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Comparative Analysis of 3D Imaging in Periodontal Disease Assessment. A Systematic review and meta-analysis

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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: INPLASY202420063

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 15 February 2024 and was last updated on 15 February 2024.

INTRODUCTION

Review question / Objective To compare the efficacy in terms of accuracy and precision of 3D imaging techniques (e.g., CBCT, MRI) for periodontal disease assessment.

Rationale To compare the efficacy in terms of accuracy and precision of 3D imaging techniques (e.g., CBCT, MRI) for periodontal disease assessment.

Condition being studied The accuracy and precision of 3D imaging techniques compared to the 2D or intra-surgical measurements for the assessment of periodontal diseases was the primary outcome.

METHODS

Search strategy The focused research question was as follows: What is the comparative effectiveness of commonly used 3D techniques for the assessment of periodontal disease in terms of diagnostic accuracy and reliability? Therefore, the PICO question was followed for the inclusion of the research papers: Population (P): Adult with periodontal disease, Intervention (I): the 3D technique used for the assessment of periodontal disease, Comparison (C): Any other 2D techniques, Outcomes (O): Accuracy, precision, and reliability of the 3D imaging techniques. An advanced search was performed using different databases, including PubMed, ScienceDirect, Scopus, The Cochrane Library, and Google Scholar from January 2003 to until 2024 using various keywords such as “three

dimensional imaging" OR "3D imaging" OR "cone beam computed tomography" OR "CBCT" OR "magnetic resonance imaging" OR "MRI" OR "digital volume tomography" AND "periodontal disease" OR "periodontitis" OR "periapical disease" OR "furcation defects" OR "periapical lesion" OR "apical periodontitis" OR "alveolar bone loss" OR "intrabony defects".

Participant or population Adults with peridontal disease.

Intervention The 3D technique used for the assessment of periodontal disease.

Comparator Any other 2D techniques.

Study designs to be included Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) criteria.

Eligibility criteria Studies published in English.

Information sources Literature was searched from different databases, including PubMed, Scopus, Web of Sciences, Google Scholar, and ScienceDirect, using PRISMA protocols.

Main outcome(s) There is limited evidence for the diagnostic assessment scoring system used in the included studies. Even then, few systems, such as the Periapical Index (PAI) scoring system. Clinical Attachment Loss (CAL), White and Pharoah approach, and Glickman's classification are identified. Overall, a significant difference was observed between 3D imaging (CBCT, MRI) and other 2D and intra-surgical procedures used for the diagnosis of periodontal diseases. However, there are few studies reported non-significant differences among the tested modalities. Moreover, a study also reported that ultrasound provided better accuracy and sensitivity than CBCT. Limitations for each study are listed.

Data management Data extraction was performed on predefined variables: study characteristics (study ID, country, study design, sample size), patient's characteristics (gender, age, teeth, periodontal disease type, prevalence, disease assessment method, comorbidity), intervention characteristics (3D imaging technique, software used for 3D), control/comparison characteristics (other method used), outcomes (diagnostic assessment, key findings, conclusion, and limitations).

Quality assessment / Risk of bias analysis The Cochrane Collaboration tool was utilized for the quality assessment of RCTs by using the web-based app Robvis. Assessment was done in five domains such as randomization process, intended intervention deviations, measurement of data, missing outcomes, and reporting. For non-RCTs, Risk of Bias (RoB) for Non-Randomized Studies-Interventions (ROBINS-I) was used, and assessment was done in seven domains, including confounding, selection of participants, intervention classification, deviation, missing outcome data, outcome measurement, and reporting outcomes.

Strategy of data synthesis In the present study, CBCT was identified as the most utilized diagnostic 3D tool for the assessment of periodontal diseases, except for one study which used MRI. There were variations in the software used for viewing the images produced by these 3D diagnostics tools. However, i-CAT viewing software was the most commonly used software, followed by NNT, and Promax 3Ds. The images obtained through 3D diagnostic tools (CBCT, MRI) were assessed by trained and well-experienced observers as indicated, and all of the studies included at least two observers/examiner for the image assessment except for one study which included only one examiner. Images were assessed for different periodontal conditions; however, most of the studies measured the axial, coronal and sagittal discs/plane to suggest the treatment plan or diagnosis of periodontal conditions. Moreover, for comparison, panoramic and periapical radiography was used in most of the studies. In addition to the radiography, surgical techniques were also used.

Subgroup analysis Due to the variability of data, meta-analysis was conducted with only five studies and 3 studies in two subgroups (horizontal and vertical) and 2 studies in furcation height, width, and depth subgroups. In the sub-group of horizontal measurements between 3D imaging and other techniques (2D or intra-surgical measurements), there was a significant difference (p=0.00001) with a mean difference of -0.75 (95% CI: -2-0.49) and 92% heterogeneity. For vertical measurements, a significant difference (p=0.00001) was observed with a mean difference of -0.59 (95% CI: -2.40-1.23, I2=92%).

Sensitivity analysis Not applicable.

Language restriction Only articles in English.

Country(ies) involved Saudi Arabia.

Keywords Three dimensional imaging, CBCT, MRI, periodontology, diagnosis, treatment planning.

Dissemination plans All the data of the article will be share after the publication.

Contributions of each author

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