Cone Beam 3D Imaging

True medical grade imaging technology at a fraction of the cost and radiation exposure
Pioneers of Cone Beam in the Dental Field

QR s.r.l. is the name that stands behind NewTom Cone Beam 3D imaging units and we were the creators of Cone Beam technology for the dental field. NewTom 9000 (also known as Maxiscan) was the very first Cone Beam in the world, which was installed in 1996. It pioneered the NewTom product line and, in general, the entire X-Ray units based on Cone Beam technology. QR’s 20 plus years of experience and success in research, development, manufacturing and distribution of NewTom products affirms our commitment to excellence and quality. QR s.r.l. is based in Italy and all NewTom products are designed and manufactured at our factory in Verona. Our products represent the Italian tradition of specialized manufacturing and NewTom is known all over the world for its reliability, high standards and state-of-the-art technology. QR s.r.l. is a comprehensive and independent working company consisting of a research and development department (hardware and software), production and technical assembling division, technical support staff, customer service, sales and marketing department and management offices. Our national and international sales network relies on strong and long-term partnerships with all our dealers and representatives that spread all over the world. NewTom’s team-oriented staff are committed to provide not only the best product available on the market, but also excellent before and after-sales support, as customer satisfaction is our best advertisement!
Traditional CT (CAT scan) uses a narrow fan beam that rotates around the patient acquiring thin axial slices with each revolution. In order to create a section of anatomy, many rotations must be done. During these repeated rotations, traditional CT emits a high radiation dose, but it leaves a gap of information between each rotation. Therefore software must stitch together the images and calculate what is missing. Cone Beam 3D imaging uses a cone-shaped beam to acquire the entire image in a scan using only one rotation. The result is a more accurate image without missing information and considerably low radiation exposure. The American Academy of Oral and Maxillofacial Radiology (AAOMR) prescribes the use of Cone Beam 3D imaging when evaluating periodontal, implant, and oral/maxillofacial surgery patients. One NewTom scan obtains a complete dentomaxillofacial image in a single database of digital information. It also helps avoid potential errors due to the image distortion found in 2D imaging technology. Various views of the information in 3D images can be created using NewTom NNT software.

Precise 1:1 Scale Imaging

With precise 1:1 scale imaging, NewTom technology eliminates the magnification errors of conventional cephalometric and opg imaging technology. 3D imaging allows the dental professional to identify potentially serious problems, such as airway passage obstructions and soft tissue abnormalities.

3D CBCT imaging technology is the best use for implantologists, orthodontists, periodontists and oral/maxillofacial surgeons.

Less Radiation than Traditional CT Scans

The scanner’s FOV determines how much of the patient’s anatomy will be visualized. Using a fan panel detector (FPD), the dimensions of their cylindrical FOV can be described as Diameter by Height (DxH). Nowadays, the need to scan different regions of interest with different dimensions is regulated by international standards in order to reduce the effective dose to the patient following the “As Low As Reasonably Achievable” (ALARA) dose principles. In particular, the use of a smaller FOV (on user-defined region in endo, peri, implant surveys and for the localization of impacted teeth) in addition to reducing the dimension of the irradiated region, allows for a dramatic increase in the accuracy and resolution of images for all the pathologies diagnosis where it is necessary to identify very small details at high definition. On the contrary, the biggest FOV (which include the roof of the orbits and the Nasion down to the hyoid bone) permits with one single rotation to scan patients where the referring doctors need to see the major part of the anatomical regions of the head (e.g. Orthodontics, Orthognatics and Maxillofacial surgeons, etc.). Even in this case NewTom has different dose protocol in order to further reduce the dose. Finally we can say that NewTom Team found the proper balance between FOV, dose and accuracy, using different dose protocol for each single FOV. Between them, medium FOV are also selectable. They can capture from the middle of the orbits down to the Menton (vertically) and condyle-to-condyle (horizontally) and they are useful for ENT, TMJ, pansi’s and implant surveys.
Hi Res Scan

Proper assessment for implants requires the visualization of all aspects of the mandibular canal. The ability to see small anatomical parts such as tooth roots and periodontal ligaments, as well as any present lesions, is critical in determining successful placement. Only 3D High Resolution imaging produces both the quality and the quantity of details necessary to accurately view the canal for secure implant assessment.

Small Fov

A voxel size reduction of 50% creates superior quality images. The smallest FOV selected can be performed in a HiRes mode. This allows the selection of just a small portion of the body, obtain a high definition image and allow the visualization of all the fine details. This scan mode improves the clarity of the image, the visualization of soft tissue and the definition of artifacts.

Effective Dose

Table: effective dose from conventional dental imaging techniques in Sv. MSCT = multislice CT

<table>
<thead>
<tr>
<th>Technique</th>
<th>Effective dose (µSv)</th>
</tr>
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<tbody>
<tr>
<td>Intraoral radiograph</td>
<td>&lt;1.5*</td>
</tr>
<tr>
<td>Panoramic radiograph</td>
<td>2.7 - 24.3</td>
</tr>
<tr>
<td>Cephalometric radiograph</td>
<td>&lt;6</td>
</tr>
<tr>
<td>MSCT maxillo-mandibular</td>
<td>280 - 1410</td>
</tr>
</tbody>
</table>

* Underline CT: Radiation Protection: Cone Beam CT for dental and maxillofacial radiology – Evidence Based guidelines 2011

Low Dose Literature

Over the past few years there have been different research conducted on the differences between MSCT and CBCT radiation dose. The radiation dose of a Multi-slice CT (MSCT) is relatively high and the difference registered between MSCT and CBCT is significant. Palomo et al in 20081 states that what allows the CBCT to lower the radiation dose mostly is: the use of a low-output fixed anode tube, which is similar to what is used in dental panoramic x-ray machines and the single rotation of the machine around the patient, during which the data is captured by using a cone-shaped x-ray beam. De Cock et al in 20112 reports that multiple dentomaxillofacial studies affirm that CBCT dose are lower than MSCT dose. It also states that thanks to the fast and comfortable acquisition technique of CBCT, it is suitable for routine imaging. The American Dental Association Council on Scientific Affairs highly recommends the use of techniques that would reduce the amount of radiation received during dental radiography. The ALARA (As Low as Reasonably Achievable) principle tries to reach the same target, optimizing image quality at reasonably low radiation dose levels.

### Stray Radiation

Measured in head phantom according to IEC 60601-2-44 par. 29.1.102.2

### NewTom VGi Dose

Comparison of effective dose for 4 different size volumes acquired with standard resolution

<table>
<thead>
<tr>
<th>VOLUME</th>
<th>VOLUME Dose (µSv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 x 15</td>
<td>99</td>
</tr>
<tr>
<td>15 x 12</td>
<td>86</td>
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<tr>
<td>12 x 8</td>
<td>69</td>
</tr>
<tr>
<td>8 x 8</td>
<td>51</td>
</tr>
</tbody>
</table>

SafeBeam™ Technology
for Automatic Dose Exposure

Only NewTom systems employ SafeBeam™ technology, the safest technology available for patient and staff. Featured in all NewTom units, SafeBeam™ automatically adjusts the radiation dosage according to the patient’s age and size. This technology uses intermittent bursts of radiation, which last only milliseconds, during image acquisition. Other systems deliver a constant stream of radiation and the same amount of radiation, whether scanning a 220 lbs (100 Kg) adult or a small child. SafeBeam™ technology automatically and continuously monitors system operations, thus eliminating the possibility of unnecessary exposures. In conjunction with our patented SafeBeam™ technology, when compared to other CBCT systems, NewTom VGi has a wider range of adjustments for the X-ray power and quantity (kV=110 and mA=1-20). As a result, patient exposure is tailored and image contrast remains consistent regardless of patient size or bone density.

Greater Patient Comfort
and Treatment Acceptance

All NewTom units add a sense of comfort for patients, allowing the patient to relax during the scan and limiting the patient movements in order to improve the image quality. NewTom scans provide the practitioner and the patient unprecedented visualization of cranial anatomic information. This leads to a better diagnosis and better treatment planning, increasing the patient treatment knowledge. The result is a more cooperative and informed consent process, understanding the need for treatment and improving the doctor-patient relationship.
NewTom NNT analysis software is the perfect integration to Cone Beam 3D imaging. NNT allows the creation of different kinds of 2D and 3D images, in a 16 bit grey-scale, and it takes only few seconds to evaluate the data taken during the scan. It is completely designed by NewTom engineers, and it fits all the requirements and needs of our clients. NNT can easily identify and mark root inclination, position of impacted and supernumerary teeth, absorption, hyperplastic growth, tooth structure anomalies and the mandibular canal. The software delivers high quality images, which allows for safer surgical planning. The images can be gathered and used in report templates, which are defined by users and can be delivered digitally (burn on CD or DVD), on paper or on film.

The software is available in different versions: an Expert version, that is used for taking exams, a Professional version, which permits data processing, an NNT Viewer, that gives to other professionals the ability to view the images processed by NNT. The images can later be exported with DICOM 3.0, in order to allow for easy sharing between imaging centers and referring doctors and they are compatible with third party software.

Software Flexibility

NewTom images are compatible with most major third-party software on the market as well as guided implant and maxillofacial surgery software. 3D imaging data is highly adaptable and can be imported and used in countless diagnostic and educational modes. Software segmentation adjusts the amount of soft tissue, underlines the hard tissue and accentuates the structure of the skull. Different software applications allow the creation of realistic models that can be positioned on images obtained from the scan. This creates multiple options that help in diagnosis, treatment planning, pre-surgical analysis, and patient education.

Superior Third-Party Compatibility
NewTom Implant Planning

NewTom Implant Planning is a software package that allows the creation of 3D implant simulation on any PC. It can simulate the implant placement on 2D and 3D models, identify the mandibular canal, draw panoramics and cross sections of the bone model. It also shows the 3D bone model and calculates the bone density. NewTom Implant Planning is used to plan prosthesis implant surgery in a faster, safer and more efficient way. It also allows the ability to export in .stl format.

Supported format

NewTom Implant Planning reads axial slices saved in DICOM 3.0 or in NNT format, which is the same format used by NewTom 5G, NewTom VG and previously released systems (NewTom 3G and NewTom 9000).

2D & 3D

It generates panoramics, cross sections and 3D bone models reading the axial slices. This helps in identifying all the anatomic aspects of the patient, the mandibular canal, the bone structure and the exact implant positions, in order to facilitate the surgery.

Measures and information

NewTom Implant Planning can plan the prosthesis implant surgery by identifying both the implant and the mandibular canal position. It measures accurately the proportion of the bone and density and makes the surgery more effective and faster.

A useful communication & motivation tool

All the images generated by NewTom Implant Planning can be used to communicate with the patient, in compliance with the compulsory rules about the informed consent. Desired cases can be saved on a CD-ROM through the image exporting functions. Thanks to the user-friendly interface, learning is easy and fast.

Clinical Cases
Implants

CBCT is one of the most effective tools available for analyzing implant sites. 3D images can accurately identify possible pathologies and structural abnormalities. Cross sectional and panoramic views facilitate various calculations as: height and width of the implant site, mandibular edentulous site, a potential implant site near the mental foramen, width of the buccal/lingual ridge and cortical bone density. 3D images highlight the cortical bone thickness, the cancellous bone density, the inferior alveolar nerve and mental foramen location. They also influence the choice of the appropriate implant to be used, its placement, its width and consideration of "die back" from dense cortical bone.

TMJ

CBCT takes the examination of the Temporomandibular Joint to a new level. After a single scan, Sagittal and Coronal views can be sectioned to show joint space and pathologies. 3D images reconstruction can clearly provide exhaustive information of the TMJ and Cervical Spine anatomy. A wide panoramic view allows a gross screening tool, where we are able to check the differences in condylar and ramus height as well as other dental pathologies.

Endo-Perio

These application fields need extremely high quality images in order to define the tooth structure, determine the exact pathology and accurately plan the best treatment. Only a proper investigation of the area of interest will make the dentist aware of the less invasive and dedicated action to take. Where the patient has had root canal therapy, but continued to complain about extreme sensitivities and endodontic retreatment did not abate the problem, the CBCT scan can reveal that the maxillary second premolar has a palatal root. It is common to expect two roots and two canals in maxillary first premolars, but it is less common to find two in maxillary second premolars. Once the dentist observed this, successful treatment could be instituted.

Oral and Maxillofacial Surgery

A 3D post-operative scan can show the exact individual anatomy and define the anatomical structures, bringing the patient to a better acceptance of the treatment. NewTom scans are useful also for maxillofacial post-surgery imaging, due to reduced image scatter and lower radiation. High Resolution 3D images (utilizing the MIP and Volume options), despite the possible high number of screw fixings present, show that there are virtually no artifacts to obstruct the images.
Orthodontics

While various pan-cephalometric machines create adequate images, Cone Beam scanners produce many types of images, including panoramic, cephalometric and 3D. Based on the physics of this technology, images are more accurate than 2D dental x-rays and 3D medical scanners. As a result, cephalometric tracings from dental Cone Beam scanners can be generated with confidence. The 3D image, in case of palatal expansion, can clearly show the buccal bone and molar roots in order to avoid unnecessary gingival recession. Impacted teeth may cause dental problems that produce few, if any symptoms. Only 3D imaging provides a complete picture of the scanned area and allows manipulation of both the angle and slice thickness of the image. There is a significant difference between the demarcation capabilities of plain radiographs vs. 3D images in determining the existence and the root shape of an impacted tooth in the maxilla.

ENT Protocols

NewTom VGi represents the gold standard for ENT examinations. Due to its multiple FOV and high level of accuracy, it shows clearly all the airways, structures of the ears, TMJ and Sinuses using always the proper radiological parameters in order to avoid unnecessary radiation to the patient. The option is available for the operator to select the high resolution for the smallest parts like in the inner ear. Many of the exams that were done by using the conventional CT scanners can now be performed by NewTom VGi showing much more detail at a lower exposure for the patient.
Clearest images possible with the smallest possible focal spot.

A dedicated digital sensor and specific algorithms provide a full range of analytical information.

Greater comfort for patients leads to a better acceptance of treatment.

NNT software makes image sharing easier.

The margin of error is reduced thanks to the precise 1:1 scale and a 16 bit grey scale.

Patient safety through SafeBeam™ Technology

Multiple FOV and different scan modes are selectable from the software to various fields of application.

NewTom VGi, from the company that was the first to use the Cone Beam technology in dental field, represents the newest in CBCT technology. NewTom VGi takes an image at every degree of rotation, 360° rotation = 360 images, increasing the range of possibilities for image manipulation. It couples a revolutionary flat panel x-ray detector technology with a very small focal spot (0.3 mm), to produce the clearest, sharpest images possible. VGi features an adjustable Field Of View, which allows doctors to irradiate just the right volume, depending on the different clinical applications. The size of FOV can vary from the smallest 6x6 cm to the biggest 15x15 and they can be selected directly from the software, before the scan. VGi emits up to 20-50 times less radiation than conventional CT, by using a “pulsed” emission, that unlike other systems, activates the x-ray source only when required and, for a full scan, it takes no more than 4 seconds of total exposure. The exam can be performed while the patient is standing or seated. The scanner is wheelchair accessible. Patient positioning tools include cross-hair lasers and a mirror, which are powerful tools for exact vertical patient positioning. The small footprint and the variable positioning make NewTom VGi the best choice for locations, where space is at a premium. The NewTom VGi does not need an air-conditioned room, its weight does not require a reinforced floor and it can function in rooms without complicated and expensive radiation protection structures.

Functioning and training

All the operations executed by NewTom, the patient’s examination and the following calculations, are computer guided. The user, when performing the scan, is supported by user-friendly menus. Each step is associated to a mouse-activated icon. Following the same process, one can enter the integrated file of image data.
Specifications NewTom VGi

X-ray Source
High frequency, constant potential (DC), rotating anode: 110 kV; 1-20 mA (pulsed mode)

Focal Spot
0.3 mm

X-Ray Cone Beam
Proprietary SafeBeam™ control reduces radiation based on patient size.

Effective Dose
99 μSv Full FOV (ICRP 2007, estimate for adult)

Scan Time
18s/26s

X-ray Emission Time
3.6s in standard mode

Image Acquisition
360 Images - 360 degree rotation

Image Detector
Amorphous silicon flat panel, 20 cm x 25 cm Field of View (7.87 in x 9.84 in)

Signal Grey Scale
14-bit scanning, 16-bit reconstruction

Multiplanar Scan Modes

<table>
<thead>
<tr>
<th>FOV Size (cm) x (cm)</th>
<th>Voxel size options (µm)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>300 250 200 150</td>
</tr>
<tr>
<td>15 x 15</td>
<td>5.90 x 5.90</td>
</tr>
<tr>
<td>15 x 12</td>
<td>5.90 x 4.72</td>
</tr>
<tr>
<td>12 x 8</td>
<td>4.72 x 3.14</td>
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<td>3.14 x 3.14</td>
</tr>
<tr>
<td>8 x 6</td>
<td>2.36 x 2.36</td>
</tr>
</tbody>
</table>

Patient Positioning
Standing or seated and wheelchair accessible

Reconstruction Time
Approximately 1 minute

Weight
Scanner unit 272 kg (600 lb), Control box 100 kg (220 lb)

Software
NNT™ with free viewer and sharing application

Power Required
10A @ 100/115V~, 5A @ 200/215/230/240V~, 50/60Hz

Specifications subject to change without prior notice.

NewTom VGi is the commercial name for a special configuration of the medical device model NewTom VG.

- Viewer and Sharing Application Included
- DICOM Conformant
- Improved Software Integration
- Small Footprint