ECRONICON OPEN ACCESS

EC DENTAL SCIENCE
Editorial

The Fractographic Analysis of Ceramic Failures

Ricardo Sgura*

Universidade Nove de Julho, São Paulo, Brazil

***Corresponding Author**: Ricardo Sgura, Universidade Nove de Julho, São Paulo, Brazil.

Received: July 25, 2017; **Published:** September 02, 2017

It has been 10 years since the release of the manuscript titled "Fractographic ceramic failure analysis using the replica technique" from Susanne Scherrer, Janet Quinn, George Quinn and Anselm Wiskott [1-6]. This article is a reference in the study of the failure of dental ceramics and shows for the clinician/researcher that, following some indications, it is possible to determine the fracture origin of a ceramic material and infer about its possible causes. The article is, above all, a challenge for academic researchers and clinicians of curious mind and spirit of research.

The article focuses on the importance of the fractographic study and shows the traces left by the fracture that reaches the ceramic material: hackles, wake hackles, arrest lines, compression curl and all the other signs that may be found on the fractured zones that tell us about the origin of the fateful crack. These traces are studied in micrographs achieved by stereomicroscopy and/or scanning electron microscopy (SEM). The authors emphasized that, following those fractographic parameters, researchers would be able to understand the crack pathways and establish its causes in a predictable and safe way. Few years after the publication of the Scherrer's article, a ceramic crown I had installed in a patient failed.

The crown was a lithium disilicate coping veneered with a feldspathic ceramic. The tooth was a premolar (15) and the prosthesis failed one year after use (Figure 1). When the patient presented herself in the dental office, two hypotheses had been raised: some mismatch in the coefficient of thermal expansion between the coping and the veneer material or some problem with the heating rate of the piece in the furnace. I studied the fractured fragment and, for our team surprise, the fracture was originated by premature contact on the internal slope of the mesial marginal ridge of the crown. The crown was rebuilt but, as a result of the fractographic study, more attention was paid to occlusal adjustments during installation. And at that time I though how it would be important to all clinicians to know the causes of their ceramic prosthesis failures. It is a viable process.

Figure 1: *Catastrophic failure of a ceramic crown after one year in use. The fracture involved the veneer porcelain and the lithium dissilicate coping.*

First of all, before removing the fractured crown, an impression must be conducted with addition silicone material. The impression must be poured with epoxy resin, then resulting in a positive replica of the fracture site. The necessity of a replica is justified when the absence of the other crown fragment occurs. The replica may present some voids or pores resulting from air bubbles trapped in the epoxy resin during its manipulation, but they cannot puzzle the examination of the specimen (Figure 2). Achieving the replica, which is a simple process, the clinician does his part, and may leave the subsequent investigations to the researcher (and there are a lot of ceramic researchers around the globe working with fractographic analysis).

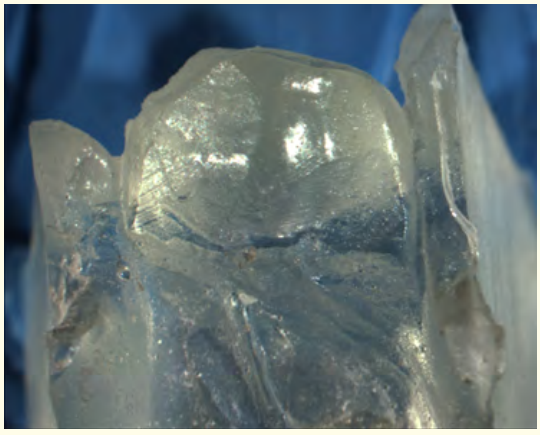

Figure 2: *A replica in epoxy resin achieved for further investigation.*

For the replica analysis, a stereomicroscope with magnification up to 45 times can be used. The stereomicroscope analysis indicates possible crack origin sites. The use of transillumination in this process is also very important. Then, based on the observations in lower magnifications, a rigorous SEM analysis must be conducted and the researcher has to follow those parameters established in academic literature (Figure 3).

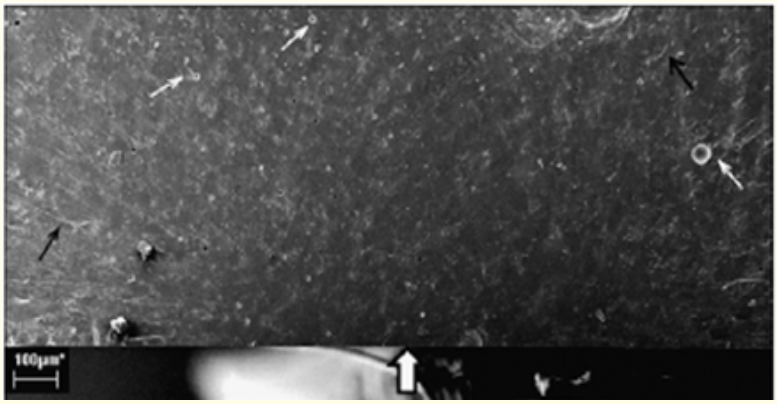

Figure 3: *An example of a fractographic analysis conducted based on SEM image. Thin arrows indicate the hackles formed during the fracture process occurring in the ceramic material (Sgura R., et al. Journal of the Mechanical Behavior of Biomedical Materials, 2012).*

Concluding Remarks

Fractographic analysis is a viable process and clinicians should be aware of the possibility of doing an epoxy resin replica when facing a fractured ceramic crown. Researchers must be trained to help in this process and should post their findings for a better comprehension of the ceramic failures to academic community. Courses and scientific articles can help them in this process.

There is a list bellow of some articles for those who are interested in this issue or who work with ceramic prostheses in their private offices.

Bibliography

1. Scherrer SS., *et al*. "ADM guidance – Ceramics: guidance to the use of fractography in failure analysis of brittle materials". *Dental Materials* 33.6 (2017): 599-620.

2. Scherrer SS., *et al*. "Fractographic ceramic failure analysis using the replica technique". *Dental Materials* 23.11 (2007): 1397-1404.

3. Quinn JB., *et al*. "Fractographic analysis of three ceramic whole crown restoration failures". *Dental Materials* 21.10 (2005): 920-929.

4. George D Quinn. "Fractography of Ceramics and Glasses". National Institute of Standards and Technology (2007): 546.

5. Quinn GD., *et al*. "Strength and fracture origins of a feldspathic porcelain". *Dental Materials* 28.5 (2012): 502-511.

6. Taskonak B., *et al*. "Analysis of subcritical crack growth in dental ceramics using fracture mechanics and fractography". *Dental Materials* 24.5 (2008): 700-707.

Volume 13 Issue 6 September 2017
© All rights reserved by Ricardo Sgura.