

# Use of an X-ray phantom in dental 3-D diagnostics in digital volume tomographs

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Fig. 1a

Fig. 1b

**Figs. 1a & b\_** DVT phantom (the maxillary sinus floor and *alveolar nerve of the mandible* are simulated with radiopaque wire structures).

**\_Undoubtedly, digital volume tomography** has significantly expanded the range of dental imaging diagnostics. Just as Paatero ushered in a new era of dental radiology at the end of the 1950s with the development of the orthopantomograph and the resulting introduction of panoramic view imaging, 3-D processes will, in turn, replace panoramic view imaging.

Although digital volume tomography has to date been mostly used for pre-implantological planning and in reconstructive surgery, now other dental disciplines are beginning to appreciate the value of this process. It is in orthodontics, endodontics, dental surgery and periodontics that digital volume tomography represents a significant improvement of the possibilities of imaging processes. Its significance in the current domain, pre-implantological diagnostics, can be assessed as even greater.

## **\_Available digital volume tomographs**

Digital volume tomographs (DVTs) have been on the market for a good decade, and the number of suppliers of such devices has increased dramatically. When observing the device market,

two clear trends are evident: the trend towards an all-in-one device (also called dual use) and the trend towards DVTs of various volumes.

### *All-in-one devices*

In addition to offering 3-D diagnostics, the majority of DVTs available on the market also provide the option of producing panoramic view images (real images, not reconstructed from a data record) and sometimes even lateral cephalogram. These devices thus cover the entire range of dental large-scale diagnostics—in contrast with the first generation, which only offered the DVT option.

The DVTs of today's generation are often similar in design and appearance to traditional DVTs. The position of the patient with these and other frame devices is typically standing or sitting, while the once dominant supine patient position of the first-generation device is passé, except for that required by one DVT manufacturer.

### *Various volumes*

The first-generation devices featured very large volumes that required time-consuming reworking



Fig. 2



Fig. 3

of the immense data record for problems beyond large and reconstructive surgery in order to be able to evaluate the relevant data and/or regions in a target-oriented manner. Today, numerous manufacturers offer devices with small and medium-sized volumes. Three types of devices are available:

- \_ small volume (4 x 5 cm) for oral surgery and dental procedures;
- \_ medium-sized volume (8 x 10 cm and higher) for oral surgery and reconstructive surgery; and

\_ large volume (18 x 20 cm and higher) for oral surgery and reconstructive surgery.

#### *Problems with small and medium-sized volume devices*

Small- and medium-sized volume devices are generally used for pre-implantological diagnostics, oral surgery, and orthodontic and endodontic procedures. The limited volume size requires careful device setting and patient

**Fig. 2\_** DVT phantom in a DVT (Kodak 9000 3D, small volume) fixated on the original patient biting aid.

**Fig. 3\_** Device settings: with the aid of the light visors, the volume is placed on the region to be captured (here region 26 and the maxillary sinus floor).

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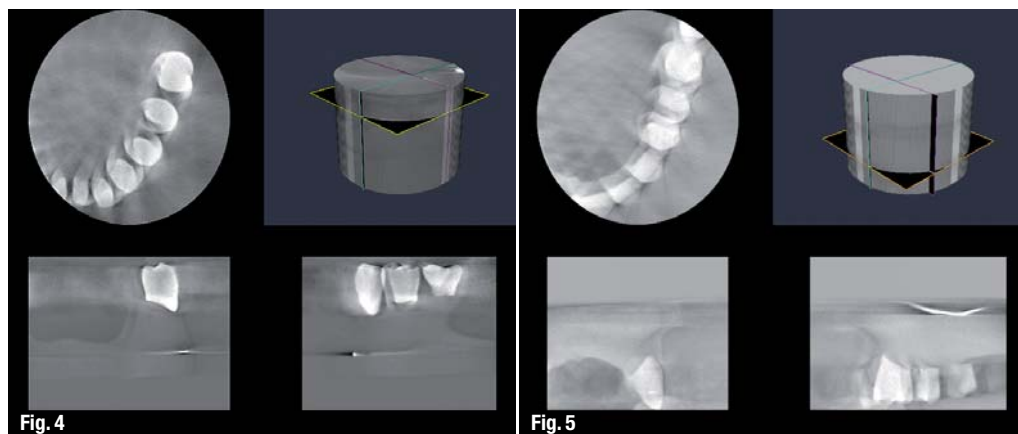
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**Fig. 4** \_DVT phantom image of the maxilla with the DVT phantom.

**Fig. 5** \_DVT phantom image of the mandible with the DVT phantom.

positioning so that the relevant structure is accurately captured.

For new users and those who only take volume tomograms once in a while, this correct setting can pose difficulties, which was our motivation for developing a DVT phantom that can be used for training purposes and for direct preparation of an image with a patient.

### **\_The DVT phantom and its application**

The DVT phantom is an X-ray phantom that depicts a medium-sized mandibular and maxillary dental arch with the teeth positioned in ideal dentition.

The phantom, which consists of a mandible and maxilla, is mounted on the individual bite or positioning support of the respective device. Barium sulphate is added to the plastic teeth so that they are visible in the X-ray image. These teeth are made by the manufacturer especially for X-ray applications. The DVT platform is then mounted on the device with the original bite support instead of a patient. The device setting can be done in two different ways:

- a) The desired volume is preset using the device programme and then manually fine-tuned.
- b) The device is manually set directly upon the region to be captured with the aid of the light visors.

Thereafter, the set positioning is saved.

#### *Using the DVT phantom for training and practice*

With the aid of the DVT phantom and the above-mentioned setting techniques, new users, who are training to become dentists or dental technicians, can learn how to set the device for the regions to be examined, generate one or more individual

images using the preview function and check whether the setting was correct. In the event of incorrect settings, a better image can immediately be generated. In this manner, there is a direct learning curve.

#### *Using the DVT phantom for preparing a patient image*

Time-consuming and tedious setting (aiming) of the DVT on a patient who is already in the device is likely to be uncomfortable for the patient. This is where presetting the device with the aid of the DVT phantom comes in handy. The desired region is captured with the phantom and, if needed, is checked with the preview function. Then, the phantom is removed and the patient is positioned in the device. Generally, only one device setting for the patient's body size and small fine-tuning are required before the image is set.

### **\_How to obtain a DVT phantom**

A DVT phantom can be produced in cooperation with practising dental technicians. The plastic teeth containing barium sulphate are available on the market and a phantom can be made in the manner described above. An easier option is to send a DVT positioning aid of your device to [dtecmfreiburg@aol.com](mailto:dtecmfreiburg@aol.com) or through [www.dtecmfreiburg.de](http://www.dtecmfreiburg.de). Master Dental Technician Christian Müller will then mount a prepared DVT phantom on your positioning aid. Industrially manufactured plastic teeth containing barium sulphate (SR Vivo Tac/SR Ortho Tac, Ivoclar Vivadent) will be used, which are then incorporated into a mandibular and maxillary model made of transparent plastic.

We hope that the fascinating field of 3-D diagnostics will establish itself quickly in dentistry and remain an imaging procedure that significantly expands upon the hitherto range of dental X-ray diagnostics in the long term.

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