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Research Paper

Two-body wear comparison of zirconia crown, gold crown, and enamel against zirconia

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ABSTRACT

Problem statement: Full zirconia crowns have recently been used for dental restorations because of their mechanical properties. However, there is little information about their wear characteristics against enamel, gold, and full zirconia crowns.

Purpose: The purpose of this study was to compare the wear rate of enamel, gold crowns, and zirconia crowns against zirconia blocks using an *in vitro* wear test.

Materials and methods: Upper specimens were divided into three groups: 10 enamels (group 1), 10 gold crowns (group 2, Type III gold), and 10 zirconia crowns (group 3, Prettau® Zirkon 9H, Zirkonzahn, Italy). Each of these specimens was wear tested against a zirconia block ($40 \times 30 \times 3$ mm^3) as a lower specimen (30 total zirconia blocks). Each specimen of the groups was abraded against the zirconia block for 600 cycles at 1 Hz with 15 mm front-to-back movement on an abrading machine. Moreover, the load applied during the abrading test was 50 N, and the test was performed in a normal saline emulsion for 10 min. Three-dimensional images were taken before and after the test, and the statistical analysis was performed using the Krushal–Wallis test and Mann–Whitney test ($p=0.05$).

Results: The mean volume loss of group 1 was 0.47 mm^3, while that of group 2 and group 3 was 0.01 mm^3.

Conclusion: The wear volume loss of enamels against zirconia was higher than that of gold and zirconia crowns. Moreover, according to this result, zirconia crowns are not recommended for heavy bruxers.

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1. Introduction

There are many diverse esthetic materials used in dental restorations. While metal–ceramic and all-ceramic restorations have been used in dental clinics for fixed partial dentures (Raigrodski, 2004) there are still some clinical limitations in using metal–ceramic and all-ceramic restorations.

Ceramic breakage, gingival discoloration, allergic reactions, and false-teeth sensations are the primary deficiencies in the case of metal–ceramic restorations (Christensen, 2009).

Though all-ceramic restorations have better esthetic points than metal–ceramic restorations, they still have limited use for posterior fixed partial dentures because of the low fracture resistance and low flexural strength. To improve the mechanical deficiencies, several newly developed ceramic materials and zirconia have been used for posterior fixed partial dentures (Raigrodski, 2004).

To overcome these limitations, zirconia was introduced to use dental restorations because zirconia has a high fracture resistance *via* transformation toughening mechanisms and is a bio-compatible material (Piconi and Maccauro, 1999). Initially, zirconia could be used as a coping material because of its opacity and could be useful for highly loaded restorations (Tinschert et al., 2001). Porcelain layered on the zicronia coping is known as a veneering ceramic, which has the potential to withstand occlusal forces applied in the posterior region and can represent alternatives for replacing metal ceramics (Att et al., 2007; Conrad et al., 2007).

Despite the good results of veneering ceramic (Att et al., 2007), veneering ceramic still suffers from chipping of the layering ceramic (Christensen, 2008; Christensen and Ploeger, 2010; Ashkanani et al., 2008).

However, full zirconia crowns showed higher strength, easier laboratory procedures, and no chipping compared to the zirconia ceramic restorations (Jang et al., 2011).

Several experiments about enamel wear against zirconia were reported because the wear rate is one of the important requisites for restoration material (Jung et al., 2010; Mitov et al., 2012; Kim et al., 2012; Janyavula et al., 2013). According to these reports, full zirconia was less abrasive than porcelain (Jung et al., 2010; Mitov et al., 2012).

Concerning the wear test methods, there were no reports on simple reciprocal enamel wear against zirconia. Therefore, the purpose of this study was to compare the simple reciprocal wear rate of enamel, gold crowns, and full zirconia crowns against zirconia blocks using an *in vitro* wear test.

The null hypothesis of this study was that wear quantity against zirconia would be same regardless of experimental subjects.

2. Materials and methods

2.1. Lower specimens

Thirty rectangular zirconia specimens ($40 \times 30 \times 3\ mm^3$) were prepared with zirconia blocks according to the manufacturer instructions (Prettau® Zirkon 9H,Zirkonzahn,Italy) and bonded in acrylic resin mold ($58 \times 38 \times 3.5\ mm^3$) with resin cement (RelyX U200, 3M ESPE, Germany) (Fig. 1C).

The zirconia specimens had no glazing process, and the surfaces were polished first with zirconia polishing kits (Magic KIT Zir, Sungwon Dental, Korea) and then high polished by a cotton wheel with polishing compound (Legabril Diamond, Fegramed GmBH, Germany). Then lower specimens were engaged with screws at the wear test machine (Fig. 2).

2.2. Upper specimens

2.2.1. Group 1 (enamel specimens)

Ten enamel specimens were obtained from the functional cusps of unrestored premolars that had been recently extracted. Each specimen was trimmed with high-speed diamond bur before it was embedded in a titanium holder (Fig. 1A).

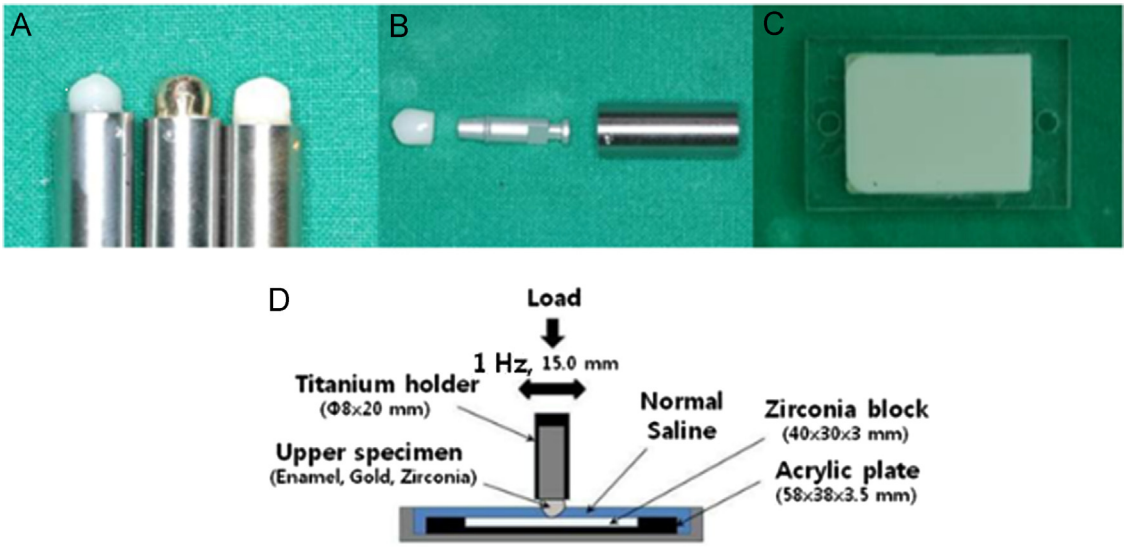

Fig. 1 – (A) Three specimens: zirconia crown, gold crown, and tooth. (B) A zirconia crown is cemented in implant abutment analogs before being embedding in titanium holders with autopolymerized resin. (C) Lower specimen: the rectangular zirconia block was attached to an acrylic plate with resin cement. (D) Schematic diagram of the wear test.