Journal of Taibah University Medical Sciences (2023) 18(6), 1384–1385

Taibah University

Journal of Taibah University Medical Sciences

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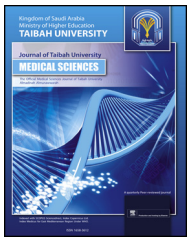

Editorial Article

Bi-axial flexure testing method for dental composites requires standardization

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Received 6 May 2023; accepted 22 May 2023; Available online 1 June 2023

Resin-based dental composites (RBCs) are being increasingly used for the restoration of anterior as well as posterior dentition. The long-term clinical performance of RBCs has become possible with the substantial efforts of researchers who are continuously researching these materials since their inception. In order to predict the clinical performance of RBCs, the investigators have evaluated their mechanical properties including compressive,[1] diametral tensile,[2] and flexure strengths[3] by means of applying different load and support configurations. The International Standards Organisation (ISO)[4] advocates the three-point flexure test for the evaluation of RBCs and it is frequently utilized by researchers across the world. In this test, bar-shaped specimens are loaded at their centre by an indenter at the loading speed of 0.75 ± 0.25 mm/min. Consequently, tensile stresses are produced on the specimen's lower convex end, ultimately leading to failure. The edge failures of the specimen are likely to occur during a three-point flexure test, which may then cause an error in strength values.[5] In addition, the length of specimens used in the three-point flexure test is greater than the tip diameter of all dental light-curing units; therefore, specimens are polymerized using an overlapping light-curing method. This curing method may cause greater polymerization of the overlapped areas of specimens as compared to the adjacent areas and thus lead to heterogeneous polymerization across the specimen's surface.[6] Furthermore, the dimensions of specimens are not clinically relevant since the sizes of restorations are relatively small.

The strength evaluation of dental ceramics is frequently carried out by bi-axial flexure testing.[7,8] The foremost benefit of the bi-axial flexure test is that the unauthentic edge failures are excluded contrary to the three-point flexure testing because most of the tensile stresses are generated in the centre of the specimen. The assessment of RBCs has also been carried out by the bi-axial flexure test.[9,10] During the bi-axial flexure test, a disc-shaped specimen is mainly fabricated, which is clinically relevant as it represents the size of molar teeth and utilizes a single-shot curing technique as opposed to an overlapping curing technique. Furthermore, the data produced during the bi-axial flexure test are not dependent upon the specimen's geometry and the flaw's direction.[11]

When we searched the 'PubMed' and 'Science Direct' databases using the keywords (Biaxial Flexure Flexural Strength Resin Dental Composites), 10 and 230 research papers were identified from January 2013 to December 2022. It indicates a wide interest of researchers towards bi-axial flexure testing of RBCs. Nevertheless, the selection of load and support configurations during the bi-axial flexure test varies widely among researchers as ball on ring,[12] piston on three balls/spheres,[13] piston on ring,[14] ball on three balls[15] and ring on ring[9] load and support configuration are well-evident. This variation in the load and support configurations may lead to distinct findings and render the comparison of data meaningless among researchers.

Undoubtedly, the bi-axial flexure strength test may be considered a suitable substitute for the ISO-advocated three-point flexure test for the RBC research work owing to its aforementioned useful features. However, consensus among the researchers regarding the single best load and

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Peer review under responsibility of Taibah University.

ELSEVIER Production and hosting by Elsevier

 https://doi.org/10.1016/j.jtumed.2023.05.017

support configuration is warranted in order to make the comparison of the resultant data more meaningful. It is proposed that this issue should be discussed at the relevant forums so that standardization of testing methods could be made possible for the meaningful generation of research data worldwide.

Source of funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest

The authors have no conflict of interest to declare.

Ethical approval

Ethical approval is not required for the letter to the editor.

Authors' contribution

NK conceived the idea, and SR and MHK wrote the initial draft of the article, NK and MSZ critically revised the final draft. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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How to cite this article: Kumar N, Rahman S, Khoso MH, Zafar MS. Bi-axial flexure testing method for dental composites requires standardization. J Taibah Univ Med Sc 2023;18(6):1384–1385.