No teeth? No problem
David Burgess unveils a dynamic solution for edentulous patients

Sinus elevation and immediate placement
By Arun Garg and Gregori Kurtzman

Partially extracted but fully digital
Filipe Amante and Patrik Zachrisson apply a digital workflow to the socket shield technique with impressive results

New horizons
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**Full-arch restoration completed with greater accuracy and safety**

*David Burgess* describes a new dynamic navigation protocol for edentulous case planning and implant placement.

The use of dynamic navigation for dental implant treatment is becoming more widespread, enabling surgeons to visually monitor the progress of the drill throughout implant site preparation.

The first version of Navident, introduced in 2015, required a radiographic marker to be attached to the teeth to establish a connection between the patient's jaw and the virtual cone beam computed tomography (CBCT) image. A graphic representing the drill appears on the CBCT throughout implant site preparation, enabling greater precision and safety.

Navident 2.0 avoids the need for a radiographic marker, as the outline of the selected reference areas, usually teeth, can be traced to the corresponding areas on the CBCT scan. This technique is known as trace registration and has simplified the workflow of dynamic navigation for dentate patients.

The challenge has been to develop a protocol for trace registration in edentulous and full-arch cases where there are no reference teeth to trace.

Alternative options needed to be considered to establish the connection between the patient's jaw and the virtual CBCT image, and to develop a consistent step-by-step protocol to place dental implants to support full-arch restorations.

The first step of this new protocol is acquiring a 3D model of the jaw. An immediate temporary bridge is made to be fitted to the implants at the time of surgery and a radiopaque replica is produced for the treatment planning. Accurate and predictable planning and placement of the implants is achieved with a modular guide.

A supporting frame for the modular overlays is developed to transfer the temporary bridge from a laboratory model to the mouth, and to fabricate the permanent bridge once the implants are integrated. Ring radiographic markers enable registration of the patient's jaw to the virtual image. Dynamic navigation is used to safely place the implants with precision.

The following case is the first occasion this protocol was used.

**Full-arch planning**

A 69-year-old female patient's upper dentition was failing. Initially, four troublesome teeth were extracted and an immediate partial denture was provided (Figure 1). Four months later, the patient opted to have the rest of her upper teeth removed and replaced by an immediate full-arch temporary bridge, supported by six dental implants.

Prior to these extractions, an intraoral scan was taken using a 3Shape Trios scanner to create a 3D printed model. This was used to manufacture an acrylic immediate temporary bridge, using the remaining teeth and partial denture as a guide for the size and position of the teeth. The 3D printed model also allowed for the creation of a base frame, radiopaque replica and shell guide (Figure 2).

On the day of the surgery, the patient was given antibiotic prophylaxis, Corsodyl mouthwash, intravenous sedation and local anaesthetic prior to extraction of the remaining upper teeth. The full-arch temporary bridge was tested to ensure the size, shape and position of the teeth were correct. This process allowed for the occlusion to be adjusted to satisfactorily align with the opposing lower

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*Figure 1:* Four troublesome teeth were extracted and an immediate partial denture was provided.

*Figure 2:* The immediate temporary bridge, radiopaque replica and shell guide.

*Figure 3:* The full-arch temporary bridge was held in position to confirm acceptable occlusal alignment with the lower teeth.

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**Dr David Burgess BDS DPDS MScConSed** has placed more than 700 implants using dynamic navigation since the technology’s inception.
dentition. These changes can also be made to the radiopaque replica and shell guide.

The full-arch temporary bridge was held in position by the patient biting down, confirming that acceptable occlusal alignment with the lower teeth had been achieved (Figure 3). The base frame was attached to the temporary bridge by connecting male and female locator components (Figure 4), and fixed to the maxilla by three horizontally placed, small-diameter implants (SDIs).

For the full-arch protocol, one SDI is placed in or close to the centre line, while the other two are placed in a more posterior position. The location of the SDIs can be altered, if necessary, to ensure stable fixation, depending on bone quality and volume. The holes that the SDIs pass through must be wide enough to guarantee the fit of the base frame to the SDIs is passive (no contact between the SDIs and the frame), ensuring the frame is not subject to canting movements during fixation.

**Alternative registration**

A customised connector was attached to the central SDI (Figure 5). This connector supports the optical marker, known as a ‘jaw tracker’, during the surgery.

Six ring radiographic markers were attached to the buccal aspect of the base frame. These aluminium cones can be used as an alternative form of registration between the patient’s jaw and virtual image on the CBCT scan. The base frame was then connected to the SDIs using a flowable light-cured composite resin (Figure 6).

Once the base frame was fixed in position, the temporary bridge was detached and the radiopaque replica fitted to the frame (Figure 7). A CBCT scan was taken with a Morita 3D system to ensure the ring markers were clearly visible. The outline of the planned position of the teeth was relayed to the CBCT image by the placement of the radiopaque replica. The CBCT scan data was then imported into the Navident software (Figure 8).

At this point in the planning process, the patient’s jaw can be registered to the virtual representation in one of two ways. The first is to register the tracer by holding it in front of the Microntracker stereoscopic camera while in contact with the calibration device. The tracer can then be used to register the jaw to the CBCT scan by placing its tip to the centre-point of the ring markers attached to the base frame.

Alternatively, registration may be carried out by tracing the outline of the radiopaque teeth using the trace registration protocol. The ring marker method, used in this case, is quicker and repeat registration can be carried out easily, if it is lost at any time during treatment.

The positions of the teeth and implants were outlined using the Navident treatment planning software, to allow for optimal safe, effective implant placement (Figures 9a and 9b). The bridge-implant interface was designed so the screw holes for the bridge were in the occlusal surfaces of the posterior teeth and the palatal surfaces of the anterior teeth.

**Precise implant placement**

When treatment planning was completed, the jaw tracker was attached to the modified arm fixed to the central SDI. Implant site preparation was carried out with dynamic...
navigation. The Navident protocol for calibration of the drill axis and drill tip was followed, using the head of the SDIs as verification points to check accurate calibration (Figure 10).

Six Dentsply Sirona Ankylos C/X implants were placed in the upper first molar, upper first premolar and upper lateral incisor sites (Figure 11). The implants in the first molar sites were angled mesially to avoid intrusion into the maxillary sinus on either side. In sites where extractions had been carried out, the implants were placed into the sockets (Figure 12). In the other sites, they were placed with a flapless procedure.

For this protocol, implant site preparations are carried out with only the base frame in the mouth, but the shell guide can be attached to the base frame, as required, to check the positioning of the implants (Figure 13).

**Accurate modelling**

After all six implants were placed in restoratively driven positions (Figure 14), Ankylos Balance Base abutments were attached. Impression transfer posts were then screwed onto the abutments (Figure 15). A 3M Impregum polyether impression was taken around the transfer posts, using the shell guide to act as an impression tray (Figure 16).

Once the material had set, the transfer posts were disengaged from the implants and the shell guide was removed from the mouth. The horizontal SDIs were unscrewed and the base frame was removed. The base frame was reattached to the shell guide, implant analogues were fitted to the transfer posts and a working model was produced with the base frame securely attached (Figure 17).

The master model had dummy implants in exactly the same position as the real implants. The shell guide was removed from the model, and the temporary bridge fitted onto the model by locating it on the base.
Throughout 2020, David Burgess will be presenting courses on how freehand surgery using real-time computer guidance aids more accurate implant placement. Further details and booking information can be found at http://bit.ly/DNSUKcourses.

Unrestricted visibility and access

The unique features of this protocol include:

- The base frame, with modular overlays and passive fixation to SDIs.
- The protocol also incorporates ring radiographic markers on the base frame, to provide registration of the patient's jaw to the virtual image.
- It employs dynamic navigation for the placement of implants in a full arch, without restriction of visibility or access. Precise location of the temporary bridge into its predetermined position is facilitated by transfer of the base frame to the master model.
- The shell guide and radiopaque replica will form the template for the permanent bridge, which will be manufactured from the working model, with the base frame attached, once implant integration is complete.

An additional impression will be required to show soft tissue changes. The base frame attached to the model will ensure the position of the permanent bridge will be identical to the temporary, though changes can be made if necessary. This saves time and reduces the number of visits required.

Natural look

This novel protocol for the use of dynamic navigation in full-arch cases proved to be highly effective.

The step-by-step approach, with modular overlays attached to a base frame, ensured the implants were placed in restoratively driven positions with accuracy and safety.

Transfer of the base frame to the working model enabled the technician to finish the temporary bridge in the exact desired position, resulting in minimal adjustment when fitted to the implants.

The patient was particularly happy with the natural look of the temporary bridge, and the minimal postoperative discomfort (Figure 22).