CLINICAL

Intraoral radiography

Chandur Wadhwani gives us the seven rules for the successful use of IOR with implant-based restorations

Radiography plays an integral role in the planning, surgical and restorative phases of dental implant therapy. It has also been used to follow the 'health' and measure long-term success of these medical devices.

A well-made radiographic image (film or sensor) can give lots of information about what is occurring, but as with any diagnostic tool, it is not without limitations. These should be clearly understood by the clinician so that information received can be properly acted upon. Here are my suggestions:

Rule number 1

Osseointegration can only be confirmed with light microscopy sections (see Figure 1) and cannot be confirmed by radiographs alone.

Radiography simply gives an indication of bone-to-implant contact, which for most offices is restricted to two-dimensional imaging even though the site is three-dimensional.

As a guide, it should be understood that limitations exist when reviewing bone-to-implant contact on a radiograph. Studies report that uniform gaps of up to 100 microns between the implant and surrounding bone sometimes go undetected, even when experienced clinicians are reviewing the images.

Rule number 2

Radiographic site information prior to restoration is extremely useful.

The implant and the adjacent sites can be evaluated for any pathosis, the implant position, the angulation and the path of restoration insertion, among other things. Radiographs can reveal bone quality and quantity and various bone patters can be highlighted by IOR images.

This is important as implants are commonly placed in alveolar bone, which may have large marrow spaces that could impact the way we restore the implant. This is well understood in other areas of dentistry (e.g., endodontics). Marrow spaces provide an easy escape route for cement, which can sometimes be observed around implants when cementing a crown.

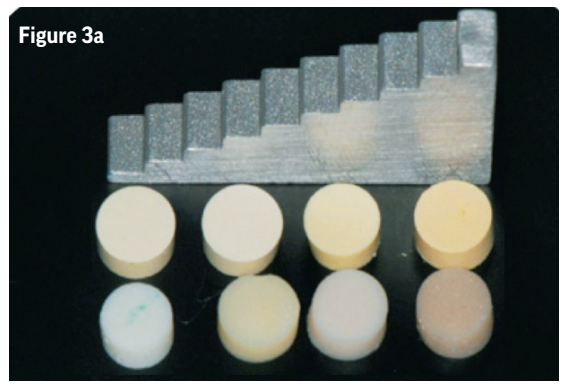
Rule number 3

X-ray angulation is everything.

When confirming how components fit, IOR can be indispensable, especially for sites that cannot be directly visualised or accessed with explorers. With the implant more than 20 degrees off the incident X-ray beam, the mismatch of components becomes almost impossible to detect. When the angulation error is closer to five degrees or less, the components can be confirmed to fit to within 50 microns or less. As a general rule, when reviewing radiographic images, the clearer the screw thread pattern seen, the closer the incident X-ray beam is to perpendicular to the implant body.

Figure 1: Osseointegration can only be confirmed with light microscopy sections like this. Radiography simply gives an indication of bone-to-implant contact

Figure 2: Marrow spaces can allow endodontic sealer to flow into them. Alveolar bone (from the latin for 'little cavities') consists of many such spaces, highlighted by this endodontic case



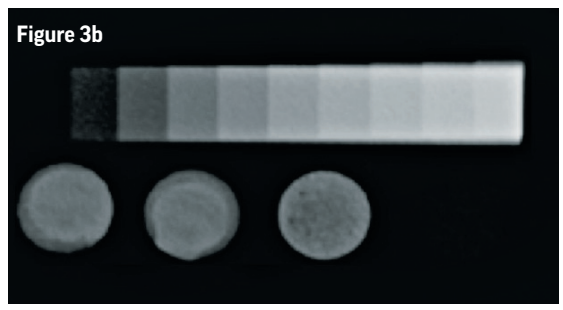


Figure 3: Here are eight commonly used cements for implant restorations in the form of uniform disks, next to an aluminum step wedge for comparison. When radiographed, at 1 mm thick, only 3 of the 8 disks can be clearly seen. Note: If all these disks were fabricated from endodontic sealer materials, they would all be clearly visible.

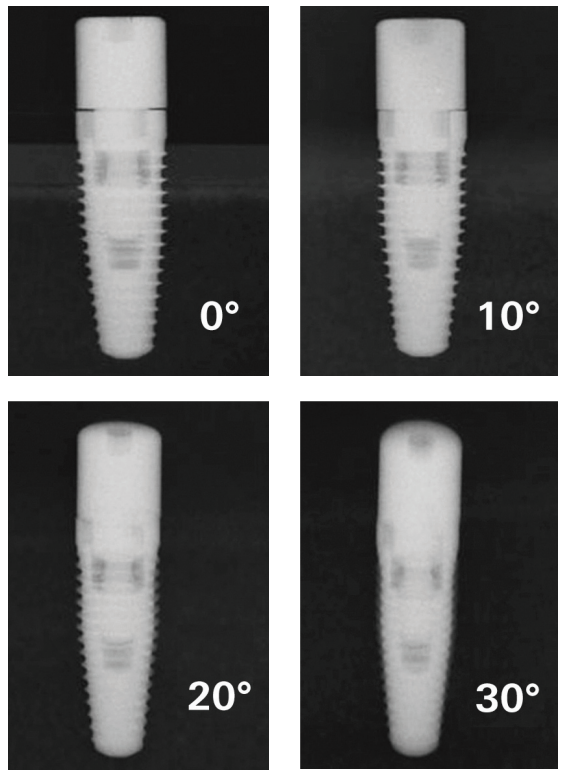


Figure 4: These four radiographs show how angulation affects the ability to detect component misfit. Note how the screw thread changes with angle. If it is clearly visible, the radiograph will more likely show an error

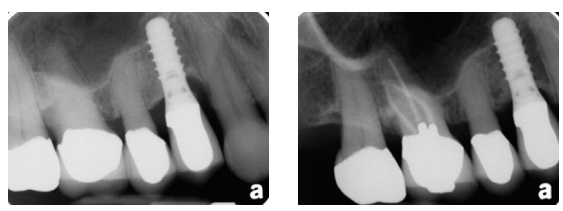


Figure 5: These two radiographs show the same site at different times. It appears that there is a difference between the bone levels on the mesial aspect of the implant but–because these two images were not taken from the same angle on identical or parallel planes–they provide very little clinically relevant comparative information concerning bone status

Rule number 4

Serial radiographs intended to monitor marginal bone levels must be standardised.

Standardised positioning requires establishing a consistent method of holding the radiographic sensor (or film) and the incident beam at 90 degrees to the implant's long axis, each and every time the image is produced. Remember, when a two-dimensional image is made of a dimensional site, angulation grossly affects what is identified in the image due to beam projection.

Interestingly, most studies on bone loss around implants fail to achieve standard,

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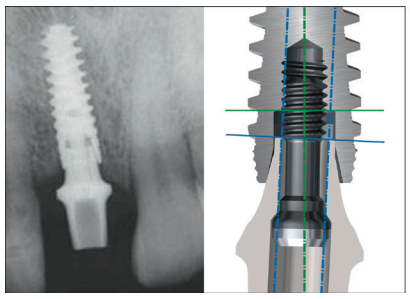


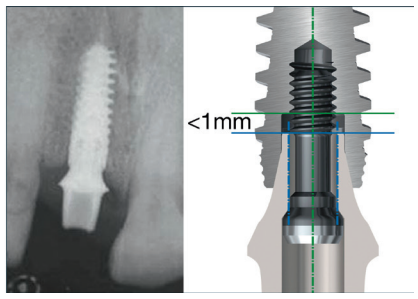
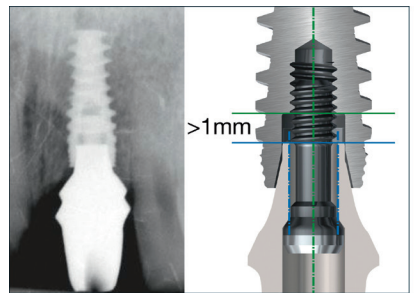


Figure 6: The implant abutment is not seated correctly in the images to the left. Note the orientation and gap size, compared to the images to the right, where the seating is correct. A radiograph taken at a right angle to the implant is invaluable



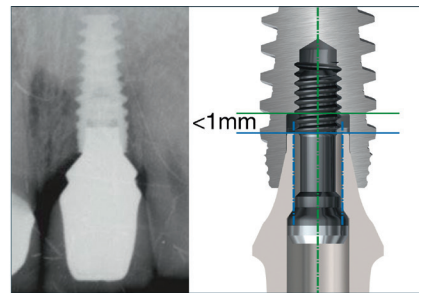


Figure 7: Failure of the abutment to seat fully: The gap is larger than 1 mm. Compare this to the images to the right, which show correct seating. Again, the value of a correctly angled radiograph is essential for appropriate interpretation of these effects

reproducible images, making comparisons between serial images just about meaningless. Note that sites adjacent to the implant offer clues to angulation errors. Radiopaque crown margins that change shape on nearby teeth are frequently a giveaway of angle shift.

Rule number 5

Understand your implant system and how the mechanical union of the parts you are working with appear on a radiograph.

Because NobelReplace and Brånemark System components have flat matching surfaces, errors in attachments can be easily detected when the radiographs have been taken 90 degrees to the incident X-ray beam. Non-flat, internal tapered systems may appear very different to their flat-top counterparts.

For instance, the Nobel Biocare conical connection fit is very distinct. By assessing the screw dimensions carefully, the clinician will readily understand if the components match well and are seated correctly.

Rule number 6

When making a cement-retained implant restoration with inaccessible margins, use IOR to locate possible residual excess cement that may cause future problems.

Use a cement that can be clearly identified on a radiographic film. Many cements show up poorly, thus remaining undetected (see images to the right, above), which could impact the future health of the tissues supporting the implant. As a general rule, choose a cement with minimum radiopacity equivalent to 3mm of aluminum (which is the same minimum required by the ADA for endodontic sealer cements).

Rule number 7

Use radiographic imaging as one of several diagnostic tools.

A variety of clinical criteria need to be taken into account before treatment decisions are made. For example, probing-depths correlate very well with radiographic bone changes, especially within the first few years following implant placement. Using more than one test to determine what, if any, therapy is required is always a good idea. Remember no test is perfect or absolute! And do remember: All radiographic procedures require that the most appropriate and best practices be used to minimise patient exposure to radiation.

For further information see 'Intra-oral radiography and dental implant restoration.' August 2012, Dentistry Today : Vol. 31 No.8.

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