INPLASY PROTOCOL

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Conflicts of interest:
None declared.

Mechanical vibrations and increased alveolar bone density in animal models as an alternative to improve bone quality during orthodontic treatment: A systematic review

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Review question / Objective: **The aim of this systematic review is to determine whether mechanical vibration increases alveolar bone density in animals models and their possible application during orthodontic treatment. In this sense, the focused question is: Is the increase in alveolar bone density by mechanical vibrations in animal models an alternative to improve bone quality during orthodontic treatment?**
Eligibility criteria: **All published animal studies will be included. Animal studies where high or low frequency vibrations were be applied, Articles where density or osteogenesis were be measured and compared to a control group. All publications will be considered except for those where the full-text article will not available, or the authors' affiliation or the place of publication will not be specified. Only articles published in English.**

INPLASY registration number: This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 28 August 2022 and was last updated on 28 August 2022 (registration number INPLASY202280103).

INTRODUCTION

Review question / Objective: **The aim of this systematic review is to determine whether mechanical vibration increases alveolar bone density in animals models and their possible application during orthodontic treatment. In this sense, the focused question is: Is the increase in alveolar bone density by mechanical vibrations in animal models an alternative to improve bone quality during orthodontic treatment?**

Rationale: **Orthodontics is the specialty that treats dentoalveolar and bone**

discrepancies through dental movement, the mechanism of dental move involves a bone remodeling sequence that consists of bone resorption in direction of the tooth movement and bone formation on the opposite side. This process is closely related to the tooth support structures like alveolar bone, Therefore, increasing bone density or the amount of bone at the alveolar level can bring benefits prior, during and after orthodontic treatment. High or low-frequency vibrations were defined as oscillations that produce frequencies greater or less than 60 Hz respectively, have been used to accelerate and improve dental movement by applying vibrations to the alveolar bone. On the other hand, it has also investigated the effects of vibrations on the alveolar bone focused on improving the bone density and quantity. In many investigations it has been proven that the use of vibrations improves the healing process and bone tissue formation after a fracture, there is scarce information about this effect in dentistry area, nevertheless, the application of such vibratory stimulation could generate possible benefits in a wide area of application such as prosthetics, surgery, periodontics and for the purposes of this research orthodontics. Therefore, the main aim of this review is to contrast the existence literature ragard the effectiveness of the vibratory stimulus to increase the density or formation of the alveolar bone in animal models as an alternative to improve bone quality during orthodontic treatment to establish the basis for clinicians to conduct future randomized clinical trials.

Condition being studied: Animal models with a condition that needs the application of high or low frequency vibrations to improve alveolar bone quality or density.

METHODS

Search strategy: An electronic search will be perform from September 2022 to October 2022 in the databases: PubMed, Scopus, and Web of Science. Additionally, a manual search will be done; only articles published in the English language will be included without limitations in publication year. The main keywords will be: 1) high-frequency-acceleration OR low-frequency-acceleration OR cyclical-forces OR high-frequency-mechanical-stimuli OR low-frequency-mechanical-stimuli OR high-frequency-mechanical-signals OR low-frequency-mechanical-signals OR high-frequency-vibration OR low-frequency-vibration. 2) alveolar-bone OR craniofacial-skeleton. 3) bone-density OR osteogenesis OR orthodontic-relapse OR bone-remodeling. 4) 1 AND 2 AND 3.

Participant or population: Animals model where high or low frequency vibrations were applied in the alveolar bone area and the density or osteogenesis were quantified (without restriction in sex, specie or age).

Intervention: Animal models where high (> 60Hz) or low (> 60Hz) frequency vibrations in the alveolar bone were applied to improve or increase bone density or osteogenesis with or without other combination therapy, No restriction on period of application.

Comparator: Models that did not apply of high (> 60Hz) or low (> 60Hz) frequency vibrations in alveolar bone how cotrol group.

Study designs to be included: In vivo studies with a separate control group.

Eligibility criteria: All published animal studies will be included. Animal studies where high or low frequency vibrations were be applied, Articles where density or osteogenesis were be measured and compared to a control group. All publications will be considered except for those where the full-text article will not available, or the authors' affiliation or the place of publication will not be specified. Only articles published in English.

Information sources: PubMed, Scopus, and Web of Science.

Main outcome(s): Quantification of alveolar bone density or osteogenesis in alveolar

bone, applying high or low-frequency vibrations, before or after orthodontic forces or other treatment.

Data management: Duplicate articles will be eliminated manually using Microsoft Excel 16.57, the management of information and references will be done through Mendeley 1.19.8. Data collections will be extracted by two authors using a homogenize table: authors, year of publication, origin, design of study, species, sex, age, sample, regimen of vibration (frequency, acceleration, magnitude, duration), quantification of bone density, quantification of osteogenesis. Data will be contrasted for validity, and any discrepancy will be determined to reexamination of the study.

Quality assessment / Risk of bias analysis: The risk of bias will be performed by two reviewers according to the Systematic Review Centre for Laboratory Animal Experimentation (SYRCLE) tool, which has been specifically designed to assess the risk of bias (RoB) of animal intervention studies. Additionally, a quality assessment will be realized according to Animal Research: Reporting of In Vivo Experiments (ARRIVE).

Strategy of data synthesis: A systematic and qualitative summary will be made with the information collected from the articles, and will be presented narratively and summarized in tables, the results will be correlated between the articles.

Subgroup analysis: It is planned to analyze subgroups according to intervention (high-frequency vibration or low-frequency vibration) and outcomes (quantification of density or osteogénesis).

Sensitivity analysis: The sensitivity analysis will be carried out in the methodology of the review to avoid discrepancies of opinion and the study will be homogeneous, applying the following: 1.SYRCLE´s risk of bias tool 2. Quality of de studies with Animal Research: Reporting of In Vivo Experiments (ARRIVE) for quality assessment.

Language restriction: Only articles published in the English language.

Country(ies) involved: Mexico.

Keywords: Mechanical vibrations, Alveolar bone, density, osteogénesis.

Dissemination The Information is planned to publish in a JCR journal that is related to orthodontics. The results of this work could contribute to changes in the use of vibrations, additionally, this information could be the basis for future experiments associated to the research lines of the mastery program of this institution.

Contributions of each author:

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