

銜接單鏡頭內視鏡使用之3D影像轉換系統應用於泌尿科手術：臨床案例研究

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Application of a single camera stereoscopic endoscope in Urology surgery: A cases study on surgeon

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Purpose:

Minimally Invasive Surgery (MIS) is indispensable from the current surgical procedures. Conventional endoscopic systems produce 2D colored video images, which do not provide surgeons an actual depth perception of the scene. There are two cameras stereo endoscope system, which synthesize a stereo image from the images obtained with the cameras enclosed in a single endoscope tube. Such stereo endoscope system has limitations that include fixed distance between two cameras in the endoscope which does not allow it to simulate the convergence of the human eyes, the diameter of the endoscope tube is not suitable for wide angle camera system and it needs an installation of a complete new system of the stereo endoscope. These disadvantages hinder the current state-of-the-art to become popular among surgeons who are already using single camera system endoscopes. Considering the limitations of the current state-of-the-art, a single camera stereo endoscope was developed in IRCAD-Taiwan (Taiwan patent No. M467436). This study presents a usability study of the new stereo system.

Materials and Methods:

Patients: Patients (n=6) who were planned for minimally invasive surgery in Urology were selected for the study. The study was approved by Institutional Review Board of Show Chwan Memorial Healthcare system. All patients were informed regarding the new equipment and they consented for its inclusion in the study. Patients with chronic diseases such as diabetes and chronic heart diseases were excluded from the study. Average age of the patients was 62±19years. 4 patients were male and 2 were female.

Equipment: The 3D system used in this study consists of a moveable computer-monitor system, which can be plugged into the conventional 2D endoscope system to acquire 2D images. The acquired 2D image is further processed in the computer of the 3D system and displayed as a stereo video on its 3D monitor (Figure 1). The stereo image can be visualized only after wearing a polarized light glass (Figure 2). The best stereo visualization is seen if the user is directly facing the monitor.



Figure 1: MonoStereo® 3D visualization system from single camera endoscope.

Surgery: All the patients went through uncomplicated procedures in Urology; cases included transurethral resection of the prostate (TURP), ureterorenoscopic lithotripsy (URSL) with 4mm Cystoscope and Ureteroscopy and laparoscopic hernioplasty with 10mm laparoscope. During the surgery endoscopic system monitor of KarlStorz® was used to display the 2D video and the stereo video was visualized in the 3D monitor of the new equipment with the help of the polarized glasses from a distance of around 1m from the monitor. The surgery was done under the visualization of stereo video. After the procedure, surgeons will answer the questionnaire and give the user feedback.



Figure 2: set up of the MonoStereo® system in the operation room

Results:

For all the six cases, the operation can be done by watching the converted stereo images without any serious adverse event happened. The experiments show the safety and low risks in the surgeries. The user experience questionnaire results shown in Table 1. The levels of the score are 5: Strongly agree 4: Agree 3: Neither agree nor disagree 2: Disagree 1: Strongly disagree.

Table 1: Questions and average score of its response.

#	Questions	Average Score
1.	The 3D perception of tissues and organs are good	3.7±0.5
2.	The 3D perception of instruments are good	4.2±0.7
3.	The 3D images displayed smoothly	3.8±0.7
4.	It's comfortable in watching 3D without any nausea or fatigue	4.0±0.6
5.	The 3D image helps in operated procedure	4.3±0.5
6.	The 3D is good compares to the original system	4.0±0.3

Conclusion:

The current study applied a new device of 3D visualization during MIS in Urology and evaluated its usefulness. The device is unique as it creates stereo video using images from conventional 2D endoscopy system. To our knowledge this is the first study where the system has been evaluated for the surgeries in Urology. Overall experience of the surgeries with the system, the new system is useful in perceiving 3D of the surgical anatomy and helps during the surgery. Moreover, the system was easy to use without disturbing the workflow of the operation room. The system was more useful than 2D system in the situations such as grabbing the stones with Ureteroscopy. In such situations it is very important to identify the depth of the structure correctly.

The current study results are based on user experience during the surgery. An objective assessment of how much the 3D system gives advantage over the 2D system with a statistical comparison would be more helpful. A comparative study of surgical procedures time under 2D and 3D system would help in establishing the benefits.

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