Inflatable Vertebral Body Distractor

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Overview

- Introduction
- Problem Statement
- Current Designs
- PDS
- Proposed Designs
- Design Matrix
- Final Design
- Future Work

Problem Statement

The goal of this project is to develop a minimally invasive inflatable vertebral body distractor for the lumbar region of the spine that can be easily manipulated and will not cause spinal fractures.

Background - The Spine

Anatomy

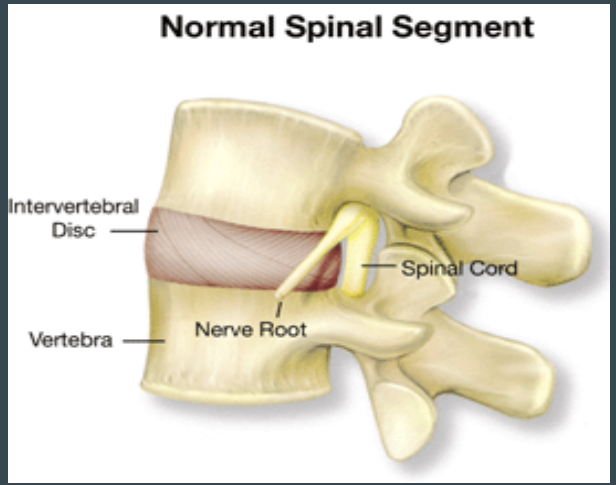
- Vertebral Body
- Intervertebral Disc
- Spinal Nerve
- Spinal Cord

Function

- Structural Support
- Protect Spinal Cord

Disc Degeneration

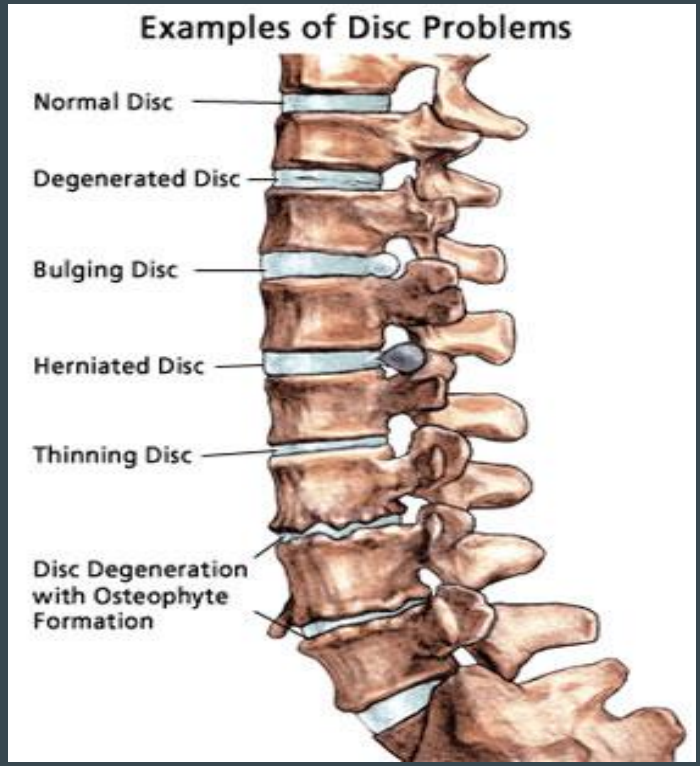
- Fluid content within disc decreases over time
- result in wear and tear
- causes tiny tears or cracks



Background - Surgery

Surgical Procedure:

- Insertion of operating needle
- Insertion of distractor
- Disc space is distracted
- Desired procedure
- Deflation and removal of distractor



Current Designs

Figure 1: Cobb elevator paddle distractor

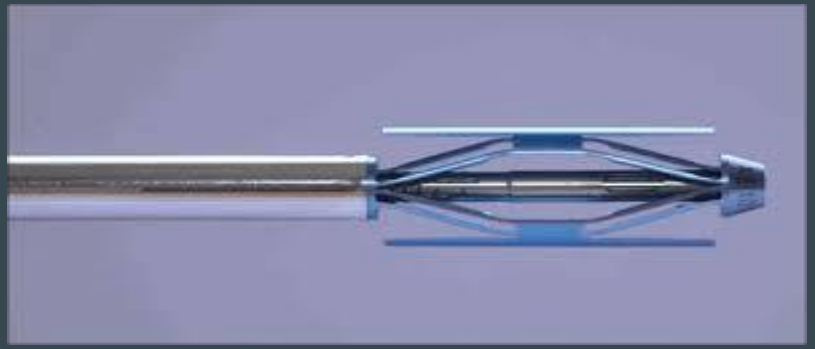


Figure 2: Scissor Jack System

Figure 3: Spine Wave StaXx

Problems

- Too Bulky
- Hard to maneuver
- Cause fracturing of bone
- Poor load distribution

Design Specifications

Mechanics

- Apply 431 N of force
- 1720 kPa
- Distraction of 4-10 mm

Safety

- Biocompatible
- Maximum contact surface

Size

- Pre Inflation: Diameter of insertion needle: 6 mm
- Post Inflation: 25x10x16 mm (maximum)

Function

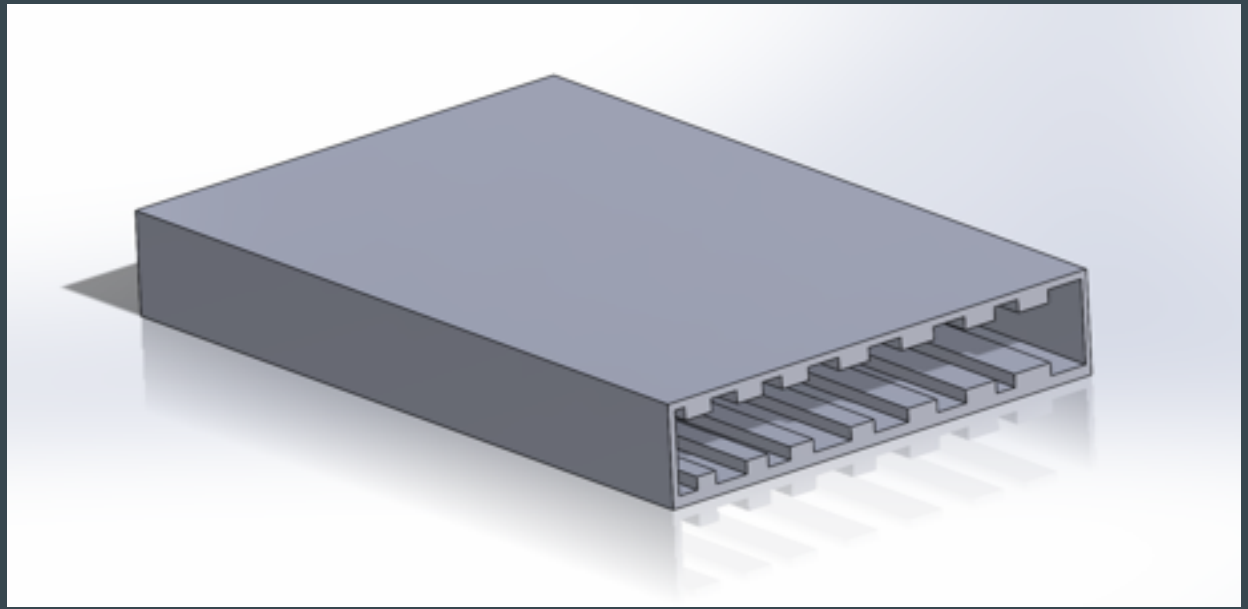
- Minimally invasive
- Feedback mechanism
  - Force
  - Pressure
  - Distraction

Design 1: Balloon

- Similar to a balloon angioplasty

Design 2: Prism with frame meshwork

- Balloon shaped as prism with an internal frame meshwork



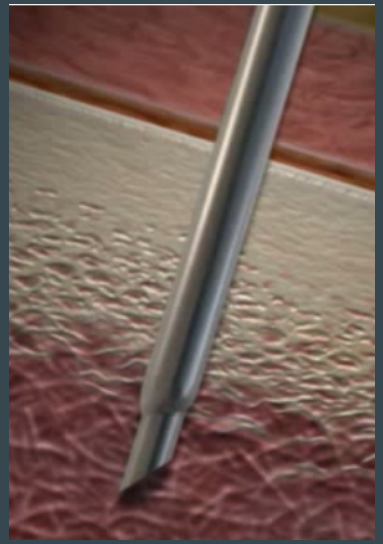
Design 3: Plated Prism

- Inflatable prism with two thicker opposing faces incorporated into the lining of the balloon.

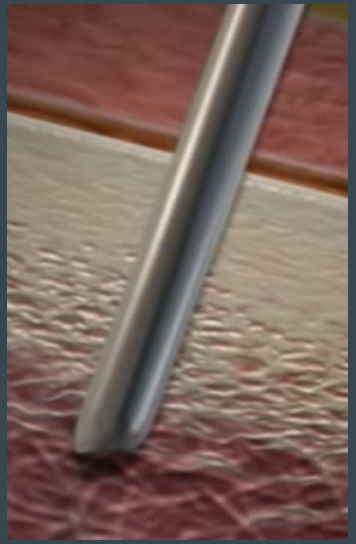
Design Matrix-Balloon

Criteria	Balloon	Mesh Prism	Plated Prism
Safety (25)	2	3	4
Uniaxial Inflation (25)	2	4	5
Ease of Manufacturing (20)	5	2	3
Stability (15)	2	3	4
Size (10)	4	3	2
Cost Effectiveness (5)	5	4	4
Total (100)	59	62	77

Insertion Method - Jamshidi

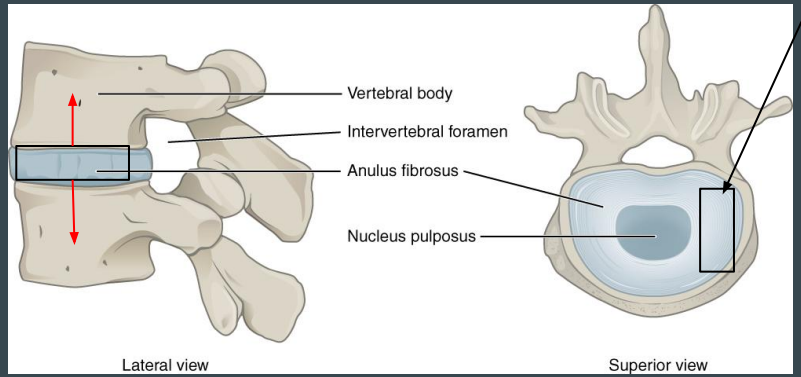


Remove inner needle



Insert device through Jamshidi shaft

Black Arrow: Angle of Insertion
Red Arrows: Direction of Inflation



Future Work

- Method of device placement - Jamshidi
- Method of device removal
- Decide what material to use for inflation
- Testing methods
- Fabrication

Acknowledgements

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Our Advisor, Professor Mitch Tyler

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