

# Which Synthetic Material in Cranioplasty has the Best Post-Operative Outcomes?

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## BACKGROUND

Cranioplasty restores skull integrity after craniectomy, trauma, or tumor resection. Complication rates remain high including infection, implant exposure, and failure often requiring revision surgery.

Multiple synthetic materials are available, yet postoperative outcomes vary widely depending on implant choice. Implants include:

- Titanium Mesh
- Polymethyl Methacrylate (PMMA)
- Polyether Ether Ketone (PEEK)
- Ultra-High Molecular Weight Polyethylene (UHMWPE)

## PURPOSE

Which synthetic cranioplasty material produces the best postoperative outcomes in terms of the lowest complication rates and best cosmetic results?

**Hypothesis:** Polymer-based implants (PEEK, UHMWPE, PMMA) will demonstrate superior outcomes over titanium mesh in infection rate, implant removal, and patient satisfaction.

## METHODS

**Databases:** MedLine, CINAHL, ALT Health, ProQuest

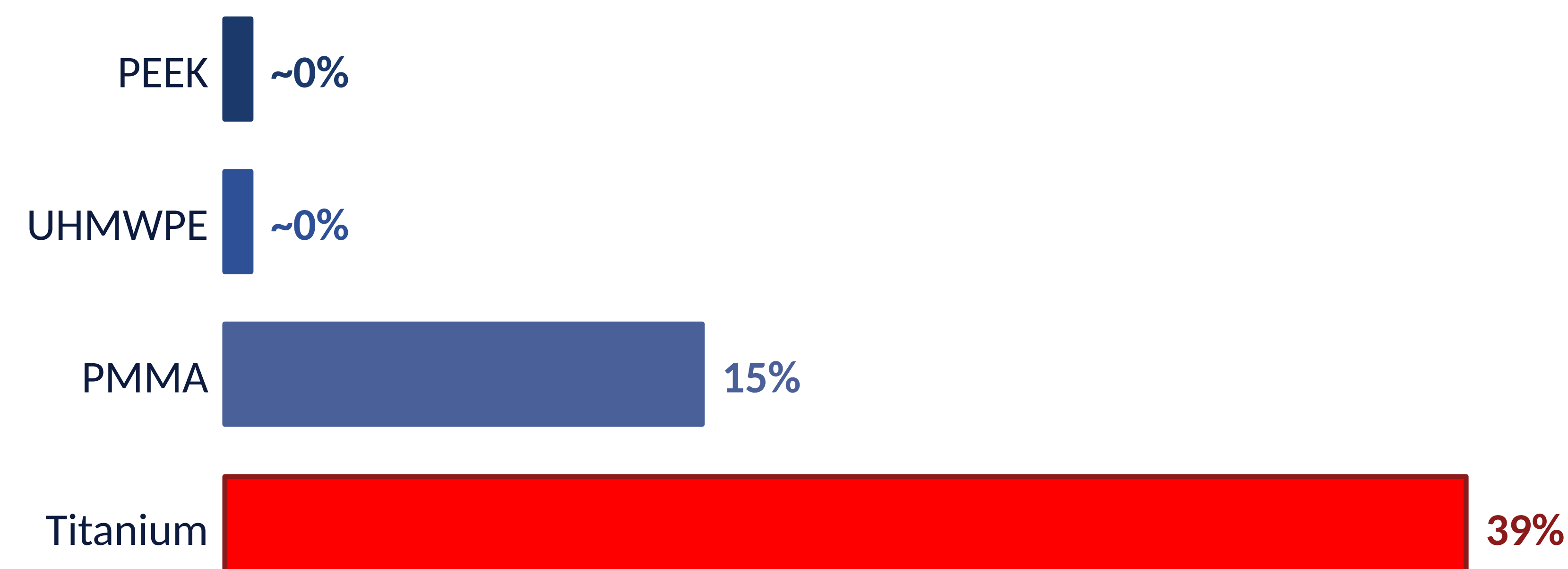
**Framework:** PICO (cranioplasty patients, synthetic implants)

**Outcomes:** Infection rate, removal rate, cosmetic satisfaction

214 identified → 42 reviewed → 10 included

## RESULTS

### Infection & Complication Rates by Material



### Implant Survival Rate (%)



### Cosmetic Satisfaction Rate (%)



Data derived from a systematic review of 10 peer-reviewed studies identified through MedLine, CINAHL, ALT Health, and ProQuest databases (2017-2025).

## DISCUSSION

Across all 10 studies, polymer implants — PEEK, UHMWPE, and PMMA — consistently outperformed titanium mesh in every outcome category, supporting the hypothesis.

### Lower Infection Risk

Polymer flexibility reduces dead space & stress shielding

### Higher Implant Survival

Patient-specific fit improves long-term retention

### Better Cosmetic Outcomes

Precise anatomical contouring → higher patient satisfaction

### Titanium: Limited Role

Best reserved for urgent or infection-related cases only

## LIMITATIONS

- Mostly retrospective, small sample sizes
- Varied follow-up periods across studies
- Single-center designs limit generalizability
- No randomized controlled trials available