

HDTV Single Camera 3D System and its Application in Microsurgery

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1. ABSTRACT

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

2. INTRODUCTION

At present, it is common for videos, either on-line or off-line, to be used to show the proceedings of microsurgery to many viewers. However, this method has the following drawbacks:

- 1) Although the surgeon has a three-dimensional view of the patient, the image on the video is two-dimensional. The viewers of the video are able to visualize a three dimensional image only through their own knowledge and experience.
- 2) In the application of the surgical footage, the present television system (NTSC) presents problems with regard to resolution and color accuracy. In its place, 35mm film cameras are often used to record the surgery.

HDTV provides images of superb quality with six times as much resolution as the NTSC system and enough quality for microscope operation in medical applications. However, the cost performance, size and weight of the system including camera unit, recorder and monitor were unsuitable for clinical use. With more recent technological innovations, the HDTV system has become smaller, lighter and less expensive.

Here, I propose a three-dimensional (3-D) HDTV system for microsurgical usage based on single camera 3-D system.

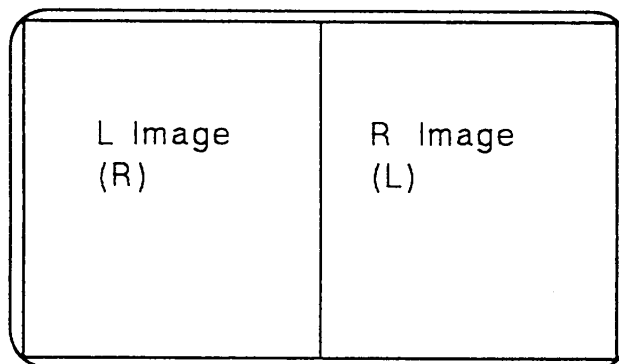


Fig.1 Screen Image of this system

3. EQUIPMENT AND METHOD

A 3-D device for attachment to the stereoscopic operating microscope was specially developed. The device conduct the right and left outputs to the stereoscopic operating microscope to each visual field individually. Fig 1. shows the schematic drawing of the system. A new light weight HDTV camera (weighing under 2 Kg) was connected to this system through an attachment (Fig. 2~3). The camera and 3-D device caused no hindrance to surgical procedures.

The aspect ratio of HDTV is 16:9, so bilateral images can be observed using a conventional parallel stereoscopic method or viewer, or to provide 3-D documentation of microsurgery on a monitor or screen using a video projector or in printed matter.

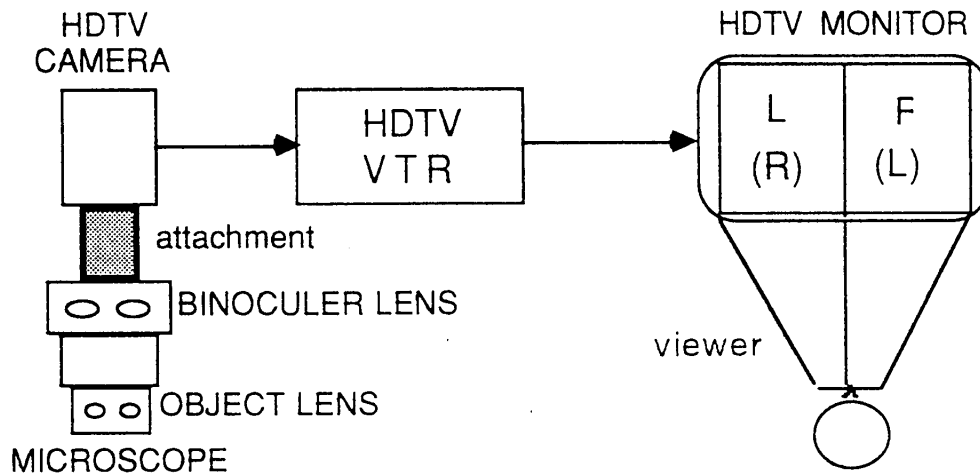


Fig.2 Developed Single Camea 3-D System



Fig.3 HDTV Camera attached to microscope with attachment

4.CHARACTERISTICS OF THIS SYSTEM

- 1) People(assistants, nurses and medical students) can watch the same 3-D images as the surgeon.
- 2) As there is no use of polarized glasses or liquid crystal glasses, the person can view bright 3-D images for a long period of time without tiring.
- 3) The images can be recorded with just one VTR and transmitted by one cable line, so this system will offer easy operation.
- 4) As two images(left and right) are put on one screen of monitor and projector, there are no differences in color characteristics.

- 5) The images can easily be printed and organized into a data base.
- 6) The images can be sent by a single transmission line so that this system offers economical operation and is easy to adapt to tele-operation in the future.

5. APPLICATIONS

1) Example of clipping of a cerebral aneurysm (Reference 1)

The surgery performed by Dr. Kobayashi was filmed and recorded at the Department of Neurosurgery, Shinshu University, School of Medicine, November, 1992 and the 3-D image film were exhibited at following conferences.

- a. The second Conference on Neurosurgical Techniques and Tools (Osaka, April, 8-9, 1993)
- b. The second society for study of computer surgery (Tokyo Women's Medical College, September 23, 1993)
- c. The 43rd Annual Meeting of the Congress of Neurological Surgeons (Vancouver, B.C October 2-7, 1993)

2) Example of surgery of small fenestra stapedectomy (Reference 2)

The surgery performed by Dr. Yagi was filmed and recorded at Nippon Medical School, July, 1993 and the film will be introduced at the General Assembly of the Otorhinolaryngology at Niigata Pref., May, 1994.

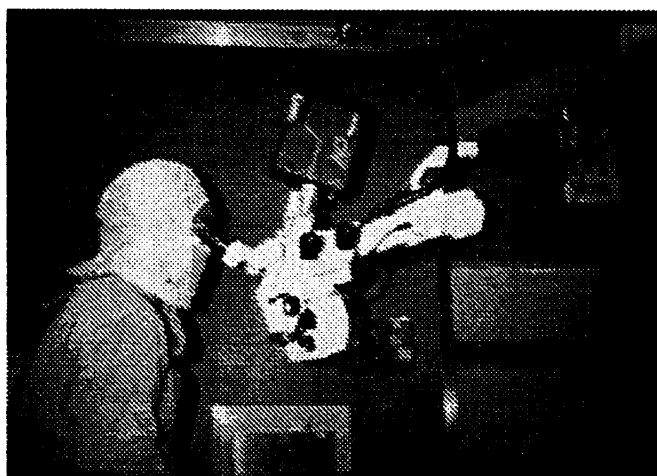


Fig.4 Doctor operating on a cerebral aneurysm

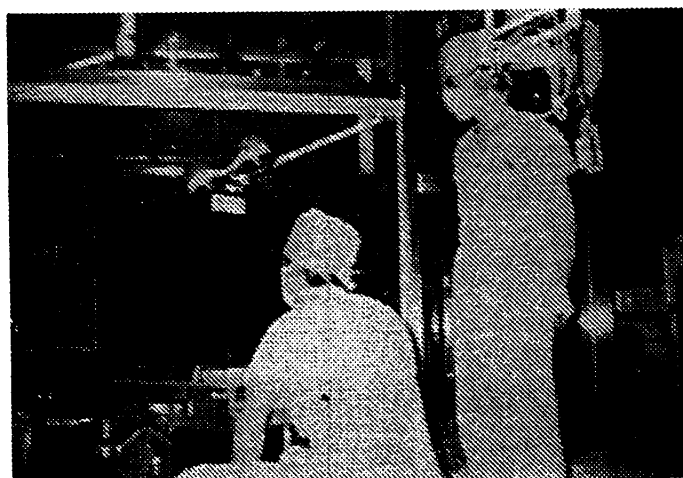


Fig.5 Watching the monitor using viewer



Fig.6 Monitor screen of clipping the preserving parent artery using double clip method

6. DISCUSSION

Furthermore, a digital multi-media system that superimposes the necessary medical information, such as X-ray CT, MRI, DSA, etc, on real microsurgical images, enables the surgery to be more accurate with minimum invasion.

The possibility of the future development of the system would be the system which HDTV camera is attached directly to Operation Binocular Microscope. In this way, the surgeon could do the operation through the picture of HDTV monitor instead of looking into the Operation Binocular Microscope lens. The advantage of the developed system would be;

- 1) The assistants and the nurses can also watch the same picture with the surgeon at the same time.
- 2) By superimposing the picture of the ultra-sonic navigation and MRI etc. on to the camera image, the invasion of the surgery is minimized, thereby achieving quick and accurate operation .
- 3) The superimposing of 3 dimensional CG model of living body created from many medical images such as MRI analysis on brain functions can be used for the operation planning and simulation.
- 4) The surgeon can stand in the most appropriate position and will be able to perform surgery for a long time.

7. REFERENCE

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- 2) Toshiaki Yagi, Ryo Mochizuki, Hiroshi Saito: Application of 3D HDTV System to Ear Surgery, *Otolaryngology-Head and Neck Surgery (Tokyo)*, Vol.66, No.2, February, 92-93, 1994