치과용 CT 개요 및 기술발전

이상철
Discovery of X-ray

X-ray radiation was discovered by Roentgen in 1895

Why X-ray Imaging?
Since Rontgen’s discovery that X-ray can identify bone structures without any surgery
Digital X-ray Imaging

X-ray imaging consists of Tube, Collimator, Detector, Acquisition system and PC

1. X-ray Tube
2. Patient
3. Detector
4. Collimator
5. Projection
6. Data Acquisition in Equipment
7. Ethernet
8. PC
9. Reconstruction & Image Processing
10. Image
Why Digital X-ray Imaging

One day diagnosis & consultation

No film-process, no film storage space, easy to find image

Precise diagnosis

Easier communication with patient

Where applicable
Making appliance
Allowing for simpler referrals
Easier insurance claim submission
Dental Imaging System

**Cephalometric**
교정진단을 위한 측면, 정면영상

**Intra Oral Sensor**
국소부위의 자세한 영상

**Imaging Plate**

**Intraoral Camera**

**CT, Pano Detector**

**X-ray Source**

**Panorama**
상, 하악골 전체구조에서의 병변 진단

**CT**
3차원 구조 및 병변 진단

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Introduction to Digital Dental Imaging

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# Dental Imaging Modality

MODALITY

Any of the various types of equipment or probes used to acquired images of the body

<table>
<thead>
<tr>
<th>MODALITY</th>
<th>RESOLUTION</th>
<th>PURPOSE OF USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intraoral Camera</td>
<td>N/A</td>
<td>Take photo for showing oral cavity</td>
</tr>
<tr>
<td>Intraoral X-ray</td>
<td>10~40 μm</td>
<td>Periodontal &amp; endodontic diagnosis</td>
</tr>
<tr>
<td>Panoramic Imaging</td>
<td>70~150 μm</td>
<td>General x-ray diagnosis</td>
</tr>
<tr>
<td>Cephalometric Imaging</td>
<td>80~150 μm</td>
<td>Cephalometric diagnosis</td>
</tr>
<tr>
<td>CT (Cone-beam)</td>
<td>80~500 μm</td>
<td>3-dimensional diagnosis for implant surgery, endodontic/orthodontic</td>
</tr>
</tbody>
</table>

- Resolution of film panoramic image is 1.5~2 lp/mm But digital panoramic image is 2~5 lp/mm
- Line Pair (lp/mm) : Resolution evaluation method, how many pair of white and black line is recognized in 1mm space
Dental Imaging

Digital / CBCT 수요 증가 및 보급 가속화
IT기술 발전 (2차원 필름, 디지털 2D 파노라마 ➔ 3차원 Dental CT)
의료기술의 발달 (ex. 임플란트 시술)로 3차원 영상진단 필요
CT Scan

Development of spiral-CT by Villafana (1991)

Development of multislice-CT (1998)

Development of practical cone-beam CT (in the near future)
Micro-CT System

- Small FOV: small size detector
- Low Contrast: Bone or high contrast image
- Low price: simple equipment

Dental CBCT
CT Acquisition to Viewing Process

Projection → Reconstruction → 3D Software

Projection to axial slice

3D Software Reconstruction for viewing

"Cone" Beam Geometry
"Fan" Beam Geometry (for single slice)

영상 재구성 (Image Reconstruction)
수학적 계산으로 내부의 구조물을 구성하는 것임
이 알고리즘에 따라 Image quality 차이
CBCT Vs. Conventional CT

CBCT

Conventional CT
Dental Imaging Network

- CBCT
- Intra-Oral Sensor
- Printer
- Workstation (Studio)
- CBCT Control
- Director’s Office
- 3D Viewer
- SmartDent
- Mobile
- Web Viewer
- Chair
- 3D Viewer
- SmartDent
- Intra-Oral Camera
- Intra-Oral Sensor

Acquisition Order, DICOM Worklist
Image send, DICOM SCU

LAN
LAN
wifi
LAN

PACS
Dental CT system

- Implagrapy, Vatech, Korea
- CB MercuRay, Hitachi, Japan
- iCAT, Imaging Sciences International, USA
- SCANORA 3D, SOREDEX, Finland
- KaVo 3D eXam, KaVo, Germany
- ILUMA, IMTEC, USA
- GALILEOS, Sirona, Germany
- ProMax3D, PLANMECA, Finland
Dental CT system

FPD (Flat Panel Detector)

CT + Pano + Ceph (3 in 1 system)

II (Image Intensifier)
**CBCT** Purpose of Use

**Traditional, before 2005**
3 dimensional anatomy analysis

**Popularization for Implant Surgery, 2006 ~ 2011**
3 dimensional analysis for implant surgery (shape of mandible, bone density, and position of canal)

**Various 3D & CAD/CAM & Appliance, after 2011**
Expand 3-dimensional diagnosis such as TMJ, Endodontic, and Orthodontics
More digitized clinic → no impression, in-clinic prosthetic & appliance
3D Computer Graphics

Graphics that use a three-dimensional representation of geometric data that is stored in the computer for the purposes of performing calculations and rendering 2D images

3D Modeling  Process of forming the shape of an 3D object
3D Rendering  Converting 3D models into 2D images with 3D photorealistic effect
Volume Rendering  CT, MRI
Surface Rendering  CAD/CAM, Animation, Entertainment
Dental CT 응용

Plastic surgery, ENT

Skin value  Bone value  Transparent

Anterior View  Lateral View

Frontal Sinus  Sphenoid Sinus  Maxillary Sinus  Airway
Dental CT 발전 및 응용

**CAD / CAM system**

스캐너를 이용한 CAD/CAM 시스템

- 치아 인상체획득
- 치아 인상체 조정
- 베이스 작업
- 절단(sawing) 작업
- 플라스틱 작업
- 마진(margin) 작업
- 스캔 작업
- 스펙트럼 작업
- 블록 작업
- 드릴링 작업
- 삽입작업
Dental CT 발전 및 응용

CAD / CAM system
Dental CT 발전 및 응용

3D scanner와 Dental CT의 응용
Dental CT 발전 및 응용

Implant Planning (NobelGuide)

Solution Steps:
- Clinical diagnostics
- Fabrication of radiographic guide
- Digitization (CB)CT Scan
- Diagnosis & Treatment planning
- Guided implantology
- Pre-fabricated prosthetic solution
Dental CT 발전 및 응용

3D Printing System

• Invisalign
Thank you