



DESIGN OF A SURGICAL SHOULDER LIFT

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Introduction

The shoulder lift is the device that is used in arthroscopic shoulder surgery to lift the arm above the body and allows the surgeon to adjust the angle of abduction, traction, and the forward flexion angle. The Arthrex 3-Point Shoulder Distraction System (Arthrex 3PSDS) is the most widely used surgical lift and is currently used in many orthopedic institutions. This lift however has certain negative qualities that surgeons want improved. This project looks to remedy these negative aspects and give surgeons a more desirable surgical lift.

The Current Lift

The Arthrex 3-Point Shoulder Distraction System (Arthrex 3PSDS) supports a person's arm during shoulder surgery but is difficult to use. It keeps the arm steady, stable, and can be adjusted to achieve different arm angles.



Figure 1: Arthrex 3-Point Shoulder Distraction System

Positives	Negatives
Supportive	Heavy
Stable	Difficult to attach
Adjustable	Free Weights
	Unused Parts
	Difficult to Adjust

Table 1: Arthrex Attributes

The Arthrex lift, because of its weight and other aspects is an ineffective surgical tool. The angle of abduction can change but this requires the adjustment of horizontal and vertical bars. Three cables create confusion and slow procedures. The Arthrex 3PSDS also has unused parts, one in particular that serves no function as the device is used today.

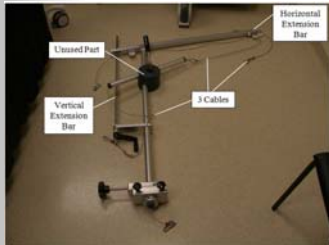


Figure 2: Arthrex Subcomponents

Operating Table Attachment

The current lift is very difficult to attach to the operating table. It weighs 21 lbs and takes several minutes to attach to the operating table. The lift requires two or more people to attach it to the operating table has to be held in position until two knobs are fully tightened.



Figure 3: Clamp



Figure 4: Clamp

Material Determination: Frame and Clamp

The frame and clamp have to be strong enough to support given loads and must resist corrosion. Before and after each surgery, the entire lift is wiped down with Chlorhexidine, a common cleaning agent. The weight of the metal is also an issue as a lighter lift is desired.

Metal	Density (kg/m ³)	Yield Strength (0.2% offset, MPa)
1045 Steel	7850	531
Ti75A Titanium	4506	517
HT 6061 T6511	2700	276

Aluminum Table 2: Material Properties

Discussion

The Arthrex 3-Point Shoulder Distraction System is very stable during surgery and can achieve any arm position. This Arthrex lift however is very heavy and takes too long to attach to the operating table. The new surgical shoulder lift is capable of holding a persons arm stable, can achieve any arm position, is much lighter, attaches much faster, and has no extra parts that can slow a procedure. The next step is to have this tested at the New England Baptist Hospital and analyzed by several orthopedic surgeons. Their feedback can be used to develop a new, more improved model.

SolidWorks and Cosmos

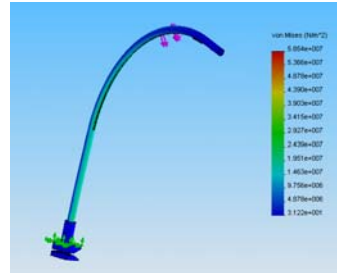


Figure 5: Lift stresses under 25 lb load

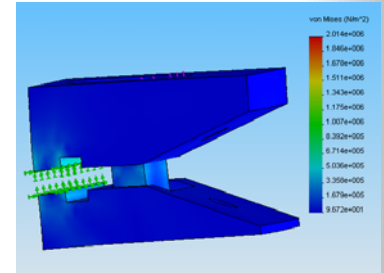


Figure 6: Clamp stresses under 25 lb load

The Improved Lift

The new design is able to achieve any arm position the surgeon may require while weighing less and taking less time to attach to the operating table.



Figure 7

Improvements

1. **Faster Attachment Time**
 - 90 seconds to less than 10 seconds
2. **Lighter Weight**
 - 21 lbs to 12 lbs
3. **Easier to adjust**
4. **New Traction System**
 - No free weights, all spring force
5. **No Unused Parts**

Key Features

1. Spring loaded clamp the securely attaches in under 10 seconds
2. 15 – 90° angle of abduction capable
3. Easy to slide pulley for adjusting angle of abduction
4. Capable of any forward flexion angle with a full 360° rotation possible
5. Spring force traction system
6. No extra parts



Figure 8: New System



Figure 9: Angle of Abduction Slider



Figure 10: Clamp



Figure 11: Clamp

Acknowledgments

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