Improvements in Preoperative Hair Removal

Kimberly Maciolek [1](Team Leader), Marie Greuel[1] (Communicator), Cody Williams[1] (BWIG), Jay Kler[1] (BSAC)
Client: Dr. Gregory Hartig[2] · Advisor: Dr. Naomi Chesler[1]
[1]Department of Biomedical Engineering, University of Wisconsin-Madison, [2]Department of Surgery, University of Wisconsin School of Medicine and Public Health

1. Abstract

Hair is removed from a surgical site prior to surgery to reduce damage to the skin and make a cleaner surgical site. After the patient is shaved, the loose hair is collected with tape, which is inefficient. Our client, Dr. Gregory Hartig, a head and neck surgeon for UW Hospital, has requested a vacuum device that collects the cut hair. Ideally, the device would use the existing suction in the OR, have a relatively low cost, and be compatible with many types of hair.

A design that combined the suction device and surgical clippers currently was proposed. However, based on client request, a separate vacuum device was chosen. Four prototypes were created. A and B as well as C and D are structurally the same with different cross sectional area. A and C have a cross sectional area of 4.6 cm^2; B and D have a cross sectional area of 2.4 cm^2.

Each prototype was tested by recording the time of hair removal off of a constant area using synthetic hair. The prototypes were tested using 2 lengths of filters (12 cm and 10 cm). The average time to collect a known amount of hair for each prototype was recorded from 5 trials and statistically analyzed using 2-sample t-tests. Device C was the most time efficient device (vs. tape, $p = 5.886 \times 10^{-13}$ and vs. device D, $p = 0.0303$). Device C as well as the tape were tested on the removal of a hair on a volunteer's shaved legs. Device C was more efficient with a time of 84.9 seconds verses 122.6 seconds for the tape. Although this initial data is promising more testing is needed to determine safety and ergonomics.

2. Background/ Motivation

Client: Dr. Gregory Hartig, a head and neck surgeon for the University of Wisconsin Hospital

Motivation:

- Our client has requested a device that retrieves hair removed from surgical sites prior to surgery.
- Currently, loose hair is collected with tape; however, this method is inefficient, and hair is often found in the surgical field.

Anatomy of Hair:

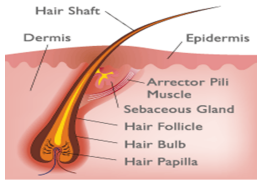

Figure 1: When shaved the hair shaft is cut. The epidermis should not be damaged[1].

3. Design Specifications

The device should:

- Be compatible with the -200 mmHg (gage) suction already available in operating room
- Remove hair more efficiently than current method (tape)
- Be handheld & easy to use
- Be applicable for different types of surgery and varying hair types
- Have a low cost
- Not be abrasive to skin or cause other harm to the patient

4. Designs

Trimmer Design

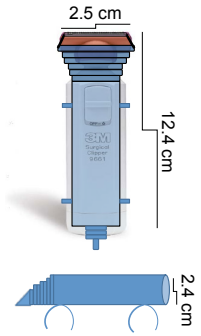

Figure 2: Sketch of design attached to trimmer (top)[3] and detached from trimmer (bottom).

- Disposable device snaps on easily
- Picks up hair as it is shaved
- Maintains pivot function
- Client desires separate device

Devices A, B

Figure 3: Devices A, B feature a rounded head.

Top view: Vent holes to prevent suction seal

Bottom view: Padding to prevent skin abrasion

Devices C, D

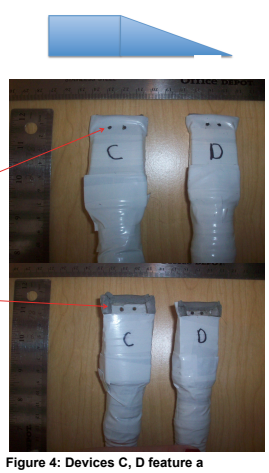

Figure 4: Devices C, D feature a rectangular head.

Cross sectional area A = 4.6 cm^2 = Cross sectional area C
Cross sectional area B = 2.4 cm^2 = Cross sectional area D

- Cone shaped filters made from nylons, 2 different filter sizes (10 cm, 12 cm)
- Handle maintains shape when bent, can be adjusted for each user for better ergonomics

5. Testing

Initial Testing

- Hair was removed from a 10 cm x 10 cm fabric square (0.84 ± 0.04 g) and spread over a 34 cm x 26 cm board
- Tape was used to remove the hair as to simulate current practices in the OR – 10 trials, timed
- Our four prototypes were tested using the same method; suction at 200 mmHg – 5 trials with 10 cm filter, 5 trials with 12 cm filter
- Device & tape times compared with 2-sample t-test

Figure 5: Photo of initial testing in progress.

Human Subject Test

- A volunteer's top half of legs was shaved from ankle to bottom of knee
- For one leg, hair was removed with tape, the other with our best preforming device
- Time and amount of hair collected by each method was recorded

Figure 6: Photo of human subject test in progress.

6. Results

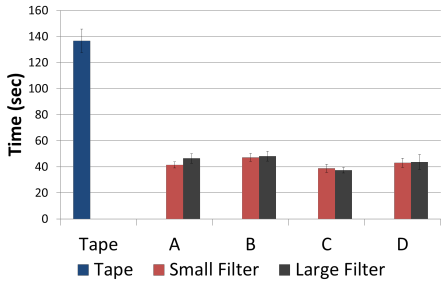

Figure 7: Data from the initial testing was graphed. Error bars represent standard deviation.

- No statistical difference in filter size ($p >> 0.05$)
- Device C significantly faster than devices A, B, D or tape ($p < 0.05$)
- Device C functioned well in human subject test – no damage to skin, did not clog, collected more hair with higher efficiency than tape

7. Final Design

Figure 8: Device C is the final design because it was the most efficient device in both types of time tests.

8. Future Works

- Make final design with 3D printer
- Test different materials
- Determine safety by testing device on carbon paper
- Research and design a way to make device more ergonomic
- Continue testing in OR setting on human subjects

9. Acknowledgements

Special thanks to: Dr. Gregory Hartig (Client) & Dr. Naomi Chesler (Advisor)

10.References

[1] Lam, S. (2008). Hair Anatomy Defined. In *Lam Institute for Hair Restoration*. Retrieved October 22, 2011, from http://www.hairtx.com/hair-growth/hair-anatomy/
[2] Dr. Gregory Hartig, personal communication, September 9, 2011.
[3] Photo retrieved December 7, 2011 from http://www.mohawkmedicalmall.com/Merchant2/ROD.php?Product_Code=3M_9661&name=3M_Surgical_Clipper_with_Pivoting_Head