

Ultimate Flexural Strength and Young's Modulus Analysis of Denture Base Resins for Masked Stereolithography 3D Printing Technology

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Abstract

Statement of the Problem: Additive manufacturing is a process that has been known for more than 40 years, but it is still a new manufacturing method for dentistry. During the last few years, it has become a more and more common process for denture fabrication. Unfortunately, along with all the advantages of this method, there are many unsolved issues with the process and the raw materials properties. Nowadays there is a relatively insufficient variety of raw materials for dental use, especially for denture base fabrication. As a result of this and the increasing popularity of 3D printing, the amount of newly offered materials started to increase at a very fast rate, as their mechanical properties are controversial. For this reason, the purpose of the current study is to observe the flexural strength properties and young modulus of two commonly used denture base resins which are suitable for masked stereolithography manufacturing process. The obtained results are compared to a control group of specimens, made by the conventional lost wax technique of heat-curing acrylic resin. At the same time all the results are checked for ISO Standard 20795-1 correspondence. The collected data reveals that the mean ultimate flexural strength of the specimens, which are 3D printed is around 87 MPa - 89 MPa. Compared to the results achieved for the heat-curing acrylic resin (93 MPa) their mean ultimate flexural strength is not far away. The mean young modulus obtained for the first group of 3D printed specimens is 2263.21 MPa and 2377.44 MPa for the second one. These results are very close to those collected for heat-cured acrylic specimens – 2396.06 MPa. As ISO Standard 20795-1 is inspected, all the data achieved covers the minimum requirements.

Conclusion & Significance: Nowadays the 3D printing process plays a more and more essential role in daily dentistry. For this reason, observation and knowledge of the raw materials properties is very important. The examined denture base materials for additive manufacturing have acceptable ultimate flexural strength and young modulus but their properties still should be slightly improved.

Image

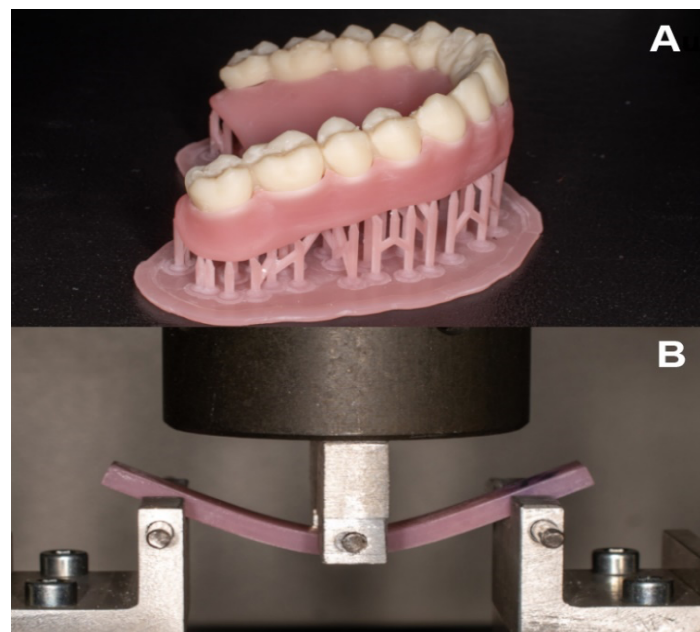


Fig. 1 A complete denture fabricated by masked stereolithography (A). A specimen made of the same denture base polymer like the denture during three-point flexural test (B).

Recent Publications

1. Dikova, T. (2019) Production of high-quality temporary crowns and bridges by stereolithography. *Scripta Scientifica Medicinæ Dentalis*,5(1):33-38
2. Dikova, T. (2019). Specifics in Production of Fixed Partial Dentures Using 3D Printed Cast Patterns. *Computational and Experimental Approaches in Materials Science and Engineering*. 90: 92-102
3. Chaturvedi S, Addas MK, Alqahtani NM et al. (2021) Computerized occlusal forces analysis in complete dentures fabricated by additive and subtractive techniques. *Technol Health Care*.29(4):781-795.
4. Unkovskiy A, Wahl E, Zander AT, et al. (2019) Intraoral scanning to fabricate complete dentures with functional borders: a proof-of-concept case report. *BMC Oral Health*.
5. Osnes, C., Davda, K., Hyde, T. et al. (2023) Current challenges for 3D printing complete dentures: experiences from a multi-centre clinical trial. *British Dental Journal*.

Photograph



Biography

Chief. Assist. Prof. DMD, PhD Preslav Penchev is chief assistant professor at the Department "Dental Materials Science and Prosthetic Dental Medicine" at Faculty of Dental Medicine, Medical University of Varna, Bulgaria. Pr. Penchev graduated as Dentist at Medical University of Varna, Bulgaria in 2016. Since 2016 he has been working as assistant professor at the Department "Dental Materials Science and Prosthetic Dental Medicine" at Faculty of Dental Medicine, Medical University of Varna, Bulgaria. In 2021 he graduated as PhD at the same department and during the same year is appointed as chief assistant at the same department. Pr. Penchev has scientific interest in 3D printing, digital dentistry, CAD/CAM technologies esthetic dentistry and has published 10 scientific papers and 1 monography.