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A comparative study of progressive wear of four dental monolithic, veneered glass-ceramics

Zhenzhen Zhang ^a, Yuanping Yi ^b, Xuesong Wang ^a, Jiawen Guo ^c, Ding Li ^d, Lin He ^{d,**}, Shaofeng Zhang ^{a,*}

^a State Key Laboratory of Military Stomatology & National Clinical Research Center for Oral Diseases & Shaanxi Key Laboratory of Oral Diseases, Department of Prosthodontics, School of Stomatology, Fourth Military Medical University, Changle Xi Road 145, Xi'an, Shaanxi, China

^b Department of Stomatology, the Third Hospital of Xi'an, Shaanxi, China

^c Department of Stomatology, Lanzhou General Hospital, Lanzhou Command of PLA, Lanzhou, Gansu, China

^d State Key Laboratory for Mechanical Behavior of Materials, Xi'an Jiaotong University, Xi'an, China

helin@mail.xjtu.edu.cn (L. He),

sfzhang1963.fmmu@gmail.com (S. Zhang).

* Corresponding author. Tel.: +86 29 82665165/ +86 29 84776468.

** Corresponding author.

Abstract**Objectives:**

This study evaluated the wear performance and wear mechanisms of four dental glass-ceramics, based on the microstructure and mechanical properties in the progressive wear process.

Methods:

Bar (N = 40, n = 10) and disk (N = 32, n = 8) specimens were prepared from (A) lithium disilicate glass-ceramic (LD), (B) leucite reinforced glass-ceramic (LEU), (C) feldspathic glass-ceramic (FEL), and (D) fluorapatite glass-ceramic (FLU). The bar specimens were tested for three-point flexural strength, hardness, fracture toughness and elastic modulus. The disk specimens paired with steatite antagonists were tested in a pin-on-disk tribometer with 10 N up to 1000,000 wear cycles. The wear analysis of glass-ceramics was performed using a 3D profilometer after every 200,000 wear cycles. Wear loss of steatite antagonists was calculated by measuring the weight and density using sensitive balance and Archimedes' method. Wear morphologies and microstructures were analyzed by scanning electron microscopy (SEM). The crystalline phase compositions were determined using X-ray diffraction (XRD). One-way analysis of variance (ANOVA) was used to analyze the data. Multiple pair-wise comparison of means was performed by Tukey's post-hoc test.

Results:

LD showed the highest fracture toughness, flexural strength, elastic modulus and crystallinity, followed by LEU and FEL, and FLU showed the lowest. However, the hardness of LD was lower than all the other three types of ceramics. For steatite antagonists, LD produced the least wear loss of antagonist, followed by LEU and FEL, and FLU had the most wear loss. For glass-ceramic materials, LD exhibited similar wear loss as LEU, but more than FLU and FEL did. Moreover, fracture occurred on the wear surface of FLU.

Conclusions:

In the progressive wear process, veneering porcelains showed better wear resistance but fluorapatite veneering porcelains appeared fracture surface. Monolithic lithium disilicate glass-ceramics with higher mechanical properties showed more wear loss, however, they did not

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