Wear Patterns of Resin Denture Teeth Opposing Restorations

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INTRODUCTION

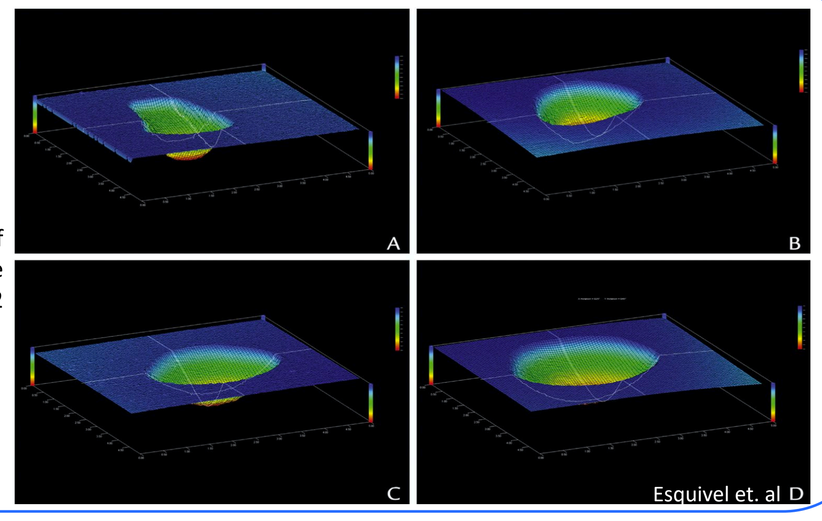
- Historically, the most common prosthetic complication with metal-acrylic resin complete-arch implant-supported prostheses is the wear of posterior denture teeth. More specifically, the most common complication associated with monolithic zirconia complete-arch implant-supported prostheses is thought to be the wear of the opposing restorations.
- Although the effects of wear vary from patient to patient, excessive wear may result in loss of vertical dimension of occlusion, changes in the functional path of masticatory movement, loss of masticatory efficiency, fatigue of masticatory muscles, and decreased esthetics, to name a few.
- The chemical composition and microstructure of resin matrix filler particles of denture teeth are reported to influence how denture teeth are resistant to wear over time.
- This research seeks to elucidate the clinical implications of volumetric wear of resin materials used for denture teeth such as PMMA, nano hybrid composite resin, CAD-CAM fabricated teeth from PMMA and acrylate polymer, in its application to complete-arch implant-supported prostheses opposed by zirconia and/or metal antagonists

METHODS & MATERIAL

- Study 1 evaluated 88 maxillary first molar denture teeth made of commercially available brands (i.e. Dentsply Sirona, Ivoclar, Formlabs) which were fabricated from a methacrylate-based photopolymerizing resin.
- Study 2 evaluated 32 maxillary central incisor denture teeth and double crosslinked polymethyl methacrylate (PMMA) (DCL), nanohybrid composite resin (PHO), and computer-aided design and computer-aided manufacturing (CAD-CAM)-fabricated teeth made from crosslinked PMMA (TEL) and acrylate polymer (ZCAD), respectively.
- Studies 1 and 2 subjected denture teeth to a thermocycling wear test opposing bullet-shaped milled zirconia styli against 36-40 N for 200,000 cycles to simulate mastication.
- Study 3 prepared 80 substrate specimens with 5 kinds of resin denture teeth, including 3D-printed denture tooth resin, made of methacrylate-based photopolymerized resin. Antagonistic surfaces were made from zirconia by milling and from cobalt-chromium (Co-Cr) alloy by 3D printing and casting.
- Study 3 subjected the specimens to a mastication simulator and volume lost was measured.

RESULTS

Three-dimensional images of the volumetric wear of the different materials from Study 2



CONCLUSION

- Denture teeth made from different materials demonstrate significantly different volumetric substance loss when subjected to occlusal wear by zirconia antagonist.
- The results suggest that 3D-printing by using resin materials provides adequate wear resistance for denture tooth use.
- Esquivel et. al. found that nanohybrid composite resin denture teeth had the least amount of volumetric substance loss.
- Pham et al concluded that 3D printed denture teeth demonstrated superior wear resistance compared to the commercially available prefabricated denture teeth, when opposed to zirconia.
- Highly cross-linked denture teeth are more wear resistant than conventional PMMA denture teeth.
- The wear resistance of the 3D printed denture tooth resin was comparable to the commercially available prefabricated denture teeth tested.

RESULTS

- A statistically significant difference in volumetric wear was found between groups of each study.
- Highly cross-linked denture teeth exhibited less wear than the conventional acrylic denture teeth, when opposing zirconia.
- According to Pham et al., 3D printed denture teeth had the most wear resistance and had at least 2 to 3.5 times less wear than all other denture tooth materials tested.
- The influence of the resin denture teeth and the type of antagonist are both statistically significant.
- The specimens of the 3D-printed denture tooth resin showed a relatively smooth surface with the zirconia antagonist whereas the the denture tooth resin exhibited cracks when opposed by the metal antagonist.

DISCUSSION

- Esquivel et. al states that 200,000 cycles applied in these studies represent approximately 9.6 months of clinical use.
- More research on comparing the results of the different studies to determine the clinical implications, such as CAD-CAM denture teeth against resin denture teeth, for instance.
- 3D printed denture teeth are composed of a single resin material and have an overall uniform and homogenous structure whereas prefabricated denture teeth are composed of multiple layers, each with different chemical compositions and mechanical and physical properties, making 3D printed denture teeth more resistant to wear.
- An increased wear rate of denture teeth represents a disadvantage both financially and clinically, resulting in potential need for earlier remakes due to loss of vertical dimension and therefore mechanical failures, including fracture of denture teeth, impairment of prosthetic substructure, or functional and esthetic alterations.

LIMITATIONS

- Difficult to replicate clinical factors in vitro, including mechanical factors, neuromuscular force, intraoral pH, and erosion since in vitro studies can only assess limited parameters as exact intraoral conditions cannot be replicated.
- Limited number of resin material tested for wear against zirconia, amongst the many available in the market.
- Cycles applied in these studies may not translate as expected into months of clinical usage.
- The studies conducted using a three-body wear method in which the third material, used as a slurry to simulate presence of food, may not be true to intraoral conditions.

CITATIONS

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