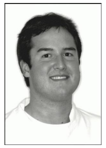

ARTIFICIAL MOUTH - INFLUENCE OF VARYING PROCESS PARAMETERS

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111

Objectives:

Artificial environments were used to simulate the clinical conditions with thermal cycling and mechanical loading (TCML). The aim of this in-vitro study was to examine the influence of varying instrument settings on the fracture behavior of three-unit all ceramic fixed partial dentures (FPDs).

Materials and Methods:

Identical human molar (human), CoCr-aloy (coCr) or Liquid Crystal Polymer (LCP) abutments with a 1mm champher finishing line were positioned pair-wise in a PMMA resin (Palapress, Kulzer, G) at a distance of 10 mm to represent a molar gap. 8 three-unit posterior FPDs were made of the all-ceramic Empress2 (Ivoclar-Vivadent, FL) according to manufacturer's instructions and adhesively luted using Variolink II (Ivoclar-Vivadent, FL). TCML (1.200.000 cycles) was performed with varying force: 50N/150N/50-150N staircase; chewing frequency: 1.6Hz/3.0Hz; mouth opening: 2mm/4mm; antagonist: human molar/ceramic sphere (d=6mm), temperature: 5°C-55°C/25°C (Fig. 1, Tab. 1). After TCML the FPDs were mechanically loaded until failure (UTM 1446: v=1mm/min, Zwick G) (Fig. 2, 3, 4). The FPDs were examined optically to describe the forms of fracture.
Median and 25%/75% percentiles were calculated. Statistics: Mann-Whitney-U-test (p=0.05).

Fig. 1: Thermal cycling and mechanical loading

parameters of artificial aging			
loading force [N]	50	150	50-100-150 (staircase)
force frequency [Hz]	1.6	3.0	
mouth opening distance [mm]	2.0	4.0	
thermal cycling temperature	25°C	5°C/55°C (2min each)	
antagonist tooth	human molar (human)	Ceramic steatite sphere 6mm (ceramic)	
abutment material	human molar (human)	CoCr-alloy (CoCr)	Liquid Crystal Polymer (LCP)

Tab. 1: Varying TCML parameters

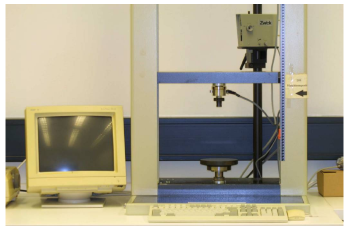


Fig. 2: Universal testing machine Zwick1446

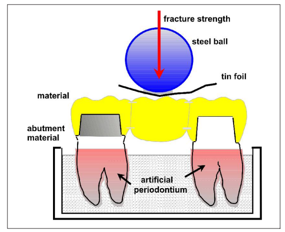


Fig. 3: Fracture strength testing configuration

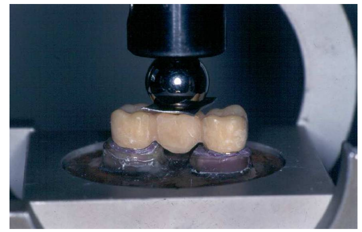


Fig. 4: FPD during fracture strength testing

Results:

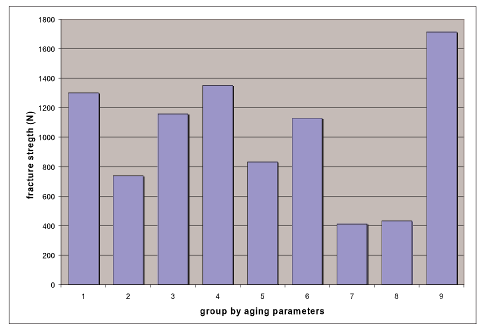
The highest fracture resistance was found on group 9 with mechanical loading at a constant temperature (1713N). Additional thermal cycling (group 1) reduced the loading capacity of the FPDs (1300N). With increasing loading force from 50N (group 1) to 150N (group 2) the fracture resistance was significantly diminished. A staircase load-increase to 150N (group 5) showed no significant differences compared to a constant load of 150N (group 2). Duplication of the chewing frequency (group 4) did not affect FPDs compared to standard test with 1.6Hz (group 1). Using human antagtonist decreased the loading capacity of the FPDs (group 6) compared to steatite ball (group 1). The duplication of the mouth opening distance from 2mm (group 1) to 4mm (group 3) reduced the fracture resistance not significantly by 150N. The loading capacity of the FPDs was significantly reduced when using human (group 7) or LCP abutments (group 8) instead of CoCr abutments (group 6). Detailed fracture strength mean values (Tab. 2), bar chart of the fracture strength values (Tab. 3), table of statistical results (Tab. 4).

group	2	3	4	5	6	7	8	9
1	0,007	0,442	0,878	0,1	0,279	0	0	0,382
2		0,38	0,005	0,721	0,015	0,006	0,008	0,001
3			0,505	0,105	1	0	0,001	0,083
4				0,038	0,328	0	0,002	0,279
5					0,105	0,004	0,005	0,007
6						0	0,001	0,05
7							0,445	0
8								0,001

Tab. 4: Results of statistical analysis (**significant differences**)

group	1	2	3	4	5	6	7	8	9
force [N]	50	150	50	50	50-150	50	50	50	50
mouth opening [mm]	2.0	2.0	4.0	2.0	2.0	2.0	2.0	2.0	2.0
frequency [Hz]	1.6	1.6	1.6	3.0	1.6	1.6	1.6	1.6	1.6
abutment material	CoCr						human	LCP	CoCr
antagonist material	ceramic					human			ceramic
temperature [°C]	5°C/55°								25°C
fracture strength mean [N]	**1300**	**738**	**1157**	**1350**	**831**	**1126**	**410**	**432**	**1713**
standard dev.	**557**	**243**	**424**	**487**	**324**	**338**	**135**	**41**	**640**

Tab. 2: Detailed fracture strength values of different TCML-groups



Tab. 3: Fracture strength bar chart of the different TCML-groups

Conclusions:

Higher loading force and a temperature gradient lead to decreasing fracture resistance. The abutment material has a significant influence on the fracture force. Fracture force after aging is dependent on the parameters of the artificial aging process.

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