

# BLINKING ORBITAL PROSTHESIS

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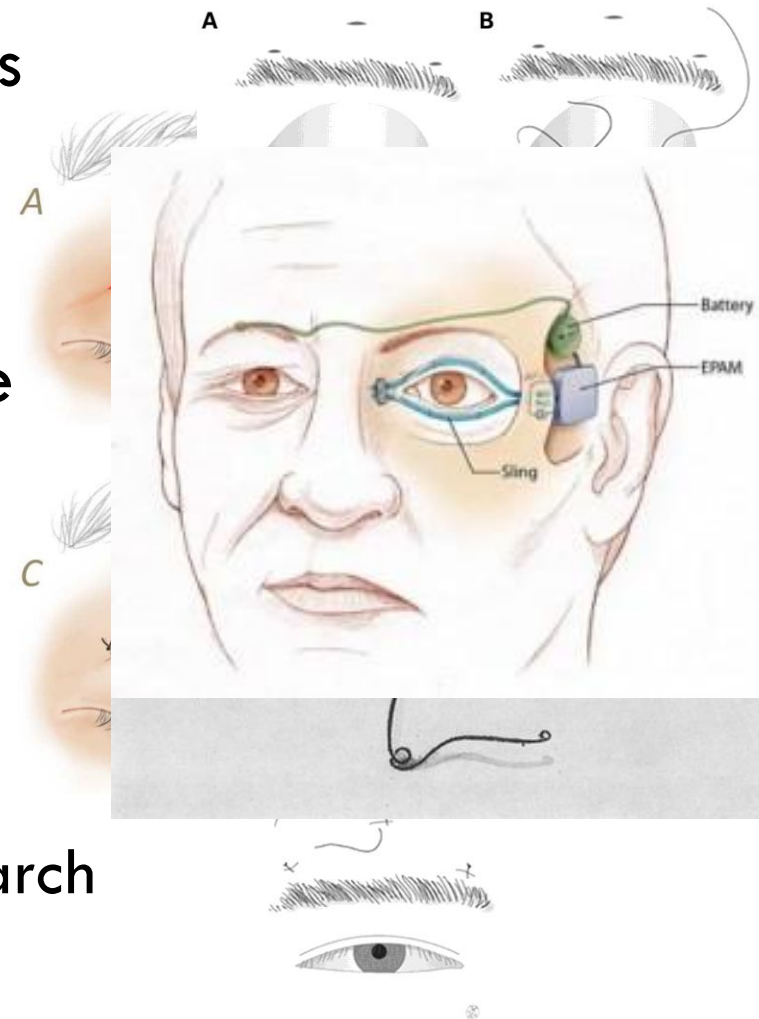
# Orbital Prostheses

- Surgical removal of eye and surrounding tissue.
- Anaplastology
- Desired natural appearance
- Custom prosthesis
- Made out of PMMA



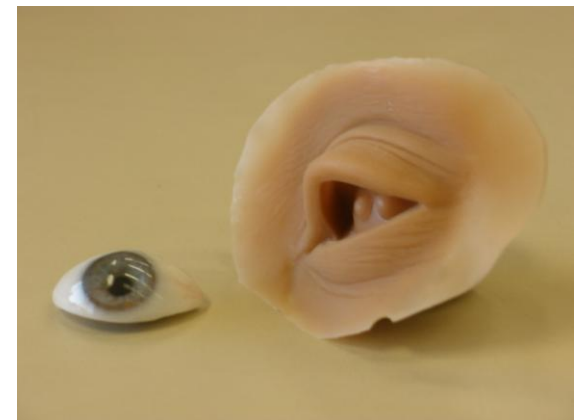
# Current Devices

- No blinking orbital prosthesis exists
- Non-blinking prosthesis
- Similar devices that could be used in a prosthesis
  - ▣ Arion sling
  - ▣ Gold weights
  - ▣ Palpebral springs
  - ▣ Artificial muscle (EPAM) research



# Problem Statement

- Removal of eye; injury, disease, genetic
- Realistic prosthetics
  - ▣ Static
- Design mechanism to allow blinking
  - ▣ Use in demonstration model

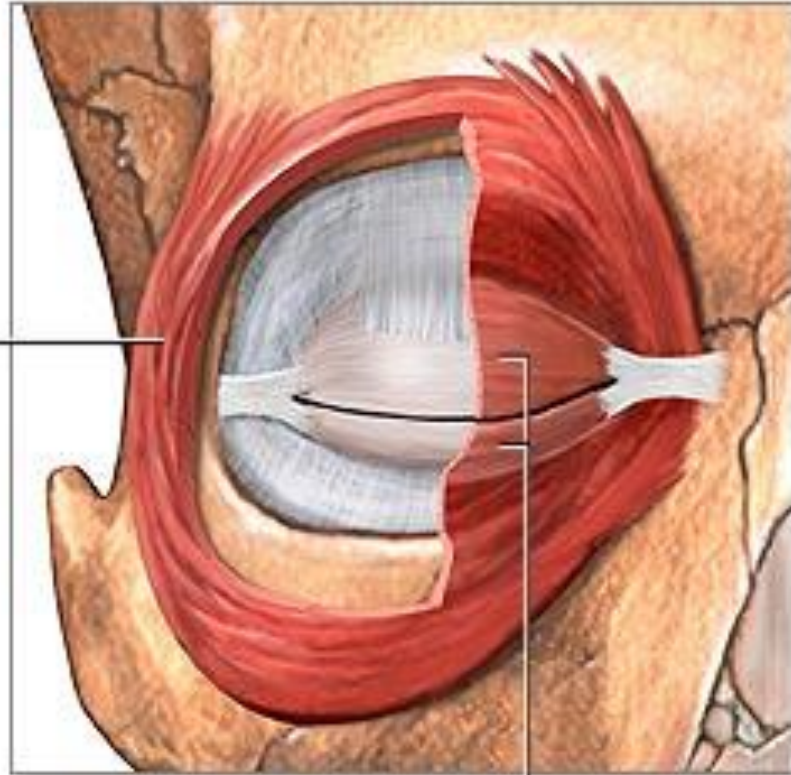


# Client Requirements

- Focus on mechanics of the blink
- As small as possible
- Model to be used at presentations or as demonstration
  - Safe
  - Reliable
  - Durable
- Try to meet some requirements of an actual implantable prosthesis
  - Same speed as normal blink
  - Quiet
- \$500 budget

# Human Blinking Mechanism

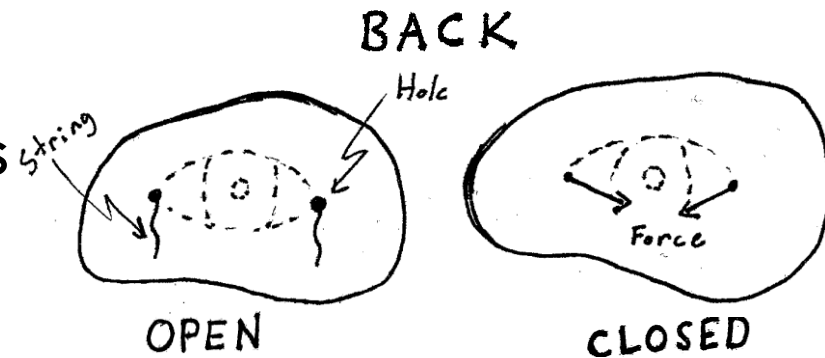
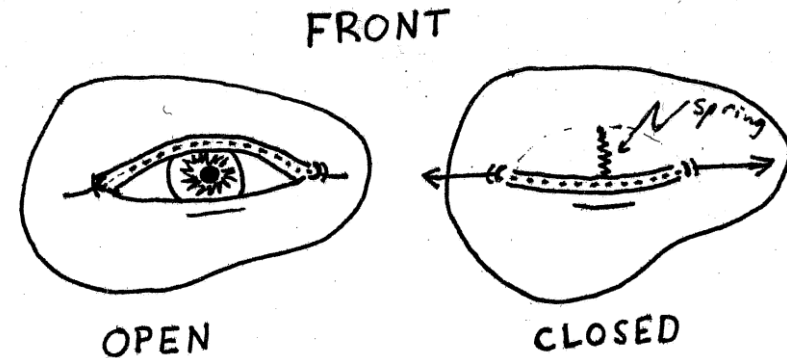
Orbicularis oculi  
(Orbital part)



Orbicularis oculi  
(Palpebral part)

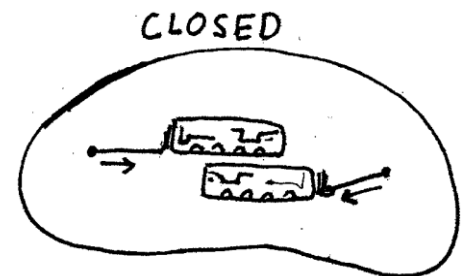
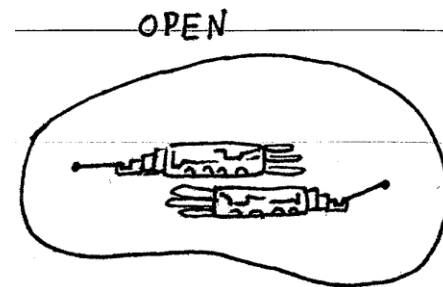
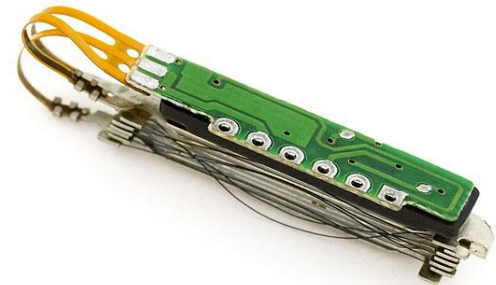
# Embedded Cord Tension Mechanism

- Materials: Thin Plastic String, Spring & PMMA.
- String runs through upper lid
- Stabilizing strap to guarantee reproducible blinking action.
- Spring to reopen eyelid
- No delay; When the string is pulled, the eye blinks



# Shape Memory Alloy

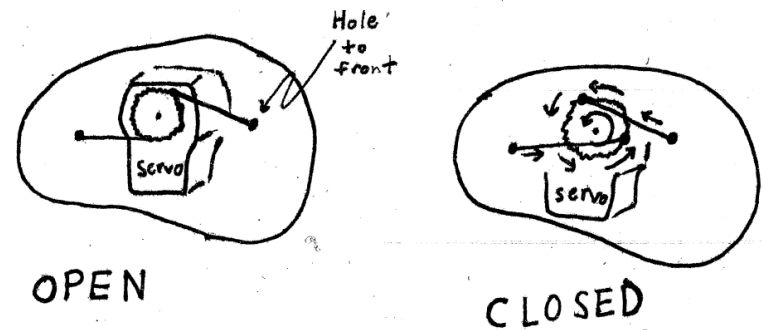
- Copper based, nickel-titanium alloys.
- Small size, and reasonable weight
- Silent
- Easily obtainable
- Power concerns
- Slow
- Short life cycle





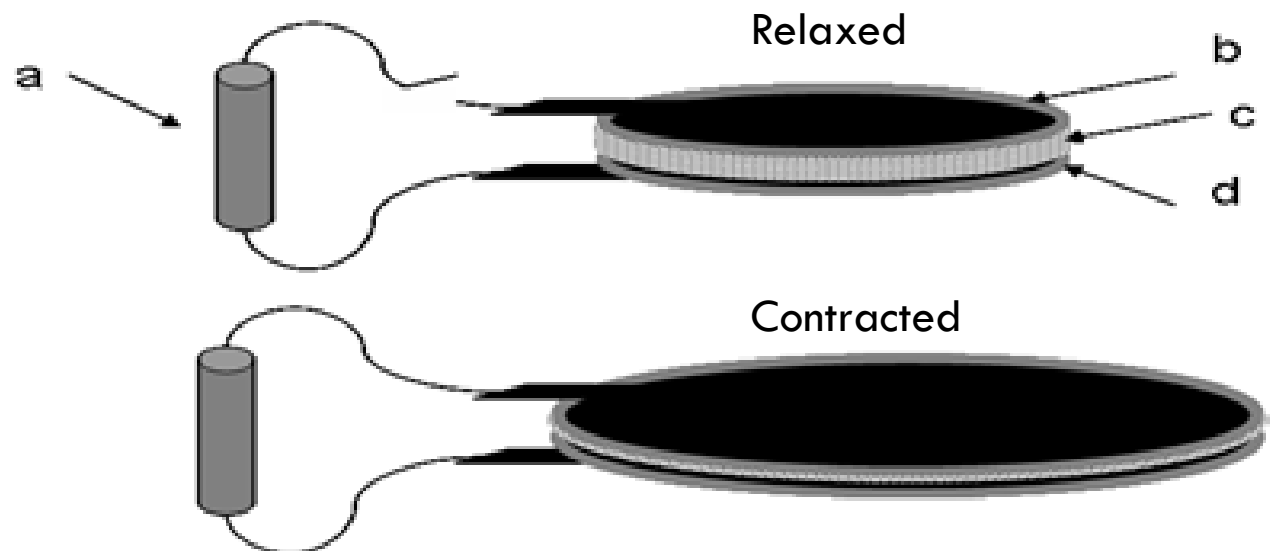
# Micro Servo

- Slightly larger and heavier than memory shape alloy motor ~ Bulky
- Noise problem
- Easily obtainable, used in RC cars.
- Strong, and quick.
- Can be controlled by wired or wireless device



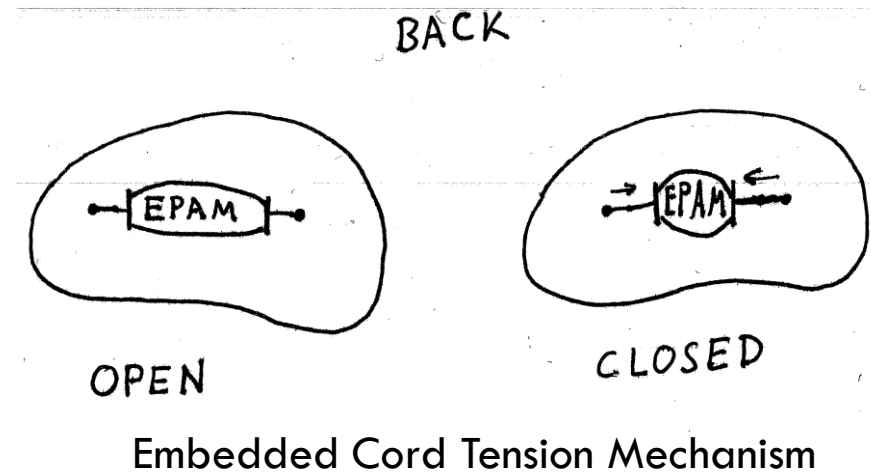
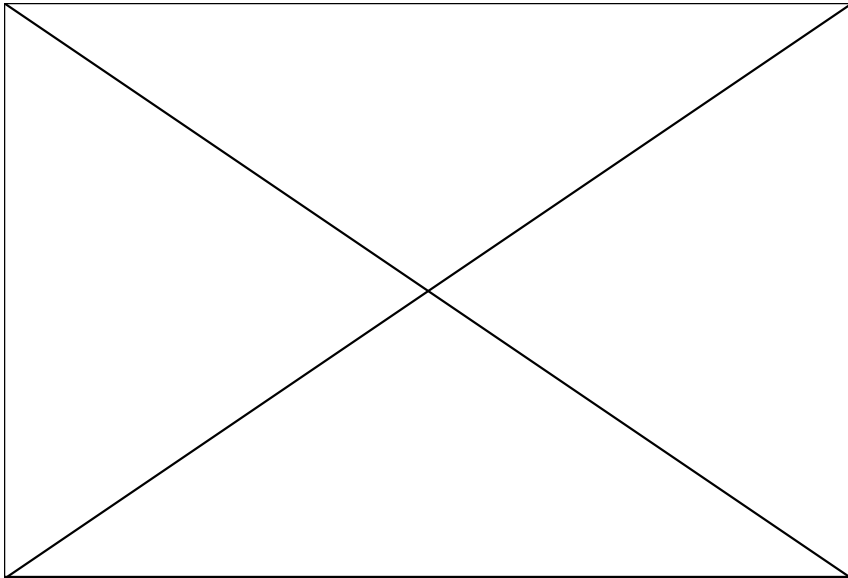
# Artificial Muscles (EPAM)

- Thin layer of dielectric polymer film between two conductive, compliant electrodes
- Mimic muscle movements of living organisms.



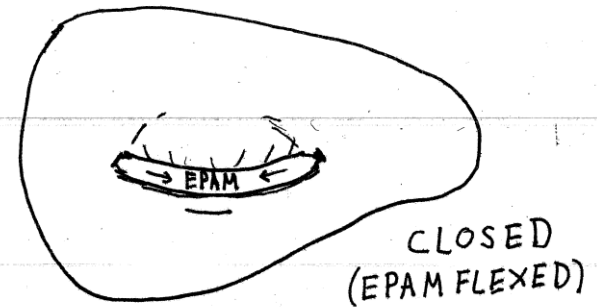
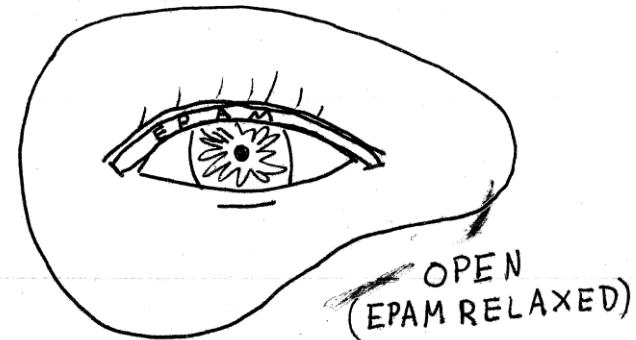
# EPAM cont. Pros

- Light, Fast, Quiet
- Applicable to Embedded Cord Tension Mechanism
- Applicable to Embedded EPAM Lid



# Embedded EPAM Lid

- Band of EPAM through top lid
- Fixed at corners of eye
- Contraction
  - ▣ Shortens muscles
  - ▣ Forces lid downward
- Relaxation allows lid to re-open
- Mimics actual eyelid movement



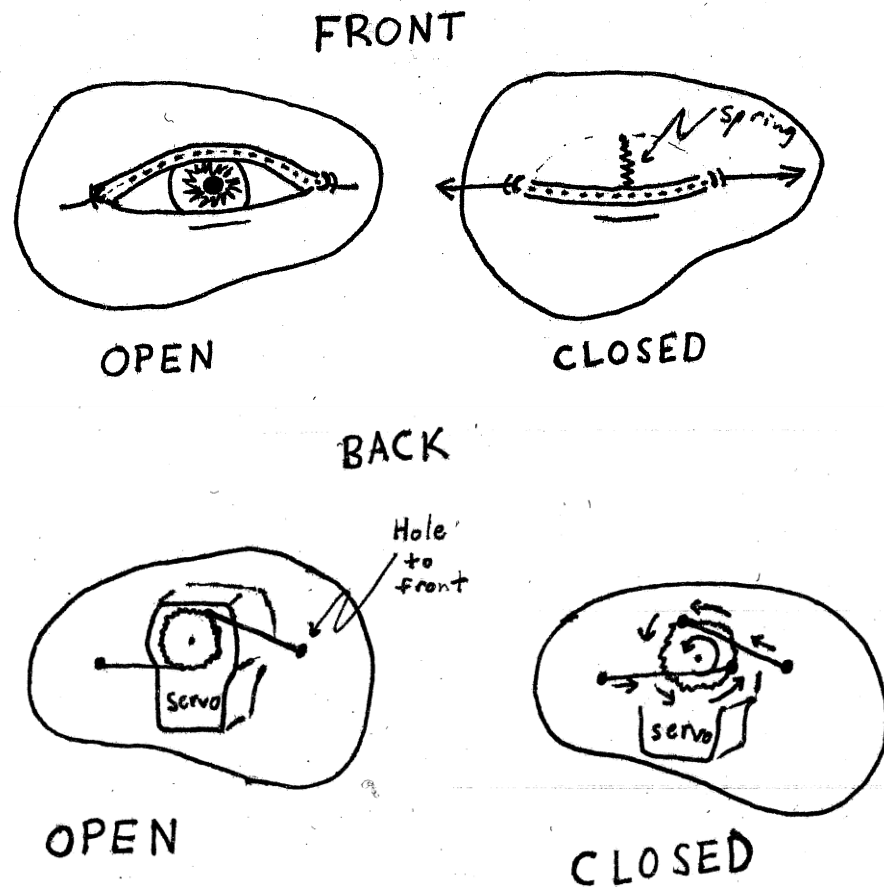
# EPAM Cons

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- Very difficult to obtain (our unobtainium)
- Artificial Muscles Inc. prefers to sell technology to larger companies or funded research groups
- Little experience with technology

# Final Design Selection

- Embedded Cord Tension Mechanism with Micro Servo Motor
- Simple
- Fast
- Available
- Adaptable



# Future Endeavors

- Build prototype of embedded cord tension mechanism without power source
- Continue researching:
  - ▣ Fast, quiet mini servo motors
  - ▣ Stretchy elastic polymers for lid construction
  - ▣ Applicable springs

# Acknowledgements

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**Thank You**

Professor Yen

Mr. Gion MMS, CCA

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Dr. Ver Hoeve

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# References

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Questions?