AFM Analysis of Conditioned IPS Empress Ceramic Core

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The purpose of this study is to investigate the conditioned ceramic core of IPS Empress systems. Due to brittle character of all ceramic materials, fracture may occur. This accident may be rehabilitated through conditioning and reparations of the prosthetic restorations. Fracture of ceramic veneer may be reconstructed with either ceramic or composite resin materials. Acid conditioning and sandblasting may improve adhesion to ceramic core. One of the methods which may evidence the aspect of the conditioned surface is Force Atomic Microscopy. Depending by the conditioning method, different maps of the conditioned ceramic cores are obtained and conditioning protocol may be evaluated and recomended for practical use.

Keywords: ceramic core, ceramic veneer, conditioning methods, Force Atomic Microscopy

All ceramic materials brought many changes in dentistry and are finding their applicability in prosthetics-venners, inlays, onlays, all ceramic crowns, fixed partial prosthesis, implantology- dental implants. Orthodontics is another branch which takes benefits form these materials. Their excellent properties makes them very attractive for fixed partial restorations, especially when restoring the teeth from frontal area.

There are a few methods or systems to make all the ceramic restorations, but in this study IPS Empress e.max is the one involved.

All-ceramic fixed partial prostheses are the best choice for excellent aesthetics. Patients have high expectations about quality and aesthetics and longevity of the dental prostheses. All ceramic fixed systems appeared more than three decades ago and along this time, they were constantly improved and developed.

At present all-ceramic systems may replace metal-ceramic fixed partial prostheses. All-ceramic inlays, onlays, veneers and crowns can restore teeth with extended destructions and which must be conserved and may also assure the integrity of partial edentulous arches. New ceramic systems are now reinforced through dispersion with leucite, glass infiltration into sintered alumina (Al₂O₃), high-purity alumina or zirconium dioxide (Zirconia, ZrO₂). All ceramic fixed partial prostheses may be performed through different techniques, such as heat pressed ceramic IPS Empress, grinding of ceramic blocks IPS Empress crowns are made from a ceramic core obtained from plasticized ceramic and burned ceramic layers. These types of prosthesis put out the metallic infrastructure which bright at the cervical area when marginal retraction of the gums takes place or the ceramic layers in third cervical is too thin. Tattoo of the cervical gum is another inconvenient. These fractures may be rehabilitated through direct methods with composite resin. When conditioning the ceramic core the adhesion composite resin used for reparation may be improved through different methods.

Ceramic mass from third incise of buccal face of each crown was removed in order to reproduce the situation of a fractured ceramic crowns repaired through direct method with composite resin. The ceramic was removed with a grinding instrument, without pressure for avoiding other additional fissures or craks. Ceramic core was exposed and conditioned. Samples were divided into three groups. The ceramic cores of first group were sandblasted with Al₂O₃ at a pressure of 3 Bar from a distance of 10mm. The second group was etched with HF 9% for 90s. Ceramic cores of the third group were grinded with a diamonded grinding instrument and etched with HF 9% for 90 s.

All the samples were investigated by Atomic Force Microscopy which may spot the differences of the ceramic surface conditioned through different methods. The extremely sensitive cantilever (5 μ height and 10 nm diameter) is scanning the conditioned ceramic surface. Interaction forces between the tip and samples surface determine the bending of the cantilever. A sensitive detector measures the cantilevers deformations while the tip is scanning the sample. The received signal is transmitted to a computer which will map the sanded surface. Positive and negative reliefs are obtained.

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Depending by the conditioning methods, different aspects of the surface were obtained. All the samples were investigated by Force Atomic Microscopy and the results give the possibility to indicate the proper method for conditioning the ceramic core.

**Results and discussions**

Atomic force microscopy is proved as a useful tool for the nondestructive imagistic evaluation method. Obtaining the real surface profile for the ceramic support is important for the quality of the future ceramic veneering. It could give information about the right material that is proper for that infrastructure, especially when repairing methods are employed.

Each conditioning protocol developed a different surface relief. Though similar, the orientation and the deep of the gaps, lines and craters are various. The group conditioned by grinding emphasized a more aggressive relief characterized as deep lines. But combining the images with the obtained results the most significant roughness is the acid conditioning and sandblasting gives a much planar relief not favourable for surface roughness. The micro retentivities may influence the surface in a positive way.

The Atomic force microscopy tools could be used in order to obtain qualitative results (fig. 2, 4, 6). In this way a statistic analysis can be produced and the results could validate the imagistic qualitative results. In this way the total surface and the deeper dimensions of the new profile obtained after different conditioning methods can be pointed out.

**Conclusions**

After applying the described conditioning methods the retentive microrelief is depending on the conditioning method. Further investigations will test the shear bond strength resulted after applying these conditioning protocols.

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References

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