

# Senior Project – Mechanical Engineering – 2007

## Inventing a Medical Device to Aid in an Emergency Cricothyroidotomy Procedure

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### Objective and Background

When a patient has any sort of severe injury, there is a requirement to maintain a reliable and stable airway to the lungs. The normal procedure used to create a stable airway would be orotracheal or nasotracheal intubation. Complications from inserting a tracheal tube through the mouth or nose can arise and cause subglottic stenosis, or swelling of the throat region. If these intubation methods fail, there is a need to create a surgical airway, a tracheotomy or cricothyroidotomy. In emergency cases, a tracheotomy is not preferred due to the complexity and risk associated to the procedure. A cricothyroidotomy involves penetrating or incising the cricothyroid membrane, located between the cricoid and thyroid cartilages, and inserting a tracheal tube. Through extensive research and development, a new concept that streamlines current operating procedure, reduces the amount of risk associated to the procedure, and supplies a more stable airway to the patient, has been invented.

### Design Requirements

#### General Design Requirements

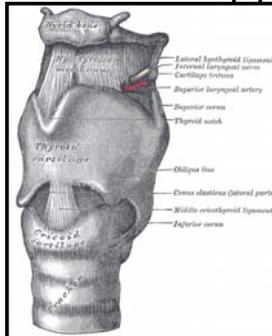
Applicable to the majority of the population  
Easy to learn and use  
Short amount of time to complete procedure

#### Device Design Requirements

Made of surgical grade plastic  
Uses a small Endotracheal Tube  
Markings along tracheal tube for positioning  
Device can fit between anatomy

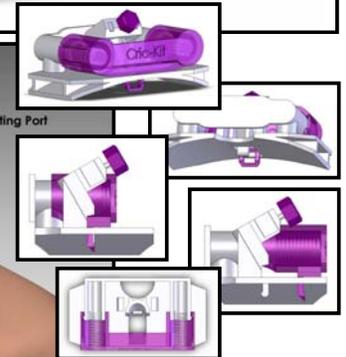
#### Ideal Marketing Selling Points

Much faster to install then current products  
Requires no fasteners around neck  
Smaller incision in patient and reliable



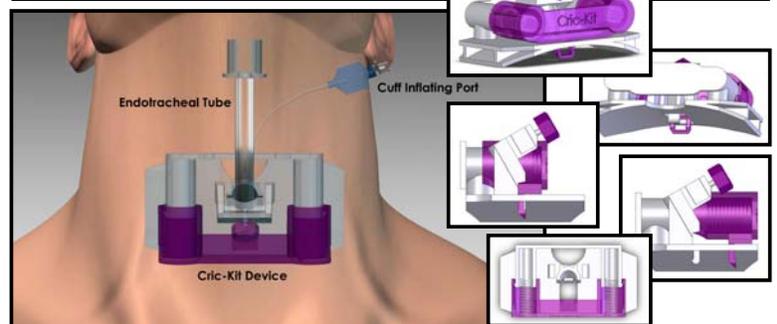
### The Cric-Kit™

The Cric-Kit™ concept was certainly not designed and developed over night. This concept was thought up from many failed attempts that seemed promising in concept but failed when prototyped. The largest constraint to inventing a concept was that many ideas have already been patented or introduced in foreign markets. I have tried to develop an idea that is entirely innovative yet simple. The physics behind the Cric-Kit™ are simple and involve two common springs. The geometry of the device allows for easy insertion and positioning around the neck. The material selected, PEEK, will provide excellent sterility and thermal properties without compromising biocompatibility.



### The Procedure

In order to locate the cricothyroid membrane, the neck skin must be cut away. This is done by making a vertical incision beneath the thyroid gland. Once the skin is deflected, a lateral incision can be made through the cricothyroid ligament. This incision needs to be 1 cm in length in order to fit the device. The device is then put into the compressed position with the right hand and then inserted into the incision made with the scalpel in the previous step. Once the device is completely flush with the neck, the device can be released. The endotracheal tube can then be inserted into the device, making sure to follow the sloped guide. Once the endotracheal tube reaches the back wall of the trachea, it will deflect and continue its way down towards the lungs. Secure the endotracheal tube by tightening the vice built into the device. Take a standard 12 cc syringe and use it too inflate the cuff on the tip of the endotracheal tube. This way, no air that is being sent down the endotracheal tube will escape back up the airway. Once the cuff is secured, syringe disconnected, the patient is ready to be resuscitated manually via an Ambu bag. Secure a strap or tape the Cric-Kit™ device in place so the device does not dislodge during travel or relocation.



### Conclusions and Recommendations

By using a spring loaded system, an incision made with a scalpel can be opened allowing room for a standard endotracheal tube to be inserted. This device has been designed in SolidWorks™ and prototyped using an ABS rapid prototyping machine. The device will be constructed out of PEEK plastic that is biocompatible and able to be sterilized for medical application. Currently a patent is being assigned to protect the intellectual property of the design. I have founded a business, Second Breath inc., with two other Union College students, Shane Hubbell U'08 and Jay Shah U'08. The purpose of this business is to further the development of this product and to bring this product to market. In order to finalize the concept, a few modifications will need to be made in order to make the device manufacturability sound. A mold will have to be designed and constructed and an injection molding machine acquired.

### Acknowledgments

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