An Interdisciplinary Collaborative Care Experience Using the Reference Denture Technique

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Computer-aided design and manufacturing technology is an emerging method for fabricating complete dentures. It can either involve additive manufacturing or subtractive manufacturing. Some benefits of this technology include increased accuracy of fit of the prostheses, decreased number of appointments, customization of tooth arrangements, and ease of duplication of the denture (Bidra et. al, 2013, Anadioti et. al 2020, Janeva et. al 2018).

Many edentulous patients wear their prostheses for longer than they should, often because they are determined to avoid change. They fear a new denture might be less comfortable, less aesthetically pleasing, or simply different than their current prostheses, to which they have grown accustomed.

The reference denture technique, sometimes abbreviated as "RefDen" or called the "denture duplication workflow," is an instructive pathway toward digital dentures that has created a paradigm shift in removable oral prostheses. By providing technicians with a sophisticated digital record of a patient's existing information, the technique allows us to rehabilitate them more confidently, predictably, and precisely then would otherwise be possible.

When executed correctly, this technique allows for a high standard of precision care and craft when treating edentulous patients who are generally satisfied with their existing denture(s) but need a replacement at the end of a device's regular lifespan.

Clinicians and technicians across the globe prefer the technique for its seamless, technically and clinically integrated workflow, which delivers increased patient acceptance and satisfaction, reduces postoperative adjustments, and ultimately improves the patient experience as it requires fewer visits to the clinic.

The reference denture process starts with a complete 360-degree scan of the patient's existing denture(s), which creates detailed digital records (the "digital duplication") of the patient's existing prosthesis. Next, this duplication is 3D-printed and used clinically to produce closed-mouth functional final impressions and capture a new centric relation record. The advantages of this workflow is that the clinician can make the necessary adjustments to the tissue bearing surfaces or any areas of irritation or over extension during the clinical process. Following these procedures, the clinician will digitize this information utilizing an intra oral scanner. Both the clinician and the technician attending will possess the data necessary to fabricate a "Functional try-in" prosthesis, which is used to evaluate fit, form, function, aesthetic and phonetic performance. At this point, small-but-meaningful modifications can be communicated to the dental technician and precisely modified in the digital denture software and proceed to the fabrication of the final definitive restoration.

This article showcases fabrication of a complete maxillary denture and complete mandibular implant supported overdenture using the Reference Denture Technique.

Case Presentation:

The edentulous patient presented for fabrication of new dentures due to dissatisfaction with the aesthetics and fit of her existing prostheses. The complete maxillary denture was the original denture that was delivered immediately post-extraction of the maxillary dentition. The mandibular implant supported over denture was a relined and retrofitted version of the original immediate complete mandibular prosthesis. The patient, like many denture wearers, was reluctant to commit to a new set of dentures as she was generally very pleased with the fit and aesthetic appearance of her current (original) set. However, despite her general satisfaction and aversion to change, the patient recognized the occlusal surfaces of her current teeth had worn down, and so the device was objectively functioning improperly (Fig 1-2).


Fig. 1


Fig. 2


Fig. 3


Fig. 4

The patient communicated a desire for her new dentures to be as similar as possible to her current set, to which she had become anatomically, physiologically, neuromuscularly, and psychologically accustomed.

Treatment commenced in Toronto Ontario, where Dr. Habsha's team conducted a 360-degree "Reference Denture" scan of the patient's existing denture using an intra-oral scanner (3Shape Trios). This method allows prosthodontists and clinicians to modify the borders' labial portions required and any areas impinging on the soft and hard tissues as necessary (Fig 3).

The 360-degree scan data—the detailed digital record or "duplication" of the patient's existing situation—was sent digitally to The Denture Center's lab located 400km away in Windsor Ontario. Here, Kukucka and his team fabricated a 3D-printed duplication of the patient's initial situation based on Dr. Habsha's digital records (Fig 4). This was utilized in the next clinical appointment as a custom tray and centric relation recording device.

At the subsequent appointment, closed-mouth functional impressions in both the maxillary and mandibular duplicated dentures were conducted. This particular impression methodology allows the impression material to be distributed under the patient's functional forces and captures the oral cavity in a functional state. This set of impressions captures muscular mastication and facial expression. The borders are captured utilizing either a heavy body or monophase material Virtual (Ivoclar Vivdaent) (Fig 5-6) and the intaglio/ tissue bearing surfaces were captured utilizing light body Virtual (Ivoclar Vivadent) (Fig 7-8). A centric relation record was registered (Fig 9).

The patient's records were scanned utilizing the reference denture scan strategy to create global accuracy of the impression scans and centric relation record. These files were digitally transferred back to The Denture Center lab through the 3Shape Communicate platform. (Fig 10)

Kukucka and his team designed a new smile utilizing 3Shape Dental Systems software based on the clinical parameters established by Dr. Habsha. The scanned reference dentures were utilized as a guide to position the anatomical tooth arches (Phonares S71-L50-NU3 NL3) (Fig 11-12) and produced a new digital oral prosthetic

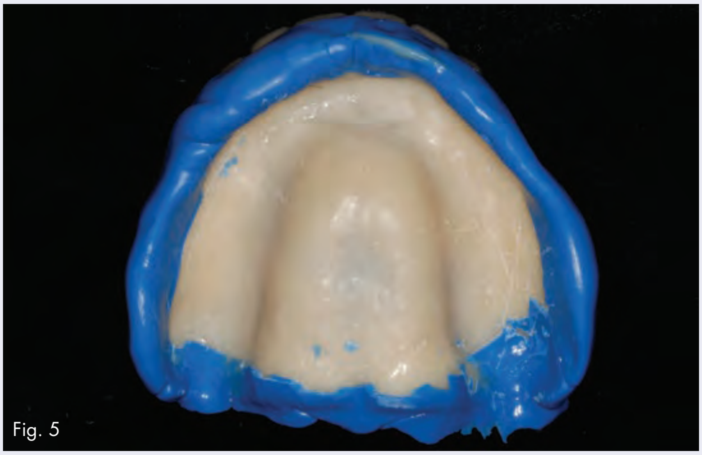

Fig. 5

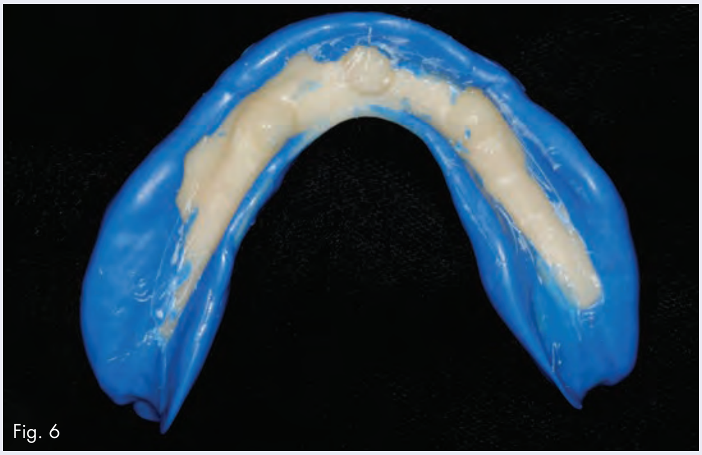

Fig. 6

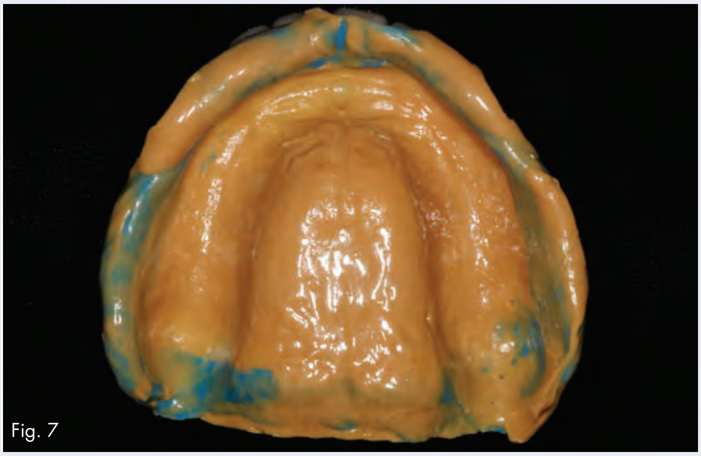

Fig. 7

Fig. 8

called a "functional try-in" prosthesis. This transitional product allows the clinician to evaluate the fit, form, function, aesthetic and phonetic performance of a denture-in-progress.

As a comparative demonstration, The Denture Center team produced and presented the patient with two slightly different try-in prostheses. The first option included some gingival composite (Sr. Nexco) added to the gingiva and the interdental papillae regions anterior teeth in both arches to highlight the high smile line for the patient's benefit (Fig 13). The second option omitted the gingival composite and was strictly what is known as a mono block try-in which is one solid shade (Fig 14).

After the initial proposal, the patient was excited. Still, despite her evident enthusiasm, minor prosthetic changes were requested by the clinician in order to enhance the prosthetic's aesthetic appearance (Fig 15). The maxillary central incisors of teeth 11 and 21 were made one millimetre longer and the buccal cusps of teeth 14 and 24 were modified (Fig 16-17). These changes were conducted in the 3Shape Denture Design software with precision and simplicity.

Once the final design was approved, The Denture Center lab milled the pink denture base from Ivoclar Vivadent's Ivotion Base, and the teeth from the company's Ivotion Dent Multi, a monolithic, polychromatic double cross-linked polymethyl methacrylate (PMMA) material (Fig 18-19). Note that, as an option, Ivoclar's revolutionary monolithic IVOTION Bi-Coloured CAD/CAM disc features both white tooth and pink denture base materials in one and can also be utilized in this indication (Fig 20). However the patient was very aesthetically driven: therefore the Ivotion Dent Multi was selected as the material of choice.

Kukucka's team used the patented Ivotion Digital Denture System "Oversized Milling Process," which meaningfully improves denture manufacturing process efficiencies and the accuracy, predictability, and overall strength of the restorations – largely by removing the need for manual removal of excess bonding material. The team

Fig. 9

Fig. 10

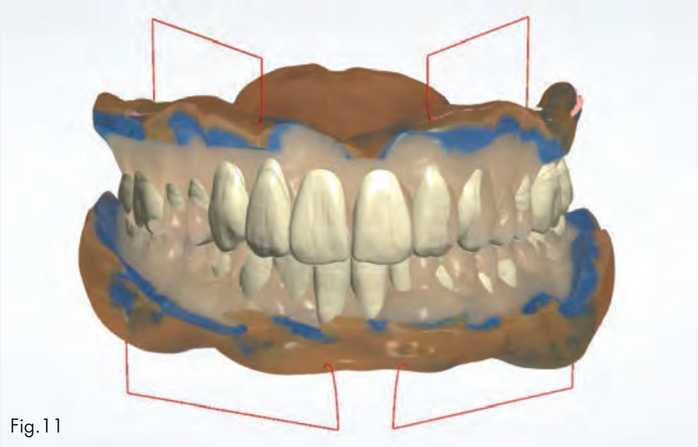

Fig.11

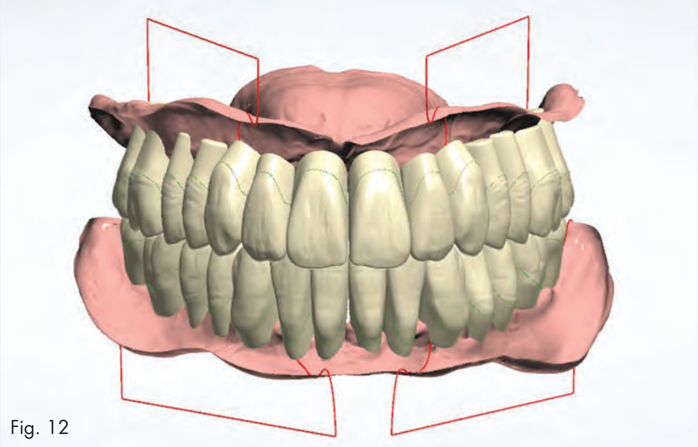

Fig. 12

Fig.13

Fig. 14

decided the Oversized Milling Process represented the ideal methodology for this unique case.

In accordance with this process, both the tooth arch and denture base were milled to approximately 80% completion, while the base sockets and tooth necks were milled to precise standards. At this stage, the arches were bonded together using Ivotion Bond, an auto-polymerizing PMMA-based material that enables a seamless chemical bond between the tooth structure and the denture base (Fig 21-22).

Finally, the denture was returned to the milling machine for finishing.

These photos represent the ultimate product, which satisfied the patient's desire for optimal aesthetic results (Fig 23-24).


Fig. 15


Fig. 16


Fig. 17


Fig. 18


Fig. 19


Fig. 20

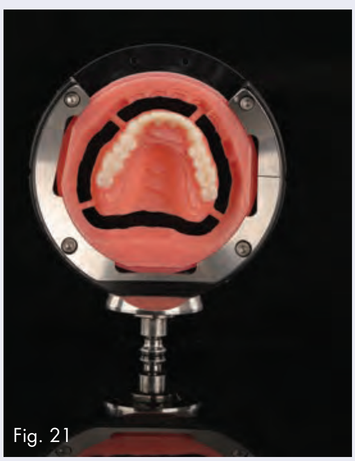
Fig. 21


Fig. 22

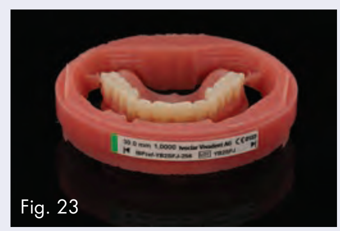
Fig. 23

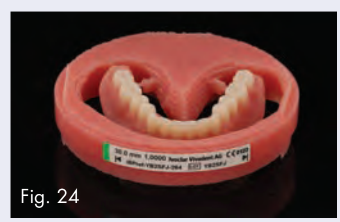
Fig. 24

Note that the final definitive restoration in this case involved an intraoral direct chair side conversion of the locator housings (Fig 25). The Milled prosthetics are finalized with a high polish (Fig 26-27).

This case study demonstrates two distinct manufacturing methods, the first as previously described and the second using a metal mesh framework. Note in the photos where the team has used digital denture technology to fabricate a metal framework surrounding the three dental implants (Fig 28). As demonstrated in the photos, the team captured a closed-mouth final impression in the mandible to pour a master cast. (Fig 29-30). Next, the cast was embedded with the metal framework and injected with SR IvoBase moulding material, which "wrapped" around the metal, increasing the strength and rigidity of the mandibular prosthesis. This process is very similar to a rebase modality in conventional dentures (Fig 31).

At the patient's post-operative appointment, the dentures required only minimal adjustments. The patient achieved excellent results in terms of fit, stability, aesthetic and phonetic function. She was thrilled with the results and the general interdisciplinary collaborative care experience (Fig 32-34).

Discussion:

Digital dentures have revolutionized the way we conceptualize and fabricate removable prostheses. The unprecedented possibilities for collaborative, interdisciplinary care opened by digital dentures cannot be ignored if we truly wish to deliver the best possible patient experience.


Fig. 25


Fig. 26


Fig. 27

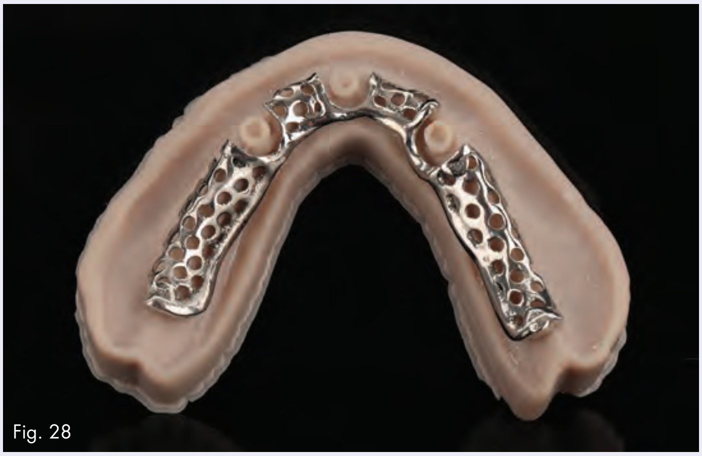
Fig. 28


Fig. 29

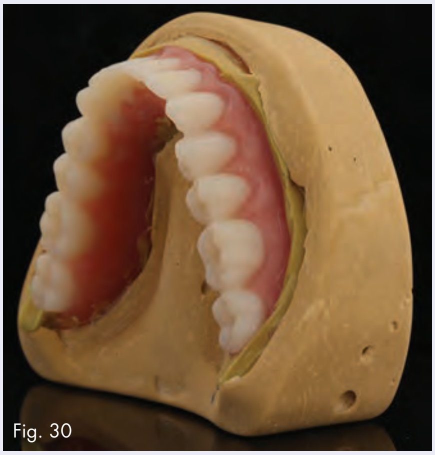
Fig. 30


Fig. 31


Fig. 32


Fig. 33


Fig. 34

Never before have oral health care professionals in different facilities, fields, and locations been able to communicate such granular, sophisticated data as precisely and efficiently as now. The current digital denture workflows allow clinicians to capture and digitize a patient's oral cavity with tremendous detail and to design and produce removable prostheses with extreme accuracy and predictability, thus minimizing the amount of post insertion adjustments.

While the reference denture treatment framework is clearly an effective and versatile treatment, it is yet to be recognized as a global standard for removable prosthodontics. Furthermore, many clinicians are reluctant to incorporate a digital denture workflow due to their lack of understanding and practice executing the technique. In our experience, clinicians and lab technicians often shy away from digital dentures and other emergent technologies because of a fundamental fear of the unknown: they aren't familiar with the technology, they avoid change as a rule, and/or they simply to not understand how to best implement it in their respective professional environments.

In time, we expect the overwhelming evidence for the efficacy of digital denture workflows will influence these attitudes to change. Ultimately, the goal of removable prosthodontic rehabilitation is to improve a patient's functional oral situation physiologically and neuromuscularly. If we do this, we improve that patient's quality of life. We believe, in many cases, the best means to this end is teamwork — and many of the very best possibilities for the precise connectivity and information sharing that drives effective teamwork are right in front of us in our clinical settings, workstations and on our computer screens. ■

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