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

Sanan 1997, Aciduman 2007
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”
● >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$^2$)

● Autoclaving

Mracek 2015, Cheng 2014, Piedra 2014
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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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