NECK POSITIONER FOR FLUOROSCOPY EXAMINATION

Advisor
William Murphy, Ph.D.
Department of Biomedical Engineering

Team Members
Natasha Benkovich, Kaitlin Brendel, Amy Lenz and Vincent Mi
Department of Biomedical Engineering

Client
Victor Haughton, M.D.
Department of Radiology

Abstract

A device is needed to replace existing methods of extending and flexing a patient's neck during a fluoroscopic examination of the cervical spine. Previous designs failed to translate the patients head a manner that smoothly repositions the neck while providing ±45° of motion. The design incorporates a carbon fiber headboard attached to a milled aluminum ring. The ring is centered at the neck and powered by a 115V AC motor at 4 rpm providing ideal motion centered around the neck.

Motivation

Currently, no device exists for movement of a patient's cervical spine during fluoroscopic imaging; therefore, technicians are responsible for manually supporting and rotating a patient's neck. This poses many risks to the hospital staff and patients via repeated exposure to radiation, inefficient support and an overall dangerous method. Our goal this semester was to remodel a motorized design to safely provide flexion and extension of the spine without interfering with x-ray imaging.

Background

Diagnostic Fluoroscopy Procedure:
Fluoroscopy is dynamic, real-time, x-ray imaging that is used in this procedure to diagnose injury to the cervical spine. The procedure is used specifically for patients who have been in an accident more than 72 hours prior to the imaging and are comatose.

Neck Extension

Previous Work:
- Inadequate range of motion
- Variable rotational speed
- Inclined backboard

There are no other devices on the market that move the head in extension in flexion in a constant motion.

Neck Flexion

Design requirements

Performance
- +/- 45° range of motion from horizontal
- ~2.5°per second of steady rotation
- Stabilize patient's head during motion
- No interference with lateral fluoroscopic imaging
- Rotation occurs about natural anatomic center

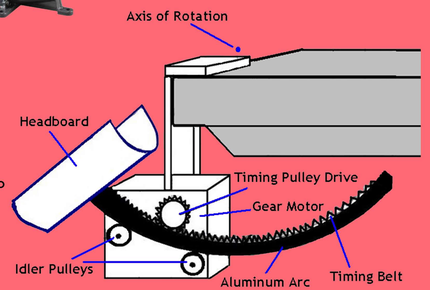
Safety
- Stable at all times
- Smooth movement to prevent further patient injury

General
- Accommodate average adult
- Aesthetic and ergonomic
- Reusable
- Low maintenance
- Easy to position patient on device
- Prototype under $300

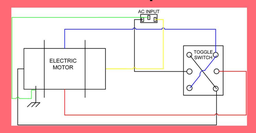
Prototype

Motor
- Right-angle AC/DC Gear Motor
- 250 in-lb torque
- 4 RPM

Aluminum Arc and Headholder
- GE Healthcare CT Headholder
- 3/8" Aluminum milled into arc of 113°
  - 12" inner radius
  - 13" outer radius



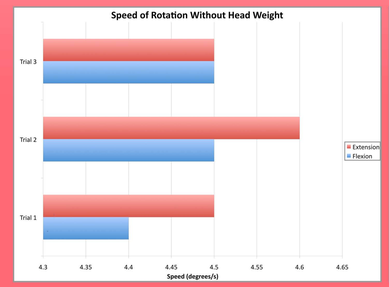
Pulley and Roller System
- Driving Gear: 0.2" pitch polycarbonate timing pulley with aluminum insert
- Guide Pulleys: 1.75" outer diameter flat belt pulleys with 0.5" bore
- Gear teeth: 0.2" pitch, 3/8" wide neoprene timing belt glued onto arc

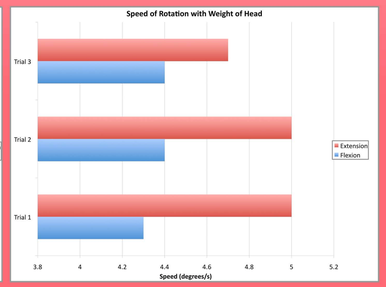


AC Circuitry
- Toggle switch
- SJO 18-4 AC rated wire.

Testing

- Weight: 28 lbs (without head)
- The circuitry this semester was secured with solder rather than electrical tape, therefore it is much more reliable.
- Rotation speed was tested by measuring time elapsed as the device rotated through its full range of motion (75°). Total angles divided by time results in speed.





Future Work

- Create more effective attachment to fluoroscopy table.
- Angle of extension/flexion displayed on side of device.
- Possible implementation of cordless controls
- Research integration with fluoroscopy control system
- Construct from plastic composites
- Propose design to IRB and WARF

References

http://www.rad.washington.edu/quickcases/cases/Case09/text.html
http://www.healthsystem.virginia.edu/uvahealth/adult_radiology/fluoros.cfm

Acknowledgements

- Dr. Victor Haughton - Client
- Professor Murphy - Advisor
- Mr. Russ Lenz - Construction and advising
- Professor Frank Fronczak - computations
- Professor Tom Yen - Motor Specifications
- Amit Nimunkar - Circuitry
- Javier Cruz - Plastics
- Larry Wheeler - Construction
- Betty Gavigan - Finances
- Jim Molenda - Finances