Clinical stem cell therapy in oral and craniofacial bone regeneration: a systematic review and meta-analysis

Parham Hazrati 1† , Abdulmohsen Alanazi 1† , Abdusalam E. Alrmali 1,2 , Pablo Galindo-Fernandez1 , Hazar Kassem1 and Darnell Kaigler 1,3 *

1 Department of Periodontics and Oral Medicine, University of Michigan School of Dentistry, Ann Arbor, MI, United States, 2 Department of Oral Medicine, Oral Pathology, Oral and Maxillofacial Surgery, University of Tripoli School of Dentistry, Tripoli, Libya, 3 Department of Biomedical Engineering, College of Engineering, University of Michigan, Ann Arbor, MI, United States

Introduction:

Craniomaxillofacial bone regeneration poses significant clinical challenges due to the anatomical complexity of this region and the inherent limitations of conventional reconstructive techniques. Stem cell-based therapies have emerged as a promising alternative in that stem cells harness the capacities of multilineage differentiation and paracrine signaling to enhance tissue regeneration. Nonetheless, the overall clinical efficacy of stem cell therapy remains a subject of debate.

Aim:

To comprehensively evaluate the safety and effectiveness of stem cell therapy in oral and craniofacial bone regeneration.

Methodology

A comprehensive search of PubMed/MEDLINE, Scopus, Embase, and Web of Science was conducted in July 2024, identifying 59 eligible prospective studies—including randomized controlled trials (RCTs), controlled clinical trials and single-arm studies—involving more than five participants each.

Inclusion criteria:

- Prospective RCTs, prospective controlled (nonrandomized) clinical trials (CCTs), and single-arm prospective pre–post studies minimum sample size: ≥ 5 patients.
- Humans with congenital or acquired craniomaxillofacial bone deformities/defects, including alveolar ridge defects, cleft palate / alveolar cleft contexts, temporomandibular joint (TMJ) disorders and other maxilla/mandible skeletal defects.

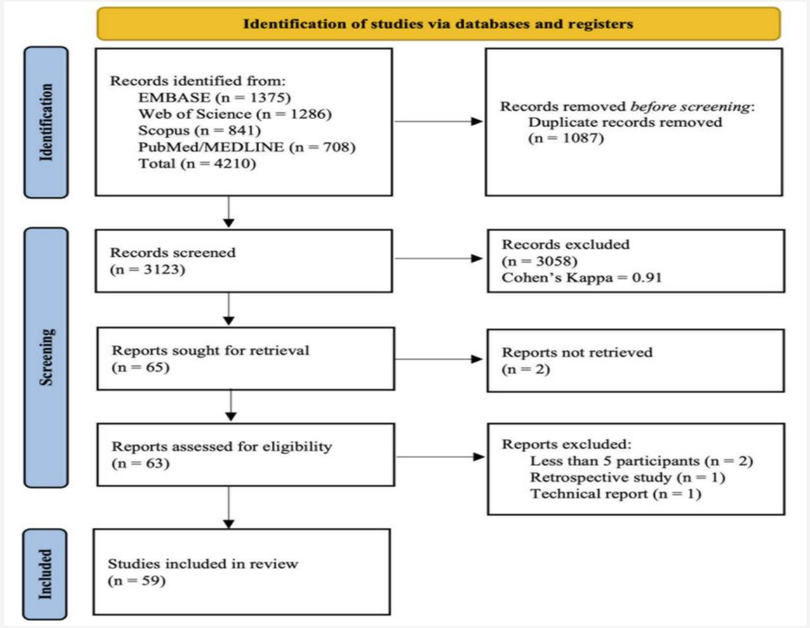
Exclusion criteria:

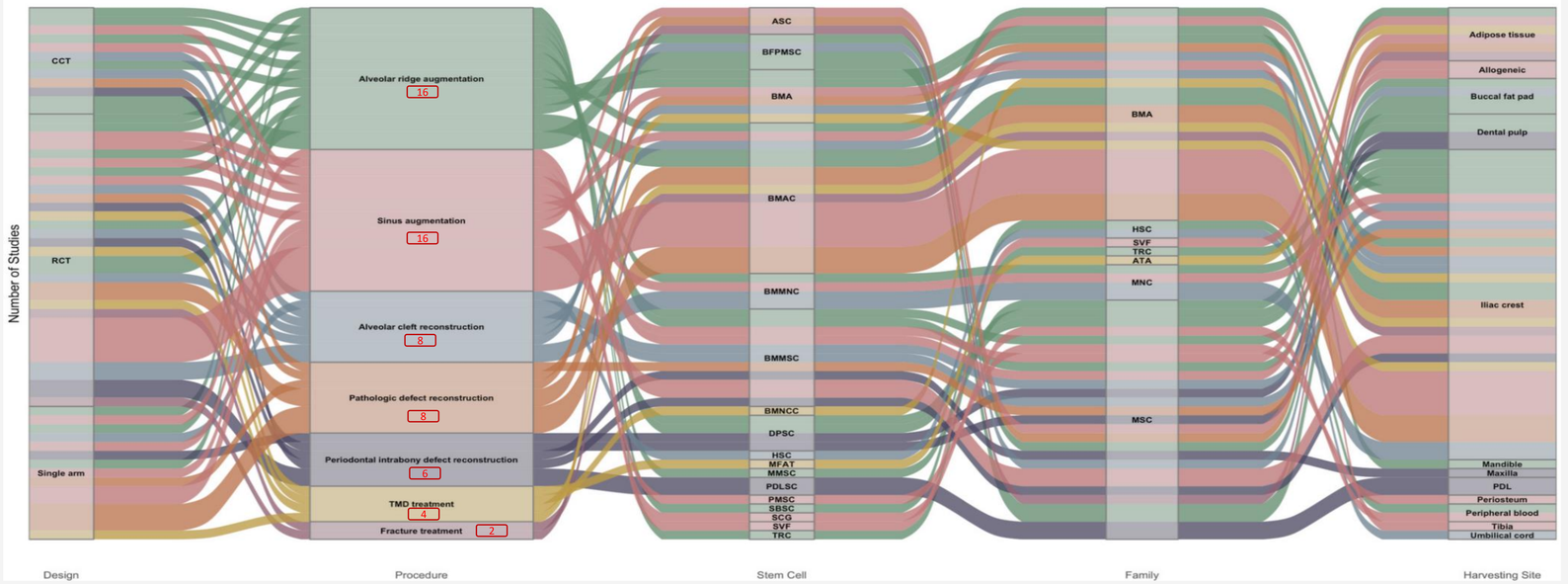
- Case reports, Single-arm prospective studies with < 5 patients and Conference abstracts, protocols, hypothesis articles, and reviews.
- Soft-tissue defects without accompanying bone defects/deformities (e.g., cleft lip without alveolar or palatal cleft).

Outcomes:

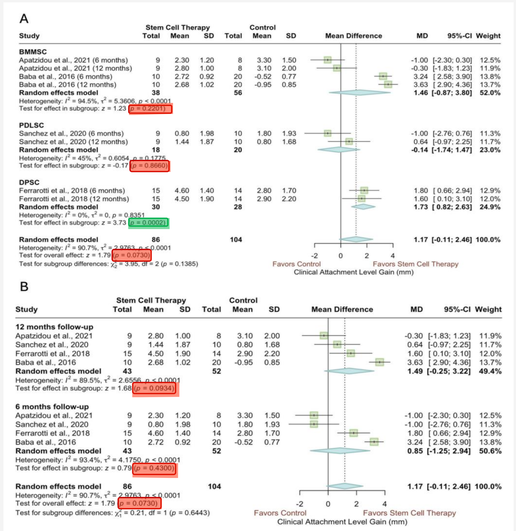
- Primary outcomes: quality and quantity of regenerated bone
- Secondary outcomes: patient-reported outcomes and periodontal clinical attachment level (CAL) gain

Results:

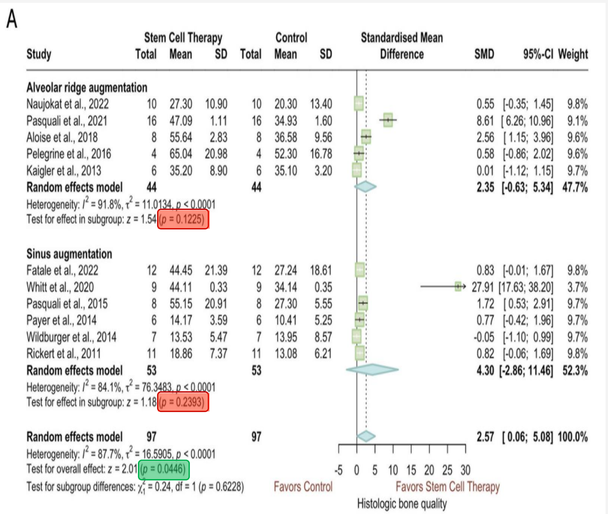




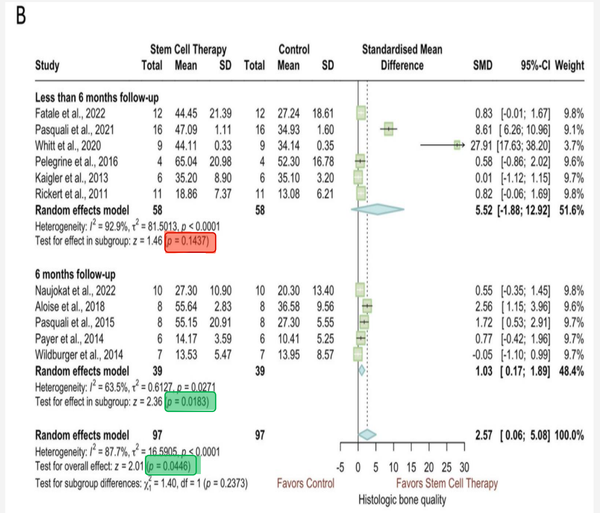
Clinical Attachment Level Gain



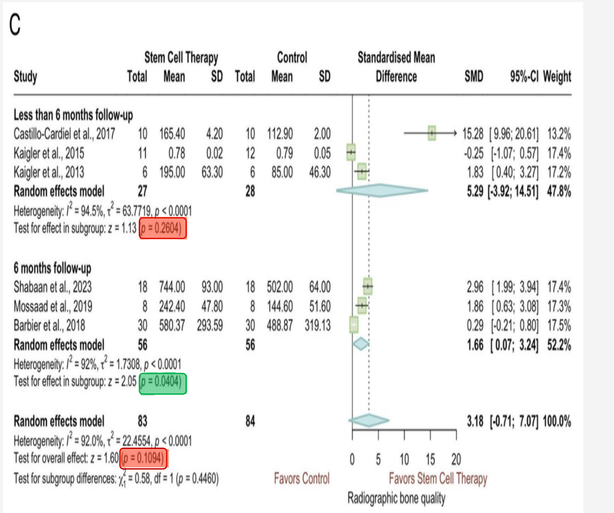
type of procedure



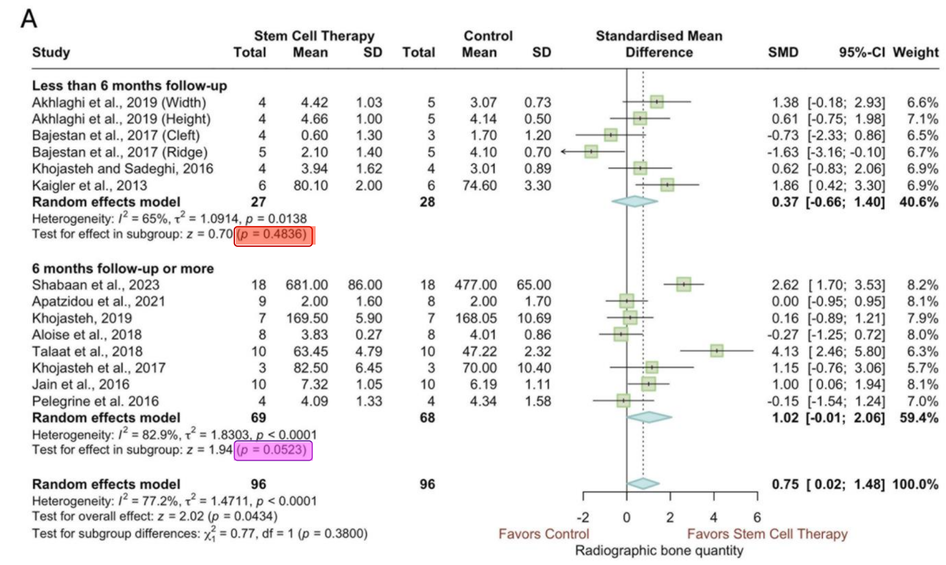
follow-up period



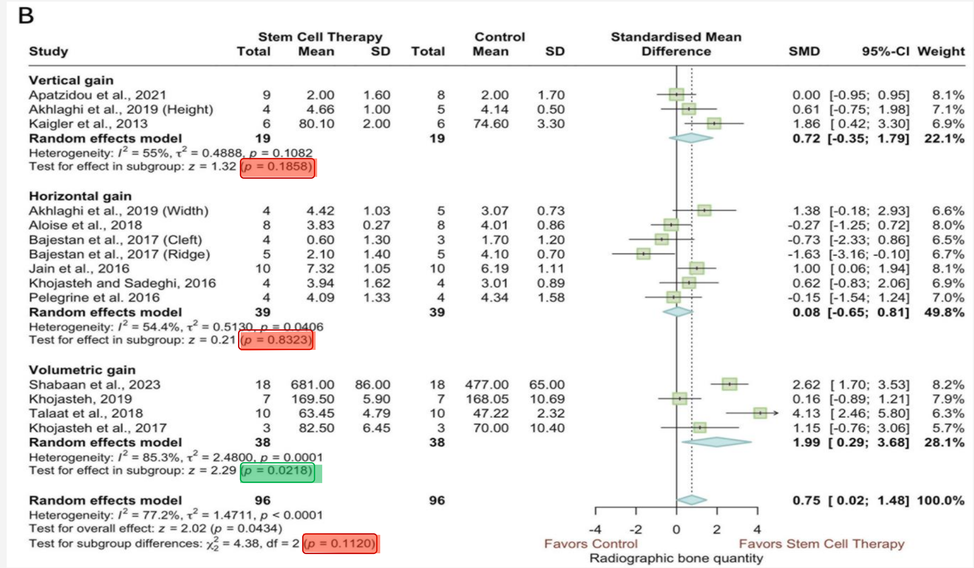
quality of regenerated bone according to radiography



follow-up period



dimension of change.



Conclusion:

Stem cell therapy shows promising potential in craniomaxillofacial bone regeneration, but heterogeneity among studies underscores the need for further standardized clinical trials to establish definitive benefits, as well as consistent reporting.