

Product Design Specifications

Neck Extender and Flexor for Fluoroscopy Examinations

Team Members

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Client

Dr. Victor Haughton, M.D.

Problem Statement: Our project involves refining a motorized neck positioner for a fluoroscopy examination. The device must extend and flex the neck and not interfere with lateral fluoroscopic radiographic imaging. The goal of the device is to provide continuous rotation of the neck while the relative motion between vertebrae is monitored by fluoroscopy. This device will facilitate the diagnosis of spinal instability and aid in diagnosing ligament injuries.

Client Requirements:

- Extend and flex the neck +/- 45° from neutral
- Rotate the neck at less than 2.5°/sec
- Stabilize patient's head during motion
- No interference with lateral fluoroscopic imaging
- Allow a completely horizontal position of the patient when the neck is rotated
- Include foam padding on head support with a head strap to prevent movement
- Must be compatible with GE and Siemens fluoroscopy units
- Operates by controls that are easily coupled with the controls that operate the patient table and the fluoroscopy unit
- Possible use with a CT unit or MR unit desirable

Design Requirements:

Physical and Operational Characteristics

a. Performance Requirements

- Operation by one person (preferably by remote control, or at a distance)
- Motion should be smooth, continuous and interruptible, to prevent patient injury
- Must flex and extend the neck +/- 45° from horizontal
- Must display the angle of neck rotation
- Provide rotation at less than 2.5°/sec
- Only move the head and neck of the patient.
- No interference with fluoroscopy or the operation of the fluoroscopy machine

b. Safety

- No sharp edges, corners, hinges that could pinch or tear
- Stable at all times
- Smooth movement to prevent further patient injury
- Emergency stop (panic button)

c. Accuracy and Reliability

- Angle measurement must be accurate within +/- 5
- d. Life in Service
 - Must last for an extended period of time (5 years)
- e. Shelf Life
 - Storable in room temperature
 - Functional after extended periods of idle time
 - Require minimal maintenance
 - Require minimal storage space
- f. Operating Environment
 - Tolerate repeated exposure to x-rays from fluoroscopic imaging
 - Withstand wear and tear from operation and movement by hospital staff
 - Circuitry protected from damage due to humidity, fluid spills, temperature, or other adverse conditions
- g. Ergonomics
 - Easy to position patient on device
 - Include foam padding on head support with a head strap to prevent movement
- h. Size
 - Fitted to dimensions of fluoroscopy examination table
 - Easily removable and storable
 - Easy maintenance and modification
 - Adapts to size of most patients
- i. Weight
 - Less than 20lb, so it can be handled by staff
 - Sturdy enough to ensure stable operation
- j. Materials
 - Metallic and/or dense materials are not permissible in the area of examination (will interfere with X-ray signal)
- k. Aesthetics, Appearance, and Finish
 - Fit under or above fluoroscopy table, but beneath hospital pad on table
 - Similar color and material as fluoroscopy table and pad (white and grey)
 - Smooth edges and texture to prevent injury during examination and handling
 - Able to be sterilized between patients without damage to components.

Production Characteristics

- a. Quantity
 - One prototype, can be a larger scaled model of actual device
 - Potential to mass produce if marketable
- b. Target Production Cost
 - Less than \$250 for prototype
 - At most \$1,000 to \$2,000 for final product
 - Final product market value of approximately \$10,000

Miscellaneous

- a. Patient-related Concerns
 - Accommodate adults from minimal height and weight to extra large dimensions(not for children)
 - Be comfortable for patient

b. Competition

- Previous projects have produced positioning devices, but none were motorized
- Individual components of this semester's design may already have patents (motors, actuators, etc)
- Patent searches yielded no existing devices capable of dynamic positioning