

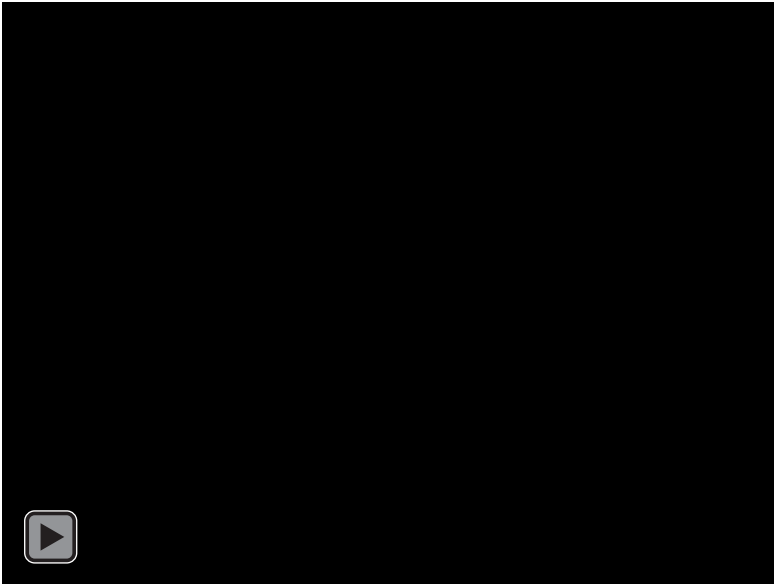


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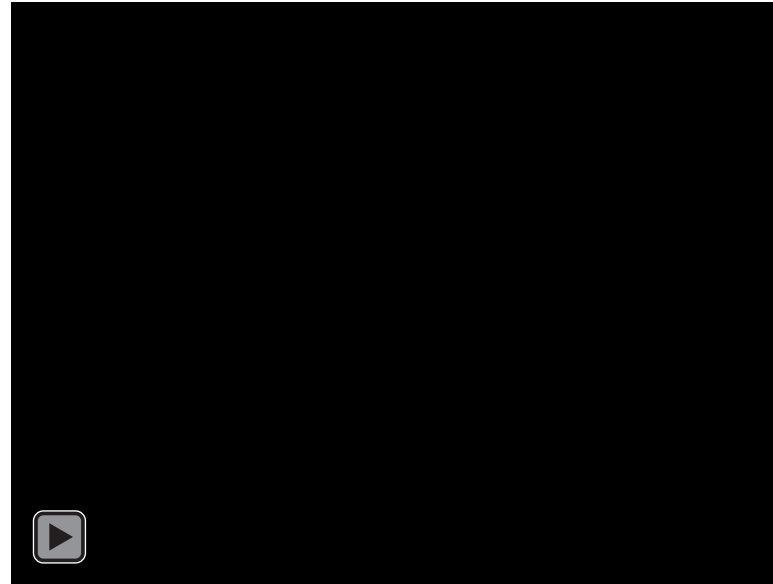
# Stainless Steel – NITI Surgical Instruments Enabled by Ultrasonic Additive Manufacturing

Boyd Panton, Marcelo Dapino, Leon Headings, Mark Gingerich,  
and Jennifer Morris

# Nitinol has the ability to Recover Shape



For a similar example see:  
<https://www.youtube.com/watch?v=wKoc7-APFsk>



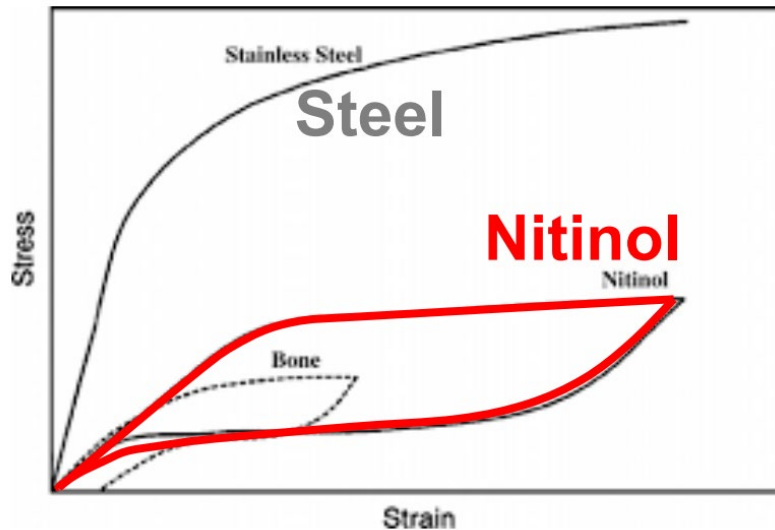
For a similar example see:  
<https://www.youtube.com/watch?v=r-Bqse9cqo8>



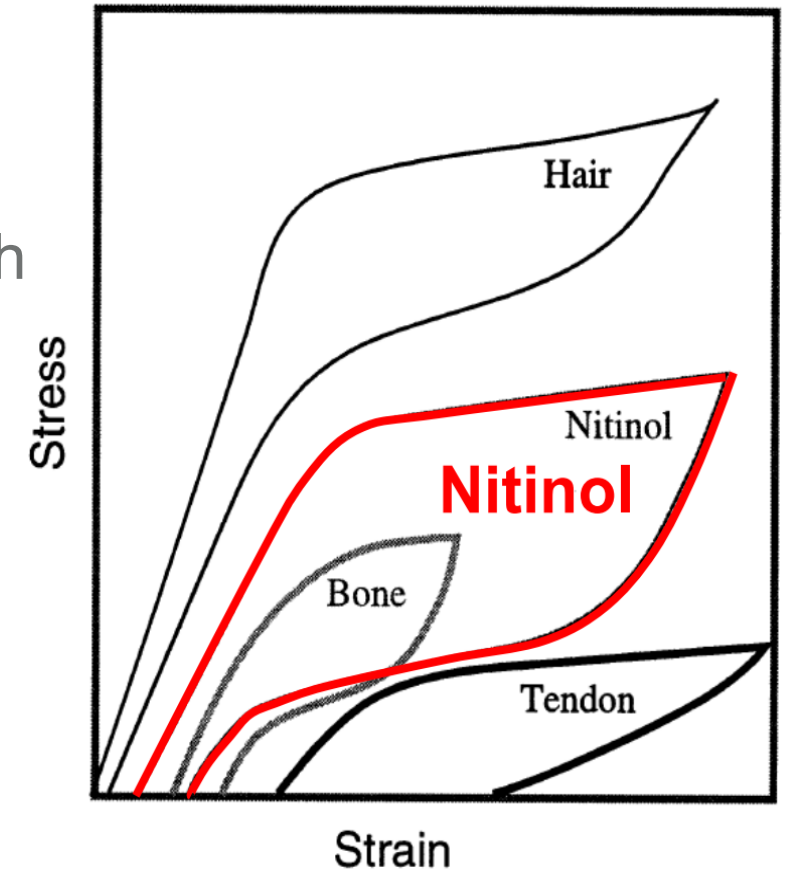
# Nitinol moves like the body

- Steel implants can damage the body due to incompatible mechanical properties

- Nitinol implants integrate with the body



[http://www.mie.uth.gr/ekp\\_yliko/NiTiImplants.pdf](http://www.mie.uth.gr/ekp_yliko/NiTiImplants.pdf)

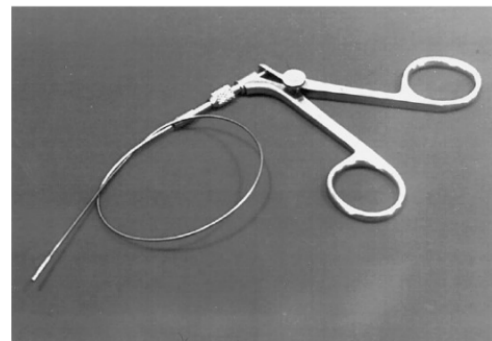
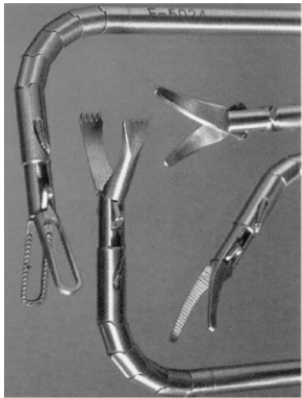


[Duerig et al. 1999]

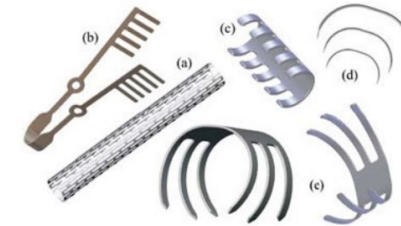


# Nitinol is used in many medical tools

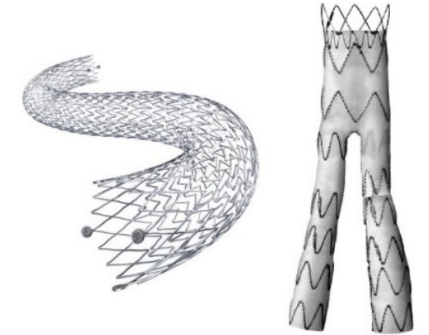
## Surgical Tools



## Implants



## Stents



## Orthodontics



# Nitinol use is limited by inability to join to other materials

- Current tools are mostly only made of NiTi (wires, drills, stents)
- Tools that are made of NiTi combined with other materials are limited to mechanical joining (clamping), which significantly limits design freedom and thus patient care
- Metallurgical joining with fusion techniques degrades the NiTi properties and forms brittle intermetallic which severely reduce the mechanical properties (unfit for service)
- Developing a method of joining NiTi to other materials will allow significant advancement in medical device manufacturing
- Ultrasonic additive manufacturing (UAM) is a solid-state joining method that has promise in creating some of these tools

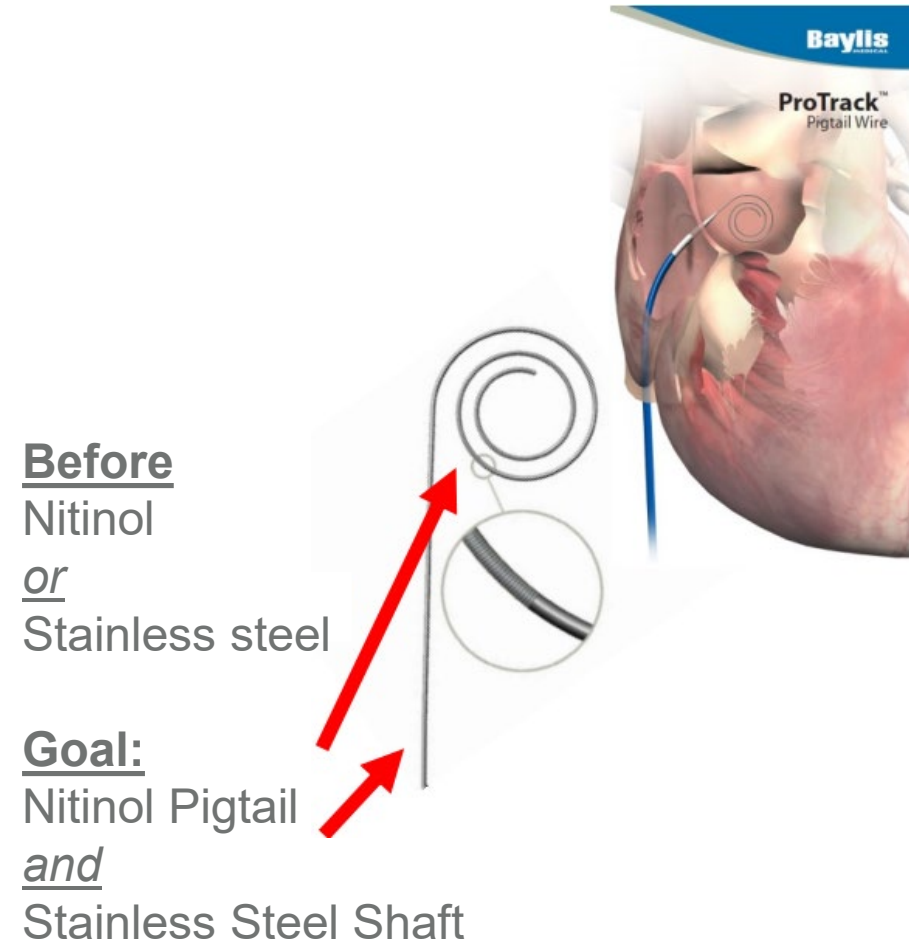


# Re-think Engineering

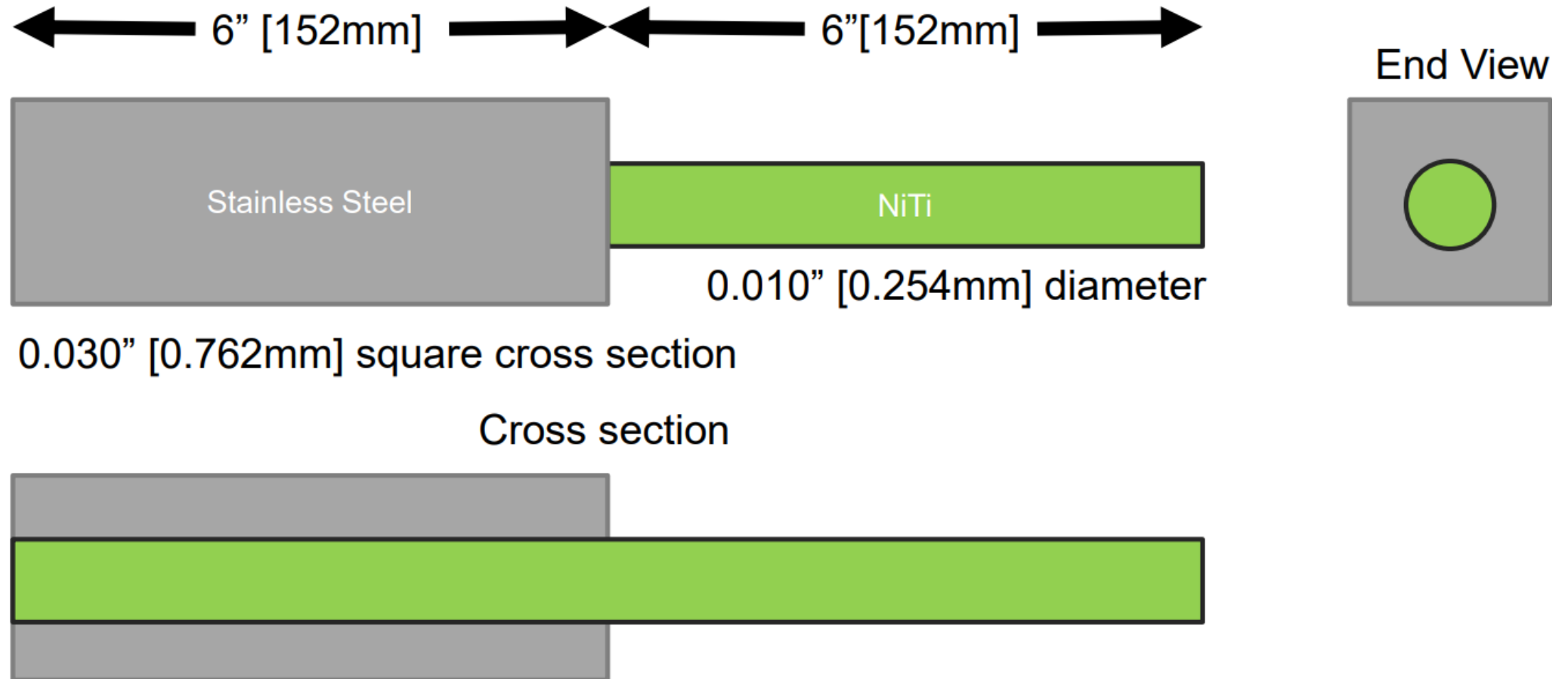
## Example Application

- A NiTi guidewire maintains its shape, giving the surgeon the optimal tool shape to treat the patient, but it is very flexible so difficult to control
- A stainless steel (SS) guidewire is much stiffer than NiTi, giving the surgeon great control to treat the patient, but it plastically deforms so loses its optimal shape.
- A tool with a SS shaft and a NiTi tip would provide the best of both cases above
- UAM could be used to create this tool

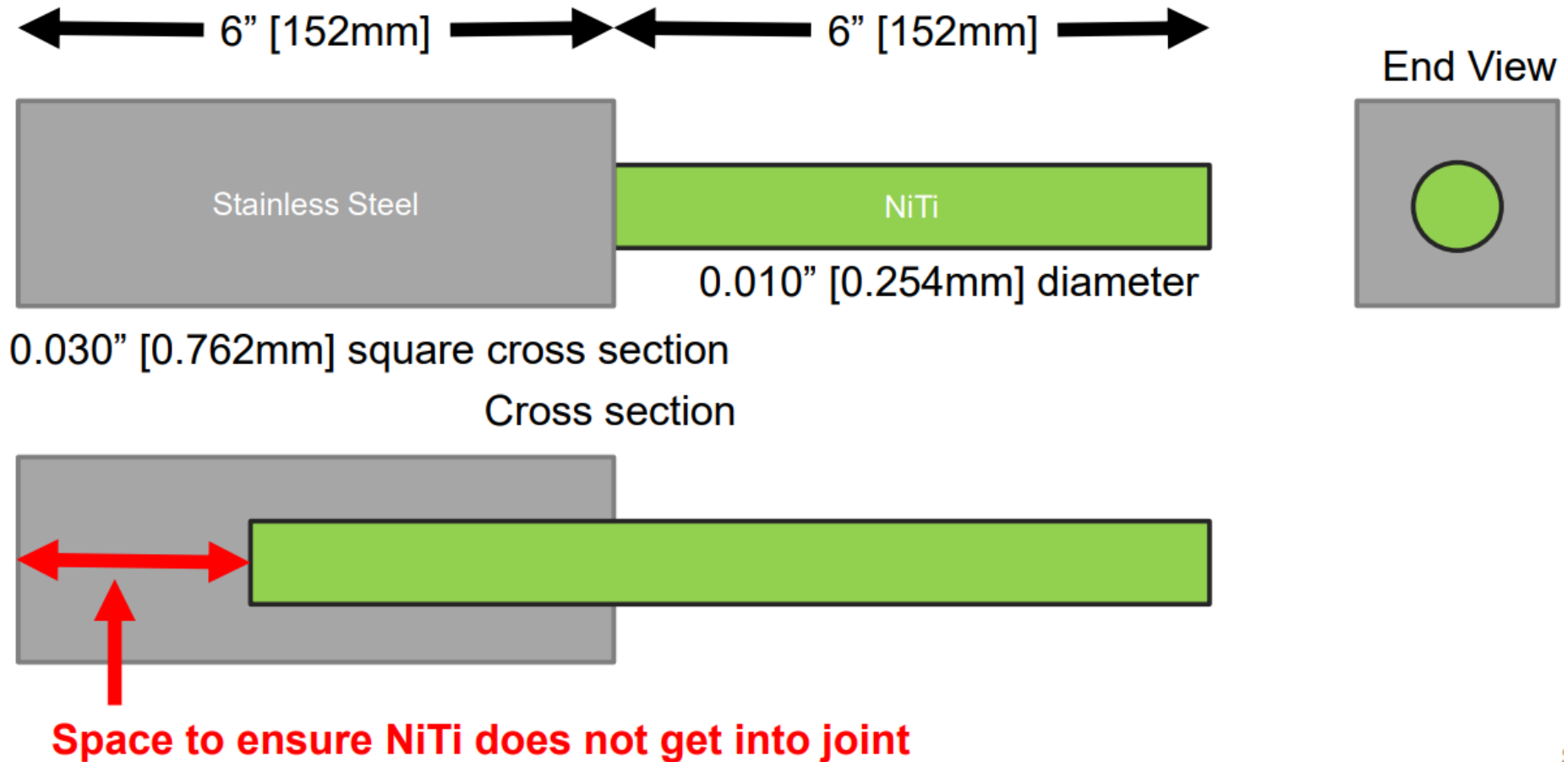
## Cardiology Guidewire



# Initial Prototype

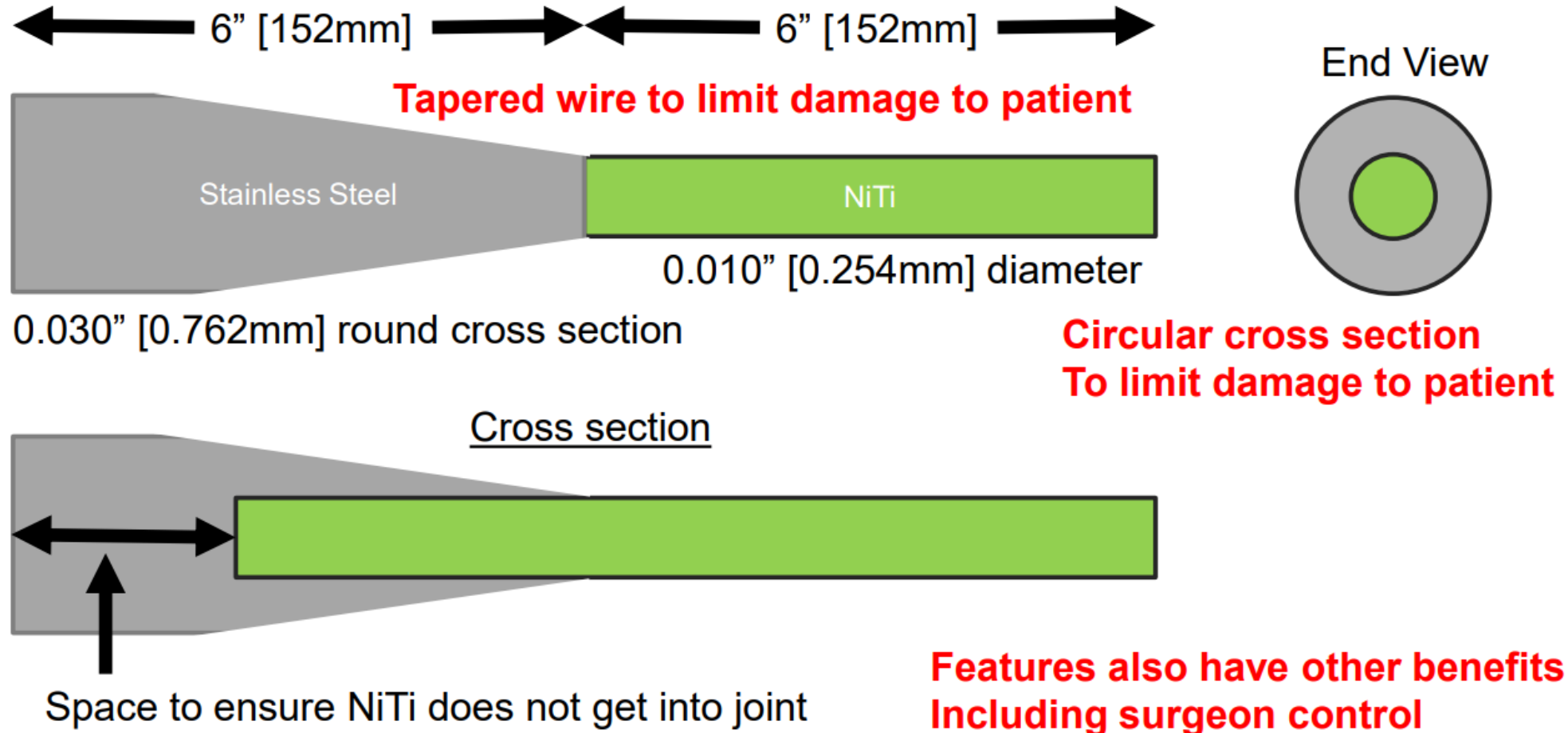


# For Joining to Stainless Steel



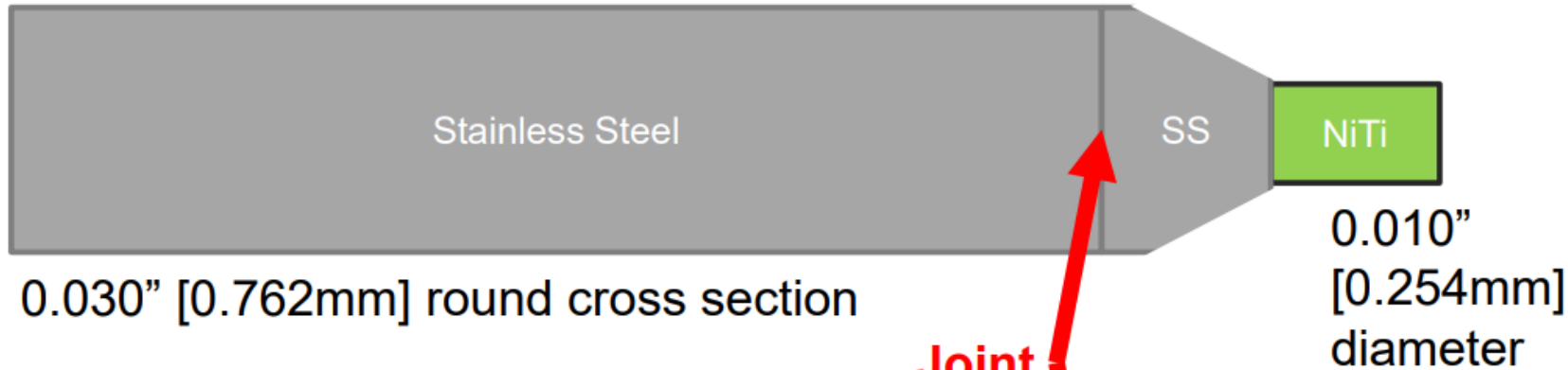
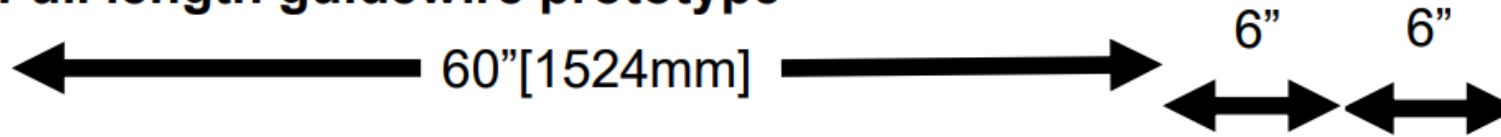


# Machining of Stainless Steel



# Joining to Stainless Steel Wire

Full length guidewire prototype



0.030" [0.762mm] round cross section

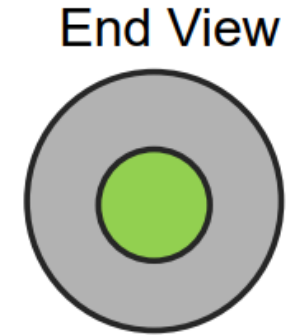
0.010" [0.254mm] diameter

Cross section

Joint

UAM

**Tip can be straight, Pigtail, J or other  
See wires on Slide 4**



End View

