Single-Stage Percutaneous Tracheostomy Device

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A percutaneous tracheostomy is a bedside-procedure that circumvents airway obstructions and offers ventilatory support to patients via a deliberate opening in the trachea. After dilating an initial incision, a tracheostomy tube is placed in the opening to maintain airflow. Current devices used for dilation require multiple rounds of instrumentation leading to increased risk of bleeding, infection, and tracheal damage during the procedure. Further limitations in the device structure can result in a lack of passive airflow, leading to hypoxia. Thus, we propose a single-stage percutaneous tracheostomy device that further reduces this range of complications, decreases the rounds of instrumentation needed to place the tube, and improves upon tactile feedback during the procedure. A passive airflow component to address the risk of hypoxia during a tracheostomy will also be included. A prototype of our device, including a novel dilation mechanism was created using 3D printing technologies, exhibiting enhanced structural detail and cost-efficiency when compared to other methods. Considerations of the biocompatibility as well as structural integrity of our device has been investigated and refined in this initial design. We have demonstrated efficacy of our model by testing on 3D-printed models of the trachea. We aim to conduct further testing on animal models and human cadavers to assess overall procedure time, ventilation, and incidence of misplacement. Upon successful execution, such a design will not only minimize patient complications, but also procedure costs and operating burden on the physicians, making the procedure more accessible and improving patient outcomes.