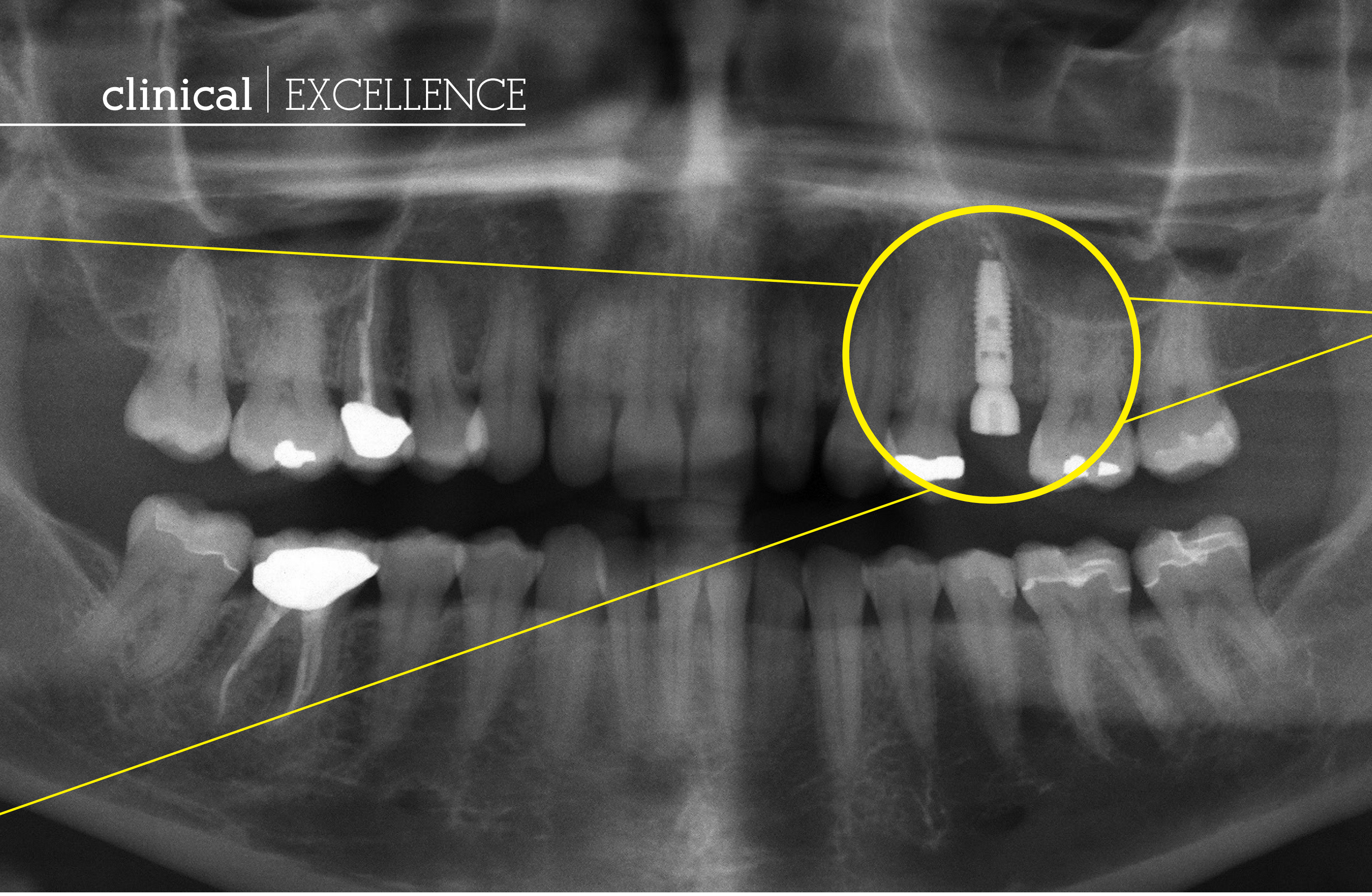

The long and short of implant drills

By Terence Whitty

Accurate placement is a key success factor in implant dentistry. In recent times, the ability for clinicians to move from a largely freehand approach that relied heavily on experienced hands and calculated guesswork to hyper-accurate computerised diagnosis, treatment planning and precision placement using guided surgery has accelerated.

The contemporary implant surgeon can now diagnose using 3-dimensional radiographs captured using cone beam computed tomography (CBCT), often installed in their own practices, that accurately reveals the amount of available bone, its quality and the position of nerves and other relevant anatomical characteristics.

Advanced treatment planning software then allows virtual implants in varying lengths and diameters representative of the inventories of all major brands on the market to be positioned into the radiographic volume in three dimensions. The most appropriate option can then be chosen based on appropriateness for the individual situation together with clinician brand preference.

Finally, the treatment planned in the software can then be utilised in the production of a surgical guide that the clinician uses to control the trajectory and depth of the implant surgical drill during surgery.

This works perfectly well provided the correct drill protocol is adhered to. Confusion can occur, however, as the drill kits from various manufacturers can appear overly complex.

An understanding of the types of drills available, their uses and limitations is fundamental to accurate implant surgery regardless of whether it's guided or freehand.

The basic twist drill was invented by Stephen Morse in 1861; he is also the inventor of the Morse taper. The original method of manufacture was to cut two grooves in opposite sides of a round bar, then to twist the bar (giving the tool its name) to produce the helical flutes. His design of this drill meant the chips and swarf were pulled out behind the cut, making drilling faster and with higher-quality results. This drill type is the most common used today; various modifications based on the original twist drill design from Morse are also common (Figure 1).

Freehand drills

The name really says it all; these are drills are made for procedures utilising freehand or manual surgery and as a result, have certain characteristics that make them suitable for this purpose. Importantly, freehand drills usually have markings up the shaft denoting different lengths measured from the tip of the drill. This is useful when different depths are required using the same drill (Figure 2).

Some freehand drills have a stop built into them and certain systems use specific length drills that are made exactly for the implant length you are placing. For example, if you are placing an implant of 10mm, the drill will be approximately 10mm in length from tip to the stop. The idea is when you get to the level of the bone, you cannot drill any further. This is a failsafe so you can't create the osteotomy deeper than needed. Others use a "slide on" stop that limits the drill length (Figures 3-4). Freehand drills usually come in kits of various widths and lengths and are perfect for freehand surgery. In experienced hands, these can yield great results. Unfortunately, freehand drills are in no way suitable for use in guided surgery. The main reason is because they are not long enough to be used successfully for guided surgery and if they have built in stops, this will interfere with a guide tube.

Guided surgery drills

Guided surgery drills are usually part of a specific guided surgery kit and meant to be used with a custom "surgical guide" made specifically to constrain the trajectory and limit the depth of the drills to create an ideal osteotomy prior to implant placement.

Figure 5 to 10 detail the basic concept of guided surgery setup for the drill guide and drill.

A 3D rendering of a lower 6 implant site created from a CBCT scan is shown in Figures 5-7 with a virtual or "planned" implant positioned in the bone. The orange ring represents the drill tube that would be placed in a surgical drill guide and the length from the top of the tube to the apex of the implant is the length of drill needed to achieve the osteotomy (Often referred to as the Drill Length Value). The length of the drill tube to the implant interface is called the "offset" and is referred to by various names such as the "D2" value or "S" value or "H" value depending on the implant system. It's actually the amount of space needed to strategically and successfully place a drill tube that guides the drill. To make it a little more confusing, some companies measure from the top of the drill tube while others measure from the bottom of the tube to the implant interface. This "offset", which is typically 9-10mm, is why freehand drills don't work for guided surgery. Guided surgery drills need to be of sufficient length to both accommodate this offset and the depth of the osteotomy.

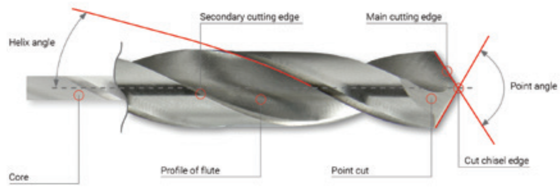

Figure 1. The anatomy of a twist drill, still in use today.

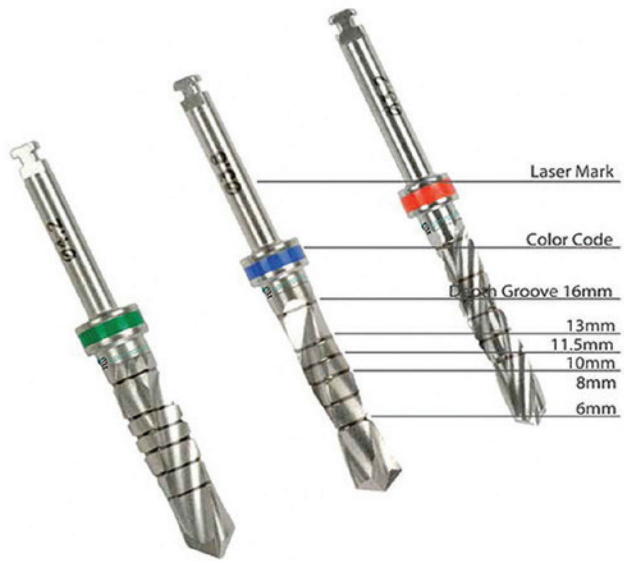

Figure 2. Freehand drills - note the markings and stops.

Figure 3. Freehand drill made for the correct length of the implant, in this case 13mm. The stop is built into the drill.

Figure 4. Drill stops of different lengths that can be placed onto the drill to achieve a stop at the required length.

Guided drills usually come in two main varieties matched to the specific implant system.

The first is a drill system that uses reducers, usually on a small handle, called drill keys (or spoons) (Figures 11-12). These keys fit intimately into the drill tube in the guide and are used in a specific sequence in unison with the various drill diameters used in the osteotomy sequence. The first drill key in the sequence has the smallest hole to begin drilling the osteotomy; subsequent keys use larger holes and larger drills until the planned maximum diameter is reached.

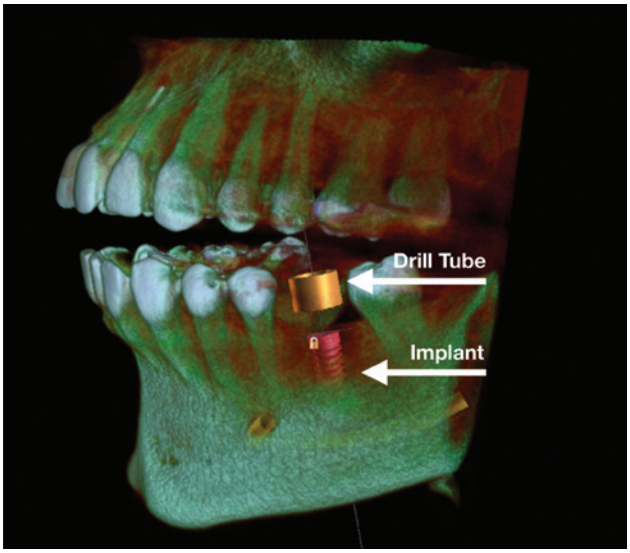

Figure 5. Virtual implant and drill tube.


Figure 6. Alternate view showing virtual tube and implant.

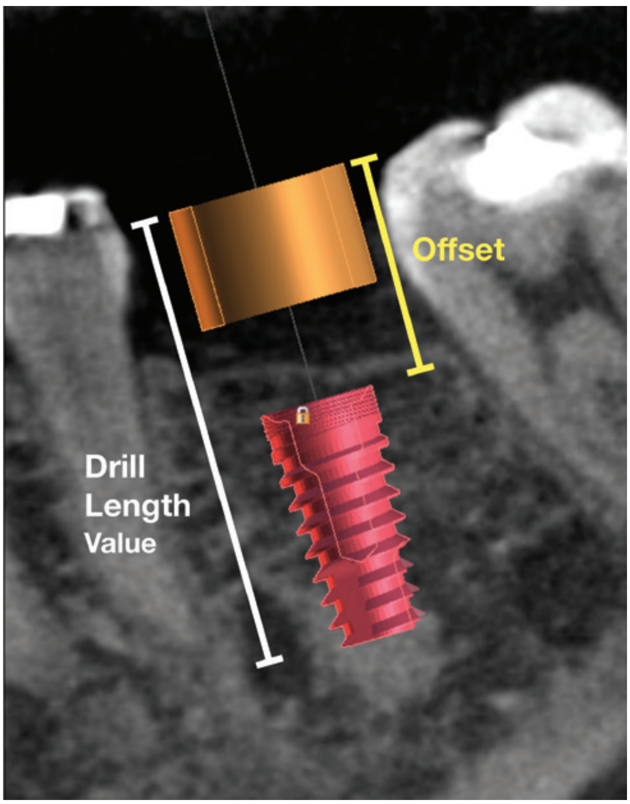

Figure 7. Drill length value and offset.

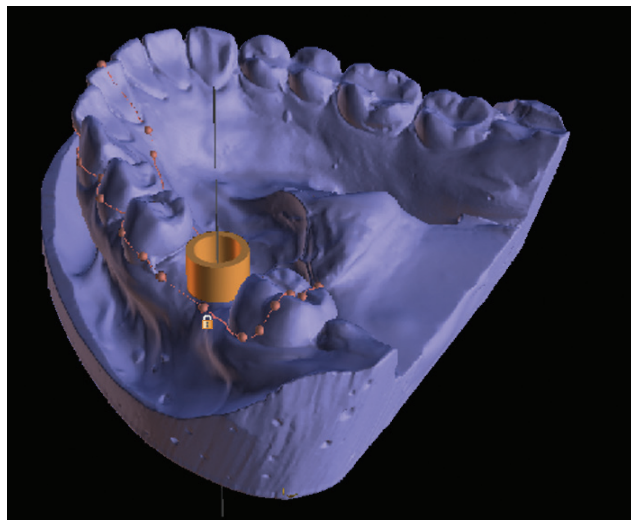
Figure 8. Optical scan of model showing virtual tube position.

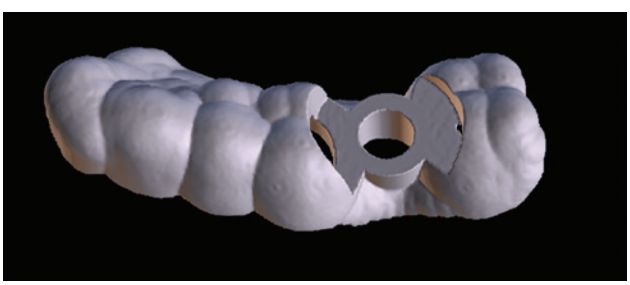
Figure 9. Virtual surgical guide ready for 3D printing.

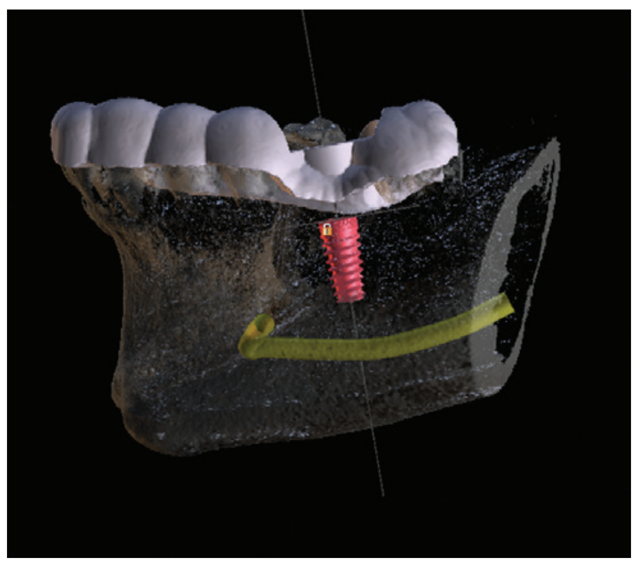
Figure 10. Virtual guide in place showing relationship to implant.

Figure 11. An example of a drill key (also known as drill spoon).

Figure 12. Drill key positioned in the surgical drill guide.

The depth is also managed by the drill lengths matching the setup of the guide set via the computerised planning.

Some disadvantages of this system is having to hold the drill key in place and drill at the same time; also, only straight drills are able to be guided correctly through the drill key. Regardless of these two limitations, the use of drill keys is an effective and useful system.

The second system is a what is known as "keyless". It works by a clever design of the drill itself as the drills have a built in "skirt" or guide shaft built into the drill that allows an intimate fit and guidance through the drill tube embedded in the custom-made surgical guide (Figures 13-14). This has many advantages including one less thing to hold during the surgery and allowing many types of drills to be guided through the drill tube. Tapered drills and implant profiling tools can guided easily and successfully using this system. Incidentally, a free-standing tapered drill without a skirt would not be able to be used successfully in a parallel walled tube as they cannot be successfully guided. Guide tubes would only be useful for cylindrical drills without skirts (Figure 15).

> "The right tools and a thorough knowledge of their correct use will ensure theory more easily translates into clinical practice and optimal patient outcomes..."

In theory, careful planning and execution of implant placement will lead to an ideal result. However, the right tools and a thorough knowledge of their correct use will ensure this theory more easily translates into clinical practice and optimal patient outcomes.

Figure 13. Drill with "skirt" or guide shaft.

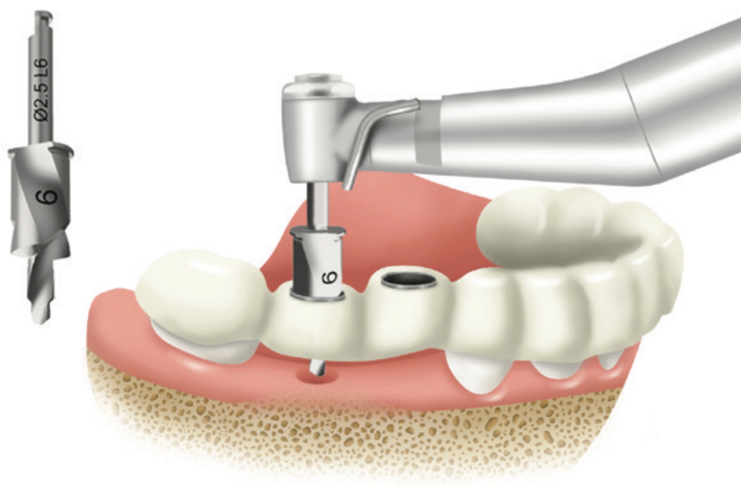

Figure 14. Keyless drill with water irrigation channel (Courtesy ADIN Implants).

Figure 15. Cylindrical drill vs Tapered drill: a tapered drill cannot be used in a drill tube; it will need a guide shaft.

About the author

Terence Whitty is a well-known dental technology key opinion leader and lectures nationally and internationally on a variety of dental technology and material science subjects. He is the founder and owner of Fabdent, a busy dental laboratory in Sydney specialising in high tech manufacturing. Using the latest advances in intra- and extra-oral scanning, CAD/CAM, milling, grinding and 3D printing, most specialties are covered including ortho, fixed and removable prosthetics, computerised implant planning and guidance, TMD, sleep appliances and paediatrics.