# Influence of the zirconia core design on the in-vitro failure performance

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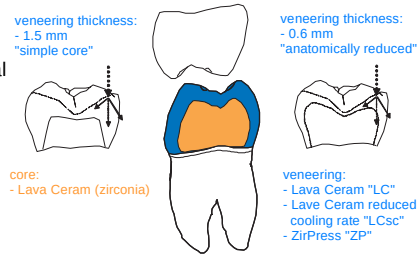
## Introduction:

The aim of this study was to test whether the core design of ceramic molar crowns has a significant influence on chipping of ceramic veneering during chewing simulation. The aim was to compare layered- and pressed- veneering techniques.

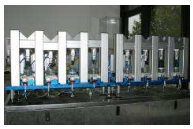
## Materials and methods:

The roots of PMMA molars (tooth 46, 1mm deep circular shoulder, Morita, G) were coated with a polyether layer (1mm, Impregum, 3M Espe, G) for simulating the periodontial mobility and arranged in resin (Palapress Vario, Heraeaus-Kulzer, G).
Molar copings (n=8 per series) of zirconia (Lava Ceram, 3M Espe, G) were made and veneered with layering ceramic veneering (**"LC"-Lava Ceram**, 3M Espe, G) or press ceramic (**"ZP"-ZirPress**, Ivoclar-Vivadent, FL).
The veneering thickness varied between **0.6 mm (anatomically reduced)** and **1.5 mm (simple core)** according to the design.
For investigating the influence of the cooling regime, one group **("LCsc")** was repeated with **reduced cooling rate.**
All crowns were cemented using Rely X Unicem (3M Espe, G).



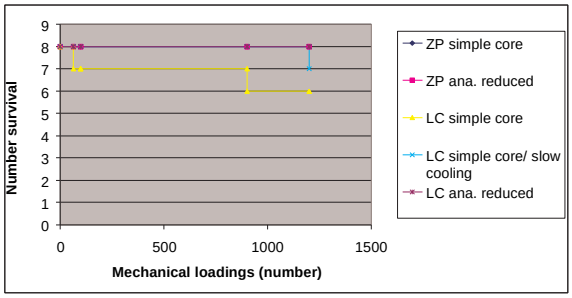
Study design

Identical antagonists (CoCr-alloy; Wirobond LFC, Bego, G/ Vita VMK13, Vita, G) and crowns were transferred to thermal cycling and mechanical loading [TCML] with 1,200,000 [ML]/50N and 6000 [TC]/2min each cycle- water: 5℃ and 55℃), which is supposed to simulate five years of service. During simulation the restorations were controlled (chipping, fracture, etc.) every 100,000 mechanical loadings.
Type and size of crown failure was analyzed (SEM; Quanta; FEI-Philips, NL).
Statistics: One-way ANOVA ($\alpha$=0.05).


Regensburg chewing simulator

## Results:

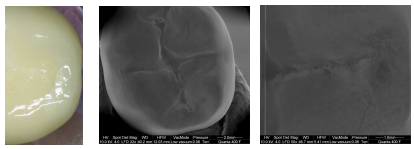
With pressed veneering for both core designs, no failures could be found during chewing simulation. For the layering technique two failures were detected for the simple core design and no failure for the anatomically reduced design. Slow cooling during veneering reduced failures for the layering technique with simple core design.



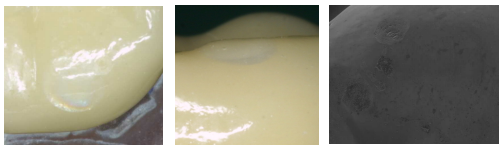

| | ZP-ZirPress | LC-Lava Ceram |
|---|---|---|
| 0.6 mm (anatomically reduced) | 0 | 0 |
| 1.5 mm (simple core) | 0 | 2 (63,000/915,079) |
| 1.5 mm (simple core) reduced cooling rate | - | 1 (1,200,000) |

Fig.: Number/date of failures during TCML

LC-Lava Ceram 1.5 mm (simple core)



LC-Lava Ceram 1.5 mm (simple core)



LC-Lava Ceram 1.5 mm (simple core) reduced cooling rate

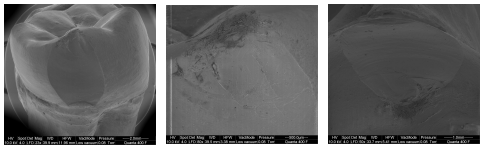


Fig.: Fracture analyis

## Discussion:

The results showed that cracking and chipping were dependent on the design of the core and the type of veneering.
**Slow cooling** during fabrication reduced failure sensitivity.

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