



WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

Medical Art Prosthetics: Prosthetic Ear Attachment Anchor

Cristian Naxi (Team Leader), Joey Campagna (Communicator), Kinzie Kujawa (BSAC),
Anna Samuelsohn (BPAG), Mitchell Glodowski (BWIG)

Client: Mr. Greg Gion

Advisors: Dr. Naomi Chesler, Ms. Ashley Mulchrone

Biomedical Engineering Design
University of Wisconsin - Madison
October 6, 2017



Overview

- Problem Statement
- Background
- PDS Summary
- Designs
- Design Matrix
- Preliminary Design
- Future Work

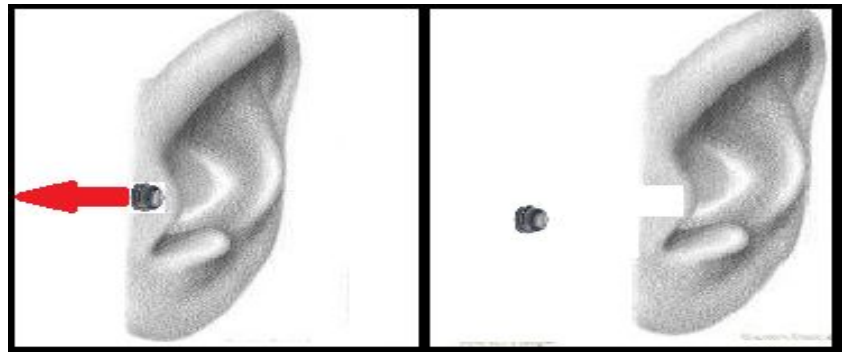


Mr. Greg Gion with a prosthetic ear¹



Problem Statement

- Silicone ear prostheses are for individuals
 - Born with microtia²
 - Who suffered loss of an ear due to cancer²
 - Who have sustained amputation of the ear²
- Current methods for molding magnets into silicone prostheses are unreliable
- Medical Art Prosthetics is seeking to increase the lifespan of their ear prostheses
- Make a customizable attachment



Demonstration of how magnet is dislodged from ear³



Background: Problem

- Microtia affects about 1 in 6,000 newborns⁴
- Medical Art Prosthetics in Madison delivers 20 prosthetic ears per year
- Inconsistent lifespan on ear prosthetics
- Unreliable chemical bonding of magnet to silicone
- Daily wear can dislodge magnet from silicone
- Magnets cannot be reattached to silicone



Grade 1 Microtia⁵



Grade 2 Microtia⁵



Grade 3 Microtia⁵

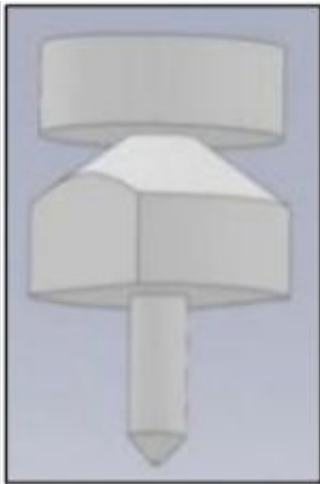
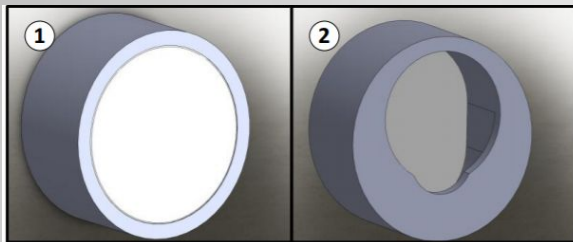


Anotia⁵



Background: Prior Work

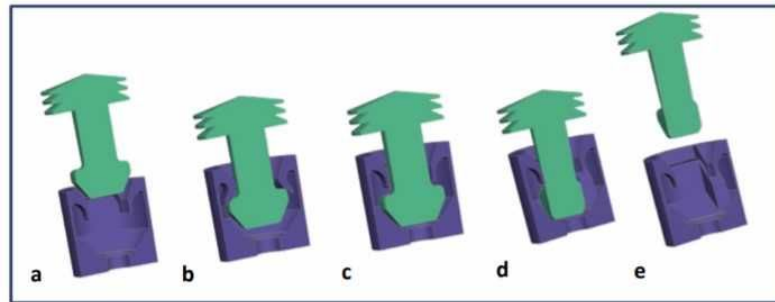
- Previous BME design projects
 - Different methods of attachment



Conical cap design with magnet⁶



Spring and Sheath (No Magnet)⁶



Prong and Flap⁶



Product Design Specifications

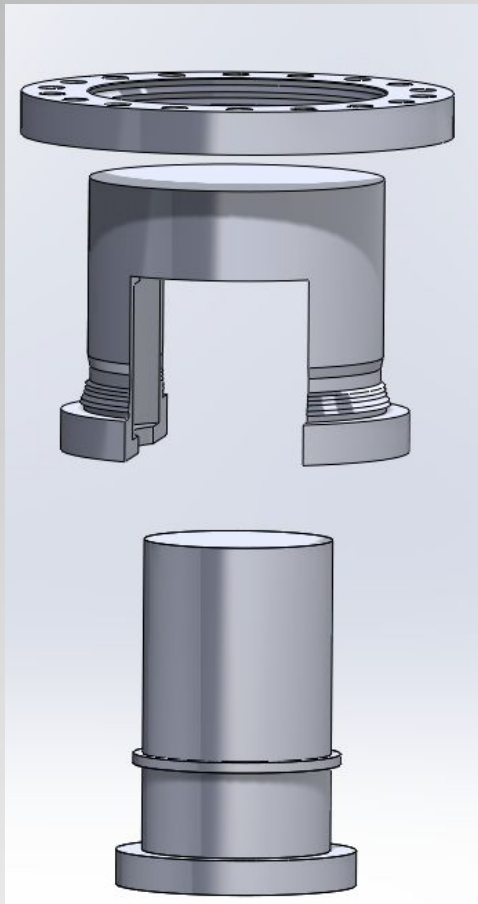
- Secure magnet to silicone ear
- Adjustable to fit different sized magnets
- 2 year lifespan minimum
- Discret inside silicone
- Withstand 200°F
- Budget: \$500
- Competition: Factor II, Inc.
 - Unknown performance
 - Too large for smaller prostheses



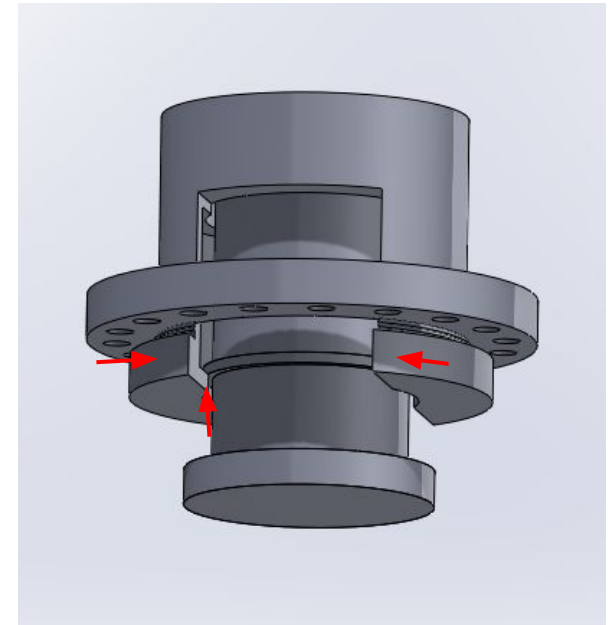
Magnet with retentive features from Factor II, Inc.⁷



Designs - Design 1: Cap and Ring



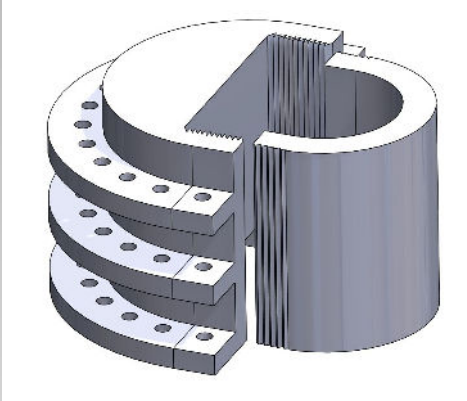
Solidworks assembly of cap and ring design with magnet underneath



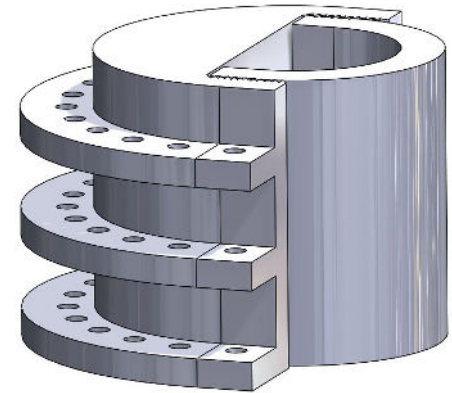
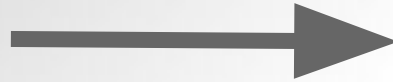
The ring slides over the cap, pinching the ring in place



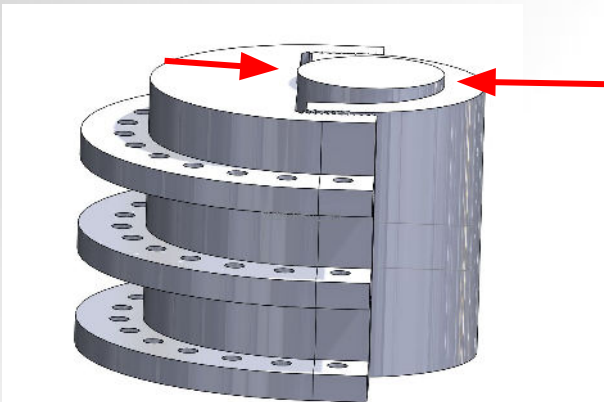
Designs - Design 2: The Buckle



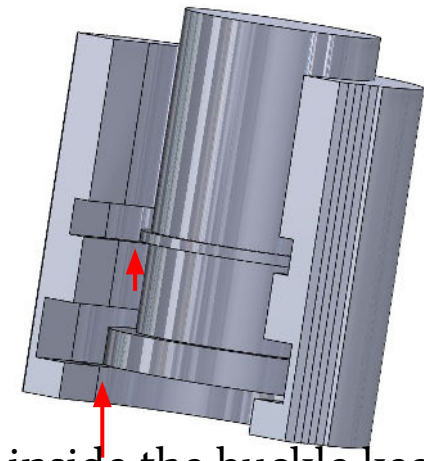
Assembly of the two separate pieces



The buckle slides together, clicking into place



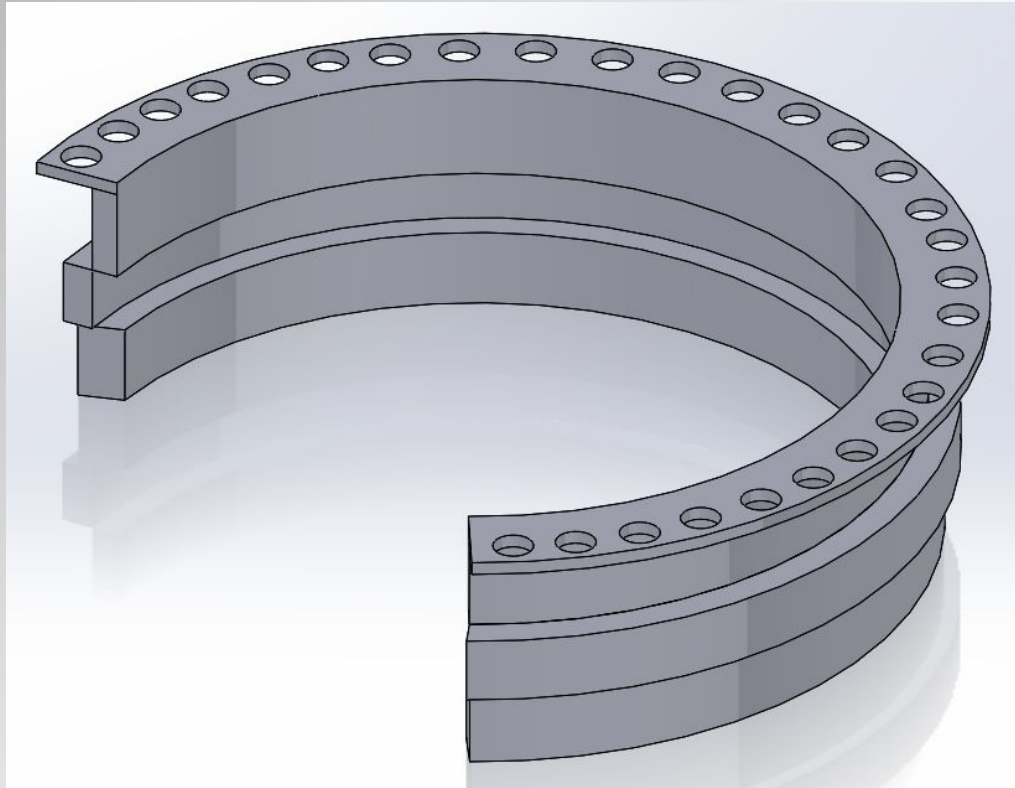
This pinching helps hold the magnet in place inside the buckle



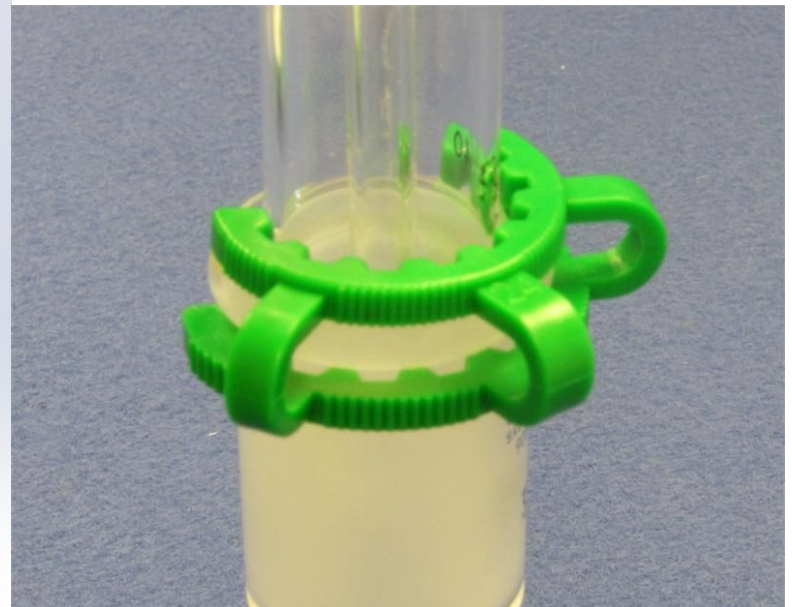
Grooves inside the buckle keep the magnet from sliding out



Designs - Design 3: C-Clip



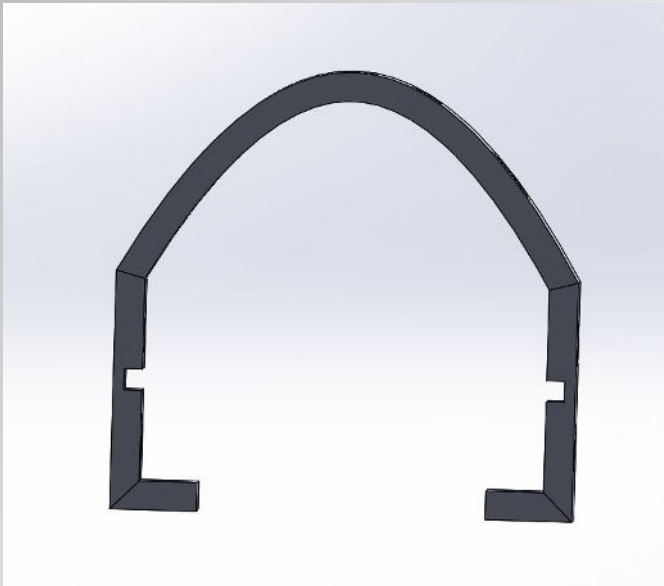
C-Clip Design



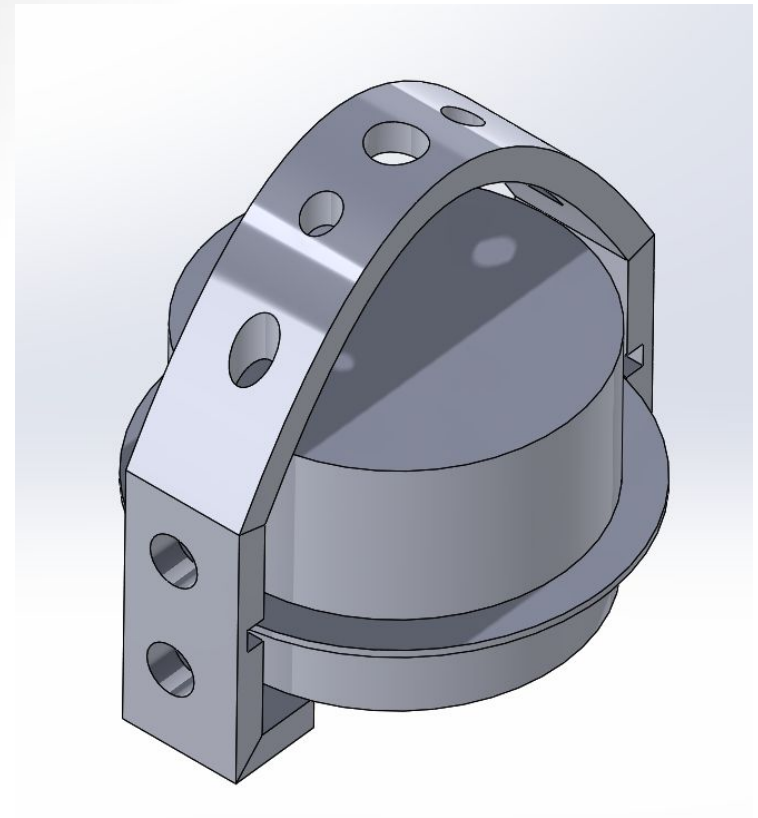
Keck Clip in use on
distillation set-up⁸



Designs - Design 4: Snap In



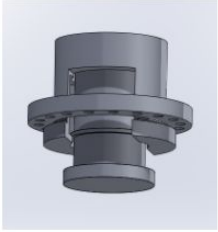
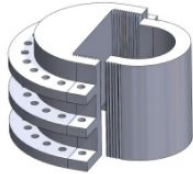
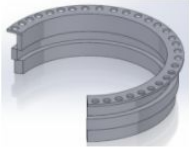
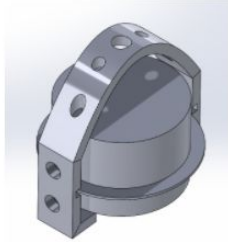
Snap In design side view



Snap In design isometric view



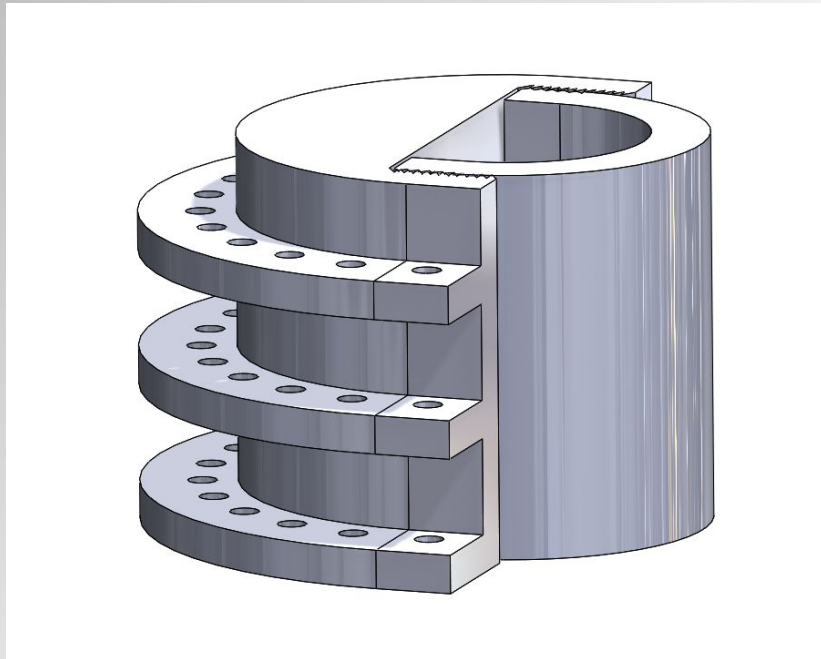
Design Matrix

Criteria (weight)	Design 1- Cap and Ring		Design 2- The Buckle		Design 3- C-Clip		Design 4- Snap-In	
								
Attachment to Magnet/Silicone (30)	3/5	18	5/5	30	2/5	12	3/5	18
Durability (25)	4/5	20	4/5	20	5/5	25	3/5	15
Versatility (15)	4/5	12	4/5	12	3/5	9	1/5	3
Ergonomics (10)	4/5	12	4/5	8	5/5	10	4/5	8
Ease of Fabrication (10)	4/5	8	4/5	8	5/5	10	4/5	8
Aesthetic (5)	2/5	2	4/5	4	4/5	4	5/5	5
Cost (5)	4/5	4	4/5	4	5/5	5	5/5	5
Total (100)	72		80		75		62	

*Scores are out of 5. Displayed as: score | weighted score



Preliminary Design



Buckle design in closed position



Mini Magnet⁷



Midi Magnet⁷



Maxi Magnet⁷



Auricular Magnet⁷



Future Work

- Design:
 - Take precise measurements of magnets
 - Material/Color selection
 - 3D print prototype
- Testing:
 - Computational modeling of stresses
 - Mechanical testing

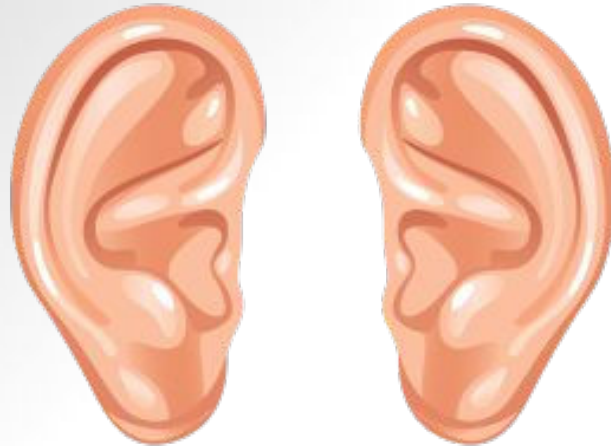


Acknowledgments

- Dr. Naomi Chesler - BME Advisor
- Ashley Mulchrone - BME Advisor
- Mr. Greg Gion - Client



Questions?





References

- 1) Greg Gion, C. (2017). *Home - Medical Art Prosthetics*. [online] Medical Art Prosthetics. Available at: http://www.medicalartprosthetics.com/?gclid=CMXw8qjp2tYCFQW5wAod-XYG_A [Accessed 5 Oct. 2017].
- 2) L. Lei, L. Zhenzhong, L. Lin and P. Bo, "Uncovering the pathogenesis of microtia using bioinformatics approach", *International Journal of Pediatric Otorhinolaryngology*, vol. 99, pp. 30-35, 2017.D. Nguyen,
- 3) "How to draw an ear – 5 easy steps | RapidFireArt", Rapidfireart.com, 2015. [Online]. Available: <http://rapidfireart.com/2015/04/21/how-to-draw-an-ear/>. [Accessed: 05- Oct- 2017].
- 4) Luquetti DV, Leoncini E, Mastroiacovo P. Microtia-Anotia: A Global Review of Prevalence Rates. *Birth Defects Research Part A, Clinical and Molecular Teratology*. 2011;91(9):813-822. doi:10.1002/bdra.20836.
- 5) "What is Microtia - Microtia-Congenital Ear Deformity Institute", *Microtia Congenital Ear Deformity Institute*, 2017. [Online]. Available: <http://microtia.net/overview/>. [Accessed: 04- Oct- 2017].
- 6) "Attachment of prosthetic ear to cranial implant abutments", Bmedesign.engr.wisc.edu 2011. {Online} Available: http://bmedesign.engr.wisc.edu/projects/s11/ear_attachment/ . {Accessed: 05-Oct-2017}
- 7) M. Magnet, "MML0-S, Magnet Lip, (Mini Micro) "S" Range, Mini Micro Lip Magnet", *Factor2.com*, 2017. [Online]. Available: http://www.factor2.com/MML0_S_Mini_Micro_Lip_Magnet_p/mml0-s.htm. [Accessed: 06- Oct- 2017].
- 8) *Keck Clips*. Laboratory Sales & Service LLC. {Online}. Available: <http://www.laboratorysales.net/keck-clips.aspx> [Accessed: 06-Oct-2017].