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Esthetics in and with All-ceramic Restorations

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Introduction

It is possible that in the near future all-ceramic systems for single crowns and fixed partial dentures (FPDs) may replace standard porcelain fused to metal restorations (PFM). The esthetic and biocompatible advantage of all-ceramic systems has become quiet clear. Several clinical studies demonstrate the success, especially for ceramic frame systems that are generated by CAD/CAM systems.

Fig. 1: Preparation of teeth 11 for veneer and 12 with all-ceramic post and core crown restoration.

Fig. 2: Adhesiv attached veneer at tooth 11

Fig. 3: After the insertion of the Procera ® all-ceramic crown at tooth 21.

Objectives

Preparation for All-ceramic Systems

The preparation principles applied in all-ceramic systems are comparable. The margin should be precisely determined either by a modified shoulder and rounded internal angles or a chamfer. The tooth preparation should have a taper of 6° to 10°. All contours ought to be smoothened and rounded. The removal of the tooth structure correlates to the manufacturer's guidelines. All-ceramic systems with zirconia core need similar preparation which is used in porcelain fused to metal restorations (PFM).

Fig. 7: PFM Bridge restoration with insufficent margins on the teeth 12 to 21.

Fig. 8: Preparation of the teeth for a zirconia all-ceramic restoration.

Fig. 9: After the insertion of the Cercon ® all-ceramic bridge.

Material and Methods

CAD/CAM Systems and Indication

Nowadays dentists and dental technicians can choose from a great variety of all-ceramic systems. The planned restoration determines the proper ceramic system. Ceramic frame systems based on zirconia are suitable for anterior and posterior restorations. As the result of these strong ceramics it is possible to make three or more unit FPDs.

Fig. 4: Teeth 13 and 12 with multiple and extensive insufficent composit restorations.

Fig. 5: Set-up of the teeth 13 and 12with quartz fiber posts, composit and preparation.

Fig. 6: One week after the insertion of the Cercon ® all-ceramic crowns.

Preparation guidelines for all-ceramic systems

system	margin	axial reduction mm	incisal reduction mm
Empress ® 1	shoulder internal rounded	1,0 - 1,5	2,0
Empress ® 2	dto.		
In-Ceram ®	chamfer, shoulder int. rounded	1,0 - 1,2	1,5
Procera ® AllCeram, AllZirkon	chamfer	0,8 - 1,5	1,5 - 2,0
Cercon ®	shoulder int. rounded, chamfer	1,0	1,5 - 2,0
Cerec ® InLab In-Ceram ® Zirkonia	shoulder int. rounded, chamfer	1,0 - 1,2	1,5
Lava ®	shoulder int. rounded, chamfer	1,0 - 1,5	1,5 - 2,0

Results

Semi sintered zirconia vs. hot isostatic pressed zirconia

The introduction of CAD/CAM systems introduced the possibility of producing dental restorations from materials of extreme hardness and flexural strength. Pre-sintered zirconia is used by manufacturers like DCS ®, Decim AB ® and Digident ®. The milling process is extremely time consuming, due to the subtractive procedure. It is even technically possible to make up to twelve or more unit FPDs.

Chalk-like, semi sintered zirconia is firstly shaped by milling and then condensed by heating. The shrinking rate of the over dimensioned ceramic frame is 20-30%. The duration of the sinter process is about 8 hours. Several studies show that the flexural strength falls back to 500 MPa due to the embriddlement and fatigue of the pre and semi sintered ceramic. Long-term assessments are still needed for evaluation.

Fig. 10: Insufficent and unesthetic PFM restoration of the teeth 14 to 16 and 17.

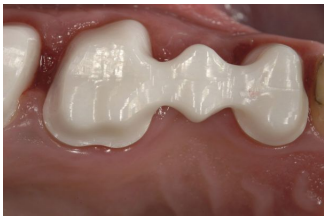

Fig. 11: Try in of the DCS ® all-ceramic bridge framework and a single crown coping.

Fig. 12: After cementation of the DCS ® bridge and crown with a glasionomer cement.

Fracture resistance and incidence

The durability depends on the flexural strength of the used materials. Ceramic with low flexural strength of 200 MPa must be adhesively cemented and can only be used for inlays, veneers and partial crowns. For premolar crowns and anterior bridges a minimum flexure rate of 400MPa is required. Extremely high flexural strength of more than 1000 MPa, provided by zirconia, can even be used for posterior crowns and multi unit FPDs.

Fig. 13: Preparation of the teeth 11 and 12 for Procera ® all-ceramic restorations.

Fig. 14: Try in of the restoration. Individualized Balance ® abuttment of a Ankylos ® implant in regio 12.

Fig. 15: After the insertion of the Procera ® all-ceramic crowns on teeth 12, 11 and 21.

Flexural Strength of All-Ceramic Systems

IPS Empress ® 1	150 Mpa	Inlays, veneers and single crowns
IPS Empress ® 2	400 Mpa	single crowns on premolars
In-Ceram ® Alumina	570 Mpa	and up to anterior 3 unit FPDs
In-Ceram ® 30% zirconia 70% alumina	700 Mpa	
Lava ®	>1000 Mpa	posterior 3 and 4 unit FPDs
Cercon ®	>1000 Mpa	
Digident ®	~1200 MPa	12 and more unite FPDs
DCS ®	~1200 MPa	

Discussion and Conclusion

- The natural appearance and translucency of the all-ceramic systems makes esthetics in dentistry more achievable.
- Zirconia allows a higher range of indications and multi unit FPDs.
- Ceramics with flexural strength below 200 MPa must be adhesively cemented.
- Accurate preparation methods are necessary.
- FPDs manufactured with CAD/CAM processes made of zirconia could replace the conventionally produced PFDs as long as the production is economical.
- First results of studies at our Institute show great promise for the use of all-ceramic systems based on zirconia frames.

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Abbreviations

FPD - fixed partial dentures
PFM - porcelain fused to metal restorations
CAD - computer-aided design
CAM - computer-aided manufacturing

This poster was submitted by Axel Bauer.

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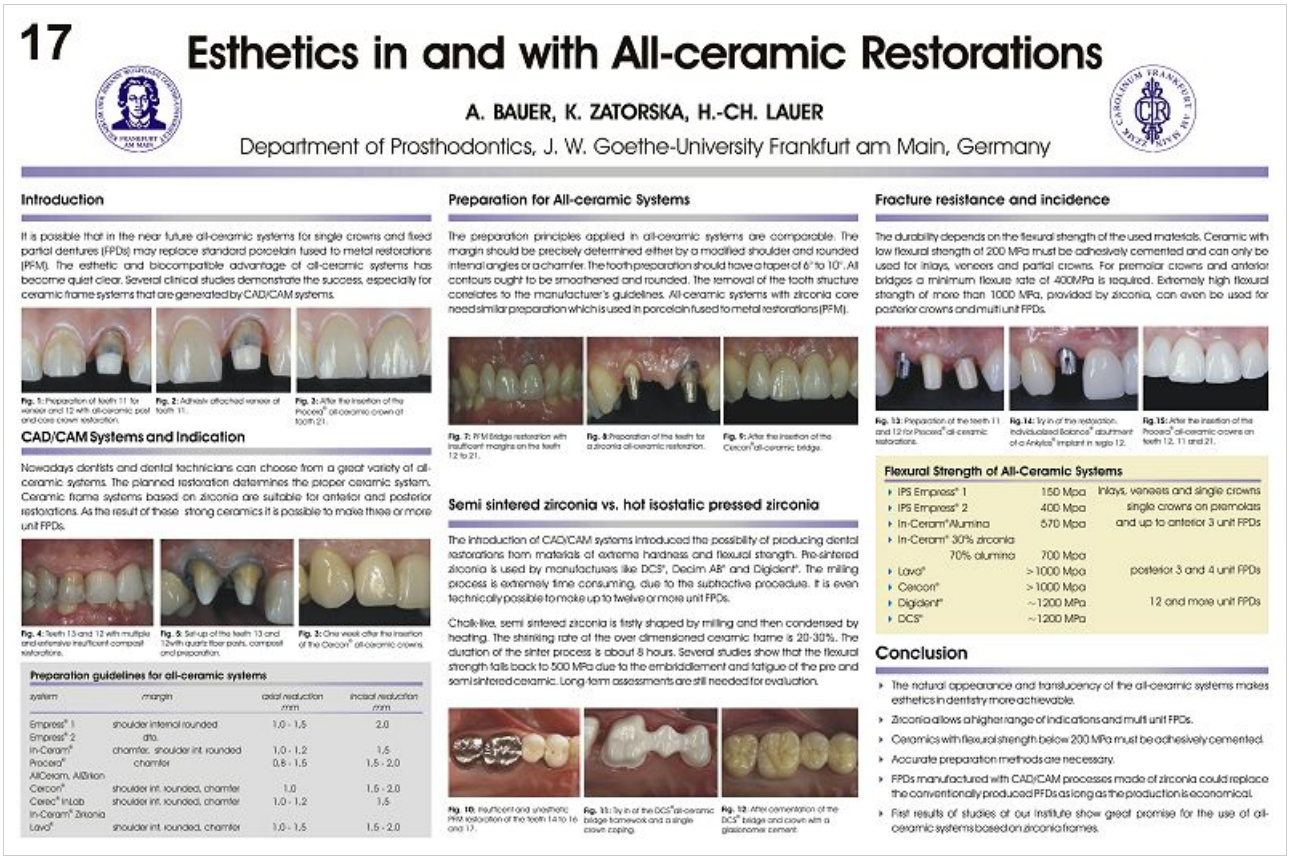

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