

Team B14: Non-Ferromagnetic IV Medical Pole for Delivery During MRI



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Motivation



Figure 1: Projectile incident involving an IV pole¹

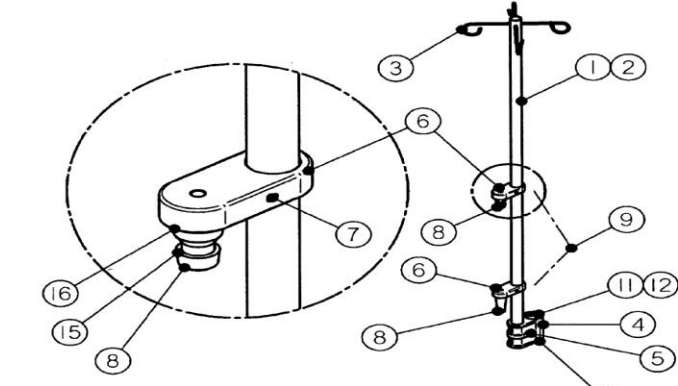


Figure 2: Non-Ferromagnetic IV Transfer System patent²

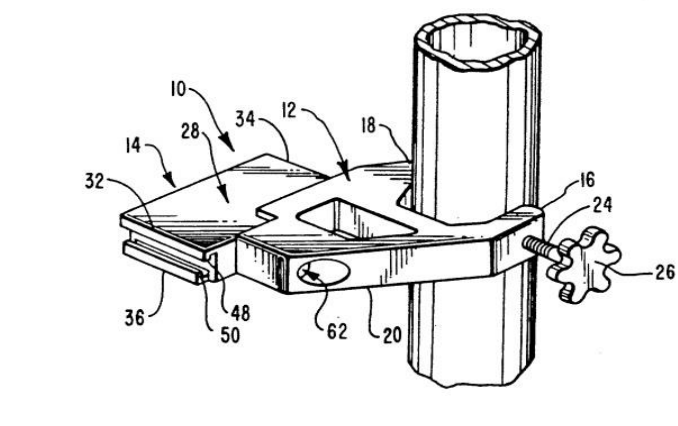


Figure 3: Universal I.V. stand mounting system patent³

It is hazardous to have any loose metal in an MRI room during use because its strong magnetic field attracts ferromagnetic objects with considerable force-known as a projectile incident. IV poles are often magnetic and may become projectile. Non-ferromagnetic IV poles exist, but they are not distinguishable from their counterpart because they have a similar design and use the same universal clamping system.

Goal: Develop an easily distinguishable IV pole system that is only compatible with nonferromagnetic components.

Methods/Design

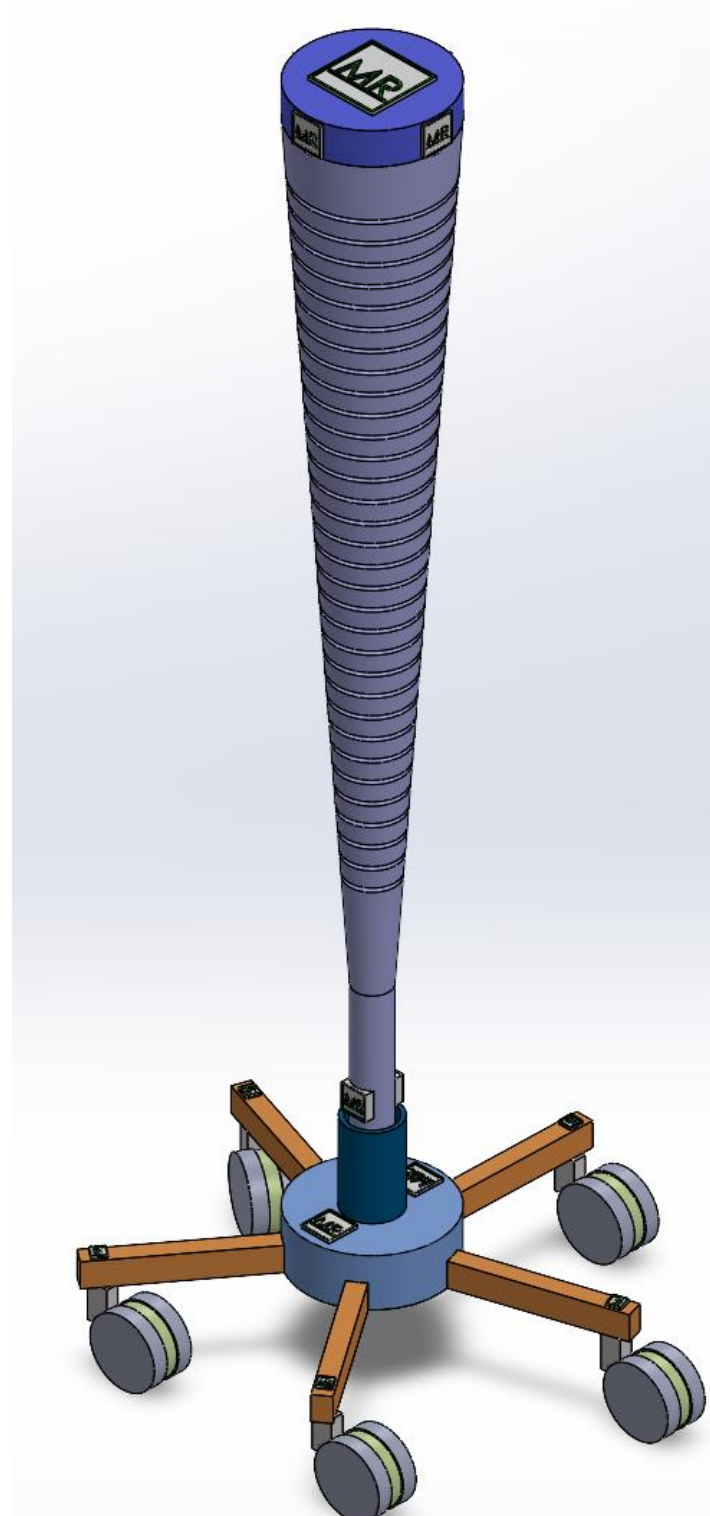


Figure 3: Full pole CAD design

Primary Components

- Inverted conical shape
 - Prevent the attachment of universal-style clamps
- Lateral clamping slits
 - Conforms to Cardellini clamps
- Embedded MRI-safe labels
 - Prevent displacement of MRI-safe labeling that occurs with standard labels

Other Considerations

- Hospital architecture standards
- Field standard cleaning reagents

Results

Mechanical Stability Testing

- FEA testing under exaggerated load using **SOLIDWORKS** simulation for the pole (ABS-M30i) and live testing for the base (standard Polylactic Acid).
- Examined both for stress, displacement, and material failure.
- PLA parts exhibited no internal deflection following repeated comparable loading and loaded lateral movement

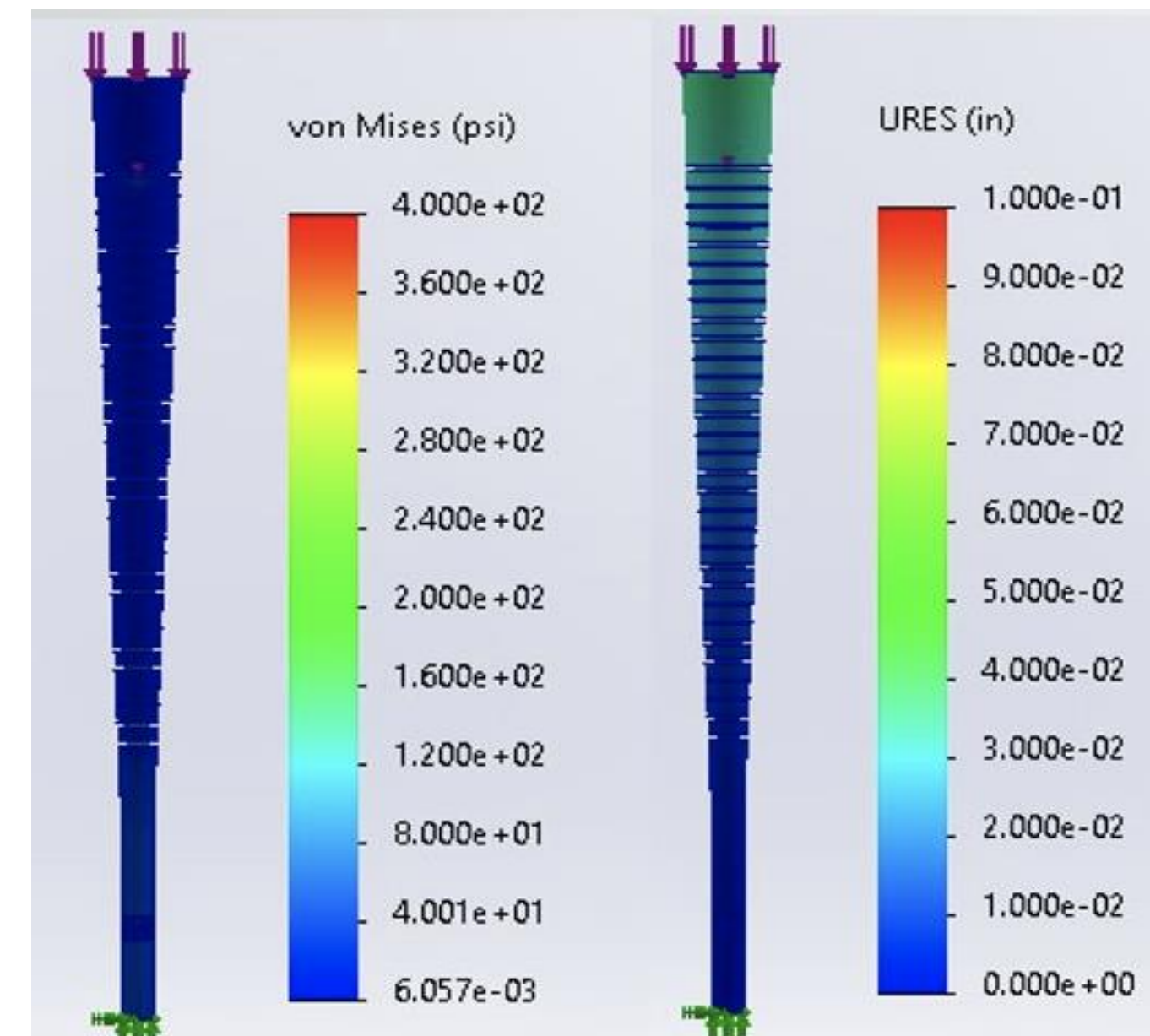
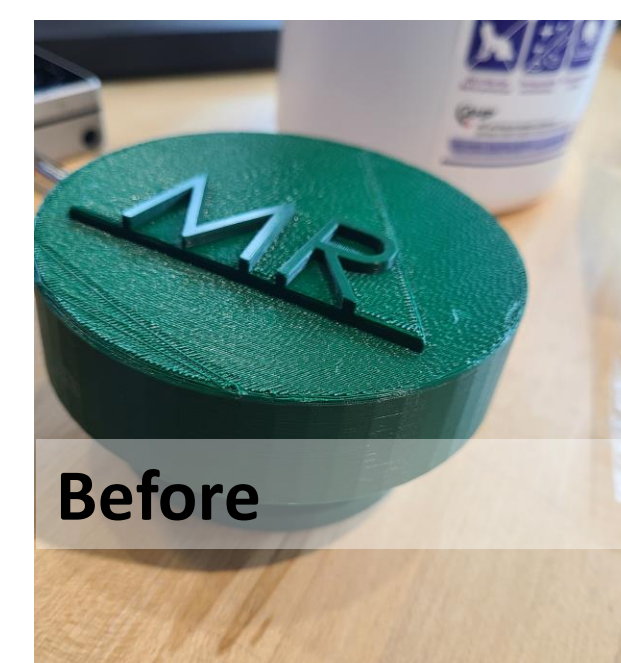


Figure 4: SOLIDWORKS FEA loading simulation for (left) stress and (right) displacement



Before



After

Chemical Stability Testing

- Oxivir TB Wipes were used to test label durability on a pole.
- 100 wipes were applied to the labeled area.
- No noticeable changes were observed in the label's appearance.

Pole Specificity Testing

- Tested using standard universal style clamp
- Compared clamping efficiency on design angle (87°) and control angle (90°)
- Design angle was successful in preventing clamp attachment



Figure 5: (left) A subsection of our designed pole. (right) a pole with a standard angle

Conclusions

- We have been able to confirm the following:
 - The pole angle is sufficient to prevent the universal clamp is does not attach.
 - PLA, which composes the base and cap, is capable of withstanding the typical cleaning reagents that the pole will interact with.
 - The pole architecture with our chosen materials can withstand the loads it would be carrying in the hospital

Bioethical Implications

- The pole is made out of non-ferromagnetic components, preventing dangerous mix-ups.
- User-friendliness factors we considered concerning the pole's usage by nurses:
 - Pole Height
 - Pole Weight
 - Distinctive design
 - Eye-Friendliness for the label

Future Work



Improve Clamp Design

- Used Cardellini clamp design as our baseline
- Improve these clamps using more stable non-ferromagnetic components

Source Superior Materials

- Scale of our project made full-size materials sourcing difficult
- Mass production will allow for unsegmented poles to be utilized



Cleaning/Maintenance Platform

- Advertise bulk IV pole product to hospitals, including regular preventative maintenance schedule and cleaning provisions
- Make our product more appealing in the health care market.

References

1. Image courtesy of Dr. Stanley Fricke
2. Reuhl J, Lingel C, Bedel C. Advanced IV Transfer System. Published online 2008.
3. Justia Patents. Iv pole clamp. Justia. March 3, 2020. Accessed October 14, 2023.