Preimplantological Diagnostic Radiography with Dental-CT Software

Predimplantološka dijagnostička radiografija s programima Dental-CT

Thomas Betz
Josip Bill
Ivan Bokan*
Jürgen Reuther

Department of Oral and Maxillofacial Surgery, Julius-Maximilians University, Würzburg, Germany
* Private Office Verden, Germany

Summary

One-mm CT or spiral CT scans were performed in 48 patients and processed with Siemens Dental-CT software. Data manipulation with this software, the so-called multiplanar reformation (MPR), creates panoramic sections and sections perpendicular to the mandibular and maxillary arch. Advanced preimplantological diagnostic radiography with Dental-CT software was used to observe important anatomical structures, such as sinus maxillaris or n. alveolaris inf., or to get an insight into the hard tissue morphology in case of severe atrophy, post-traumatic states or in tumor patients with free or microvascular graft reconstruction. The position and angulation of implants could be visualized using radioopaque pins. Simultaneously performed orthopantomography and tomography of the molar region of the upper and lower jaws were clearly inferior to Dental-CT scans according to the information produced. With the use of Dental-CT scans, the implantological treatment could be properly planned and damage to important anatomical structures avoided.

Key words: *preimplantological diagnosis, dental implants, Dental-CT*

Acta Stomatol. Croat.
1994; 28: 301—305

REVIEW

Received: November 30, 1994
Primljeno: 30. studenog 1994.

Introduction

Diagnostic procedures in dental implantology have extended to insertion of endosseous dental implants into anatomically important regions, such as n. alveolaris inf. or sinus maxillaris, or in unfavorable conditions due to extreme atrophy of the alveolar ridge or trauma. Preimplantological-preprosthetic steps, such as sinus elevation or transposition of the n. alveolaris inf., require authentic reproduction of anatomical structures in space and dimension by means of digital imaging. Dental-CT software enables the calculation of panoramic sections and sections perpendicular to the mandibular or maxillary arch (4—6). Computed tomography with Dental-CT software provides the following information: vestibulo-oral and cranio-caudal life-size dimensions of the mandible and maxilla; authentic presentation of the course of the mandibular nerve and position of the foramen mentale relative to the space; shape and dimension of the sinus maxillaris and cavum nasi; and three-dimensional extension of bone defects in case of traumatic lesions or clefts of the maxilla.

Material and Method

Computed tomography was performed by a Siemens Somatom Plus S. Siemens Dental-CT is a software option for the Siemens Somatom Plus and Somatom HiQ CT scanners (4). Radiographs are performed with the patient in supine position and the alveolar ridge parallel with the scan plane (1, 4). Immobilization during the scanning procedure is achieved by an occlusal silicone overlay integrated in the mouth of the patient to encode his occlusion. Drilling templates produced during preoperative diagnosis simulate the position and angulation of the implants, by means of radio-opaque pins (Figs. 1 and 2). Their integration into the patient's mouth during the scanning procedure allows control of the preoperatively planned implant position and direction by Dental-CT.

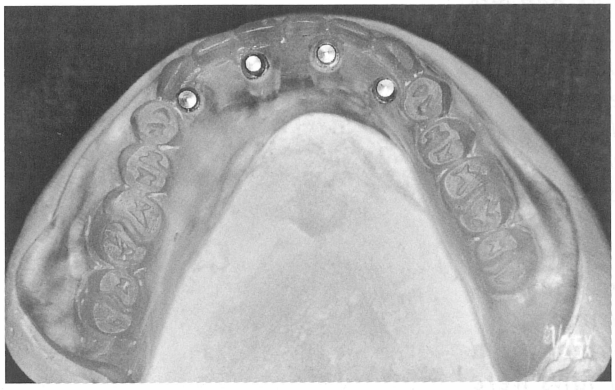

Figure 1. *Drilling template with radio-opaque pins*

Slika 1. *Individualna šablona s neprobojnim indikatorima*

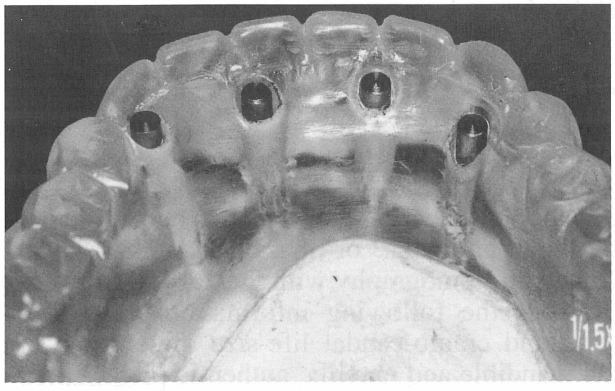

Figure 2. *Drilling template with radio-opaque pins*

Slika 2. *Individualna šablona s neprobojnim indikatorima*

Computed tomography is performed with a 1-mm CT scan or a spiral-CT (2-mm spiral/ 1-mm increment). Due to a short examination time, spiral CT should be preferred. For reproduction of each jaw, 25—35 scans are needed. Dental-CT software processes a maximum of 64 axial scans. After selection of the scans to be reconstructed (section), the central panoramic scan is defined by a maximum of 13 and minimum of 3 marks set along the mandibular arch. The next two panoramic scans are automatically generated buccally and lingually to the central panoramic scan (Figs. 3 and 4). The distance between the panoramic scans is 2 mm. Paraxial scans, perpendicular to the central panoramic scan, are generated automatically using data

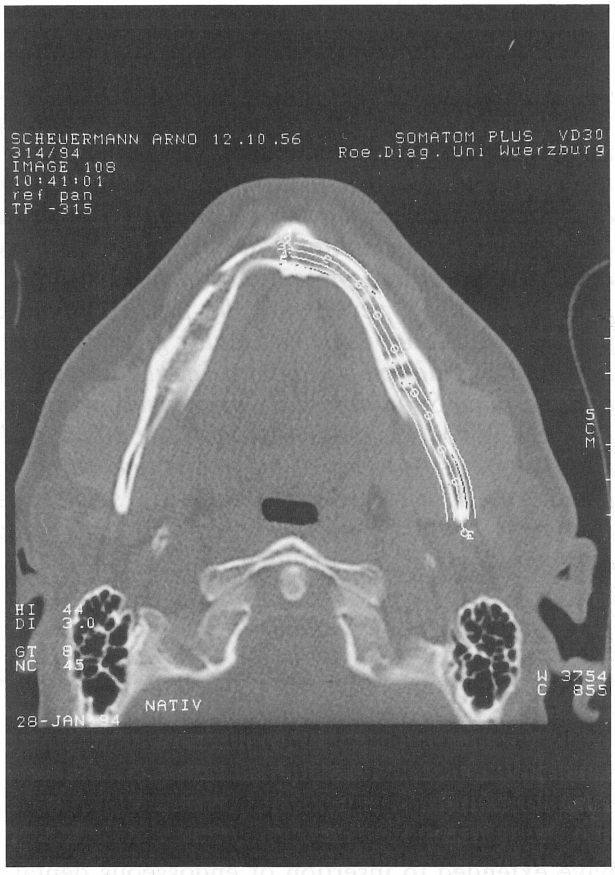

Figure 3. *Definition of the central panoramic scan with marks (max. 13, min. 3) set along the mandibular arch*

Slika 3. *Određivanje središnje panoramske snimke oznakama (max. 13, min. 3) duž mandibularnog luka*

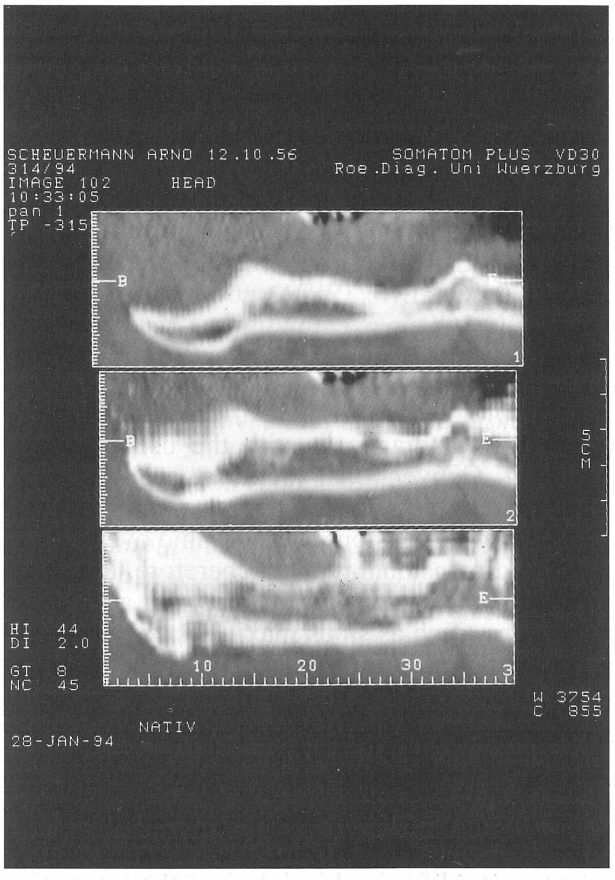

Figure 4. *Panoramic scan: image 3 shows the course of the canalis mandibulae*

Slika 4. *Panoramska snimka: treća snimka prikazuje tok mandibularnog kanala*

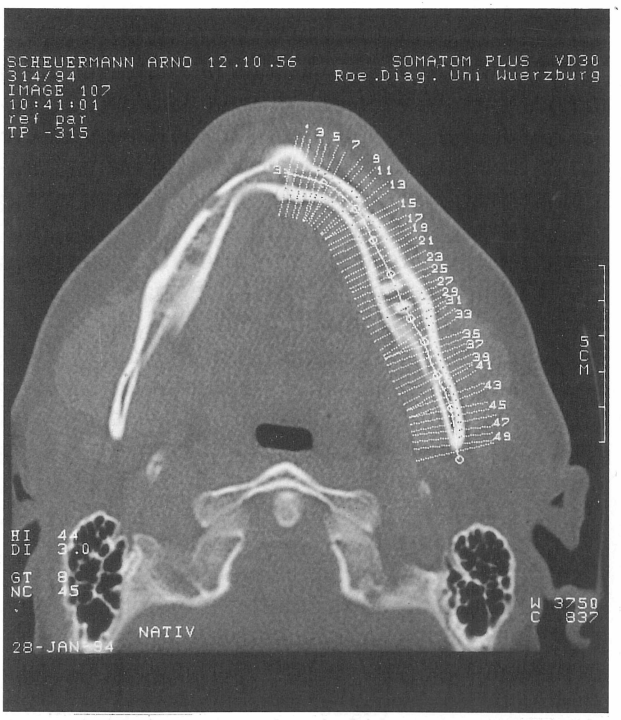

Figure 5. *Paraxial scans perpendicular to the central panoramic scan*

Slika 5. *Paraaksijalne snimke postavljene okomito na središnju panoramsku snimku*

manipulation, the so-called multiplanar reformation (MPR; Figs. 5 and 6) (4—6). The distance between them may vary from 2 to 10 mm. A maximum of 50 paraxial scans can be processed. The standard scan length is 24 mm and may vary between 16 and 32 mm. The reconstructions have a thickness of one pixel. Secondary reconstructions are performed on a 256 matrix.

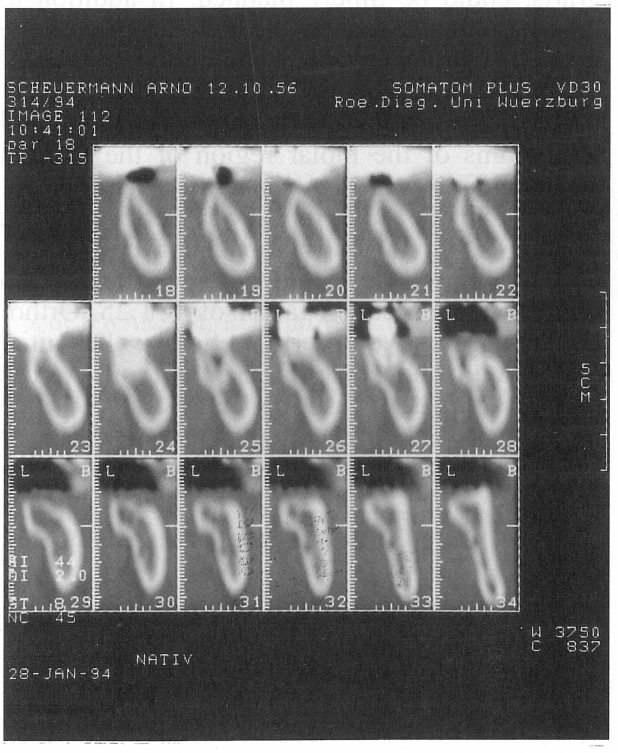

Figure 6. *Paraxial scans showing the course of the canalis mandibulae*

Slika 6. *Tok mandibularnog kanala prikazan paraaksijalnim snimkama*

Results

Advanced preimplantological diagnosis with Dental-CT was performed in 48 patients. Thirty--five spiral CT and 13 1-mm CT scans were done. The procedure revealed the following findings: sinus lift (N = 13); implantation in the region of n. alveolaris inf. (N = 11); state after resection and reconstruction of the mandible (N = 9); augmentation with bone grafts (N = 8); and advanced atrophy of the jaws (N = 7).

Computed tomography with Dental-CT software allowed authentic reproduction of the examined craniofacial region in dimension and space. The ideal position and angulation of the implants, ascertained by model analysis, could be transferred to the radiograph using positioning templates and checked for the bone supply established. The position and three-dimensionality of affected anatomical structures, in particular sinus maxillaris and canalis mandibulae, could be simply identified and spared during the surgical treatment. In case of bone defects and preprosthetic treatment with implant insertion planned, the dimension and shape of the bone grafts required could be preoperatively determined. Implantological treatment as part of oral rehabilitation, e.g., after tumor resection and reconstruction with microsurgical revascularized bone grafts, could be timely planned. In addition to detailed information on the morphology of the examined structures, information on bone density could also be obtained.

Expressiveness of orthopantomograms and tomograms of the molar region of the maxilla and mandible was obviously inferior to that of Dental-CT. The radiographs were performed by a Siemens Orthophos. Program 11 of the Siemens Orthophos produces orthopantomograms with a uniform magnification factor of 1 : 1.25. Orthopantomograms were very useful for the initial estimation of bone supply, even without the use of radio-opaque measuring balls, and provided an adequate radiologic diagnostic tool in case of classical diagnosis for insertion of endosseous dental implants. In case of poor image quality, however, tomograms of the molar region of the mandible, obtained by program 16 of the Siemens Orthophos, could not be used for the determination of bone supply and course of the canalis mandibulae.

Discussion

Considerable diagnostic advances in dental implantology have resulted in improved preimplantological diagnosis with the use of digital imaging. Conventional methods, such as panoramic radiography or tomography, can only provide a two-dimensional topographic overview of a three-dimensional reality. Therefore, the shape and three-dimensionality of important anatomical structures, such as sinus maxillaris or neuro-vascular bundle within the canalis mandibulae as well as the shape of the alveolar ridge in case of post-traumatic states or severe atrophy, cannot be properly judged (3, 7). Conventional 1-mm CT scan or spiral CT with Dental-CT software provide all relevant information. Panoramic and paraxial Dental-CT scans allow the implantologist to get a life-sized insight into the interesting hard tissue morphology. Regarding difficult preprosthetic or purely implantological questions, Dental-CT also offers valuable information. The implantological treatment can be properly planned, which may prove highly beneficial for the patient (2, 5—7). However, it should be made clear that the use of Dental-CT by no means excludes the need of careful consideration of conventional diagnostic records. Computed tomography and Dental-CT should be performed as a complementary diagnostic tool in special cases like sinus lift operations or transposition of the n. alveolaris inf., in post-traumatic implantology and in implantological treatment of tumor patients.

PREDIMPLANTOLOŠKA DIJAGNOSTIČKA RADIOGRAFIJA S PROGRAMIMA DENTAL-CT

Address for correspondence:
Adresa za korespondenciju:

Sažetak

U 48 bolesnika učinjene su CT snimke s razmakom od jednoga milimetra ili spiralni CT, a podaci su obrađeni Siemens Dental-CT programom. Manipulacija podataka ovim programom, tzv. multiplanar reformation (MPR), stvara panoramske sekcije i poprečne prereze kroz mandibulni i maksilni lûk. Predimplantološka dijagnostička radiografija Dental-CT programom rabljena je kako bi se pozornost usredotočila na važne anatomske strukture, npr. sinus maxillaris ili n. alveolaris inf., kako bismo dobili uvid u morfologiju koštanih tkiva u slučaju teške atrofije, posttraumatskih situacija ili u bolesnika s tumorima u kojih je provedena rekonstrukcija čeljusti slobodnim ili mikrovaskularnim transplantatima. Položaj i angulaciju implantata moguće je predvidjeti uz pomoć radio-neprozirnih indikatora. Istodobno provedene ortopantomografija i tomografija molarnoga područja gornje i donje čeljusti bitno su siromašnije informacijama koje pružaju u usporedbi s Dental-CT snimkama. Pomoću Dental-CT snimaka moguće je uspješno planirati implantološku terapiju. Također smo pomoću ove metode uspjeli očuvati od povrede važne anatomske strukture.

Ključne riječi: *predimplantološka dijagnostika, dentalni implantati, Dental-CT*

Dr. Thomas Betz
Dept. Oral & Maxillofacial Surgery
Julius-Maximilians University
Pleicherwall 2
97070 Würzburg
Germany

References

1. DULA K, BUSER D, PORCELLINI B, BERTHOLD H, SCHWARZ M. Computertomographie/Orale Implantologie (I) Dental-CT®: ein Programm zur computertomographischen Darstellung der Kiefer: Grundlagen und Aufnahmetechnik. Schw Monatsschr Zahnmed 1994; 104:450—459.
2. FUCCI G, MEOLI S. Nuovo imaging con Tomografia Computerizzata nell'implantologia dentale. Radiol Med 1992; 84:7—10.
3. HIRSCHFELDER U. Radiologische Übersichtsdarstellung zur präoperativen Beurteilung des Gebisses: Dental-CT versus Orthopantomographie. Fortschr Kieferorthop 1994; 55:14—20.
4. IMHOF K. Dental-CT: Ein neues Programm zur Planung und Überprüfung von Kieferimplantaten. Electromedica 1992; 60:26—29.
5. SCHWARZ M, ROTHMAN S L G, RHODES M L, CHAFETZ N. Computed tomography: Part I. Preoperative assessment of the mandible for endosseous implant surgery. Int J Oral Maxillofac Implants 1987; 2:137—141.
6. SCHWARZ M, ROTHMAN S L G, RHODES M L, CHAFETZ N. Computed tomography: Part II. Preoperative assessment of the maxilla for endosseous implant surgery. Int J Oral Maxillofac Implants 1987; 2:143—148.
7. WICHT L, MOEGLIN A, SCHEDEL H, PENTZOLD C, BIER J, LANGER R, FELIX R. Dental-CT-Studie zur präoperativen Beurteilung der Kieferatrophie. Aktuelle Radiol 1994; 4:64—69