Attachment of prosthetic ear to cranial implant abutments

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Outline

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- Background Information
  - Reasons for ear prostheses
  - Existing options for patients
  - Problems with current designs
- Client Specifications
- Osseointegrated Abutments
- Design Ideas
  - Evaluation of ideas (design matrix)
- Future Work

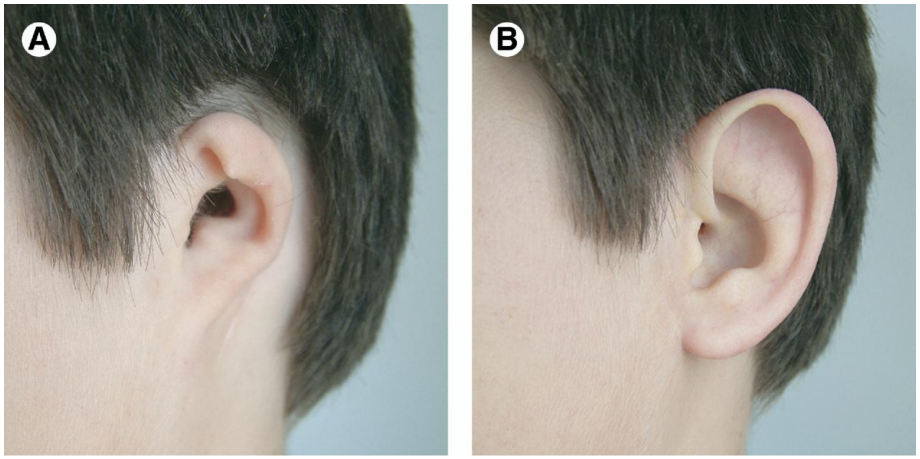
Problem Statement

- To develop an auricular prosthesis attachment mechanism that is able to improve the current design

- The design should:
  - ensure a strong hold to the surgically implanted abutments
  - withstand the stresses of everyday use
  - release in the presence of excess force
  - allow the patient to easily affix and remove the prosthesis

Why are ear prosthetics needed?

- Microtia
  - Congenital defect that occurs unilaterally (1 in 8,000 births)
- Cancer effects
- Hemifacial microsomia (Goldenhar's syndrome)
  - Second most common birth defect (1 out of 4,000)
- Trauma



A. Example of left ear microtia **B**. Slip-on prosthetic in situ

Current Options for Patients

- Reconstructive surgery
- Ear Prosthesis
  - Sleeve/Slip-on (onto actual ear)
  - Bar-clip
  - Magnet attachment
  - Biocompatible drying adhesives

Example of Ear prosthesis (left) compared with matching ear (right)

Problems with Current Designs

- Sleeve/slip-on design
  - Only applicable in limited number of cases
- Bar-clip design
  - Bulky, difficult to clean, not aesthetically pleasing
- Magnet design
  - Issues with security of attachment

Current Osseointegrated Abutments

Three cranial implants surgically placed in the mastoid bone structure

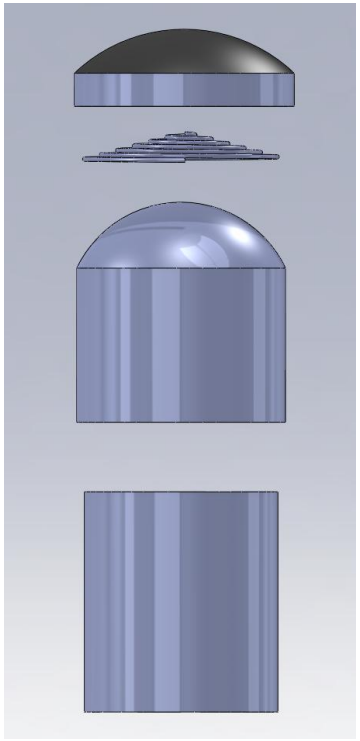
Auricular prosthetic placed in situ using the same three abutments

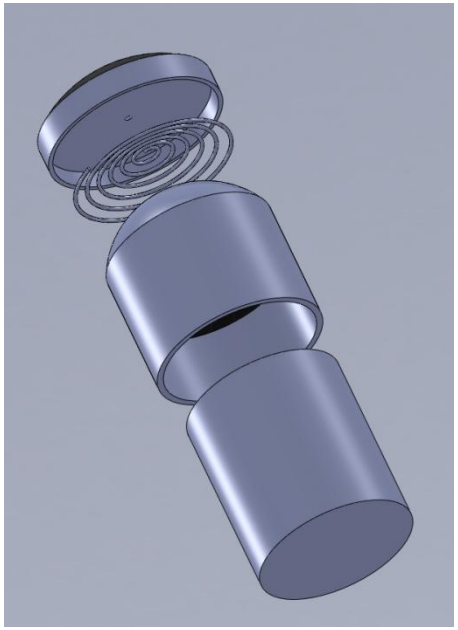
Client Specifications

- Prosthesis should resist unintentional dislodgement
- Must be low profile and aesthetically pleasing
- Able to withstand considerable anterior and posterior force—approx. 5-10 lbs
- Adaptable to current abutment size (4.4 mm diameter)
- Prosthesis should be easy for patient to attach and remove

Flat Spring and Magnet Cap

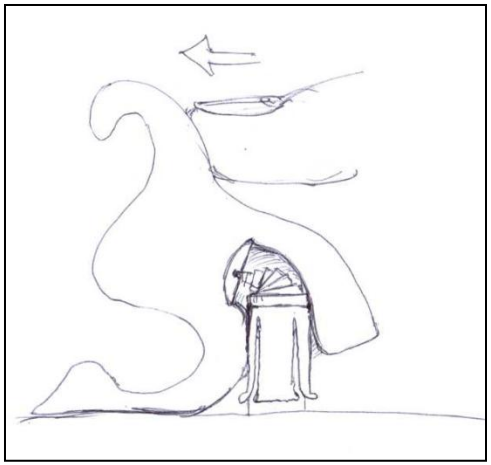
- Uses current magnet cap, but includes attached spring
- Spring attached to housing cap molded into prosthetic
- Spring allows for additional lateral force absorption

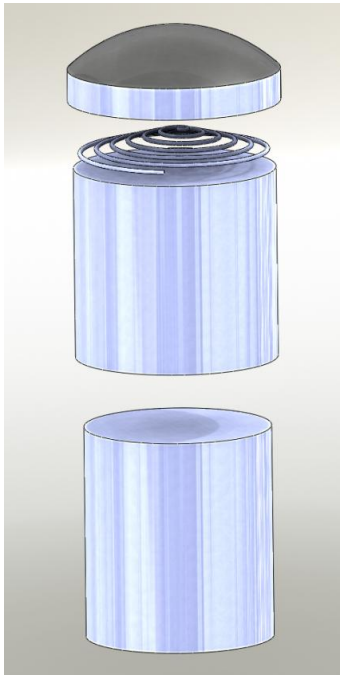




Flat Spring and Sheath

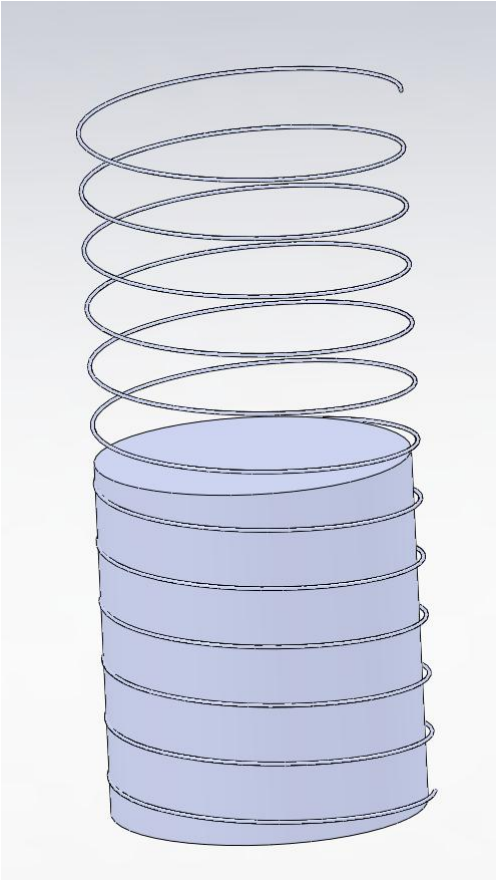
- Sheath slips over abutment and connects to spring before connecting to prosthetic
- Sheath allows for more stability than magnet
- Possible breakable/crumple sheath





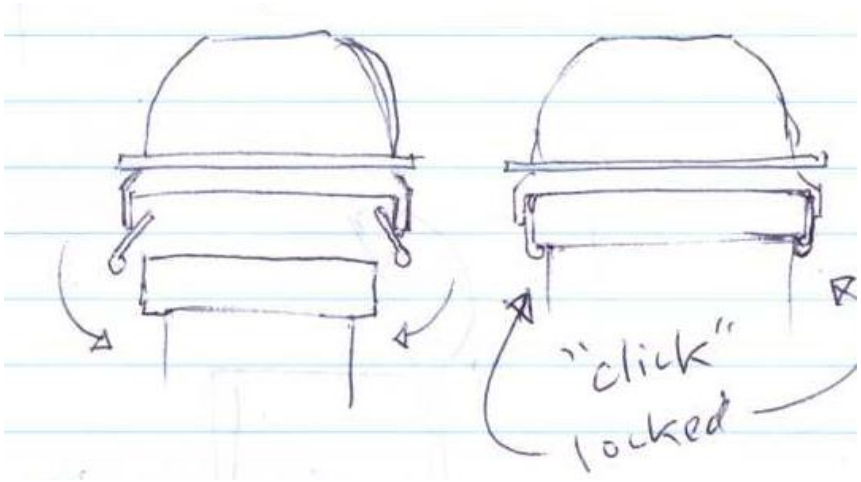
Cylindrical Spring as Sheath

- Uses spring as means of both attachment and force absorption
- Spring acts as cap/sheath
- Simple design, but would not be secure



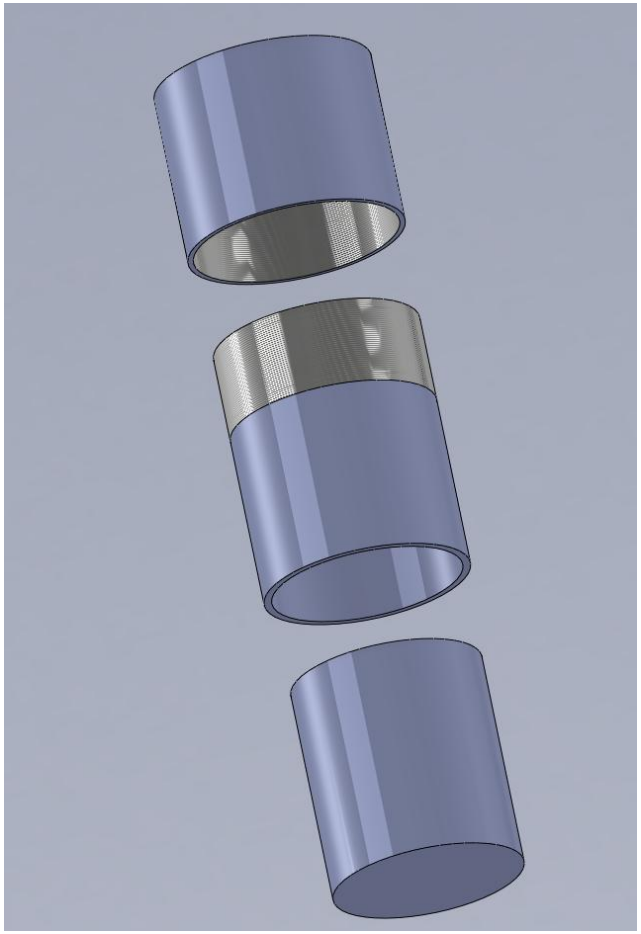
Active Clip with Magnet

- Uses current magnet design in conjunction with active clip onto abutment
- Provides a greater amount of security
- Poses problems in attachment and removal



Rigid Shearing Sheath

- Sheath design fits over abutment and connects to prosthetic
- Sheath made from breakable material to prevent excess force on abutment
- Would be made to be replaceable



Design Matrix

	Security [20]	Ease of Attachment [15]	Ease of Removal [15]	Simplicity [10]	Durability [5]	Cleanability [5]	Ease of Fabrication [10]	Aesthetics [15]	Material Cost [5]	Total [100]
Flat Spring and Magnet Cap	15	13	11	8	4	3	7	13	3	**77**
Flat Spring and Sheath	17	10	13	8	3	3	8	13	4	**79**
Cylindrical Spring as Cap	11	12	10	9	4	2	5	12	4	**69**
Active Clip with Magnet	19	13	9	6	4	4	6	12	3	**76**
Rigid Shearing Sheath	12	10	14	10	1	4	9	11	5	**76**

Future Work

- Other designs brought up by client
  - Use of silicone as spring material
- Possibility of combining aspects of several designs
- Order components
- Fabricate and test prototypes

Acknowledgments

- Gregory Gion
- Willis Tompkins
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