# Thyroid Retractor

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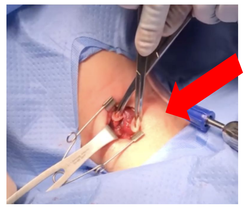
## Abstract

In a thyroid retraction, surgeons often use one or two Rochester-Pean forceps with a piece of gauze, collectively referred to as a "peanut." However, the single point of contact may cause folding or slippage on the thyroid. The adapted Weitlaner design was chosen and iterated to the required specifications through cadaveric testing and an ergonomic evaluation.. A simulated surgery and ergonomic testing was conducted. Future work includes manufacturing the retractor in stainless steel and approaching the Wisconsin Alumni Research Foundation to submit a patent application.

## Problem - Motivation

- Two Peanuts are used in order to retract larger thyroid glands. This results in both of a surgeon's hands being lost.
- A thyroid retractor with a single handle and two prongs to retract the thyroid from multiple points of contact is necessary



Anterior view of a patient's neck. Notice two peanuts are being used

**Figure 1:** An image from one of Dr. Doubleday's surgeries.

## Background

- The current thyroid retractor in use allows for one point of contact, which does not allow for complete retraction of larger, or irregularly shaped thyroids (see Figure 1)
- Since thyroidectomies are performed over 130,000 times per year [1], the effect of this retractor may go beyond
- Thyroid Dimensions
  - 4-4.8 x 1 to 1.8 x 0.8-1.6 cm [3]
  - 10-20 grams [3]
- Reasons for operation:
  - Thyroid maintains hormone homeostasis
  - Parathyroids regulate calcium
- Single point of contact difficulties: folding over and lack of traction


**Figure 2:** Image of Rochester Pean Forceps [2]

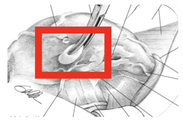


**Figure 3:** Diagram of a medial thyroid retraction using a peanut [4]

## Design Specifications

- Surgical instrument specifications:
  - Surgical grade stainless steel
  - Length: ~ 20 cm [5]
  - Weight: ~ 50 g [6]
- Separated into two prongs
- Adjustable distance between prongs
- Safe for use on patient
- No atypical protrusions

## Ergonomic and Cadaveric Testing

**Ergonomics Testing**

- Questions addressed:
  - Surgeon comfort
  - Ratcheting mechanism function
  - Finger hole comfort
  - Distal legs length
  - Effectiveness of treads
  - Ease of use
- Responses came from surgeons of Waukesha Surgical Specialists and UW Health clinicians

**Cadaveric Testing**

- Performed a simulated medial retraction of the thyroid on a cadaver
- Results indicated legs of retractor should be longer in length.

**Figures 4:** Cadaveric testing at UW gross anatomy lab

## Tissue Analog and Computational Modelling

**Methods**

- Simulated surgery of a tissue analog with optical markers and accelerometer
- Video file analyzed in Kinovea software to determine maximum acceleration and force
- Calculated forces and clinical thyroid constants applied to build computational model [7]
- Model interactions of thyroid and device as two distributed loads

**Results**

- Large deformations observed, required to dislocate thyroid from resting anatomy
- Maximum von Mises stress below failure strength for soft tissues [8]
- Maximum engineering strain below rupture point for soft tissue [9]

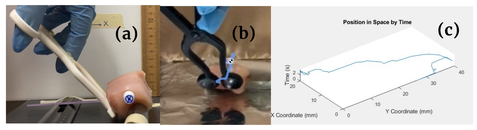



**Figure 5:** Simulated surgical displacement of one lobe of the thyroid gland, using a tissue analog(a). The video file is analyzed in motion capture software Kinovea (b) and exported to Matlab to determine maximum acceleration and forces

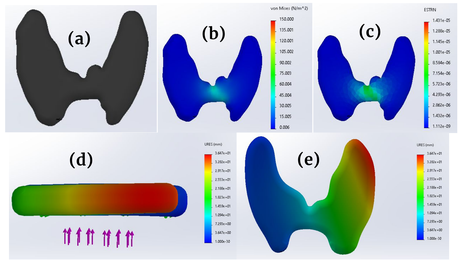



**Figure 6:** Computationally modeled interactions of the thyroid and tissue-contacting device. Thyroid model used in calculations (b). Von Mises stresses in N/m² (a). Engineering strain (c). Displacement perpendicular to the loading plane, shown as purple arrows (d). Displacement parallel to the loading plane (e).

## Final Design

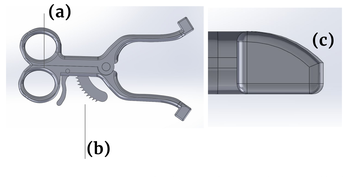



**Figure 7:** Treaded Weitlaner design (left) with tissue-contacting geometry (right)

**Treaded Weitlaner**

- All-in-one reusable design with no disposable components
- Ergonomic handle for single-handed use (a)
- Locking mechanism (b)
- Tissue contacting geometry for increased surface contact and minimal potential for damage (c)

## Discussion

- Qualitative and quantitative testing helped guide the creation of the final design
- Results from the survey and cadaver testing indicated the legs of the device should be lengthened and grooves should be added to the distal ends
- Results from the tissue analog and qualitative testing indicated the device is able to retract a thyroid from multiple points of contact
- The maximum von Mises stress and maximum engineering strain were below the failure strength and rupture point for soft tissues respectively
- Future testing will need to be performed with more clinicians, but the results show the device is able to successfully retract a thyroid during a mock thyroidectomy from two points of contact

## Future work

- Ergonomics survey should be sent to more clinicians
- Research into creating a prototype made out of AISI 420 steel
- An in depth market analysis of the medical device market should be performed
- Possibly modify ratcheting system of device to improve reliability

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