Ceramic restorations—What is the key to success?

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The issue I would like to address in this article is one well known to many of the readers. However, occasionally it can be beneficial for us to consolidate and evaluate our knowledge. Therefore, I would like to set out my own experiences acquired over many years of work as a dental technician. I hope that the majority of readers will share my opinion that in order to guarantee a successful ceramic restoration it is important to choose the right material and construction and to ensure that it is properly made. Prosthetic work carried out in this way ensures an aesthetically pleasing appearance, perfect marginal seal and durability for the entire restoration. Naturally, it cannot be expected that crowns set on a non-precious metal will look beautiful and provide a natural distribution of light, for example.

Technicians will always face a dilemma when it comes to choosing the right coping, and only a skilful consideration of all the arguments for and against any specific solution will guarantee a successful outcome. My observations primarily concern the materials and technologies that I have most frequently used to make ceramic crowns.

The firing method used for a ceramic mainly depends on the material of the coping. In turn, the aesthetic quality of the prosthetic restoration (transparency, opalescence, fluorescence) is mostly influenced by the type of coping used.
Ceramic prosthetic crowns differ both in the technology used to construct them and in the materials from which the restoration is prepared. Porcelain can be fired on:

- alloys: precious metals (alloys with high gold content—above 75%, medium—50–70%, low—up to 50%) and non-precious metals (chrome, cobalt);
- galvanic structures;
- transparent zirconium dioxide ZrO₂ (nanoceramic—size of grain below 30 µm, purity of material 99.9999 %, and opaque zircon—grain value above 30 µm);
- aluminium trioxide Al₂O₃;
- press porcelain; and
- feldspathic porcelain.

I will briefly outline the pros and cons of the crowns we use most frequently in our office.

**Porcelain fired directly on refractory die**

**Advantages**
- natural distribution of light in finished restoration
- optimal cohesion of material
- excellent aesthetic effect when making individual crowns for anterior non-discoloured abutment teeth or veneers and inlay/onlay restorations
- physiological wear with the antagonist
- chameleon effect

**Drawbacks**
- a difficult restoration technology, as no adjustments can be made once the refractory material is removed
- not possible to control and monitor individual stages of the work
- limited application for making individual anterior crowns to be placed on non-discoloured abutments or for inlay/onlay restorations
Case study: ceramic restorations

Preparation is possible only with a simple, relatively even shoulder around the entire circumference.

Porcelain fired on zirconium dioxide ZrO₂

Advantages
- Reproducibility and accuracy of restoration (only in CAD/CAM system)
- Good light dispersion
- Covers dark abutments and metal posts and cores (opaque zircon)
- A wide range of applications (crowns, bridges, bars and implant abutments, telescope crowns, ledges)
- Possibility of preparation with limited shoulder and chamfer/bevel
- Individual stages of the work can be monitored, even in the patient’s mouth
- Construction retains shape when ceramic is fired

Drawbacks
- Construction has limited elasticity
- Micro chipping on active surface
- Construction cannot be repaired
- Liners must be used

Porcelain fired on metal

Advantages
- Chemical bonding of construction with porcelain
- Construction can be repaired
- High elasticity
- A wide range of applications (bridges, crowns, telescope prosthetics, posts and cores, bars and implant abutments)
- Individual stages of the work can be monitored, even in the patient’s mouth
- Oligodynamic effects (in the case of gold)

Drawbacks
- No transparency in substructure
- Oxidation necessary
- Risk of margin deformation when firing ceramic
- External factors may influence construction (temperature, proportion, refractory material)

I will present several cases in which various kinds of substructures were used to achieve the most natural appearance possible.

Case I (Figs. 8–17)

A 28-year-old patient presented with pronounced discoloration of the teeth, which was a result of medication from the tetracycline group taken during her childhood (Fig. 8). There was also significant damage to the enamel of the patient’s teeth. The uneven cervical line had damaged the aesthetic appearance of her dentition. The patient wished to change both the shape and appearance of her teeth.

The first task was to ensure a proper cervical line and achieve an effect of longer teeth without changing the occlusal line. Owing to the skilful work of the dentist and the ideal construction of the temporary crowns made by the technician, it was possible to
achieve excellent results in the red aesthetic zone. Figures 16 and 17 show that the gingiva formed in accordance with our expectations.

As I mentioned earlier, in order to guarantee success, it is important to choose the right technology for crown fabrication. In this case, I considered two possibilities for making the restorations: either on a coping using press technology or fired directly on the refractory material. I was faced with such a dilemma because I was unsure whether the crowns made using feldspathic porcelain would cover the dark abutments of the patient’s teeth. After the preparation, however, it turned out that the stumps of the teeth were not as drastically discoloured as the colour prior to the preparation had indicated.

The effect of the reconstruction is left to the appraisal of the readers. The use of a metal coping and even a zircon solution would not have achieved the desired aesthetic result.

Case II (Figs. 18–21)

A 26-year-old patient presented with a discoloured tooth 11 (Fig. 18). Previously, the operations performed by the dentist on the patient had involved making composite veneers, which had changed colour over time.

The first stage of the work involved changing the fillings in teeth 21 and 22, then making the preparation and taking the impression. In this case, I considered three variants for the substructure: made using the press method, a zirconium dioxide coping or a galvanic structure. The patient wanted a natural restoration identical to the one on tooth 21.

The press method would have been too risky, as the stump of the tooth was severely discoloured. I was concerned that the dark colour would show through the cemented crown. A crown inserted on a galvanic gold coping, in spite of its warm tone and its ability to cover the dark abutments, would not have dispersed light in such a way that when looked at from any angle it would be impossible to notice any features distinguishing it from a natural tooth. Hence, I decided to make a crown based on a zirconium dioxide substructure.

Case III (Figs. 22–23)

A patient visited our surgery for a typical dental check-up. After a preliminary examination, caries was found to be present in several teeth, including the patient’s two lower premolar teeth (secondary caries reaching the pulp chamber). Unfortunately, in cleaning the zone affected with caries the dentist had to devitalise the tooth and perform endodontic treatment. On completion of the treatment, the remaining dental tissue was found not suitable for partial restoration. Hence, the dentist decided to make ceramic crowns and place them on stumps strengthened beforehand with gold alloy posts and cores. The stumps prepared in this way were subjected to analysis that showed that the optimal solution in this case would be porcelain crowns made on a zirconium dioxide substructure. This would ensure an aesthetically pleasing appearance and durability. Such characteristics could not be achieved with crowns made using the press method or fired on a refractory material or a metal coping. Only using zirconium dioxide as a substructure guaranteed the intended effect, which is left to the readers to judge.

In conclusion, I would like to thank the dentists who helped me prepare the work presented here. I would also like thank Robocam for providing the zirconium dioxide.

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