INPLASY

Evaluation of compressive strength of conventional glass ionomer cements and nano- filled glass ionomer cements used in dentistry: 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.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 23 March 2024 and was last updated on 23 March 2024.

INTRODUCTION

Review question / Objective 1. Consolidate existing evidence on the compressive strength properties of nano-filled GICs, 2. Providing valuable insights for dental practitioners and researchers.

Rationale The evaluation of compressive strength in C-GICs and nano-filled GICs used in dentistry holds paramount importance in assessing their suitability for various dental applications. By synthesizing data from a wide range of studies, including experimental in-vitro investigations, this review seeks to establish a comprehensive understanding of the comparative performance of C-GICs and nano-filled GICs in terms of compressive strength.

Condition being studied Glass ionomer cements (GICs) are the materials, widely used due to their biomechanical properties and these properties can be enhanced with the addition of nanoparticles particularly, compressive strength. Therefore, the present study aimed to consolidate existing evidence on the compressive strength properties of nano-filled GICs and compare them with conventional GICs.

METHODS

Search strategy The search strategy was based on the PICO criteria due to the comparative nature of the study; Population (P): fillers used in dentistry, Intervention (I): Nano-filled GICs, Comparison (C): Conventional GICs, Outcomes (O): Compressive strength. An advanced search was performed using different databases including ScienceDirect, PubMed, Scopus, Google Scholar, and The Cochrane Library, limited to articles published between 1 January 2003 to March 2024. Different keywords such as “compressive strength” OR “compression strength” OR “high strength” OR “toughness” OR “hardening” AND “conventional glass ionomer cements” OR “traditional glass ionomer cements” OR “conventional GICs” OR “traditional GICs” OR “Glass polyalkenoate cement” AND “Nono-filled glass ionomer cements”

OR “nano-filled GICs” OR “Nanoparticles and glass ionomer cement” OR “nanoparticles and GICs” and combination of these keywords were also utilized.

Participant or population Silicone-based dental impression.

Intervention Use of Disinfectants.

Comparator Rinse with water or saline or no treatment or other competitor.

Study designs to be included According to the protocols of Preferred Reporting for Systematic Reviews and Meta-analysis (PRISMA).

Eligibility criteria This research included studies on the impact of shelf-life and storage conditions on the accuracy and performance of additional silicone impression materials. Published literature fulfilling the modified PICO criteria was included.

Information sources (PubMed, ScienceDirect, The Cochrane Library, Web of Sciences, Scopus, and Google Scholar).

Main outcome(s) After rigrous screening process, 31 research articles were selected. Different types of nano-particles were used to be incorporated in conventional-glass ionomer cements (C-GIC) such as Hydroxyapatite, Fluorapatite, Titanium dioxide, and Silver were the most commonly utilized nano-particles as additives in GICs. Nano-filled GICs were found to be superior over conventional GICs in terms of compressive strength. The pooled data for the efficacy of antimicrobial agents vs control was 8.49 (95% CI: 4.57, 12.41). A high heterogeneity (I 2 =100%) was found among the studies with a statistically significant difference (p<0.00001). Furthermore, 29 studies were found of medium quality.

Additional outcome(s) Overall, our findings suggest that nano-filled GICs generally had superior compressive strength compared to C-GICs, attributed to the reinforcement effect of nano-fillers on the cement matrix. This underscores the potential of nano-filled GICs in enhancing the longevity and performance of dental restorations, particularly in load-bearing applications. However, caution is warranted in consideration of the concentration as some of the nano-particles had lower compressive strength at higher concentrations. Further research is warranted to elucidate the optimal composition and processing parameters for nano-filled GICs, addressing existing gaps in the field to advance clinical practice and improve patient outcomes in dentistry.

Data management Pre-defined data variables were extracted using a Microsoft Excel sheet. The included variables were study characteristics (study ID, country, study design, sample size), intervention characteristics (nano-filled type used, concentration, state), control/comparison characteristics (C-GIC type, state), Compressive strength measurements (specimen preparation, testing method), and Outcomes (key findings, and limitations).

Quality assessment / Risk of bias analysis The QUIN assessment tool was utilized for the methodological quality assessment of the included studies. The quality assessment tool has twelve items, and each study was evaluated according to these items and rated as yes (1-2 points), no (0 points) or not applicable [28] . Later, each research article was graded according to points response. High risk of bias (RoB) scores <50%, 50-70% were the medium RoB, and >70% were the low RoB.

Strategy of data synthesis Initially, 520 research articles were identified and retrieved from different electronic databases (PubMed, ScienceDirect, The Cochrane Library, Web of Sciences, Scopus, and Google Scholar) utilizing different keywords (Supplementary Table 1). In the initial phase of identification, 107 duplicated research articles were identified and removed. In the screening phase, 413 research articles were screened through titles and abstracts, and 375 research articles were removed due to their irrelevancy to our study. In the phase of eligibility, 38 research articles were evaluated through full-text screening and eligibility criteria were followed. In this phase, 7 research articles were eliminated due to different reasons as stated in Figure 1. In the last phase of inclusion, 31 research articles were included in the present study.

Subgroup analysis The data was compiled from a variety of articles: • Author(s), year of publication, country, study design. • Total number of patients/ datasets. • Training/validation datasets • Test datasets • Aim of the study.

Sensitivity analysis None.

Language restriction Only articles in English.

Country(ies) involved Saudi Arabia.

Keywords Antimicrobial agents, UV lights, chemicals, microbes, microorganisms, addition

silicone impression, condensation silicone impression.

Dissemination plans Data will be shared after publication of the article.

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