Sternal Fractures

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Injury/Disease Demographics

- Sternal fractures after blunt trauma are relatively uncommon (0.33%).
- Before airbags were introduced, the incidence of sternal fractures was much higher (3-6.8% in motor vehicle collisions).
- Sternal fractures are predominantly associated with deceleration injuries and blunt anterior chest trauma.
- The most common mechanism of injury is MVC followed by auto vs pedestrian.
- Associated injuries:
    - rib fractures occur in 49.6%
    - blunt myocardial injuries in 8%,
    - thoracic aortic injuries in 4%
    - cardiac lacerations in 2.4%
- Sternal fractures can be markers of more severe injuries: traumatic brain injuries (48%), thoracic spine (38%), lumbar spine (27%), and cervical spine (22%).
- Elderly patients, post-menopausal women and patients on long-term steroid therapy are at particular risk.

Evaluation/Diagnostics

- Patients with sternal fractures present with acute sternal pain, aggravated by deep breathing and coughing.
- Patients may have localized tenderness and signs of respiratory insufficiency, these include tachypnea, cyanosis, and the use of accessory muscles for ventilation.
- Inspection of the anterior chest wall may show ecchymosis or contusion with or without a step off deformity.
- Palpation may reveal crepitus secondary to the fracture.
- The majority of sternal fractures are seen on CT scan only and the vast majority of these are not clinically significant. These "CT-only" injuries are associated with low mortality.

Management

Non-operative Management:

- The overwhelming majority of sternal fractures can be managed non-operatively.
- Sternal fractures which are transverse, oblique, comminuted, or compressed can be managed non-operatively. As long as the patient does not have concern for cardiac injury or a large retrosternal hematoma causing cardiac compromise, the injury should be managed non-operatively. The majority of these heal without incident and a very small number of these sternal fractures will have non-union of the fracture.
- Non-union of sternal fractures is at risk of infection from hematogenous seeding of bacteria.

- Sternal fractures can either occur in isolation, or with other associated injuries. Prognosis is excellent for isolated sternal fractures, with most patients recovering completely over a period of weeks (average 10.4 weeks).

Indications for Operation:

- Sternal fractures are uncommon and most can be managed non-operatively as such surgical indications are limited and less common; operative fixation may be indicated for markedly displaced or unstable fractures.
    - Transverse, oblique, posterior dislocation sternal injuries where the ends of the fracture are either significantly distracted, are distracted during respiration, or there is concern with cardiac compression during respiration should be considered for stabilization.
    - These sternal injuries will remain unstable with the likely potential for non-union to occur.
- These may cause debilitating chest pain or be associated with flail chest, compromising pulmonary or cardiac function.

Preoperative Preparation

- It is essential to address other lifesaving injuries first:
    - A pneumothorax should be initially decompressed with a chest tube.
    - If the patient has a blunt myocardial injury, this must first be stabilized.
    - The possibility of an aortic injury should be evaluated and if discovered should be addressed.
    - Any spine injuries should be defined and addressed for those needing operative stabilization.
- For patients with a significant retrosternal hematoma and a sternal fracture, a cardiac injury should be considered:
    - If the retrosternal hematoma is compressing the heart, hemodynamic effects should be decompressed with a medial sternotomy. Once decompressed, the pericardium should be opened to confirm there is not an associated cardiac injury.
    - In the stable patient, a pericardial window can assess the integrity of the pericardium. If hemopericardium is present a median sternotomy to evaluate the heart is indicated. In this setting the sternum is occasionally left open due to cardiac swelling. Formal repair of the sternum should be done when the patient is stable.

Operative Technique

- Sternal fixation has historically been performed using sternal wires. More recently formal osteosynthesis using plate and screws has become the preferred method for stabilizing a fractured sternum.
- The patient should be supine position. Adequate IV access and an arterial line should be placed. The arms are placed next to the patient in stable condition. Pre-operative prophylactic antibiotics are given.
- The majority of simple repairs can be performed with sternal plates.
- Injuries not requiring median sternotomy:
    - A 2 D lateral view CT scan of the chest is essential the measure the sternal thickness as an initial estimation. Otherwise, once the screw hole is drilled one must use a depth gauge to assess the thickness of the sternum for appropriate screw selection.
    - Several commercial plate systems are on the market. Some are placed transversely for midline fractures. Most are placed longitudinally long the length of the sternum or overlapping the manubrium.
- Dissection of the anterior sternum should be only to expose enough of the sternum for the plate to lay flat. The periosteum of the sternum should not be stripped off but preserved as much as possible.
- The distracted fracture should be debrided and any devitalized tissue should be removed from the fracture site. The ends of the fracture should be approximated.
- A drain is typically not required unless there is concern for significant oozing from the bone or tissues
- The incision is closed in standard fashion with subcutaneous tissue and skin closed in layers.
- Sternal repair for patients undergoing median sternotomy can be repaired using standard wires, commercial ties, or transverse plates

Postoperative Management and Potential Complications

- Most patients will have typical post-operative pain easily managed with narcotics which can be quickly titrated down.
- Consider muscle relaxants
- Complications following sternal fractures include short and long term sequelae:
    - Short term complications include chest pain post-injury, which has a mean duration of 8 to 12 weeks for all age groups.
    - Hardware pain can develop 6-12 months after the sternum has healed. It is typically manifest with a “band-like” pain across the upper chest in patients who had sternal stabilization overlapping the angle of Louis with a longitudinal plate. This is most likely due to the lack of natural flexibility of the manubrium sternal junction. Elective removal of the hardware will typically resolve the pain.

Special Populations

- Diabetic mellitus patients are at higher rise of wound infection and sternal infection.
- Post CABG patients are special concerns especially if they have had prior IMA bypasses which may compromise the sternal blood flow. This increases the risk of wound and sternal infection.

Suggested Readings

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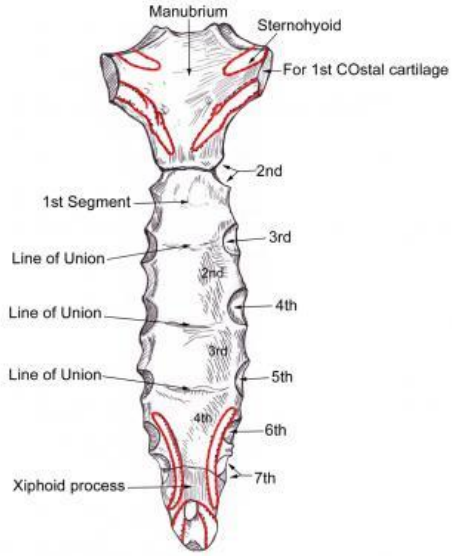
Manubrium
Sternohyoid
For 1st COstal cartilage
2nd
1st Segment
3rd
Line of Union
2nd
4th
Line of Union
3rd
5th
Line of Union
4th
6th
7th
Xiphoid process

Sternal Fractures: plain film and CT scan of the chest reconstruction

Sternal fracture: 3D