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Inside Dental Technology

Special Supplement // March 2019

Optimizing the Digital Workflow

Rapid-turnaround 3D-printed dentures and more



Using 3D Digital Denture Technology to Treat Edentulism

*By Sean Thorp, CDT,
and Jim Miller, DDS*

Fast, Easy Denture Design Software Is Here

By Jeremy Wohlers, CDT

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Inside Dental Technology

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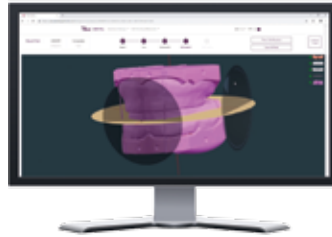


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Optimizing the Digital Workflow

The dramatic revitalization of the removable prosthetic market is being driven by rapid changes in demographic, technological and social forces that promise to continue revolutionizing this segment of dentistry. As a result, the US removable market is projected to be one of the fastest growing prosthetic segments in the dental industry over the next two decades and a business opportunity ripe for exploration and adoption for laboratory owners and managers.



Current estimates hold that 20.5% of adults in the United States older than 65 years of age have lost all their natural teeth due to tooth decay or gum disease. Another 178 million are missing at least one or more teeth. The numbers of US adults who are missing teeth will only increase as the average life expectancy moves upward from the current 78.9 years to a projected 79.5 years by 2020 and 82.6 years by 2050. This increase in average life expectancy, along with the aging of the 79 million US Baby Boomers and their “forever young” mindset, has boosted the demand for precision-made removable prosthetic appliances for decades to come.

Meeting the demands of this silver tsunami has challenged the dental industry to retrench, rethink, and re-innovate. Not only must the problem of fewer skilled and experienced denture technicians be solved but also the on-going problem of dental schools’ reduced curriculum for removable prosthetics, producing generations of graduates not well schooled in prosthetic principles. Compounding these workforce and clinical knowledge shortages has been the challenge of reducing the traditional 5-6 appointment patient protocol and improving final outcomes.

The industry’s pioneering spirit has been rapid. On the heels of success on the fixed side of dentistry, manufacturers quickly moved to digitize the removable process. Software engineers created sophisticated CAD modules for designing both full and partial denture prosthetic appliances while CAM and 3D print manufacturers created innovative materials and production processes to automate the try-in and final product phases. Although still in its infancy but evolving at a rapid pace, automated CAD/CAM production for removable processes and materials hold the answer to the demand and supply conundrum the

industry faced less than a decade ago. Digitizing and automating removable processes also opened the door for fixed laboratories to adapt and apply their 20-plus years of CAD/CAM skills and knowledge to the removable side, greatly expanding the supply-side of removable services. Most importantly digitization has brought much-needed precision and consistency to the process.

Digitization of the removable process also addresses the needs and expectations of today’s patients. Unlike previous generations, the Baby Boomer generation and those that follow expect dentistry not only to restore their former natural function and esthetics but also to do so in an expedient process that is not unduly disruptive of their busy work, social and family lives. They are less patient with the tedious five-to-six appointment protocol and waiting times inherent in the traditional laboratory and clinical diagnostic and treatment process for removable prosthetics. And they are decidedly less patient and understanding of a prosthetic that does not fit perfectly and meet their expectations of natural function and life-like esthetics.

For laboratory owners and managers, the digital denture market presents an important business opportunity. Only 3.8% of the total dentures manufactured in the US are digitally produced by dental laboratories, according to a 2017 NADL Cost of Doing Business survey. This presents a ground-floor opportunity to take advantage of a new segment of dentistry that is young, vital, and growing. For fixed laboratories already outfitted with automated production technologies and looking to expand their product line as well as their bottom line, the transition from digitally produced crowns and bridges to dentures should be seamless. For removable laboratories eager to finally be included in the digital revolution, the knowledge and skill brought to the digital landscape will help elevate this market as it matures. The digital denture market is in an expanding evolutionary stage as advances in new materials, processes and technologies continue to be brought to market. As the fixed market quickly learned, the best time to get involved in the digitally-driven process is at the beginning before it passes you by.

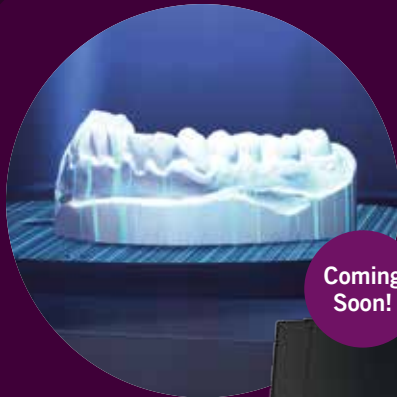
Pam Johnson
Founding Editor
Inside Dental Technology

Pala Digital Dentures 2.0 Digital Workflow

STEP 1: SCAN
USE IMPRESSIONS, OR
MODELS AND BITE RIMS

STEP 2: DESIGN
CAD SOFTWARE, 3SHAPE
KULZER TOOTH LIBRARY

See the step-by-step video at youtube.com/KulzerNorthAmerica



Coming Soon!



Equipment you'll need:

- **Scanner (coming soon)**
cara Scan 4.0
- **Impressions**
Pala Digital Dentures impression trays
- **Models & Bite Rims**
if not scanning impressions

Equipment you'll need:

- **Pala Design Studio**
CAD denture design software
- **Kulzer Tooth Library**
If designing with 3Shape, purchase the Kulzer Tooth Library for your 3Shape® dongle. This will allow you to print Pala denture teeth.



TO LEARN MORE about denture prototype and finishing options, visit kulzerUS.com/3DPrintedDenture.

STEP 3: PROTOTYPE

CARA PRINT 4.0, DIMA PRINT, HILITE POWER 3D



STEP 4: FINISH

FULLY 3D PRINTED DENTURE, OR ALTERNATE TECHNIQUES

Pala Fully Printed Denture, powered by cara and dima



Watch the webinar at kulzerUS.com/education

Equipment you'll need:

- **3D printer** cara Print 4.0
- **Nesting software** cara CAM
- **Print resins** dima Print material
- **Post curing unit** HiLite power 3D
- **Tooth cutting jig** (if necessary)

Equipment you'll need:

Print complete, high quality final dentures quickly, accurately, and economically with the **cara Print 4.0** 3D DLP printer and FDA cleared **dima Print** materials.

Traditional processing methods can also be used if desired.

3 Prototype Options:



All-white try-in



Printed base & Mondial teeth



Fully 3D-printed denture

Use Pala cre-active to add **individual characterization** to a printed denture base.



Using 3D Digital Denture Technology TO TREAT EDENTULISM

By Sean Thorp, CDT, and Jim Miller, DDS

ABSTRACT

This article discusses how digital technology for denture fabrication can benefit the dental laboratory, clinician, and patient. The authors were able to treat an edentulous patient with digital denture therapy using the Pala Digital Denture system, also incorporating 3D printing technology.

The substantial growth in the population of edentulous patients has been well-documented, and the authors have observed it first hand over several decades. Additionally, the number of dental laboratory technicians has been declining—especially in the removable area. Finding experienced denture technicians has been a challenge throughout the United States. While the primary author was interviewing and trying out some potential laboratory technicians, he was approached by a clinical representative from Kulzer regarding digital dentures and the Pala Digital Dentures brand. This was very interesting because the laboratory was very involved in digital technology in its fixed department. The primary author pursued this digital denture technology, hoping it would help the laboratory improve its efficiency and proficiency in the fabrication of removable dentures.

The next step was getting the clinician onboard to utilize this technology. The whole team must work together to make this all come together. This was easier than anticipated, however. The primary author contacted a few clients, some younger dentists and even some that had been in dentistry for quite some time, and they were all willing to try it

out. They now have now utilized Pala Digital Dentures for approximately 2 years, with very strong success. It is well known that technology advances, and in this area, it is advancing very rapidly, with both milled dentures and 3D printed dentures. The primary author explored both options and followed the direction of the 3D printed dentures, purchasing the first Kulzer cara Print 4.0 3D printer in the United States, and has yet to be disappointed.

CASE PRESENTATION

A 62-year-old male presented with edentulous upper and lower arches. He had been edentulous for 3 years, due to broken down dentition and decay. He had a small torus in the middle of the maxilla (Figure 1). He was advised to have it removed but decided against it. The clinician and technician decided to proceed with case.

CLINICAL STEPS

The first step, of course, was to take impressions. Two options exist for this (Figure 2 and Figure 3).

The first option is Kulzer's Pala Digital Denture impression system, which can help obtain the vertical dimension of occlusion (VDO) as well as a Gothic arch tracer to obtain centric occlusion. The first step is to choose the size of the tray (small, medium, large, or extra-large). Next, use a heavy-body impression material to border mould the tray. Place it in the mouth and manipulate the cheeks and lips. Remove the impression tray,

load it with medium-body material, and place it in the mouth for the impression, pressing firmly on the designated area on the impression tray. Repeat for the lower impression.

Next, cut the distal of the impression on the lower as designed on the tray. Unsnap the distal extensions. Place the VDO pin in the tray, and open and close it to obtain the correct VDO. Utilize the Gothic arch tracer to obtain centric relation. Use bite registration material to lute both arches together. Remove from the patient and send to the laboratory. Pictures of patient are also very helpful.

The second option is to take initial impressions and make custom impression trays. Take the final upper and lower impressions, and send them to the laboratory to make bite blocks. Place the bite blocks and trim the wax to obtain the proper VDO. Using a Fox plane also helps obtain the proper occlusal plane. Also mark the patient's midline, smile line, and canine line on the bite block. Send to the laboratory to mount on an articulator. Pick the shade and mould of teeth. The authors use Kulzer Mondial i teeth.

DENTURE FABRICATION

Having obtained all the information required, the laboratory could scan the models with a 3Shape scanner to produce an STL file for Kulzer to design the dentures. Once the information was received by Kulzer's design team, they imported it into their software and designed the dentures. The design team then emailed the laboratory a PDF file that could be manipulated to review the design and communicate any desired changes. Once the laboratory approved the design, the final version was sent so a prototype denture could be printed with the cara Print 4.0 and sent to the clinician for try-in (Figure 4). The clinician checked for fit, bite, VDO, and esthetics. The VDO on the

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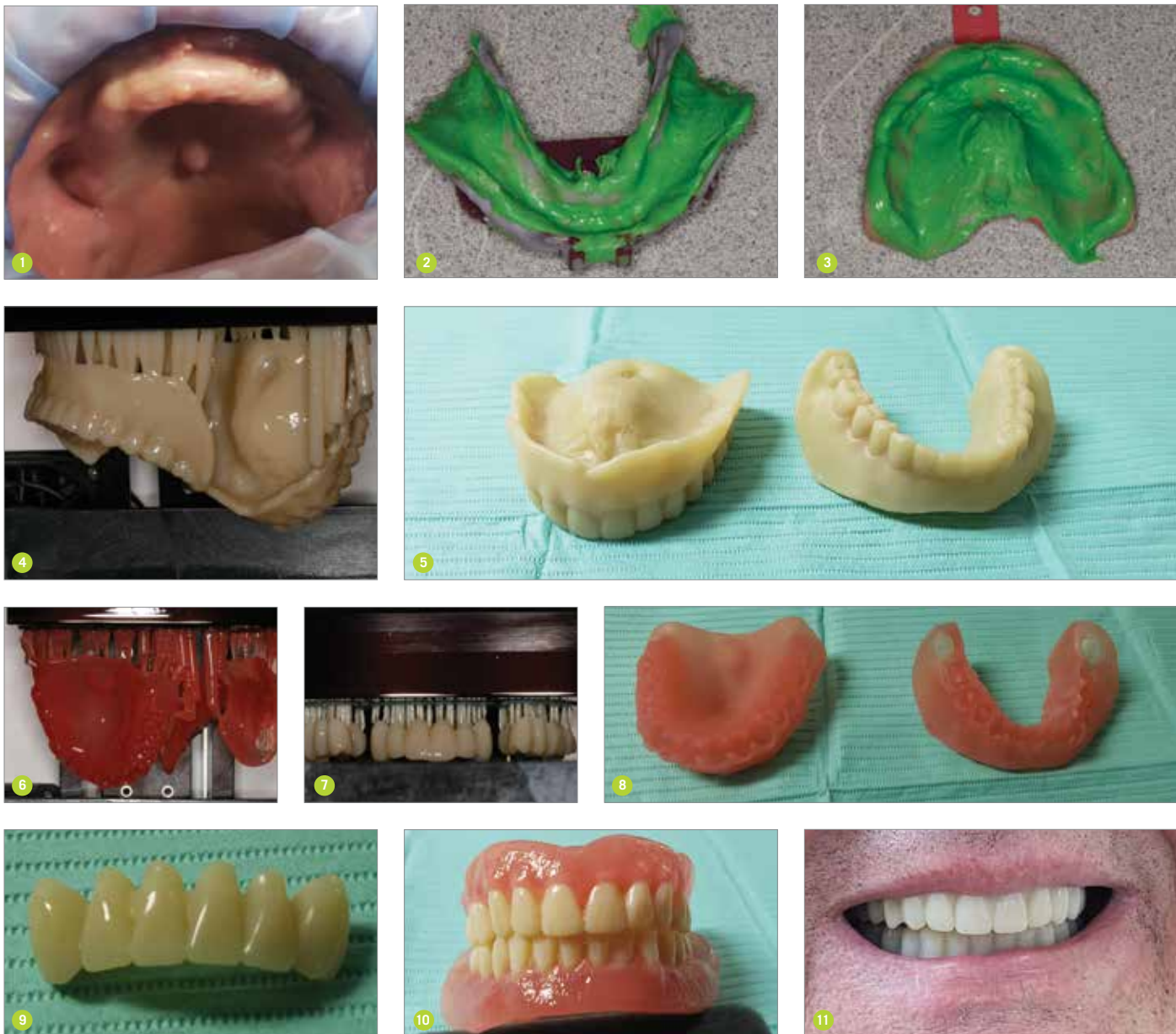


FIG 1. A small torus is shown on the maxillary arch. **FIG 2.** The lower impression. **FIG 3.** The upper impression. **FIG 4.** Printing a prototype with the cara Print 4.0. **FIG 5.** Prototype dentures ready for try-in. **FIG 6.** Printing bases. **FIG 7.** Printing teeth. **FIG 8.** 3D printed bases using the cara Print 4.0. **FIG 9.** 3D printed teeth. **FIG 10.** Staining using Creative composite kit. **FIG 11.** The patient's final smile.

patient looked great (Figure 5). The bite was spot-on and the fit was great. The patient could hardly remove the dentures from his mouth. There were no adjustments necessary in this case, but if the bite had needed to be adjusted of the VDO needed to be opened or closed, the laboratory would have taken a bite rescan of the prototype and sent it back to the designers to import the new scan with adjustments and adjust as needed.

FINAL FABRICATION

Because no adjustments were necessary, the laboratory asked the designers to send the split file, which included the denture teeth. Anteriors were splinted and the posteriors

were splinted, so three separate segments were on each arch, in addition to the denture bases. The primary author next printed the denture bases with the cara Print 4.0, using pink denture base material (Figure 6). The material was then changed to print the teeth (Figure 7). Once the teeth and bases were printed (Figure 8 and Figure 9), the teeth were luted to the bases using the same resin that the base is printed from and cured once done. Once cured with the HiLite power curing unit, the denture could be custom-stained using Creative composite stain kit (Figure 10).

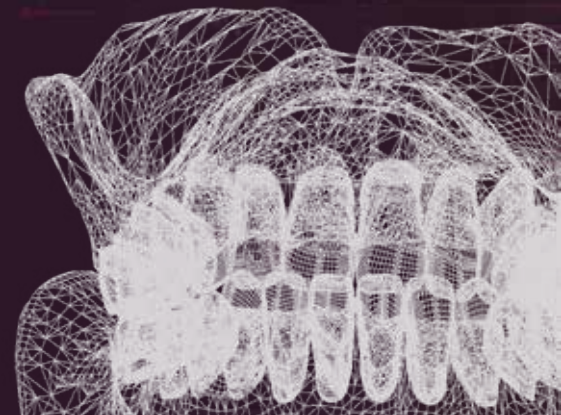
DELIVERY DAY

On the day of delivery, the clinician placed

the upper denture and checked for fit and esthetics. The lower was placed, and fit and bite were checked. Everything was beautiful, and the patient was ecstatic (Figure 11).

CONCLUSION

The authors were able to use digital technology as a helpful tool in the dental laboratory to compensate for the difficulty of finding experienced technicians. Additionally, the clinician has fewer appointments for the patient and provides better materials. Technology continues to advance, and in the near future the clinician will be able to use intraoral scanners to take the impressions digitally for removable appliances.



Revolutionizing Denture Design

Pala Design Studio is the world's first web-based denture design software. Developed by the experts at Kulzer and DENTCA, this online service allows dental laboratories to design cases for 3D printed or milled formats in a simple and efficient way. So efficient, in fact, that you will be able to design a case in 10 minutes and have the final STL file rendered in under an hour.

With Pala Design Studio, multiple technicians can design cases simultaneously without any software installation required. And, new projects can be started while current cases are undergoing rendering, eliminating the need to wait for final generation to finish. Your lab will be able to maximize its output and production like never before.

Pala Design Studio is easy to integrate into your workflow. Here's an overview of the process:

1: Scanning and Uploading

The first step is to upload 3 scanned STL files of the case you are working on: maxillary, mandibular, and bite.

2: Entering Design Information

Next, enter patient information and select the type of impression used in the case – Pala Digital Dentures trays or wax rims.



3: Matching

Match both arches with the bite: simply click to add a colored reference point on the bite scan, and click the same area on the model to align.

4: Trimming

Establish trim lines on the maxillary and mandibular arches by clicking to place dots along the models.

5: Choosing Landmarks

The landmarks consist of three upper points and two lower points: the incisive papilla, the left and right hamular notches, and the retromolar pads. Click to select all 5 points, and verify your teeth selection. Pala Design Studio will then match, trim, create the occlusal plane, and arrange the teeth automatically.

6: Verification

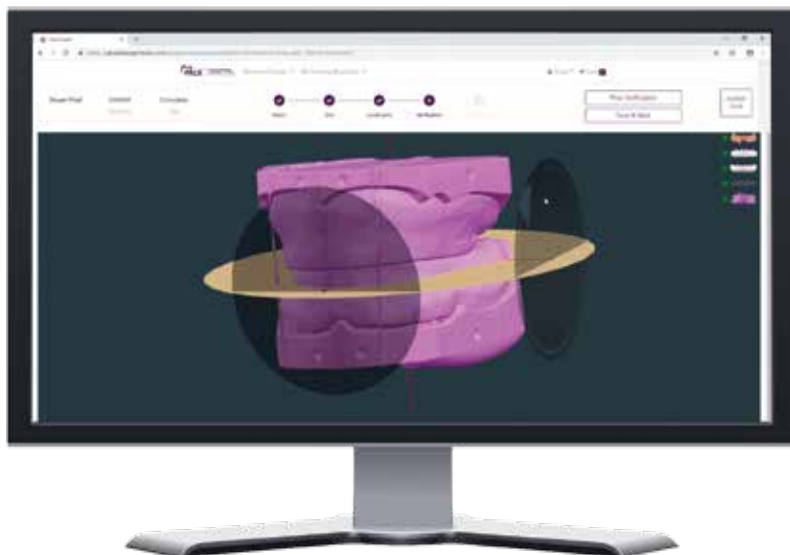
Verify the matching, trimming, and occlusal plane placement. You can make any necessary adjustments at this time.

7: Teeth Setup

Pala Design Studio automatically generates an ideal tooth setup for your case based on the teeth and gum shape and style that you chose. If there are certain esthetic parts that need to be customized, you can do so now. Once you are satisfied with the teeth setup, submit the case for final generation.

8: Ordering and Final Output

Once the final generation is done, you can view the completed design. Designs are optimized for 3D printing or milling, and the STL files can be downloaded as a try-in or final dentures.



Go to PalaDesignStudio.com

to watch our Guided Tour videos.



Fast, Easy Denture Design Software Is Here

3D PRINTING DENTURES IN-HOUSE BECOMES MORE VIABLE

By *Jeremy Wohlers, CDT*

I was really excited when Kulzer called me near the end of 2018 and asked me to beta test the new Pala Design Studio. I immediately wanted to use it and push it to every limit I could find and every boundary they gave me. CAD/CAM technology for removables is evolving rapidly, and user-friendly, fast software programs like this one will change the industry.

Pala Design Studio is quick and gives me control over where I set the teeth. I can do a denture setup and individualize it without needing to know the complex intricacies of some of the more popular CAD software. It is very easy to manipulate the teeth, and I can create characterized setups for an upper and lower denture and download the files within only about an hour to print. And within the next hour, I can have a full printed denture.

For a small laboratory like mine, speed and ease of use are huge. The more complex denture design software modules are very good, but that level of complexity is only necessary for the most challenging cases. For the routine cases such as immediate dentures

that are our bread and butter, I just need software that is easy and quick.

With Pala Design Studio, in 1 day I can set six full dentures—upper and lower—and print four of them. That is a significant number for a one-man laboratory where I handle shipping, receiving, and everything else myself.

The software is completely open, meaning I can use it not only for cases submitted via the Pala Digital Denture impression system but also for cases that arrive with models and bite rims. Kulzer offers the full package now with its scanner, design software, and printer, but all of those products integrate well with other systems as well, giving users plenty of freedom.

Additionally, the software is free to use, as I only purchase my downloads. It is web-based, so there is no need for a dongle. Once a design is finalized, I pay a minimal fee to download the file for printing.

Pala Design Studio completes my in-house denture system. I am able to scan, design, and print same-day dentures easily, which is truly transformative for my laboratory.

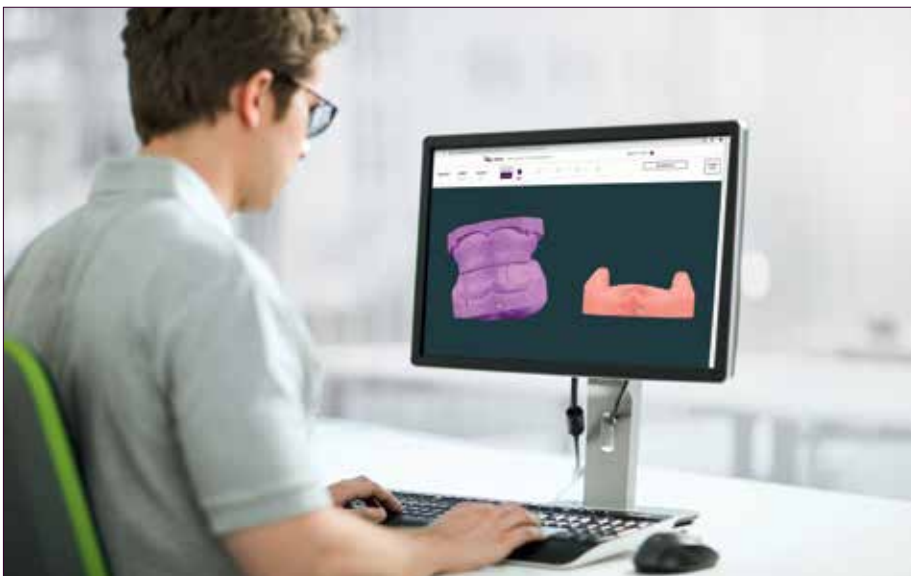


ABOUT THE AUTHOR

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Yakima, WA

KEY TAKEAWAYS

- Manipulate teeth quickly and easily
- Open software allows anyone to utilize it, regardless of hardware
- No upfront costs to use the software; only minimal download fees for each case





Cara Print 4.0 by the Numbers



<2 HOURS*

to Design, Print, & Finish
Pala 3D-Printed Dentures
(*time depends upon skill level)

Use dima Print **(FDA Cleared)** materials*

1 HOUR OR LESS
to print these appliances:



dima Print Material	Print time per part
Ortho	14 min
Impression	18 min
Guide	10 min
Model	40 min
Cast	18 min
Denture Base try-in (white)	45 - 60 min
Denture Base try-in (pink)	45 - 60 min
Denture Base	50 - 56 min
Denture Teeth	22 - 28 min



4 Denture Base Shades

Dark Pink Original Pink Light Reddish Pink Light Pink

6 Denture Teeth Shades
Includes A1, A2, A3, A3.5, B1, and B2.

\$0 No licensing fees

Customer support team
staffed by dental experts

x2 Printer comes with
2 build trays

5 REASONS TO BUY



- 1 The Pala 3D Printed Denture can be nested, printed, cleaned, post-cured, bonded, polished, and ready for delivery in less than 2 hours.
- 2 The 3D-printed solution for dentures reduces production time while increasing laboratory efficiency and quicker patient turnaround times.



- 3 This fully 3D-printed denture solution makes it possible for customers to enjoy exceptionally precise results quickly and affordably.
- 4 Kulzer recently launched 10 new FDA-cleared dima Print materials, four Denture Base shades and six Denture Teeth shades.
- 5 Using the cara Print 4.0 3D DLP Printer along with Pala cre-active, technicians can add individual characterization to any printed denture base.

3D PRINTED DENTURES

More Details on the Pala 3D-Printed Denture:

Kulzer's dima Print Denture Base materials are light-curable resins indicated for fabrication and repair of full and partial removable dentures and baseplates. They are alternatives to traditional heat-curable and auto-polymerizing resins. Kulzer's dima Print Denture Teeth are light-curable resins for fabricating, by additive manufacturing, pre-formed denture teeth used in a denture. These materials for a fully 3D-printed denture solution make it possible for customers to enjoy exceptionally precise results time after time, quickly and affordably.



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cleared

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- 3D-DLP technology—for precise, accurate results every time.
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Giving a hand to oral health.



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