Fatigue Resistance of CAD-CAM Composites and Lithium Disilicate Glass-ceramics

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Objectives

Materials fatigue resistance is sparsely studied because it is time-consuming; however, it constitutes an important property to predict prostheses clinical performance. This work aims to compare the long-term flexural fatigue resistance of commercially available CAD-CAM composite materials, an experimental Polymer-Infiltrated Ceramic Network (PICN) and a lithium disilicate glass-ceramic under cyclic mechanical loading

Methods

Five commercial CAD-CAM composites (Cerasmart, GC (CER); Brilliant, Coltene (BRL); Tetric CAD, Ivoclar Vivadent (TET); Katana Avencia, Kuraray (KAT); Grandio, Voco (GRN)), an experimental PICN (Majeb (EXP)), and a lithium disilicate glass-ceramic (IPSe.maxCAD, Ivoclar Vivadent, (EMX)), were tested for flexural fatigue resistance. Blocks were cut to produce bars of dimensions (1.6±0.1)-mm x (4.0±0.1)-mm x (17.0±0.1)-mm, which were polished with a diamond pad (10-µm) under water (n=15). EMX were then fired according to the manufacturer's recommendations. Bars (n=5/group) were tested for fatigue in a water bath at 36°C in 3-point bending at 100-, 150- and 200-MPa for 1-million cycles (1Hz) or until fracture. Means ± standard deviations of flexural fatigue results were compared by ANOVA-1, followed by Tukey's test (*$p<0.05$;**$p<0.010$;***$p<0.001$).

Results

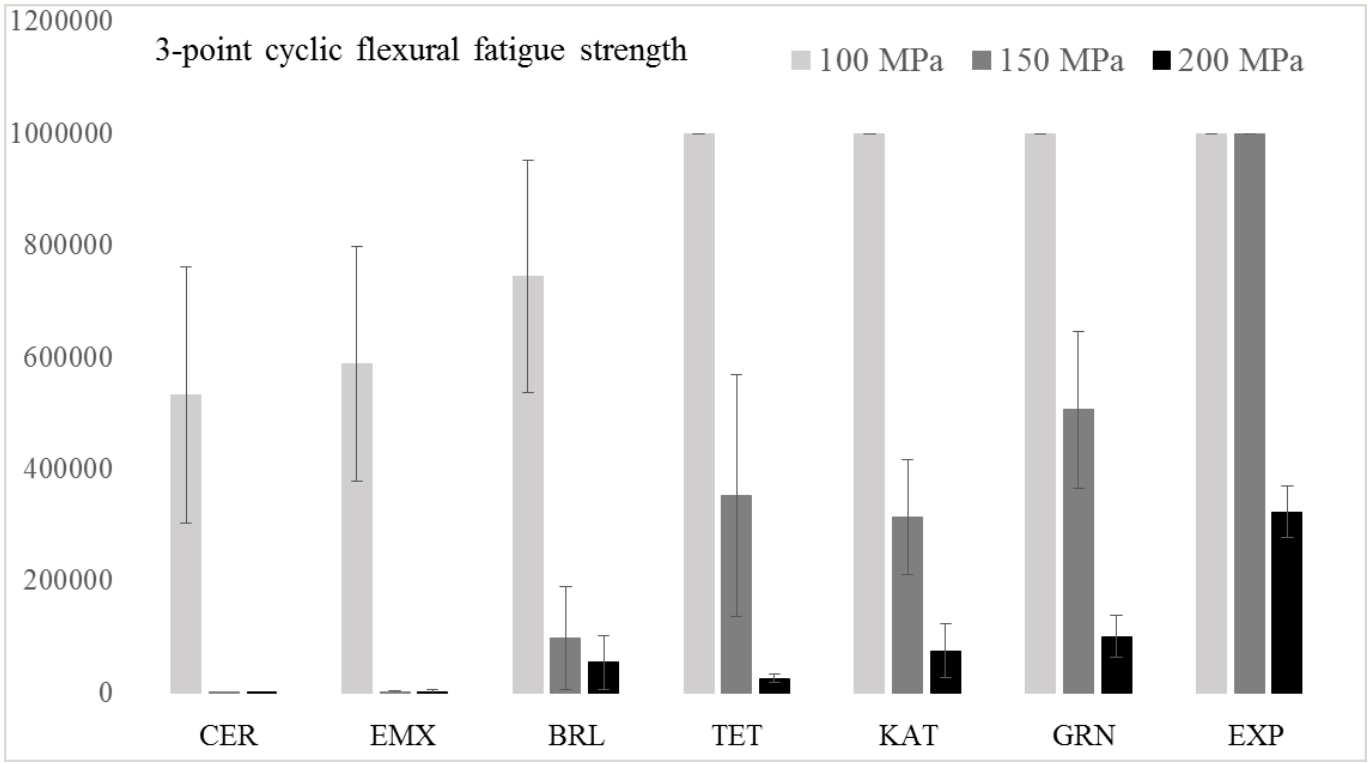
At 100-MPa, TET, KAT, GRN and EXP did not fracture after 1-million cycles, and the rest of the materials fractured, but there was no significant difference among all the tested materials. At 150-MPa, only EXP did not fracture after 1-million cycles and showed significantly higher fatigue resistance than the rest of the materials. It was followed by GRN (506,960±280,249)*, TET (353,126±433,511)**, KAT (315,108±206,414)***, BRL (977,84±183,588)***, EMX (2,649±4,845)*** and CER (215±229)***. At 200-MPa, EXP showed the highest fatigue resistance significantly (323,210±460,52) cycles, followed by GRN (101,403±73,612)***, KAT (74,765±96,456)*** BRL (54,521±95,157)***, TET (26,503±15,842)***, EMX (2,893±4,569)*** and CER (1±1)***.

Conclusion

EXP showed the highest fatigue resistance significantly. Results highlight that the flexural strength of materials is not predictive of their fatigue behavior, which should be considered in clinical practice.

Keywords

CAD-CAM; prosthodontics; dental prostheses; biomaterials; flexural resistance


3-point cyclic flexural fatigue strength
100 MPa
150 MPa
200 MPa
1200000
1000000
800000
600000
400000
200000
0
CER
EMX
BRL
TET
KAT
GRN
EXP