Oral radiology – DA and DH training

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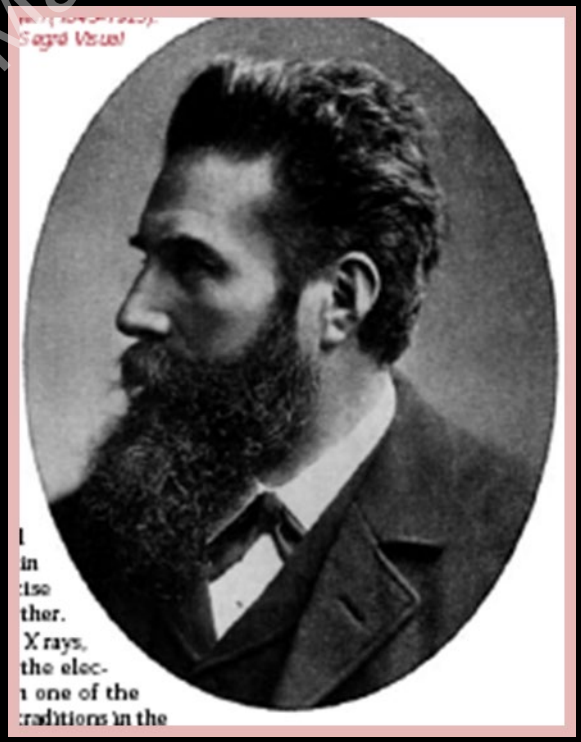
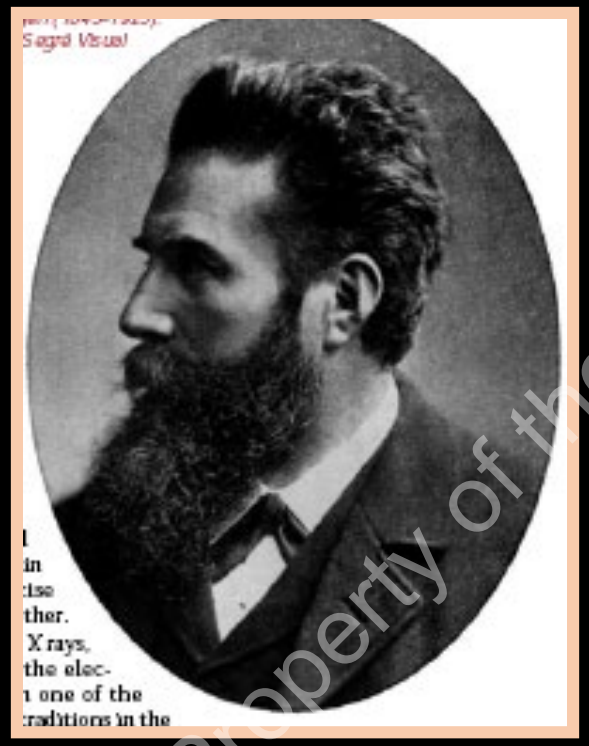
Outline of the presentation

- General principles
- Panoramic radiography general principles
- CBCT general principles

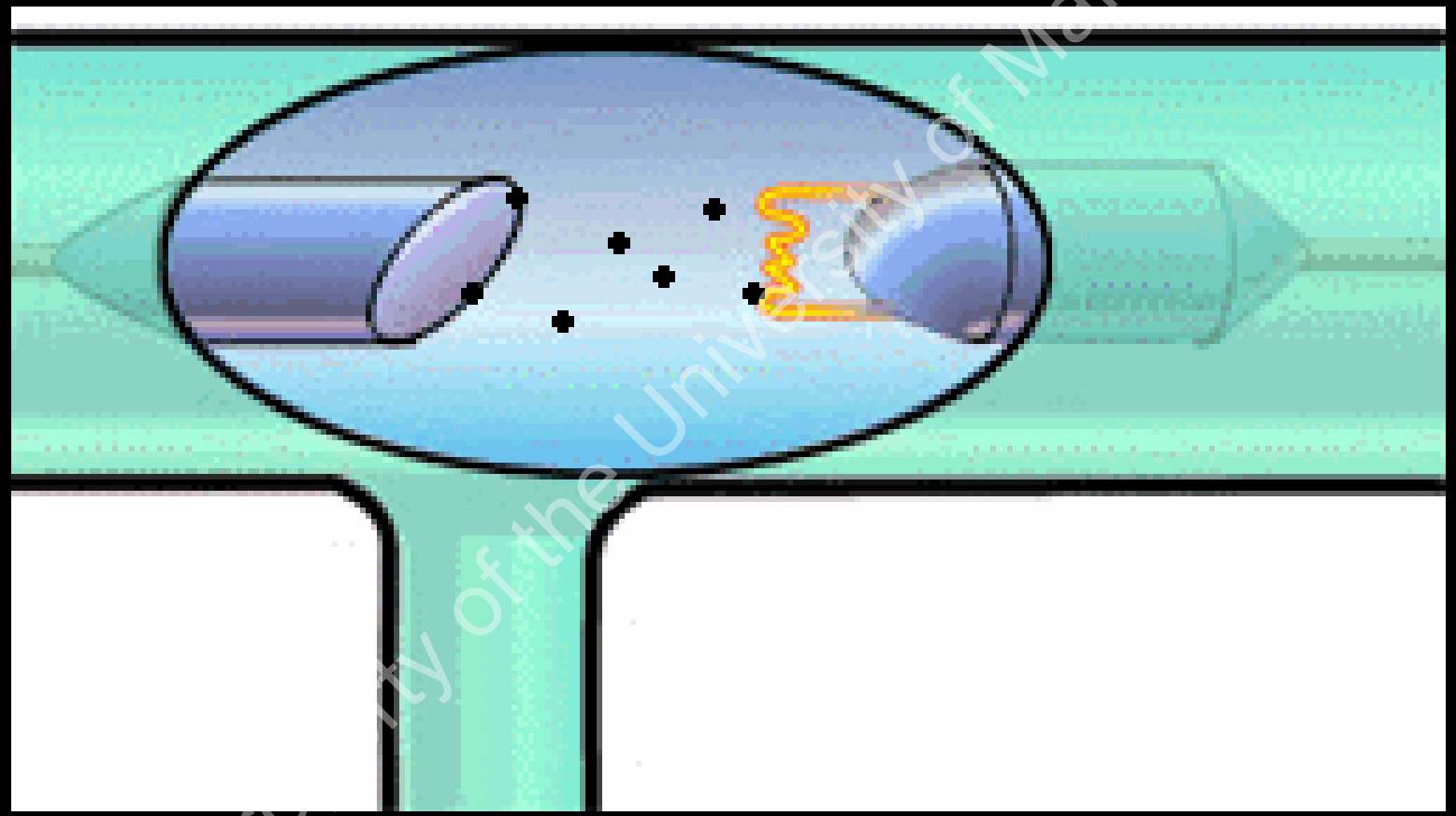
Oral radiology



Discovery of x-rays



Schematic representation of x-ray production

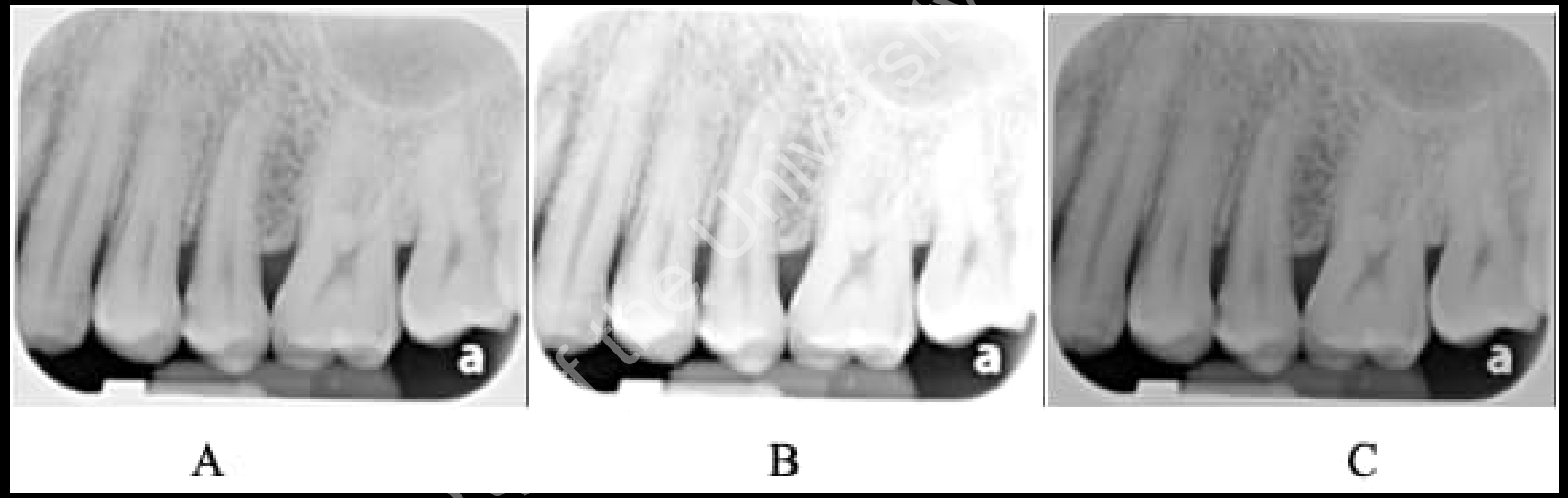


DENSITY

- The overall degree of darkening of an exposed film is referred to as radiographic density

$$D = \log \frac{\text{Incident light}}{\text{Transmitted light}}$$

What is the difference between these images?

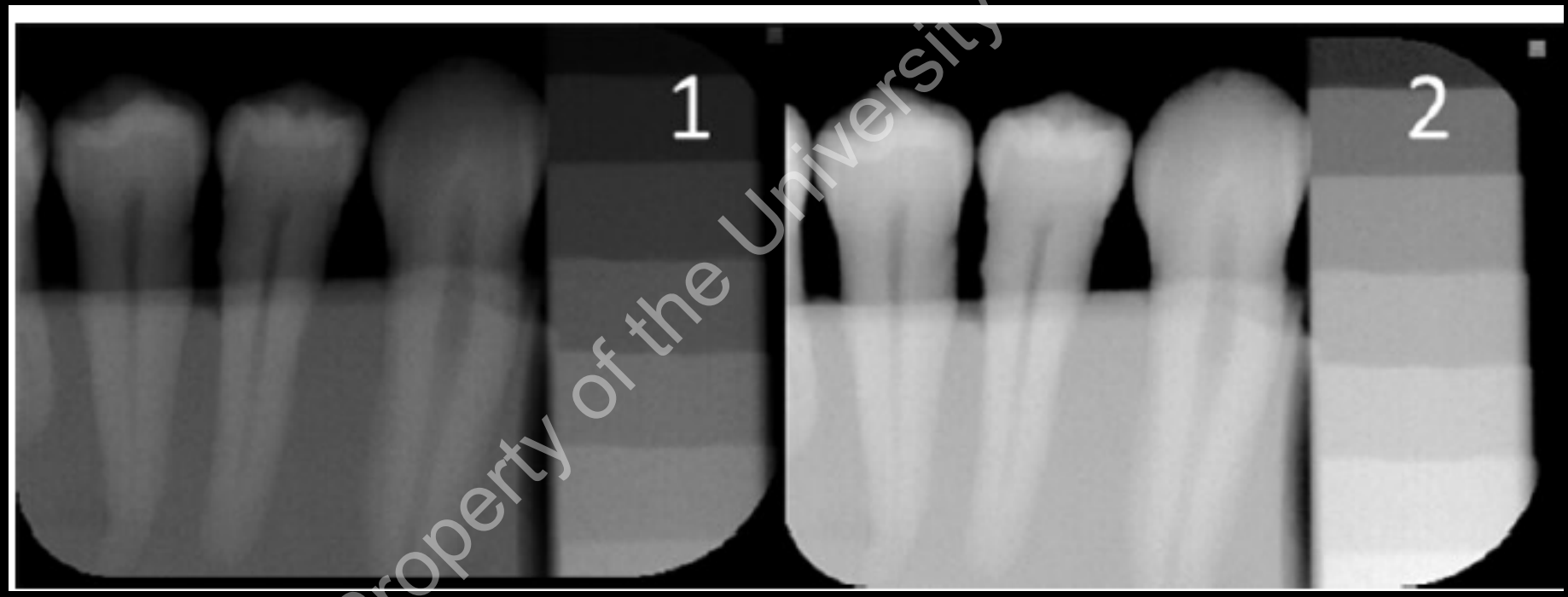


RADIOGRAPHIC CONTRAST

- General term used to describe the range of densities on a radiograph
- ***High Contrast*** – ***Short Gray Scale*** of contrast.
- ***Low Contrast*** images – ***Long Gray Scale*** of contrast

Commonly available exposure parameters

- kVp – Voltage – Contrast on the image (60-120 kVp)



Dentomaxillofacial Radiology (2018) **47**, 20180100

SHARPNESS OF THE RADIOGRAPHIC IMAGE

- Geometric factors.
- Subject and its movement known as motional factors.
- Film factors.

Which image has better sharpness?

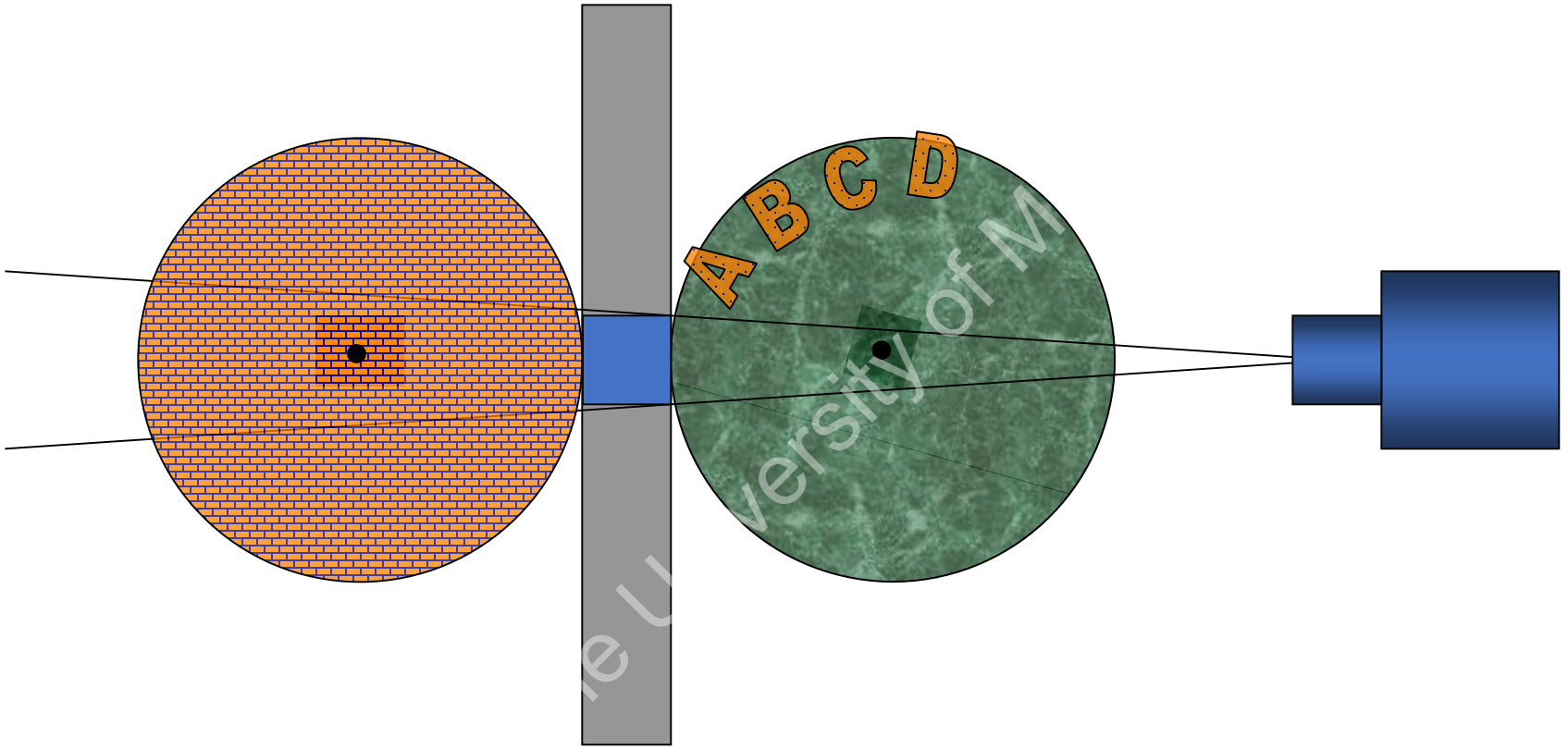
RADIOGRAPHIC NOISE

- Appearance of uneven density of a **uniformly exposed film**
- Primary causes
  - Radiographic mottle
  - Radiographic artifact

ORTHOPANTOMOGRAM

- ORTHO - Orthodontics refers to the teeth
- PAN - Refers to the panoramic display of the teeth produced by the technique
- TOMOGRAM - X-ray image that is focused in a single plane of the patient which shows a sharp image; layers above and below it, being unsharp or blurred

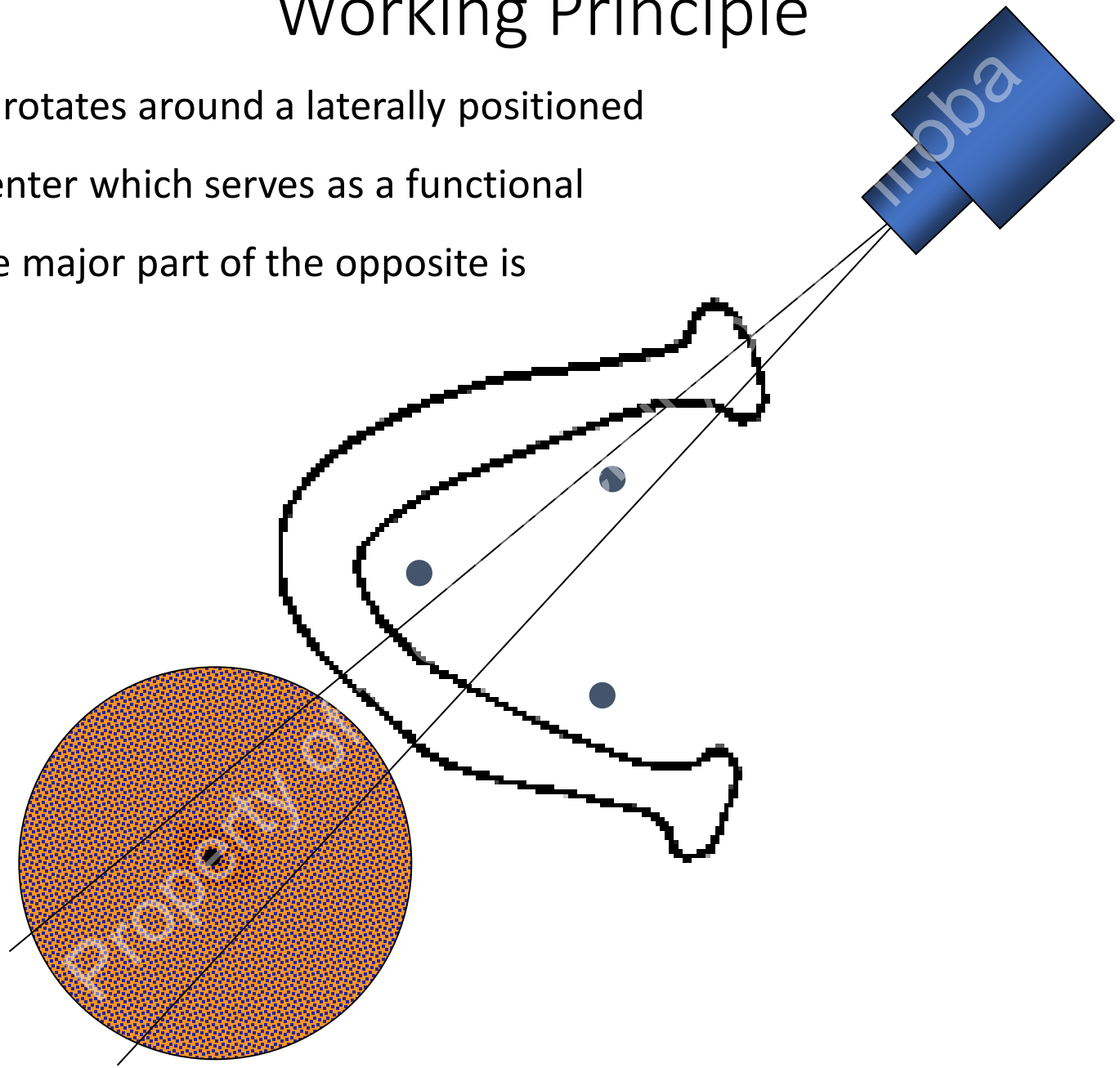
Working Principle



♪The radiopaque objects A,B,C,& D on disk-1 rotate past the slit and their images are recorded on disk-2 which we now consider as a film, which also moves past the slit at the same time

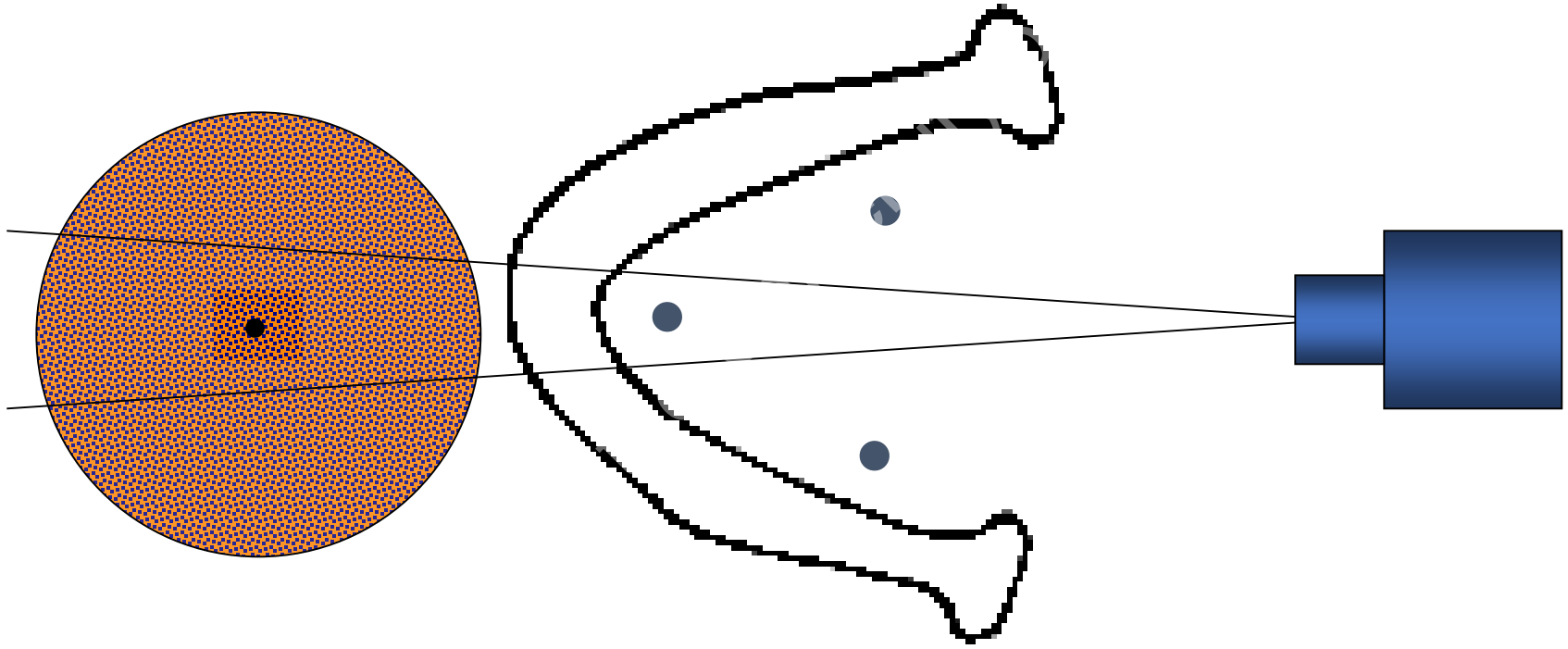
Working Principle

Beam first rotates around a laterally positioned rotation center which serves as a functional focus while major part of the opposite is exposed

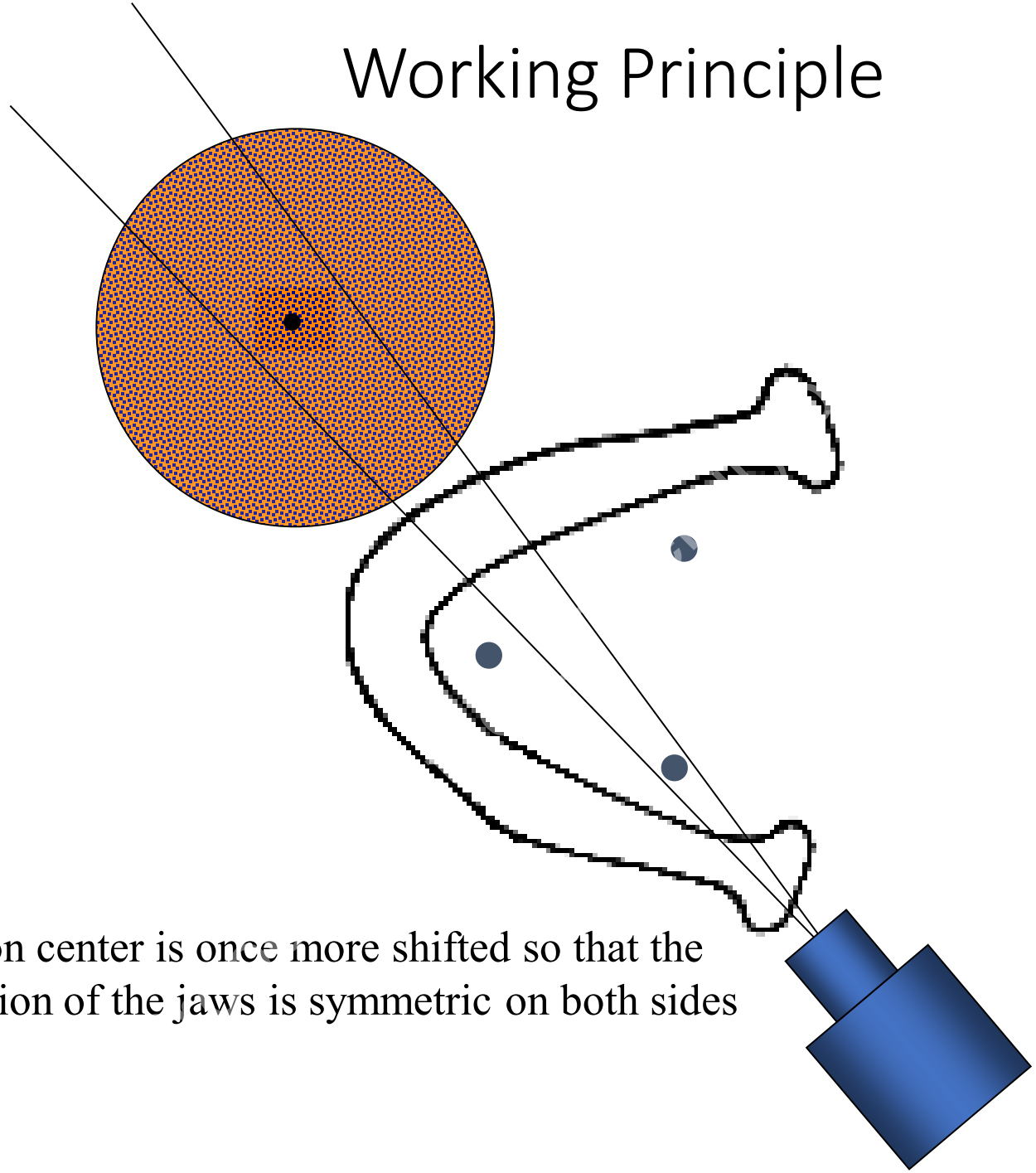


Working Principle

The anterior region is now exposed with this second rotational center as the functional focus



Working Principle

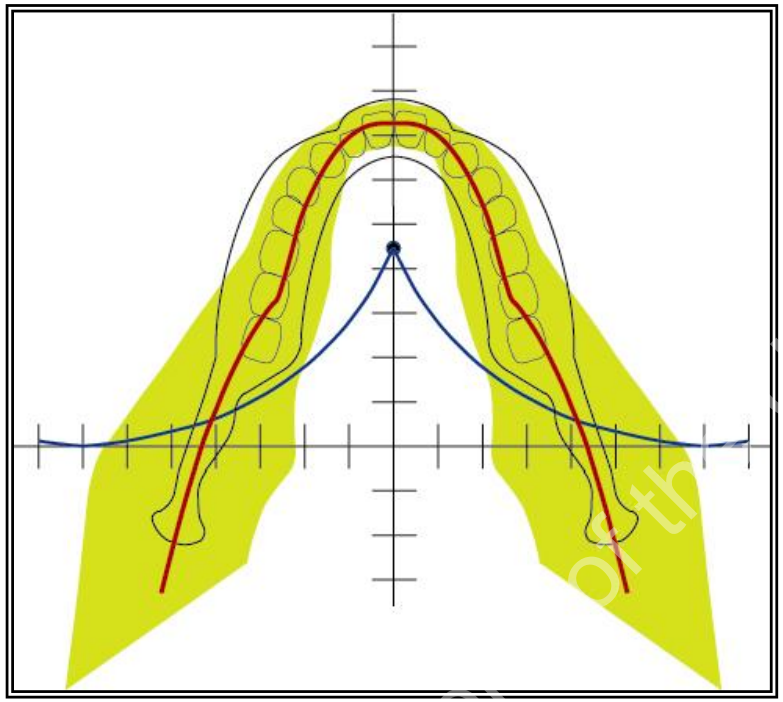


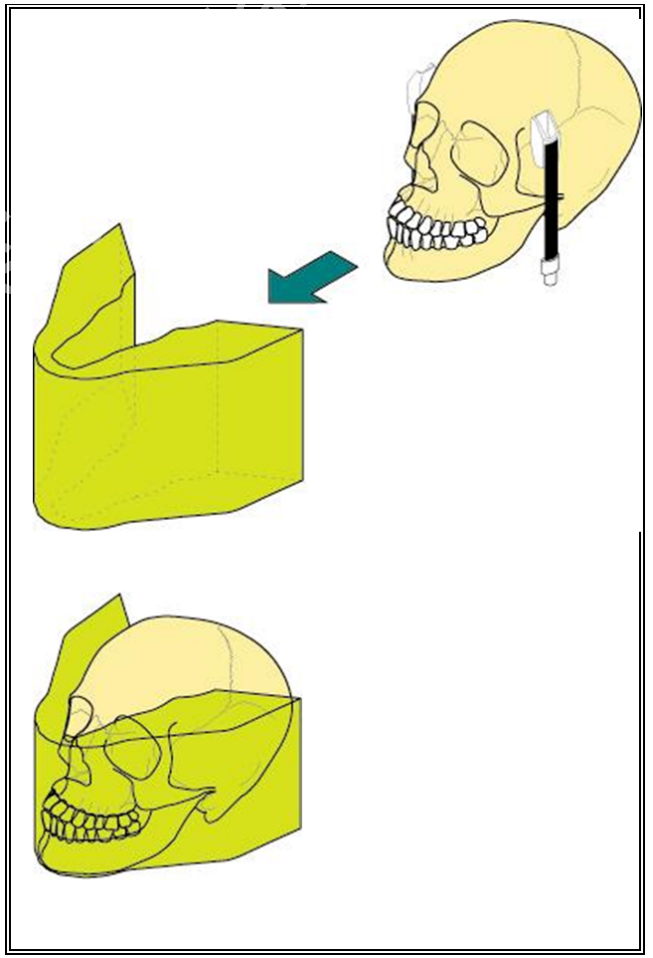
Rotation center is once more shifted so that the projection of the jaws is symmetric on both sides

Focal trough (zone of sharpness)

- The focal trough is a three dimensional curved zone or image layer in which the structures are reasonably well defined on panoramic radiograph.
- It is curved in vertical plane because all machines use film that has its flat surface in vertical plane
- The shape of focal trough varies with the brand of equipment.
- Machines are designed to have zone, shaped like dental arch (*HORSE SHOE SHAPE*)

Focal trough

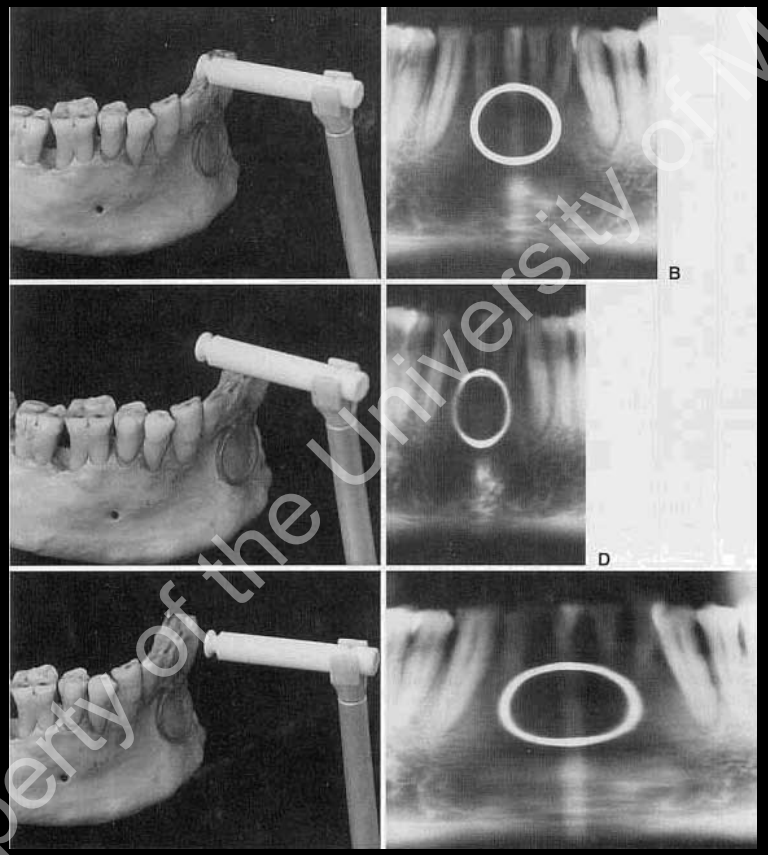




Technical aspects

- Exposure time – 16.2 seconds
- Operating kVp 60-70 kV
- Operating current 1-7.5 mA
- Automatic exposure controls: The tube current (mA) controlled simultaneously based on the density of the patient.

Illustration of focal trough



White and Pharoah's Oral Radiology , 6th Edition Principles and Interpretation

Panoramic ghost shadows

Dentomaxillofac Radiol. 2011 Sep; 40(6): 397–399.

Illustration of ghost shadows

Dentomaxillofac Radiol. 2011 Sep; 40(6): 397–399.

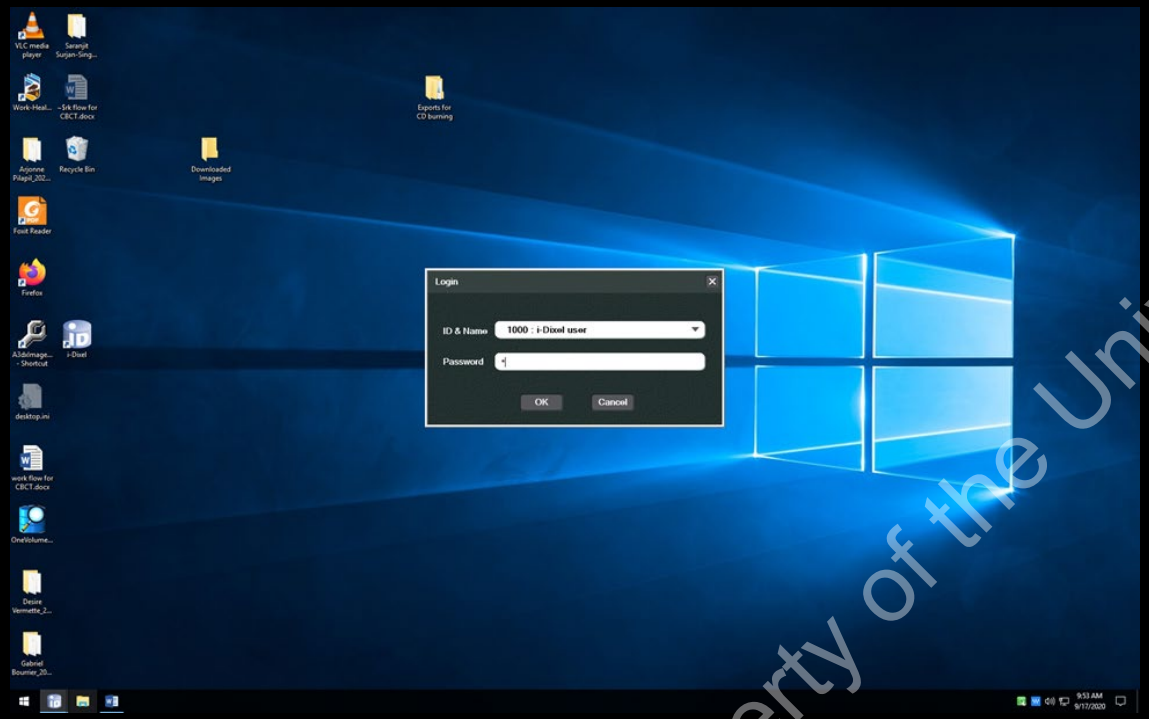
Tongue not on palate

Too far back in focal trough

Too far forward

CBCT general principles

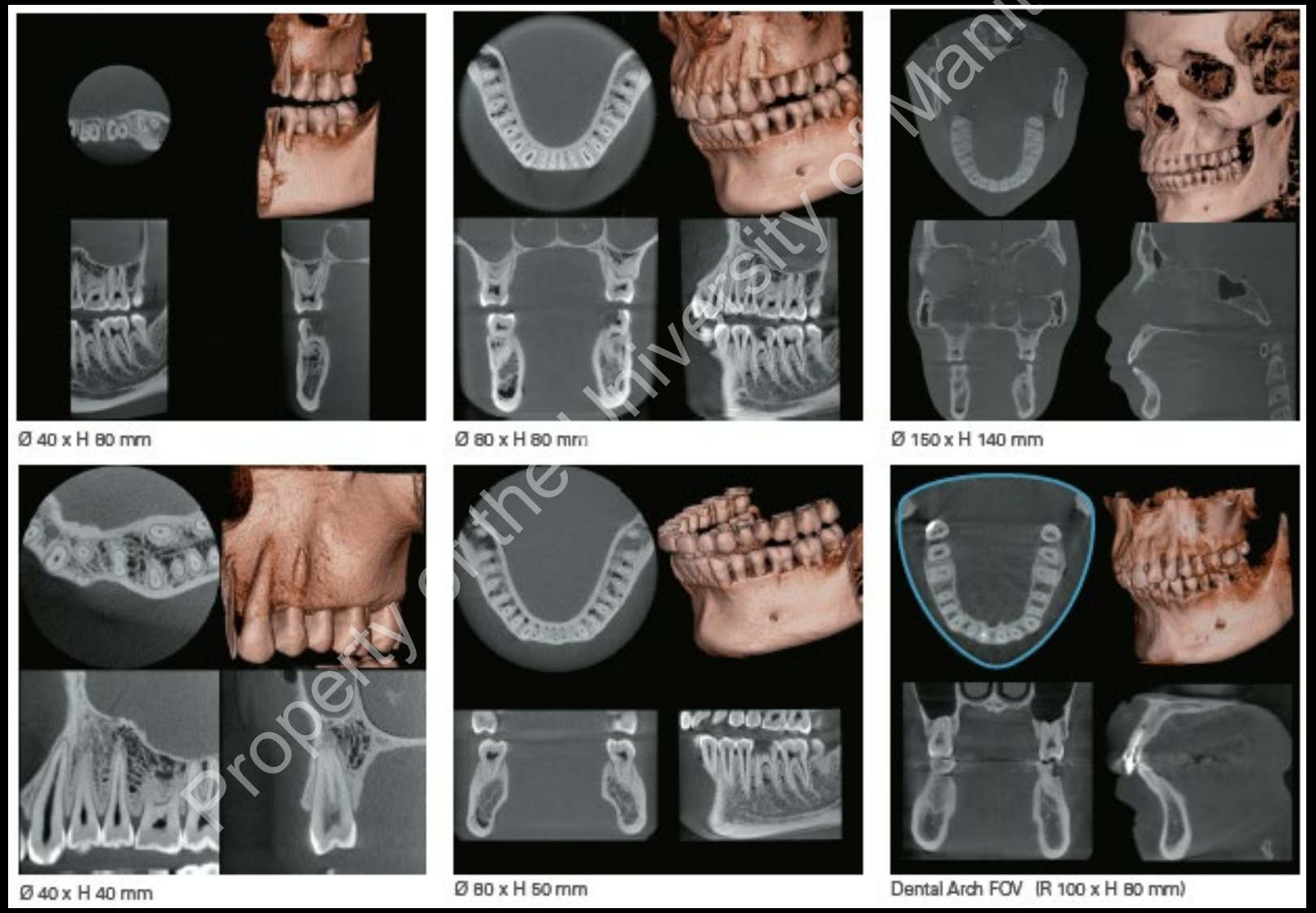
Patient positioning in the machine



Key point : The software controls the CBCT hardware

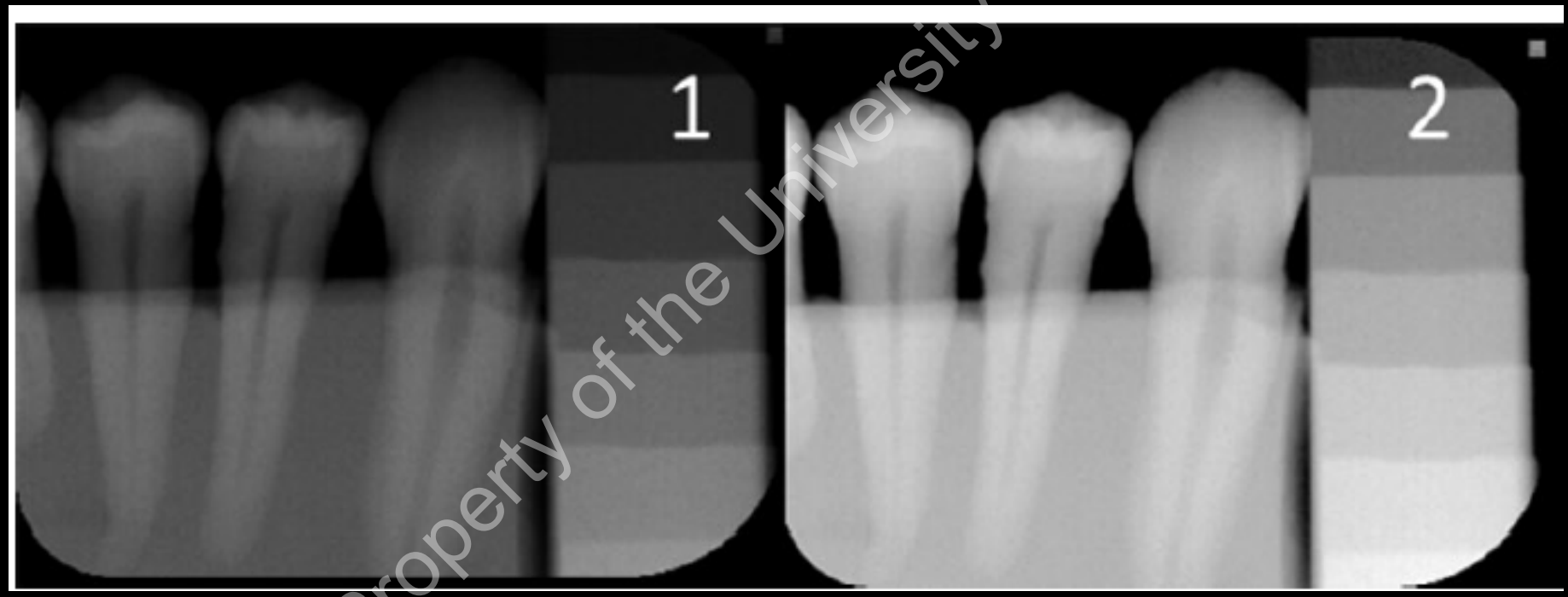
Patient positioning in the machine

Different fields of view in CBCT machines



Commonly available exposure parameters

- kVp – Voltage – Contrast on the image (60-120 kVp)



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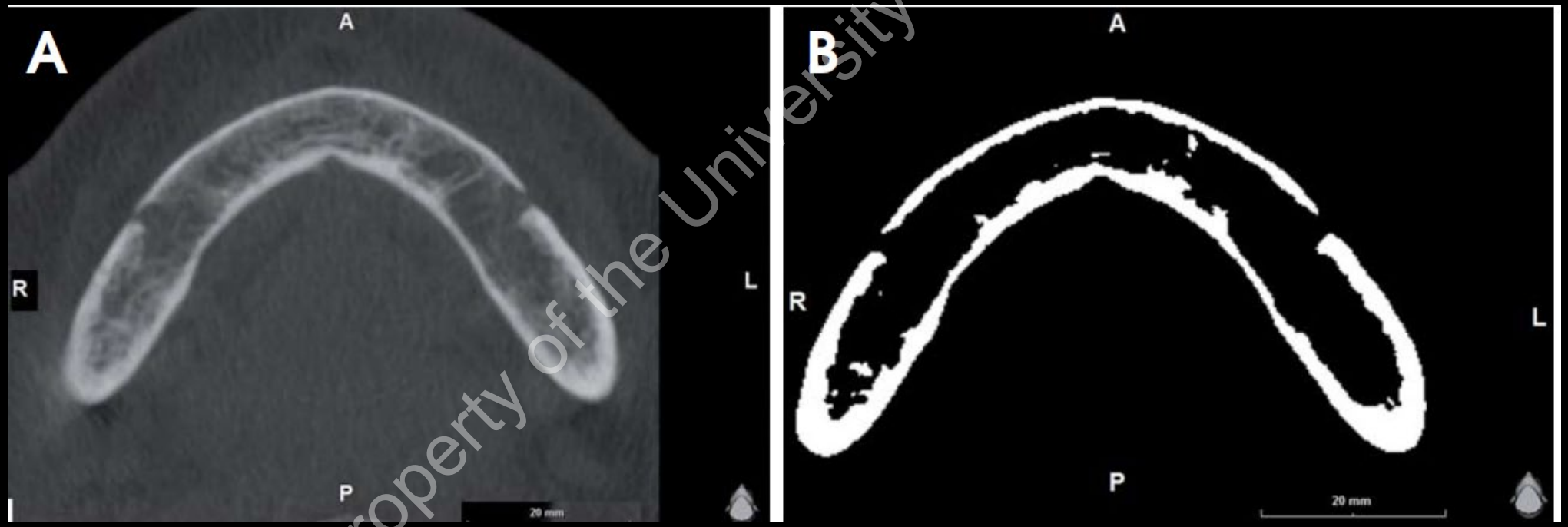
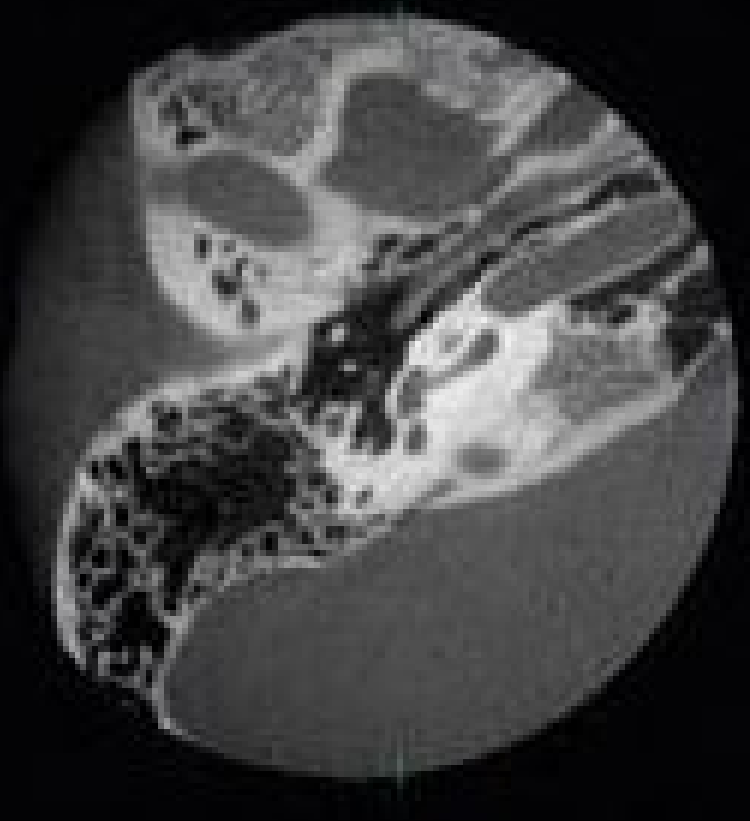
Commonly available exposure parameters

- Tube current and time (mAs) – (1-10 mA) (5.4 – 40 Sec) - Density



Commonly available exposure parameters

Hi Speed - 10.8/5.4 S



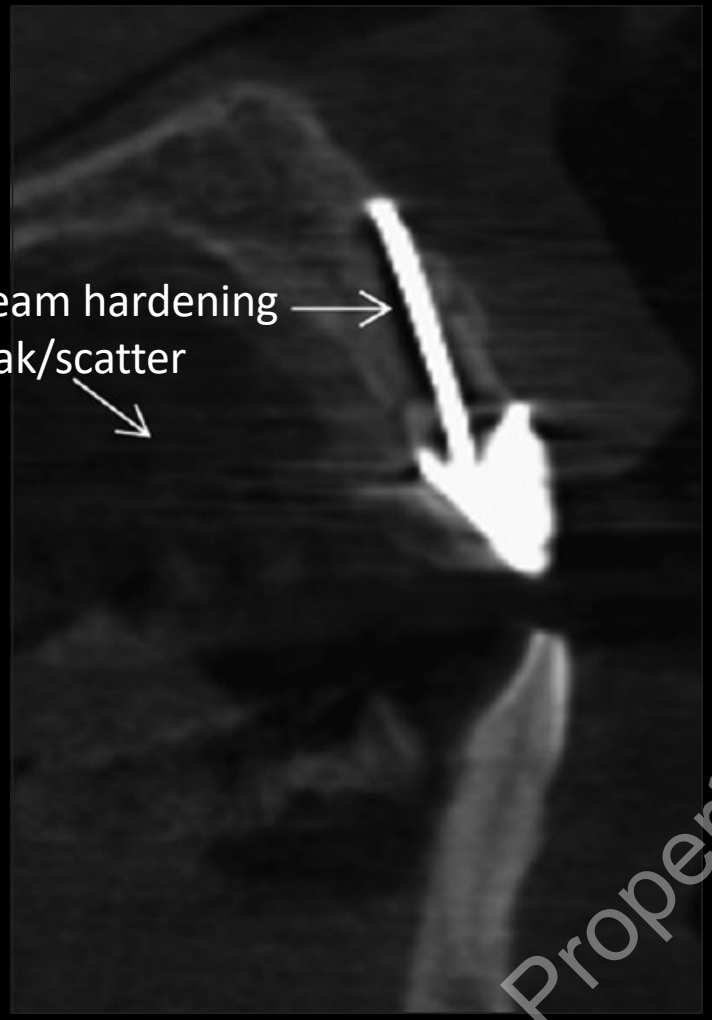
Hi resolution – 30.8/15.8 S

Hi Fidelity - 30.8/15.8 S

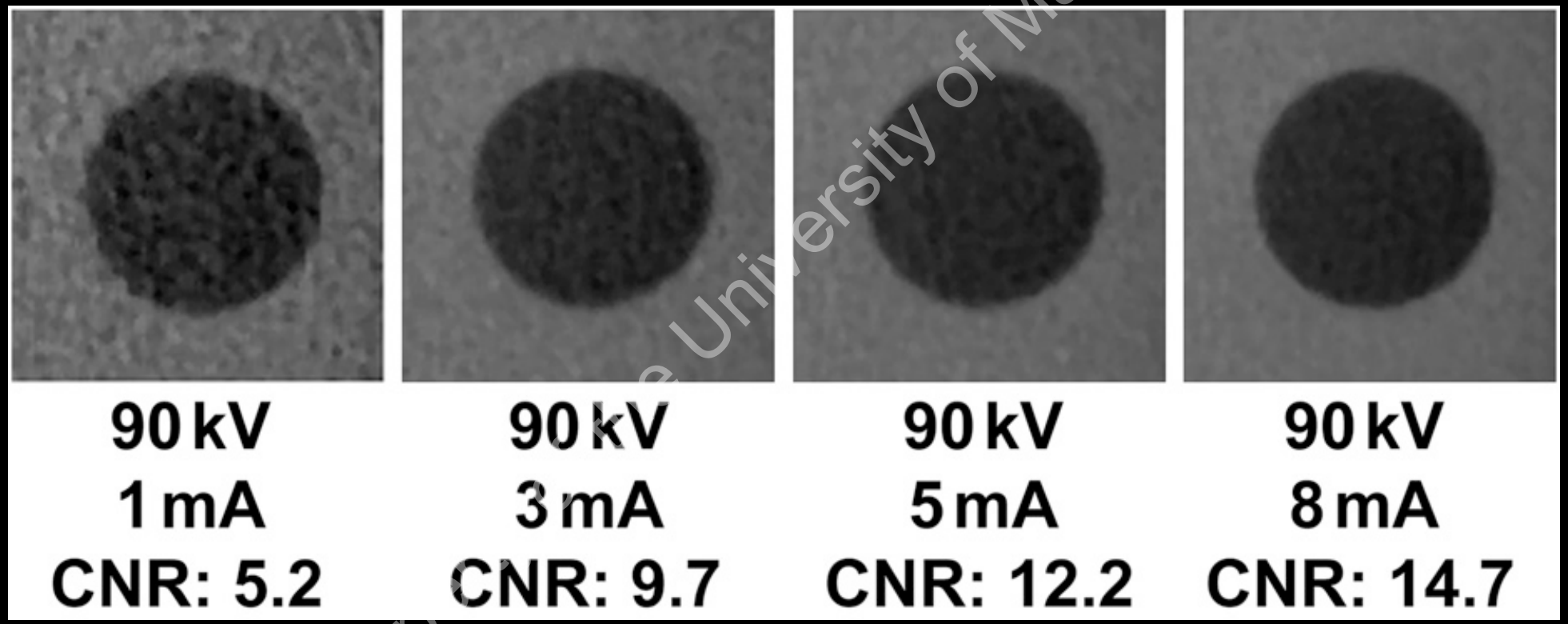
Standard – 17.5/9 S

Tube rotation – Half and Full rotation scans

Common artifacts

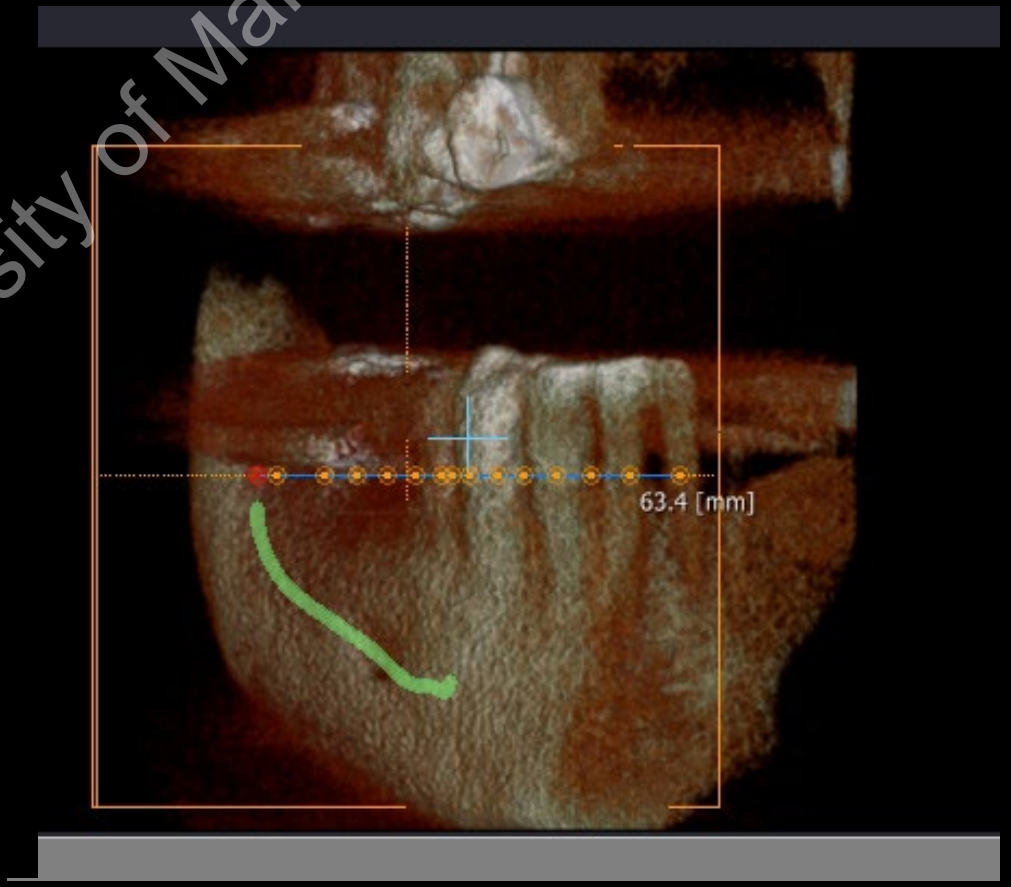


Setting optimum mA

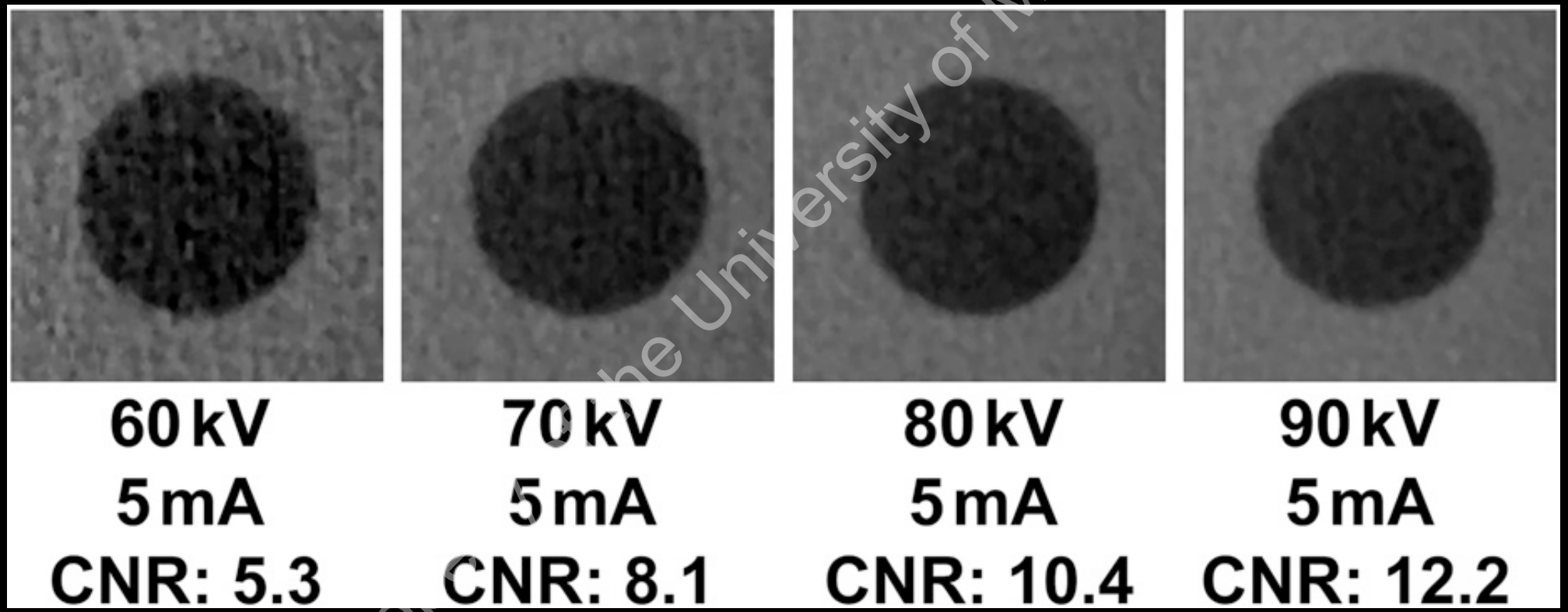


R Pauwels et al. Optimization in CBCT through mAs reduction DMFR 2015

Setting optimum mA

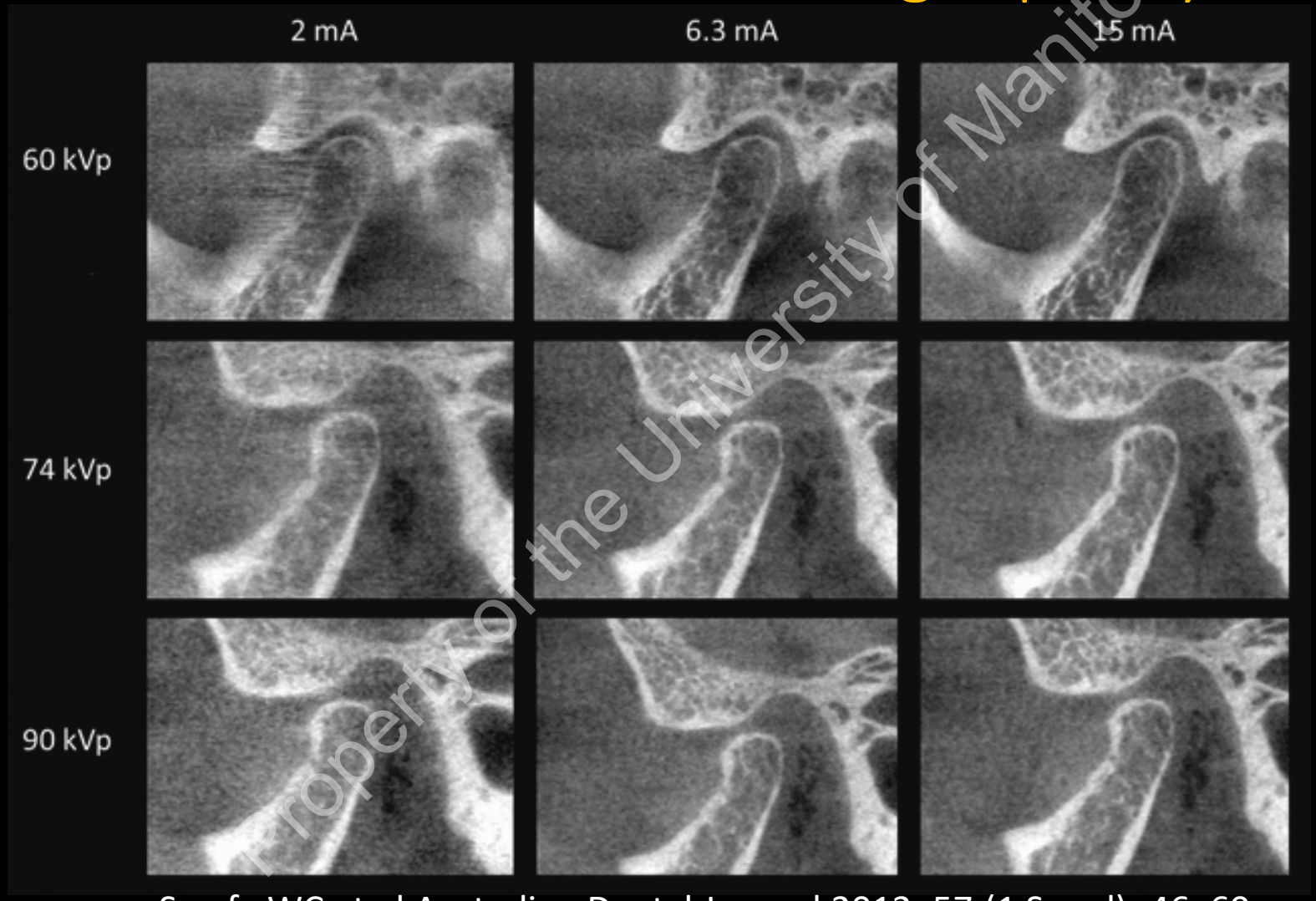


Setting optimal kVp



R Pauwels et al Optimal kVp in CBCT: CNR vs dose DMFR 2014

Effect of mA and image quality



Scarfe WC et.al Australian Dental Journal 2012; 57:(1 Suppl): 46–60

Optimum exposure parameters – adults

- Highest KVp Always provides best image contrast
- Set mAs 10-20% less than the manufacturer recommendations
- Use half rotation scans if patients needs multiple scans
- *The most optimal contrast at a fixed dose was found at the highest available kVp setting.*
- *Image quality remained acceptable at exposure levels below the manufacturer's recommended setting.*

Pauwels R et.al Dentomaxillofac Radiol. 2014 Jun; 43(5): 20140059.
Pauwels R et.al Dentomaxillofac Radiol. 2015;44(9):20150108

Optimal exposure parameters – pediatric population

- Optimum kVp – 70
- Optimum mAs – half of the adult dose
- Use quick scan/ultra low dose/half rotation scans
- Combining relatively low mAs (16) and kVp (70) with a small voxel size (180 µm) seems to be the optimal option under the tested conditions, due to the low effective dose associated to high image quality scores.

Oenning AC et.al Scientific Reports volume 9, Article number: 5521 (2019)

Thank you