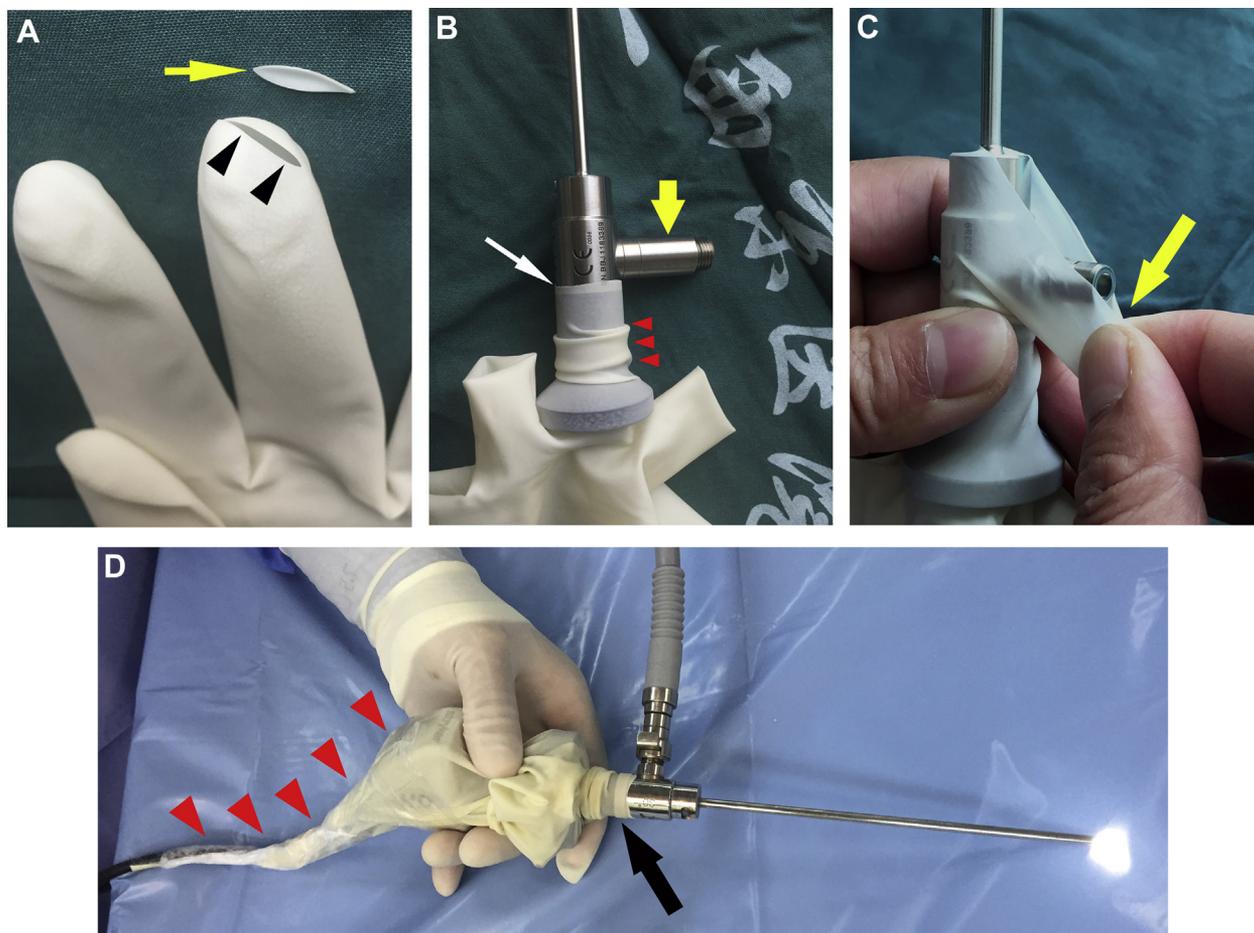


Fig 1. Construction of the device. (A) A hole is cut in the fingertip of the glove (black arrowheads), and the small piece (yellow arrow) is removed. (B) The proximal portion of the arthroscope shaft is passed through the hole, and the fingertip (white arrow) of the glove is very tightly wrapped around the thick distal part of the arthroscope shaft. The light post adaptor (yellow arrow) is unloaded and reloaded so that the glove is passed through more easily. Plicate rubber (red arrowheads) wrapped around the shaft is very helpful for avoiding the ingress of water. (C) The arthroscope light post is much bigger than the hole, so it needs a small trick to pass very carefully without breaking the glove. (D) The distal part of the arthroscope and camera head are sealed up by the glove and incise drape (red arrowheads). The black arrow indicates the fingertip of the glove.

shape, the posterior portion of this device is tightly sealed up by the incise drape (Fig 1D). Because the ingress of water may happen anywhere, a section of camera cable about 5 cm long is also tightly sealed into the incise drape.

Discussion

The history of avoiding steam on the camera is as long as that of arthroscopy, because it is performed in water. The condensation of moisture onto a cold lens leads to fog on the camera,¹ so it is sometimes difficult to keep the view of the arthroscope clear during the entire surgery. Several causes, including the water discharged from portals spraying onto the arthroscope, the loosening of the seal between the arthroscope and camera, and the changes in temperature of the lens caused by the surgeon's hands, may lead to a blurred view. Compared with knee arthroscopy, steam happens more

frequently in shoulder arthroscopy because the arthroscope is often in a position lower than some portals through which water may spray directly onto the arthroscope. Sometimes surgeons may lose their cool when they need to disassemble the arthroscope from time to time to wipe the steam or water during several hours of surgery.

Many techniques and devices have been tried to avoid steam, such as performing the portal as small as possible,¹ sealing the arthroscope cover tightly and very carefully, and even utilizing antisteam products for the lens. However, this annoying problem has never been resolved completely, and it can cause unpredictable trouble.

Our device terminates this problem. The diameter of the hole, the size of the glove (6½ or 7), and plicate rubber wrapped around the arthroscope shaft are important (Table 1). We have tested holes of various

Table 1. Pearls and Pitfalls of the Device for Avoiding Steam on the Arthroscopy Camera**Pearls**

The glove passing through the light post is the most difficult procedure in the assembly. The glove will be torn if the surgeon overexpands the hole or moves too quickly.

The shape of the arthroscope shaft of different companies varies, so the size of the glove, the selection of the finger, and the diameter of the hole in the fingertip should be modified according to the diameter of the arthroscope shaft.

Preservation of 3 to 5 folds of rubber plication under the light post helps protect against the ingress of water.

Pitfalls

Water may go into this device along the camera cable. Do not neglect to seal the posterior portion of the device.

Tidying up and packing the distal part of the arthroscope and camera head into the glove should not be ignored. Packing too tightly or allowing too much air into the glove may lead to continuous miniscule shifting of the glove in surgery, which will compromise the duration of the protection against water.

After the operation, while using sharp scissors to remove this device, attention should be paid to avoid scratching the camera, cable, and arthroscope. The cable is vulnerable in this procedure.

diameters, and we found that a diameter between 8 and 13 mm can prevent steam, whereas a bigger hole may compromise the capability of protection. A length of 8 mm is best for protection and the smallest length with which the glove does not break when the arthroscope shaft passes through. Tiny shifting of the glove in surgery may compromise the duration of protection against water (Table 1). We immersed our device in 10 cm of water for 2 hours, and it was still waterproof. However, with the glove shifting in surgery, the device may lose the capability of protection within 2 hours. Thus, to avoid glove shifting, tidying up and packing the arthroscope and the camera into the palm of the glove should be carefully done (Table 1).

Table 2. Advantages and Disadvantages of the Device for Avoiding Steam on the Arthroscopy Camera**Advantages**

The materials for the device can be obtained in any operating room.

These materials are very inexpensive and standard.

The device is very simple. After several practice rounds, any surgeon can assemble this device in 3 minutes.

Disadvantages

The diameters of arthroscope shafts of different types of arthroscopes are diverse. It may take several tries to find the suitable size and suitable glove finger for a certain arthroscope. Without practice, a surgeon may tear the glove when he or she assembles this device. The device must be assembled manually by surgeons—the device and its function are not standard.

Furthermore, we suppose that the diameter of the finger of the glove and arthroscope shaft are also considered to be factors affecting the capability of protection (Table 2). In our study, we used a 4-mm diameter rigid arthroscope. However, for other types of arthroscopes, a surgeon may try several times before surgery to find the suitable size and suitable glove finger.

Some limitations exist with our device. The device is assembled manually on the operation table, so its ability to prevent steam is subject to the performance by the surgeon. Obviously, the device and its function are not standard and not always reliable. This limitation can be resolved with further study. Considering that our device is very simple and costs little (Table 2), it may be developed into a standard, reliable, inexpensive, and disposable product in the future.

Reference

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