

# The Ring Cutter Design for Emergency Department

## Project Design Specifications

**Team:** Camille Duan; pduan4@wisc.edu; Team leader  
Maggie Zhou; zzhou269@wisc.edu; BPAG  
James Tang; btang8@wisc.edu; Communicator  
Kavya Vasani; BWIG/BSAC

**Date:** September 20th, 2019

**Function:** Emergency physicians commonly face the challenge of removing a metal ring from an injured digit when the edema prevents it from being moved. [1] Under such circumstances, a ring cutting tool must be used to remove the ring from the finger. The most commonly used ring cutters are made of steel and are either manually operated or battery powered. These devices work well on rings made of gold or silver but physicians often have a difficult time removing modern rings made of hard metals such as titanium and tungsten carbide. Our mission is to design a device that could potentially remove the ring on the injured digits but keep it intact or improve and automate the cutting procedure.

### Client Requirements:

- The device should have a complete protection system for both the physicians and patients and can be easily utilized by the physicians during emergent situations..
- All ages of patients should be included for this design.
- The device must be different from the current existing ones or be the refined version. It should not exceed the size of the currently existing devices.
- Minimize manipulation, patients' uncomfotability and jewelry damaged.

### Design Requirements:

1. Performance Requirements: The device should be able to be utilized by the physicians in the ER to remove rings (if possible keep the ring intact) that are made by hard metals, such as titanium and tungsten carbide. The device should not hurt the patient's already injured digits during the removal process.
2. Safety: The device must meet the general safety standard for medical devices and try to minimize discomfort for patients. The materials used for the device must be sterile, and mechanically as well as chemically stable, such that additional harm to the patient is avoided.

3. Accuracy and Reliability: The device must be able to estimate the thickness of the ring and the gap between the ring and the finger. The cutting blade in the device should be able to meet the same standard after each use and be able to cut through hard metals such as titanium and tungsten carbide.
4. Life in Service: The desired ring cutting device should be able to last for years and the cutting blade should not be easily burned off..
5. Shelf-Life: 5-10 years
6. Operating Environment: The device should be operated under a general physician in the emergency department after simple training and it should be kept under dry environment to avoid rust formation.
7. Ergonomics: Our device will aim to keep the force required by the physician to the minimum. It's also crucial that the device is lightweight and easily secured to ensure stability and avoid injury during use.
8. Size: The relative size of the device should be small in order to be operated by a single physician. (ex. < 17 x 20 in).
9. Weight: The relative weight of the device should be light enough so that it does not require more than one person to operate ( device weight: < 20 lbs).
10. Materials: The body of the device should be made from plastic to minimize excess weight usage and cost. 3D printing can be used to make plastic components of the device since it is relatively cheap. The cutting blade will be made from a metal stronger than titanium. All materials of the device should be sterilized before use.
11. Aesthetics
  - a. Although the device is a prototype, it should be in shape to allow the operator to use comfortably during the ring cutting process

**Production Characteristics:**

1. Quantity: Our client only request for one piece of the device, however, consider the future use of this device and potential mass production after successful testing, the quantity of the products might be increased.

2. Target Product Cost: Our targeted budget will be limited to 500 dollars, which is also subject to change depends on the metal choice of the device. The current competing design costs around 200-500 dollars.

### **Standards and Consumer Characteristics:**

1. Standards and Specifications: The device specifications will have to comply with the FDA's Federal Register, as well as the Code of Federal Regulations. The FDA also requires a number of approvals and clearances to ensure that a device is safe and effective before used on patients in hospitals. These include a 510(k) Premarketing Submission and Premarket Approval (PMA).
2. Customer: The product will be operated by trained mechanical professionals. The product should be usable on a wide range of ring users who have difficulty removing the rings.
3. Patient or User-related Concerns: The device should have safety guard to avoid cutting patient's body. There is little room for error during the cutting procedure which makes it even more important that our design is safe and effective so it does not discomfort the patients or even bring any pain to the patients, and make the procedure take longer than it needs to be.
4. Competition
  - a. Power Ring Cutting Kit for Titanium [1]
    - i. This ring cutting kit for titanium contains a diamond coated disc that will cut through the titanium in less than five minutes without heat or discomfort. The process involves slides the lower jaw of the cutter between the ring and the finger and the circular saw is turned by the cordless power driver to cut through the ring.
  - b. The Gem Ring Cutter Emergency Ring Removal System [2]
    - i. The Gem ring cutter relies on its unique cutting discs to abrade successive layers of material until a cut is made. It requires only light pressure for best results, and the handpiece is passed back and forth across the constriction allowing the slowly-turning abrasive disc to make cuts through soft and hard metals alike. The Gem ring cutter is available in both AC corded and battery-powered cordless models. A carbide disc is included for softer metals, and the diamond disc is included for harder metals like Titanium, Chromium Cobalt, and Tungsten Carbide ceramics. The Gem ring cutter also includes one finger guard.
  - c. Ring Craker [2]
    - i. It is used for very hard and resistant materials, like tungsten carbide ceramics. A ring cracker typically makes use of a sharp, hardened point

that is slowly tightened against the ring until enough pressure is applied to safely crack the material.

**References:**

[1]C. L. Gardiner, K. Handyside, J. Mazzillo, M. J. Hill, E. F. Reichman, Y. Chathampally, and B. R. King, “A comparison of two techniques for tungsten carbide ring removal,” *The American Journal of Emergency Medicine*, vol. 31, no. 10, pp. 1516–1519, 2013.[Accessed: 10-Sep-2019].

[2]“Can Titanium or Tungsten Carbide ring be cut off?,” Titanium Ring Cut Off | Tungsten Rings Emergency Removal. [Online]. Available:

<https://www.titaniumstyle.com/titanium-tungsten-ring-cut-off.htm>. [Accessed: 08-Sep-2019].

[3]“www.atlasprosales.com,” Cast Saw, Cast Cutter, Cast Saw Blades, Cast Saw Repairs, Cast Saw Service, Cast Saw Sales. [Online]. Available:

[https://www.atlasprosales.com/Ring\\_Cutter\\_s/88.htm](https://www.atlasprosales.com/Ring_Cutter_s/88.htm). [Accessed: 09-Sep-2019].