

Pin-on-block wear of ceramics and antagonists

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Introduction:

The aim of this in-vitro study was to compare the two-body wear resistance of different ceramics versus steatite and human enamel antagonists.

Materials and Methods:

Two-body wear tests were performed in a chewing simulator with steatite and enamel antagonists (enamel cusps). A pin-on-block design with a vertical load of 50 N for 1.2×10^5 cycles ($f=1.6$ Hz; lateral movement: 1 mm, mouth opening: 2 mm) was used for the wear test. For quantification of the wear resistance, wear tests were performed with standardized steatite spheres. Human enamel was used as a reference. Six different ceramics (manufacturers: Ivoclar Vivadent, FL and Vita Zahnfabrik, D) were investigated, including zirconia, fluorapatite and lithiumdisilicate materials. Surface roughness R_a (SP6, Perthen-Feinprüf, G) and wear depth were determined using a 3D-Profilometer (Laserscan 3D, Willytec, G). SEM (Quanta FEG 400, FEI, NL) pictures were used for evaluating wear performance of both, ceramics and antagonists. Statistics: One-way Anova ($\alpha=0.05$).

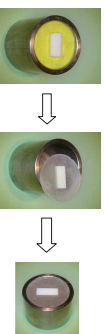


Fig. 1: Specimen preparation

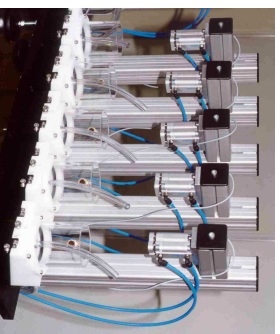


Fig. 2: Regensburg chewing simulator

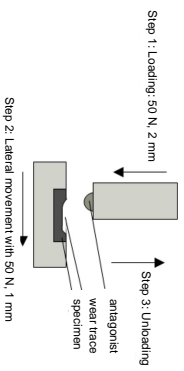


Fig. 3: Schedule of the pin-on-block wear test

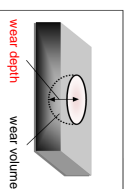


Fig. 4: Wear measurement

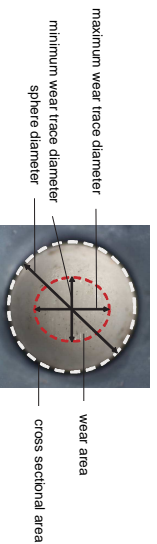


Fig. 5: Antagonist wear

Results:

Material	Steatite: wear depth [µm]	Steatite: antagonist wear [$3 \times 10^{-3} \text{ mm}^3$]	Enamel: wear depth [µm]	R_a [µm]
Human enamel	27.4+/-187.4	38.2+/-40.1	123.3+/-131.0	0.9+/-0.2
IPS e.max CAD	240.9+/-32.1	86.2+/-19.6	120.0+/-37.1	0.1+/-0.0
IPS e.max Ceram	137.4+/-35.9	54.5+/-12.0	92.2+/-29.1	0.2+/-0.1
IPS e.max Press	178.0+/-39.3	65.9+/-13.6	110.6+/-45.3	0.2+/-0.1
IPS e.max ZirPress	264.3+/-39.4	91.7+/-13.3	96.4+/-25.3	0.2+/-0.1
In-Ceram YZ Cubes	0.0+/-0.0	36.4+/-9.7	0.0+/-0.0	0.1+/-0.0
IPS e.max ZrCAD	0.0+/-0.0	39.3+/-14.5	0.0+/-0.0	0.1+/-0.0

Table 1: Results

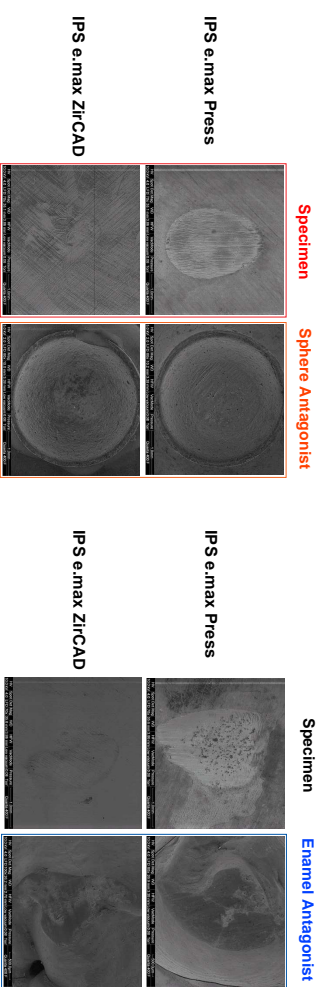


Fig. 6: SEM-Analysis

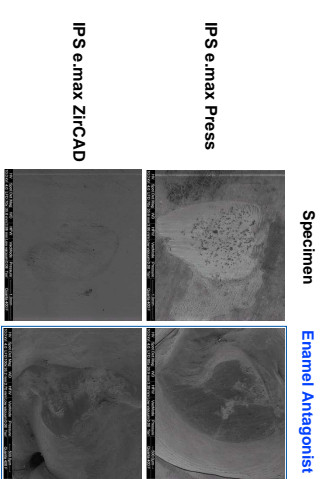


Fig. 7: SEM-Analysis

Conclusion:

The results of the wear test with steatite or enamel antagonists indicated no measurable wear on zirconia surfaces. Ceramic showed significantly higher wear than zirconia. Antagonistic wear against zirconia was found to be lower than wear against ceramic.