Influence of abutment material on the fracture resistance of ceramic-FPDs.

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Introduction:

Due to their constant dimensions and steady physical properties, artificial teeth were used to substitute human teeth in in-vitro studies. The aim of this study was to compare the influence of different abutment materials with simulated periodontium on the fracture resistance of three-unit FPDs after artificial aging.

Materials and methods:

A three unit posterior situation with one missing tooth (10mm gap) was simulated. The abutment teeth were made of:
(A) a liquid crystal polymer (LCP-blend) with a E-modulus comparable to dentin, periodontium simulated with a rubber sealing ring (Fig.1)
(B) a steel material, periodontium: root was covered with a deep-drawn rubber (Fig. 2)
(C) human molars with resin roots (roots covered with polyether) (Fig. 3) and as a reference
(D) human molars (roots covered with polyether) (Fig. 4).
32 all-ceramic three-unit FPDs (Empress2, Ivoclar-Vivadent, FL) were fabricated and adhesively luted onto the abutments (Variolink2, Syntac Classic, Ivoclar-Vivadent) (Fig. 5).


Fig. 1:
Abutment teeth made of liquid crystal polymer, periodontium simulated with a rubber sealing ring.


Fig. 2:
Abutment teeth made of steel, periodontium simulated with a deep-drawn rubber.


Fig. 3:
Human molars with resin roots, periodontium simulated with polyether.


Fig. 4:
Human molars, periodontium simulated with polyether.


Fig. 5:
All-ceramic three-unit FPD (Empress 2).


Fig. 6: Artificial oral environment

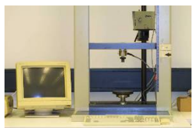


Fig. 7: Universal testing machine Zwick 1446, G.

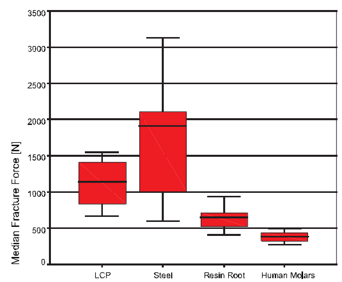

Fig. 8: Fracture load at the center of the pontic with a steel ball of 12,5 mm in diameter.

After 24 h storage in water (37°C) and thermal and mechanical cycling (6000 cycles 50°C/55°C, $1.2x10^6x50N$, each 2 min.) (Fig. 6), all FPDs were mechanically loaded until failure (UTM 1446: v=1mm/min, Zwick, G) (Fig 7., Fig 8.). The FPDs were examined optically to describe the forms of fracture. Median and 25% / 75% percentiles were calculated. Statistical analysis was performed using the Mann-Whitney *U* test (level of significance p=0.05).

Results:

Abutment material	LCP	Steel	Resin root on human molars	Human Molars
Artificial periodontium	Ruber sealing ring	Deep-drawn rubber	1mm Polyether layer	1mm Polyether layer
Median Fracture Force (25%/75% Percentiles) [N]	1138 (916/1348)	1906 (1124/2054)	647 (533/715)	387 (330/445)

Table 1: Fracture force: Median and 25%/75% percentiles



Statistics:

	LCP	Steel	Resin root
LCP			
Steel	-		
Resin root	*	*	
Human molars	*	*	*

-: no significant differences *: significant differences

Table 2: Statistical analysis: Mann-Whitney-U-test (p=0,05).

Conclusion:

Highest loading force was found for the steel and LCP abutments. The significantly lowest fracture force was found for individual human molars with polyether periodontium. The combination of abutment material and artificial periodontium had a significant influence on the fracture resistance of all-ceramic FPDs after artificial aging.

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