Modern workflow of immediate zirconia implant surgery utilising dynamic navigation: case studies and benefit analysis

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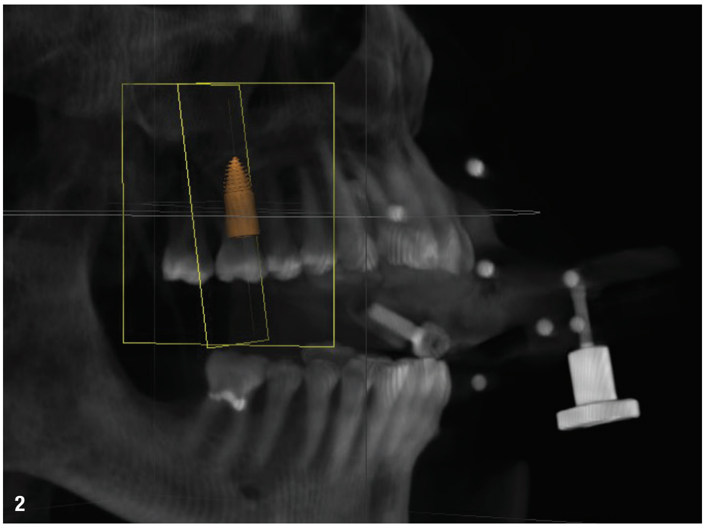
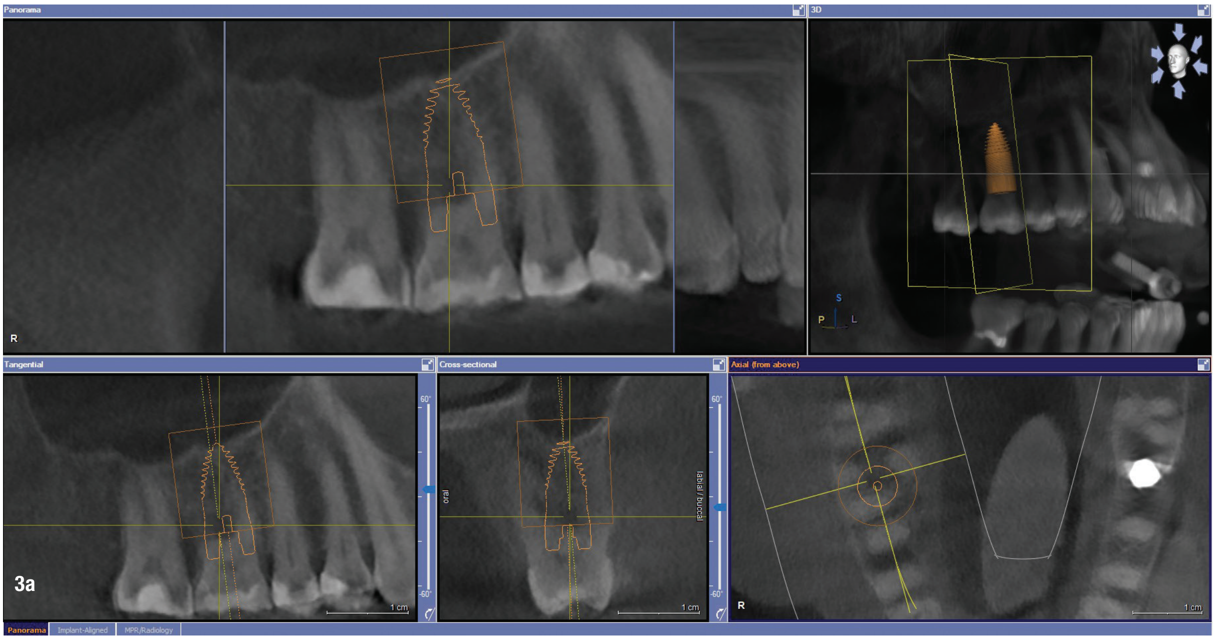


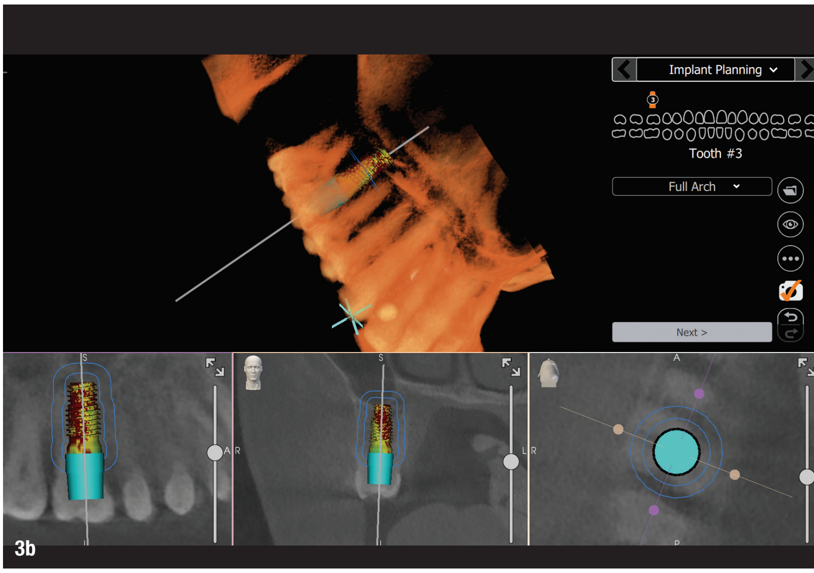
Fig. 1: Yomi-Link and fiduciary array. **Fig. 2:** CBCT of initial situation with link attached.

Dental implant therapy is an integral and growing treatment modality for today's clinicians. With the advent of digital workflows dental implant treatment has become more accessible, faster, safer, and more predictable. All which can provide a better patient experience and more idealised final restorations.

As the knowledge of the excellent healing profiles and popularity of zirconia implants continues to grow, ideal placement and treatment outcomes of these implants becomes ever more important.[6–9] As such we must look at designing predictable and repeatable surgeries. Studies have shown adding dynamic navigation resulted in higher accuracy than the freehand surgical method and while similar accuracies were found between dynamic navigation and static guidance for deviations; we will look at some potential benefits of dynamic guidance using the Yomi platform (Neocis Inc.) over static guidance in the digital implant workflow.[1–5]

Despite the introduction of CBCT-based planning software and fabrication of static surgical guides, challenges remain in efficiently and accurately transferring the plans to surgery. Limitations inherent in the static guide workflow include multiple steps and appointments in fabrication, the risk of poorly fitting guides, and the physical bulk of the guide impeding surgical site access and visualisation.[1–5] Immediate dental implant placement in conjunction with tooth extraction can require us to be dynamic in our placement. We as dental surgeons know that sometimes what we plan on a CBCT and what we see visually intra-orally, may have us wanting to alter our plan. Immediate implants have well documented success rates and navigating anatomical variations and tooth associated pathologies is essential to their long-term success.[12] Small changes in direction, depth and angulation can be the difference between success with proper initial stability and the inability to place the implant the same day. Robotic assistance using haptic boundaries





Figs. 3a & b: Surgical planning for bicortical fixation with placement in furcal bone.

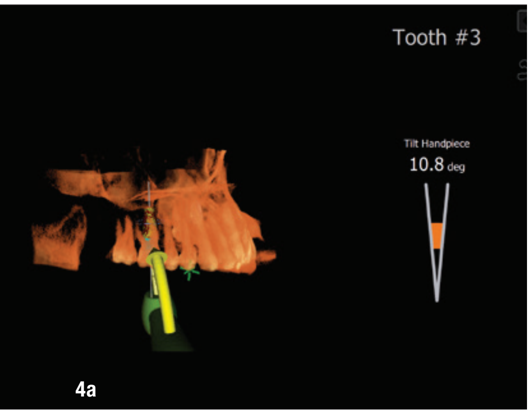
has been shown to enhance accuracy, precision, and flexibility across surgical fields.[1,2] The Yomi dynamic navigation platform with haptic feedback allows for small adjustments in real time and accurate visualisation of drills into the surgical site. This can be significantly impactful when managing close implant placement to sensitive anatomical structures of the IAN, drill depth management in vertical sinus lift augmentation, and assuring immediate implant placement into adequate native bone. The following case studies will review the digital workflow of dynamic navigation with Yomi when performing immediate zirconia implant surgery and the perceived benefits therein.

Case presentations

Case 1

A 60-year-old female presented with history of LANAP at the periodontist on #3 for a 9mm periodontal pocket on the DB one year ago. Upon recall at the periodontist, the vertical bone defect was non healing, and the tooth was deemed hopeless. The patient came to our clinic hoping for extraction and immediate implant placement, risks and alternatives were given to the patient including the possibility of inability to place the implant the same day due to bone anatomy in the area.

Yomi link was attached to her upper left using bite registration and a CBCT was taken with the additional fiduciary arrays attached to the link (Figs. 1 & 2). Surgery was planned for bicortical fixation with placement in furcal bone avoiding the defect on distal (Figs. 3a & b). The surgical procedure involved a planned implant depth to the sinus floor, followed by a gradual increase in depth to perform an internal sinus lift. The extraction was carried out atraumatically, and the socket was thoroughly cleaned. Yomi guide arm was then attached to the link and the landmark verified, ensuring accurate stable navigation. Under surgeon guidance and robotic assistance the pilot drill was guided to the surgical site. The osteotomy continued with a drill path and depth that locked once in the planned position. The osteotomy was completed to the sinus floor with confirmation of depth via dynamic live CBCT navigation. Incremental advancement of the drill depth stop was used to complete the sinus lift. Proper visualisation aided in depth management of the transgingival implant. The implant (2.2_5411, SDS) was placed



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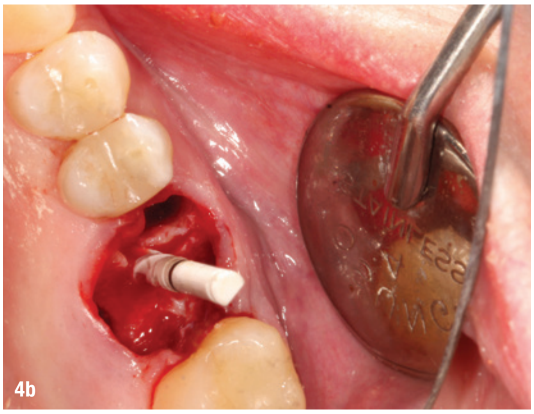
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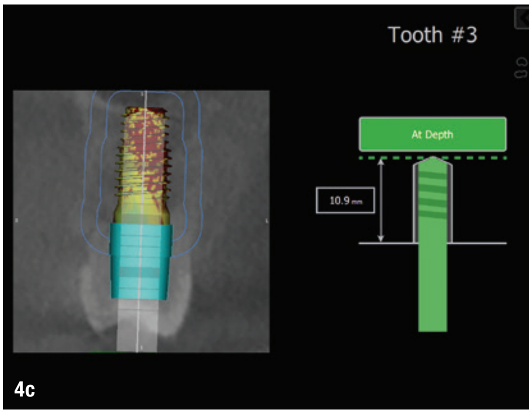

4c

to 35 Ncm, and the sockets were subsequently grafted with allograft (cortical min/demin blend, particle size .25–1mm), hydrated with i-PRF, and covered with an A-PRF+ membrane that was sutured in place (Figs. 5 & 6). The postoperative radiograph showed accurate implant placement (Fig. 7).

Discussion

Visualisation of the surgical site was crucial in this scenario to prevent a bone defect on the distal and ensure sufficient native bone around our implant. The plan and guide path were adjusted in real time for ideal depth and location to achieve optimum results.

Case 2

The patient presented having previously seen an endodontist who deemed the retreatment of tooth 19 non-restorable. The patient wanted to explore replacement options, and a comprehensive clinical assessment was performed, including CBCT and bitewing radiographs. Multiple periapical radiolucencies were noted, associated with failing root canals of teeth 19, 21, and 27, and a horizontal root fracture was observed in tooth 29 (Figs. 8a & b). Due to decay and abscess, a failing double abutted bridge was observed in teeth 21/22-27/28, making full-mouth rehabilitation without implants a poor option (Fig. 9).


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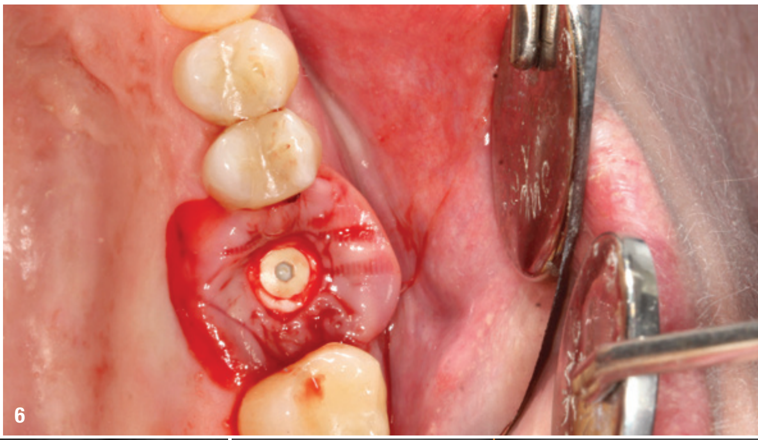
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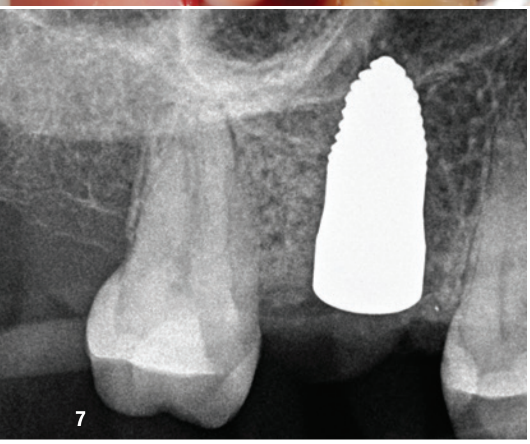
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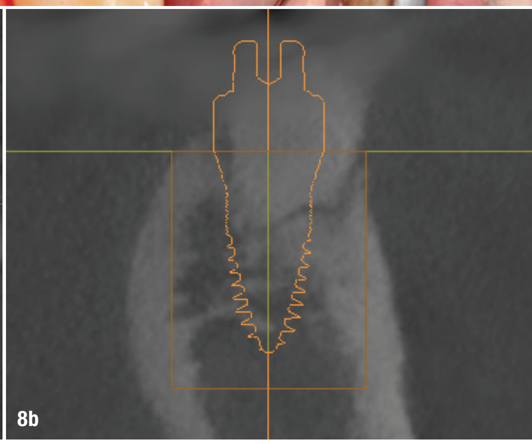
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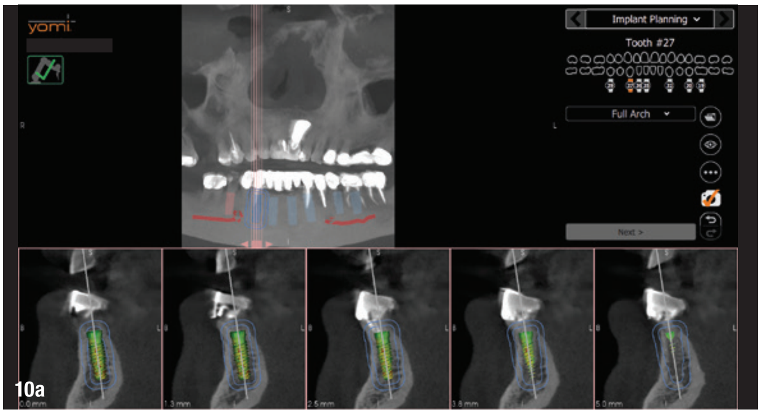

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Treatment plan

A thorough discussion of treatment options, limitations and risks was reviewed with the patient. Poor long-term prognosis was given to remaining mandibular teeth except #30. The patient's primary concerns were to have no teeth during healing, not wanting a removable prosthesis, and to have biologically friendly materials. Delicate consideration was made to design an immediate implant surgery that provided the patient with a stable temporary restoration and protected our healing implants. One-piece SDS (Swiss Dental Solutions) implants were chosen for their variety of diameters and lengths. Posterior teeth 18, 28, 30 were elected to remain in place during the temporary healing phase to provide posterior stops for occlusion and to maintain stability of implants and temporary restoration during healing phase. Pre-surgical planning was performed using CBCT and Yomi planning software to parallel all implants (Figs. 10a & b). Preoperative maxillary and mandibular arch scans were taken and sent to the lab to aid in temp mock-up (Fig. 11).

Surgical Phase

The procedure began with the administration of bilateral inferior alveolar nerve blocks for anaesthesia, followed by sectioning and removal of the PFM bridge. The Yomi link was then attached to the lower left using bite regis-


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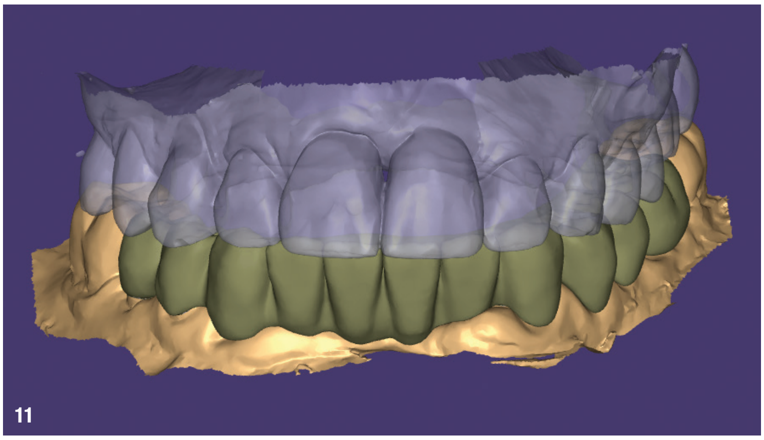
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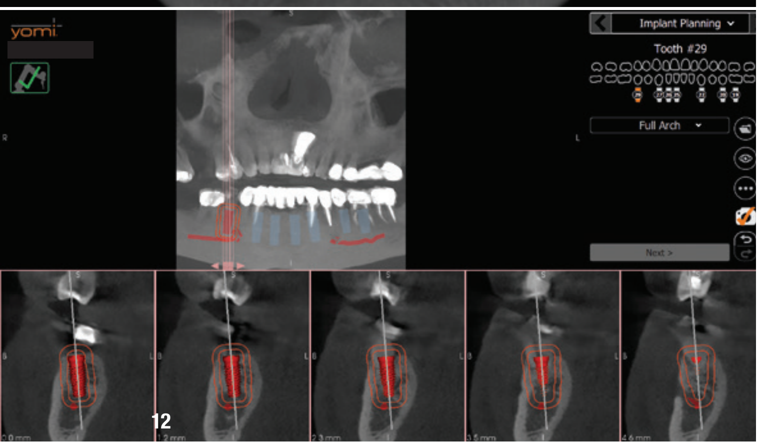

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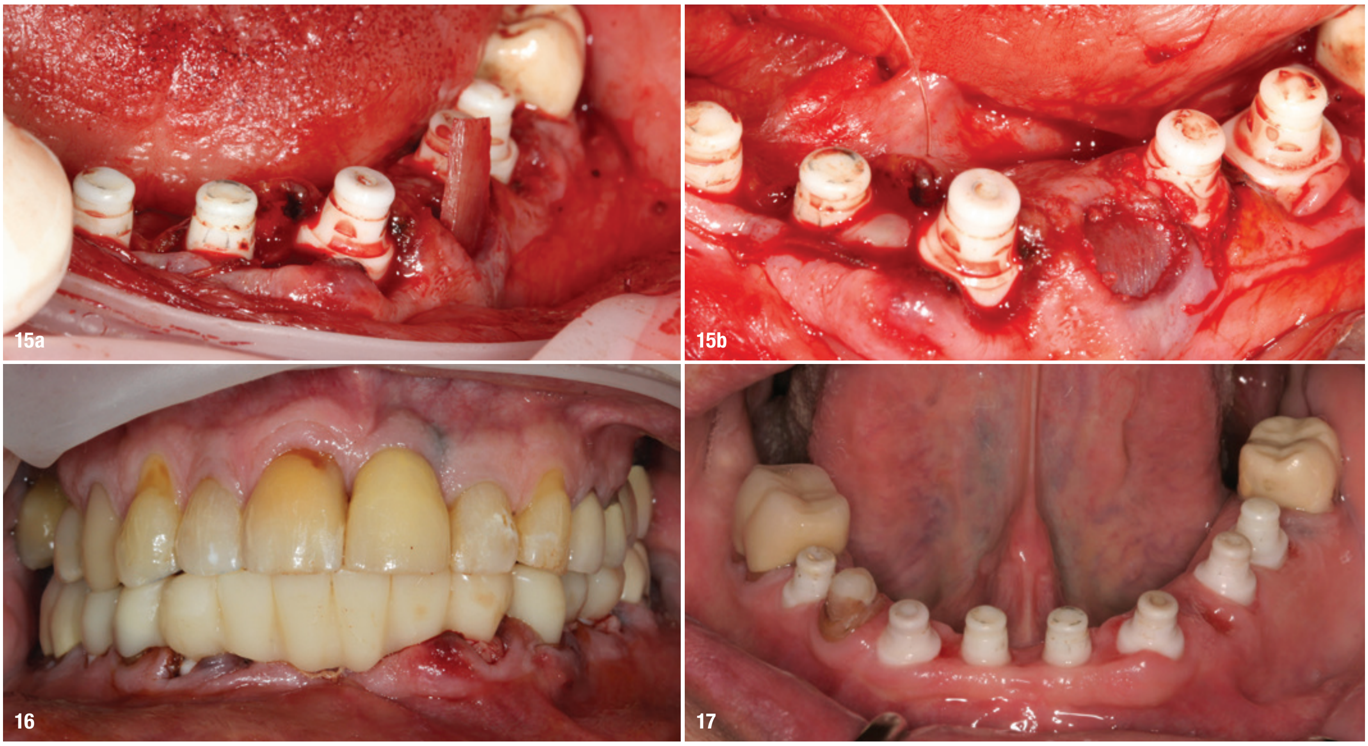
Fig. 4a: Placement of the pilot drill into the surgical site via dynamic live CBCT navigation. **Figs. 4b & c:** Osteotomy was completed to the sinus floor with confirmation of depth via dynamic live CBCT navigation. **Fig. 5:** Placement of the ceramic implant (2.2_5411, SDS) to 35 Ncm. **Fig. 6:** PRF covering with allograft. **Fig. 7:** Postoperative radiograph showing accurate implant placement. **Fig. 8a:** Initial situation on CBCT showing multiple periapical radiolucencies associated with failing root canals of teeth 19, 21, and 27. **Fig. 8b:** Horizontal root fracture in tooth 29. **Fig. 9:** Failing double abutted bridge in teeth 21/22-27/28. **Figs. 10a & b:** Pre-surgical planning using CBCT and Yomi. **Fig. 11:** Preoperative maxillary, mandibular and bite scans to aid in temp mock-up. **Fig. 12:** Immediate implantation in site #29 using the Yomi robot with haptic controls and locked drill path depth and angulation.

Fig. 13: Intra-oral scans of the surgical sites for temporary fabrication. **Fig. 14:** 3D lab-printed temporary with Flexera-Smile Ultra+ (Desktop Health).

tration, and a CBCT scan with fiducial arrays was taken for accurate planning. The placement of the link allowed for complete visualisation of the surgical field between teeth #22 and 30. A-PRF+ and i-PRF were created using horizontal centrifugation to aid in healing. Atraumatic extractions of teeth #29, 27, and 22 were performed initially, followed by the creation of a small crestal incision and full-thickness flap from teeth #27 to 22. The surgical sites were degranulated using curettage and degranulation burs, and decontamination ozone therapy was administered to the sockets using 03 gas and 03 water. Surgery was then initiated using a lance drill in sites #29, 27, 25, and 24, with osteotomies being incrementally increased to manufacturer's recommendations. The orientation of the drills was confirmed intraorally and via dynamic live CBCT navigation. Close proximity to the nerve was successfully navigated during immediate implantation in site #29 with high confidence using haptic controls and locked drill path depth and angulation with Yomi robot (Fig. 12). Implants were placed in sites 29, 27, 25, and 24. The first phase of the surgery was completed in approximately 90 minutes, and the Yomi link was removed, and the guide arm detached.

The second phase involved the removal of teeth 19, 20, 21, and 22. An attempt was made to connect link to



Figs. 15a & b: Placement of laminar bone sheet into minimally released buccal and lingual flap. **Fig. 16:** Full arch temp adjusted and seated with temp cement. **Fig. 17:** Excellent healing situation seven weeks after surgery.

the the lower right side of the patient's mouth, utilising teeth 30 and 28, and implant abutments 29 and 27, but it was then unsuccessful. Yomi's traditional workflow only allows for working on one quadrant of the mouth at a time, and a new scan and four or more stable teeth are required to anchor the link on the other side. This has now been overcome with a new Yomi bone link which would have been ideal in this case.

Freehand immediate placement and parallelisation of implants (#22, 20, and 19) was possible with the visual aid of the previous implants. Intra-oral scans of the surgical sites were made and sent to the lab for temporary fabrication (Figs. 13 & 14). Site #21 had significant bone loss due to infection and was grafted with allograft and a laminar bone sheet. The bone sheet was trimmed and placed into a minimally released buccal and lingual flap and covered with A-PRF+ (Figs. 15a & b). Suturing was completed, and a full arch temp was adjusted and seated with temp cement (Fig. 16). Seven weeks later, the patient's loose temp was removed, cleaned, and recemented. Excellent healing of the soft tissue was shown in Figure 17.

Discussion

Ceramic dental implant placement can be a delicate process, having ideal emergence with one piece dental implants remains one of the biggest challenges and ideal placement is essential. A fixed drill path and depth combined with Yomi's surgical flexibility and the dentist's visualisation during surgery may be one of its advantages over other guided navigation systems. As patient awareness grows of different dental materials, zirconia implants with their excellent healing profiles are poised to continue to gain attention. Accurate and ideal placement of zirconia implants is essential in gaining trust of our patients and dental community. With the variety of modern digital workflows choosing a surgical method that is predictable and repeatable is what we as clinicians must evaluate. The benefits of robotic assistance point towards Yomi holding its place in the surgical suite and will likely continue to pave the path forward in giving patients access to safe, efficient, accurate and long-lasting zirconia implant therapy.

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about the author

Dr Daniel Madden received his Doctor of Dental Surgery from the University of Minnesota and pursued advanced studies in implantology and comprehensive dentistry abroad at the Radboud University Medical Center in Nijmegen, the Netherlands. He has served as adjunct affiliate assistant professor at Oregon Health and Science University and is a certified Integrative Nutrition Health Coach. He has a passion for education and technology in dentistry, and believes that this leads to a more comfortable, efficient and pleasurable patient experience. He offers patients biologic treatment solutions for optimum oral and whole-body health at Lotus Dental Wellness in Lake Oswego, Oregon, and his surgical services through his company Peak Potential Dental at multiple private practice locations in Oregon and Washington State.

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Literature