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## Micro-CT 1172 in Restorative Dentistry

HAKAN KAMALAK<sup>1\*</sup>, HICHAM NUAIMI<sup>2</sup>

<sup>1\*</sup>DDS, İnönü University, Faculty of Dentistry, Department of Restorative Dentistry, Malatya, TURKEY

<sup>2</sup>BDS, H specialist Diploma Restorative and Aesthetic, H specialist Diploma Implantology, MSC in Restorative and Aesthetic, Lecturer in Conservative Department, Ishik University, Iraq

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### ABSTRACT

Micro-computed tomography device, Skyscan 1172, is a product of the new generation. The system in which both the bed of the samples and the camera of X-ray is moving shows the highest level of image resolution. Through computerized tomography, it is possible to obtain information from the object image, to handle cross-sectional images obtained in different ways by editing, to obtain the desired color regions, and to focus on area of interest and then remove that area. In this article, after giving information about Micro CT, especially in applications of restorative dentistry; the information has been given about in which areas and with what purpose it can be used. However; it has been explained that whether the use of micro CT alone in the studies done is sufficient or not.

**Keywords:** Micro-Computed Tomography, Research, Skyscan 1172

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### Introduction

Obtaining three-dimensional images of objects using computer which had been scanned with X-rays or gamma rays was for the first time tried by Hounsfield in 1960 [1]. After 1960s, advanced diagnostic methods have been developed in imaging techniques. In the early 1970s, computed tomography (CT) has begun to appear [1]. While Clinical CT devices typically produce 1 mm<sup>3</sup> volume images comprising voxels; X-ray Computed Tomography (Micro-CT or  $\mu$ bt) system that was developed in the early 1980s and produced approximately one million times smaller voxels by volume has much better resolution [2].

Micro - CT was initially developed by Jim Elliott at the beginning 1980s. Computed Tomography is a three-dimensional x-ray imaging technique which includes obtaining x-ray projection images of an object from different angles around an axis and a tomographic

reconstruction algorithm application in order to create a thin stack of tomographic images of consecutive transaxial slices for that object.

Images are made up of voxels. Once the samples are affixed within the device, it is scanned on a vertical rotating axis by a stationary x-ray source. Although the term micro-CT is widely used for CT scanners with micron-level voxel resolution; nowadays the term of Microscopic CT which is a more convenient generic name is used. According to the spatial resolution, microscopic CT are of three kinds: mini-CT, micro-CT and nano-CT [3].

The use of Micro CT device in the restorative dentistry work is common. In present studies, it is used for different purposes such as calculating the microleakage, the internal and external adaptation alignment of materials with each other, surface roughness of materials, polymerization shrinkage of the materials, degree of anisotropy (the homogeneity of materials), number of open pores and closed pores in the materials, volume of pores, porosity of materials, the volumetric measurement of the defects on the teeth formed with chemical agents, demineralized and remineralized region formed on enamel or dentin.

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\*Correspondence

**Dr. Hakan Kamalak**

DDS, İnönü University, Faculty of Dentistry,  
Department of Restorative Dentistry, Malatya,  
TURKEY

**Email:** [hakankamalak@hotmail.com](mailto:hakankamalak@hotmail.com)

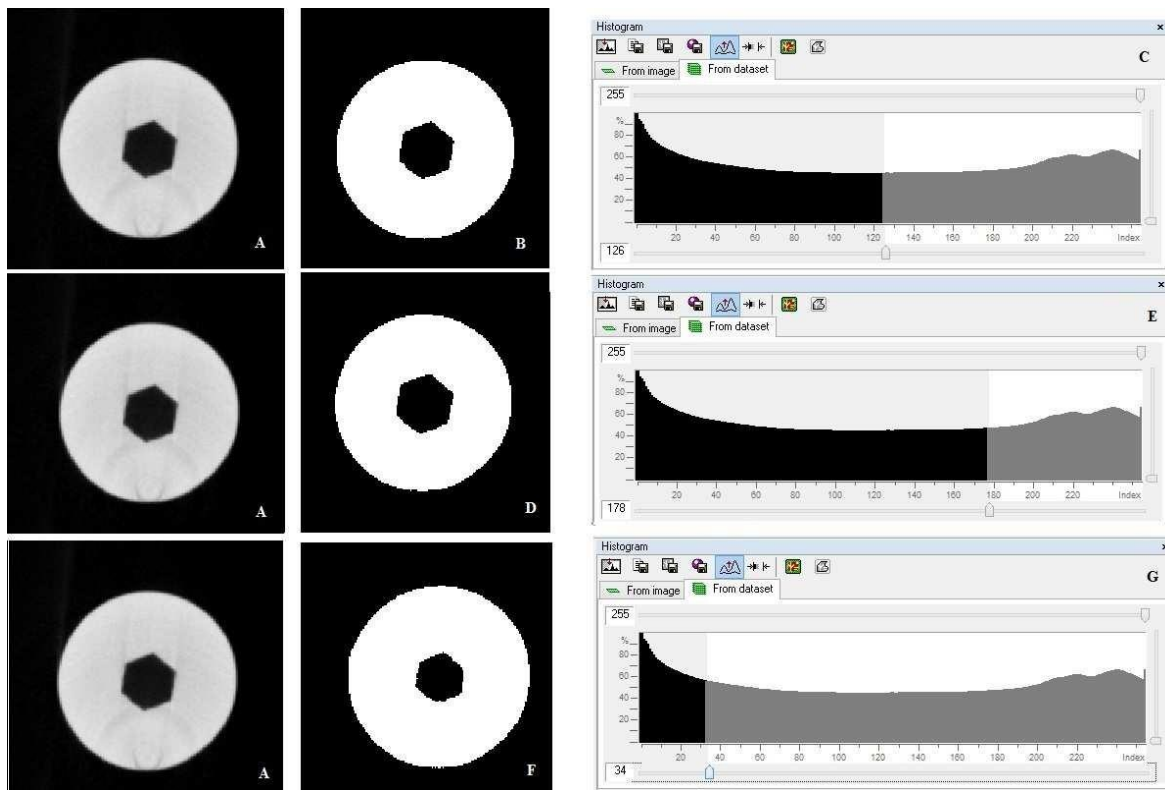
### Discussion

After scanning by Micro CT, analysis of studies are carried out with Skyscan CT-Analyser. CT-Analyser is an application to produce quantitative parameters and to create images from data sets obtained and scanned by Skyscan Micro-Ct tools CT-An provides to monitorize real-time operated volume model. Quantitative measurement is a black and white image which is based on a second segment having both densitometer (voxel

attenuation coefficient or calibrated intensity) and morphometry (Size and shape analysis) [4].

All kinds of desired measurement is carried out in the region by analyzing images obtained from the objects with CT Analysis Programme. Software Programme uses a threshold value in order to define the volume of materials [5].

Increase or decrease the threshold value affects the result of research. While decreasing threshold value, diameter of voxels forming the object increases. In Figure 1 shows detailed explanation regarding this matter.



**Figure 1:** The image of threshold value worth. **A.** The original state of the object scanned with micro ct. **B.** Thresholding procedure which is the basic step to be able to analyze the scanned objects. **C.** The lower and upper limit of thresholding values are shown. (Lower limit 123, upper limit 255). **D.** The upper limit of Thresholding was kept constant and lower limit value was increased to 178. **E.** The lower and upper limit of thresholding values are shown. **F.** The upper limit of Thresholding value was kept constant and lower limit was reduced. **G.** Threshold upper value was kept constant and the lower limit value was reduced to 34.

As seen in Figure 1, while increasing threshold value and decreasing the density of the object more and more, the total volume of the material is reduced. When threshold value is reduced, the volume of material is analyzed as having a much larger volume of its initial state.

### Conclusion

Micro-computed tomography device is a product of the new generation. Research on many different fields are

performed with Micro-CT devices. It also has a wide use in dentistry. When working with Micro CT device, it especially is important to prefer materials having different densities. While analyzing materials having

approximate density, problems may be encountered. In the studies using Micro CT device, if the research has superficial operations, the use of different research techniques along with micro CT is needed. For example, in the evaluation of the impact of bleaching agents on dental tissue, Micro CT applications alone may not be enough. Together with the Micro CT, Scanning Electron Microscope (SEM) can be used. Along with this, finding the ideal quantitative range of the thresholding value during analysis will increase correctness of the work performed.

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