Three-dimensional Hi-Vision System for Microneurosurgical Documentation Based on Wide-vision Telepresence System Using One Camera and One Monitor

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Abstract

A three-dimensional (3-D) high-definition television (Hi-Vision) system suitable for attachment to a stereoscopic operating microscope allowing 3-D medical documentation using one Hi-Vision camera and one Hi-Vision monitor is described. The system provides 3-D high-definition microneurosurgical recorded images suitable for viewing on a screen or monitor, or for printing.

Key words: three-dimensional imaging, documentation, microsurgery, high-definition television, Hi-Vision

Introduction

The Hi-Vision system is a new high-definition television (HDTV) technology intended to replace the National Television System Committee (NTSC) system. HDTV provides images of superb quality with a greater resolution than NTSC systems by using 1125 instead of 525 scanning lines.²⁾ In 1987, we reported the first use of the Hi-Vision system in the medical field for relaying and recording neurosurgical procedures under the operating microscope.⁹⁾ Stereoscopic recording and presentation were achieved using two Hi-Vision cameras and recorders in 1988.⁸⁾ However, the cost performance and the size of the system including the camera unit, recorder and monitor were unsuitable for clinical use.^{8,9)} With more recent technological innovations, the Hi-Vision system has become smaller and cheaper.

Here, we propose a three-dimensional (3-D) Hi-Vision system for microneurosurgical documentation based on the wide-vision telepresence system using one camera and one monitor.⁷⁾ Technical details of the system and illustrative stereoscopic images are demonstrated.

Equipment and Method

The 3-D Hi-Vision documentation system is based on the wide-vision telepresence system using one camera and one monitor⁷⁾ (developed by Media International Corp., Tokyo).

A 3-D device (manufactured by Nagashima Medical Instrument Corp., Tokyo) for attachment

Fig. 1 3-D attachment device with Hi-Vision camera installed on the stereoscopic operating microscope.

Fig. 2 Schematic drawing of the 3-D Hi-Vision system using one camera and one monitor: the wide-vision telepresence system. CCD: charge coupled device.

to the stereoscopic operating microscope (Mizuho Ikakogyo Co., Tokyo) was especially developed (Fig. 1). The device conducts the right and left outputs of the stereoscopic operating microscope¹⁴⁾ to one visual field individually. Figure 2 shows the schematic drawing of the 3-D attachment device and system design. A new light Hi-Vision camera using charge coupled device, weighing 2 kg, was connected to this system. The camera and 3-D device caused no hindrance to surgical procedures.

The Hi-Vision system uses a height:width ratio of 9:16,²⁾ so bilateral images can be recorded simultaneously in one Hi-Vision image. The recorded Hi-Vision images can be observed using a conventional parallel stereoscopic method or viewer, or to provide 3-D documentation of microneurosurgery on a monitor or screen using a video projector or in printed matter.

Illustrative Case

A 62-year-old female underwent clipping of a ruptured right middle cerebral artery (MCA) aneurysm 1 year ago. At that time, angiograms also showed unruptured multiple aneurysms at the left MCA and basilar bifurcation. A second operation was planned to clip the MCA and basilar bifurcation aneurysms.

Fig. 3 Hi-Vision stereograms printed directly from the recorded 3-D Hi-Vision images. Clipping of the basilar bifurcation aneurysm via the left opticocarotid space (*upper*), and clipping of the left MCA aneurysm with the L-shaped clip (*middle*) and the short ring clip (*lower*) can be seen using a parallel eye method without optical devices.

A left frontotemporal craniotomy was performed with her in the supine position. The Sylvian fissure was opened proximally and dissected distally to locate the MCA aneurysm. After exposing the aneurysm, the basilar system was approached. The basilar aneurysm was identified in the opticocarotid space, and clipped with a straight 20 mm Sugita clip (Fig. 3 *upper*). The MCA aneurysm was then exposed and clipped with an L-shaped clip (Fig. 3 *middle*) and a short ring clip (Fig. 3 *lower*).

Discussion

Visual documentation using television and video systems is very important in modern medical practice, especially for the education of medical students,⁴⁾ the training of residents^{5,12)} and records for medical conferences.³⁾ For the documentation of microsurgery^{6,11,13,15)} and endoscopic surgery,^{1,10)} the video system is essential.

The printed images taken from the recordings by our Hi-Vision system of the illustrative case clearly demonstrate the high quality and definition achieved, which are comparable to that of 35 mm movie film. As the system only requires one camera and one recorder, the cost performance and size make it very suitable for microsurgical and endoscopic documentation.

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