



# Around the Kitchen Table

Presented by



## Medical Technology Projects

October 18, 2011

5:30 – Meet and Greet

6:00 – Student Presentations

6:30 – Dinner Buffet

6:40 – Dinner Discussions



## **Team tCoil:**

Wirelessly Powering Procyron's  
Ventricular Assist Device With  
Transcutaneous Energy Transfer

# Wirelessly Powering Procyrion's Ventricular Assist Device With Transcutaneous Energy Transfer

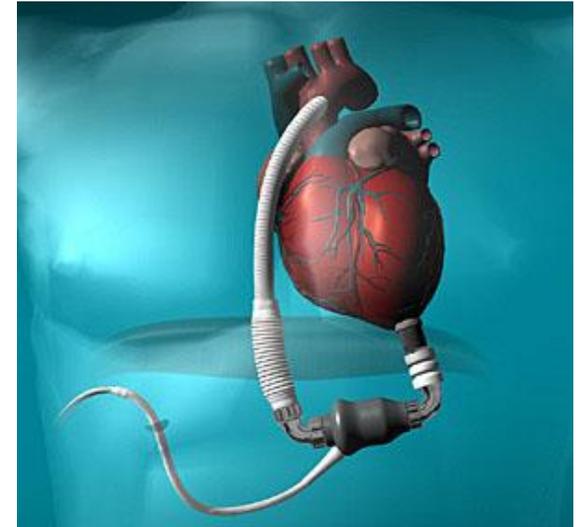
**Team tCOIL:** Alexander Dobranich, Trevor Mitcham,  
Michael Torre, Hana Wang, Erin Watson, Tyler Young  
**Mentors:** Michael Cuchiara, Maria Oden, Gary Woods



# Ventricular Assist Devices (VADs)

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- Heart Failure
  - Occurs in 1 in 5 people over 40<sup>1</sup>
  - Kills 60,000 people, costs > \$40 billion per year in US



Left Ventricular Assist Device

- Common Heart Failure Treatment: VADs
  - Provide supplemental mechanical circulatory support
  - Procryon: catheter deployed VAD

# Issues with Percutaneous Wires

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- Procyrion's VAD requires percutaneous wires
- Percutaneous wires cause infection
  - 30% left VAD patients with wire leads develop sepsis<sup>2</sup>



Percutaneous Wires

# Creating a Wireless Power Source

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- Create a system that wirelessly powers Procyrion's catheter deployed VAD
- Key Device Requirements
  - Run >30 minutes without external power
  - Lifetime: 90 days
  - Size: <10 cm diameter
  - Distance: 1-2 cm
  - Biocompatible
  - Data up- and downlink
  - Power: 5 W

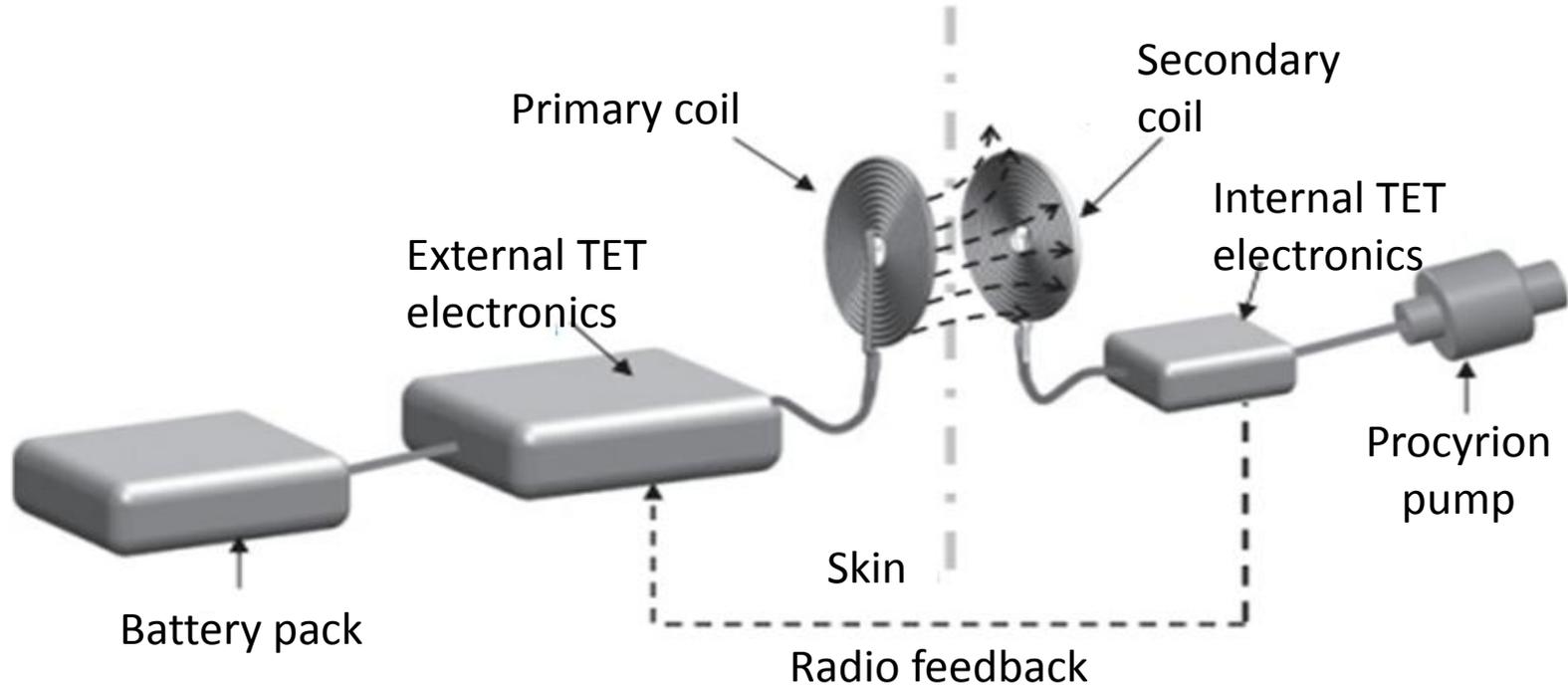


Procyrion's Catheter Deployed VAD

# Transcutaneous Energy Transfer (TET)

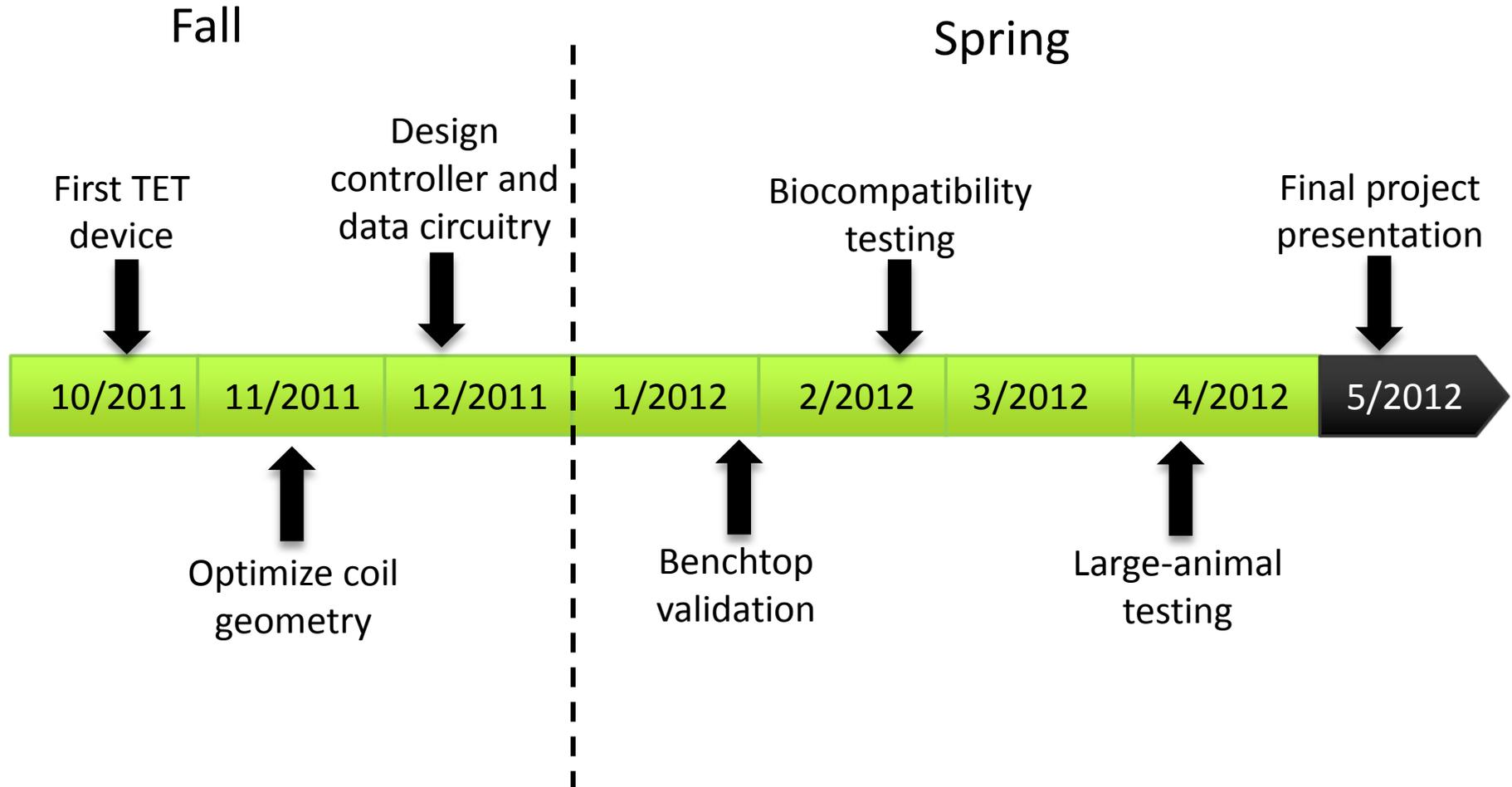
- Inductive Coupling

- Current in primary coil generates magnetic flux
- Changing flux induces current in secondary coil



# Future Steps in Designing TET System

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# Using TET to Power Procyrion's VAD

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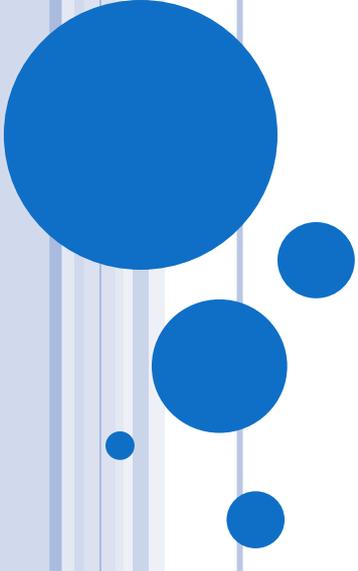
- No infection risk from percutaneous wires
  - Viable for long term use
- Higher quality of life sans wires
- Applicable to many other implantable devices



Coils for TET

**Team OPTO:**  
Regulated Tube Shunt for Glaucoma

# **OPTO: Saving the Future's Vision**



**Felix Chang  
Chris Fan  
Karen Marsden  
Kevin Perkins  
Eva Thomas**

# THE BURDEN OF GLAUCOMA

- Pathophysiology
  - Impeded flow of aqueous humor through the trabecular meshwork results in an increase in intraocular pressure (IOP)
  - Optic disc damage resulting in visual field loss
- Current problems
  - **2<sup>nd</sup>** leading cause of blindness worldwide
  - **60 million people** currently afflicted worldwide
  - **\$1.5 billion** annually in U.S. Social Security

NORMAL VISION

EARLY GLAUCOMA

ADVANCED GLAUCOMA

EXTREME GLAUCOMA

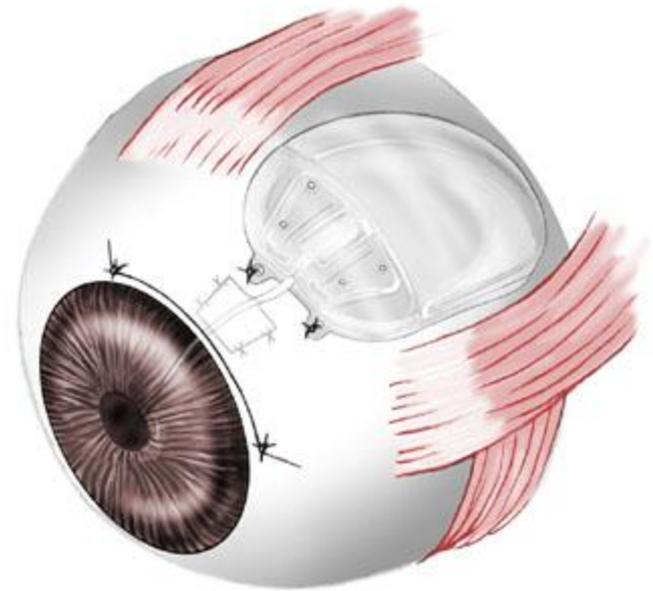


# TUBE SHUNTS: PROBLEMS AND POTENTIAL

- Non-functional pressure regulation
  - Hypotony in first 6 weeks
  - Variable long term pressure

Variable fibrous encapsulation

- Ideal tube shunts:
  1. Effective solution
  2. One time application
  3. Tunable to personal needs



Anterior  
Chamber  
(Driving Force)

Tube  
(Routing)

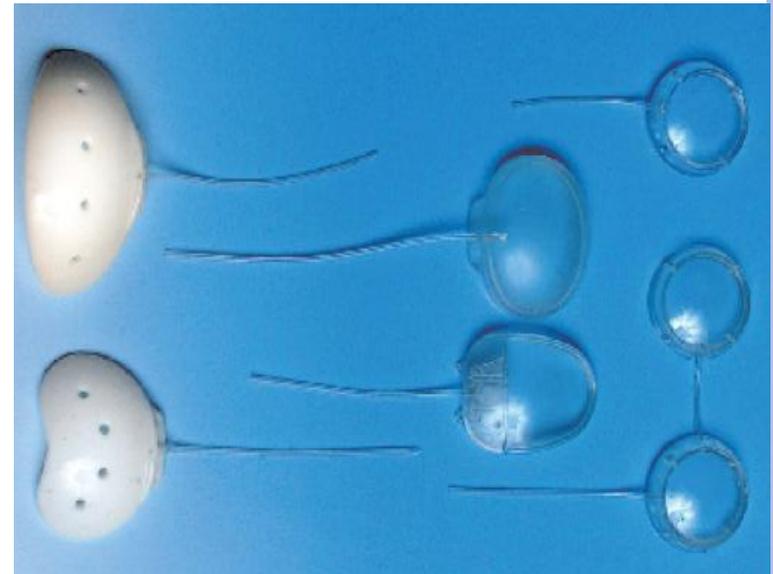
Valve  
(Regulation)

Plate  
(Dispersion)

Sclera  
(Reabsorption)

# SHUNT DESIGN CRITERIA

- Functionality: valves & drainage plates
  - Regulate pressure (8-14 mmHg)
- Size/Shapes (32 mm x 15 mm x 2 mm)
  - Permit easy implantation and patient comfort
- Cost (<\$1000)
- Implantation complexity
- Durability



# DESIGN CHALLENGES

## Microscale

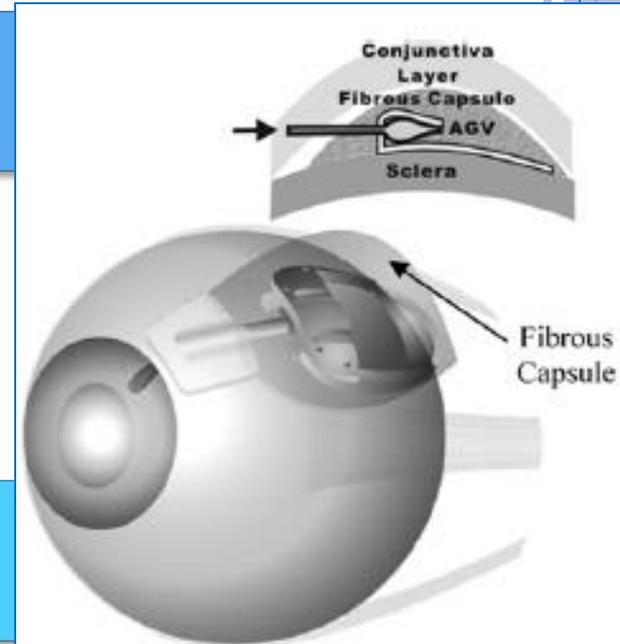
- Plate size limited to roughly 32x15 mm
- Thickness of < 2 mm
- Restricts design solutions
- Barrier to fabrication and testing

## Role of the inflammatory response

- Affects long term function
- Variable degree of encapsulation
- Lack time and resources to test fibrous encapsulation

## Lack of established precedents

- Most of our solutions have no existing analogue
  - At best, theoretical proof of concept



# PRESERVING THE FUTURE'S VISION

- 60 million suffer from glaucoma
- Current solutions are inadequate
  - Variable IOP
  - Hypotony
- Our aims:
  - Tight IOP control
  - Specific target IOP
- Improving quality of life
  - Fewer complications
  - Reduce glaucoma progression



## REFERENCES

- Image source: Modeling and characterization paper
- <http://www.babble.com/CS/blogs/strollerderby/2009/01/grandparents.jpg>



**Team Break and Make:**  
Designing an Automated Linear  
Distraction Mechanism

# Team Break and Make:

## Designing an Automated Linear Distraction Mechanism

October 18, 2011

Alvin Chou, Mario Gonzalez, Stephanie Herkes,  
Raquel Kahn, Elaine Wong

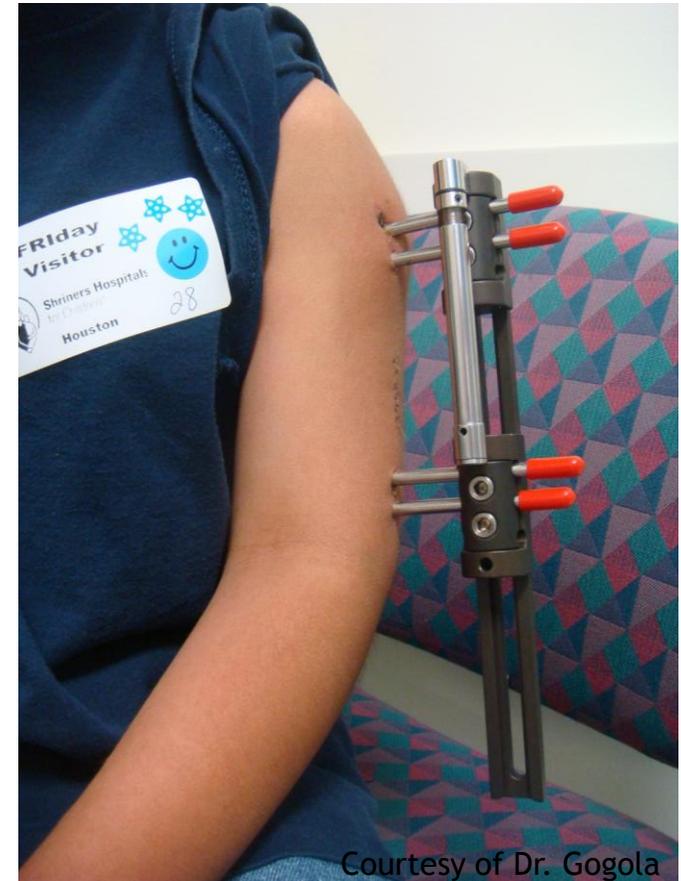
Advisor: Dr. Marcia O'Malley  
Mentor: Dr. Gloria Gogola

*This project was sponsored by a gift from Chuck and Sharon Fox. The design work for this project was supported by the resources of the Oshman Engineering Design Kitchen.*

# Background

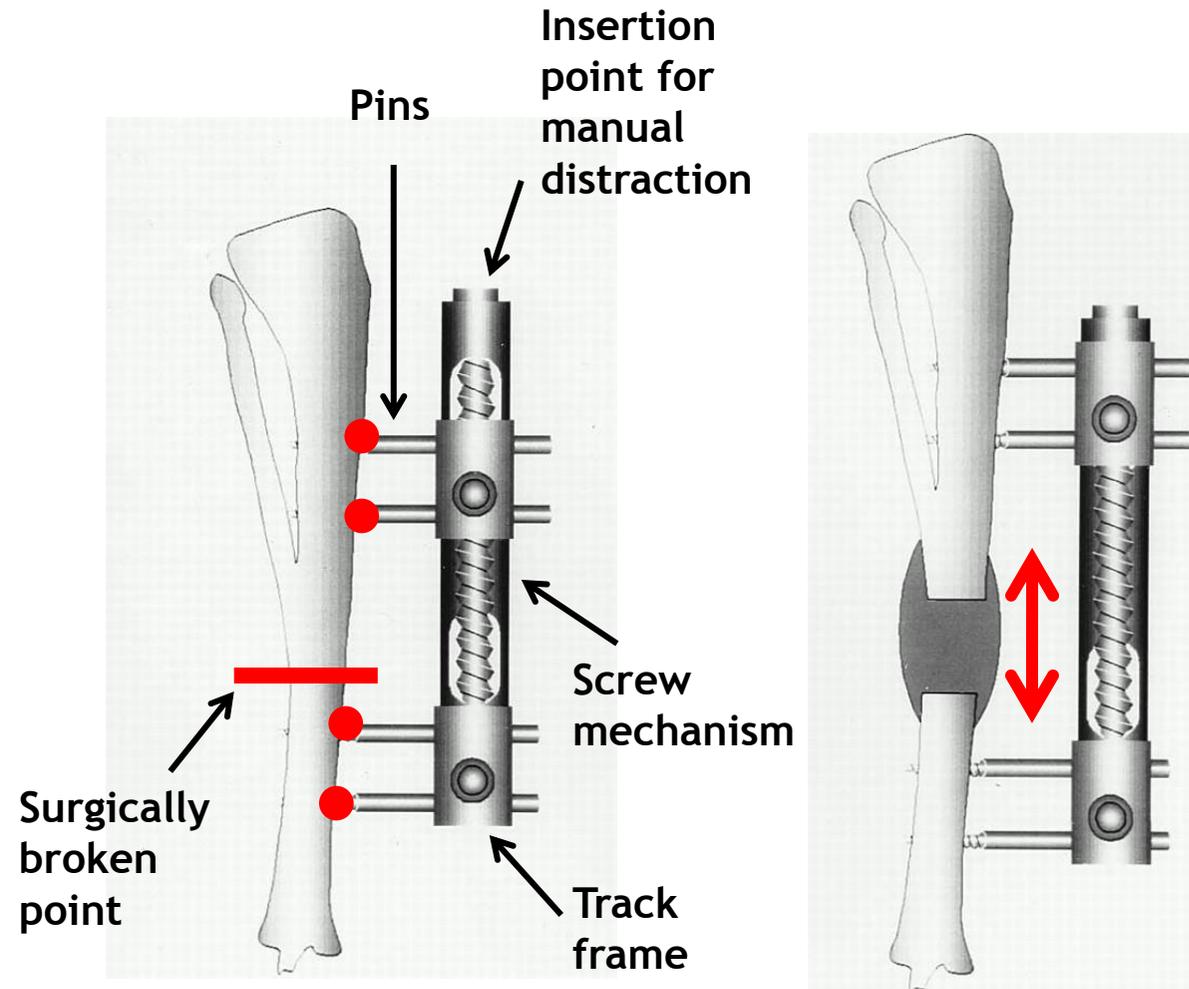
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- ▶ Deformed bones
  - ▶ Trauma
  - ▶ Infection/Disease
  - ▶ Congenital Disorder
  
- ▶ **Solution:**  
**Distraction Osteogenesis**



Courtesy of Dr. Gogola

# Current Devices

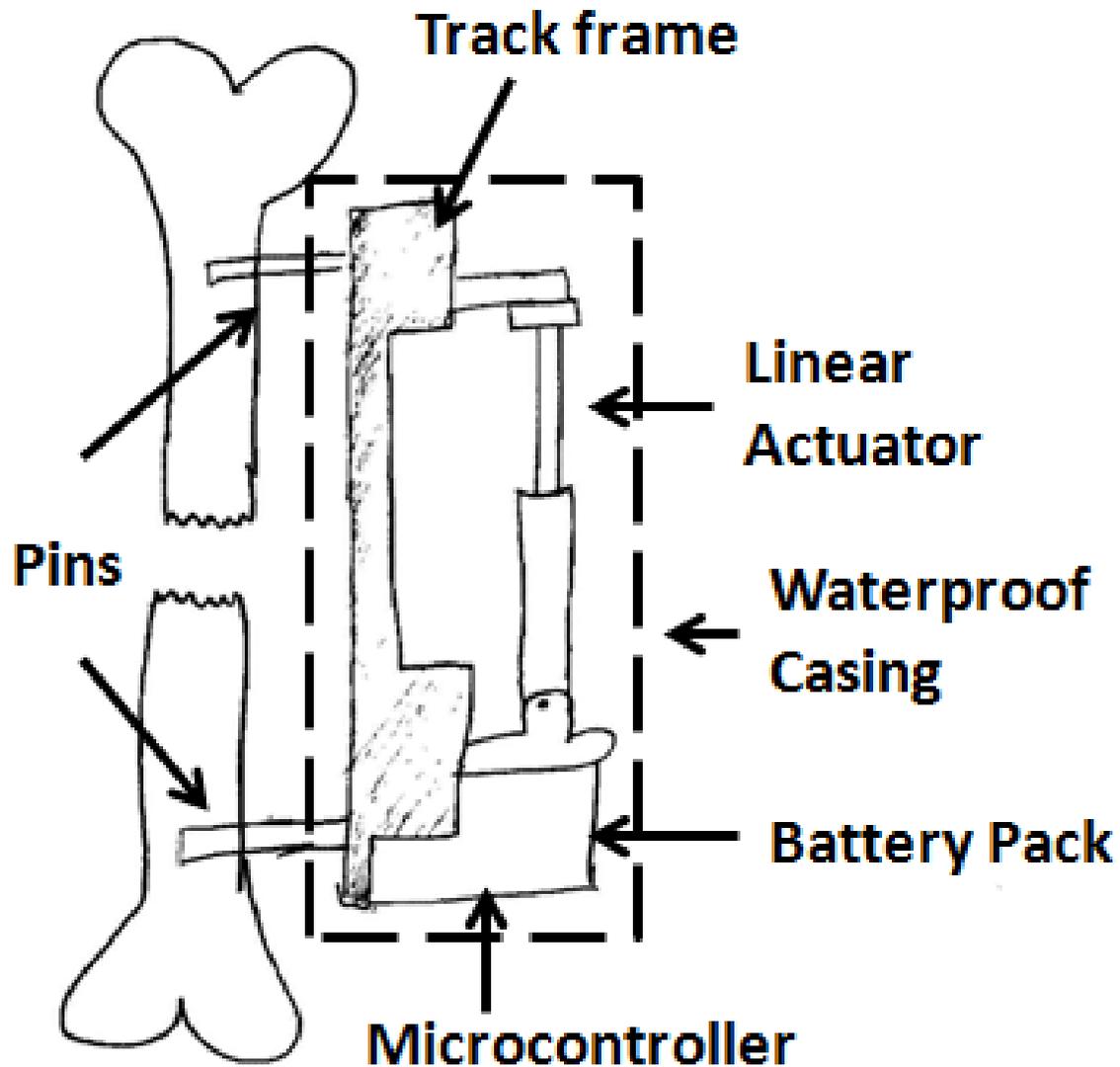


Courtesy of Dr. Gogola

- ▶ Distraction controlled manually
- ▶ Purely mechanical
- ▶ Weekly clinic visits

# Team BAM's Self-Adjusting Automated Distractor

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- ▶ Safety
- ▶ Waterproof
- ▶ Durability
- ▶ Accuracy
- ▶ User Friendliness
- ▶ Dimensions
- ▶ Weight
- ▶ Cost of Prototype
- ▶ Feasibility

# Moving Forward

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**Select**



**Design**



**Implement**

October -  
November

November -  
December

January - April

- Select components
- Order parts

- Generate CAD model
- Run simulation
- Design and build prototype

- Refine design
- Run testing
- Modify prototype

# **Team CivSAFE & Team Collar ID:** Cervical Spine Immobilization

# Cervical Spine Immobilization

Team CivSAFE

&

Team Collar ID

October 18, 2011

Presenters: Kelsey Horter and Kareem Ayoub



# Cervical Immobilization Importance

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- 30% of all trauma fatalities are caused by spinal cord injuries (SCI) <sup>[1]</sup>
- Improper immobilization causes 3,000 deaths per year <sup>[1]</sup>
- SCI account for 7.4% of military trauma cases <sup>[2]</sup>
  - Each year, 450 newly injured military members receive SCI rehabilitation <sup>[3]</sup>
- 25% of deaths from SCI occur from a secondary injury <sup>[1]</sup>

# Problems with Existing Collars

- Spinal distraction [4,5,6]
- Incomplete immobilization
- Airway obstruction
- Pain and discomfort
- Environmental complications

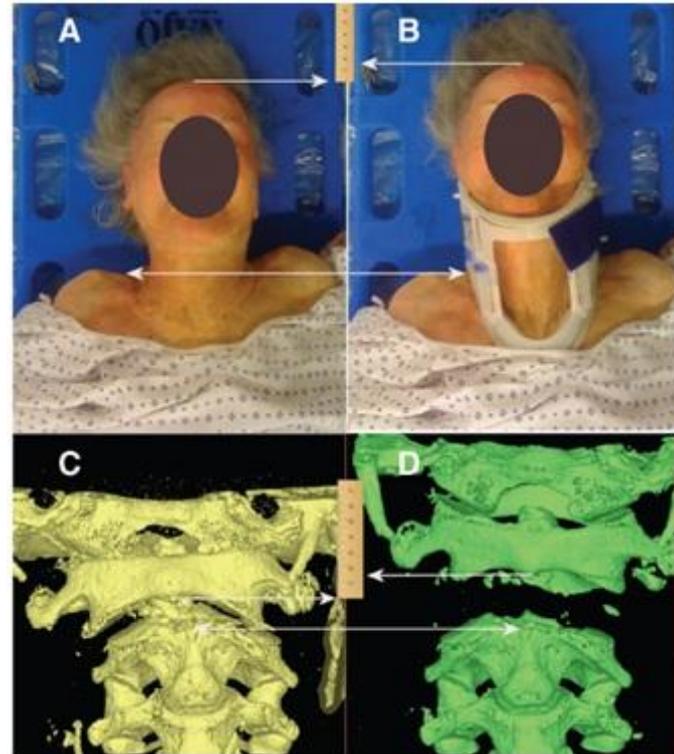
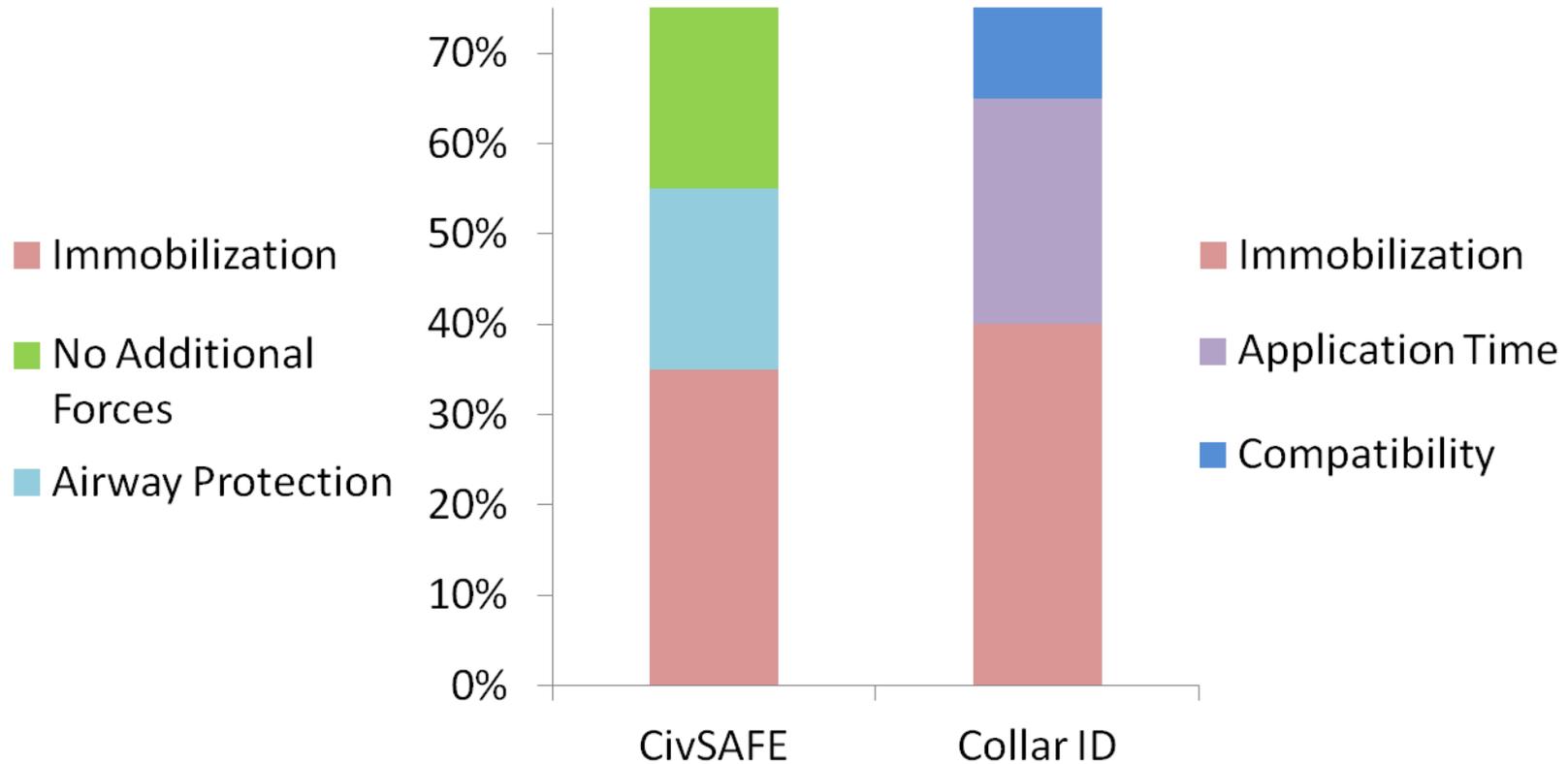


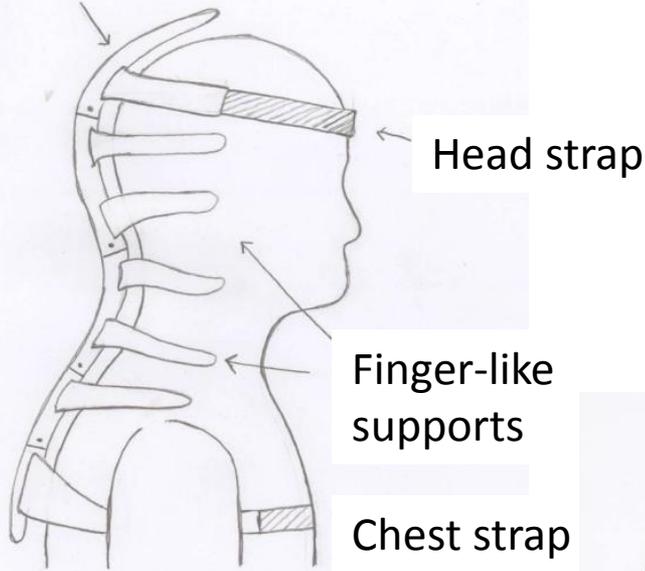
Photo credit: Ben-Galim, Peleg. "Extrication Collars Can Result in Abnormal Separation Between Vertebrae in the Presence of a Dissociative Injury"

# Design Criteria



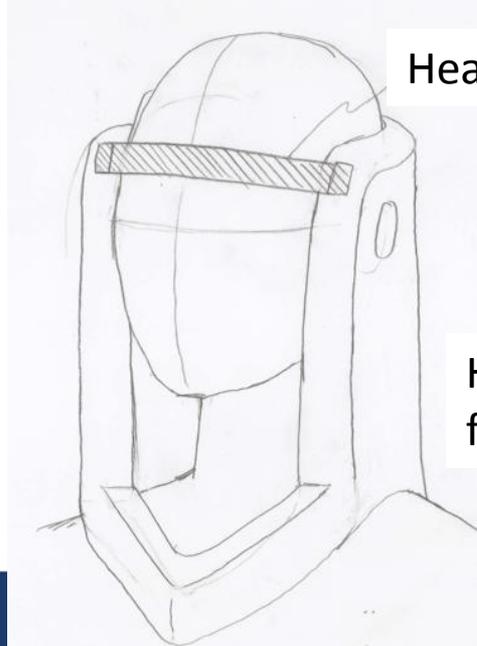
# Civilian Immobilization Designs

Adjustable  
spinal joints



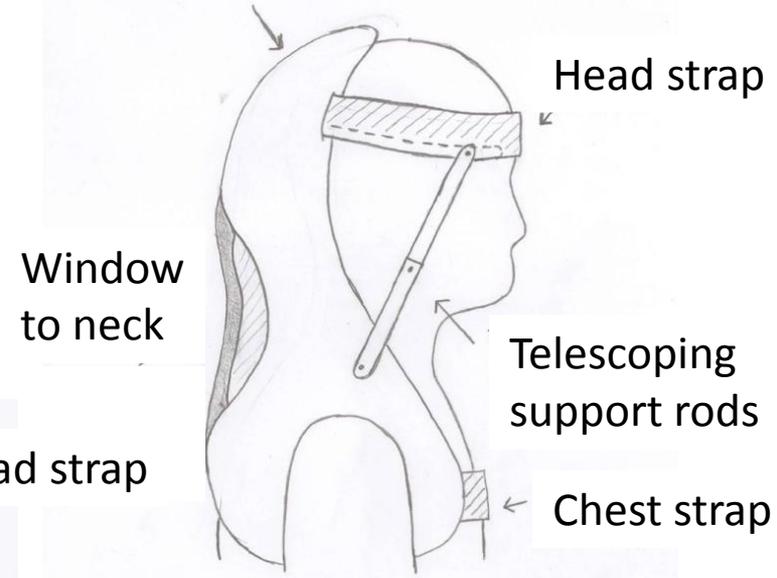
**FINGERS OF LIFE**

**HEAD SPLINT**



Hard plastic shell,  
foam interior

Hard plastic shell, foam interior

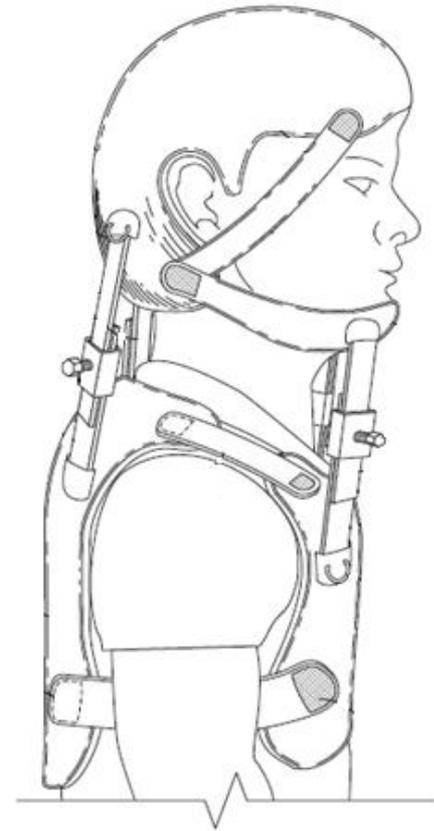


**HEADCASE**

# Military Immobilization Design

## Modified traditional suspension collar

- Integrates with military gear
- Attachment points between head and torso
- Suspension system isolates cervical spine from external forces



# Acknowledgements

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CivSAFE and Collar ID would like to express our gratitude to the following individuals for their contributions to our projects:

**Dr. Ben-Galim**

**Dr. Hipp**

**Dr. Oden**

**Dr. O'Malley**

**Dr. Persse**

**Dr. Wettergreen**

And special thanks to our project sponsors:

**BP and Davis/Bucholtz**

# References

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- [1] Ben-Galim, Peleg, Niv Dreiangel, Kenneth L. Mattox, Charles A. Reitman, S. Babak Kalantar, and John A. Hipp. "Extrication Collars Can Result in Abnormal Separation Between Vertebrae in the Presence of a Dissociative Injury." *The Journal of Trauma: Injury, Infection, and Critical Care* (2010): 1. Print.
- [2] Schoenfeld, Andrew J. et al. "Characterization of Combat-Related Spinal Injuries Sustained by a US Army Brigade Combat Team During Operation Iraqi Freedom." *The Spine Journal*. 10 (2010). Print.
- [3] "Fact Sheet:VA and Spinal Cord Injury."Department of Veterans Affairs. Jan 2009. Website.  
[http://www1.va.gov/opa/publications/factsheets/fs\\_spinal\\_cord\\_injury.pdf](http://www1.va.gov/opa/publications/factsheets/fs_spinal_cord_injury.pdf)
- [4] USOCOM. "Tactical Combat Casualty Care Guidelines." Aug. 2010. Web. <http://www.itstactical.com/wp-content/uploads/2010/10/TCCCGuidelinesAug2010.pdf>
- [5] Lunsford T, Davidson M, Lunsford B. "The Effectiveness of Four Contemporary Cervical Orthoses in Restricting Cervical Motion." *J Prosthet Orthot*. 1994; 6: 93–99.
- [6] James, Colleen et al. "Comparison of Cervical Spine Motion During Application Among 4 Rigid Immobilization Collars." *Journal of Athletic Training*. 2004; 39(2): 138–145.



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# THANK YOU!

