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 restaurations. 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 reconmanded 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 applycability in prosthetics- venners, inlays, onlays, all ceramic crowns, fixed partial prosthesys- implantology- dental implants. Othodontics is another branch witch 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 prosthesis are the best choice for excellent aesthetics. Patients have high expectations about quality and aesthetics and longevity of the dental prosthesis. 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 prosthesis. 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 (Al_2O_3), high-purity alumina or zirconium dioxide (Zirconia, ZrO_2).. All ceramic fixed partial prosthesis may be performed through different techniques, such as heat pressed ceramic IPS Empress, grinding of ceramic blocs 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 which affects the aesthetic aspect. Despite of its qualities metallic infrastructure is replaced by ceramic core made through heat pressing or grinding procedure. Ceramic layers are layered and burned over the ceramic core. All ceramic fixed partial prosthesis has a few sensitive properties. One of them is the fracture of ceramic veneer or ceramic core. It takes place because ceramic masses have no elasticity and have a brittle character. Occlusal overloading, defects into the ceramic mass which appear during technological process, fissure which may generate the fracture of the ceramic veneer and cement wash in case of an incorrect marginal adaptation which lead to absence of stability and adhesion of the all ceramic crowns. These are a few reasons for which an all ceramic crowns can fail.

Experimental part

Materials and methods

The demand for all ceramic systems is increasing. For this study 15 all ceramic crowns were made through heat pressing technique. All the crwons restore the upper first incisor and were made through IPS Empress. e.max sustem. Though the aesthetic aspect of the restoration was ot the purpose of this study, all the setps and morphological aspects were made. Unusally due to brittle character of ceramic masses the fracture of ceramic component is located in the third incise or third cervical area. These two areas are suusceptible to fracture because the ceramic is not plain layed and the layers are thinner and the resistance is compromised. 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 diferent 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 fisures or craks. Ceramic core was exposed and conditioned. Samples were divided into three groups. The ceramic cores of first group were sandblasted with Al_2O_3 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 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 extremelly sensitive cantilever (5μm 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 recived signal is transmited to a computer which will map the sanded surface. Positive and negative reliefs are obtained.

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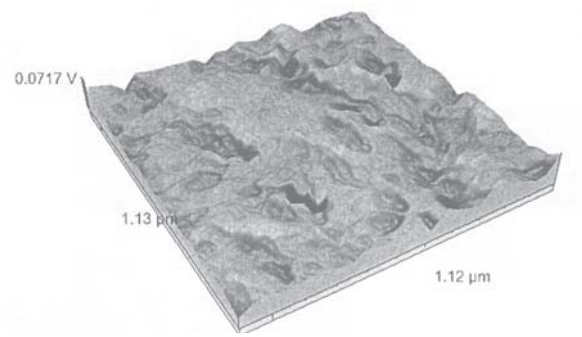

Fig. 1. Acid conditioning HF 9% of ceramic core

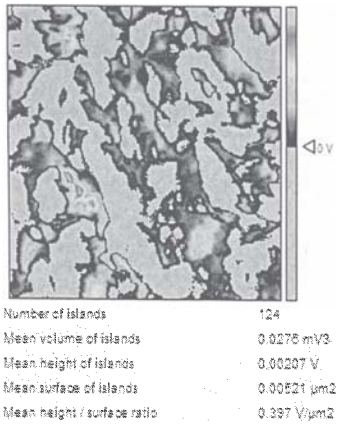

Fig.2 Volme of islands 546nm

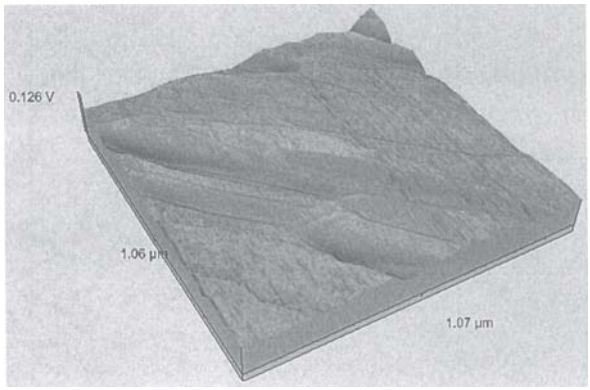

Fig. 3. Grinding and acid conditionig HF 9% of ceramic core

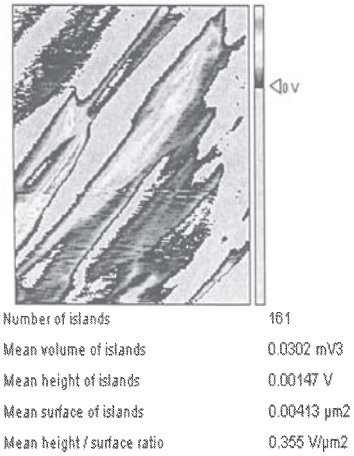

Fig.4. Volme of islands 1micro

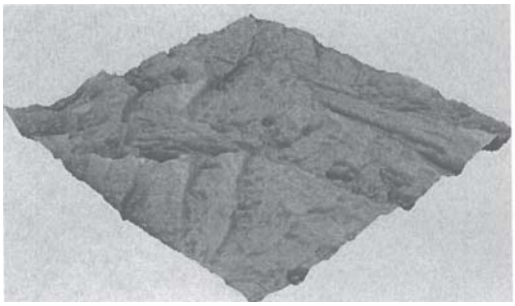

Fig.5. Sandblasted ceramic core

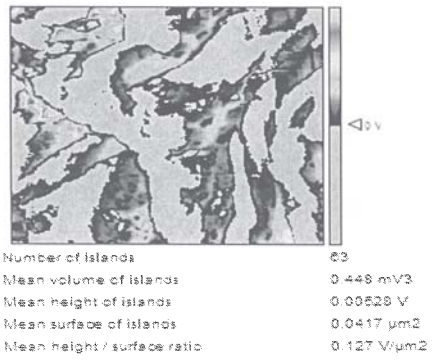

Fig. 6. Volume islands 2 micro

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 posibility to indicate the proper method for conditioning the ceramic core.

Results and discussions

Atomic force microscophy is proved as a usefull tool for the nondistructive imagistic evaluation method. Obtaining the real surface profile for the ceramic suport is important for the quality of the future ceramic veneering. It could give information about the right material that it is proper for that infrastructure, esspecialy 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 grindin emphasised a more aggresive relief characterized as deep lines. But combining the imagies with the obtained resuts the most signifiant roughness is the acid conditioning and sandblasting gives a much planne relief not favourable for surface roughness. The micro retentivies may influence the surface in a positive way.

The Atomic force microscophy tools could be use in order to obtain quatitative results (fig. 2, 4, 6). In this way a statistic analisys can be produced and the resuls could validate the imagistic qalitative results. In this way the total surface and the deeper dimensions of the new profile obtained after different conditionig 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 this conditioning protocols.

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