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Purpose:

Our main goal was to perform ophthalmic operations with fewer tremors and more precision, therefore not only improving many current clinical procedures but also getting the future possibility of new treatment options. This work investigates the design and development of a surgical assistance robot which overcomes the current limitations and moreover provides surgical abilities for treatment of diseases such as Retinal Vein Occlusion (RVO), the robot had to intuitively fit into the operation theater and guarantee the maximum patients safety.

Methods:

Based on 23G pars-plana vitrectomy equipment, a robotic additional interface tool was designed to dock to the patient's eye and stabilize the instrument during manipulation. The final precision of the device is ~5µm and the angular precision of the robot is 5.88×10^{-5} rad which should be largely sufficient for all ophthalmic applications. The working volume of the robot resembles a box of $50\times50\times50$ mm with 360 degree of free tool rotation while the maximum linear velocity of the tool motion is $40mm/s$. The robot was designed with an adjustable remote center of motion point that allows it to be configured to manipulate the tool pivoting around the insertion point.

Results:

A compact 6DOF robot smaller than human hand and with the weight of 312gr was developed. This robot is mounted on patient's head during the operation and holds conventional surgical tools. The surgeon controls the robot using a master console which is located close to the patient's head. Beside maximum safety consideration this approach enables scaling of surgeon's motion. The compatibility of the robot in the ophthalmic operation environment was evaluated. This evaluation approved that the robot won't conflict other surgical devices such as microscope and assured that the surgical area remains available for the surgeon. The entire setup was already tested successfully in the laboratory in cadaver eyes.