Design of a Standing Exoskeletal Support for a Surgical Lead Vest to Reduce Wearer Fatigue

Overview
Surgical lead vests must be worn by surgeons, doctors, and nurses at the Hershey Medical Center during surgical procedures to protect against harmful x-ray radiation. In cases of difficult or long procedures, these vests can be worn for up to 8 hours per day, resulting in surgeon fatigue, chronic pain, and in some cases damage to the joints. Developing a way to reduce the weight supported by the lead vest wearer would reduce fatigue and chronic issues, resulting in better care and less health care costs.

Objectives
The purpose of this project was to design and fabricate a cheap, comfortable, and reliable support system to reduce the lead vest weight supported by the wearer.

Approach
- An on-site visit of the operating room at the Hershey Medical Center was completed and surgeons and nurses were consulted to determine the most important needs for the design.
- Three conceptual designs were created to address the problem and were graded through a concept ranking matrix against the sponsor needs of comfort, cost, mobility, deployment time, durability, and manufacturability.
- Detail design of the selected conceptual design was completed through a full CAD mockup using Inventor.
- Finite element analysis of areas of high stress was performed to confirm the mechanical stability of the design with an acceptable factor of safety.
- A full scale working prototype of the design was fabricated.
- The prototype was tested by multiple wearers and the lead vest weight supported was calculated.

Outcomes
- Percentage of lead vest weight supported by the design was on average 143%.
- Mobility and range of motion was maintained, with the ability to walk at pace, bend at the waist, and twist all unobstructed.
- The time to put on the design was within the 30 second requirement of the sponsor.
- The total cost of the design was $300, a significantly reduced price from current commercially available products.