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## Cone-beam computed tomography: Small cone big scoop!

Seeing 3D just like the movies... but without the need of 3D glasses

**Language:** English

**Authors:**

Dr. Archana R. Shenoy, Dr. Sushma P, Prof. Dr. Ashok Lingappa, Prof. Dr. Sujatha G. P,  
Department of Oral Medicine and Radiology, Bapuji Dental College and Hospital Davangere, Karnataka, India

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### Introduction

Cone-beam computed tomography (CBCT) is the latest advancement in diagnostic imaging that has begun to emerge as a potentially low dose cross-sectional technique for visualizing bony structures in the maxillofacial region.

**CBCT yesterday... today... tomorrow...**

Pioneers in X-ray computed tomography: Sir Godfrey Hounsfield and Allan McLeod Cormack  
First CT scanner - 1972  
First CBCT for angiography - 1982  
First CBCT in dentistry - 1998

**Advances:**

MVCBCT (Mega Voltage CBCT)



Abb 1: Sir Godfrey Hounsfield

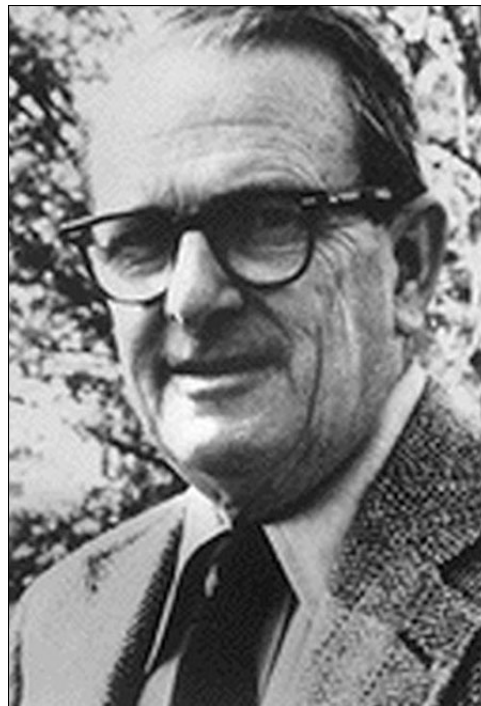


Abb 2: Allan McLeod Cormack

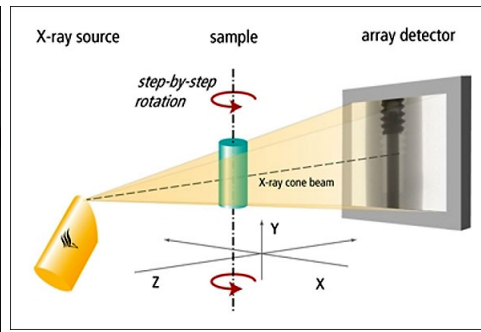


Abb 3: Mega Voltage CBCT

Abb 4: Principle

## Conclusions

### Principle:

CBCT scanners utilize a 2D detector and cone-shaped source of ionizing radiation allowing for a single rotation of gantry to generate a scan of the entire region of interest.

How does it work?

### X-ray generation:

3D X-ray beam with circular collimation → Cone shaped beam

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### Image detection system:

Image intensifier tube/ charged coupled device combination or flat panel detector arrays

↓

### Image reconstruction:

Acquisition of single projection images known as "basis" images and reconstruction using Feldkamp software algorithm

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### Image display:

Axial, sagittal and coronal planes

### Diagnostic value:

1. Dentomaxillofacial imaging
2. Orthodontic planning
3. Periodontal diseases
4. TMJ analysis
5. Cephalometric analysis
6. Jaw pathologies
7. Radiotherapy guidance
8. Implant site assessment
9. Impacted tooth evaluation

### Medical applications:

1. Interventional radiography
2. Angiography
3. Mammography
4. Airway assessment

### Benefits:

1. Size: reduced
2. Cost: ¼ to 1/5 of conventional CT
3. Rapid scan time: less than 30 seconds
4. Submillimeter resolution: 0.4 mm to as low as 0.125 mm
5. Patient dose reduction: 52-1025  $\mu\text{Sv}$  = 4-77 digital panoramic radiographs
6. Interactive analysis: for real-time dimensional assessment and measurements
7. Image artifact: reduced

### Limitations:

1. Image noise
2. Poor soft tissue contrast

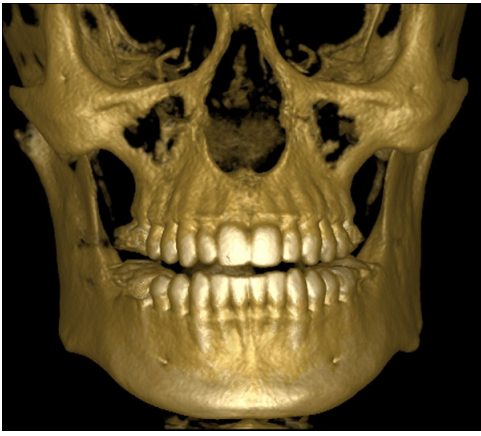


Abb 5: Dentomaxillofacial imaging

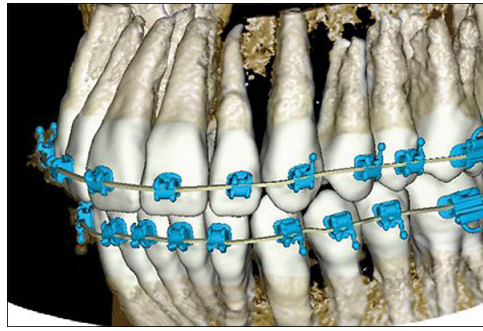


Abb 6: Orthodontic planning



Abb 7: Periodontal diseases



Abb 8: TMJ analysis



Abb 9: Cephalometric analysis

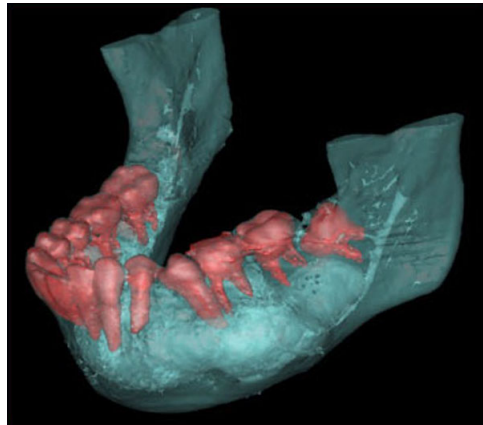


Abb 10: Jaw pathologies

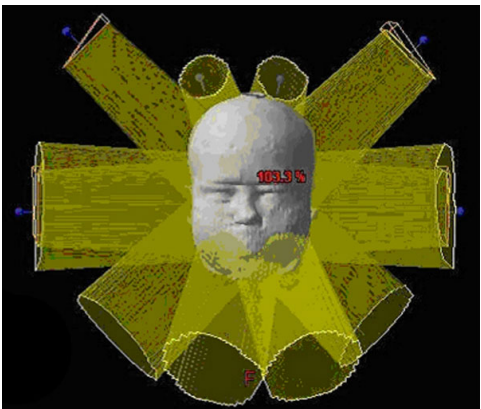


Abb 11: Radiotherapy guidance

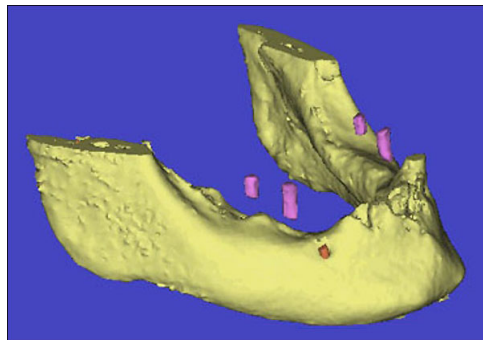


Abb 12: Implant site assessment

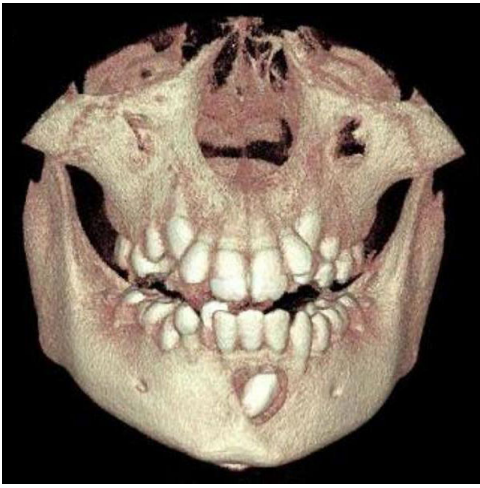


Abb 13: Impacted tooth evaluation

Abb 14: CBCT Scanner

### **Conclusion:**

The ability of CBCT to provide images in three dimensions with a high level of detail makes it a very attractive method for many dental applications. There is no doubt that cone-beam technology will become an important tool in dental and maxillofacial imaging over the coming decades.

### **Literature**

1. White SC, Pharoah MJ. Oral Radiology - principles and interpretation. 6th edn. India: Elsevier; 2009. p.225-243.
2. Miracle AC, Mukherji SK. Conebeam CT of the head and neck, Part 2: clinical applications. Am J Neuroradiol 2009 Aug;30:1285-92.
3. Scarfe WC, Farman AG. What is cone-beam CT and how does it work. Dent Clin North Am 2008;52:707-730.

### **Abbreviations**

2D - 2 dimensional  
CT - Computed tomography  
CBCT - Cone-beam computed tomography

*This Poster was submitted by [Dr. Archana R. Shenoy](#).*

### **Correspondence address:**

[Dr. Archana R. Shenoy](#)  
Bapuji Dental College and Hospital  
Department of Oral Medicine and Radiology  
Davangere - 577 004  
Karnataka, India

# CONE-BEAM COMPUTED TOMOGRAPHY SMALL CONE BIG SCOOP !

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today--  
tomorrow--

Pioneers in X-ray Computed Tomography



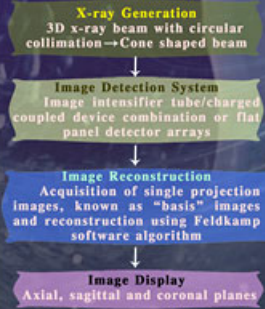
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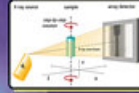


How does it work ?



Principle

CBCT scanners utilize a 2D detector and cone-shaped source of ionising radiation allowing for a single rotation of gantry to generate a scan of the entire region of interest.



Medical Applications

- > Interventional radiography
- > Angiography
- > Mammography
- > Airway assessment

Benefits

- > Size: Reduced
- > Cost: One 4th to one 5th of conventional CT
- > Rapid acquisition time (10s-30s)
- > Submillimeter resolution: 0.4mm to as low as 0.125mm
- > Patient dose reduction: 52-102µSv => 4 to 7% digital panoramic radiographs
- > Interactive analysis for real-time dimensional assessment and measurements
- > Image artifact: Reduced

Limitations

- > Image noise
- > Poor soft tissue contrast

The ability of CBCT to provide images in three dimensions with a high level of detail makes it a very attractive method for many dental applications.

There is no doubt that cone-beam technology will become an important tool in dental and maxillofacial imaging over the coming decades.

Authors: - Shrey Archana R, Sushma P, Lingappa Anshu, Sujatha G.P  
163 Post Graduate Students, 2 Professor & M.D, 4 Professor

Department of Oral Medicine & Radiology  
Bapuji Dental College & Hospital, Davangere, Karnataka.