How to do dentures digitally

The Reference Denture Protocol

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Renowned denturist and lecturer, Mr. Eric Kukucka, believes that producing dentures digitally enables professionals to "rehabilitate patients more confidently, predictably, and accurately than previously possible."

He adds that going digital with your denture workflow creates "a seamless technically and clinically integrated workflow. It is a 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."

According to Kukucka, a digital workflow can reduce a patient's clinic visits to only two or three appointments versus five in a conventional workflow. Working digitally can also reduce labor time by over 33 percent. When compared with the conventional workflow of approximately seven and a half hours the digital workflow can be carried out in as little as two and a half hours.

Whether you are a dentist, prosthodontist, lab technician, denturist, dental professional, this digital denture eBook series will help you successfully take advantage of digital pathways when designing and manufacturing dentures.
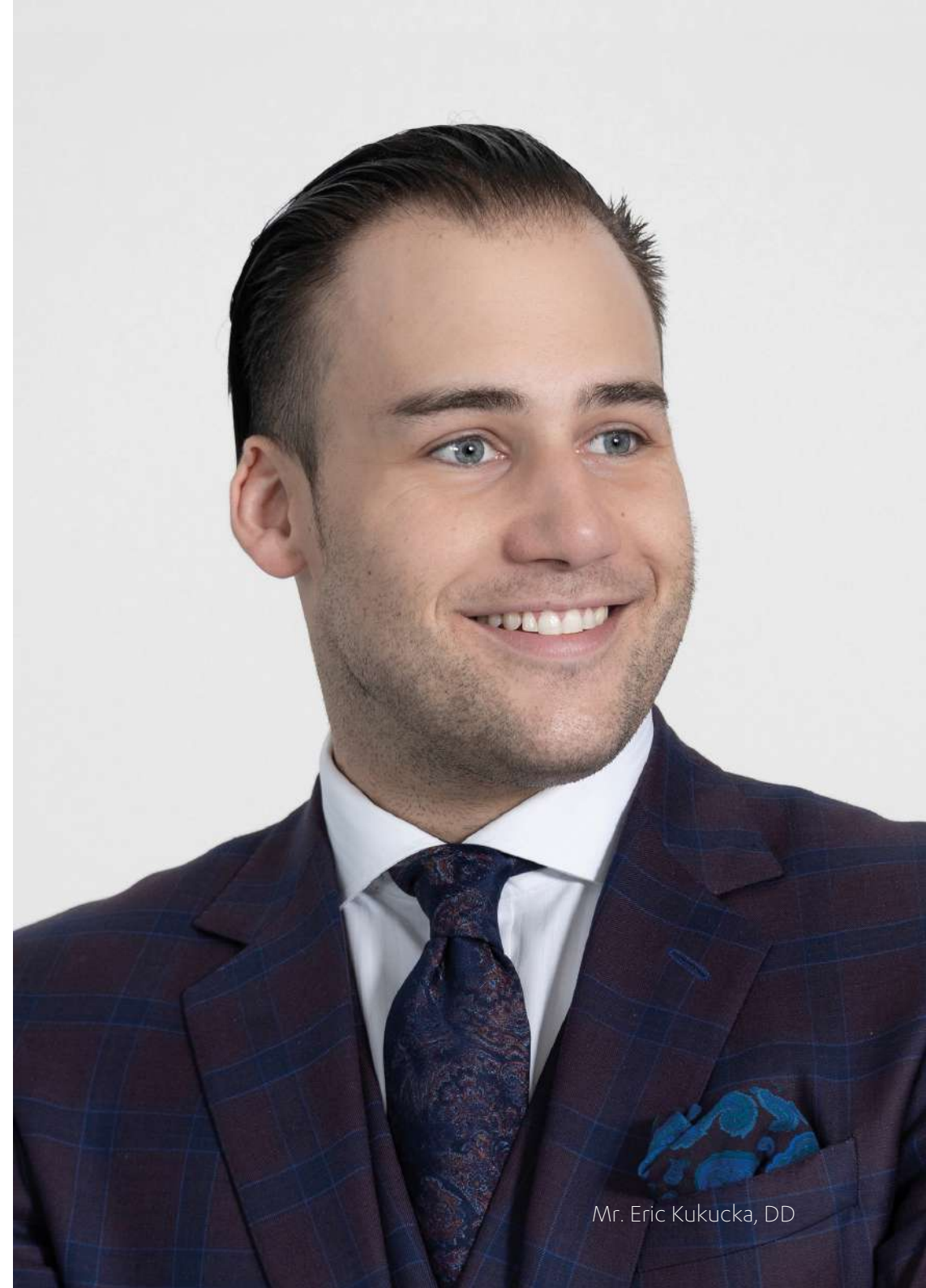
Mr. Eric Kukucka, DD

Two-eBook series

The two-part eBook series focuses on important protocols within the digital denture ecosystem. The books include protocols for capturing clinical records, digitizing these records, utilizing an intraoral scanner, and optimizing your workflows.

Each eBook, in the two-part series, focuses on a protocol for capturing scan data using an intraoral scanner and the workflows needed to document the patient's oral situation.

The first eBook outlines the reference denture protocol for data acquisition. It is based on the patient's present prosthesis and uses both digital and conventional impressions.

The second eBook focuses on workflows for documenting the patient's oral situation using only an intraoral scanner for data acquisition on fully or partially edentulous patients - first time denture wearers.

Throughout the two eBooks, workflows, a variety of protocols, and advice are generously provided by experts within the field. Diagrams and methods of recommended intraoral scan paths are included.

While methods may differ, the contributing professionals in this series unanimously agree that scanning and producing dentures digitally leads to a reduction in chair time, less appointments, and higher consistency in the quality, design, and overall fit of your prosthesis.

Dutch denturist, Germen Versteeg adds that since going digital, his business has grown by 300%!

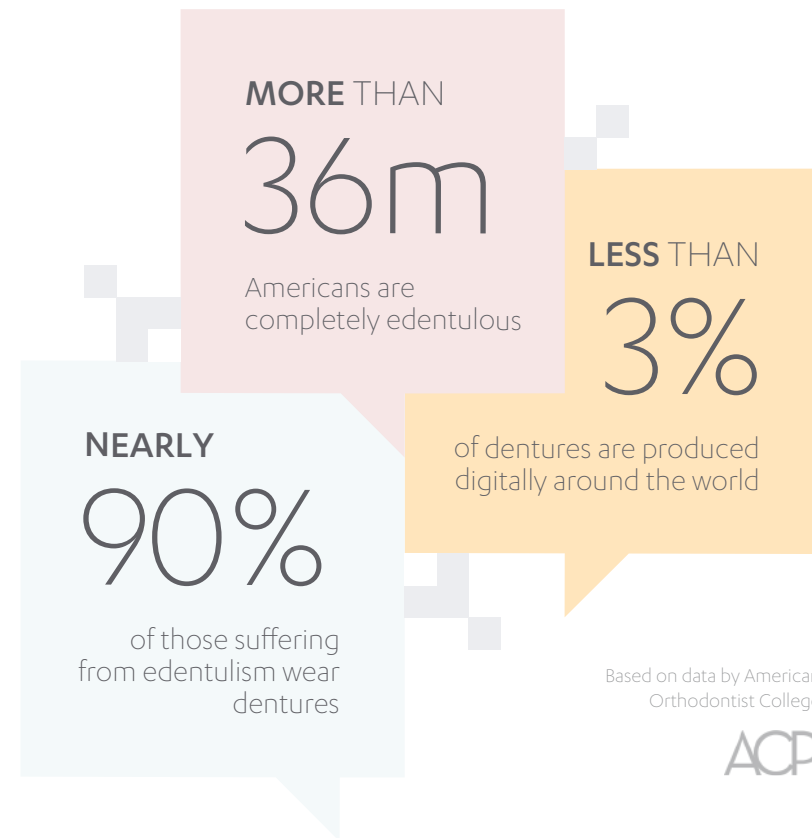## Better for them, better for you.

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Background

According to the American College of Prosthodontists, more than 36 million Americans are completely edentulous, with 120 million people in the U.S.A. missing at least one tooth. These numbers are expected to grow in the next two decades.

In the USA's geriatric population, the ratio of edentulous individuals is 2 to 1. About 23 million are completely edentulous with approximately 12 million edentulous in one arch.

Of the edentulous population, 90 percent of those suffering from edentulism wear dentures. The number of partially edentulous patients is expected to grow over the next 15 years to more than 200 million.

According to global statistics, some 50 million removable dentures are produced per year. With less than 3% being digitally produced.

These numbers highlight that the need for dentures is growing exponentially. This eBook series will provide you with important insights and techniques to help you meet the growing demand. And do so, with more efficient and predictable outcomes, according to the contributors to this eBooks.

MORE THAN

36m

Americans are completely edentulous

LESS THAN

3%

of dentures are produced digitally around the world

NEARLY

90%

of those suffering from edentulism wear dentures

Based on data by American Orthodontist College

ACP

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The Reference
Denture Protocol

The reference denture protocol uses a patient's existing denture as a reference to create a new digital denture. The reference denture is used as a guide to produce functional impressions and to position the anatomical tooth arches and produce a new digital removable prosthesis.

In our workflow example, the reference denture is scanned with a **3Shape TRIOS** intraoral scanner. This scanned data is then used to create the digital denture design.

According to USA-based practitioner, **Dr. Michael Scherer**, the reference denture technique accounts for approximately 85% of the dentures he fabricates within his practice. He adds that "with the other 15%, the dentures are either so bad that I cannot use them, or the patient wishes to use their existing denture and I reline it instead."

As the reference denture technique has become more commonplace, tutorials are available. **Mr. Eric Kukucka** has kindly shared his expertise and protocol.

Eric maps out the reference denture protocol technique step-by-step. This includes not only his scan strategies, but a "how-to" for documenting the patient's oral situation & clinical protocols.

Reminder

" Remember to first confirm that the patient's existing denture meets basic acceptable criteria established by Sato et al. These criteria include, acceptable VDO, acceptable centric, no/minor esthetic change requests, phonetics within approximate range, and minimally overextended or underextended borders. If these criteria are not met, then adjustments will need to be made before the denture can be used as a reference. "

Dr. Michael Scherer
LearnDigitalDentures.com

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Securing case acceptance
with 3Shape Smile Design

As a prelude to beginning the workflow, Eric Kukucka recommends using **3Shape Smile Design** to create patient excitement and confidence around the treatment. A smile design can also assist in facilitating the aesthetic outcomes and tooth positions of the new prosthesis

Dr. Edmond Armand Bedrossian, a US-based Prosthodontist agrees. He says that "the ability to perform a digital smile design within the TRIOS software is very powerful... not only for communication between the clinician and his laboratory but with his patient as well. It allows them to envision the proposed treatment outcome."

Kukucka believes that the smile design app can aid both the clinician and dental technician when selecting the ideal tooth morphology, as well as shade. He recommends the use of smile design for both an edentulous situation as well as layering the design over a reference denture to help the patient gain perspective as to how they will look with the newly proposed denture design.

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Creating functional impressions —
verifying the patient's dental situation

Step by Step Guideline
for taking a conventional impression
using the reference denture

Eric Kukucka prefers to prefers to line the reference denture with impression material and use a functional impression technique to capture the patient's muscle movements of mastication and facial expressions.

Eric shares his guide to taking this conventional impression.

Step 1

Depending on the current denture border extensions, heavy body or monophase material should be used (Virtual Ivoclar Vivadent is used in this example). If the denture border is significantly underextended, then heavy body material is merited. If the borders are within normal limits, then a monophase material is indicated for the border moulding of the peripheral borders of the denture.

Step 2

Final wash impression of intaglio surface is conducted utilizing light body impression material. (Virtual Ivoclar Vivadent used in this example)

Step 3

Optional Monophase post dam, this technique provides the highest degree of suction effectiveness in the maxillary prosthesis.

Step 4

Capturing the centric relation record — it is important to facilitate this registration in the patient's most retruded unstrained repeatable position.

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Documenting the functional movements
of the oral cavity with the conventional impression

Once the impression material is applied to the prothesis, the technique for documenting both the mandibular and maxillary arches involves seating the prosthesis in the oral cavity. Hold it for 7 seconds and then have the patient swallow and close. Then have the patient with their mouth closed, say ooo-eeee.

Next, have the patient open, and utilize your index finger on the buccal aspect of the dentures to keep the dentures stable and ask the patient to stick their tongue straight out and move it side to side.

Lastly, the patient will press their tongue against their palate then swallow and close.

According to Mr. Kukucka, these functional movements will result in the most ideal impression attainable.

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Reference
Denture Scan Strategy
by Mr. Eric Kukucka, DD

Getting Started

❶ Before you begin scanning, evaluate the prosthesis for its distinct characteristics, considering undercuts; the depth, height, and width of the alveolar ridges; peripheral border thickness; and overall size and shape. Go over the scan strategy in your mind. Visualize the win, by which is meant a perfect scan.

❷ **Important:** After the impressions are completed, remove any excess impression material on the facial, buccal, occlusal, and lingual aspects of the prosthesis to avoid miss-alignment of scans and inaccuracies in occlusion.

❸ Under the order form creation in **3Shape Unite**, select the removeable scanning indication. Once you have selected the removeable indication and manually selected the arches you wish to scan, the system will prompt you and ask: "how do you wish to Scan the Lower Jaw" / "How do you wish to scan the Upper Jaw". Since we are scanning reference denture impressions, we will be selecting impression scan.
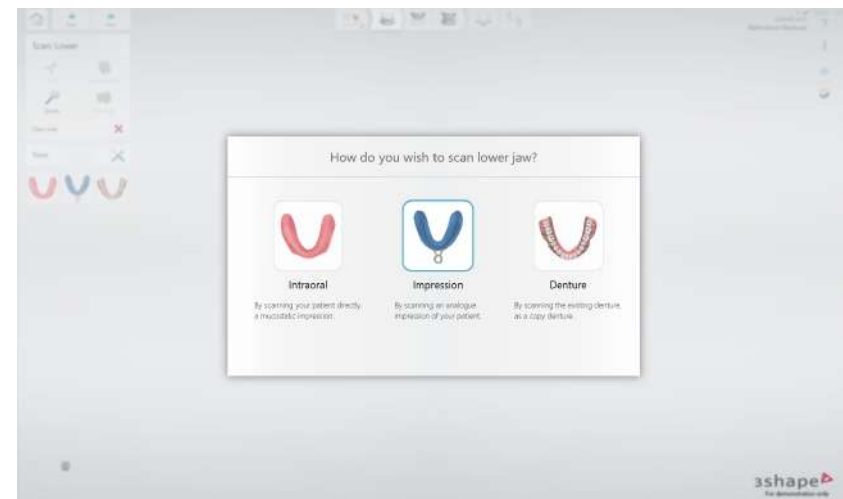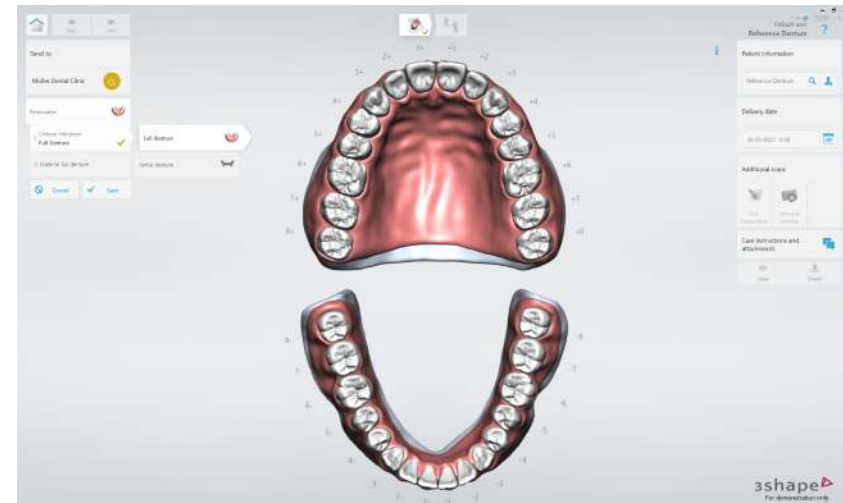
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Maxilla scan strategy

Step by step

A proper strategy is required to achieve global accuracy in scanning the maxillary impression within the prosthesis due to its wide surface and anatomical features, including palate shape, undercuts, and ridge form. Fortunately, this can be handled easily.

Step **1**

Start the scanning process from the tuberosity area of one side of the prosthesis and proceed along the center of the residual ridge towards the tuberosity area of the opposite side.

Step **2**

Return to the midline and complete the scan of the palate using smooth side-to-side movements.

Step **3**

Proceed with scanning the buccal aspect of the ridge at a 45-degree angle.

Step **4**

Stop the scanner and allow the scans to render.

Step **5**

Position the scanner on the maxillary tuberosity and slowly rotate it towards the peripheral border extension in this region. Continue to scan the entire peripheral border along the maxillary arch.

Scan the facial and occlusal surfaces of the prosthesis. This will allow for a reference in the bite scan alignment as well as provide the necessary information to the dental technician using 3Shape Dental System.
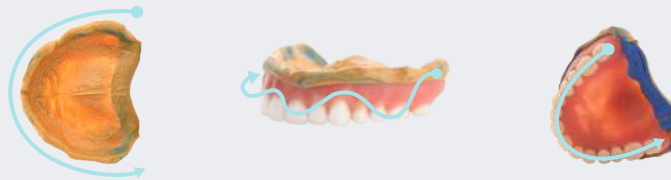
Quick Tip

Step 5 A & B can be accomplished in a single pass, but this is often challenging. If you are new to scanning reference dentures, I recommend you work in stages. In this sequence which side is scanned first is of no reference and you can develop a process that works best for you — according to Kukucka.

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Mandible scan strategy
Step by step

The goal of scanning the mandibular impression within the prosthesis is to achieve global accuracy. This goal is achievable, but it requires a proper strategy due to the mandibular impression's narrow surface and anatomical features, like the retromolar pad, alveolar ridge, lingual borders, and undercuts.

Step 1

Start the scanning process from the first molar area on one side of the mouth and proceed to the retromolar pad. Move back along the center of the residual ridge and constantly rotate across the ridge towards the area of the opposing side.

Step 2

Stop the scanner and allow the scans to render.

Step 3

Re-start the scan at the retromolar pad, roll the scanner to the lingual peripheral borders, and scan the entire lingual border.

Step 4

Position the scanner back on the retromolar pad. Rotate the scanner across the buccal peripheral borders and scan the buccal borders and facial portion of the prosthesis.
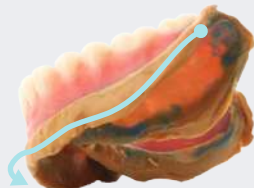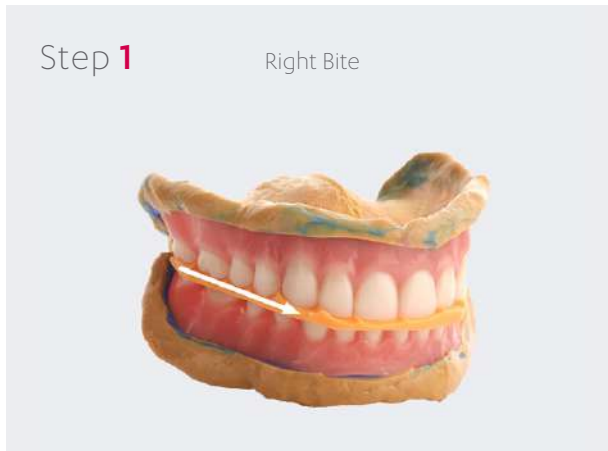

Step 5

Scan the facial/labial/buccal and occlusal surfaces of the prosthesis.

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Bite Scanning

Step by step

Step 1   Right Bite

Step 2   Left Bite

Alternative   360° Bite scan
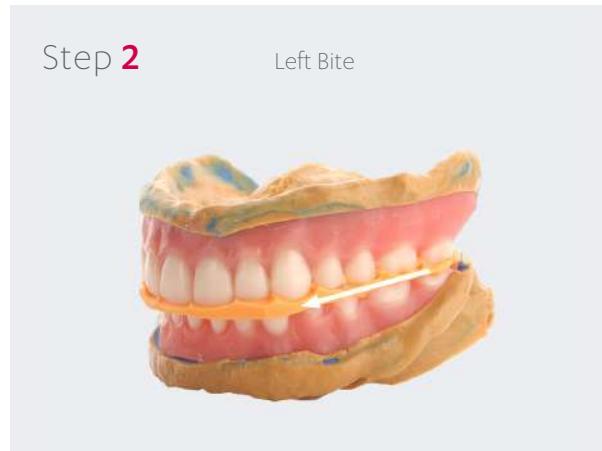
Important: It is much easier to utilize the buccal bite scanning indication and recommended as the ideal scanning methodology for reference dentures. Ensure that you do not have an excessive amount of impression material by removing it with a scalpel blade. Make sure that you can see the buccal surfaces of the posterior teeth.

Scan right side bite by positioning the scanner 50% on the upper arch and 50% on the lower arch. Continue the bite scan for an additional 3 seconds after the bite has aligned.

Scan left side bite by positioning the scanner 50% on the upper arch and 50% on the lower arch. Continue the bite scan for an additional 3 seconds after the bite has aligned.

❶ Scan the maxillary impression surface.

❷ Roll the scanner over the entire front side.

❸ Roll the scanner over the peripheral border of the lower.

❹ Scan the internal impression surface in its entirety.

❺ Align the 360 Scan with three-point alignment for the maxillary arch and mandibular arch.

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Using the scanned reference denture

| Reference Denture Impressions | Functional Try in | Final Digital Dentures |

The scanned reference denture is first used to produce a functional try-in.
This transitional product can then be used to evaluate the fit, form, function, esthetic, and phonetic performance of a denture-in-progress. Any modifications can be communicated back to the dental technician. You will thereafter receive the final digital denture with perfect fit and aesthetics.
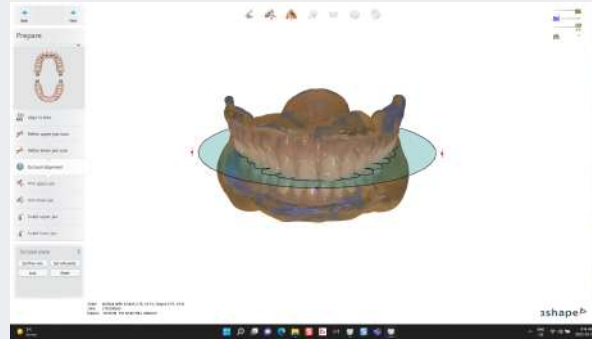
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For dental technicians

Step by step

The following is a quick guide for dental technicians working with reference dentures and generously provided by Eric Kukucka.

Step **1**

Align the reference denture scans to create the ideal positioning for the digital master casts. Make sure to use the Refine tool to improve the quality of your scans.

Step **2**

Create a master cast by trimming the scans of the reference dentures to dissect the impression surface from the reference denture.

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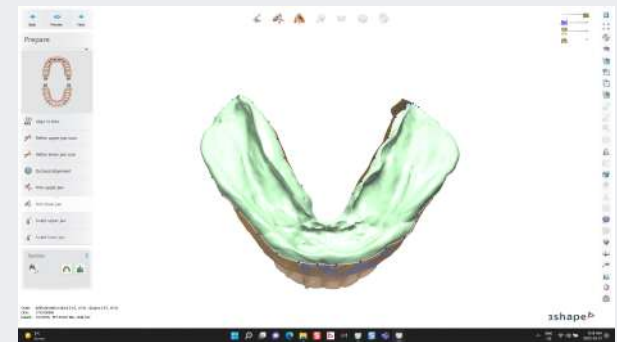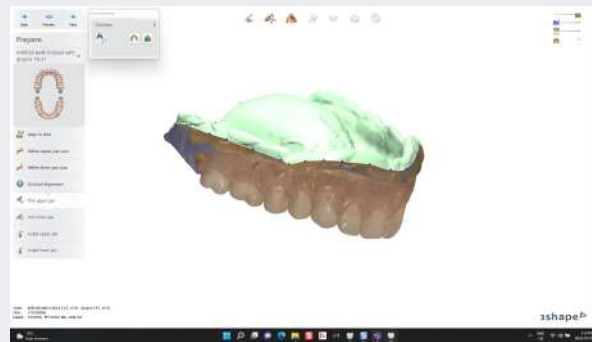
Designing the new denture

Step by step

Step **3**

Characteristic points are marked to create your model analysis. This provides you with the necessary anatomical landmarks to create a denture that is both physiologically and functionally harmonious to the oral cavity.
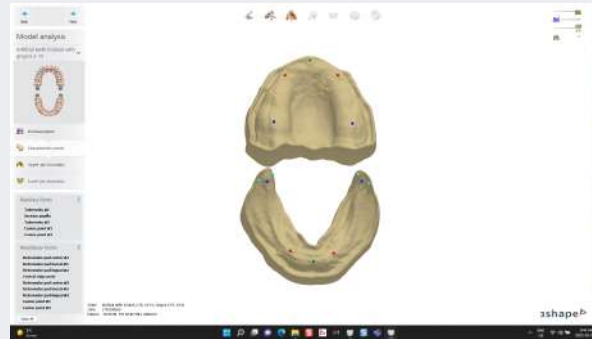
Step **4**

Using 3Shape Smile Composer, select an appropriate tooth design. Various libraries and occlusal schemes are available through 3Shape Dental System software.
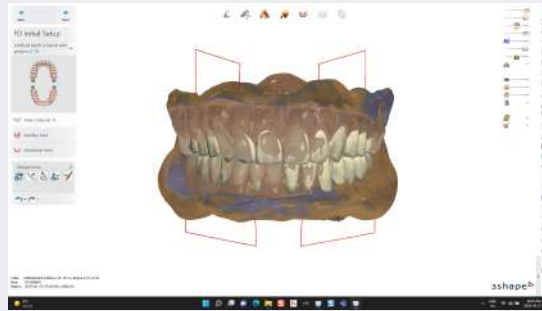
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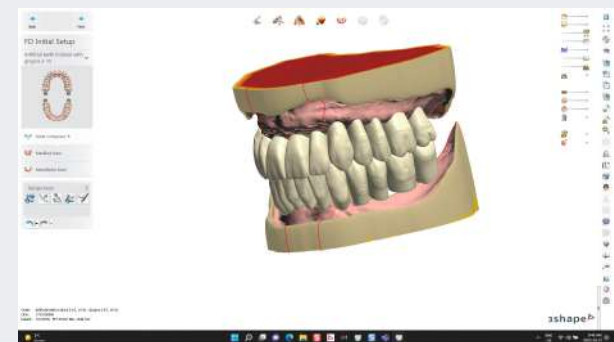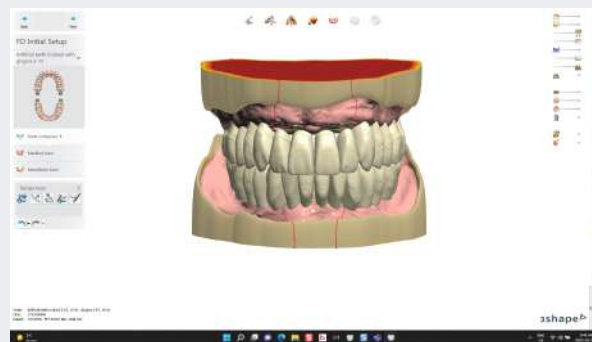
Designing the new denture

Step by step

Step **5**

Visualizing the initial scans of the reference denture enables the dental technician to make the necessary changes to the new prosthesis with unparalleled precision. This in turn results in the most optimized physiological and functional reference denture.


Step **6**

The Model Analysis is visualized in Smile Composer to ensure that the new digital teeth are positioned within the neutral zone to confirm idealized fit, form, function, rustics, and phonetics.
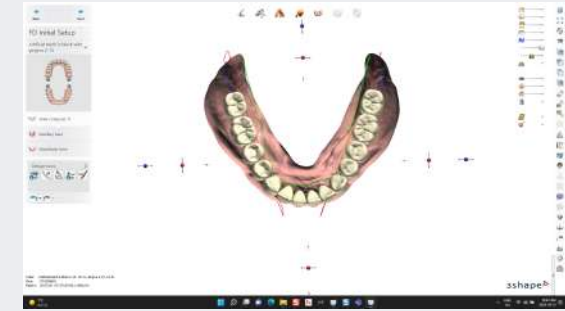
Step **7**

The Maxillary Base enables you to create a harmonious uniform thickness of the denture base as well as select various gingival contours (Delicate, Natural, Intense, and Customized). These options can help you improve various factors of interdental papilla depth, thickness, width, gingival margin improvements and much more to optimize comfort and promote acceptance of the prosthesis by the patient.

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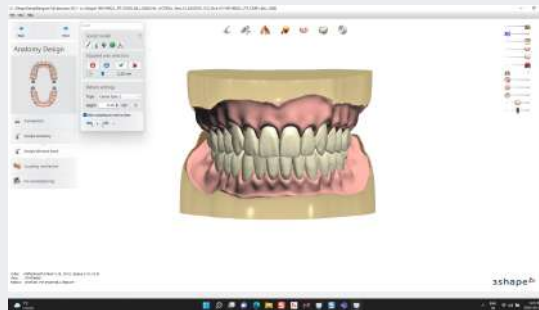
Denture Production

Monoblock Functional Try-in

The "Monoblock Functional Try-in" is, in most instances, 3D printed to produce a restoration that replicates the finalized digital denture. This functional try in is utilized by the clinician to verify fit, form, function, esthetics, and phonetics.

Alternatively, the functional try-in can be fabricated with 3D Printed Base material and tooth materials in instances where the patient has high esthetic demands. The advantages of a monoblock try-in for manufacturing is the ability to print multiple restorations in one seamless printing cycle according to Eric Kukucka.

Monoblock try-ins are available in various tooth shades: A1, A2, A3, C1, C2, C3, as well as additional shades depending on the manufacturer.

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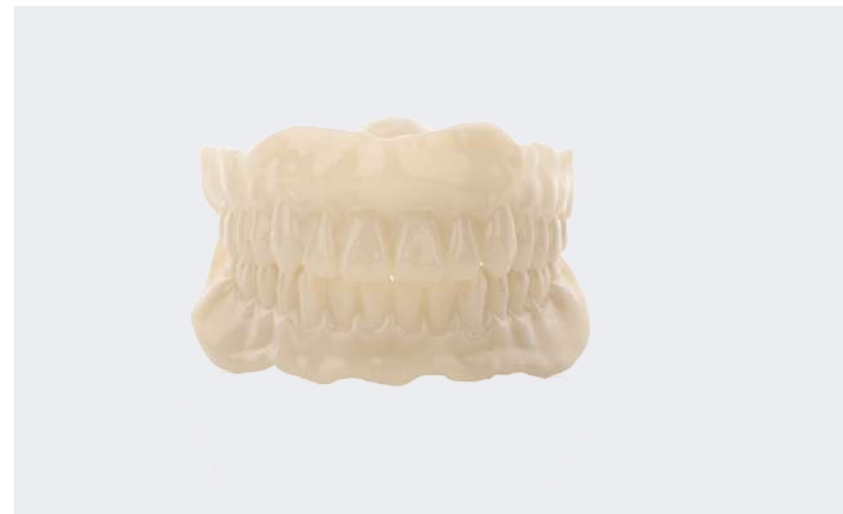
Denture Production

Milling

If efficiency and performance are what you are after, then high-performance milling technology is the right choice according to Kukucka.

The manufacturing method is suitable for a variety of materials and applications, and for digital dentures.

There are a variety of milling machines on the market today for producing high quality restorations of PMMA materials. Kukucka recommends milling dentures as the most seamless and clean process for producing restorations. Most machines are equipped with high-power 5-axis milling capabilities allowing the ability to contour even the most severe undercuts.

Milled restorations can be distinguished by their outstanding surface quality and excellent accuracy of fit. According to Kukucka, one of the most impressive milling solutions is the Monolithic Bi-Coloured Ivotion Disc from Ivoclar Vivadent. Digital dentures made with Ivotion are milled from one disc in a single uninterrupted milling process without time-consuming manual working steps.

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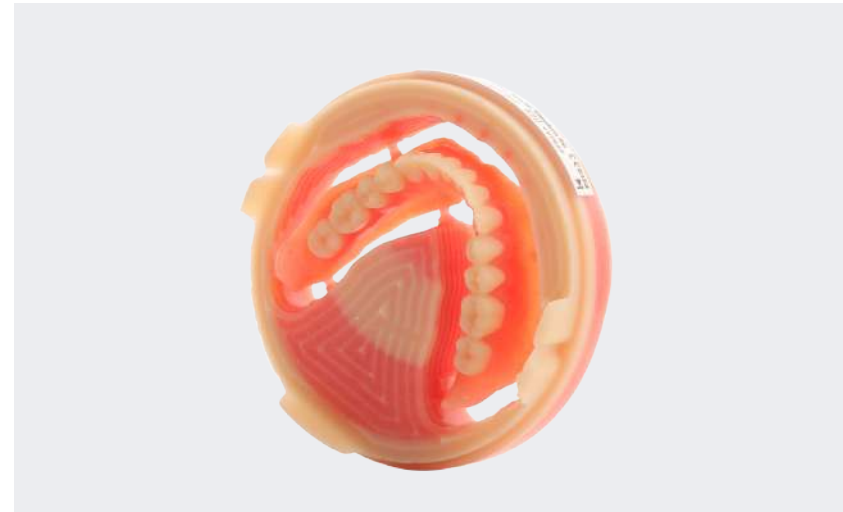
Denture Production

Printing

The production of 3D printed dentures combines quality, efficiency, and increased production. Various 3D printed solutions provide the opportunity to print a multitude of bases & or tooth arches. Depending on the size of the platform as many as 6-10 bases & or tooth arches can be printed at one time.

The tooth arches are bonded to the printed bases and cured utilizing various UV light technologies to produce a restoration that is of high quality.

According to Kukucka, the technology and evolution of these materials are very promising for the future industry standard of manufacturing digital dentures.

He, and many others, believe that 3D printing will revolutionize the industry in many ways.

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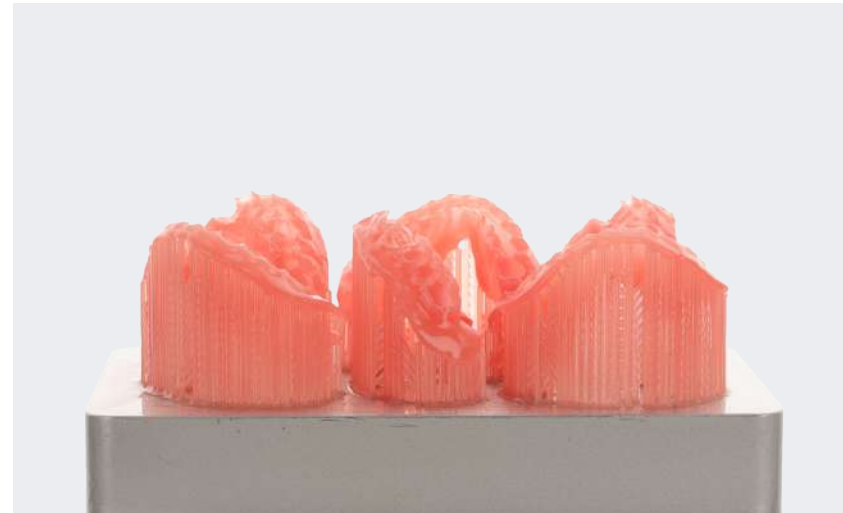
Denture Production

Finishing

The goal for dental professionals, is to create a natural appearance for a dental prosthesis.

When it comes to complete digital removable individualization, surface textures play a paramount role in delivering true to nature aesthetics and individualism, says Kukucka.

Diamond Cutting Discs can be used to individualize and create separations between the tooth arch structure as well as defining the interproximal embrasures and contact points. This will create a truly individualize tooth surface and structure that is both aesthetic and functional. In addition, it will help to define the labial developmental depression, marginal grooves, lobes & surface textures, as well as the interproximal embrasures and contact points.

Defining all of these areas with this process, will create a true-to-nature appearance for your restorations believes Kukucka.

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Final result

Depending on your preference,
the final restorations can be milled or printed.
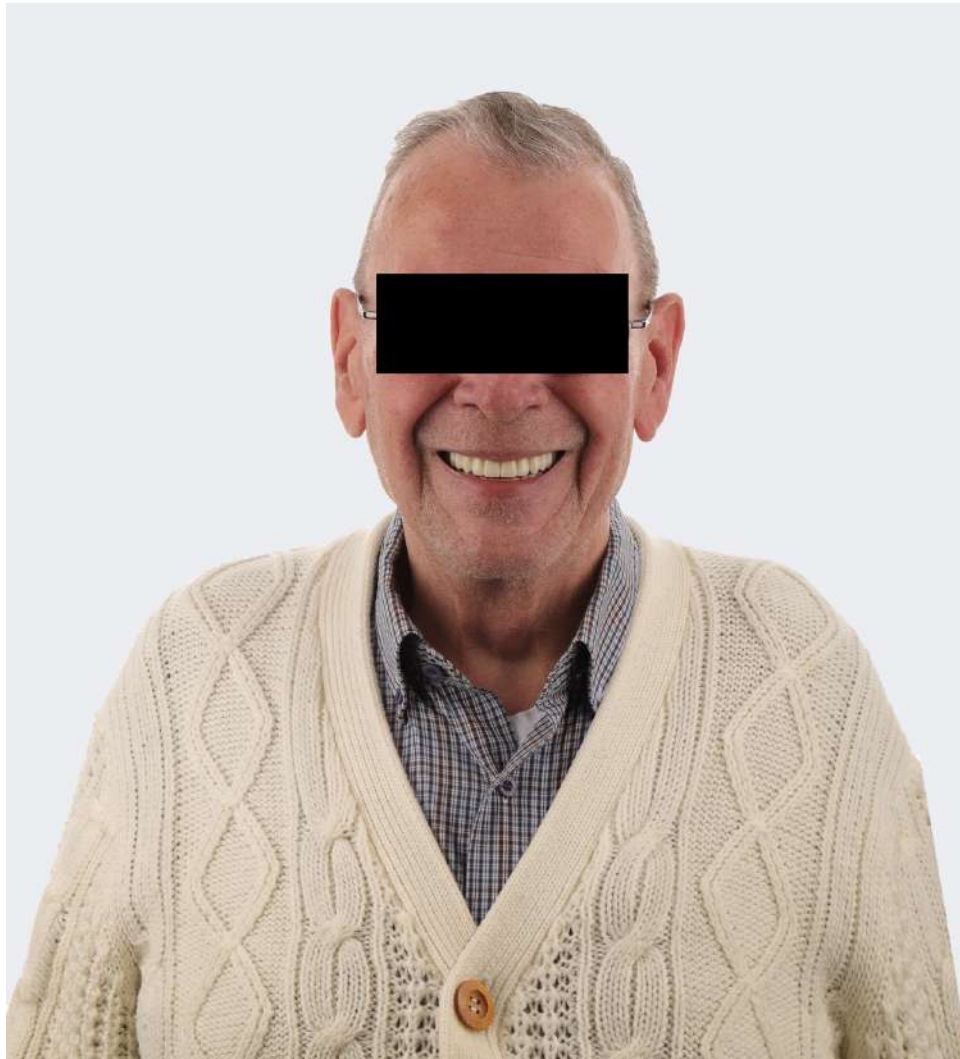
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About
Eric Kukucka, DD

Eric graduated from George Brown College with Honors and was named Valedictorian of all health sciences in 2010. Eric lectures globally as a key opinion leader for **Ivoclar Vivadent**, **3Shape**, and **Nobel BioCare**. His practices are in Ontario, Canada, where he owns and operates two denture clinics, The Denture Center. The Denture Center has positioned itself as the center of Digital Denture innovation globally. Eric is dedicated to building great relationships with dental professionals while always striving to create the highest standard of care for edentulous patients.

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In 2014, became
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America beta testing
digital dentures for
Ivoclar Vivadent

Has given over
62 keynote / virtual
presentations in
9 countries and
two languages and has
authored over 30
published articles
including the JPD & JPD
Digital, and will be co
authoring a Textbook
scheduled for release
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ABOUT 3SHAPE

3Shape is changing dentistry together with dental professionals across the world by developing innovations that provide superior dental care for patients. We partner with industry leaders to give dental professionals open choices for their patient care as well as supporting professionals' continued education. 3Shape's solution portfolio includes the multiple award-winning 3Shape TRIOS® intraoral scanner and dental lab scanners, design services, and market-leading scanning and design software solutions for both dental practices and labs.

Our more than 2000 employees serve customers in over 100 countries from 3Shape offices around the world. 3Shape's products and innovations continue to challenge traditional methods, enabling dental professionals to treat more patients more effectively.