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Octacalcium phosphate in Cranio-Maxillofacial Critical Sized-Defect on Animal Model: Systematic Review

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ADMINISTRATIVE INFORMATION

Support - Faculty of Dental Medicine, Universitas Airlangga, Surabaya, East Java, Indonesia.

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

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 13 January 2024 and was last updated on 13 January 2024.

INTRODUCTION

Review question / Objective A focused question was formulated in accordance with the Participants, Intervention, Control, and Outcomes (PICO) principle (Participants: animals; Intervention: octacalcium phosphate with or without modification and combination; Controls: xenograft, autograft, allograft, left without treatment, or other regenerative materials; Outcomes: new bone formation (n%Bone) of cranio-maxillofacial critical sized-defects). The focused question was: “What is the prospect of OCP to stimulate the regeneration of cranio-maxillofacial critical sized defects on animal models?”A focused question was formulated in accordance with the Participants, Intervention, Control, and Outcomes (PICO) principle (Participants: animals; Intervention: octacalcium phosphate with or without modification and combination; Controls: xenograft, autograft, allograft, left without treatment, or other regenerative materials; Outcomes: bone regeneration of cranio-maxillofacial defect). The focused question was: “What is the prospect of OCP to stimulate the regeneration of cranio-maxillofacial critical sized defects on animal models?”.

Rationale The size of the defect in the cranio-maxillofacial area is often interpreted as a critical-sized defect due to failure in the healing process due to the inability to spontaneously heal and surgical intervention is required. The gold standard used in bone defect repair is autograft taken from the patient's body, but still has disadvantages, namely increasing the transmission of infection and foreign-body rejection, as well as limited quantities. In recent years, scientific developments have emerged of tissue engineering as a strategy for bone reconstruction. Octacalcium phosphate (OCP, Ca8H2[PO4]6·5H2O) is attracting attention as a potential biomaterial in hard-tissue repair. Previous in vitro study related to the biological properties of the material showed good results, so it was able to replace autogenous bone.

Condition being studied This systematic review aims to evaluate the currently existing animal evidence on the efficacy of octacalcium phosphate for regeneration of cranio-maxillofacial defect on animal models.

METHODS

Search strategy A systematic review protocol based on PRISMA 2020 was drafted. In addition, reporting was based on the PRISMA 2020 checklist9. The following database were searched: MEDLINE/PubMed (https://pubmed.ncbi.nlm.nih.gov accessed on 24 September 2023), Scopus (https://www.scopus.com/ accessed on 24 September 2023), Web of Science/ ISI-Web of Knowledge (https://www.webofscience.com/accessed/ accessed on 24 September 2023) and Embasse (https://www.embase.com/ accessed on 30 September 2023). This review was undertaken with completed with a manual search.Furthermore, the gray literature in The New York Academy of Medicine Gray Literature Report (http://www.greylit.org accessed on 24 September 2023) and the European System for Information on Gray Literature (http://www.opengrey.eu accessed on 24 September 2023) was screened. The search process to get the results according to the purpose using the keywords octacalcium phosphate, bone regeneration, cranio-maxillofacial, critical-sized defects and its synonym using the Boolean "AND". Modification of the search on the database was done to get more relevant results. Manual searches were undertaken to support the accuracy of completed searches. The literature search process was carried out from September 2023 until October 2023.

Participant or population Animal.

Intervention Octacalcium phosphate with or without modification and combination.

Comparator Xenograft, autograft, allograft, left without treatment, or other regenerative materials.

Study designs to be included In vivo on animal models.

Eligibility criteria The following categories of articles were included in this review: original articles that focused on the methodology of using OCP as biomaterial in animal models to stimulate the regeneration of cranio-maxillofacial critical sized defects. Open access (accessed through the Master of Dental Health Science Program of Dental Medicine, Airlangga University's IP address) of full-text articles relevant to OCP for regeneration or cranio-maxillofacial critical sized defect were used as inclusion criteria. Reviews, short communications, editorial notes, processes, and recommendations were not considered and excluded. All types of experimental and observational studies in English were included. Nevertheless, no duplicate studies were included in the analysis and any other objects of in vivo research. Any species, gender, age and weight of animal are acceptable study subjects. Cranio-maxillofacial defect, critical sized defect, and OCP as well as any additional therapies involving tissue engineering, were included in the research as study factors or exposures. Bone regeneration, bone repair, bone remodelling, and any other measure of bone regeneration in cranio-maxillofacial critical sized defects were among the outcomes of the research examined with bone volume. Articles in languages other than English, letters to the editor, and all types of reviews and commentaries were excluded. There were no restrictions on the year of publication, but only full papers could be accessed for free. The most recent search was conducted in September 2023.

Information sources The following elcetronic database were used as search engine: MEDLINE/PubMed (https://pubmed.ncbi.nlm.nih.gov accessed on 24 September 2023), Scopus (https://www.scopus.com/ accessed on 24 September 2023), Web of Science/ ISI-Web of Knowledge (https://www.webofscience.com/accessed/ accessed on 24 September 2023) and Embasse (https://www.embase.com/ accessed on 30 September 2023).

Main outcome(s) To evaluate the currently existing animal models evidence on the efficacy of bone regeneration for cranio-maxillofacial defect.

Additional outcome(s) To answer the focused question of: "What is the prospect of OCP to stimulate the regeneration of cranio-maxillofacial critical sized defects on animal models?".

Data management The two reviewers (A.S.A.M and S.M.R) independently conducted electronic literature searches and selected the studies. Any disagreements were resolved by discussion or by consulting a second reviewer (N.H and A.P.N). The reviewers (A.S.A.M and S.M.R) worked to duplicate screening, extract, and recapitulate data using a standardised form in Microsoft Excel that had been validated prior to use. Data was primarily extracted using the PICO protocol (Participants: animals (for in vivo studies); Intervention: Octacalcium phosphate with or without modification and

combination.; Controls: untreated or other regenerative materials; Outcomes: new bone formation (n%Bone) of cranio-maxillofacial critical sized-defects; Data relevant to methodology, sample size, duration of the studies, and the investigations carried out were extracted from each study. Results from the animal (in vivo) studies were tabulated in the table using predetermined data collection forms by the two investigators independently.

Quality assessment / Risk of bias analysis Investigators evaluate each study separately and independently based on its type. They committed to adopting the Animal Research: Reporting of In Vivo Experiments (ARRIVE) guidelines were selected for animal studies. Any disagreements were solved by discussion between investigators. The risk of bias evaluation was carried out in accordance with a technique derived from prior systematic reviews9. This assessment evaluated the description of several quality assessment parameters, including a well-defined OCP as an biomaterial for regeneration, standardised sample or subject preparation, randomization of samples or subjects, tests conducted by a single blinded operator, a clear test method specification, and comprehensive reporting of results. The article was labelled “Y” for a given parameter if the authors reported it and “N” if the information could not be located. The articles were classified as having a high, medium, or low risk of bias based on the number of “Y” elements included (1–2, 3–4, or 5–6).

Strategy of data synthesis The keywords generated a total of 458 papers, with 114 papers from Pubmed, 83 papers from Scopus, 179 papers from the Web of Science, and 82 papers from the Embase. Among them, 250 articles were removed due to the process of duplicates and languages screening, 83 studies was removed as well as title and abstract reading. The number of articles assessed for eligibility at the full text are 125 articles. The reviewers read the complete texts of those articles and eventually chose 26 articles that matched the eligibility criteria.

Subgroup analysis Nil..

Sensitivity analysis Descriptive statistics were used on this study using Microsoft Excel (2021, Microsoft, Chicago, IL, USA) that had been validated prior to use.

Language restriction English.

Country(ies) involved Indonesia, Malaysia, Denmark, Australia.

Keywords Octacalcium phosphate; tissue engineering; cranio-maxillofacial critical; sized-defects; medicine.

Contributions of each author

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