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Nada, A; Imran, K; Ishfaq, M; Fawaz, B; Ibrahim, M; Mashail, H; Abosofiyan, M; Kanwalpreet, K.

Corresponding author:
Nada Alhussain

naalhussain@kku.edu.sa

Author Affiliation:
King Khalid University.

ADMINISTRATIVE INFORMATION

Support - King Khalid University.

Review Stage at time of this submission - Completed but not published.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY2025100036

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 11 October 2025 and was last updated on 11 October 2025.

INTRODUCTION

Review question / Objective To evaluate whether intraoperative 3D imaging improves surgical accuracy, reduces reoperation rates, and enhances outcomes in zygomaticomaxillary complex and orbital fracture repair compared with standard methods.

Rationale Precise anatomical restoration in ZMC and orbital fractures is essential to prevent asymmetry, diplopia, or enophthalmos; intraoperative 3D imaging offers real-time verification that may prevent postoperative revisions.

Condition being studied Zygomaticomaxillary complex and orbital fractures requiring open reduction and internal fixation.

METHODS

Search strategy Search was conducted across electronic databases like PubMed, Embase, Scopus, and Cochrane CENTRAL (2000–Oct 2025) using terms for intraoperative imaging.

Participant or population Patients of any age undergoing operative management of ZMC and/or orbital fractures, including both acute and secondary reconstructions.

Intervention Use of intraoperative 3D imaging to verify reduction accuracy and guide real-time correction before wound closure.

Comparator Standard fracture repair without intraoperative 3D imaging, relying on visual assessment, palpation, or 2D imaging only.

Study designs to be included Randomized controlled trials, prospective or retrospective comparative cohort studies, and quasi-experimental designs.

Eligibility criteria Studies comparing intraoperative 3D imaging with standard care, reporting clinical or radiographic outcomes; excluding cadaveric, simulation, or non-comparative case reports.

Information sources MEDLINE (PubMed), Embase, Scopus, Cochrane CENTRAL, ClinicalTrials.gov, and WHO ICTRP, along with citation chasing.

Main outcome(s) Unplanned revision surgery within 30-90 days and objective radiographic mal-reduction.

Additional outcome(s) Diplopia, enophthalmos, operative time, intraoperative adjustments, radiation exposure, sensory deficits, costs, and patient satisfaction.

Data management Dual independent screening and extraction using standardized forms; conflicts resolved by consensus and verified by a third reviewer.

Quality assessment / Risk of bias analysis Assessed with ROBINS-I for non-randomized studies and RoB 2 for RCTs; overall risk of bias was moderately found.

Strategy of data synthesis Narrative synthesis was performed for all studies, and random-effects meta-analyses were conducted for outcomes reported by at least two studies with comparable definitions.

Subgroup analysis By fracture type (ZMC vs orbital), imaging modality (CT vs CBCT), adjunct technology (navigation or implants), and case complexity.

Sensitivity analysis Leave-one-out diagnostics and restriction to low/moderate bias studies confirmed result stability.

Language restriction Included only English-language publications.

Country(ies) involved Saudi Arabia, United States of America, India.

Other relevant information None

Keywords Intraoperative 3D imaging; cone-beam CT; computed tomography; zygomaticomaxillary fracture; orbital fracture; reoperation; systematic review; meta-analysis.

Dissemination plans Results intended for publication in peer-reviewed surgical journals and presentation at maxillofacial and trauma conferences.

Contributions of each author

Author 1 - Nada Alhussain - Conceptualization, Methodology.

Email: naalhussain@kku.edu.sa

Author 2 - Imran Khalid - Visualization.

Email: imajid@kku.edu.sa

Author 3 - Muhammad Ishfaq - Project administration.

Email: mishfaq@kku.edu.sa

Author 4 - Fawaz Baig - Initial draft writing, Data curation.

Email: fbik@kku.edu.sa

Author 5 - Mohammed Ibrahim - Data analysis, Statistical analysis.

Email: mafdel@kku.edu.sa

Author 6 - Mashail Hamid - Final proof reading of the study.

Email: mhamid@kku.edu.sa

Author 7 - Abosofyan Salih Mohamed Salih - Publications.

Email: amohamedsalih@kku.edu.sa

Author 8 - Kanwalpreet Kaur - Funding acquisition, Publications.

Email: drkanwalpreet@yahoo.co.in