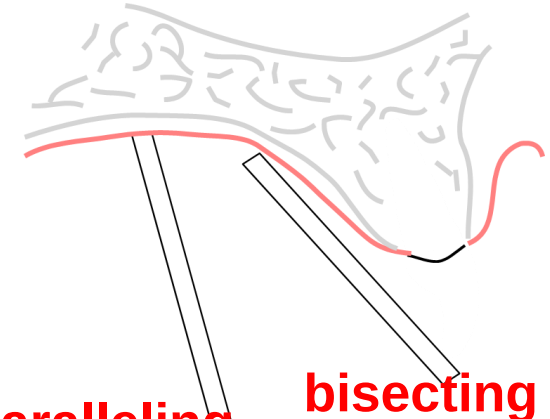
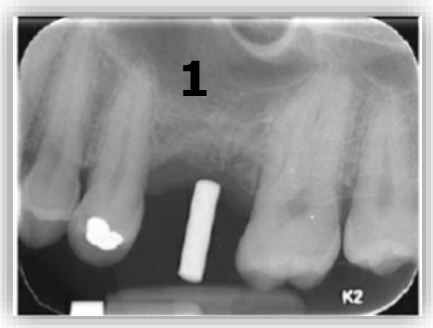
TABLE 15.1
Commonly Used Imaging Techniques for Implant Placement

- Periapical imaging
- Panoramic imaging
- CBCT imaging

Imaging Technique	Advantages	Disadvantages	Recommendation
Periapical imaging	• Readily available • High resolution • Minimal distortion • Lowest financial cost and radiation exposure	• Restricted anatomic coverage • Cannot assess buccolingual dimension • Subject to elongation and foreshortening • Anatomic superimposition • Difficult to reproduce projection geometry • May be limited by patient compliance and anatomy	• Initial assessment of single edentulous space or short edentulous span • Intraoperative imaging during implant placement • Initial postoperative radiograph and recall imaging





Elongation →

← Foreshortenning

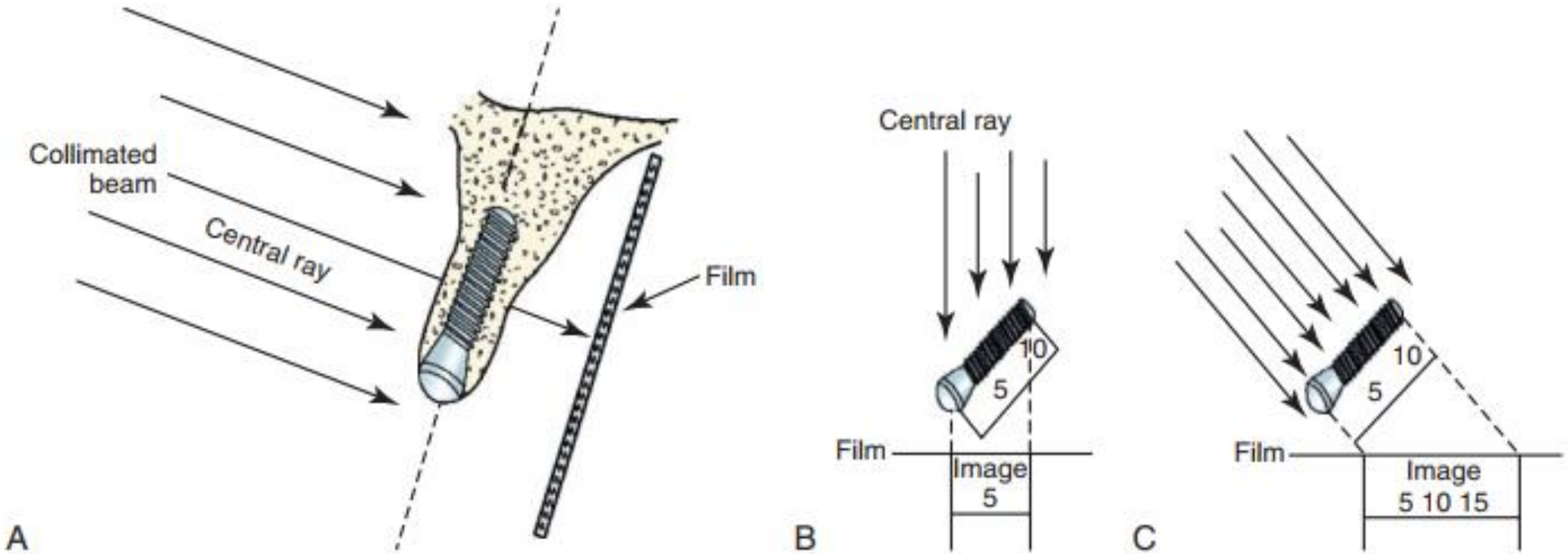
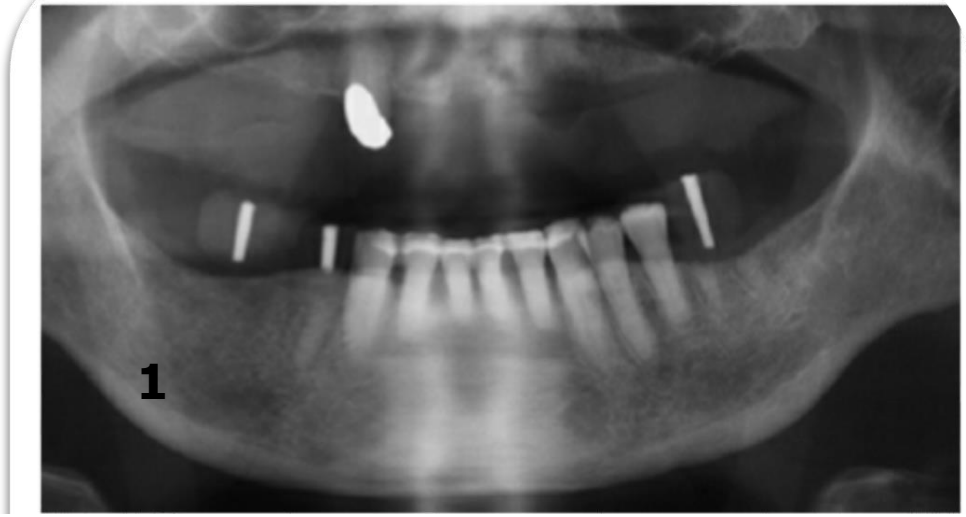
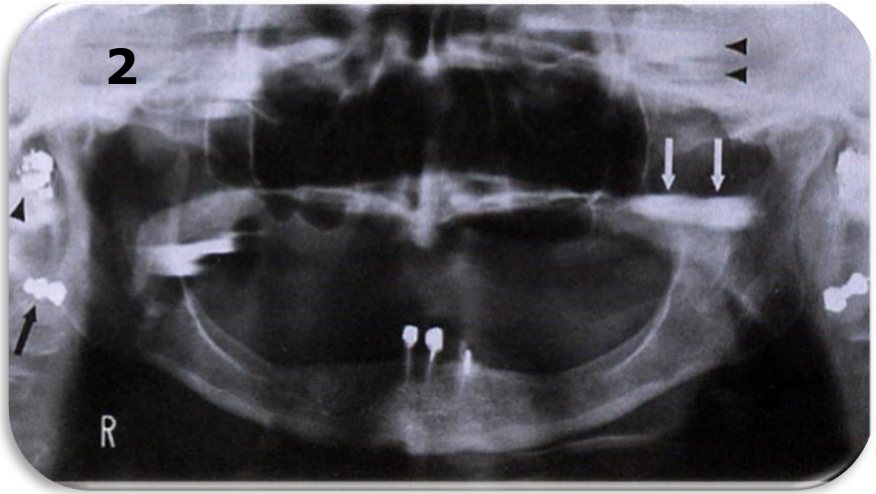


FIG 4.1 Film positioning. (A) The central ray is perpendicular to the bone, object, and film, resulting in no distortion. (B) The central ray is perpendicular to the film, but not to the implant, resulting in foreshortening. (C) The central ray is perpendicular to the object, but not the film, resulting in elongation. (From Misch CE: *Dental implant prosthetics,* ed 2, St. Louis, 2015, Mosby.)

Panoramic imaging	• Readily available • Broad anatomic coverage • Low financial cost and radiation exposure	• Image distortion • Anatomic superimposition and ghost images • Lower	• Initial examination of multiple edentulous spaces • Radiographic follow-up of multiple implants
		• Cannot assess buccolingual dimension • Technique sensitive	





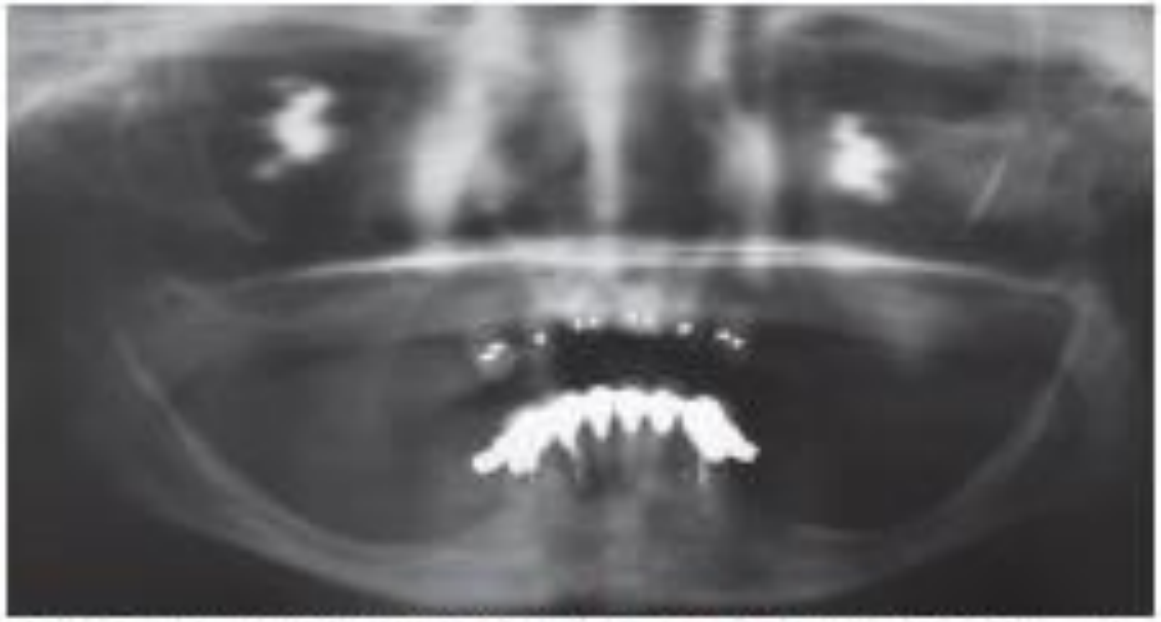


FIG 4.2 All panoramic radiographs exhibit magnification, distortion, overlapping of images, and ghost images, making these images inaccurate as the sole determination for dental implant diagnosis.

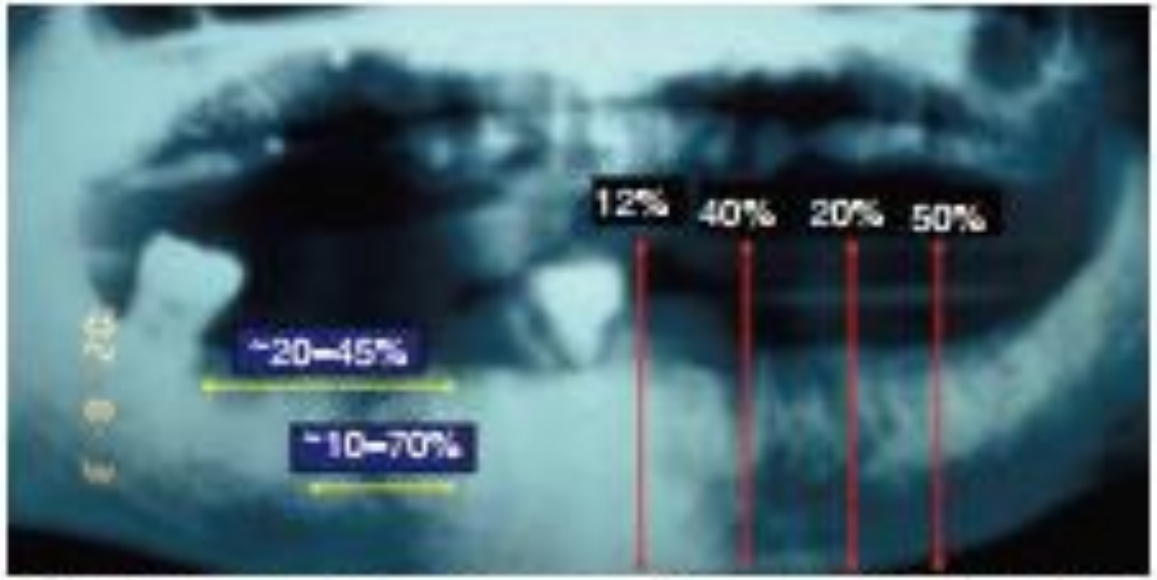
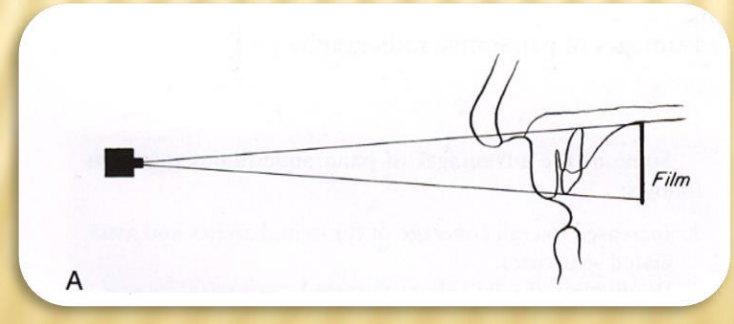
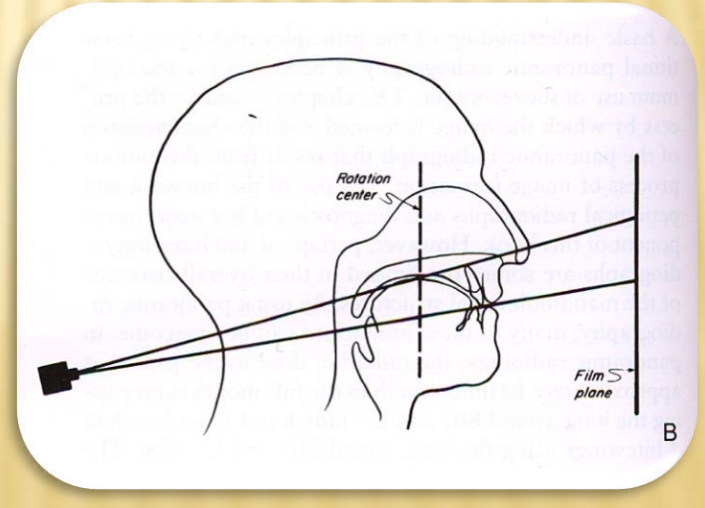
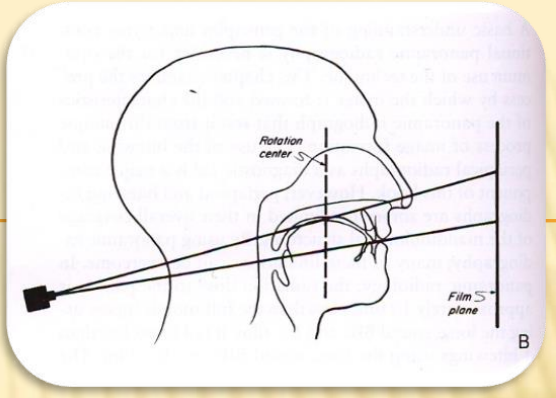
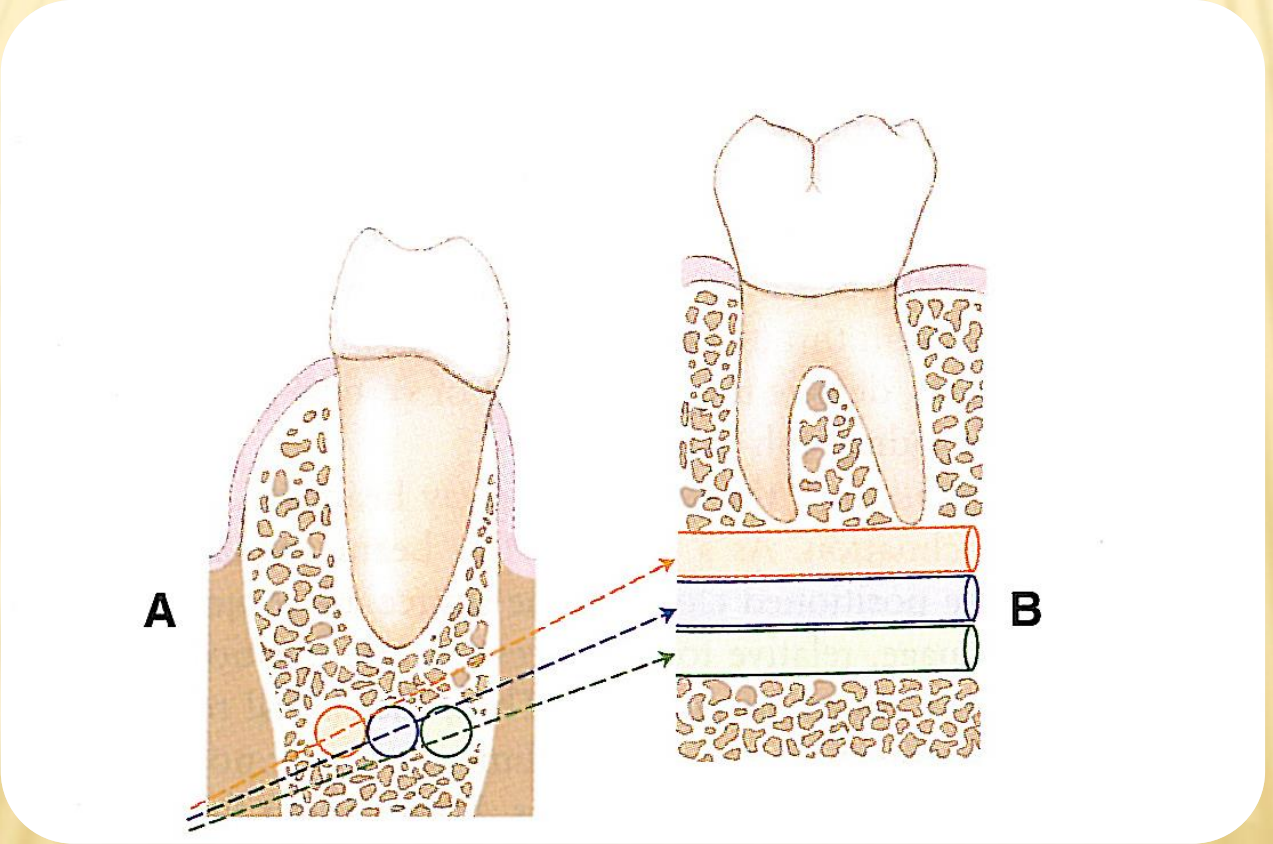


FIG 4.3 Panoramic showing nonuniform magnification in the vertical and horizontal plane depicting inaccurate measurements. Vertical magnification can be determined; however, horizontal magnification is entirely inaccurate.

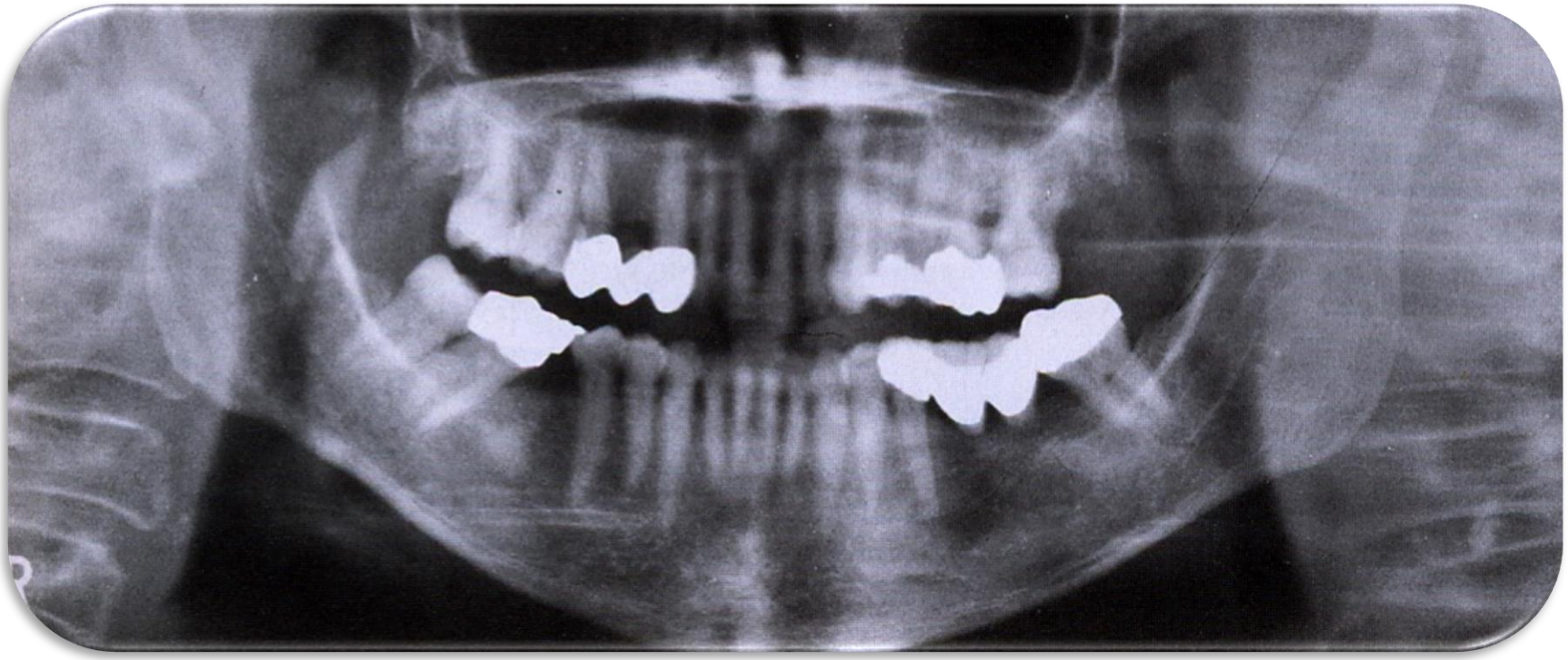

Film
A

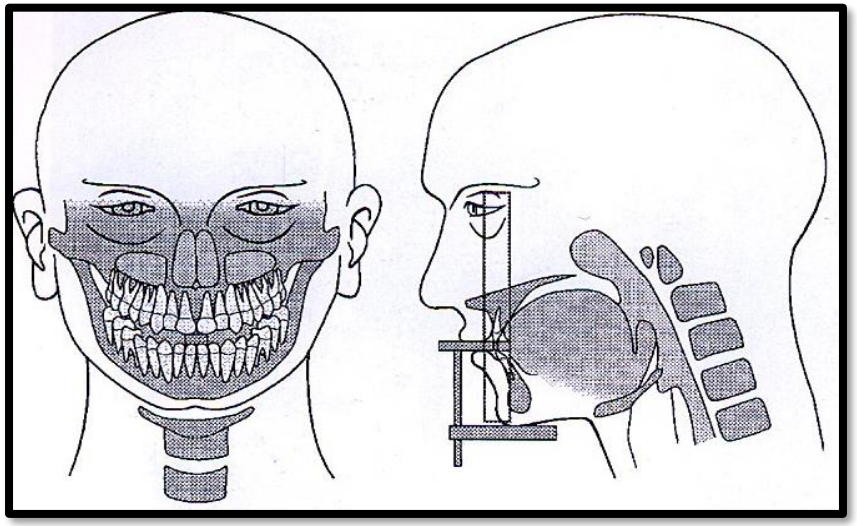

Rotation center
Film plane
B

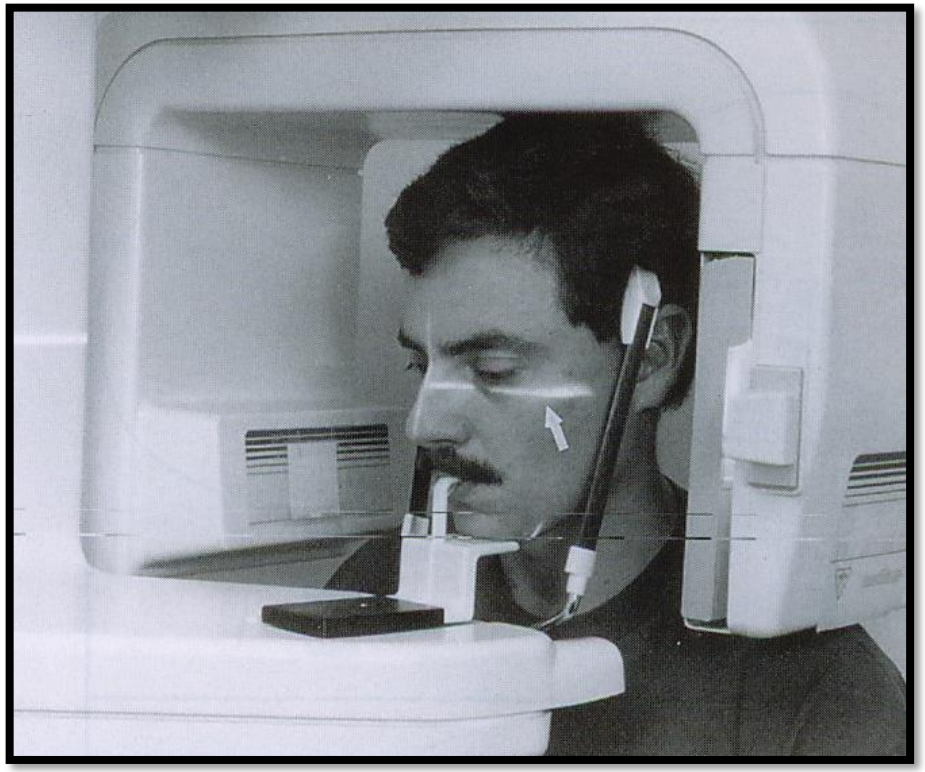

Rotation center
Film plane
B


A
B

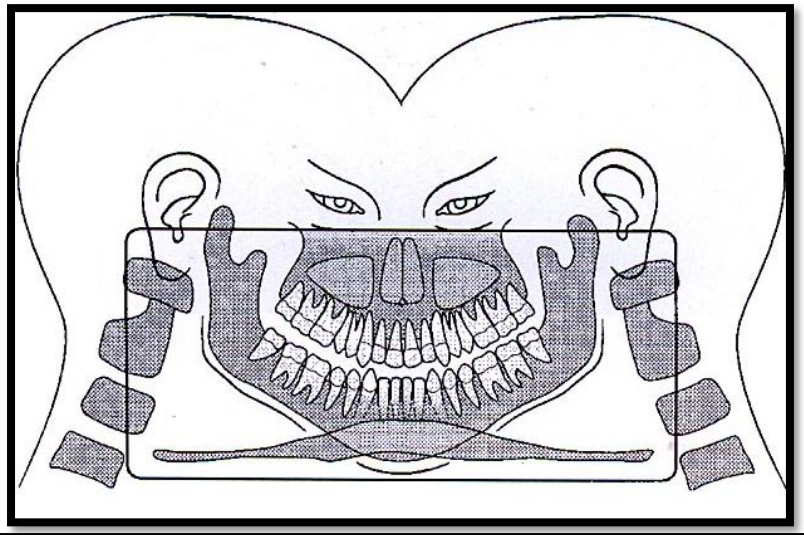
Too far forward

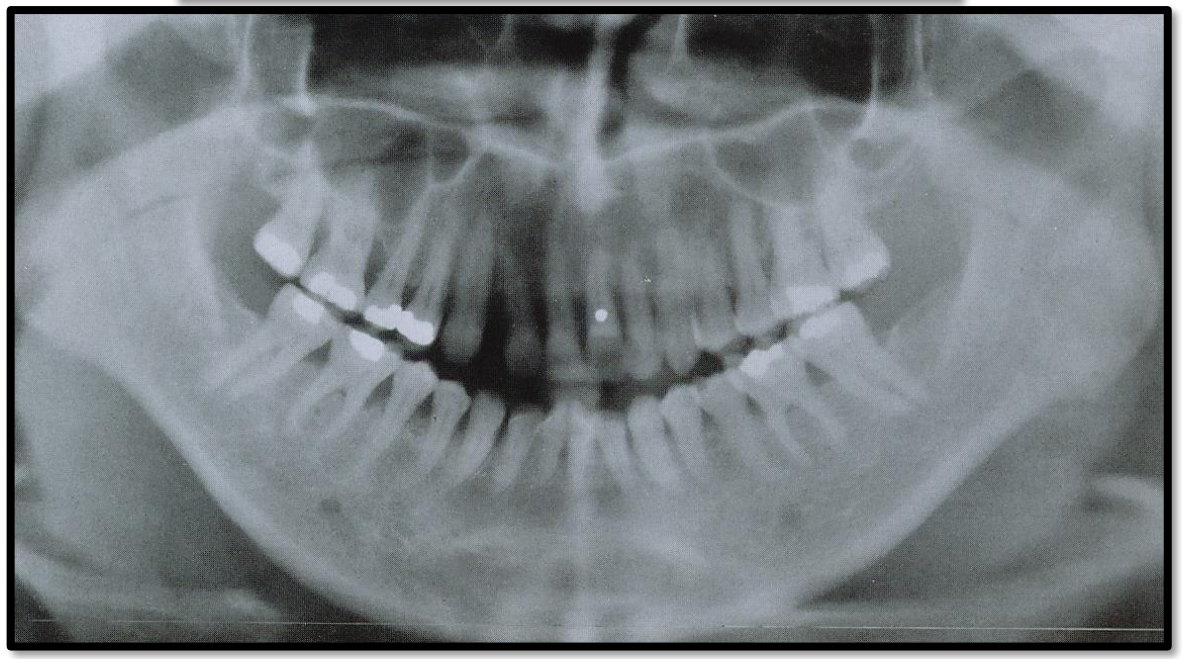


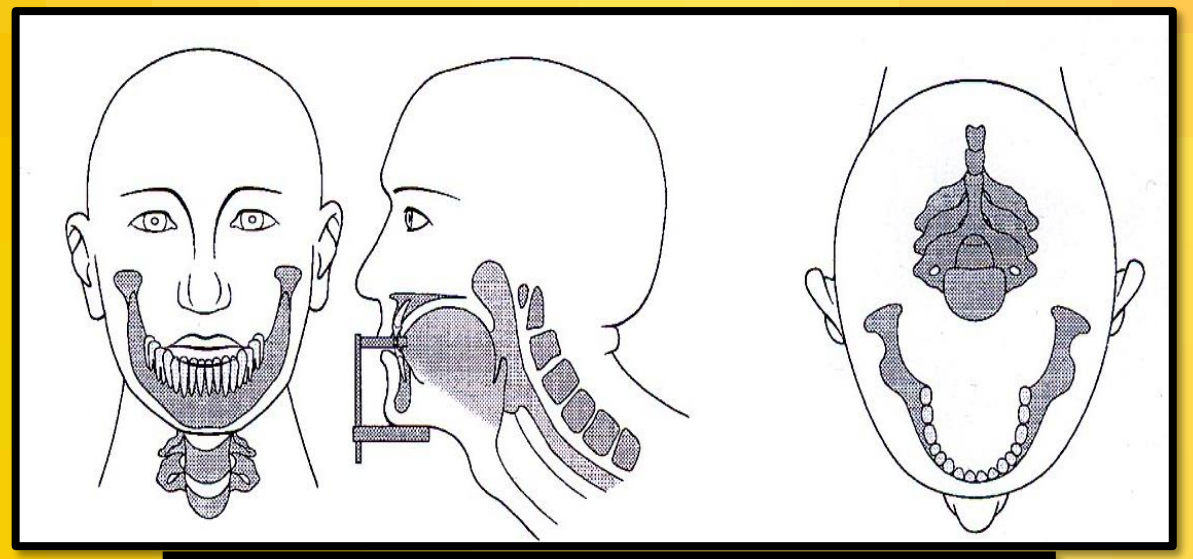




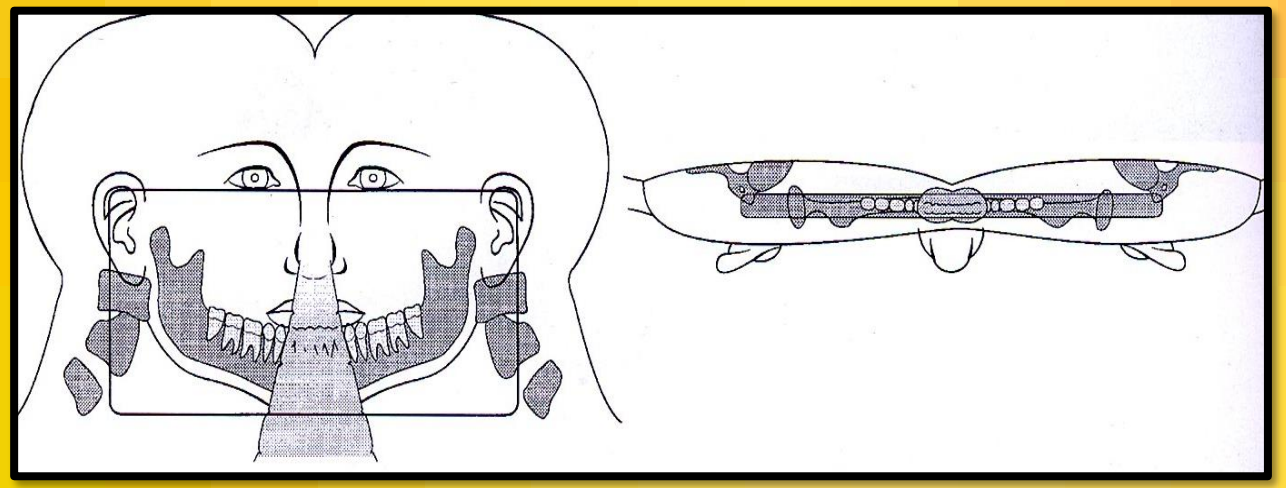
Tipping too low

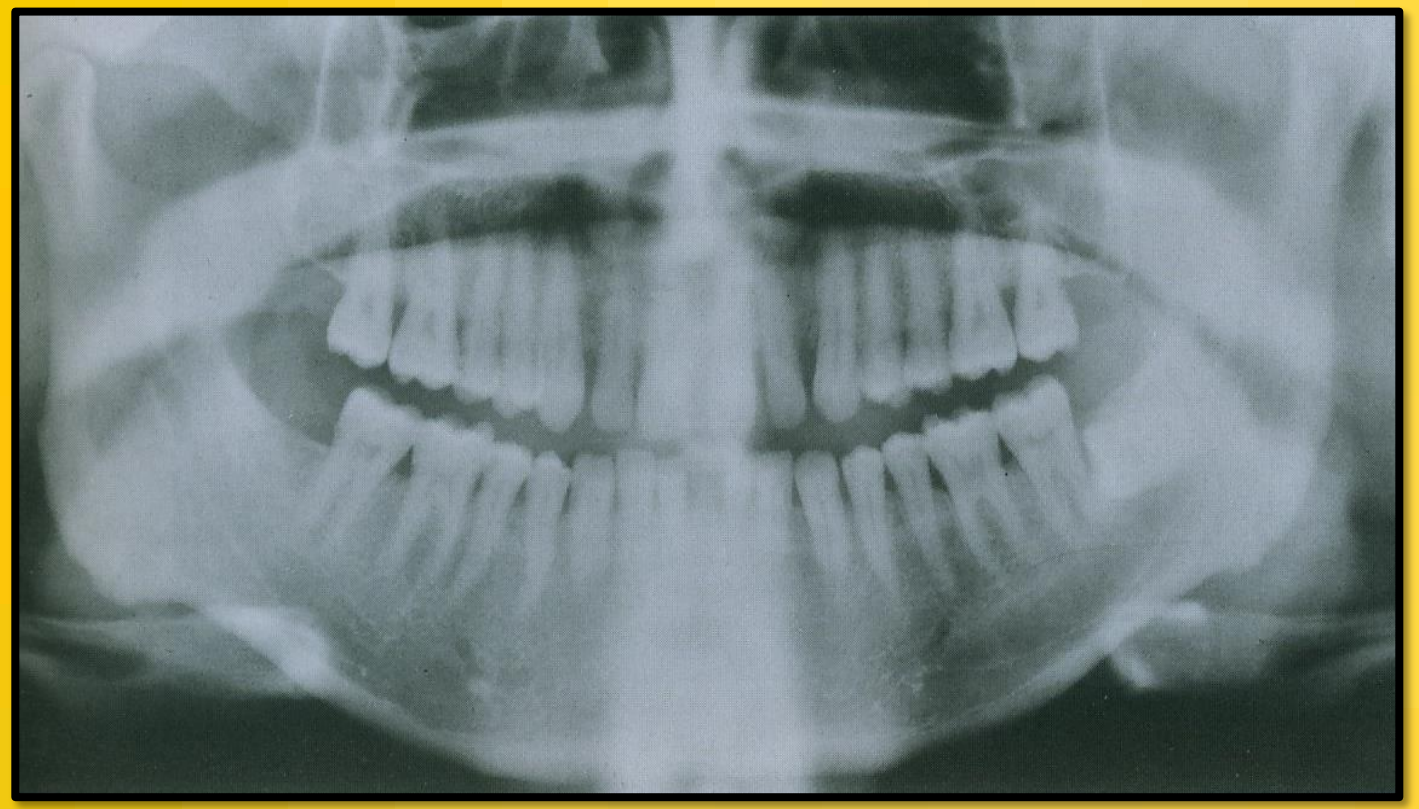




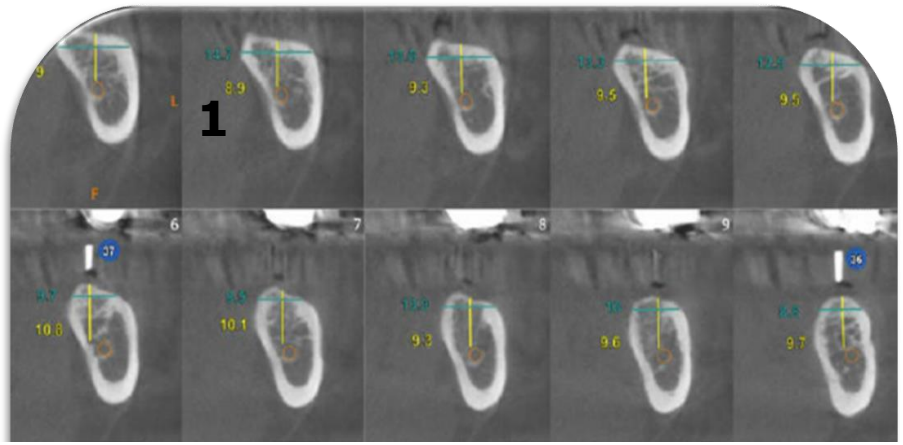


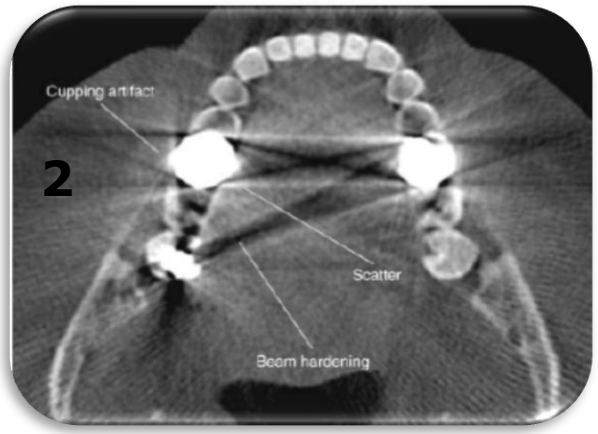
Slumping

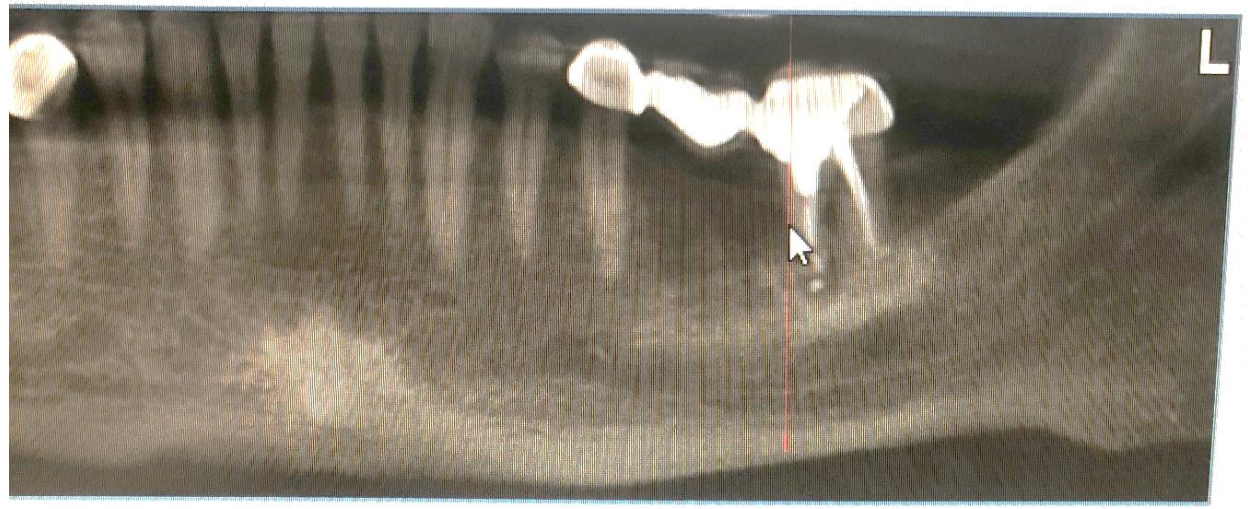




CBCT imaging	• Variable field of view: from single edentulous site to full jaws (manufacturer-dependent) • 3D tomographic imaging: no superimposition • Dimensionally accurate • Increasingly accessible • Simulate implant surgery with specialized software	• Moderate financial cost and radiation exposure • Susceptible to beam hardening artifacts • Technique-sensitive (especially to patient motion) • Special training for interpretation • Not calibrated for bone density measurements (HU) • Poor soft tissue contrast	• Following initial examination, CBCT is recommended for thorough radiologic assessment • Recommended before and after bone augmentation • Postoperatively, recommended for symptomatic implants (implant mobility, altered sensation, displaced implant) • Not appropriate for asymptomatic recall imaging






L

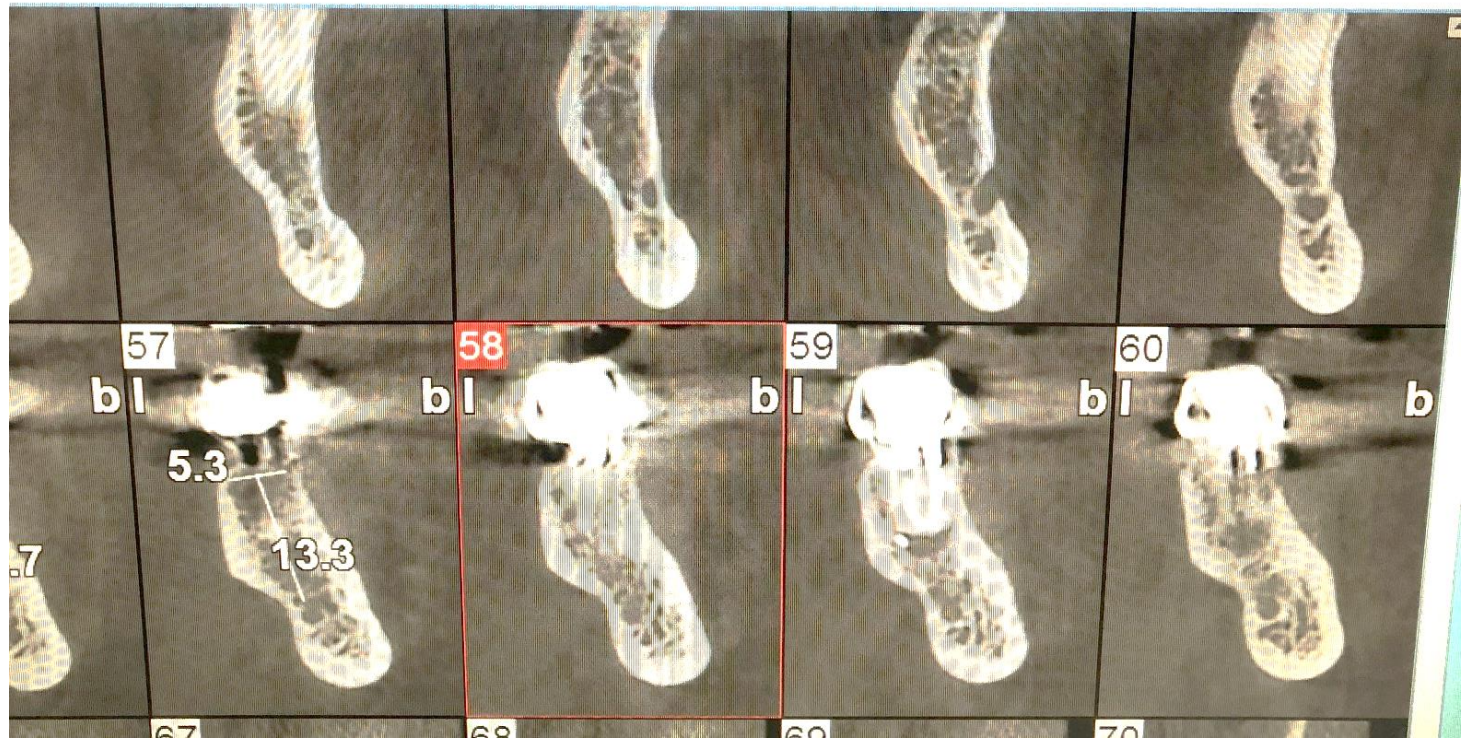
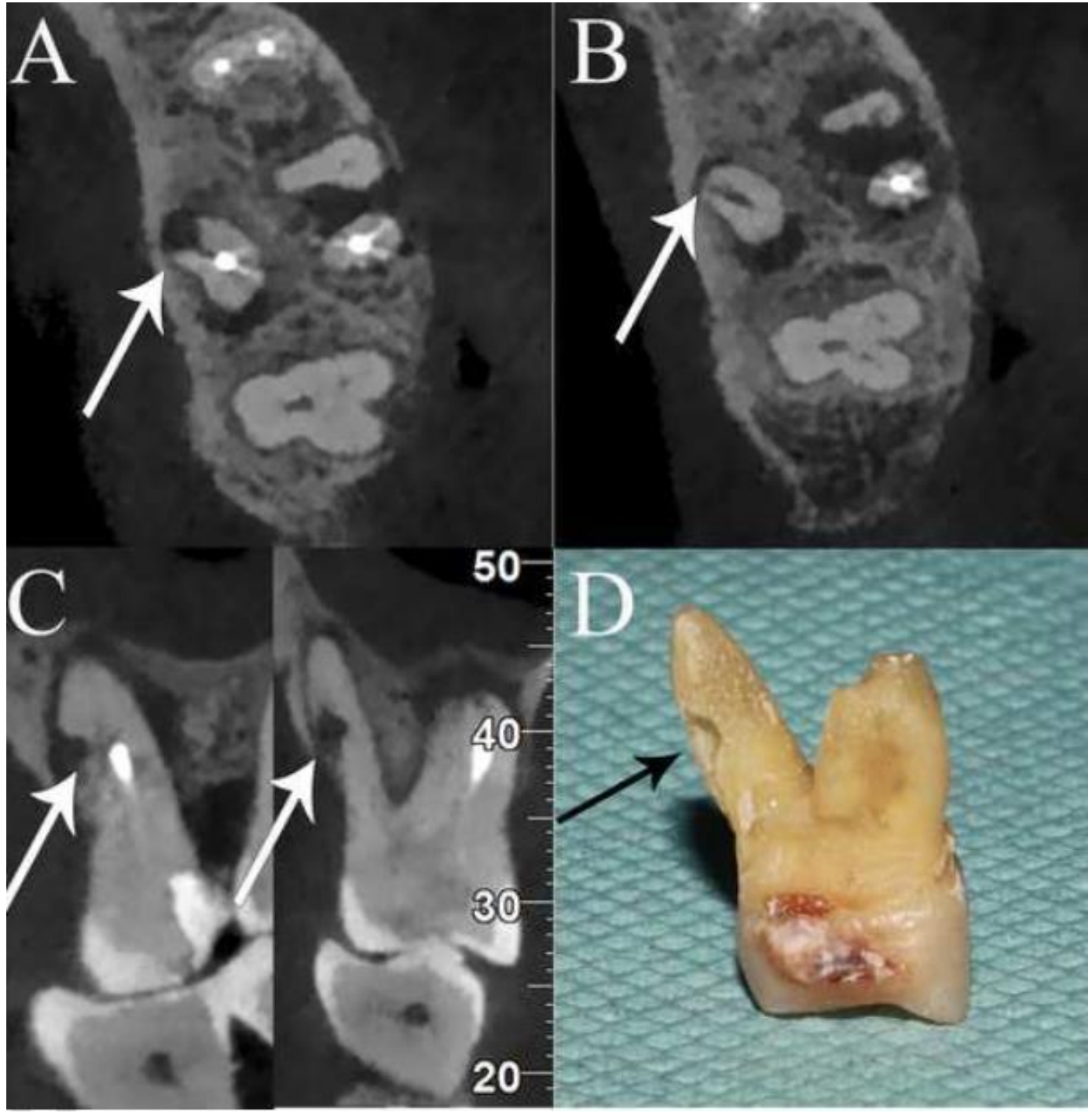
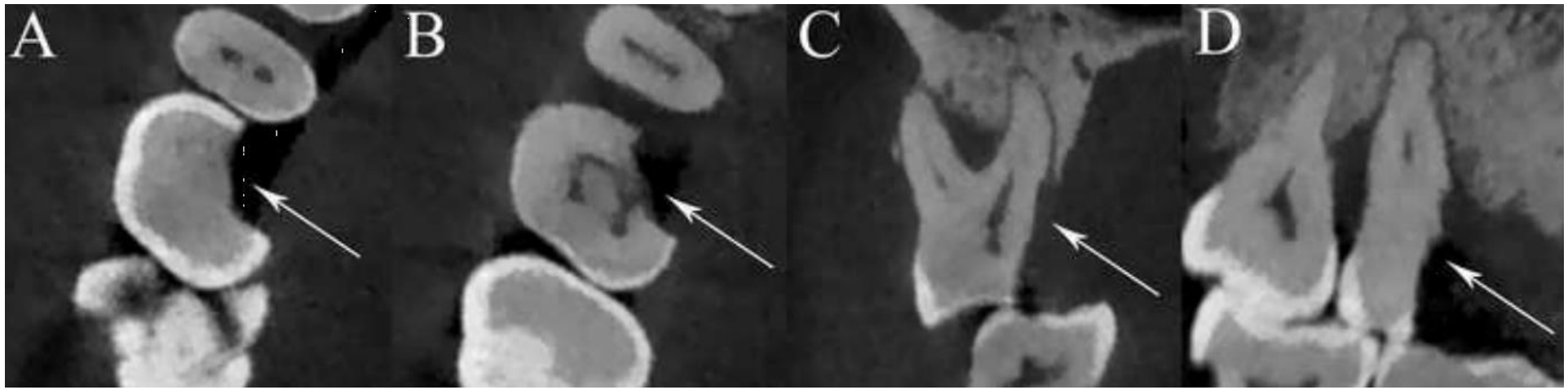

57
58
59
60
b l
5.3
13.3

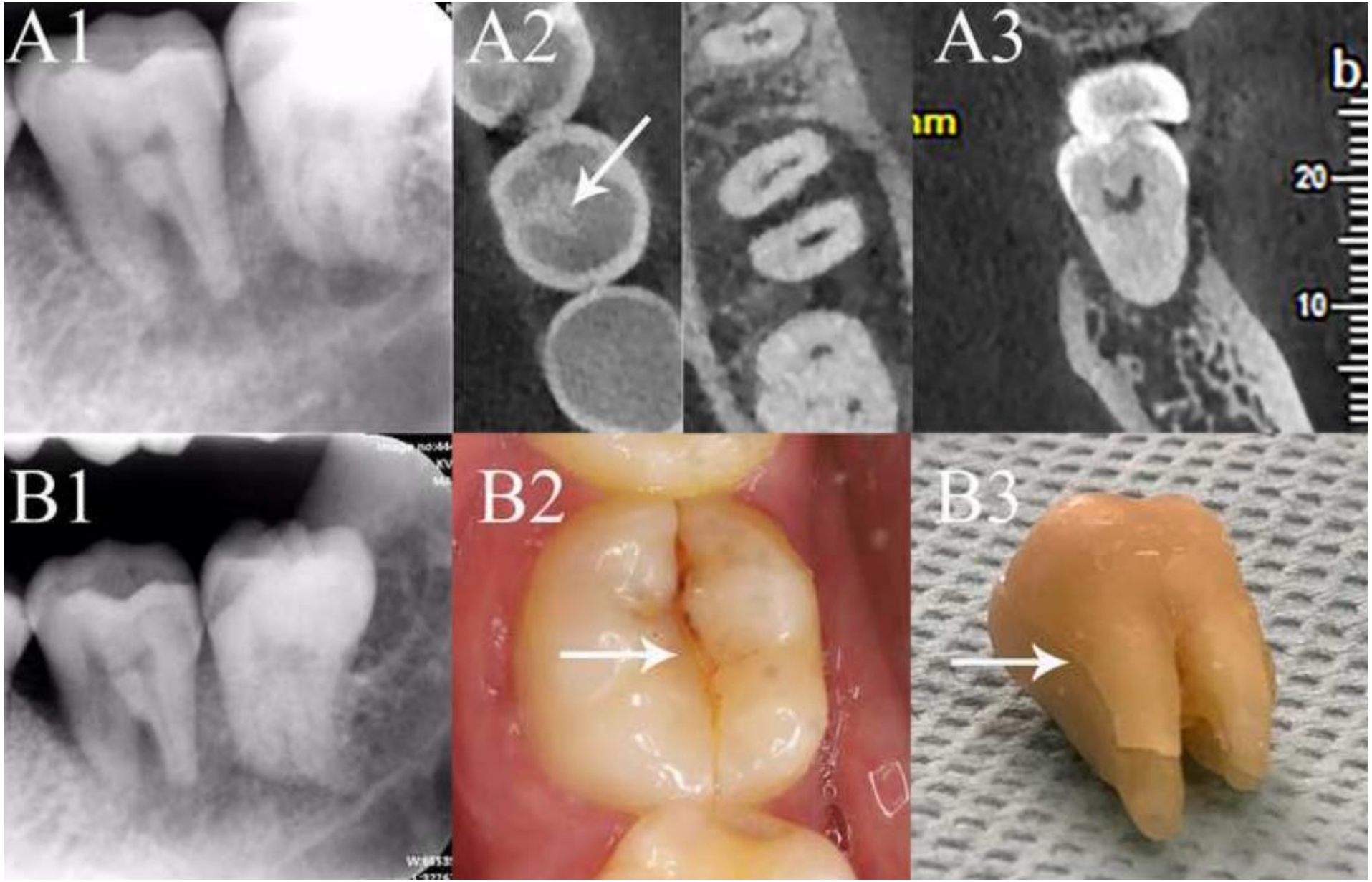
FIG 4.6 Beam hardening, which results in radiolucency surrounding the implant that frequently is misdiagnosed as a failing implant. This is caused by the dense nature of titanium implants and the exposure of more low-energy photons.

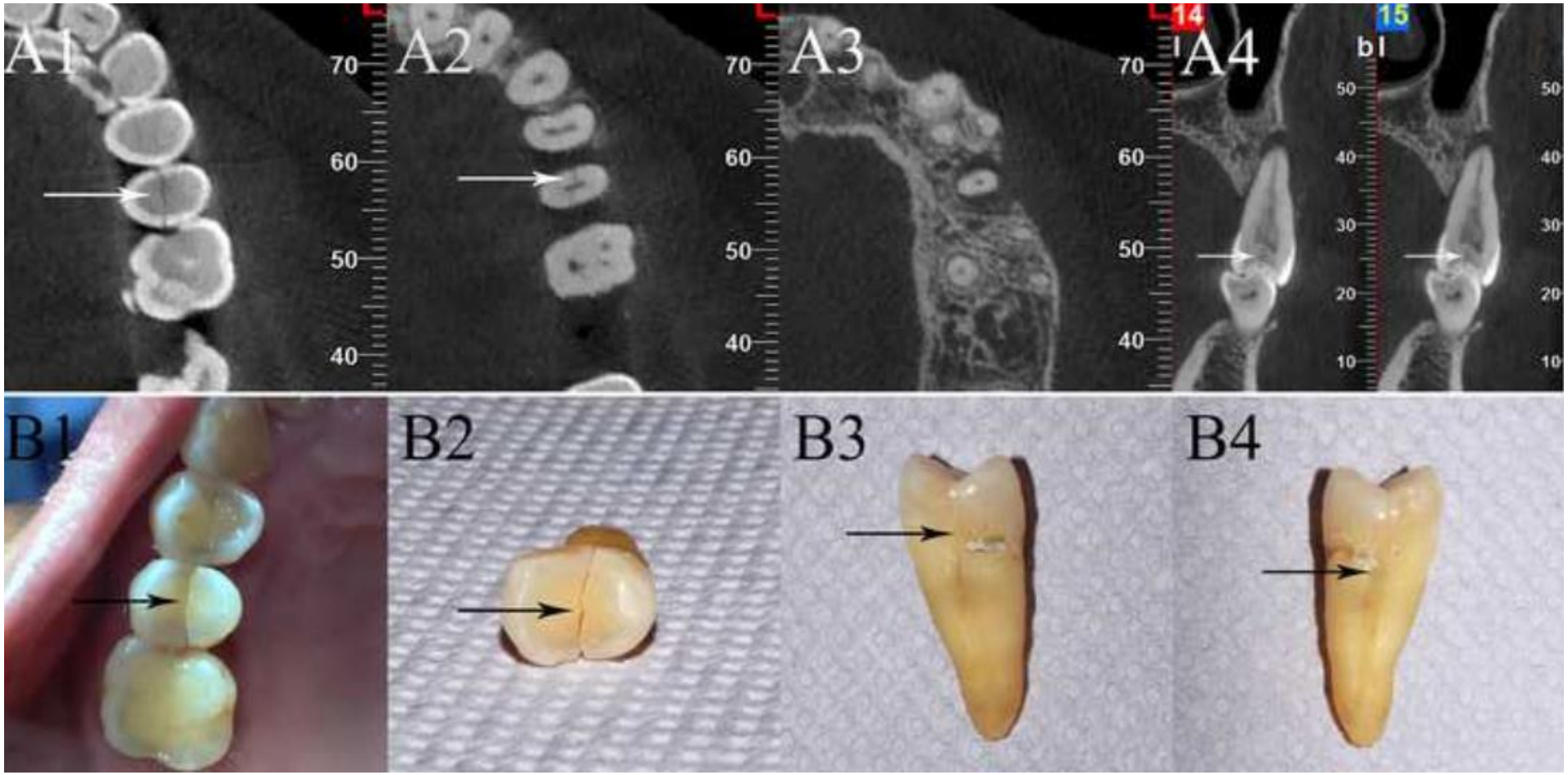
Table 1 Summary of influence factors and possible strategies improving accuracy in the diagnosis of cracks/fractures using CBCT

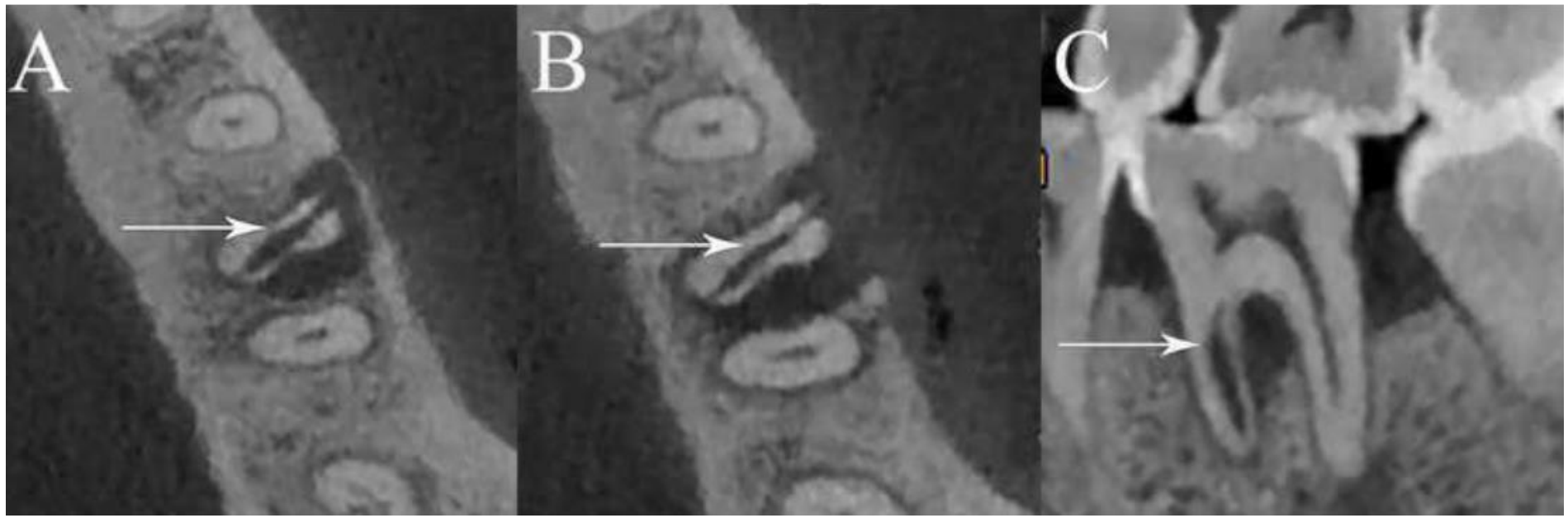
	Influence factors	Possible strategies improving accuracy
CBCT Unit	Voxel size	Choose smaller voxel size for narrower cracks/fractures
	FOV	Choose dentoalveolar FOV
	Exposure parameter	Increase mAs and number of basis images if possible
	Receptor technology	Inherent property of CBCT units, unelectable
	Reconstruction algorithm	Inherent property of CBCT units, unelectable
Patient (teeth)	Motion Artifact	Keep patients as still as possible
	Beam hardening artefacts	Take off removable metal materials
		Develop artefact reduction algorithm
	Width of the cracks/fractures	Congenital property of teeth
Observer	Experience	Advance training

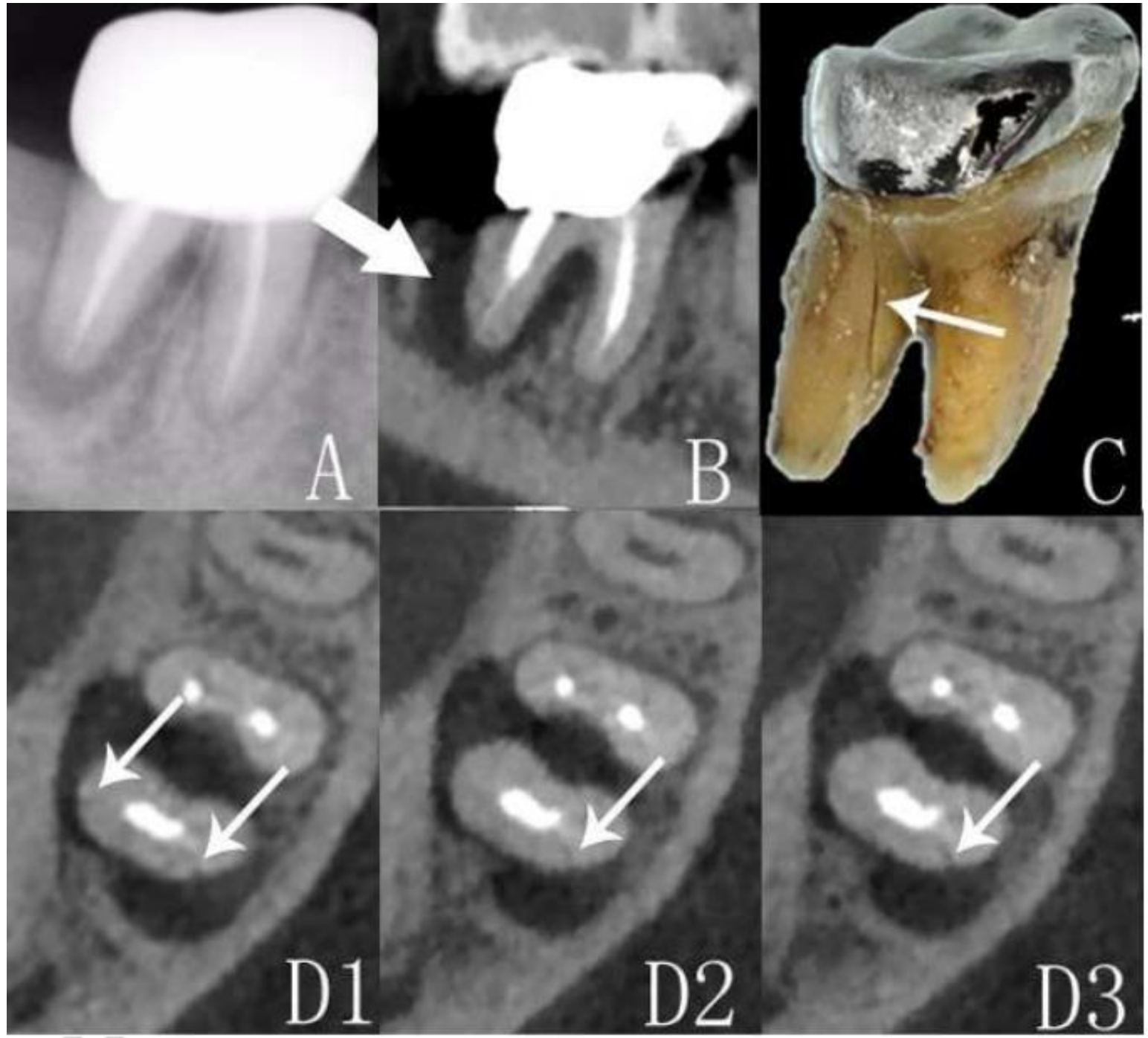

A
B
C
D
50
40
30
20

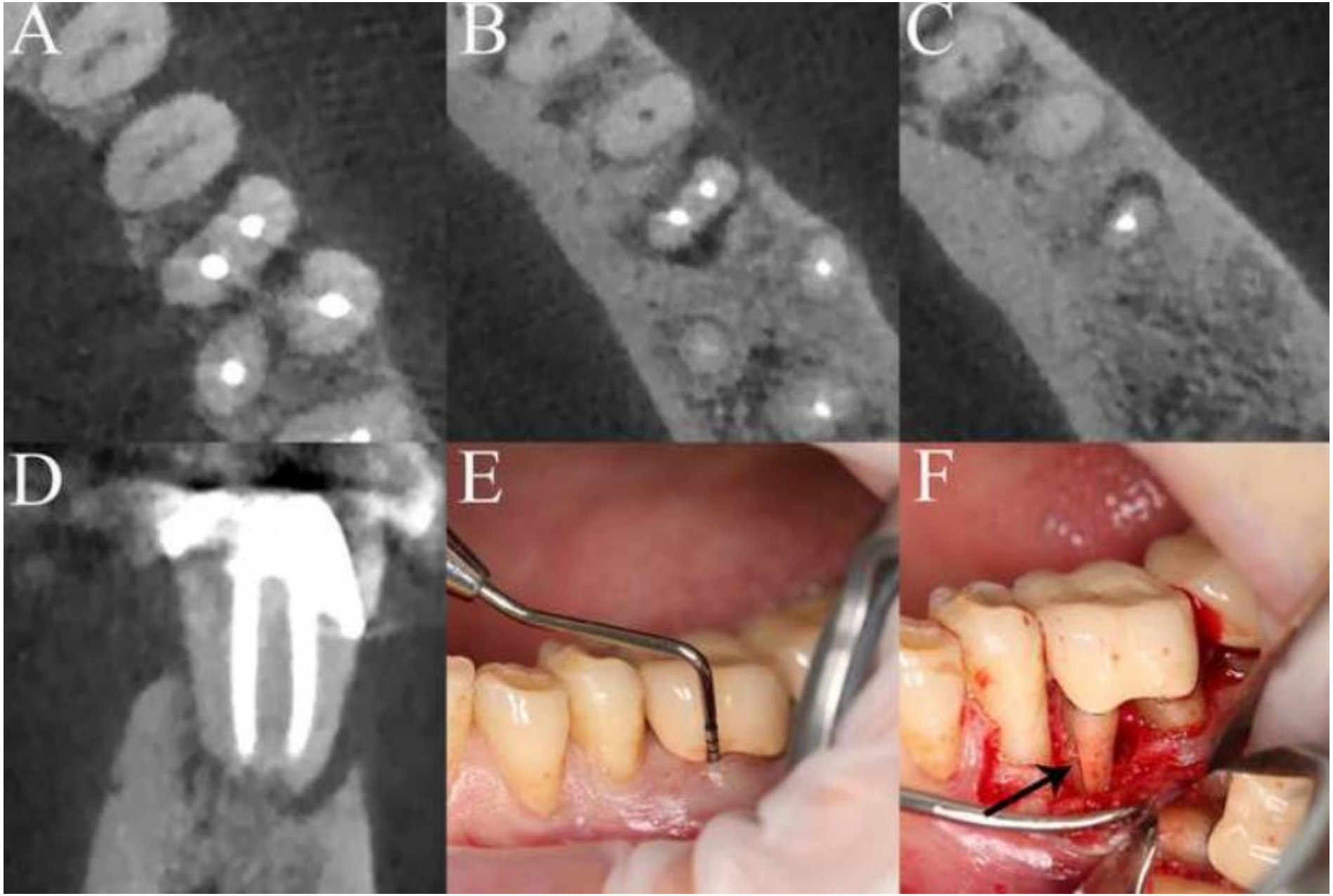

A
B
C
D

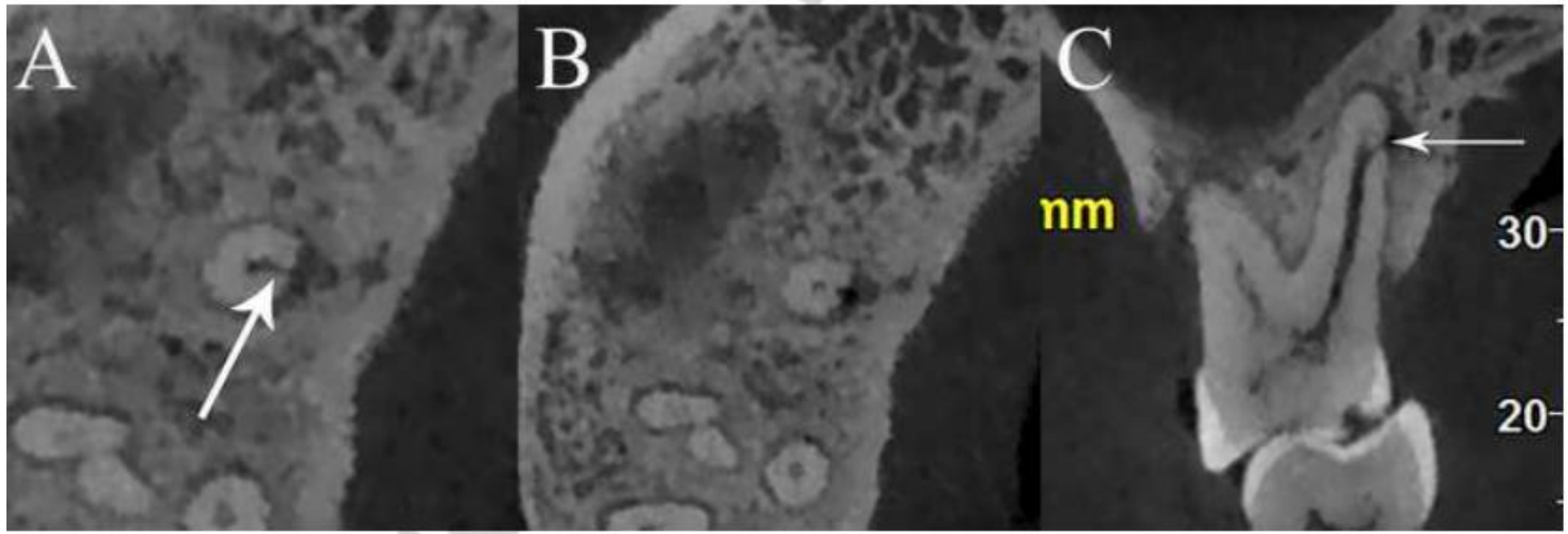

A1
A2
A3
20
10
B1
B2
B3

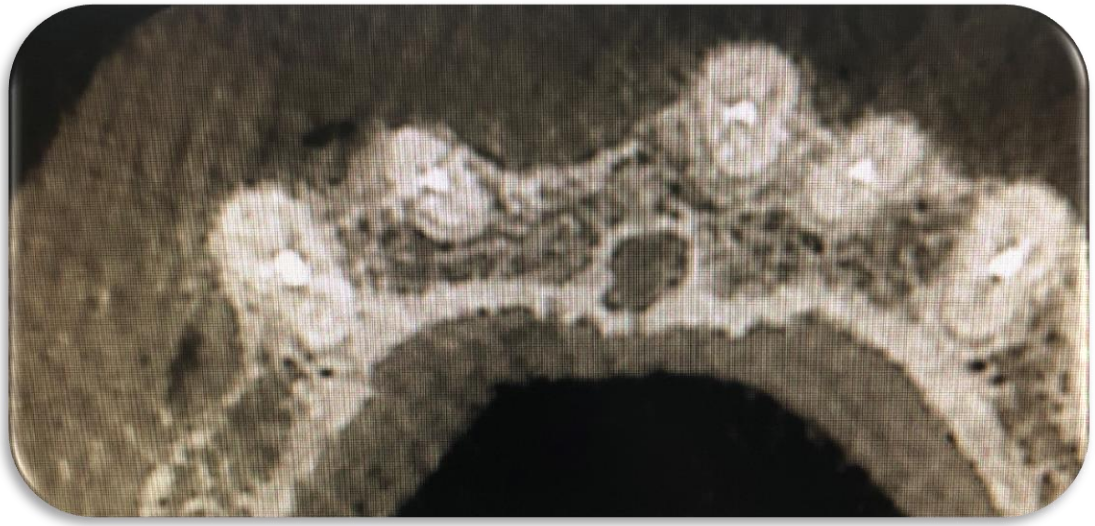

A1
A2
A3
A4
B1
B2
B3
B4

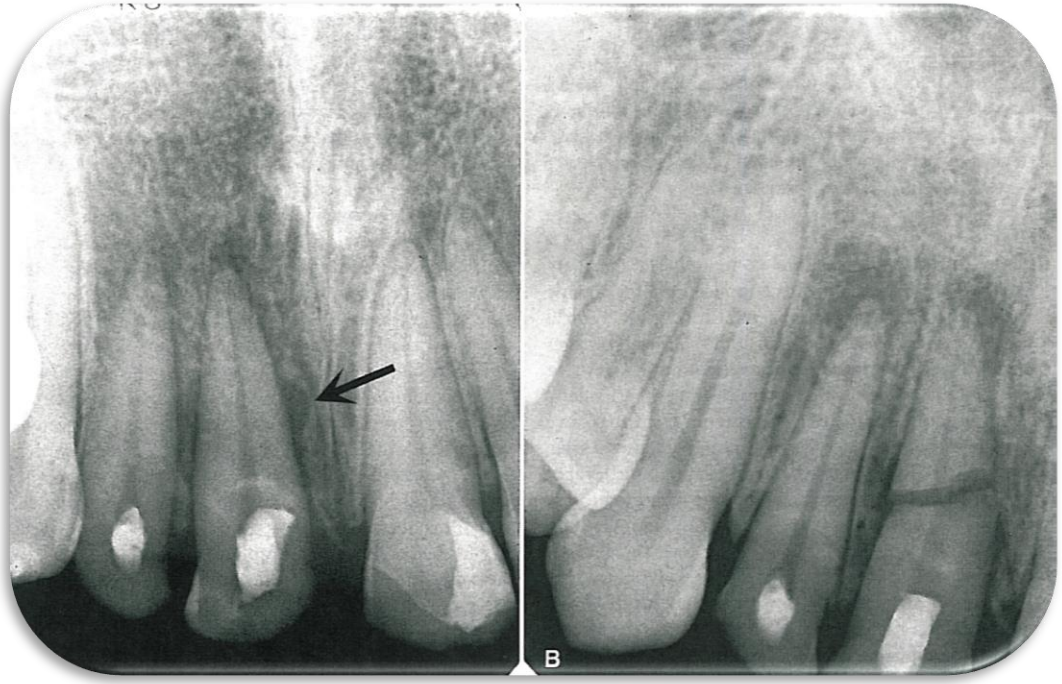

A
B
C

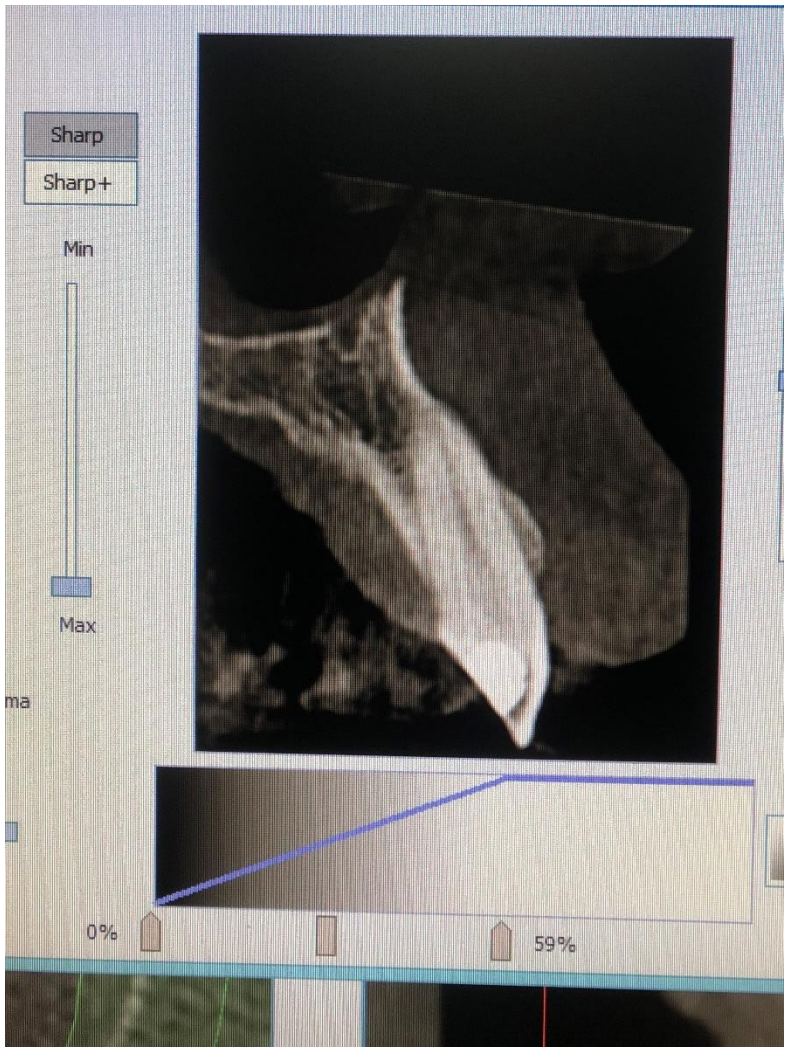

A
B
C
D1
D2
D3


A
B
C
D
E
F


A
B
C
nm
30
20




B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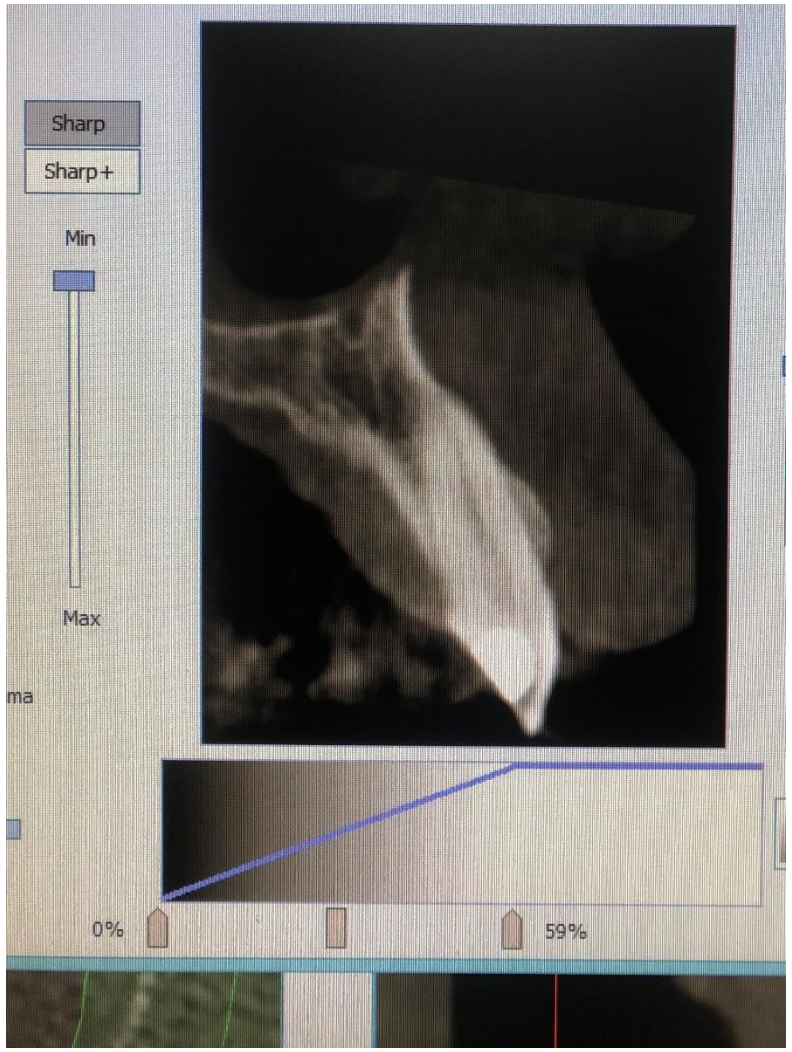
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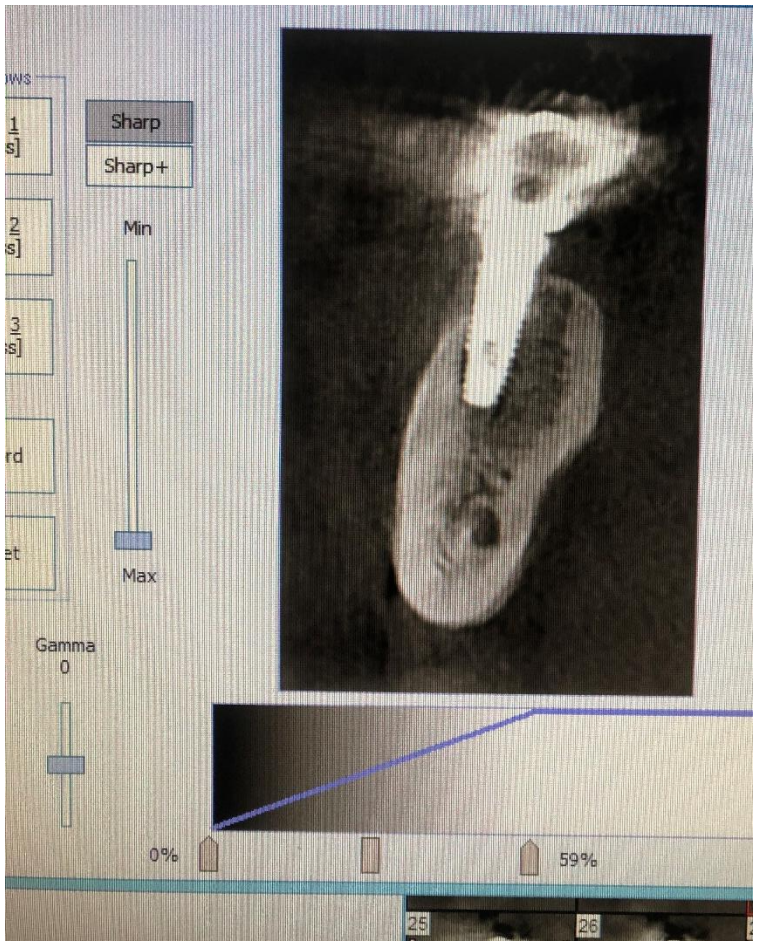
Sharp
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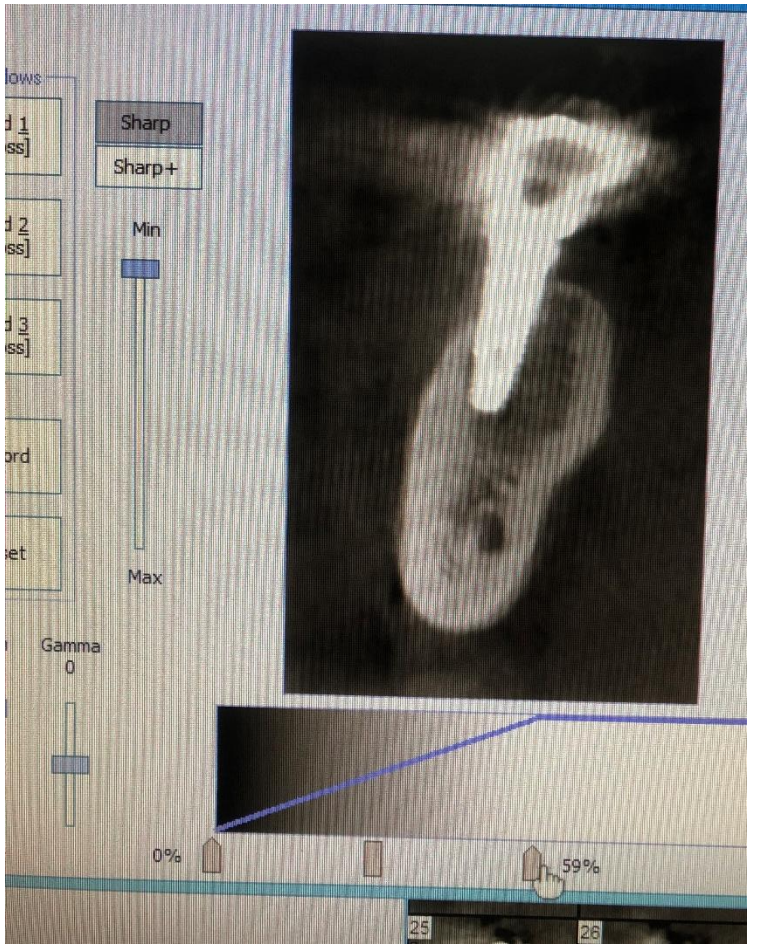
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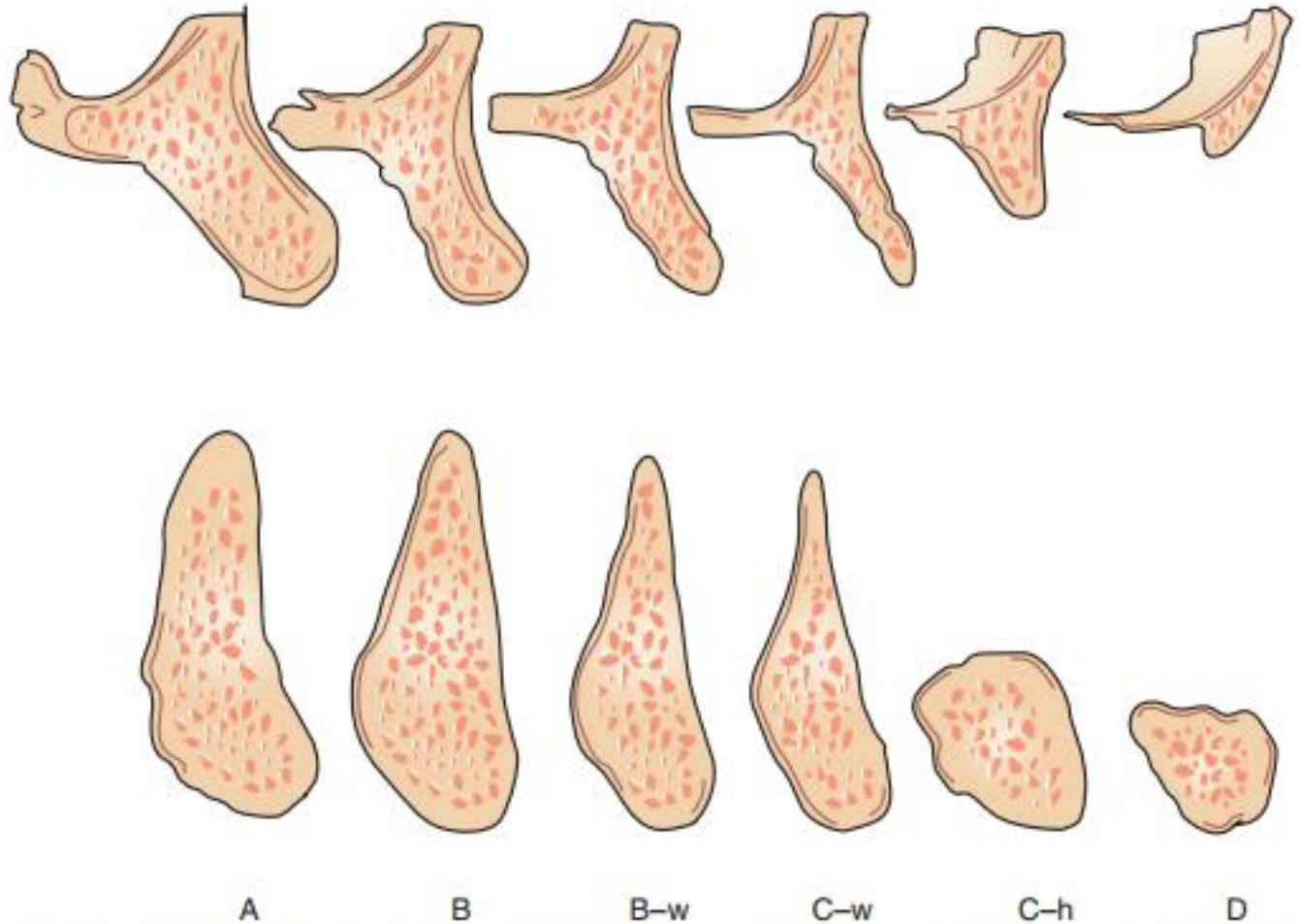

FIG 3.26 In 1985 Misch and Judy presented a classification of available bone (Divisions A, B, C, D), which is similar in both arches. Implant, bone-grafting methods, and prosthodontic-related treatment was suggested for each category of bone. *A,* Abundant; *B,* barely sufficient; *C,* compromised; *D,* deficient; *h,* inadequate height; *w,* inadequate width. (From Misch CE: *Dental implant prosthetics,* ed 2, St Louis, 2015, Mosby.)

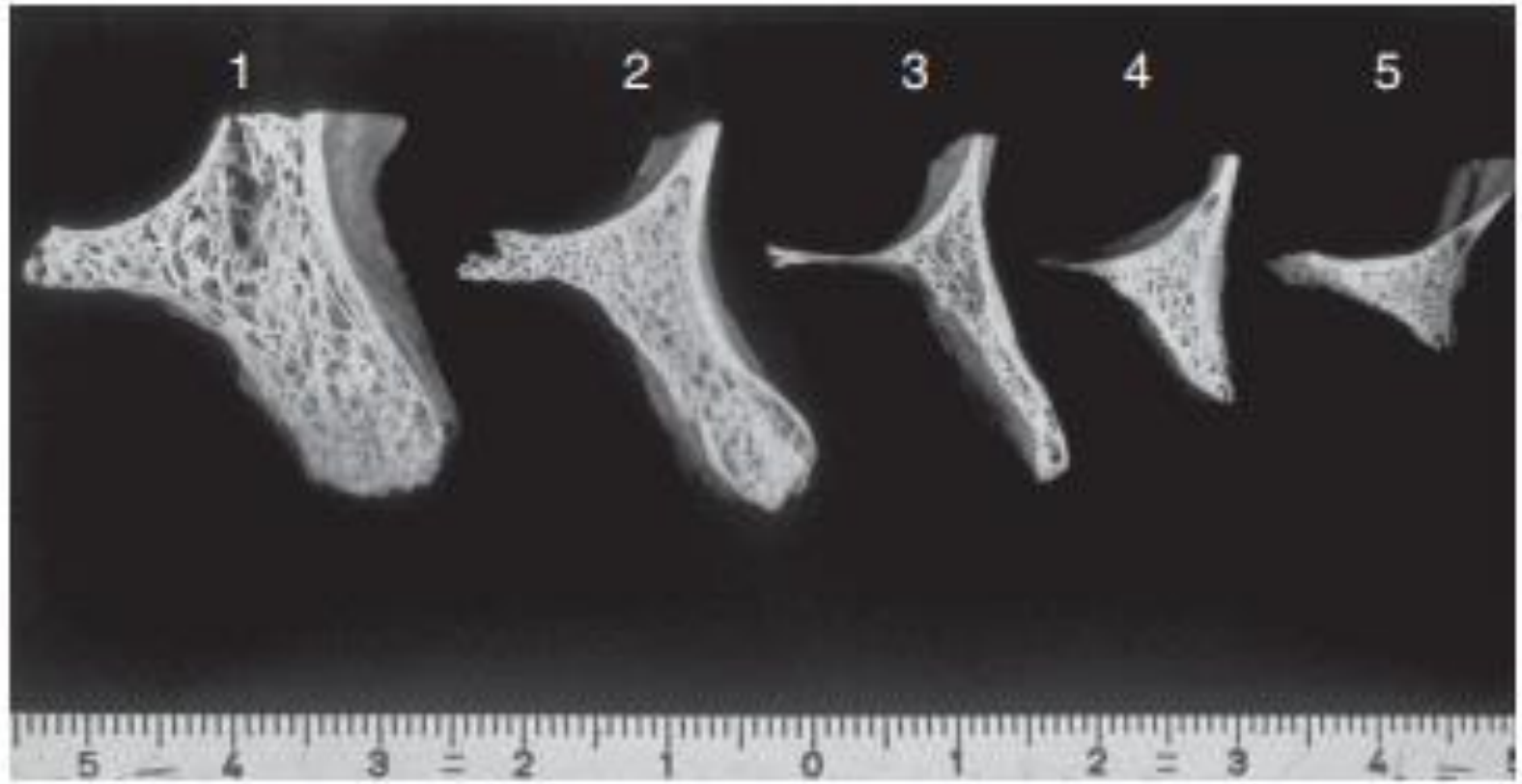

FIG 3.20 The anterior maxilla most often has the palatal wall of bone parallel to the facial cortical plate. Osteoplasty is less effective to increase the bone width. Augmentation procedures are most often warranted. (From Misch CE: *Dental implant prosthetics,* ed 2, St Louis, 2015, Mosby.)

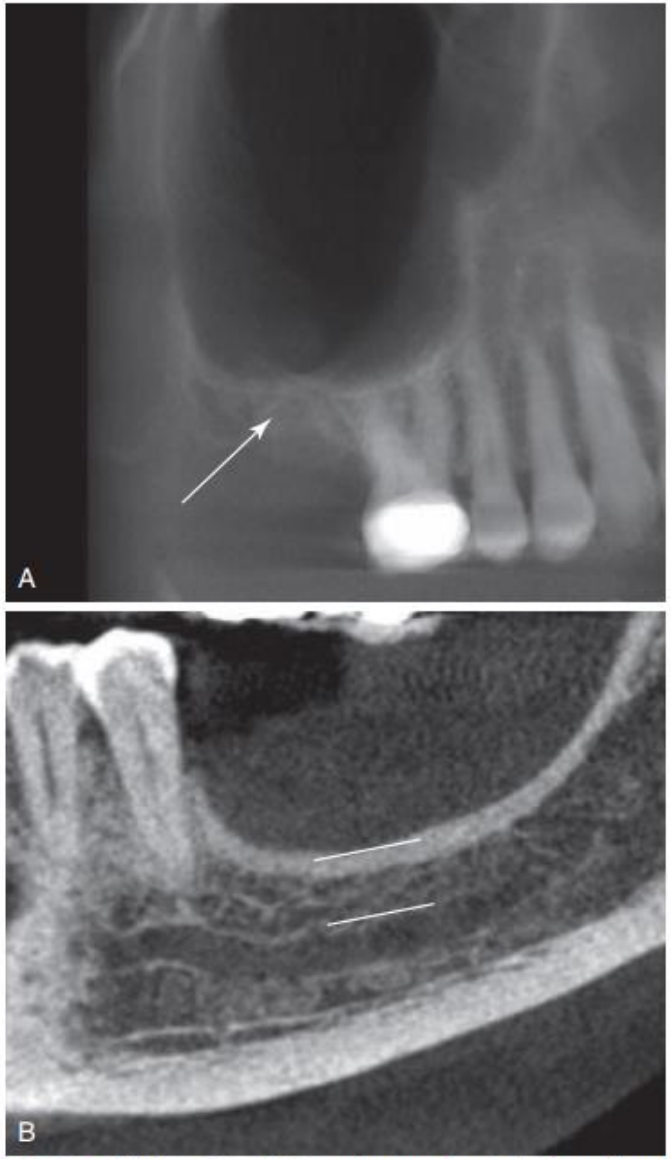

FIG 3.34 Division C–h. (A) Posterior maxilla depicting minimal bone below the sinus. (B) Posterior mandible, premolar area

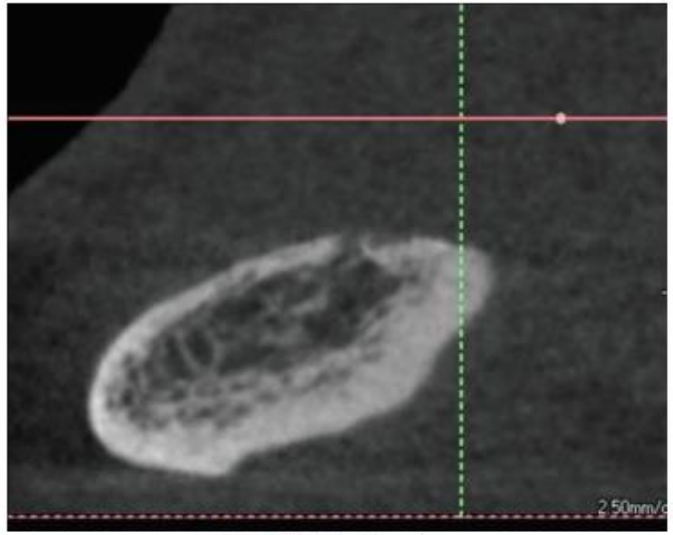

FIG 3.35 Division C–a.

Additionally, muscle pull from the buccinator muscles along with compromised interocclusal space make this area one of the most difficult to restore with dental implant prostheses.

Fixed prosthesis: excessive crown height space. A fixed restoration in the Division C–h mandible may require both anterior and posterior implant support when force factors are greater than usual. The fixed prosthesis in Division C–h bone with greater than 15 mm CHS is most often a hybrid device, with denture teeth attached to a precious metal substructure with acrylic resin. In this way, the complications and costs of a porcelain-metal fixed restoration may be reduced and repair is easier. Additionally, fixed prosthesis with excessive CHS tend to be much heavier, which leads to common patient complaints.

Biomechanical disadvantages. In general, Division C–h presents less favorable biomechanical factors to the implant support. Additional implants, cross-arch stabilization, soft tissue support, or an opposing removable prosthesis, often need to be considered in the prosthetic design to improve the