

Introduction:

The aim of this investigation was to compare fracture resistance (FR) and marginal adaptation (MA) of experimental preformed pediatric composite crowns, NuSmile and stainless steel crowns after thermalcycling and mechanical loading.

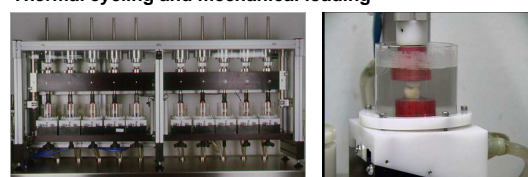
Materials and methods:

The roots of human primary molars were fixed with a 1mm polyether layer to imitate the periodontium. Eight crowns per test-group were prepared as listed below. Single molar crowns were fabricated with NuSmile (Orthodontic Technologies, USA), experimental preformed pediatric composite crowns and stainless steel crowns (all 3M ESPE, USA). The crowns were cemented as listed and thermocycled and mechanically loaded (TMCL: 12000x5°C/55°C, 2.4 x1 06x50N, 1.66 Hz) with human antagonists, then axially loaded to failure (Zwick 1446; v=1mm/min). Failure detection was set to 10% of Fmax.

Occlusal wear was measured in comparison to the unworn surface by a 3-D scanning device (Willytec, G). MA (%perfect margin) was determined in a scanning electron microscope (Phillips Quanta FEG 400, NL) via replica-technique at the interface cement-crown before and after TCML. Statistical analysis was performed with the Mann-Whitney-U-test ($\alpha=0.05$).

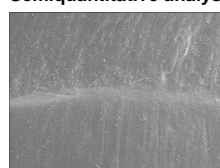
Group	Crown	Cement	Preparation
1	3M stainless steel primary molar	RelyX Luting Plus	tangential preparation
2	NuSmile veneered stainless steel primary molar	RelyX Luting Plus	tangential preparation
3	3M Pediatric Composite crown prototype	RelyX U100	shoulder preparation
4	3M Pediatric Composite crown prototype	RelyX Luting Plus	shoulder preparation
5	3M Pediatric Composite crown prototype	KetacCem	shoulder preparation

Thermal cycling and mechanical loading

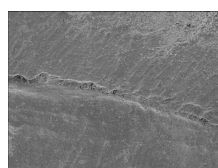


"Regensburger" artificial oral environment

Semiquantitative analysis

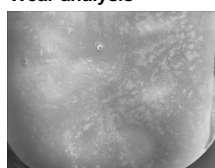


„perfect margin“ = smooth transition, no interruption of continuity

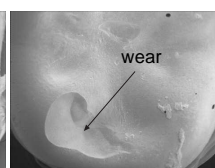


„marginal gap“ = separation of the components due to adhesive and/or cohesive failure.

Wear analysis



before TCML

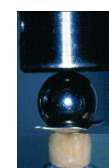


after TCML

Fracture test



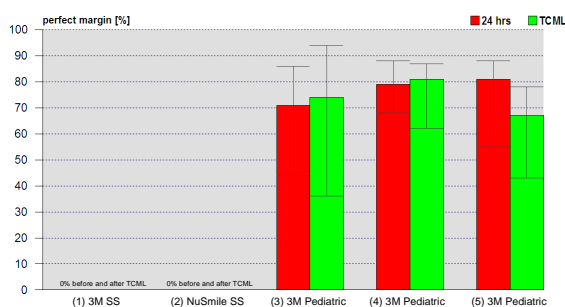
Universal Testing Machine



Analysis of fracture strength

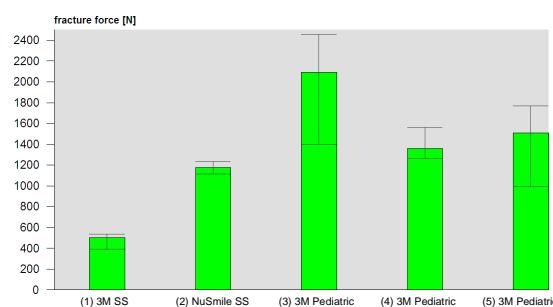
Results:

Semiquantitative analysis (interface: cement/crown)



The analysis of the marginal areas at the interface cement/crown showed statistically significant better results for groups 3,4,5 than for the groups 1 and 2 before, as well as after, TCML. The comparison of the results before and after TCML showed no statistically significant differences.

Fracture test after TCML



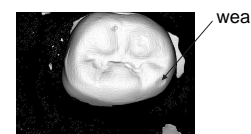
The median fracture strength of 3M Pediatric Composite crowns was between 1359 N and 2091 N in comparison to 503 and 1243 N for stainless steel crown restorations. The statistical analysis showed statistically significant better results for groups 2, 3, 4 and 5 than for group 1 and better results for groups 3 and 4 in comparison to group 2.

Wear analysis

The comparison of the crown surfaces indicated less traces of wear for 3M stainless steel crowns and comparable traces of wear for 3M Pediatric Composite crowns and NuSmile veneered stainless steel crowns. Exemplary 3D Scan pictures of 3M Pediatric Composite crown surfaces before and after TCML are displayed.



before TCML



after TCML

Conclusion:

Highest fracture resistance and good marginal adaptation was found using 3M Pediatric Composite crowns. The comparison of the crown surfaces indicated less traces of wear for 3M stainless steel crowns and comparable traces of wear for 3M Pediatric Composite crowns and NuSmile veneered stainless steel crowns. These results indicate that 3M Pediatric Composite crowns may be fit for clinical application in pediatric dentistry. Clinical research is needed to confirm.