

# Roller Design Document

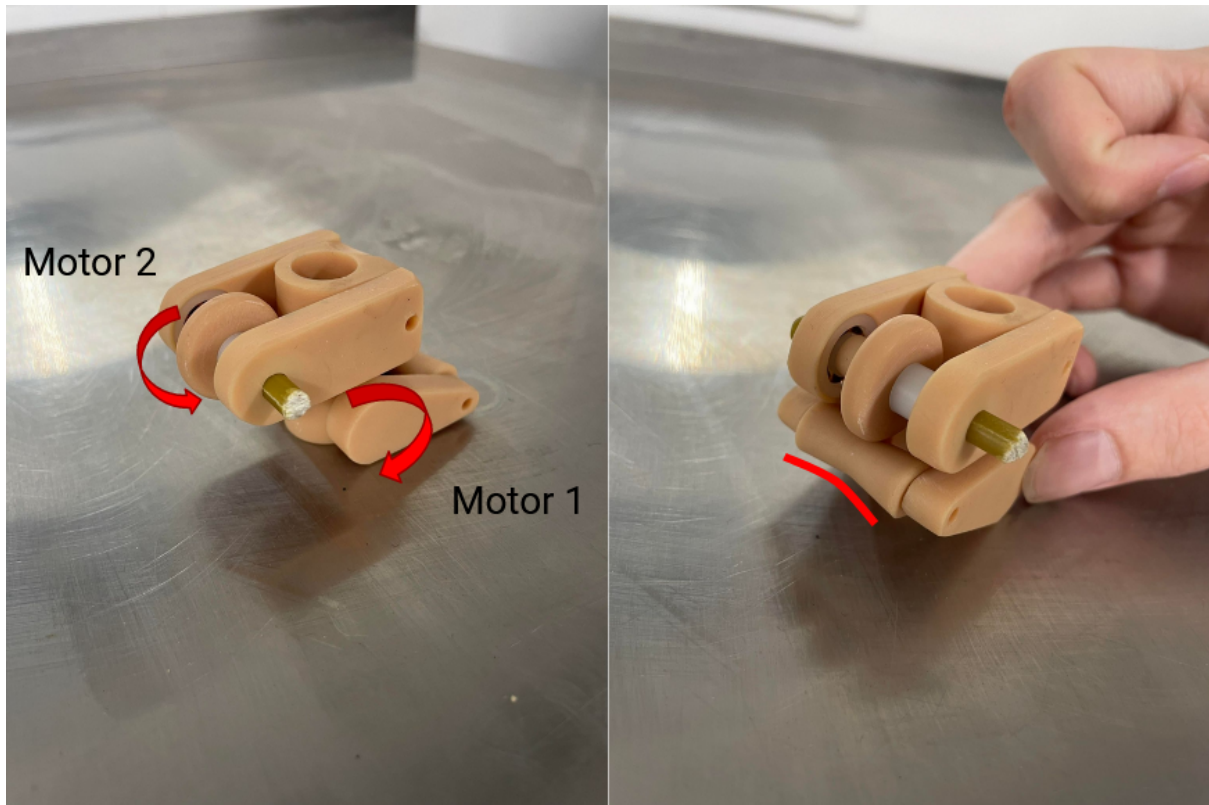


Figure 1a (Left) Roller suture management prototype in the open configuration. 1b (right) Roller suture management prototype in the closed configuration.

The suture management device (SMD) slides over the end-effector of the Endo360. It is fixed just above the rotating wrist of the ENDO360 using 2 set screws. The SMD consists of 2 parts, one which is stationary and one which is moving. On top of that, it has 2 DOF shown in Figure 1. Note that the ENDO360 gripper points downwards in this figure. Motor 1 actuates the swinging arm and motor 2 is responsible for actuating the fixed rotor responsible for tightening the thread. Lastly, the power transmission happens through a cable system which allows the actual motors to be placed outside the human body. This reduces the diameter of the SMD that goes into the body.

The SMD works by swinging the arm from one side to the other. In doing so, it catches the loose hanging thread. The thread is now squeezed between the swinging arm and the actuated rotor. Note that the end of the swinging arm is not actuated but spins passively. While squeezing, the rotor starts spinning, tightening the suture. During this process, adequate friction is necessary meaning motor 1 will have to provide a certain torque. In

order to reduce this torque, which could deform both the thread and the SMD, both the passive spinner and the actuated rotor are covered with a high-friction rubber material. On top of that, the spinner and rotor have complementary shapes. This ensures the thread will always be tightened at the same lateral position along the rotor axis avoiding the thread getting stuck in the bearings or other spinning parts. The suture is tensioned adequately when motor 2 exceeds a certain current value. Following this, the arm swings back and the next stitch can be placed. The process repeats itself afterwards.