

## Mirror glasses for minimally invasive surgery

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Running Head: Mirror glasses for minimally invasive surgery

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Techniques for minimally invasive cardiothoracic surgery, such as video assisted lobectomy and minimally invasive mitral valve repair, are now standard [1-3]. However, the small thoracotomy incision and manipulations of endoscopic instruments limit visualization to some extent. This problem can be overcome to some degree by means of the optical scope, but it is still partly the presence of two-dimensional images. While humans do recognize an object as a stereoscopic image by observing it with two eyes, the operator performing minimally invasive surgery is prevented from seeing the whole field with both eyes by the restricted incision. To overcome this problem, we developed mirror glasses.

#### Device description

A small unit, comprising four mirrors and two convex lenses (Fig 1), was constructed for the independent recognition of the right or left vision by the right or left eye, respectively (Figure 2A). With the use of this unit, by calculation, the operator's pupillary distance appears to come closer by together about one-third, and the overlapping area of both right and left visual field through a small incision is extended. As a result, the focused area seen stereoscopically is enlarged (Figure 2B).

## Methods

Use of these glasses was evaluated in terms of the time required for threading of sutures with endoscopic forceps. A box was prepared having a hole 3 cm x 4 cm in dimension, and three surgeons was asked to ligate sutures in the box with endoscopic instruments, relying only on the view obtained through the hole in the box. Each surgeon ligated thread a suture five times with and without use of the glasses, and the mean time was calculated for each surgeon.

## Results

The time required for ligation (mean  $\pm$  SD) was  $24.2 \pm 2.9$  sec. with mirror glasses and  $27.0 \pm 2.5$  sec. without the glasses. The difference was significant ( $p = 0.01$ ). The operators reported that, when they wore the glasses, the floating thread could be caught easily, and that the glasses were most useful.

## Comment

In minimally invasive surgery, the operator observes either a

two-dimensional image obtained by the optical scope or the surgical field directly using a single eye, even though thoracotomy has been performed. To improve visualization under these circumstances, we developed new mirror glasses. We found that vision with both eyes through the small incision was excellent and that they significantly facilitated and expedited performance of a simple operative procedure. These glasses also facilitated operative manipulation and dissection of adhesions in the fresh human cadaver. With the first prototype, which did not have convex lenses, problems included the ability to sense an object at a distance, but this final version of the glasses permits magnification of the appearance of objects visualized by 2.5 times. Additionally, the attachment system help the surgeon whoever wears glasses. The indications of minimally invasive surgery are expected to increase in the future, and these glassed may be found particularly useful for fine manipulation.

## References

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## Figure legends

Fig. 1.

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Fig. 2.

A. Four mirrors applied to mirror glasses.

B. Overlapping area of both right and left visual field in small incision is expanded by mirror glasses.



Figure 1

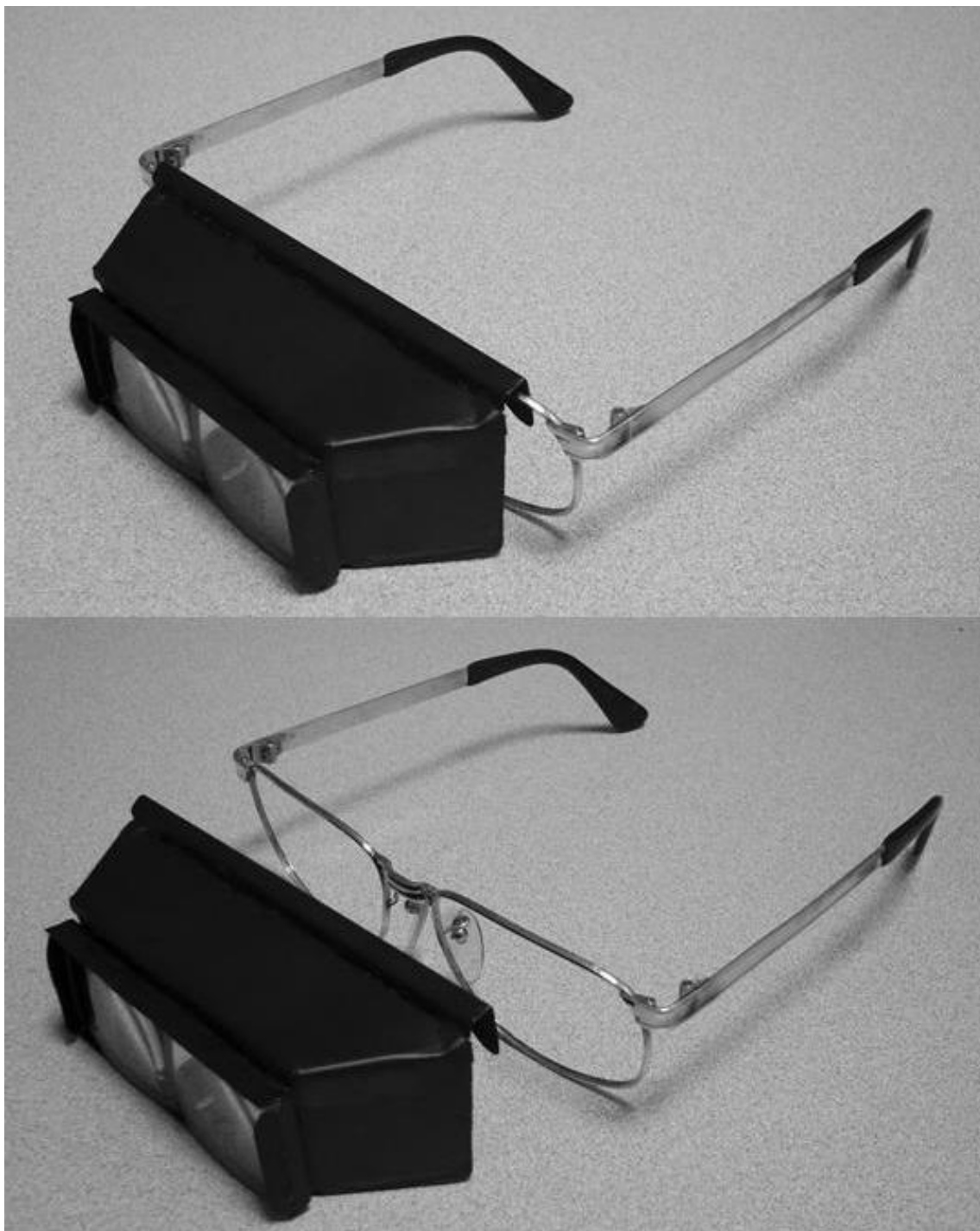


Figure 2

