Implant digital workflow opportunities

Dr Ross Cutts, UK

Whether we like it or not we are embracing the digital era in our brave new world. Many dental practices are now becoming paper free—a digital innovation—and even using tablet computers to record patient details and medical histories. We are continually surprised by the rising age of the technologically savvy patient, particularly those of a certain generation that perhaps we assume to be less "digital" than the perceived smartphone generation. This change in patient demographic and attitude towards technology is filtering through to us in the dental profession.

Fig. 1: Printed models.

Dental implantologists tend to lend themselves more readily to the digital revolution of dentistry in the UK and globally. Many practitioners opposed to or reluctant to embrace it, are actually being influenced by it from shifting workflows in dental laboratories even where more traditional clinical practices are followed chairside. Quite often wet impressions are poured, and stone models are scanned to produce digital stereolithography (STL) files for laboratories to process during crown and bridge unit manufacturing.

As an implant clinician you do not have to invest in a computer tomography (CT) scanner or chairside intraoral scanner—there are ways that other centres and laboratories can provide these services—however having these tools at your disposal greatly increases your efficiency and you are not relying on external services for your patients.

So how do we begin the implant digital workflow?

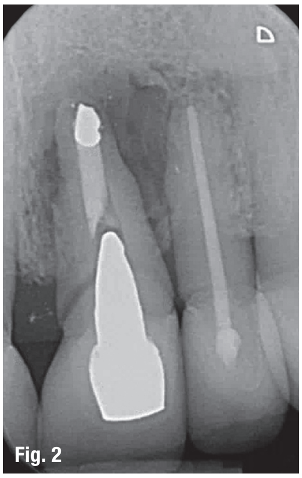
Treatment planning

Successful implant treatment begins with thorough case assessment and planning of the proposed restoration. This is important for all cases not just what we deem the complex ones, even the most experienced implant placer can miss a potential treatment planning hazard especially during a busy day.

Accurate study model casts are an essential part of this, however we can now use intraoral scans preoperatively to begin the digital workflow. We take a scan rather than impressions to form digital models. Our laboratory can then use these to create digital wax-ups of proposed treatment outcomes (Fig. 1).

We are routinely used to 2-D radiograph imaging techniques within dentistry but with the availability and access to cone beam computed tomography (CBCT) scanning devices now we are able to assess bone quantity and quality of proposed implant surgical sites (Figs. 2 & 3). With ever reducing doses of 3-D imaging and improving accuracy we have the option to use CT scans combined with clever software packages such as coDiagnostiX™ (Dental Wings) to plan safe and accurate implant placement and restoration. We are able to preoperatively plan precise implant placement with safe surgical margins away from important anatomical structures such as the inferior alveolar nerve or maxillary sinus. From this we are then able to design and either mill or print a surgical guide to use for precise implant placement (Figs. 4–6).

“If you fail to plan—
then you plan to fail.”
Benjamin Franklin



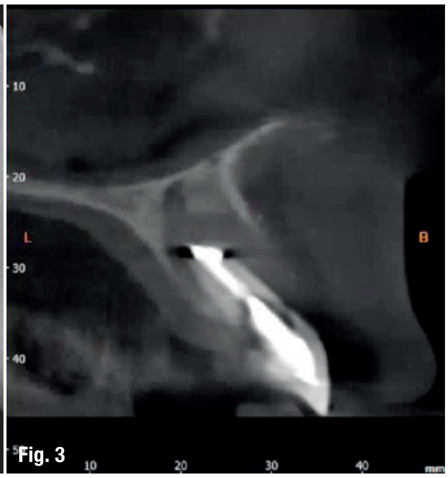


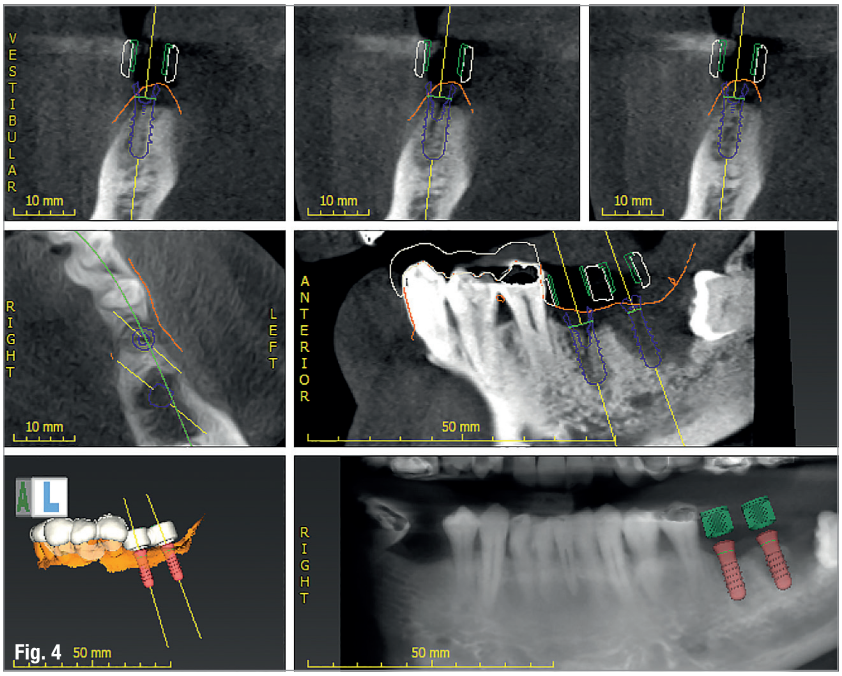
Fig. 2: 2-D radiograph. **Fig. 3:** 3-D radiograph.

Surgical treatment phase

Even with assisted or guided surgery there are sometimes certain restrictions that prevent us from achieving the most ideal implant placement, such as in the case presented here, where posterior access in the second molar region is reduced, making it extremely difficult to achieve the perfect parallel (Figs. 7 & 8).

There are fully guided systems available which allow for absolutely precise implant placement, but these are fraught with complexities and should be reserved for experienced placers. The accuracy of surgical guides should not be used to make up for a lack of surgical competency.

There are many factors to be considered when using surgical guides, depending on whether the guide is tooth-, soft-tissue- or bone-supported. Tooth-supported allows the greatest degree of accuracy.



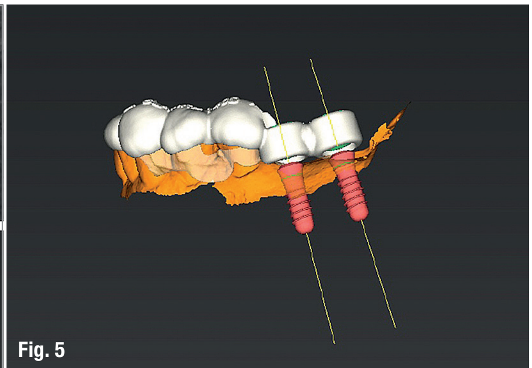


Fig. 4: coDiagnostiX™ screenshot. **Fig. 5:** coDiagnostiX™ screenshot of guide production. **Fig. 6:** Printed surgical guide.

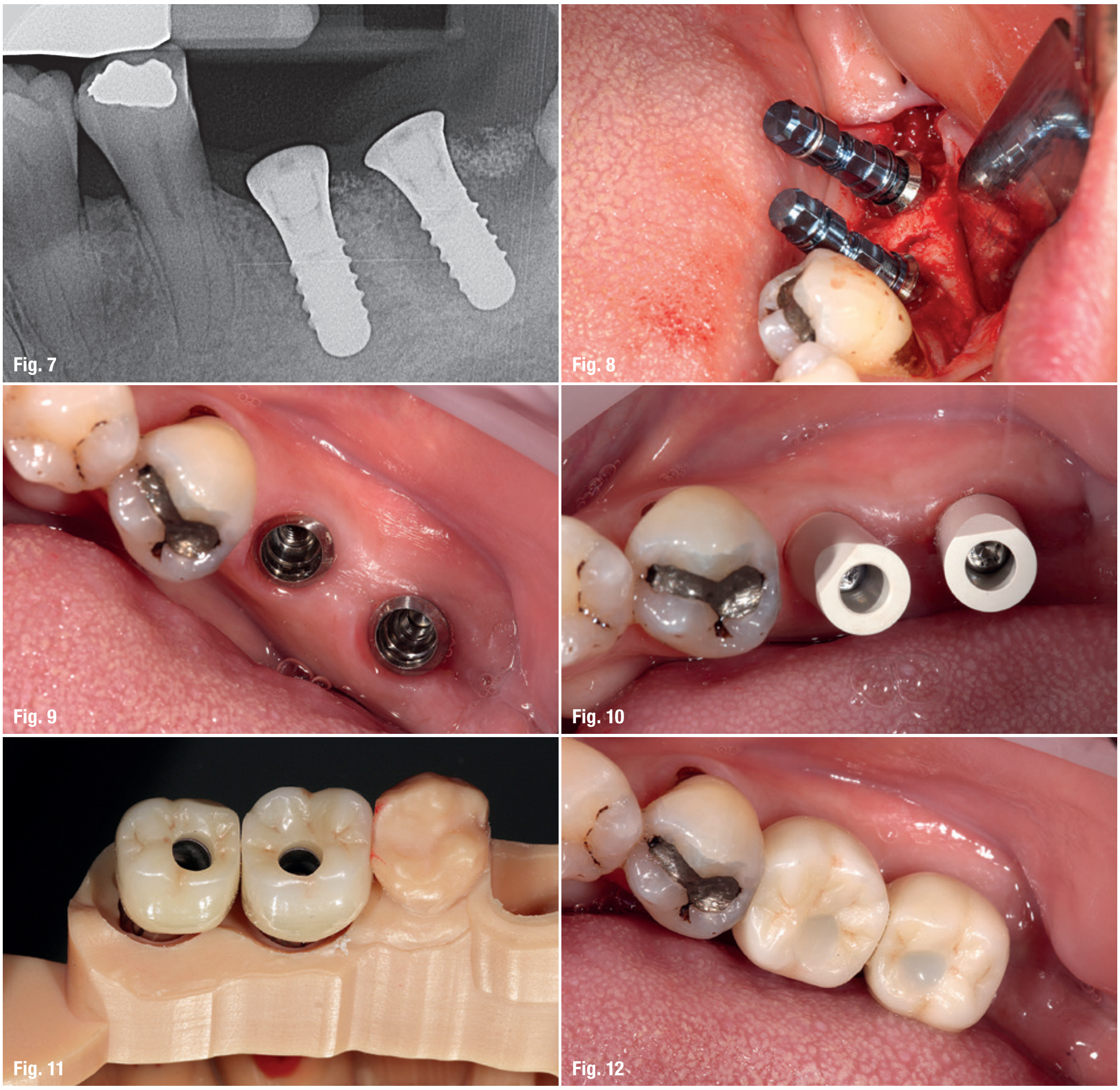


Fig. 7: Postoperative radiograph of implant placement. **Fig. 8:** Surgical placement of LL67 implants. **Fig. 9:** Tissue-level implants. **Fig. 10:** Scanbodies. **Fig. 11:** Crowns on printed model. **Fig. 12:** Crowns *in situ*.

If tooth-supported:
- Are there windows in the guide which demonstrate full seating of the guide?
- Are the teeth which support exact positioning of the guide mobile? Any mobility adds a degree of inaccuracy.
- Is the guide made from a direct intraoral scan or a scan of a study model? If scanning a study model, would this be an accurate stone model representation? Otherwise one could risk poor seating and inaccuracy of the guide.

If soft-tissue-supported:

Mobility completely negates any accuracy of the guide, so it should only be used for a pilot drill and then a more conventional surgical protocol should be adopted.

If bone-supported:
- Raising a very large surgical flap is likely.
- It is very difficult to get accurate full seating of a bone-supported guide in the precise planned position, thus one has to rely upon external fixation.

Prosthetic reconstruction

Once the implants are placed *in situ* and fully integrated we then have the option to choose between conventional wet-impression techniques and digital intraoral scanning devices. For the majority of cases intraoral scanning is extremely predictable and reliable—more so than conventional techniques—with milled (and lately printed) models having excellent properties and fewer accumulation of processing errors. However deeply placed

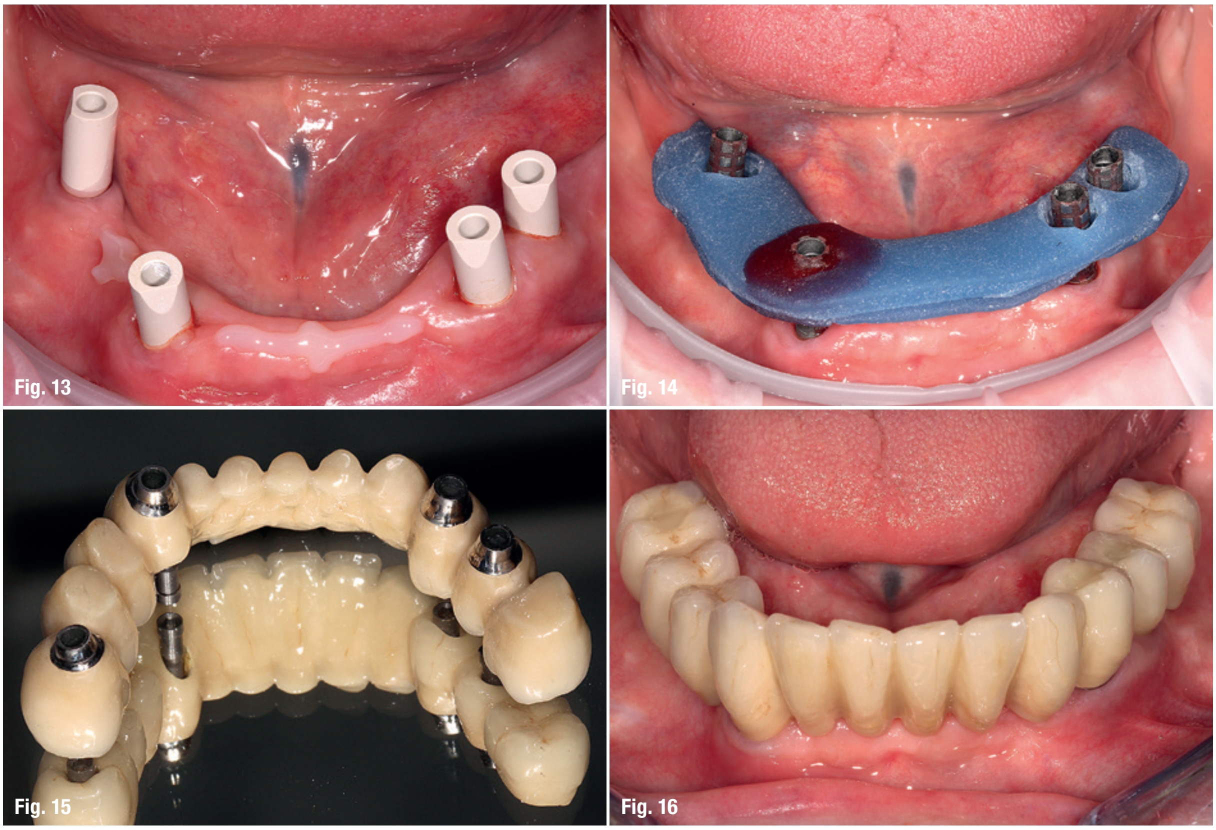


Fig. 13: Composite flow material used to increase scanning reference points. **Fig. 14:** Verification jig locked *in situ* to verify passive implant positioning. **Fig. 15:** Createch framework showing the fit surface. **Fig. 16:** Final metal-ceramic bridge *in situ*.

implants, relative to adjacent teeth with deep contact points, are very difficult to scan and pick up. Straumann tissue-level implants offer a very straightforward restorative platform to scan from (Figs. 9–12).

With greater numbers of implants and fewer teeth to act as reference points intraoral scanning becomes less reliable, particularly across the arch. Therefore, we need to act with caution and be aware of its limitations. We have used composite flow stuck to the soft tissues to increase reference points for our scanners increasing their ability to stitch images more accurately together. With this in mind we cannot assume the scan to be accurate and any framework fabricated would be non-passive, we therefore are obliged to use other methods to verify the scans accuracy. We have found locking temporary abutments within a composite framework intraorally the easiest and most reproducible way to do so. It then allows us to design and mill a truly passive framework by Createch and a temporary acrylic bridge (Figs. 13–16).

Conclusion

There are many opportunities to opt in and out of using technology regarding the digital implant workflow. For anyone considering capital investment, the most important question to ask is, how will or can this improve the outcomes I provide to my patients and then determine whether that warrants the expenditure. Too often we are subjected to sales pitches of the next biggest thing by company sales representatives and gadgets and gizmos end up by the wayside.

Acknowledgements to Andy Morton and Ian Murch, the fantastic laboratory technicians at Borough Crown and Bridge, that I work closely with.

contact

Dr Ross Cutts
Cirencester Dental Practice
12 Castle Street
Cirencester GL7 1QA, UK
cuttsrg@aol.com

Author details