Using Nitinol Continuous Compression Clips for Chest Wall Injuries

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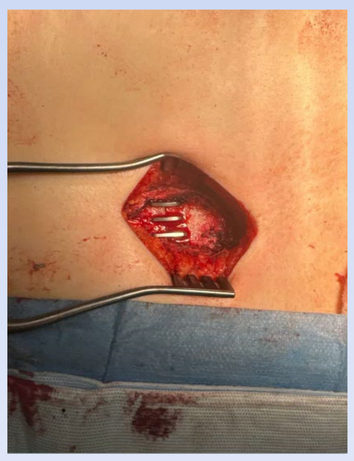
Introduction

- SSRF has become an accepted option for many severe chest wall injuries.
- Sternal fractures and costochondral disruptions techniques are less standardized.
- Nitinol has recently been developed for fixation as a low-profile, continuous compression implant.
- Nitinol is equal parts nickel and titanium.
- "Super-elastic" + structural memory.
- We present a series of patients with unstable sternal fractures and/or costochondral disruptions who were stabilized using nitinol clip implants with successful outcomes.



Nitinol clips demonstrated on the sternum.

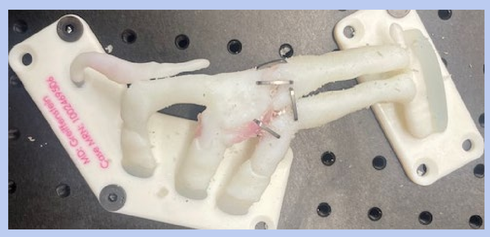
Case Series

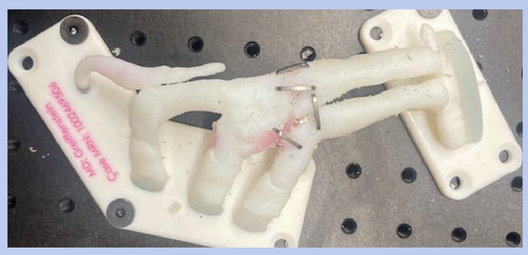
Case 1

- 35-year-old female: nondisplaced anterolateral left fourth and fifth rib fractures, severely displaced and unstable right second through fifth rib fractures with associated flail chest, an unstable, displaced sternal body fracture, and a right anterior pneumothorax.
  - SSRF of the fractures to right ribs three through six and Nitinol clip placement to the sternum.

Case 2

- 36-year-old female: nondisplaced left eighth rib fracture with associated pulmonary contusion and a sternomanubrial fracture with associated dislocation.
  - Initially underwent sternomanubrial fixation. On post-op visit found to have displacement of hardware & pain.
  - Underwent hardware removal, ORIF of the sternomanubrial fracture with Nitinol clips, and replacement of the plating hardware.





3D Model of clips in place.

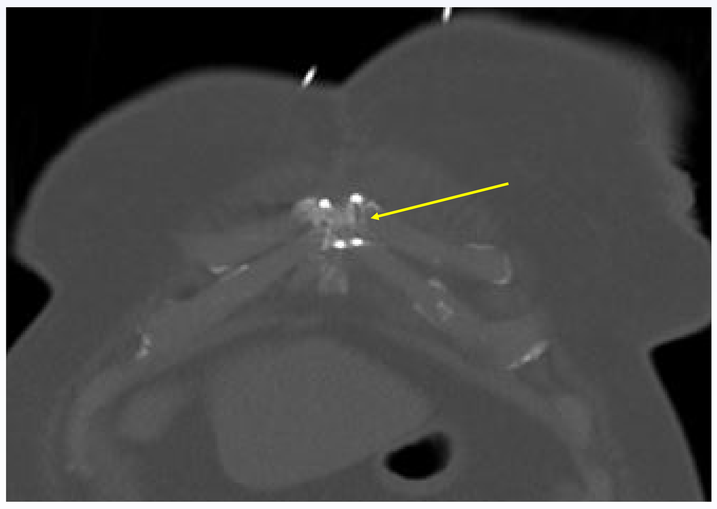
Case Series

Case 3

- 61-year-old female: non-displaced right fifth through seventh rib fractures, minimally displaced left ribs fifth through seventh rib fractures, and a severely comminuted sternal fracture with associated sternal flail.
  - Initially underwent ORIF of the sternum. On post-op visit, she had continued pain.
  - Underwent repair of chronic nonunion of the lower sternum, debridement and fixation of the joint with nitinol clips and bone marrow aspirate concentrate (BMAC).

Case 4

- 46-year-old female: displaced left sixth through ninth rib fractures with associated hemothorax. On post-op visit had continued chest pain.
  - Underwent SSRF of the left ribs five through nine.
  - CT one year later demonstrated chronic nonunion of the left rib fractures at the costal margin.
  - Underwent SSRF of the left sided rib fractures.
  - Her pain returned and CT scan revealed hardware fracture.
  - She underwent removal of the fractured hardware with resolution of her pain.
  - Patient continued to experience chronic pain; she underwent multiple rounds of cryoablation with interventional radiology.
  - Chest CT with reconstruction demonstrated chronic nonunion. She underwent Nitinol clip placement with BMAC.



Postop CT scan of patient 3 showing complete bony healing of fracture (arrow) at 3 months.

Conclusion

This case series highlights the use of Nitinol clips in complex chest wall repair.
Its advantage is in small surgical wounds with limited landing zones for hardware fixation requiring stabilization and continuous compression for osteosynthesis.