



A Lateral Canthotomy and Cantholysis (LCC) Part-Task Training System

Project Overview

- Funded via a Small Business Innovative Research (SBIR) award through the Defense Health Agency to design and develop a hands-on, low-cost, and realistic simulation-based training system to perform the Lateral Canthotomy and Cantholysis (LCC) procedure.
- 13 years of conflict in the Middle East caused a considerable number of treatable eye injuries that resulted in permanent visual impairment.
- Ocular traumas account for 5-10% of all combat injuries attributed to improvised explosive devices.

Owens, B. D., Kragh, J. F., Wenke, J. C., Macatis, J., Wade, C. E., Holcomb, J. B. (2008). Combat wounds in operation Iraqi freedom and operation enduring freedom. The Journal of TRAUMA Injury, Infection, and Critical Care, 64(2), 295-299.

Oculofacial Trauma

- Blunt trauma to the face (Figure 1) can cause a retrobulbar hemorrhage (Figure 2) which can result in a compartment syndrome of the orbit.
- The build up of blood in the orbit can place pressure on the optic nerve thereby denying blood flow to both the nerve and the retina (ischemia).
- Permanent damage to the optic nerve and retina can occur after as little as 90 minutes of ischemia; permanent damage results in irreversible vision loss.



Figure 1. A retrobulbar hemorrhage patient.



Figure 2. A CAT scan illustrating fluid buildup within the orbital cavity and the resulting proptotic eye.

Figure 1. adapted from U.S. Center for Prehospital Medicine/Tactical Combat Medical Care (2018). Ocular Trauma (lecture slides).

Figure 2. adapted from Rubin, P. A. D., & Tayan, R. (1999). 4 Year old boy with proptosis of the left eye and an afferent pupillary defect. Digital Journal of Ophthalmology, 5(9), 1-5.

Lateral Canthotomy and Cantholysis (LCC)

- The LCC procedure (Figure 3) can alleviate intraocular pressure and restore blood flow to the optic nerve, and retina, thus saving the Soldier's eyesight.
- The LCC is a simple, learnable, eyesight saving skill.

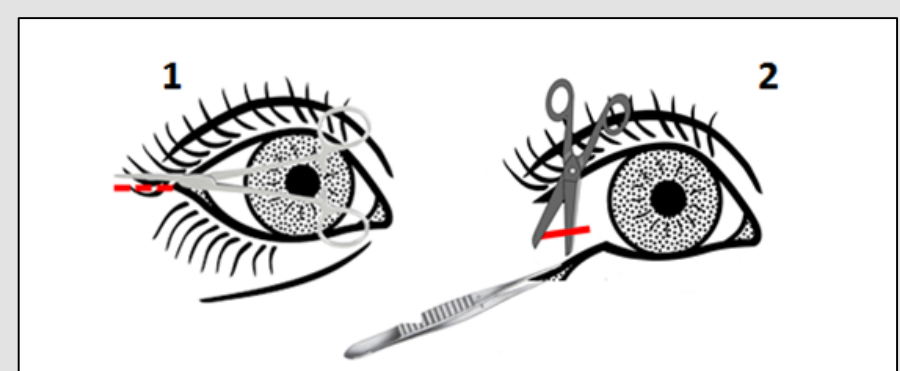


Figure 3. Schematic of the lateral and vertical transecting cuts that are performed during the LCC procedure.

Image adapted from Morgenstern, J. (2015). Procedure: Lateral canthotomy. Retrieved from https://first10em.com/lateral-canthotomy

Simulation Objectives

- Develop a part-task trainer that allows students to rehearse the LCC procedure until they are comfortable with, and proficiently able to perform, the procedure.
- The part-task trainer aims to simulate: the pressure of a proptotic eye, relevant anatomical landmarks of the eye and orbit, tendon strumming, and tendon cutting.
- The simulated eyes react to medical interventions in real-time to provide diagnostic tactile feedback to the student (Figure 5, Figure 6, and Figure 7).

Developing a Part-Task Training System

- An iterative, user centric, design and development process was utilized to develop the LCC training system (Figure 4).
- This development method enabled the translation of medical requirements and technical objectives into quantitative design and production metrics.
- User evaluations and rapid prototyping were essential to the success of the system engineering process.

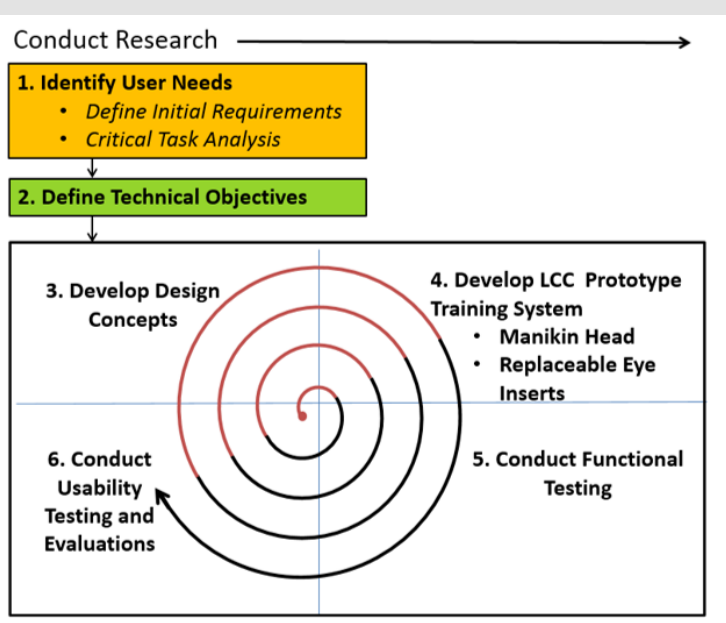


Figure 4. The iterative development process that was followed during the development of the LCC Training System.



Figure 5. The LCC Training System being used to rehearse the LCC procedure.



Figure 6. A case of eye inserts that allow students to quickly rest the trainer.

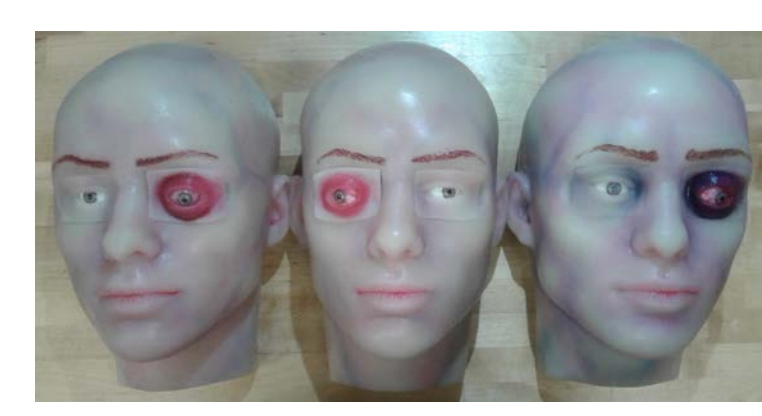


Figure 7. Three LCC Training Systems.

Challenges

- Defining standards for system design and manufacturing methods to produce a low cost per use training system

Future Work

- Extend capabilities to support training additional ocular traumas encountered at point of injury and during Prolonged Field Care, as well as integration with the Advanced Modular Manikin (AMM) platform
- Produce a commercially available LCC training system in 2021



Figure 8. Hands-on Review at Madigan Army Medical Center.

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