

Design of a Multifunctional Forceps for Use in Endoscopic Surgery

Andrew Rau

The Pennsylvania State University

Mary Frecker, Abraham Mathew, and Eric Pauli

Hershey Medical Center, The Pennsylvania State University

This paper presents a 3.0 mm diameter endoscopic forceps design for use in minimally invasive surgical procedures, which re-

quire significant grasping and spreading forces. Models of the proposed design predict considerable improvements in the opening range (140%) and force application (87%) for both grasping and spreading when compared with currently used endoscopic forceps. Several of the tool's design characteristics promote fail-safe malfunctions, including locking before catastrophic failure and the decreased likelihood in detached parts. Initial benchtop testing showed good agreement between prototype performance and model prediction. Frictional losses experienced during testing were found to depend on load orientation. A surgical prototype is currently being manufactured for ex vivo testing.

Cuffed Inner Cannula and Flexible Outer Cannula Tracheostomy Device: Ensuring a Stable Airway

Sanjay Athavale

Vanderbilt University Medical Center

Todd Dutton

*Department of Mechanical Engineering,
Vanderbilt University*

Robert J. Webster III

Vanderbilt University

Tracheostomy tubes (TTs) are used to provide a direct airway to a patient's trachea when natural respiration is no longer possible. A TT generally includes an elongate outer cannula as well as a smaller inner cannula formed so as to have a gradual curve to facilitate insertion into a patient's trachea. In order seal the airway around the tube, a conventional TT generally has an inflatable cuff attached to the perimeter of the outer cannula. When inflated, the cuff seals the airway around the cannula, thereby, requiring air to pass through only the cannula. In order to retain the distal end of the device in its operative position, the TT generally includes a neck plate or other fixation device, which is attached to the proximal end of the outer cannula. There are many potential drawbacks with current TTs, which can range in effect from minor irritation

to death. Varying sizes of individuals and differences in anatomical dimensions leads to discomfort from TTs that fit poorly. The rigid ends of the outer cannula often put pressure on the walls of the trachea, which can cause irritation and ulceration. Cuffed inner cannulas are required to be replaced with uncuffed inner cannulas as soon as possible, after placement, to avoid pressure necrosis and allow for vocalization. The process of switching TTs may also be very hazardous, especially when treating obese patients. The stoma can easily be lost among layers of fat and skin, as well as the trachea, which all move independently of one another. Losing the stoma may cause suffocation and possibly death. Our novel device is a TT for use with a neck plate having an aperture. The TT comprises an elongate outer cannula having a lumen and configured to extend through the aperture. An elongate inner cannula having a lumen and an inflatable cuff and configured to extend through the lumen of the outer cannula such that the cuff extends beyond a distal end of the outer cannula and an interlocking mechanism configured to releasably secure a proximal end of the inner cannula to a proximal end of the outer cannula. This superior TT has the potential for wide application with a special emphasis on application within the obese population. Such patients experience the most difficulty with current devices. There is no single device in the market today that packages the numerous features of this particular design.