

Title	Infection rates following custom-made cranioplasty using heterologous materials: insights from a systematic review on 3260 patients with a focus on follow-up length
Journal	Neurosurgical Review
Authors	Faedo F, Zaed I, Pizzi A, Iaccarino C, Servadei F.
Study type	Systematic Review.
Product	Cranioplasty materials: PEEK, PMMA, titanium, HAP, Composite
Objective(s)	Post op cranioplasty complications (focus infections)
Method of Analysis	Systematic literature review for published articles reporting on complications of cranioplasty after craniectomy.
POINTS	
1) Method	A systematic review of the available literature was conducted to identify infection and explantation rates associated with materials used in custom-made heterologous cranioplasty. A comprehensive search of PubMed/MEDLINE, Scopus, and Embase databases yielded 3437 articles. After screening, 43 articles met the inclusion criteria and data on study parameters, patient populations, and infection characteristics were extracted.
2) Results	Forty-three articles were selected and included in this review, analyzing a total of 3260 implanted cranioplasties, divided by material as follows: 931 titanium, 1227 hydroxyapatite, 680 PMMA, 379 PEEK, and 143 composites. The cumulative infection and explantation rates were: 8.2% and 3.7% for titanium, 6.7% and 5.3% for hydroxyapatite, 14.9% and 6.1% for PMMA, 11.1% and 3.8% for PEEK, and 4.2% and 6.2% for composites. Importantly, the follow-up duration varied significantly among materials. Studies involving titanium and composites had the shortest follow-up, potentially underestimating infection rates, while studies on PMMA and hydroxyapatite had the longest follow-up, providing more robust estimates.
3) Conclusions	This review confirms general trends in infection rates among cranioplasty materials and emphasizes the critical role of follow-up duration in interpreting complication rate. Differences in study design and reporting standards limit direct comparison between materials. Future research should adopt standardized follow-up thresholds and uniform outcome definitions to enable reliable cross-material comparisons.
ADDITIONAL COMMENTS / POINTS TO STRESS / POINTS OF STRENGTHNESS	
<ul style="list-style-type: none"> • CustomBone is the cranioplasty device with the highest number of published patients, long-term follow-up and quality of studies; • Infection rates for cranioplasties utilizing PEEK, titanium, and hydroxyapatite are 11.1%, 8.2%, and 6.7%, respectively. Titanium cranioplasty is generally associated with shorter follow-up durations, while hydroxyapatite cranioplasty is supported by three studies with follow-ups exceeding 36 months. 	