Introduction

Conventional laparoscopes consist of a rigid tube containing rod lenses to transport the image which is then captured by an external camera. While flexible fiber-optic endoscopes allow for a deflection of the tip, their image quality is inferior due to limited image resolution. To obtain high-definition images as well as a good overview of the surgical field, straight scopes with angled tips are employed and rotated along their axes and around a pivot point to change the field of view. However, this approach calls for a camera assistant who has to be extremely well coordinated with the surgeon to ensure a safe intervention.

Methods

In order to facilitate interventions without a camera assistant, we developed a new type of electronically controlled flexible endoscope that may be fixed to a mounting device. An advanced combination of joints, moved by motorized spindles, allows a movement of the tip and therefore a change of angle of view. This is achieved without rotating the horizon of the image, thus providing better orientation during surgery. An image sensor and an optical system containing miniaturized linear motors for moving the lenses are integrated into the endoscope tip.

Results

The novel endoscope allows for great freedom in electronically controlled angle of view. When the endoscope shaft is mechanically fixed, previously defined areas can be found automatically and repeatedly with high accuracy. The movement of optical lenses in the tip offers zoom and focus functionality.

Conclusion

Electronic control of tip and lens movement enables the surgeon to work without a camera assistant using almost any man-machine interface. Also, autofocus may be achieved by evaluating image contrast and automatically adjusting lens position accordingly. In sum, this new endoscope technology promises substantial benefits for intervention safety and the medical staff’s working conditions.