

# Aseptic Bone Resorption Following Cranioplasty

## *A Systematic Review Of Overall Incidence And Risk Factors*

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# Disclosures

None

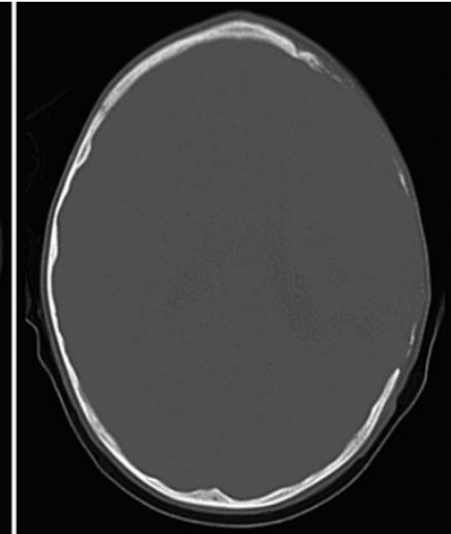
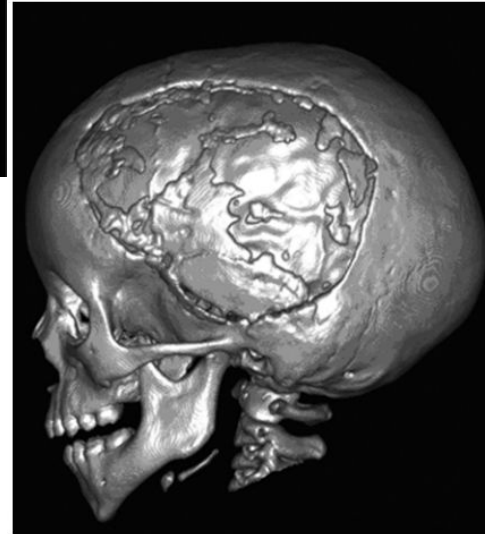
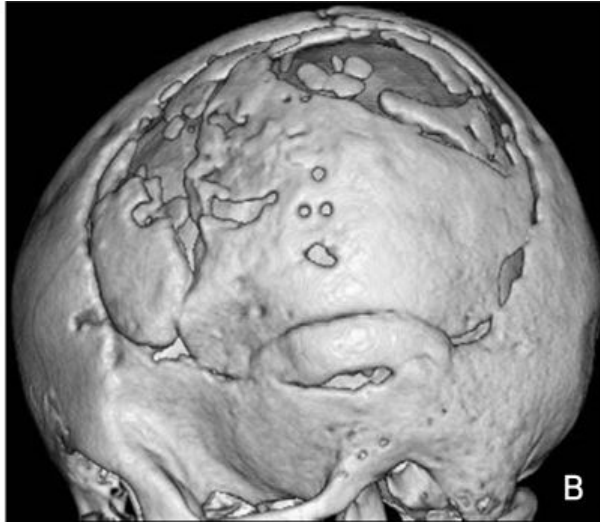
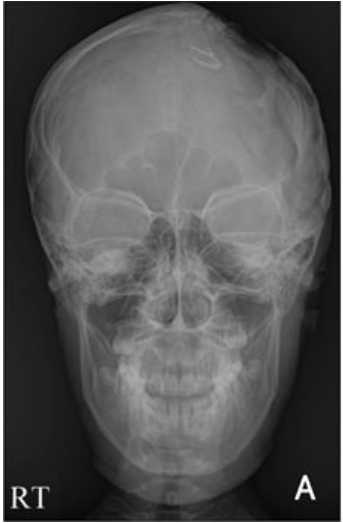
# A History Of Cranioplasty

- 3000 BC - Incas in Peru with **gold & silver**
- 460 BC - Hippocrates
- 170 AD - Galen
- 1565 - Fallopius & Petronius - gold plate
- 1668 - van Meekeren, unnamed surgeon, **canine bone**
- 1940 - Methylmethacrylate

# Complications post-cranioplasty after decompressive craniectomy

- Infection
- Hemorrhage
- CSF disturbances
- Cosmetic defect
- Seizures
- **Resorption**

11 yo girl with AVM rupture  
1 year post-cranioplasty



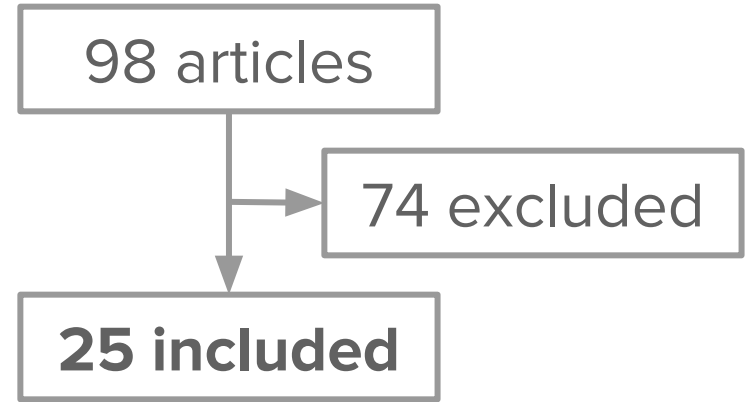
2 yo girl, trauma  
3.5 months post-cranioplasty

# Methods

- PRISMA guidelines
- Query: “cranioplasty AND resorption”
- PubMed, 2005 - 2015
- >3 months follow up
- Humans, all ages
- Outcome: any mention of resorption
- Risk factors

# Results

- 25 articles
- 2,062 procedures
- Adult (17), pediatric (4), mix (4)
- Range of outcomes
  - asymptomatic cortical thinning on imaging
  - significant cosmetic defect requiring reoperation
- Risk factors
  - **age (8)**
  - VP shunt (1)
  - timing of cranioplasty (1)



overall rate of resorption

**14.9%**

n = 307 / 2,062

- Compared to infection: 6.0%
  - 2015 review (n=565/9359)
- Under-diagnosed
- Often no need for intervention



# Age < 18 is a risk factor for resorption

- Eight studies looked at age
- Younger age was a significant risk factor
  - 4 studies with all ages
- Pediatric-only studies found a **50% incidence**
  - 4 studies, 55 of 111 patients
- Odds of resorption in pediatric: **OR 7.36** ( $p < 0.0001$ )
  - Mantel-Haenszel pooled OR using 3 studies, fixed-effect, 231 patients

# Why is it increased in children?

- Pathophysiology is unclear
- **Growth**
  - High level of bone turnover and metabolic activity
  - Highest risk between 0-7 years
  - Leave dura intact if < 2 yo?
- Thinner skull

# Other risk factors

- Presence of a VP shunt
  - OR 35.6 ( $p < 0.0001$ )
- Cryopreservation vs subcutaneous storage ?
  - Thinner calvarial width on CT with cryo ( $p = 0.039$  ?)
- Timing of delayed cranioplasty ?
  - 15% early ( $< 6$  wks) vs. 19% late ( $> 6$  wks) ( $p = 0.5863$ )
- Larger defects had a higher rate ( $> 75$  cm<sup>2</sup>)
- Autoclaving

# Conclusions

- Rate of resorption is higher than infection
  - **14.9% incidence** for all ages
  - Underreported, often left untreated
- Pediatric patients are at greatest risk
  - **50% incidence in children**
  - **OR 7.36** ( $p < 0.0001$ )
- No recommendations
  - Increased awareness

# Future work

- Classification of resorption patterns
- Reoperations
- Timing of cranioplasty

# *Questions?*

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# References

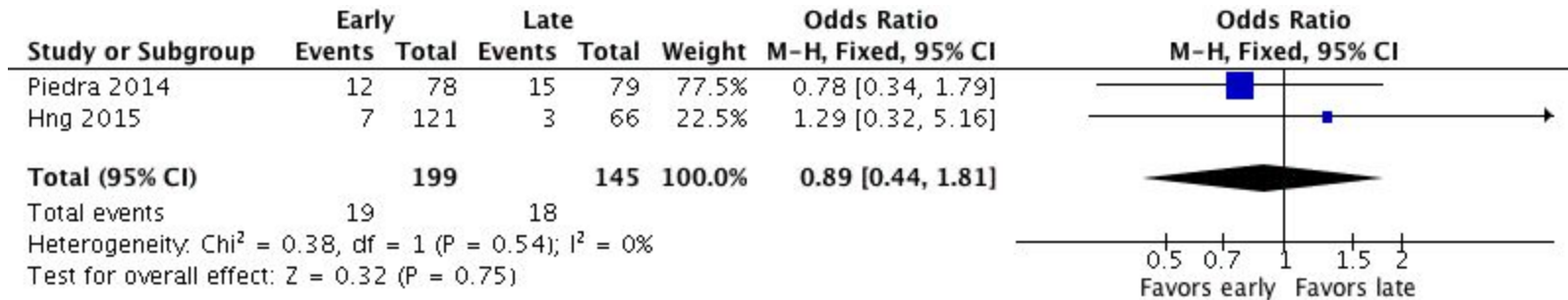
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# Early cranioplasty does not increase odds of resorption

Cranioplasty within 3 months of craniectomy

OR 0.89 p-value 0.75



# Cryopreservation may carry some risk

- Dominant storage method is cryopreservation
- General consensus is that flap resorbs in abdomen
- No good studies looking at this
  - Zingale review found no significant risk but still recommended cryo
- Three studies utilized subcutaneous pockets
  - 195 patients
- One study found thinner cortical width with cryo
  - Unable to replicate stat calculations