Methodology to analyze gap dental copings using tridimensional parameters

T.M.P. Santos, R.T. Lopes

Federal University of Rio de Janeiro, Rio de Janeiro - Brazil

Aims

Although the microCT be used to analyze the gap present between support and dental copings [1-3], the methodology used is very simple and subjective, since the quality parameters are uni-dimensional and measured in some viewers chosen by the operator. This method is very used and the quality parameter is the range of thickness in specific regions [4, 5]. The aim of this work is to develop a methodology to analyze dental copings using tri-dimensional parameters, like volume, through of microCT technique.

Method

To develop this methodology, first a silicon that represent the gap between support and dental copings was acquired in a system SkyScan 1173 calibrated with 30kV and 180µA and detector matrix of 2240 x 2240 pixels. The pixel size was 11.04µm and the rotation step of 0.5º with total rotation of 360º. After that, the projections were reconstructed in software NRecon to be analyzed in CTAnalysis.

On CTAnalysis the reconstructed images were segmentated using a threshold of 30-255, followed by different analysis. To analyze the slices, it was used the 2D analysis and 3D analysis tools, where the principal results desired were object perimeter, object area, structure thickness and object volume. The results were obtained per slice which makes it possible to analyze slice by slice.

To develop the tri-dimensional parameter, first was used the object perimeter per slice. On Figure 1 is possible to observe it step by step. After that, it was used the half perimeter to represent the surface of the support. Then it was divided this surface in small pieces, which have the approximate shape of rectangles. Each small rectangle is associated to it an area whose height is equivalent to the gap thickness. The total gap area per slice is equal to the sum of all small rectangles' area. Considering the slice thickness, the sum of all slices volume corresponds to the gap ideal total volume.

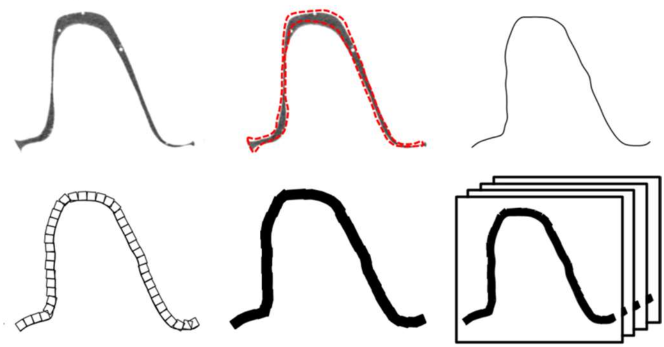

Figure 1: Step by step of the methodology used to calculate the ideal gap volume.

Besides that, this proceeding was realized for the sample divided in three regions: base (0 – 1.5mm), middle (1.5 – 3.0mm) and top (3mm – 6mm) (Figure 2), since the thickness fluctuate for differents regions, (Figure 3).

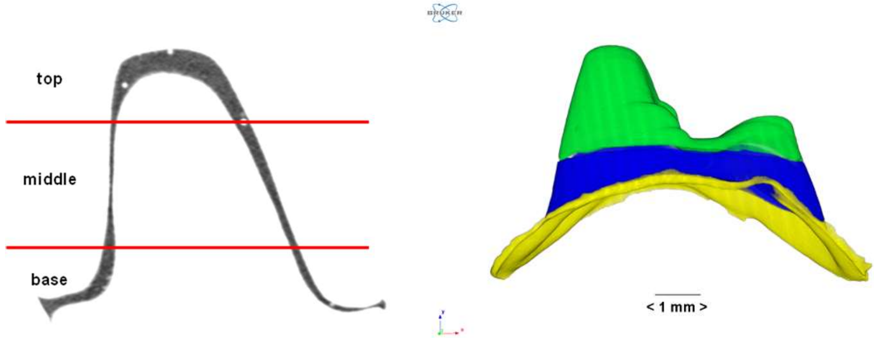

Figure 2: Regions of the sample: base, middle and top.

It can be visualized through of Figure 3, where the 3D image represent the difference of thickness along the sample. On figure 4 it was observed that the sample present thickness variation from 11um to 475um, however, the frequency of high thickness is low, predominating a range from 144 to 254um.

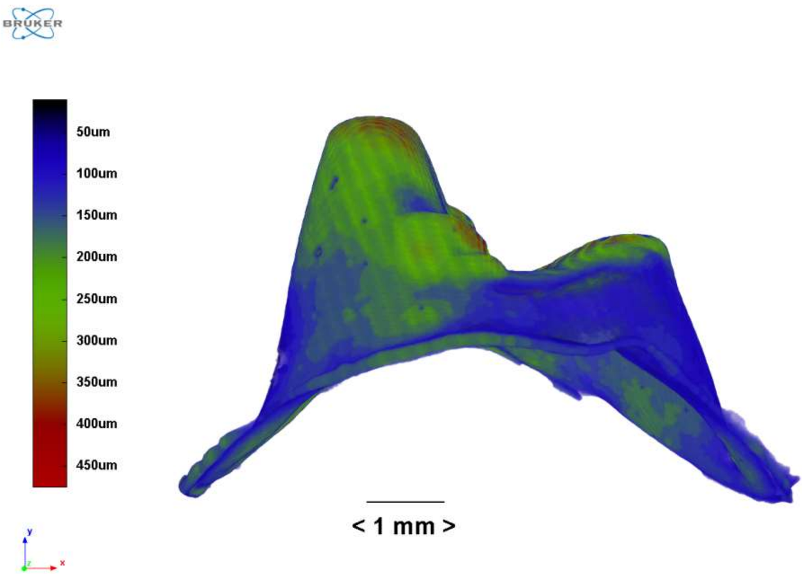

Figure 3: 3D image of the sample with color separation of thickness distribution along the sample.

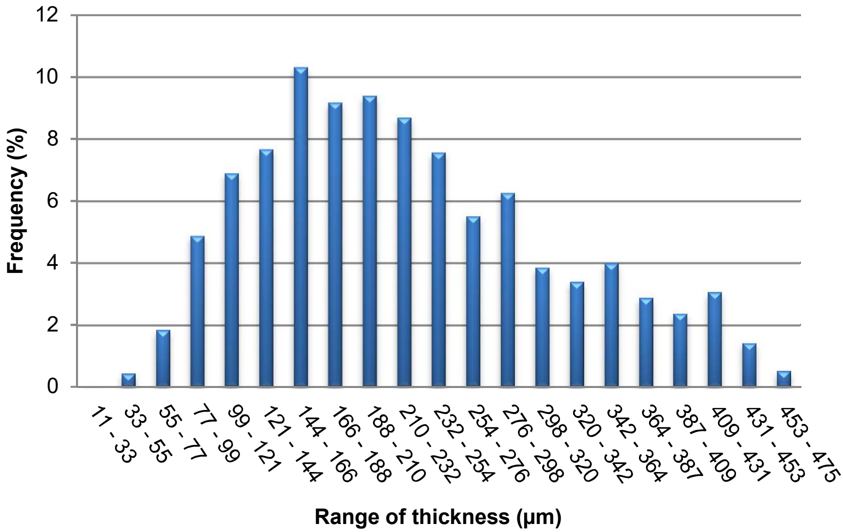

Figure 4: Thickness distribution.

Results

This proceeding was realized with the ideal thickness like the average thickness obtained in 3D analysis and the results obtained were total volume of 16.81mm³, using average thickness of 223.23um, compared with the value available on the software that was 13.79mm³. For each region, the results obtained through of methodology were 4.85mm³ at base, 3.33mm³ at middle and 8.18mm³ at top, where the average thickness used were different for each region, accord the value available for CTAnalysis. These results can be visualized on table 1.

Table 1 – Comparison of the volumes by methodology and by software.

	Volume (mm³) (Methodology)	Volume (mm³) (CTAnalysis)	Average thickness (um)
Base	4.85	3.80	175.65
Middle	3.33	2.90	163.99
Top	8.18	6.71	276.41
Total	16.81	13.79	223.23

Conclusion

MicroCT technique was essencial for this study because of the available tools of 2D and 3D analysis, besides qualitative tools, as 3D images, and became possible to analyze the gap between support and copings through of tri-dimensional parameters and to obtain an avaliation more realistic.

The results obtained were satisfactory, however, it is important realize more studies to improve the methodology and to obtain volumetrics parameters to evaluate the coping fabrication quality.

References:

1. E. Anadioti, S. A., Aquilino, D. G., Gratton, J. A., Holloway, I. Denry, G. W., Thomas, F., Qian, “3D and 2D Marginal Fit of Pressed and CAD/CAM Lithium Disilicate Crowns Made from Digital and Conventional Impressions”, Journal of Prosthodontics, 610 – 617, 2014.
2. D. P., Alfaro, N. D., Ruse, R. M. Carvalho, C. C., Wyatt, “Assessment of the Internal Fito f Lithium Disilicate Crowns Using Micro-CT”, Journal of Prosthodontics, 381 – 386, 2015.
3. T. M., Santos, I., Lima, M. A. C., Pimenta, E. G., Rivaldo, L. C. F., Frasca, R. T., Lopes, "Inside Marginal Adaptation of Crowns by X-ray MicroComputed Tomography", 1594 - 1599, 2016.
4. S. Pelekanos, M. Koumanou, S-O, Koutayas, S. Zinelis, G. Eliades, “Micro-CT Evaluation of the Marginal Fit of Different In-Ceram Alumina Copings”, The European Journal Of Esthetic Dentistry, 278 – 292, 2009.
5. M. Borba, P. F., Cesar, J. A. Griggs, A. D., Bona, “ Adaptation of all-ceramic fized partial dentures.”, Dental Materials, 1119 - 1126, 2011.