
In the name of God

Dental implants:

Imaging techniques:

Essential characteristics:

- Visualize the implant site: mesiodistal,faciolingual,superioinferior
- Reliable
- Evaluate trabcular bone density & cortical thickness
- Capacity to correlate the imaged site with the clinical site
- Reasonable access & cost
- Minimal radiation risk

Application:

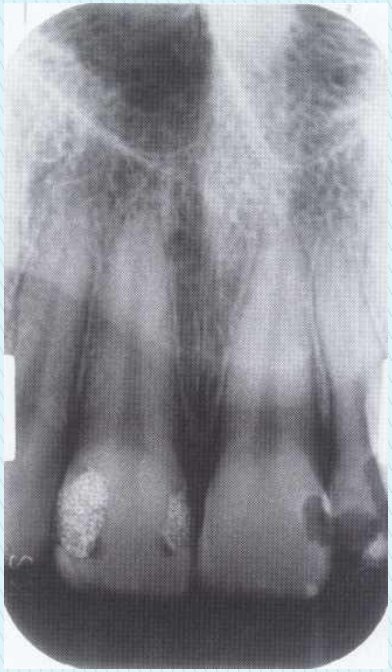
- Single implant : periapical , panoramic , conventional radiography , occlusal(only lower jow)
- Multiple implants : periapical , panoramic , conventional radiography ,computed radiography, occlusal (only lower jow)
- Edentulous : periapical , panoramic , conventional radiography , computed radiography
- Augmentation : periapical , panoramic , conventional radiography , computed radiography , occlusal (only lower jow)

TABLE **30-1**

Commonly Used Radiographic Procedures with Time Intervals for Treatment Planning and Assessment of Dental Implants

STAGE OF TREATMENT	TIME (MONTHS)	RADIOGRAPHIC PROCEDURES
Treatment planning	−1	Periapical, panoramic radiography; conventional tomography; reformatted computed tomography; cephalometric radiography
Surgery (fixture placement)	0	Imaging only for correction of problems
Healing	0 to 3	Imaging only for correction of problems
Remodeling	4 to 12	Periapical, panoramic radiography; scanography
Maintenance (without problems)	13+	Periapical, panoramic radiography; scanography (follow up approximately every 3 years)
Complications	Anytime	Periapical, panoramic radiography; scanography; conventional tomography (as indicated)

Intraoral radiography



Intraoral radiography:

Advantage:

- Readily available
- High image definition
- Minimal distortion
- Least cost &radiation exposure
- Evaluate the status of adjoining teeth and remaining alveolar bone in the mesiodistal dimension
- Determining vertical height , architecture , and bone quality

- **There are four types of bone in the human face and the length of treatment for placing and restoring implants with a "tooth" and crown depends on which type of bone the implant is placed in. Implants have to integrate with the surrounding bone before a tooth and crown is placed on it.**

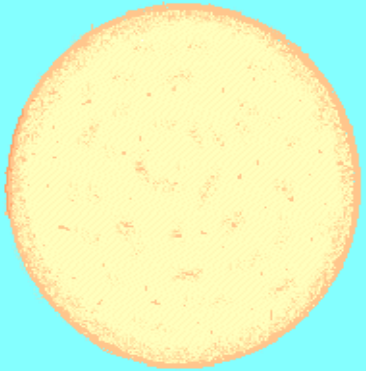
- **Type I bone is comparable to oak wood, which is very hard and dense. This type of bone has less blood supply than all of the rest of the types of bone. The blood supply is required for the bone to harden or calcify the bone next to the implant. Therefore, it takes approximately 5 months for this type to integrate with an implant as opposed to 4 months for type II bone.**

- **Type II bone is comparable to pine wood, which isn't as hard as type I. This type of bone usually takes 4 months to integrate with an implant.**

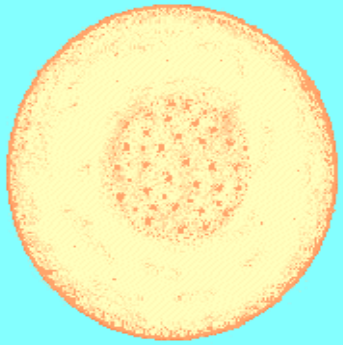
- **Type III bone is like balsa wood, which isn't as dense as type II. Since the density isn't as great as type II, it takes more time to "fill in" and integrate with an implant. 6 months time is suggested before loading an implant placed in this type of bone. Extended gradual loading of the implant can, however, improve the bone density.**

- **Type IV bone is comparable to styrofoam, which is the least dense of all of the bone types. This type takes the longest length of time to integrate with the implant after placement, which is usually 8 months. Additional implants should be placed to improve implant/bone loading distribution. Incremental loading of the implants over time will improve bone density. Bone grafting or augmentation of bone are often required. Bone expansion and/or bone manipulation can improve initial implant fixation.**

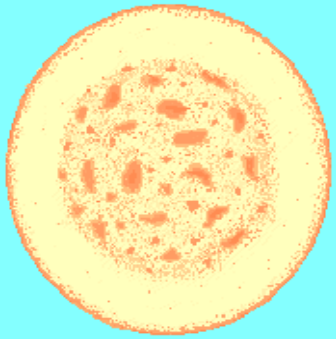
TYPE I



TYPE II



TYPE III



TYPE IV

Disadvantage:

- Limited imaging area
- No facial-lingual dimension (periapical)
- Limited reproducibility
- Image elongation & foreshortening
- Occlusal image records only the widest portion of mandible
- Occlusal technique is not useful in imaging the maxillary arch

Applications:

- Single implant
- Multiple implant (2_5)
- Edentulous(6+) not occlusal
- Augmentation

Lateral & lateral-oblique cephalometric radiography:

- Useful in placement of some implants near the midline for overdentures
- Documents axial tooth inclinations & dentoalveolar ridge relationships in the midline
- Soft tissue profile is apparent to evaluate profile alternations
- Images of non midline structure are superimposed

Panoramic radiography:

Advantage:

- Readily available , large imaging area , minimal cost & radiation exposure
- Useful & popular as a screening & assessment
- Preliminary estimations of crestal alveolar bone & cortical boundaries of mandibular canal maxillary sinus & nasal fossa
- Angular measurement

Disadvantage;

- No facial-lingual dimension
- image distortion ,technique error common
- inconsistent magnification , geometric distortion
- Vertical measurements are unreliable

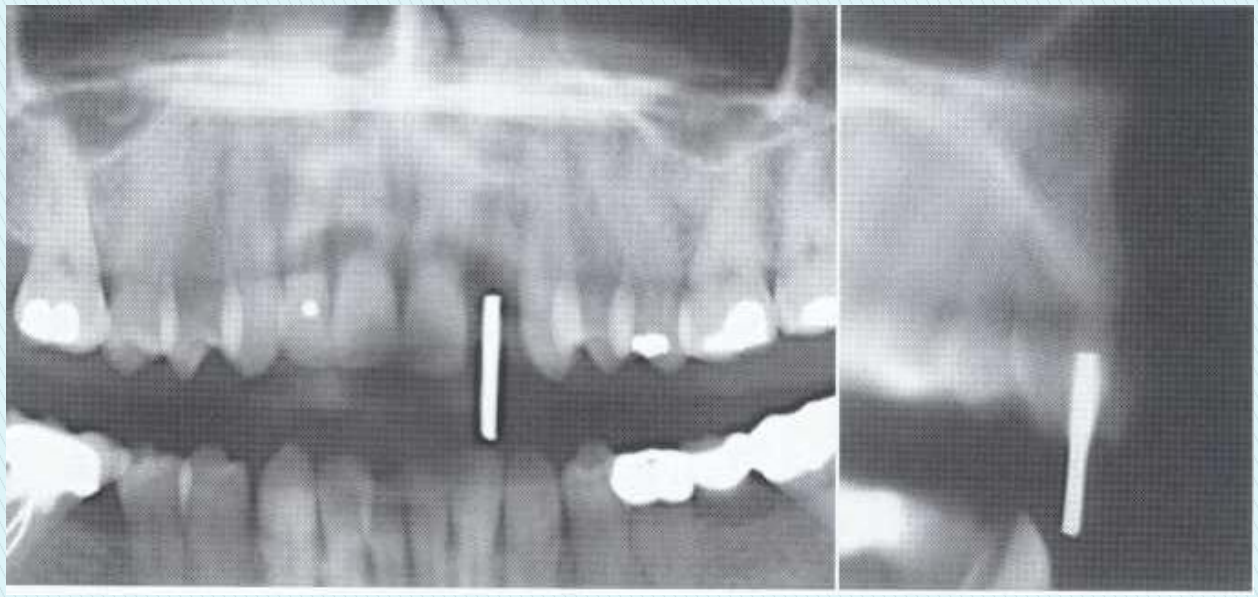
Application:

- S,M,E,A

conventional tomography:

Advantage:

- Minimal super imposition
- Facial-lingual dimension
- Uniform magnification
- Measurement accurate within about 1mm
- Simulate placement with software
- The dimensional accuracy of cross sectional tomograms is useful in measuring the distance between the alveolar crest & and adjacent structure



Disadvantage:

- Less image definition than plain films
- Somewhat limited availability
- Special training for interpretation
- Sensitive to technique errors
- Greater radiation exposure for multiple sites

Application:

S,M,E,A

Reformatted CBCT:

Advantage:

- Evaluation of all possible sites
- No superimposition
- Uniform magnification
- Measurement accurate within 1mm
- Estimate internal bone density
- Simulate placement with software

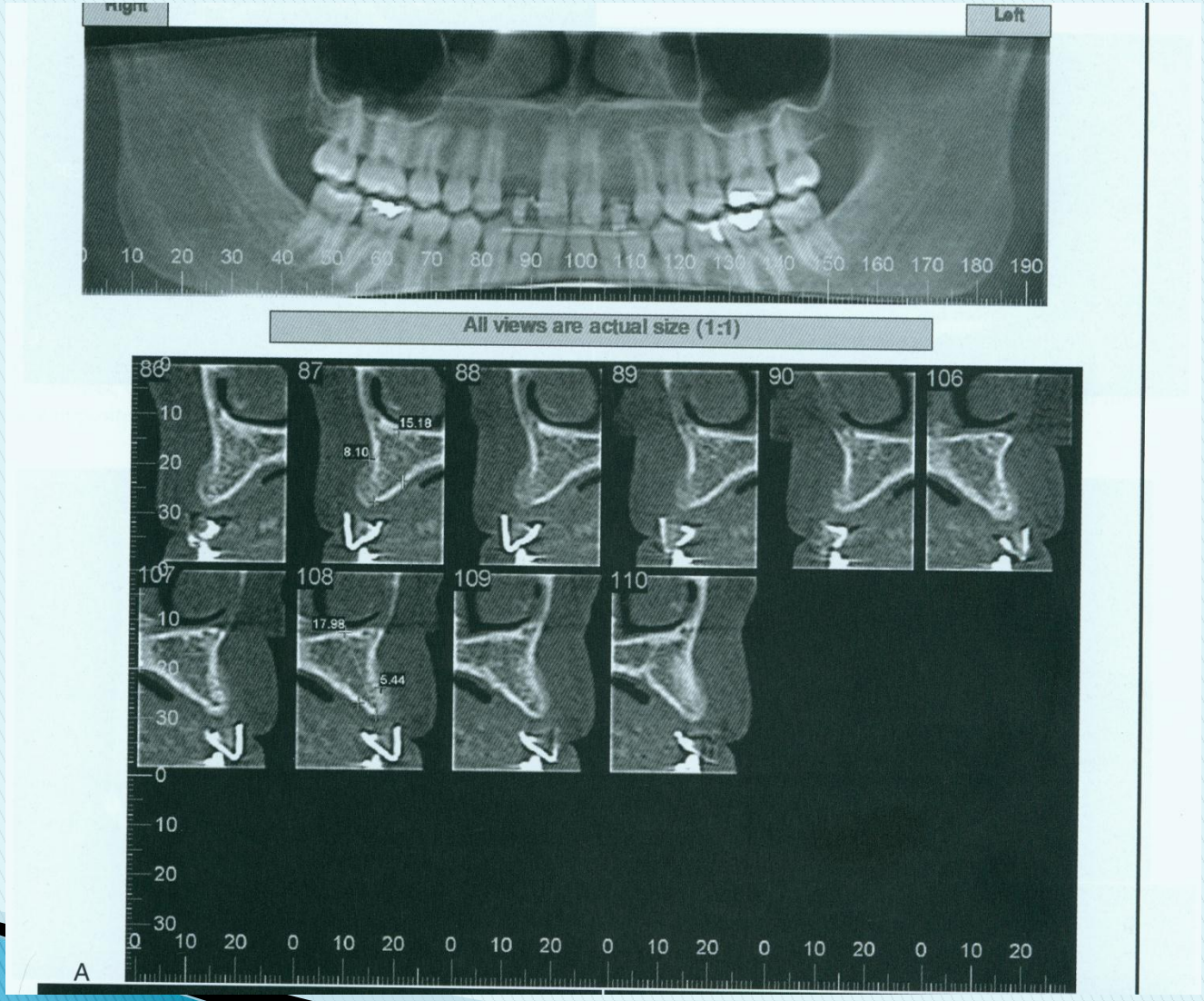
Disadvantage:

- Limited availability
- Sensitive to technique errors
- Some metallic image artifacts
- Special training for interpretation
- Moderate cost & radiation exposure
- Volume averaging contributes to measurement error

Application:

- M,E,A

Reformat CBCT of maxila



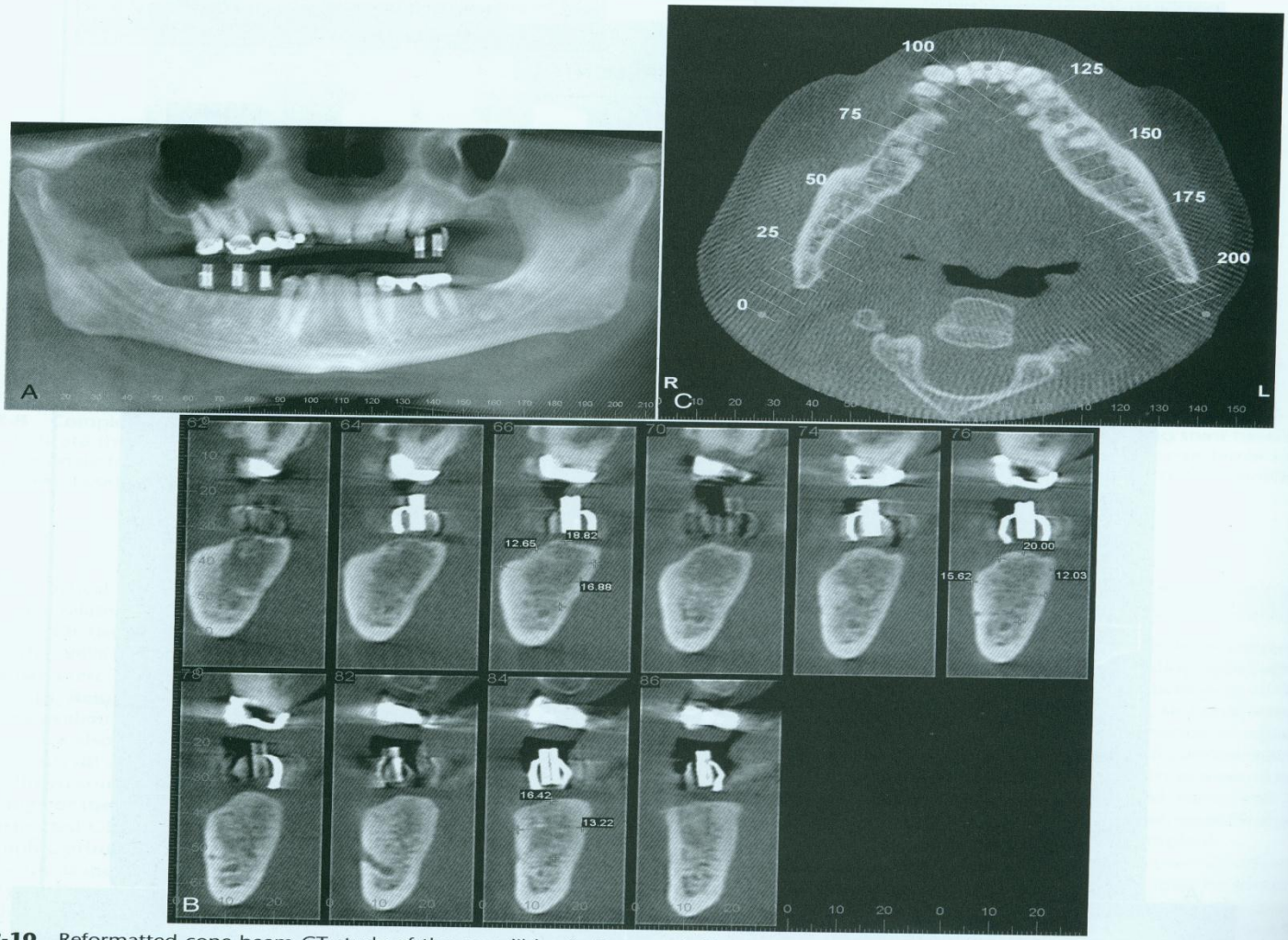


FIG. **32-10** Reformatted cone-beam CT study of the mandible. **A,** Panoramic-like curved linear reconstructed image. The imaging stent incorporates copper cylinders for the path of insertion and radiopaque strips defining the buccal and lingual contours of the proposed prosthesis. The copper cylinders will allow the imaging stent to be used as a surgical guide when the implants are placed. **B,** Correlating cross-sectional images. **C,** Reformatted axial image through the alveolar ridge depicting the panoramic arc and correlated cross-sectional images. (Courtesy Oral and Maxillofacial Imaging Center, Baylor College of Dentistry, Dallas, Tex.)

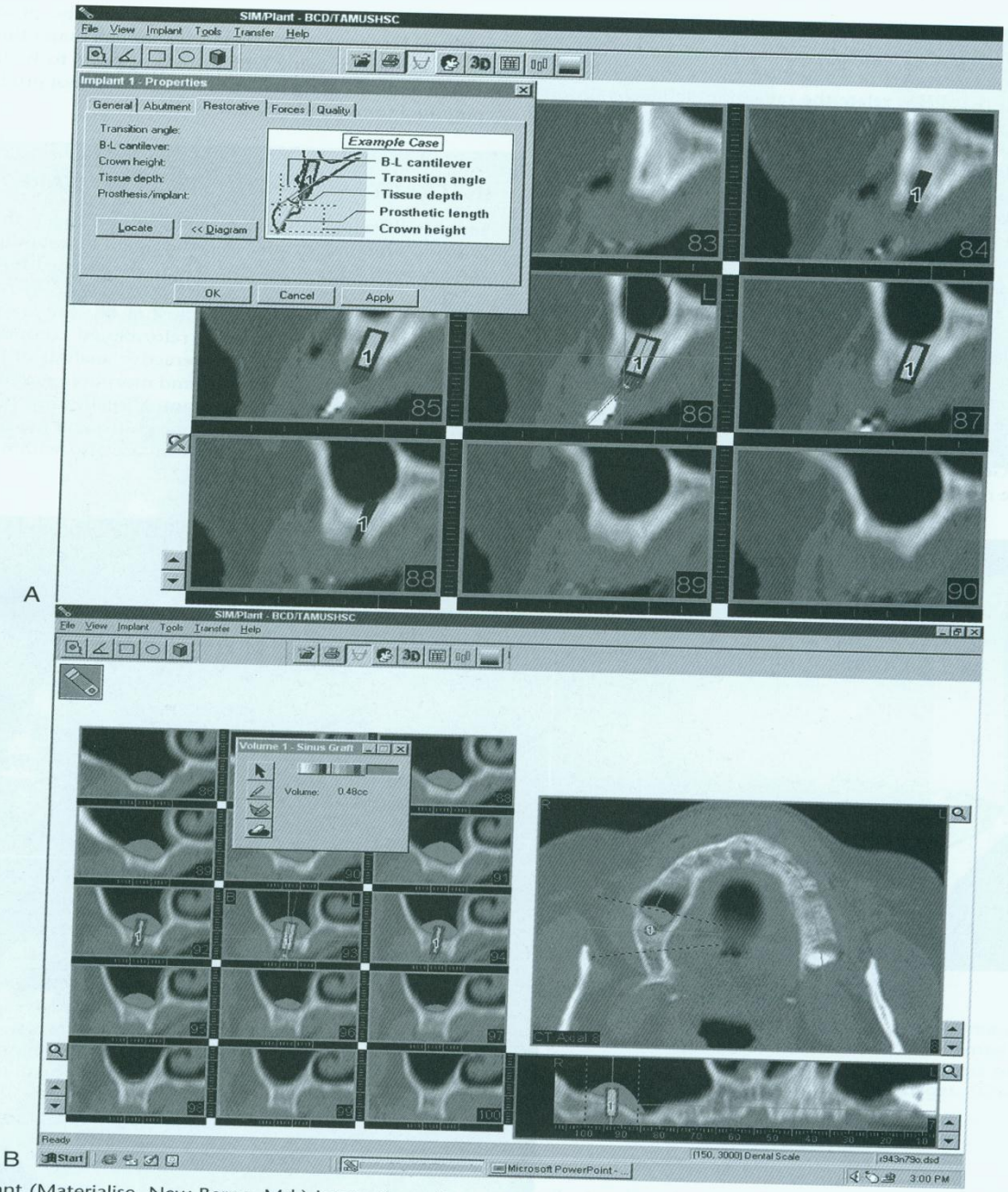


FIG. **32-12** SIMPlant (Materialise, New Berne, Md.) interactive software. **A,** Simulation of implant placement and predicted restorative dimensions are displayed on cross-sectional images. **B,** The volume of bone grafting material for a sinus lift procedure is predicted in a case with inadequate alveolar ridge height.

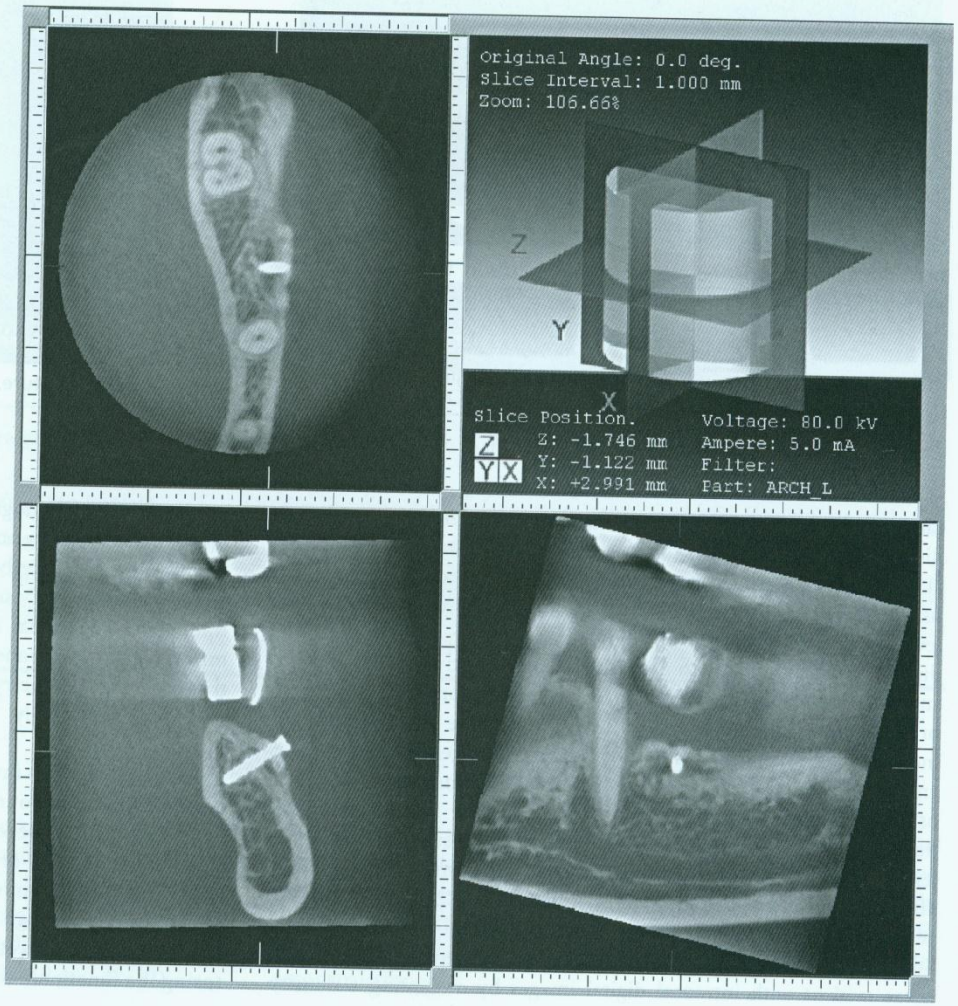
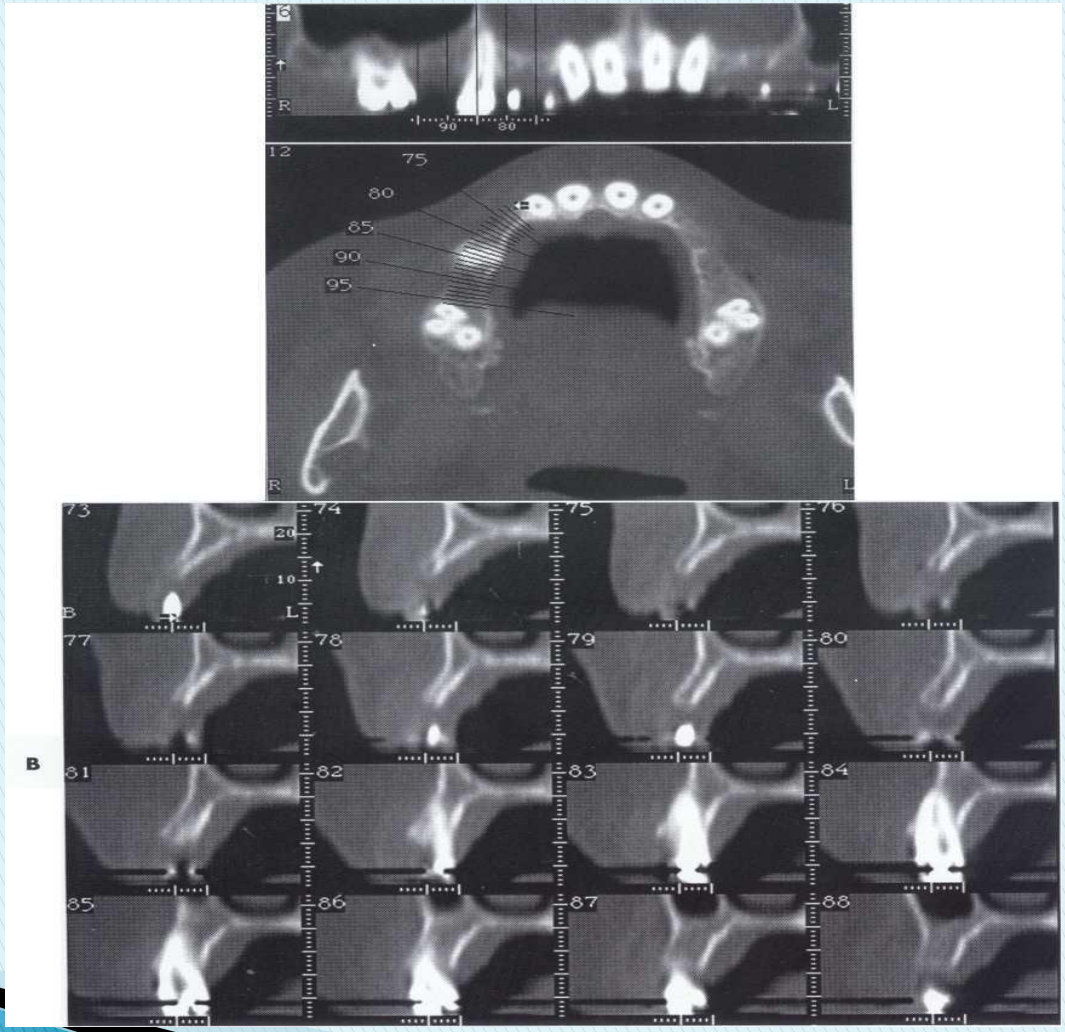
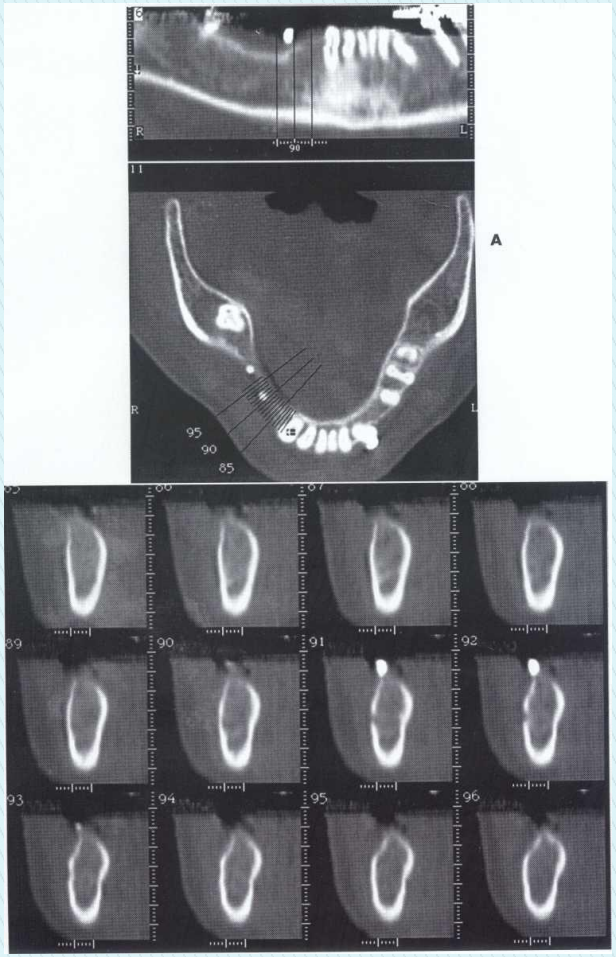


FIG. **32-13** Reformatted axial, coronal, and sagittal cone-beam CT images to assess the viability of an osseous graft before implant placement.

Reformatted CT study of maxilla using 3D soft ware :



Reformatted CT study of mandible using 3D soft ware :



Reformatted multi detector CT:

Advantage:

Evaluation of all possible sites

No superimposition

Uniform magnification

Measurement accurate within 1mm

Estimate internal bone density

Simulate placement with software

Disadvantage:

- Limited availability
- Sensitive to technique errors
- Some metallic image artifacts
- Special training for interpretation
- higher cost & radiation exposure
- Volume averaging contributes to measurement error

Application:

- M,E,A

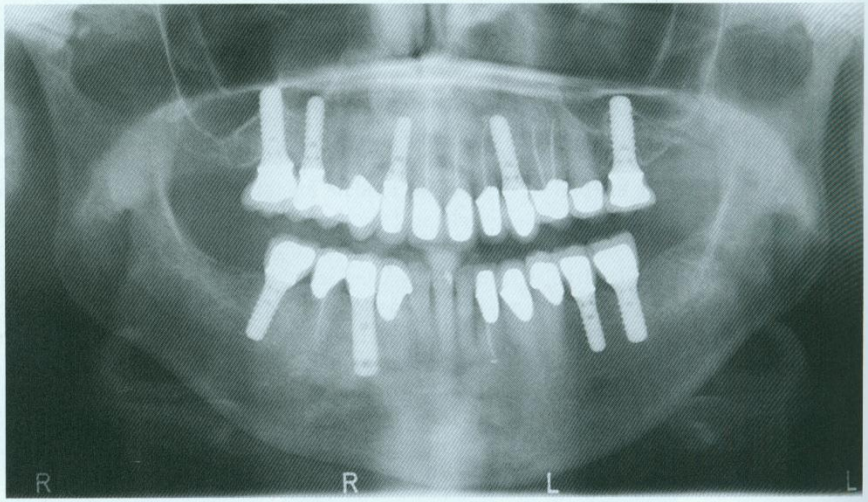


FIG. **32-14** A panoramic radiograph used for postoperative assessment of multiple successfully restored rootform implants. The threads are visualized on all of the implants except for the mandibular right premolar, which is a smooth cylinder.

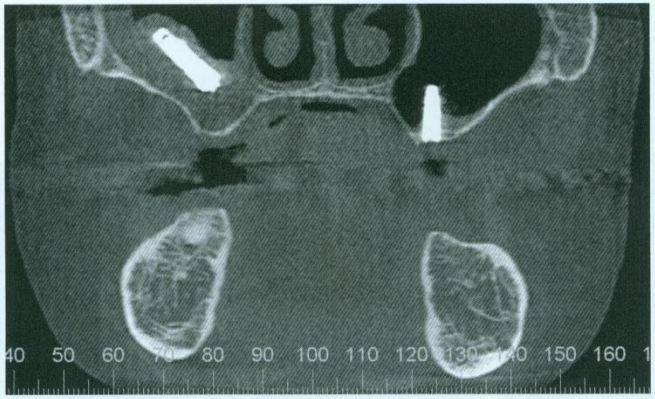


FIG. **32-15** Reformatted cone-beam CT study for postoperative assessment of an implant cylinder displaced into the right maxillary sinus, associated with mucositis in the right antrum. The implant on the left alveolus is not well supported by bone and extends well into the antrum. (Courtesy Oral and Maxillofacial Imaging Center, Baylor College of Dentistry, Dallas, Tex.)

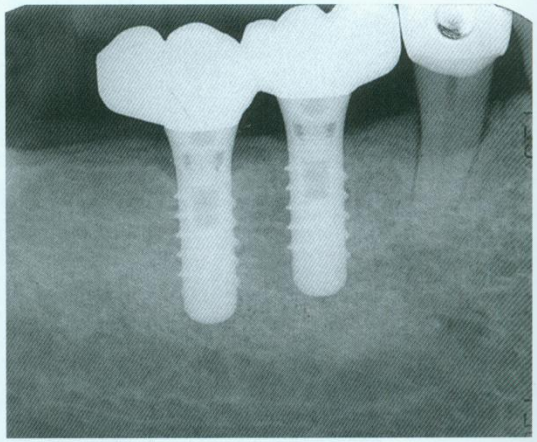
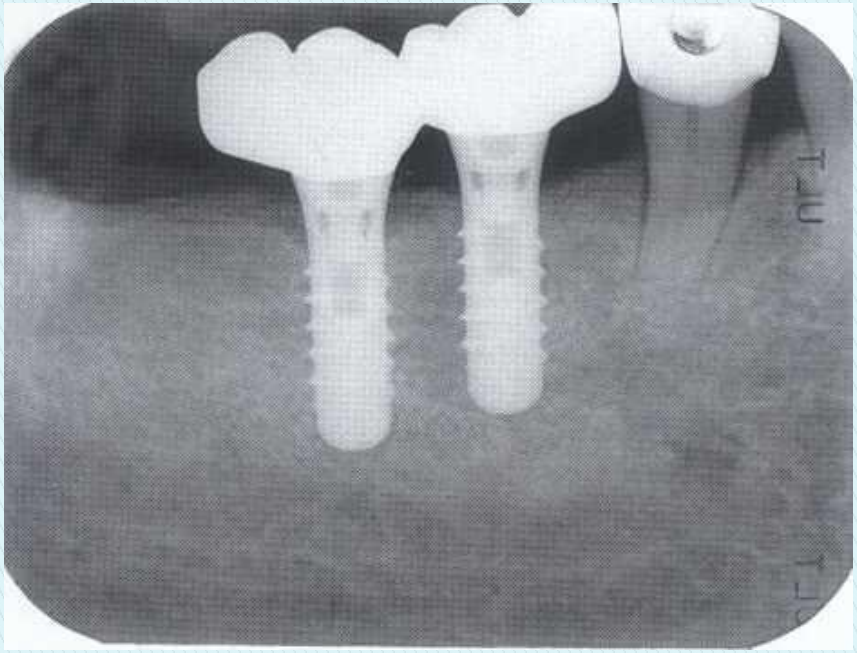


FIG. **32-16** A periapical radiograph of two successful dental implants. Note the close apposition of the bone to the surface of each implant. A minor amount of saucerization is present at the alveolar crest adjacent to the distal fixture.



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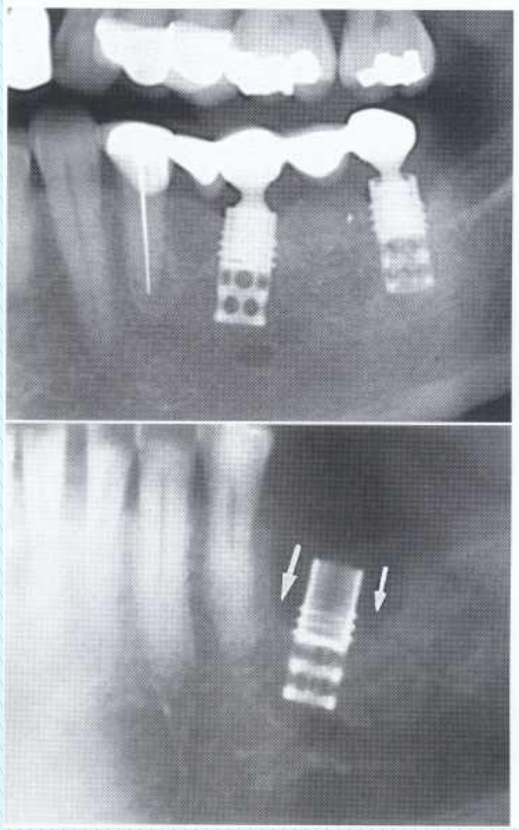
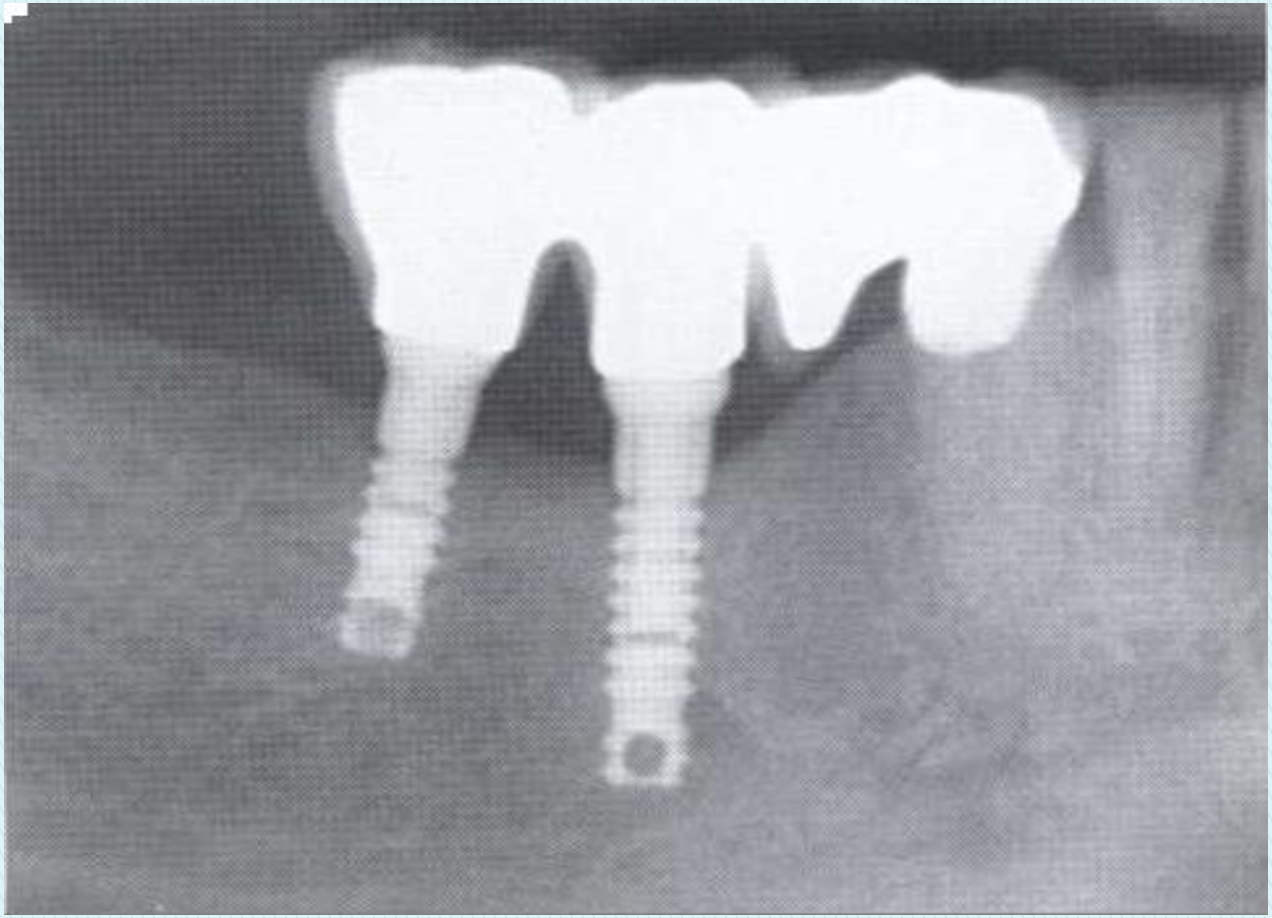
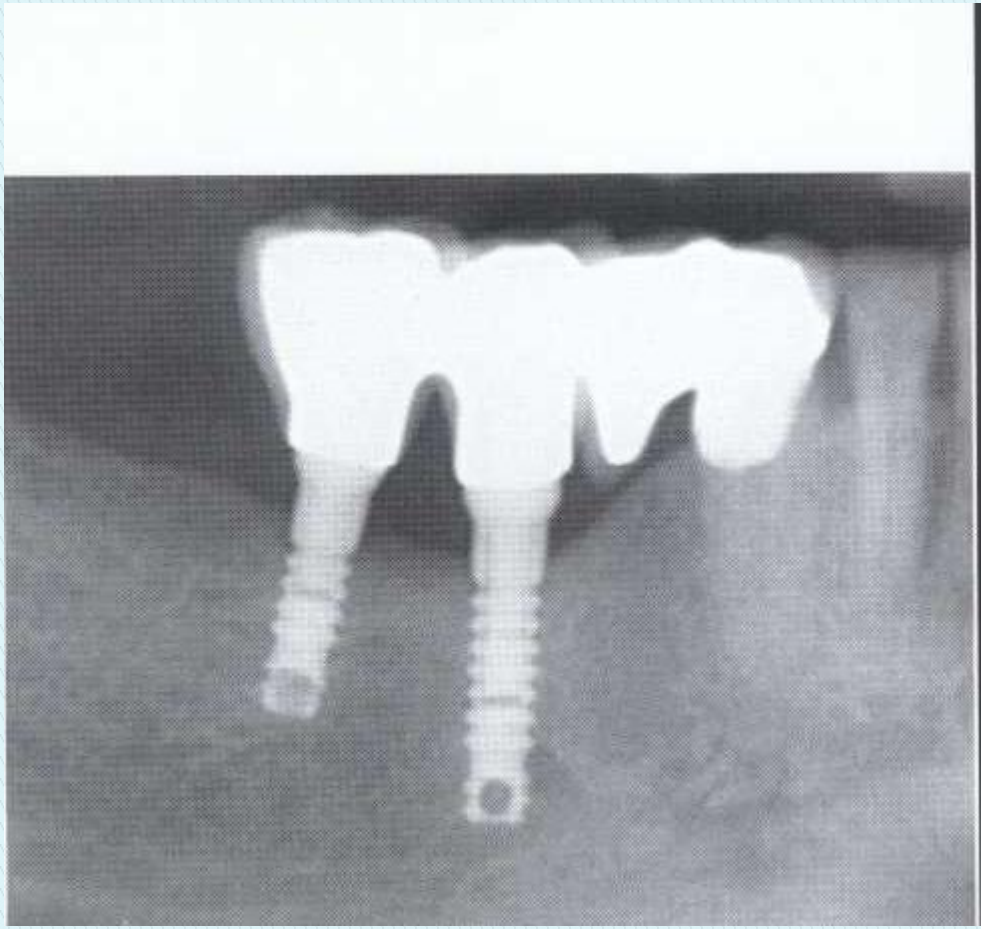
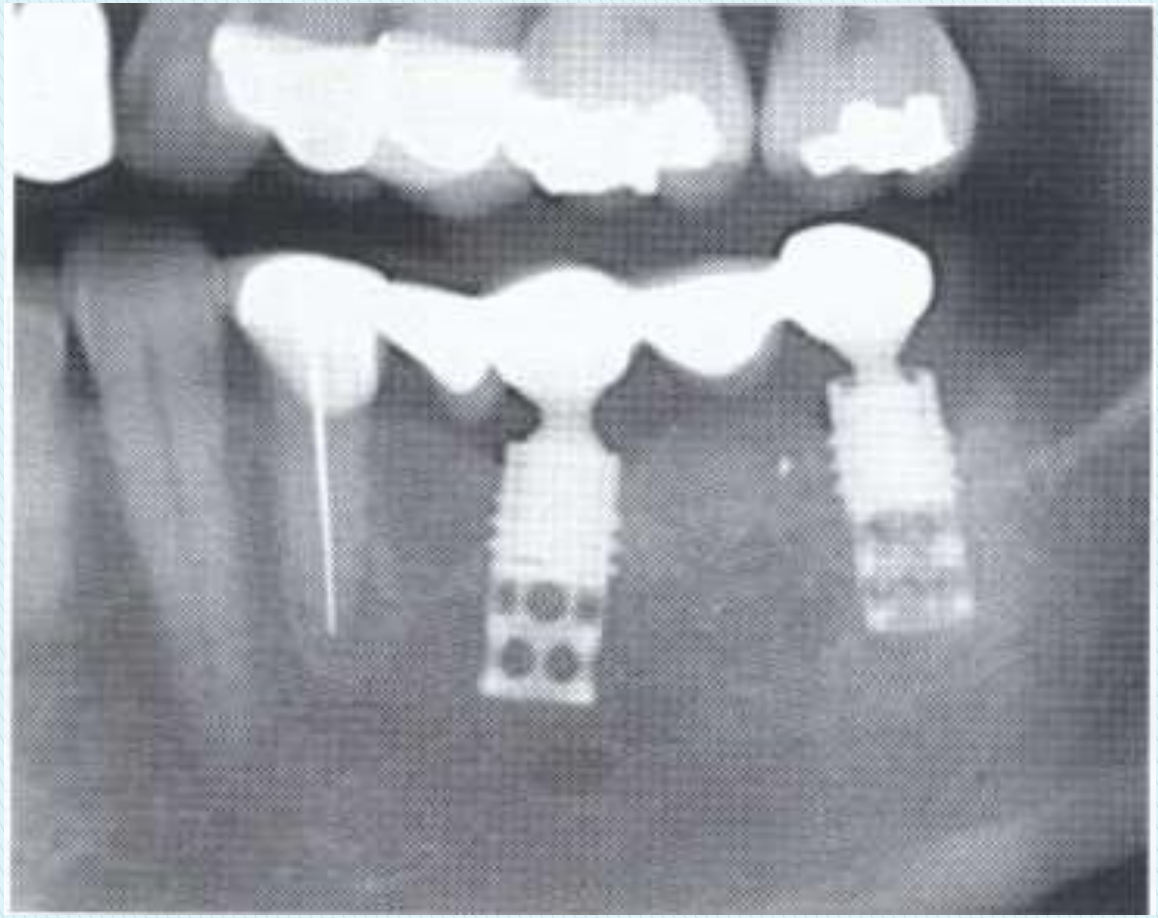


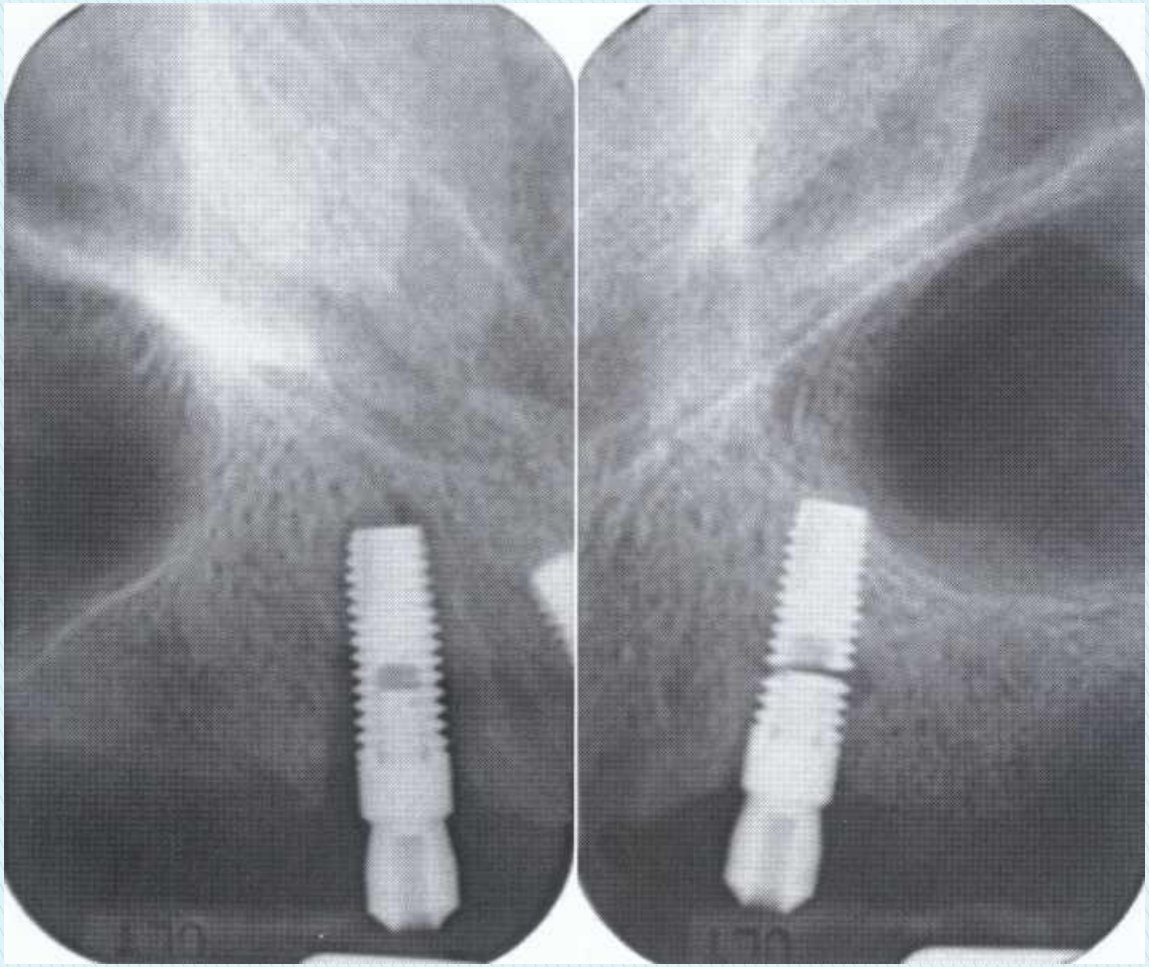
A, Periapical radiograph of marginal bone loss ("saucerization" type) around the cervical region of a rootform dental implant. B, Marginal bone loss around the cervical region of a root-form dental implant



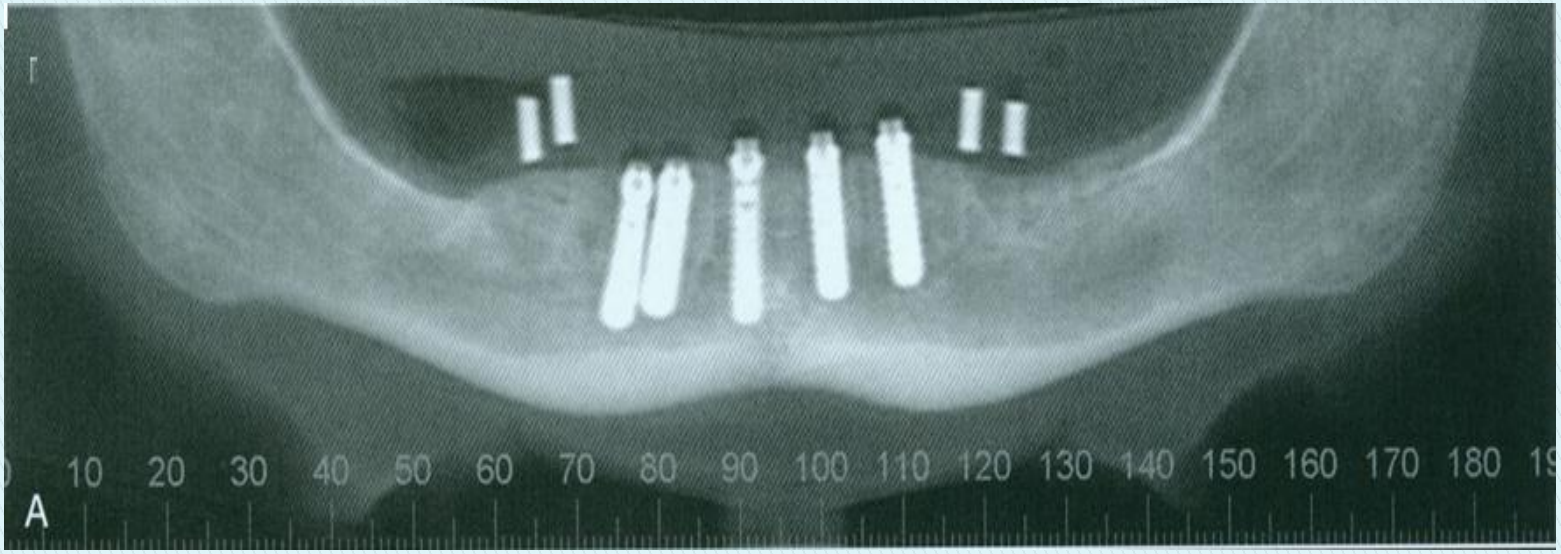


A, Panoramic image demonstrating an apparently successful implant placement. B, Conventional tomogram of the distal implant reveals perforation of the lingual cortical plate of the mandible and encroachment on the submandibular gland fossa





A, Periapical radiographs of perifixtural bone loss around a root-form dental implant, indicating failure of osseous integration.
B, Periapical views of a fractured endosseous implant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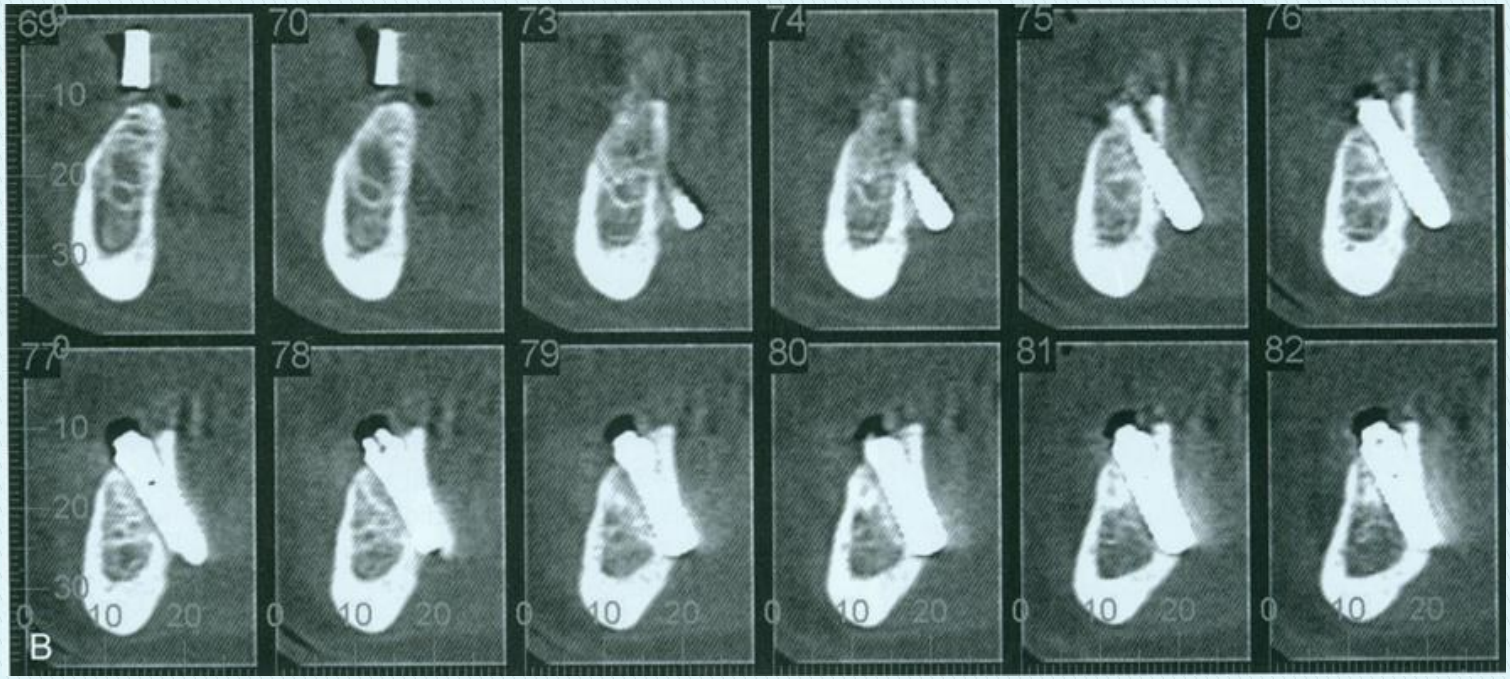
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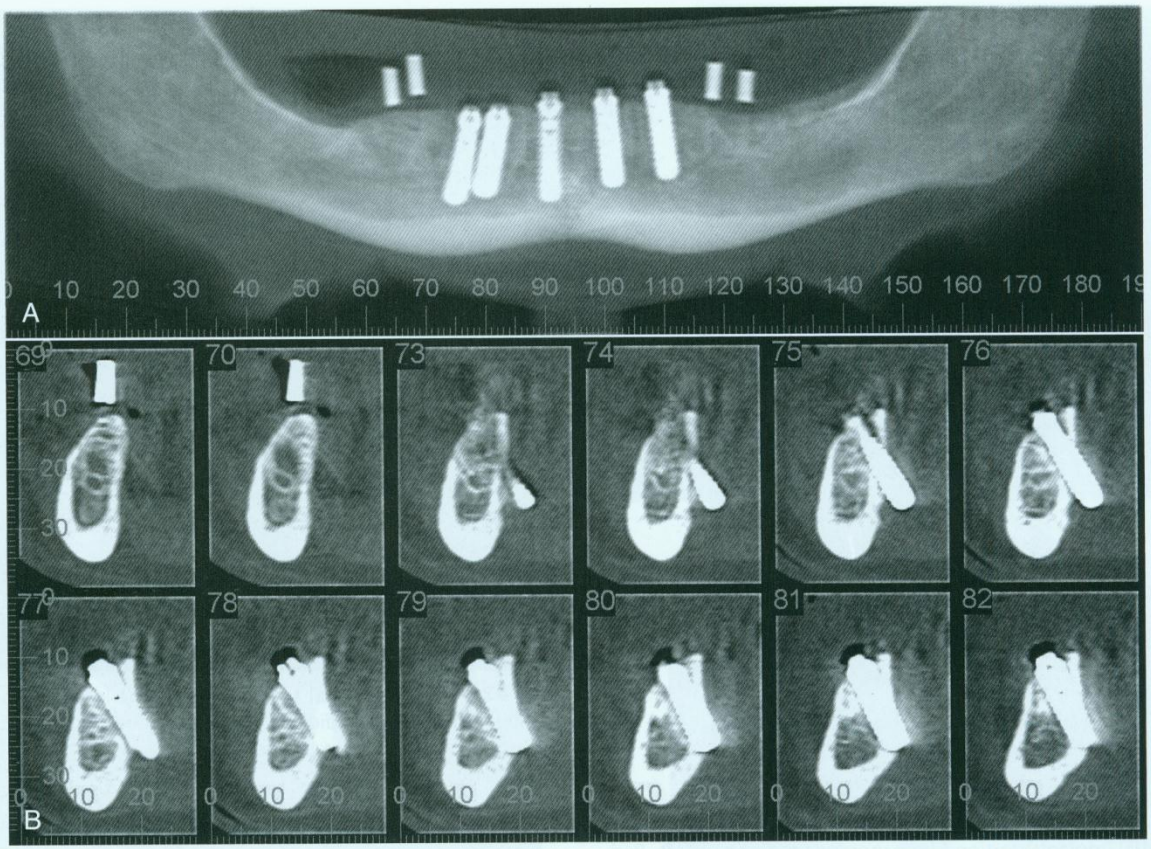
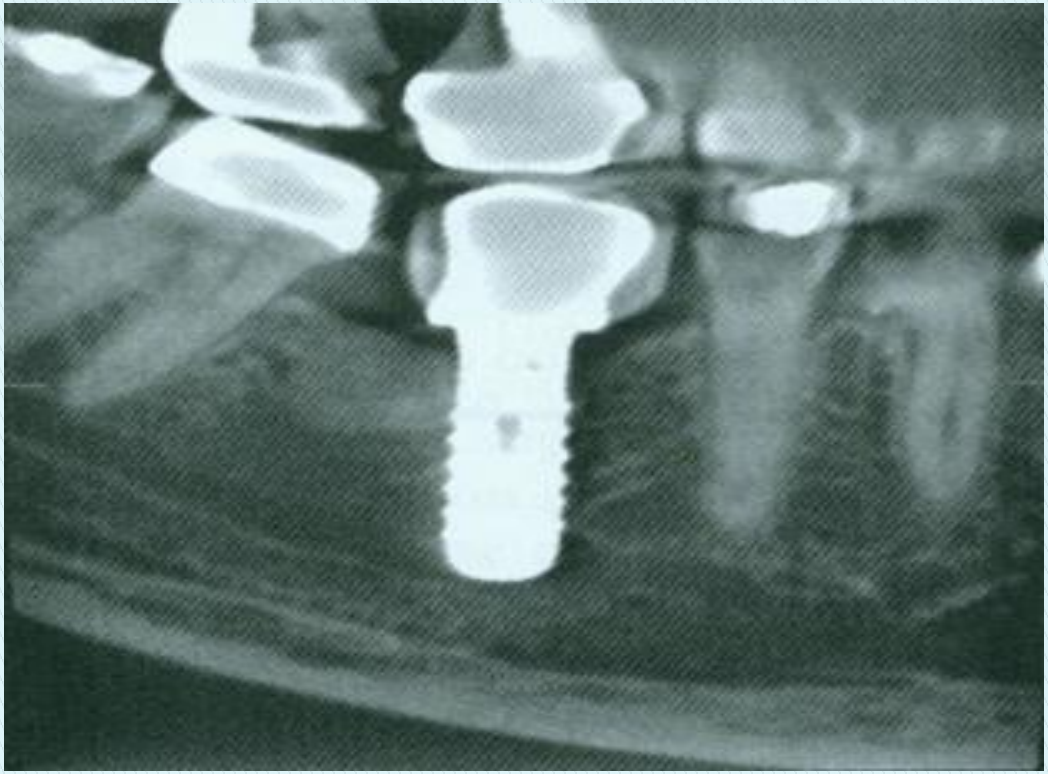
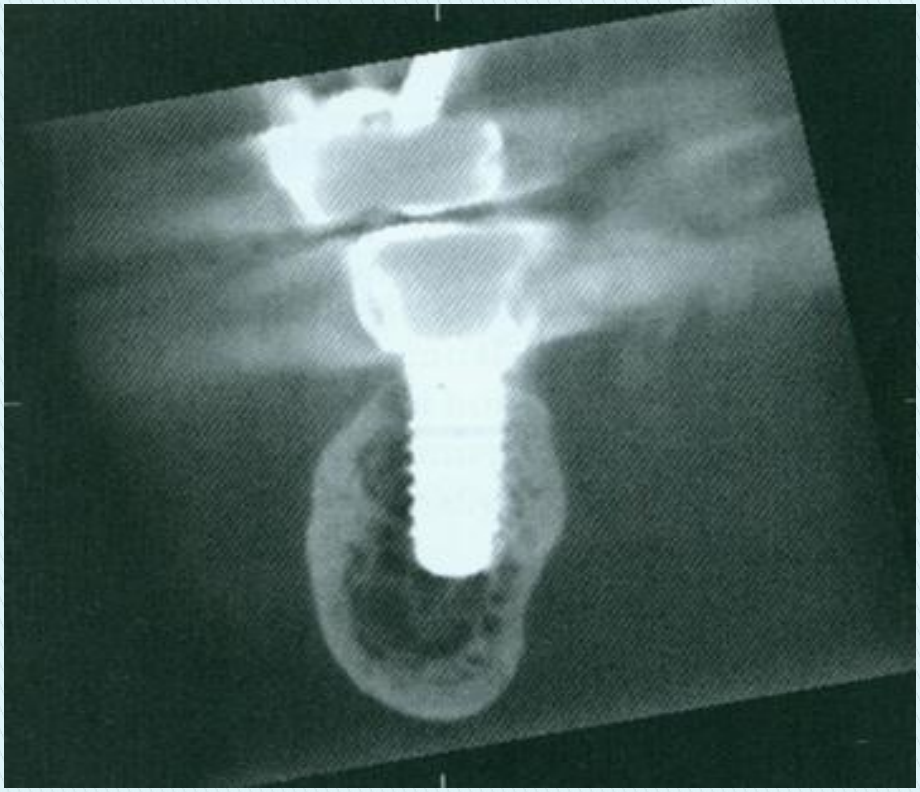


FIG. **32-19** **A,** Panoramic-like curved linear reformatted cone-beam CT (CBCT) image initially made for implant planning. In this image, the existing implants appear reasonably normal in orientation. **B,** The cross-sectional reformatted CBCT images reveal nonrestorable ectopic placement of the existing implants with lingual cortical perforation and extension into the lingual tissues. (Courtesy Oral and Maxillofacial Imaging Center, Baylor College of Dentistry, Dallas, Tex.)





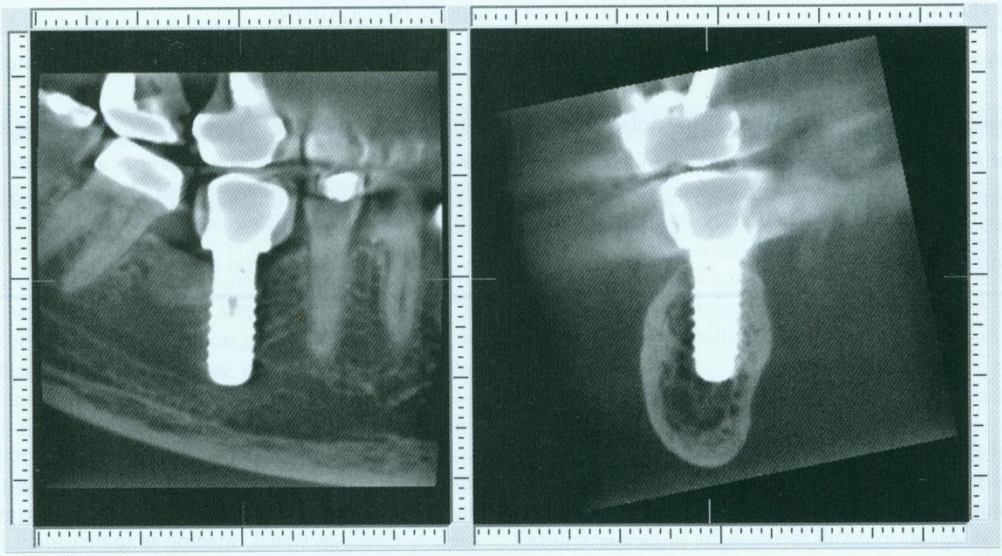


FIG. **32-20** Reformatted cone-beam CT images of a symptomatic patient reveal embarrassment and compression of the mandibular canal by the implant.

TABLE **30-3**

Radiographic Signs Associated with Failing Endosseous Implants

RADIOGRAPHIC APPEARANCE	CLINICAL IMPLICATIONS
Thin radiolucent area that closely follows the entire outline of the implant	Failure of the implant to integrate with adjoining bone
Radiolucent area around the coronal portion of the implant	Periimplantitis resulting from poor plaque control, adverse loading, or both
Apical migration of alveolar bone on one side of the implant	Nonaxial loading resulting from improper angulation of the implant
Widening of the periodontal ligament space of the nearest natural abutment	Poor stress distribution resulting from biomechanically inadequate prosthesis-implant system
Fracture of the fixture	Unfavorable stress distribution during function

CBCT

- **Advantage:**

Locate and determind the distance to vital anatomic structures

Measure alveolar bone width and visualize bone contours

Determine if a bone graft or sinus lift is needed

Select the most suitable implant size and type

Optimize the implant location and angulation

Increased case acceptance

Reduced surgery time

Build patient confidence

Cone-beam Units

NewTom 3G by AFP

Galileos by Sirona

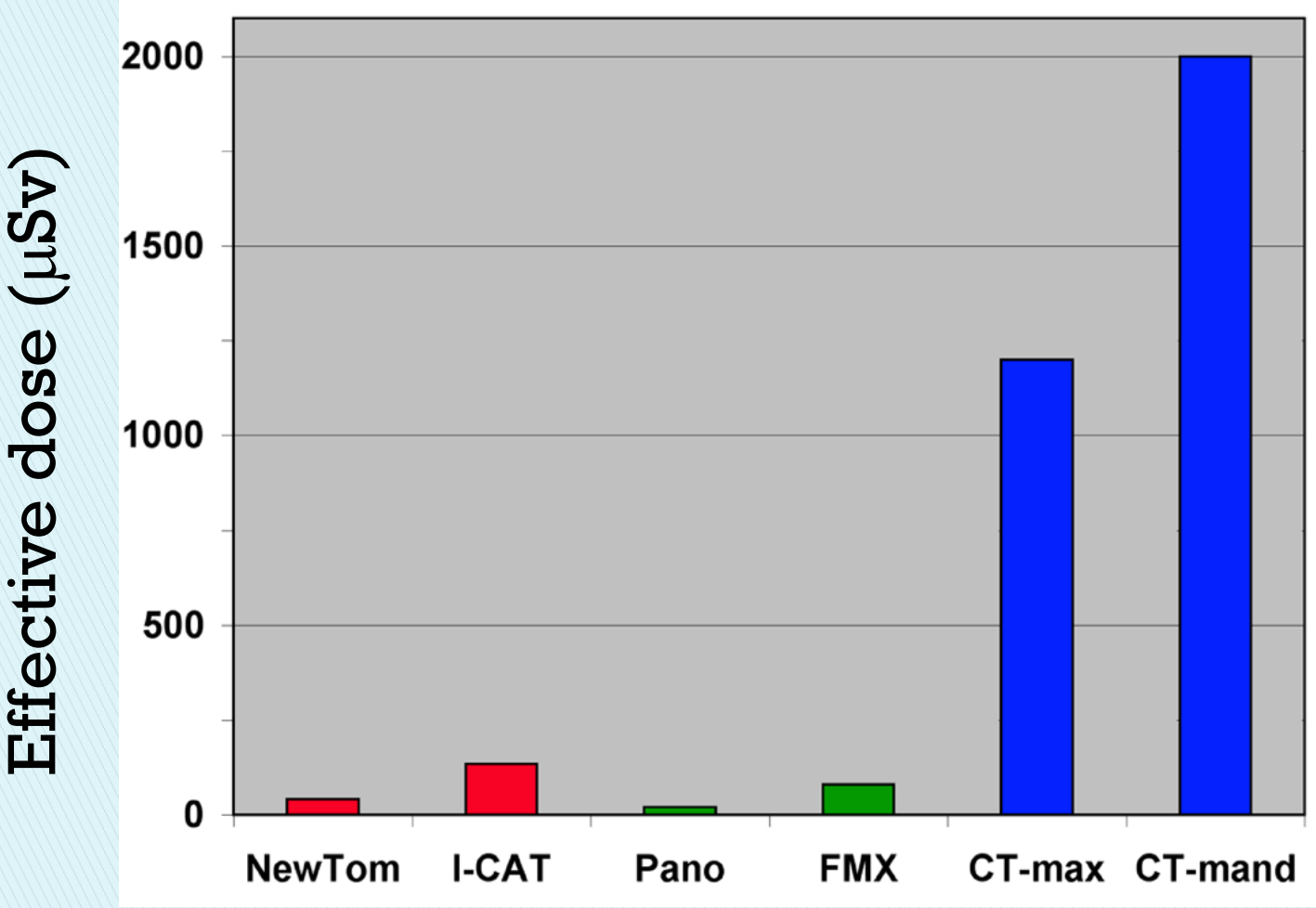
MercuRay by Hitachi

I-CAT by ISI

3D Accuitomo
by J. Morita

Iluma by IMTEC

Comparative Dosimetry



Source; Stuart White- UCLA School of Dentistry

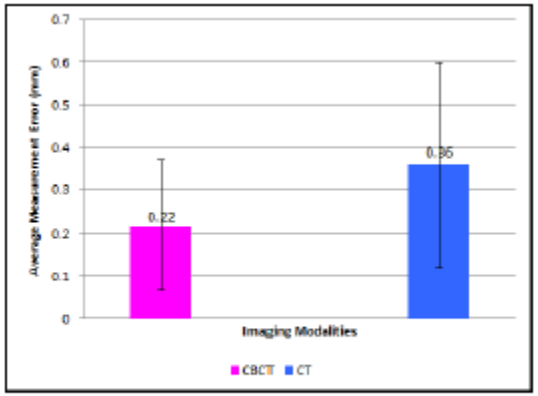


Figure 1. Average measurement error (mm) for distance measurement between cbCT and CT images.

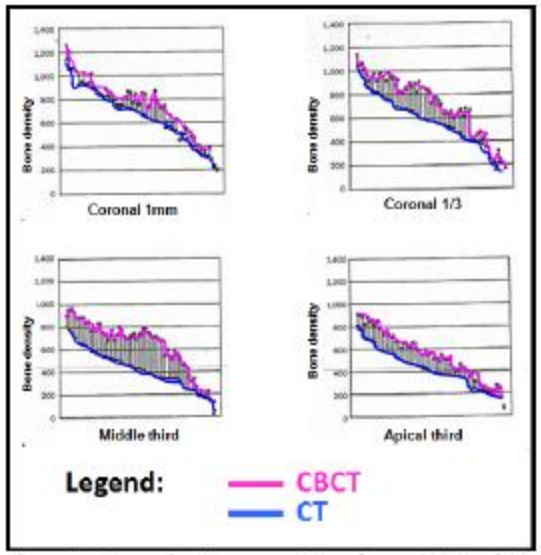


Figure 2. Bone density comparison from cbCT and CT images.

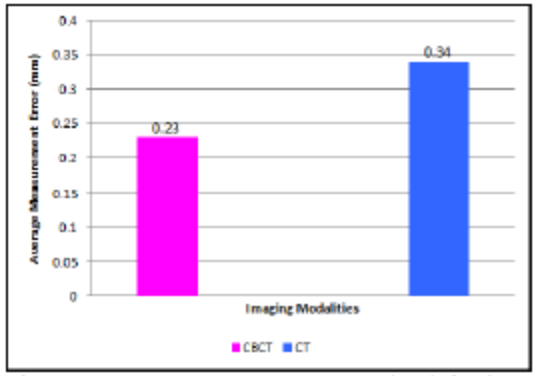


Figure 3. Average measurement error (mm) for bone width measurement between cbCT and CT images.

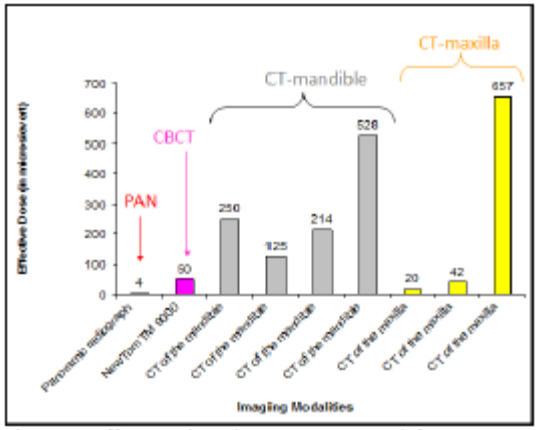


Figure 4. Effective dose (E; in microsievert) from various oral maxillofacial imaging examinations.

width measurement between CBCT and CT images.