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#1897

91th General Session & Exhibition of the IADR Seattle March 20 – 23, 2013

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Longevity of All-ceramic CAD/CAM fixed partial dentures. A Comparative In-vitro-study of Different Materials

Objectives

All ceramic materials are used regularly in dental medicine. High-strength zirconium dioxide (ZrO_2) frameworks are established for posterior fixed partial dentures [1,2]. Main problem in clinical practice are cohesive fractures of the veneering ("chipping") [3]. Monolithic materials might solve the problem. Conventional glass ceramics are excellent in esthetics, and are established for inlays, onlays, veneers and single crowns in front teeth. Modern lithium disilicate glass ceramic (LS_2) combine good esthetics and improved fracture strength [4]. Still LS_2 is not indicated for posterior fixed partial dentures by manufacturer.

The aim of the present in vitro study is the comparison of fracture strength of posterior zirconia based and LS_2 fixed partial dentures before and after aging.

Material and Methods

16 three-unit LS_2 fixed partial dentures (e.max CAD, Ivoclar Vivadent, Schaan, LI) and 32 three-unit ZrO_2 frameworks (Organic Zirkon, R+K CAD/CAM Technology, Berlin, DE) were fabricated by using computer-aided design and manufacturing (CAD/CAM; Tab. 1). 16 ZrO_2 frameworks were conventionally veneered with low fusing veneering porcelain (IPS e.max Ceram, Ivoclar Vivadent) and 16 overpressed (IPS e.max ZirPress, Ivoclar Vivadent). All fixed partial dentures were cemented using glass ionomer cement (Ketac cem Aplicap, 3M Espe, Seefeld, DE). 8 fixed partial dentures per group were artificially aged (Willytec, Munich, DE). Mastication was simulated by 1.2 mio cycles per 50N, and thermal cycling was 10000 cycles with 5°/55°C.

Fracture strength of all fixed partial dentures were tested in an universal testing machine until fracturing (Fig. 1) at a test speed of v=1mm/min (Zwick 010, Zwick, Ulm, DE) and statistically analyzed (ANOVA, T-Test, p<0.05).

Tab.1 Tested all-ceramic systems

Technology	Blanks	Veneering	Manufacturer
Veneered	Organic Zirkon Ytterium stabilized zirconium dioxide	IPS e.max Ceram Nano-Fluorapatite glass ceramic	Ruebeling & Klar, Berlin, DE
Pressed	Organic Zirkon Ytterium stabilized zirconium dioxide	IPS e.max ZirPress Fluorapatite glass ceramic	Ruebeling & Klar, Berlin, DE
CAD/CAM	IPS e.max CAD Lithium disilicate glass ceramic	-	Ivoclar Vivadent, Schaan, LI


Fig.1

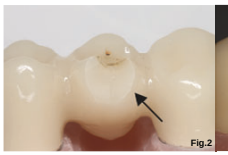
Fig.2


Fig.3

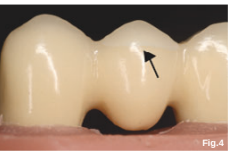
Fig.4

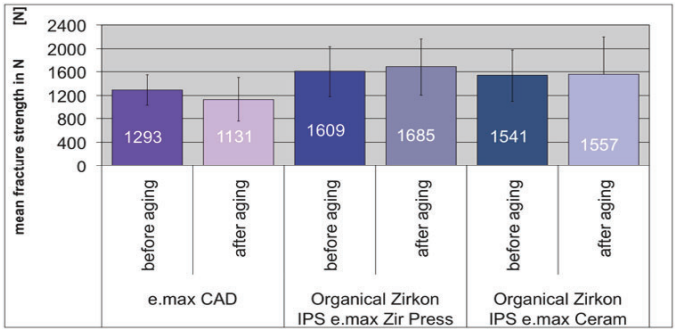

Fig. 5 Mean fracture strength

Results

Fracture strength of overpressed zirconia FPDs ranged between 1040N and 2390N before aging, and after aging between 1250N and 2510N. Mean fracture strength before aging was 1609N±427N and after aging 1685N±480N.

Fracture strength of veneered zirconia FPDs ranged between 978N and 2240N before aging and after aging between 859N and 2510N. Mean fracture strength before aging was 1541N±438N and after aging 1557N ±643N.

Fracture strength of lithium disilicate glass ceramic FPDs ranged between 1090N and 1850N before aging, and after aging between 909N and 1920N. Mean fracture strength before aging was 1293N±237N and after aging 1131N±374N.

After aging one LS_2 abutment and 2 cusps fractured (Fig. 2). 5 zirconia based veneering porcelain only showed superficial cracks (Fig. 3, 4). There were no significant differences between fracture strength before and after aging, as well as between the different materials.

Minimal fracture strength of posterior fixed partial dentures before aging are postulated at 1000N. All tested fixed partial dentures fulfill the requirements.

Conclusion

All fracture strengths were above 1000N before and 900N after aging. Fixed partial dentures made of lithium disilicate glass ceramic showed good results compared to zirconium-dioxide based fixed partial dentures. Chipping of veneered porcelain did not appear. Further clinical tests are required.

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3 Sailer I, Feher A, Filser F, Gauckler LJ, Luthy H, Hammerle CH. Five-year clinical results of zirconia frameworks for posterior fixed partial dentures. Int J Prosthodont 2007;20:383-388
4 Guess PC, Zavanelli RA, Silva NR, Bonfante EA, Coelho PG, Thompson VP. Monolithic CAD/CAM lithium disilicate versus veneered Y-TZP crowns: comparison of failure modes and reliability after fatigue. Int J Prosthodont 2010;23:434-442

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