

# DDHK

DIGITAL DENTISTRY & HEALTHCARE KNOWLEDGE

M A G A Z I N E

VOLUME 2  
ISSUE 01 - WINTER 2021

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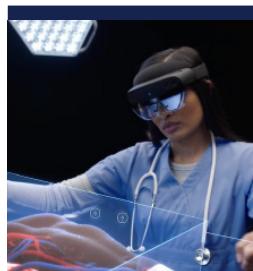




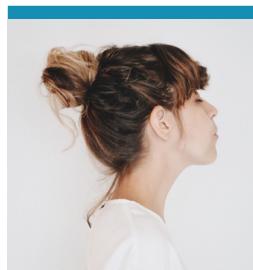
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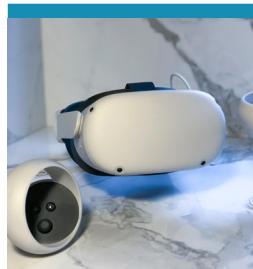
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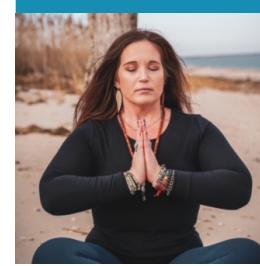
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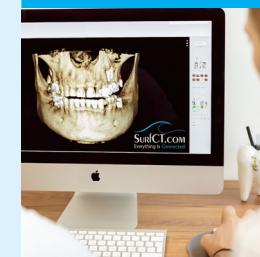
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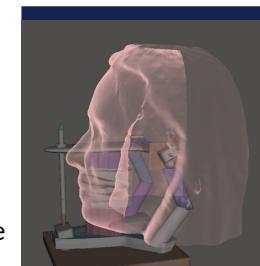
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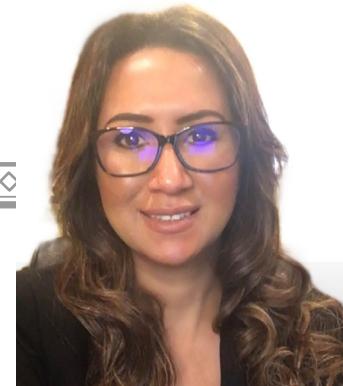
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# EDITOR'S DESK

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## A NOTE FROM OUR EDITOR IN CHIEF KRISTY A. MONTOYA



Dear Friends and Colleagues:

It is with great gratitude and enthusiasm, we announce the release of our Winter 2021, 3rd issue of Digital Dentistry & Healthcare Knowledge (DDHK) Magazine! Extensive work is involved behind the scenes when creating an issue. Never is it taken for granted, the learning experience we encounter through collaborating with the versatile minds of those integrally involved.

We hope that everyone is staying active and safe as you continue to gain and spread knowledge with one another! The COVID-19 pandemic has produced unprecedented challenges in the new way we function in our everyday lives. Read articles from Dr. Manuela Rodrigues and Randi Sachetta who provided tips on, "Mindfulness at the Dental Clinic" and ways on, "Finding Your Center." Many have taken the current times, as an opportunity to revisit the way we operate and have overcome several of the obstacles faced, as a result of the impacts from this virus. Implementations of patient safety workflows, access to dental treatment, medical services, traveling, interaction with one another, and participation of events continue to progress.

Thank you to the contributing authors who took the initiative and reached out to our editorial team! You provided us with the most cutting-edge material to share with our readers! I was fascinated by the rapid speed of action taken by industry leaders who are currently pushing technology to the limits; very much needed during these times! Vincent Silva, CEO and Founder of Virtual Healthcare Systems (VHS) and his team played a huge role in allowing me to fully immerse myself in Virtual Reality's (VR) dental and healthcare industry learning environments. In order to excite the DDHK board members and our readers, I needed to experience VR for myself! Linda Nguyen, Executive Administrator of VHS is Vincent's right hand and can easily walk through even the most technology challenged individual or team on Virtual Reality. Dr. August de Oliveira gave the DDHK Magazine team a tour of his dental office and a background on the tools and resources being used in his practice. Hope you too can capture his funny personality from the, "On the Scene" page and through his article, "Virtual Insanity in Dentistry." Virtual Reality is anything but new to SurfCT! Enjoy reading the article from Paul Vigario, CEO and Founder of SurfCT and Juan Estrada, SurfCT's Digital Workflow Engineer as you, "Discover What's Possible When Everything is Connected." Shannon Sommers and Alicia Webb gave us great insights on, "3D Printing in Dentistry" their excitement and involvement keeps us curious as to what their next project will include. Dr. Mayra Torres Vasques continues to impress us with how well she uses technology during COVID times, as she shared on, "The Use of 3D Printing for Distance Learning Training in Dentistry." I have to say Dr. Varo Boyer's article on,

"3D Printed Surgical Guides Same Day Tooth Replacement in the Aesthetic Zone" was quite impressive! Dr. Boyer submitted the most organized and detailed article I have ever come across and he was great to work with during the entire process, thank you! Hope to catch one of his lectures! Be sure to check out the interview with Toothpick, "Your Dental Eco-System" and download their app. Looking forward to the ease of ordering supplies and registering for courses offered through this app at the most affordable pricing! A huge shoutout to Christopher Owens for his commitment and persistence on keeping our team and readers up to date through social media! Graphic Designer, Nikki Harrison has been a major support to our publication with her creativity in graphic designs and ability to work seamlessly with the team. When Nikki and I interact "it's crunch time!"

It is rewarding to see our editorial board members' interest grow intensely through their involvement of this publication. I am truly humbled and pleased with their services and willingness to help whenever needed. It is a pleasure to share their accomplishments, wisdom, and skillset in collaboration with the contributing authors. This type of involvement has allowed us to positively spread Digital Dentistry & Healthcare Knowledge worldwide. Our growth and adventure will continue to carry on, as we gather information and resources to share the most forefront technologies and solutions with our readers.

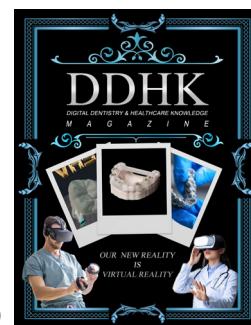
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All my best,

Kristy A. Montoya – Editor in Chief

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AUGUST DE OLIVEIRA, DDS

# VIRTUAL INSANITY IN DENTISTRY

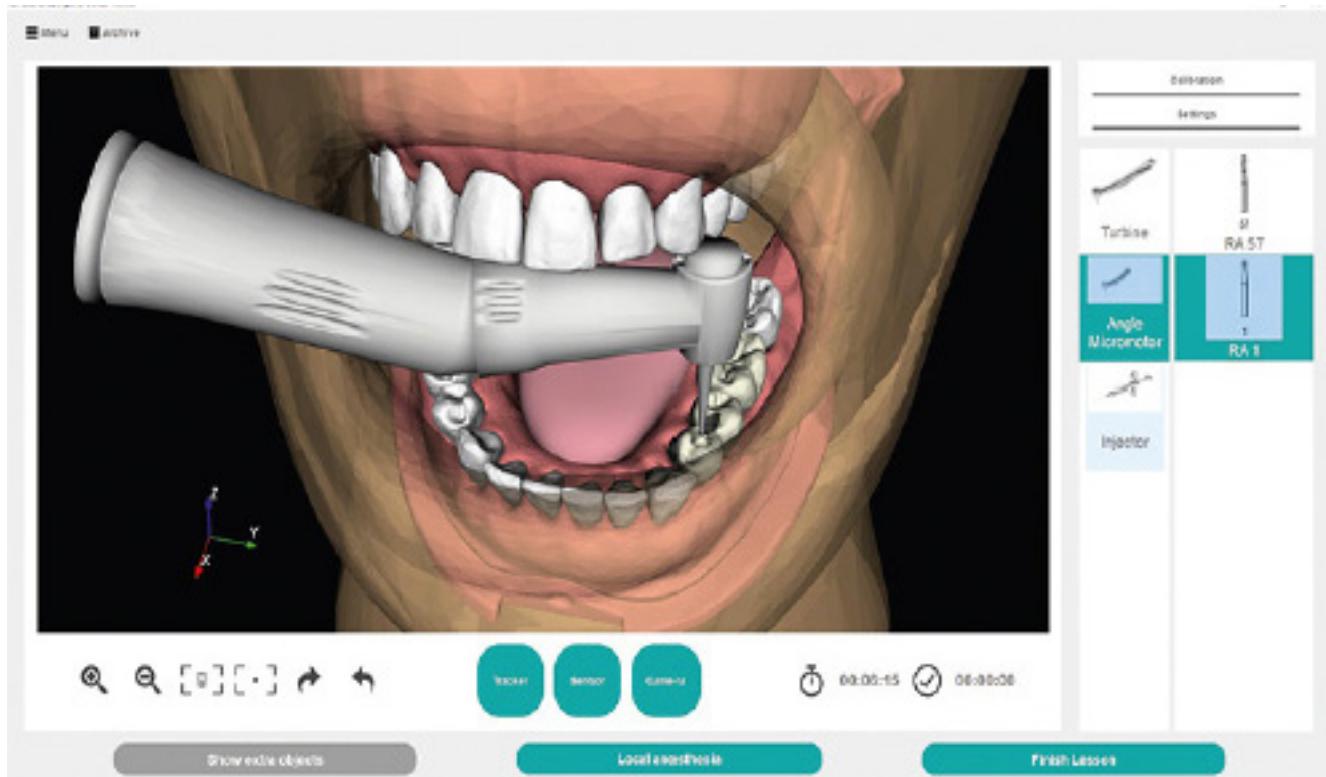


Figure 1: Image from Leonardo Dental Simulator from Geotar Manufacturing. <http://www.leonardo-dental.com>

I've never been much of a gamer. I'm 51, grew up with Atari, PC games, had a few Xboxes and a Nintendo Wii, but never thought I would be buying Gamer PCs or looking for cooling pads because my games were running too hot. And as a stodgy old dentist, I kept watching the advancement in Virtual Reality and Augmented Reality creep into dentistry with sideways glances. That being said, here we are and I have to say, I didn't know what I was missing! I bought a Quest 2 for \$299 and was hooked!

Let's get a few boring details out of the way, and then we will dive into why AR (Augmented Reality), VR (Virtual Reality) and MR (Mixed Reality) will absolutely change how you do dentistry and learn new procedures. AR, VR and MR are lumped into a blanket term, Extended Reality or XR. More or less, we are using computers to either remove ourselves from our world or add and interact with things in it. So let's get AR and MR out of the way, as they are going to change everything, yet are pretty "green" and need a few years to really live up to their potential.



Figure 2: The Oculus Quest 2 Headset from Facebook sells for \$299 USD.

## Augmented Reality: (AR)

AR is everywhere, but mostly used for silly stuff. You can put on a set of dog ears, try on the latest lipliner or see how IKEA furniture looks in your guest room. Augmented Reality uses either QR codes, facial recognition or just your phone to add 3D models (STL, OBJ or FBX files) as an overlay to a video feed. (Figure 3)



Figure 3: Snapchat was one of the first Augmented Reality apps to use 3D facial scanning to add ridiculous dog features.

AR is used in Dentistry with Implant Photogrammetry. Devices such as Imetric4D and PIC. Photogrammetry is a topic for a whole other article, and I am using it a lot with my digital, model free hybrid workflow. With these devices, special scan bodies that look like dominos act as “bar codes” and due to the fact that the cameras only read black and white data, they have incredible accuracy as to where implants are positioned for full arch cases. When a “domino” is being read, the AR overlay will change color until enough of the data of the position of the scan body is recorded. (Figure 4)

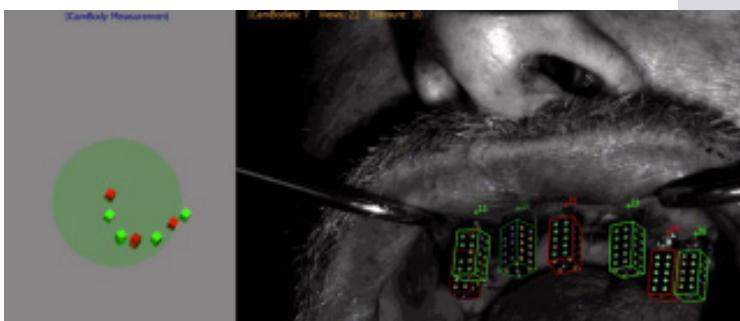


Figure 5: The Microsoft HoloLens uses front facing cameras and sensors to record your environment and superimpose 3D models that you can interact with.

## Mixed Reality: (MR)

AR is cool. You can see stuff overlaid on other stuff. But you can't do anything with the 3D stuff except post on Snapchat. Mixed Reality allows you to interact with 3D models and the models can interact with you and your environment. Devices such as Microsoft's HoloLens (Figure 5) or the Magic Leap have LIDAR (Light Detection and Ranging) which have been added to most new phones. (Figure 6) Think of these as portable 3D scanners that can map out where things are in your room or eventually, in the mouth. One drawback of Virtual Reality is that you bang into things a lot. The VR headset completely obscures your view of the world around you, which is the point. Mixed Reality is like AR, in that you can see the room you are in, but the cool thing is, the headset or glasses can see your room too and enhance it. Read having a mentor log in and show you exactly where to access a tooth for a root canal or where to place an implant, overlaid on your patient.



Figure 6: The Magic Leap is an MR device that can use “digital zoom”, like loupes, to magnify your field of view with an unlimited depth of field.

Figure 4: Dr. Naif Sinada, DMD, MS using the ICam4D Photogrammetry scanner to get accurate implant positions for an implant hybrid case.

One current area that MR is working on is optics. Apple teamed up with Rayban for their new MR glasses aka Apple Glass. We use loupes and loupes are based on pretty old tech, like 1600s tech. With an MR headset you could have 20X loupes with an unlimited depth of field and use "night vision" to see in all the dark spots our lights can't reach. No more bulky microscopes or head gear that makes you look like you are a coal miner. But enough of what may happen, let's talk about the now, VR.

## **Virtual Reality:**

I have been hearing about how totally awesome VR will be since I was a kid, and I'm, well, old. It's never really caught fire until Facebook bought Oculus for a bazillion dollars and Google and Alibaba pitched another bazillion with Magic Leap (actually MR, but let's not sweat the details)!

Virtual Reality simulations in dentistry, at the time of writing this, are pretty scarce. In Medicine, they are far more prevalent. In a study in May 2016, Dr. Marcia Frelick from John Hopkins Medical Center, published a report that medical error was the third leading cause of death in America after Cancer and Heart Disease. In 2013 over 251,454 patients died as a result of medical error. To put that into perspective, 34,436 people died from car accidents. Virtual Reality is being used at Medical Schools (and some Dental Schools) to reduce that error. In a UCLA study on 2/5/2020 at the David Geffen School

of Medicine, VR has increased Surgical Accuracy by 38% and over 230% Surgeon Improvement. In a study done on 5/15/2016 at the ICENI Centre General Hospital in Colchester, Australia, surgeons completed procedures 20% faster when trained in VR. (Figure 7)

At the Dental Simulation Center in Mahidol University in Thailand, dental students go through 3 different VR simulation labs before working on a patient. Precise handpiece movements are recorded with haptic feedback (sounds and vibrations) to give the students the feel of drilling on patients. Furthermore, the students can go back and see where mistakes were made in the simulator, before entering the clinic. (Figure 8)

What about the social aspect of learning dentistry? I love teaching and going to courses and learning alongside my friends and meeting new ones. With COVID-19, there are less and less in person dental courses available. And there is only so much you can experience with a Zoom meeting. After purchasing the Oculus company, Facebook launched Facebook Horizon a VR extension of the Facebook Social Platform. (Figure 9)

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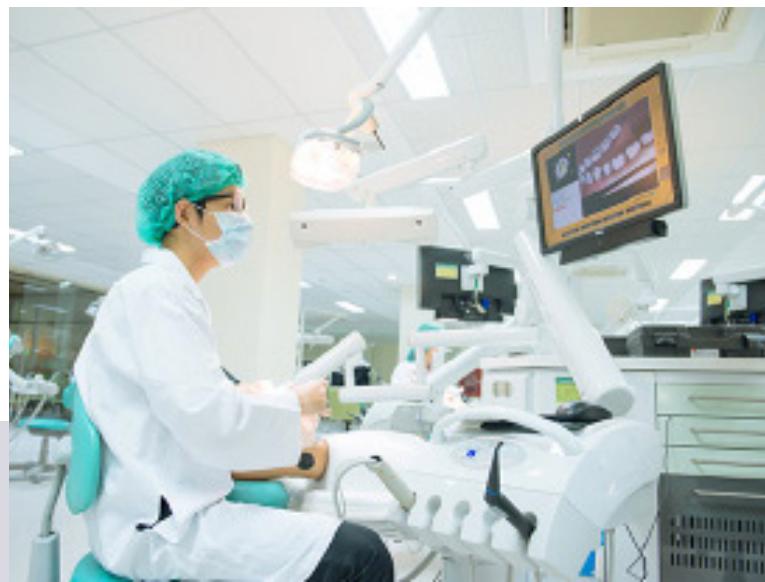


Figure 8: A dental student at Mahidol University practices restorative dentistry virtually.

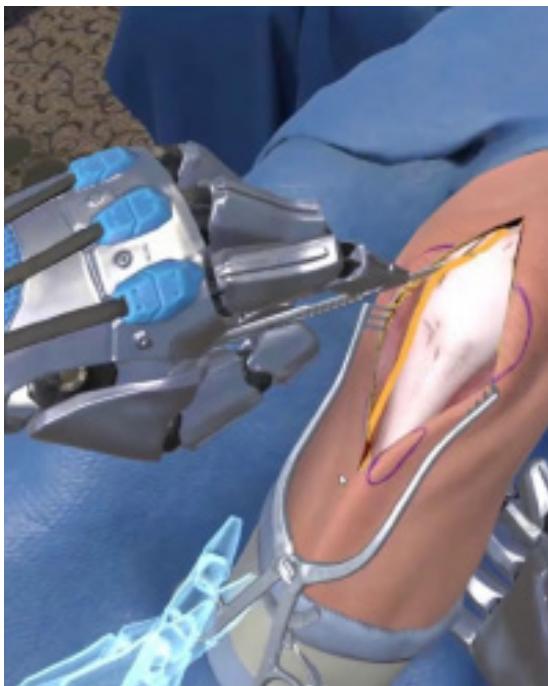


Figure 7: Ghost Productions has a program called Wraith VR where Orthopedic Surgeons can practice total knee replacement. You can download the VR demo at <https://store.steampowered.com/app/1136210/>

Figure 9: In Facebook Horizon you can meet up with your Facebook Friends in either public or private rooms and work on projects together in 3D.



VHS is a platform where you use a VR headset, or even your phone or computer, to meet up with friends and take courses. VHS will allow instructors to import digital models you can interact with and an instructor can help you perform hands on projects. (Figure 10)

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In conclusion, I think you can see where AR, MR, and VR can help you see better, be more efficient, do procedures better, and learn dentistry, hands on. Keep your eye out for better and smaller headsets, faster computing and apps related to dentistry. To see for yourself, you can buy an Oculus headset for \$299. It's a small investment in education, and if you don't like it, you can always become a Gamer!



Figure 10: VHS is a VR platform that allows you to learn about dentistry with virtual models and you can talk and interact with other dentists.



## Meet the Author - August de Oliveira, DDS

Dr. August de Oliveira graduated from dental school in 1997 from the University of Washington and completed his General Practice Residency in Los Angeles in 1998. Dr. de Oliveira has been lecturing on 3D technology since 2004, when he started as a CEREC Basic trainer. Since 2008 he has been involved with Implant Direct's R&D department developing Guided Surgery Software and Hardware and testing their CAD Milled Bars and Substructure Department. Dr. de Oliveira has written three books on Dentistry: *Implants Made Easy*, *Dental 3D Printing Made Easy* and *Guided Implantology Made Easy*. He has been involved with beta testing Sirona's Sidexis Program, as well as developing the Opti and CEREC Milled Surgical Guides. Dr. de Oliveira is on the board of directors at Sprintray and beta and alpha tests numerous 3D printers and 3D printing software. Dr. de Oliveira has completed over 100 digital hybrid arches and teaches Digital and Analog Restorative at Implant Pathway, on live patients. He also teaches for Implant Direct, Ivoclar, Patterson, Henry Schein and holds his 3D Printing Parties world wide. Dr. de Oliveira is a certified Unity VR and AR Software Developer and is currently developing Virtual Reality simulations in dentistry and Mixed Reality 3D diagnostic tools for the Microsoft Hololens.

MANUELA RODRIGUES, DDS

# MINDFULNESS AT THE DENTAL CLINIC:

## Reduce stress, enhance performance, and improve overall wellbeing

**H**ave you ever worked with a person who was clearly carrying a lot of tension in his jaw, face, and shoulders? Have you noticed how this person's tension held back the potential creativity and performance of his work? Has that person, ever been you?

The concept of a stress-free dental work practice or a stress-free dentist is not realistic or even desirable, as stress is a natural part of dentistry work. The result might be spending most days in automatic pilot, sometimes just reacting to whatever the day throws at us.

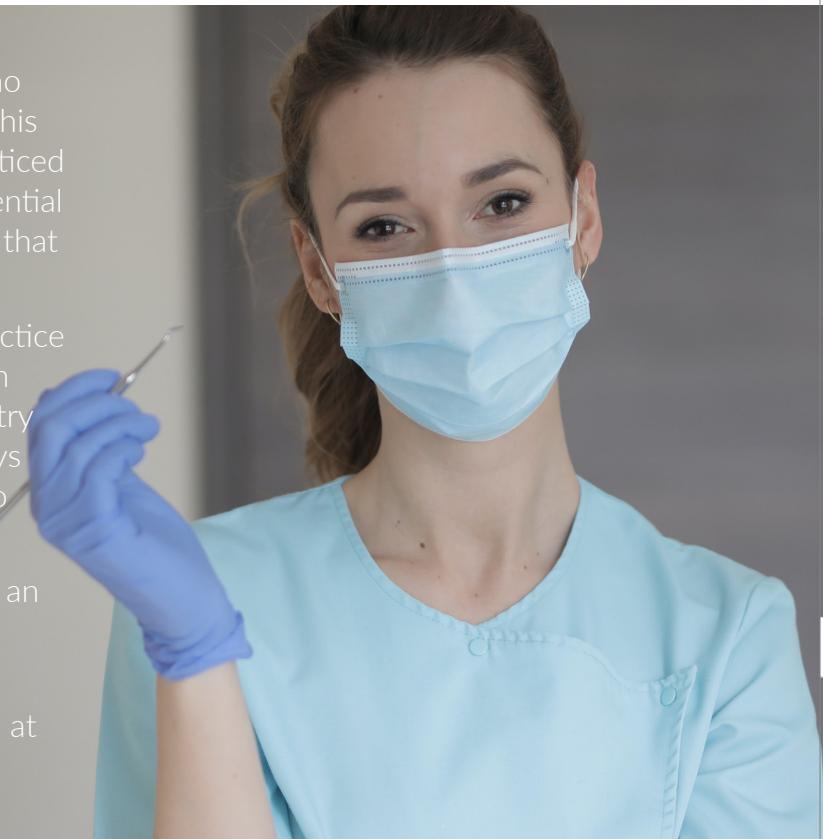
The good news is, rather than being stuck in an unhealthy reaction to stress, we can learn to skilfully return to a relaxed natural presence.

Have you ever considered using mindfulness at the dental clinic?

Mindful Dentistry translates into this quality of being aware and present during our daily dental practice.

And it is not that difficult to apply:

- **Pay attention:** mindfulness is the art of paying attention. Not only to what is in front of us or to what we are doing but also to our thoughts, to our emotions, to our body sensations, to our breath. This helps to listen attentively, to observe carefully and to make better conscious decisions.
- **Respond in the face of stress:** the first step in responding is not action but awareness. Pause before reacting. When faced with difficult thoughts, emotions, physical sensations, or situations: pause and choose a helpful response, rather than reacting automatically (mostly in a not helpful way).
- **Watch your thoughts:** when the body holds on to stressful thoughts, tension increases because the stress hormones, adrenaline and cortisol are secreted.



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Practicing mindfulness and self-awareness of thoughts allows us to interrupt this sequence before it gets a strong hold of us.

Once you start applying it, you will start to approach clinical challenges with a more inner calm, taking control and decisive action from a place of clarity and being present to what is actually going on – instead of from reactivity and wishing the situation to be something else.

- **Recognize when the autopilot takes over:** you might say “well I’ve done this procedure a million times already, so why not space out?” The habit of being lost in thoughts can also mean you miss out on the parts of your work that make a difference: the subtlety of interpersonal communication, the joy of being creative, an opportunity to solve a problem in a different way, or the subtle look of gratitude that flashes in a moment. How many other things are you missing?



- **Complete the stress cycle:** where did we as dentists forget to complete the stress cycle? Dentistry creates many triggers and often we spend most of our day in “fight-flight” mode with a chronic state of Sympathetic System over-activation. Conscious attention to the Parasympathetic System brings the pendulum back to center. Deep breaths and muscle relaxation are the most accessible tools to activate the PNS.

As we notice tension there is a natural releasing, not only of our body, but also of our mind, our critical thinking, our creativity, our ability to collaborate and to solve problems.

A colleague that once attended my Mindful Dentistry Training Program told me how in a stressful situation, he was reactive and acted out in tension by raising his own voice, unable to hear any criticism. After practicing mindfulness, noticing his own tension, and returning to a relaxed presence, his tolerance grew. He started communicating without animosity, what enabled him to hear feedback.

Relaxing happens naturally as we direct a gentle awareness to the areas of tension in our body.

Learning to release our tension through conscious relaxing is an important skill that brings our full intelligence and creativity out.

- **Practice self-compassion:** learning how to rewire the self-critical brain is crucial in dentistry. We are rarely aware of it, but our judgments can affect every part of our life and work, our relationships, productivity, and creativity. This feeling of imperfection is a common experience among dentists. For most of us, habits of self-judgment are quite persistent. If we can calm our inner critic, we can rewire our brain for a deeper understanding, better performance, and deeper connections.

Start by bringing recognition to the patterns of worrying and self-criticism that often generate more stress and learn to relate to yourself with more acceptance and kindness.

- **Invest in your mental well-being:** practice breathing exercises, practice being present, meditate daily, practice positive self-talk, do physical exercise, network, laugh and engage in self-care. Make it a point to take care of yourself. Notice when you feel something is off and be able to intervene with purpose, whether that means taking a walk to clear your head or pausing to do a body scan meditation.

In conclusion, in dentistry you cannot negotiate with stress. By applying mindfulness at your everyday busy dental practice, you will promote body awareness, stress awareness, compassion, and relaxation. You will relax in a deep physical and mental level and you will wake up with energy and clarity for you and your patients. Mindfulness is a simple and effective tool that belongs to the dental clinic. Give it a chance.

Releasing tension  
through **conscious**  
**relaxing...**



brings your **full**  
**intelligence and**  
**creativity out.**



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**Meet the Author -** >  
**Manuela Rodrigues, DDS**

Manuela Rodrigues, DDS, graduated from the medical university of Lisbon, Portugal in 2001. She has been working both in Portugal and Belgium. She completed the Mindfulness Based Stress Reduction (MBSR) Teachers Training in 2018 and specialized in mindful dentistry. Over the last few years she took MBSR to the dental office: a reputable mindfulness program that is designed with dentistry in mind, and that better fits dentist's needs. Her mission is to enable dentists to create mindful and compassionate work environments. This year she launched her Mindful Dentistry Training online and started to work with dentists from all over the world.

Manuela Rodrigues, DDS and founder of the Mindful Dentistry Training, a Mindfulness Based Stress Reduction Program for dentists and dental teams. Contact by email at [mindfuldentistry@gmail.com](mailto:mindfuldentistry@gmail.com) or via [www.mindfuldentistrytraining.com](http://www.mindfuldentistrytraining.com)

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Las Vegas, NV  
August 19-21, 2021



# 3D PRINTED SURGICAL GUIDES FOR SAME DAY TOOTH REPLACEMENT In the Aesthetic Zone

## Introduction:

The advances in 3D printing and digital dentistry have made guided implant surgery both very predictable and also affordable. A rapidly increasing number of practitioners have modern digital technology in their practice, and are able to provide predictable and safe treatment to their patients. Research has shown that currently 28% of all dentists have digital scanners in their practice, while 17% have a CT/CBCT scanner. What is more, 15% of dentists have an in-office milling unit and 4% have their own 3D printer<sup>1</sup>.

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A recent systematic review by Weigl et al<sup>9</sup> showed that immediately placed and loaded implants in the anterior maxilla have a high success rate - 98.25% after a mean follow-up period of 31 months. In order to immediately place and immediately load dental implants in the aesthetic zone, a high stability of the implants should be achieved<sup>9,10</sup>. The stability of the implant depends on multiple factors, among which are quality and quantity of available bone, the osteotomy protocol and the design of the implant<sup>9,11,12,13</sup>. Implant stability can be measured by using the insertion torque values (ITV) and resonance frequency analysis (RFA). The use of RFA to measure implant stability was first described by Meredith et al<sup>18</sup> in 1996. In addition to being a completely non-invasive method, the major advantage of RFA is the ability to take multiple measurements at various intervals (placement, follow-ups and even after the delivery of the restoration). RFA measures the resonance frequency of a small transducer (peg) that is attached to the implant fixture. Based on this measurement, a resulting number is generated, which is called the Implant Stability Quotient. The ISQ values are shown as a scale of numbers from 1-100; values above 70 are considered high stability, between 60-70 as medium stability, and values below 60 are considered as low stability<sup>19</sup>.

The quality and quantity of the available bone can be evaluated both clinically and radiographically. When a CBCT scan is performed, a bone density report is generated, which can help the clinician plan the osteotomy protocol. Research has shown that there is a correlation between bone qual-

3D printing, also known as additive manufacturing, has many applications in healthcare and has been used in dental research, care and education<sup>2,3</sup>. Fully guided implant surgery by using 3D printed static surgical guides has been shown to be safer and more predictable than free-hand surgery or partially guided surgery<sup>4,5,6,7</sup>. Since the aesthetic zone in the mouth is the most challenging area from the technical and cosmetic standpoint<sup>8</sup>, precision, accuracy and predictability are paramount when replacing teeth in this area. Furthermore, when immediate tooth replacement is requested, the margin for error is even smaller.

ity assessed by using a dental CBCT and implant stability achieved during placement<sup>14</sup>. In order to achieve high initial implant stability, the osteotomy is usually undersized and a more aggressive (tapered and deeper threads) implant design is chosen in soft bone and in extraction sites to achieve higher stability<sup>15</sup>.

The following case report illustrates the use of 3D printed surgical guides in same day replacement of maxillary central incisors with dental implants with splinted provisional fixed prosthetics. Individual permanent fixed prosthetics were delivered after an osseointegration period of four months.



Figure 1: Clinical presentation of maxillary central incisors preoperatively.

## Initial Presentation:

A 64 year old male patient presented to our clinic with a chief complaint of mobility of his front two teeth. Patient had no history of smoking, diabetes or other systemic issues. He had no missing teeth, mild history of parafunction

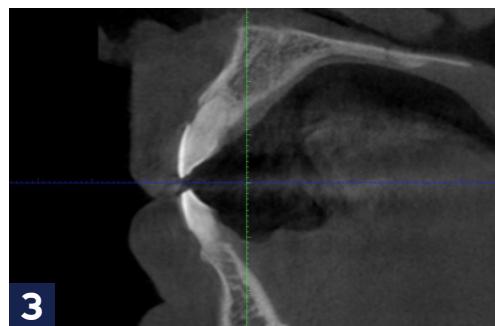


and a 1.5mm diastema between maxillary central incisors (Figure 1). Clinical and radiographic examination revealed horizontal bone loss and unfavorable crown to root ratio. There was also vertical bone loss on the mesial of the left central maxillary incisor (Figure 2). Patient had a thick gingival biotype and no signs of active infection in the area. When it comes to biology and aesthetics, research has shown that thick gingival biotype is essential in the success of immediately placed implants<sup>9,16</sup>.



**2**  
Figure 2: Periapical radiograph showing periodontal bone loss and unfavorable crown to root ratio.

USA). Two tapered 4.0 x 11.5mm ETIV Hiossen implants were inserted at 40 N/cm<sup>2</sup> torque (Figure 7) and resonance frequency analysis was performed using a Penguin type device (Integration Diagnostics, Sweden) and MultiPegs. The implant stability quotient (ISQ) values for both implants were above 70. The gap between the implants and buccal plate was filled with sticky bone consisting of PRF and a 50/50 mix of Veragraft allograft (Avtec Surgical, USA) and A-graft xenograft (HiOssen, USA). Patient also received an immediate splinted provisional on two 17 degree prefabricated abutments. No sutures were used. Standard post-operative instructions were given, over the counter anti-inflammatory medication and painkillers were prescribed. Post-operative healing at two weeks was without any complications, infection or inflammation, and soft tissues looked as healthy as they were preoperatively.



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**Figure 3:** Cross section of the CBCT showing intact buccal plate and adequate bone past the tooth apex.

**Figure 4:** Surgical guide (3D printed) and guide sleeves.

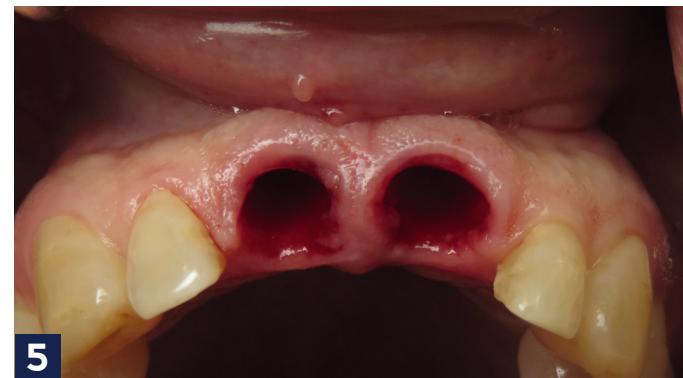
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## Treatment Planning and Preparation:

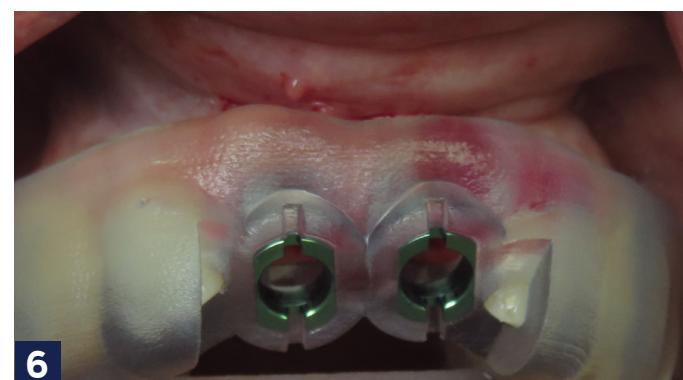
Given the presence of multiple favorable factors, a treatment plan including two immediate dental implants and an immediate fixed provisional was selected. A cone beam CT scan was obtained using Promax 3D Mid (Planmeca, USA) and an intraoral digital scan was performed by Medit i500 scanner (MEDIT, South Korea). The CT scan showed sufficient bone height and width past the apices of the central incisors and intact buccal plate (Figure 3). Digital treatment planning was done using 3Shape software (3Shape A/S, Denmark), and a surgical guide was printed on a Stratasys Objet Dental 3D printer (Stratasys Ltd, USA). Prefabricated surgical metal sleeves were inserted into the surgical guide (Figure 4), luted in place, and delivered to the practitioner for surgery.

## Surgical Procedure:

Prior to procedure, the patient underwent a standard implant protocol, which includes antibiotic premedication and rinse with chlorhexidine rinse. After local infiltration anesthesia, the maxillary central incisors were atraumatically removed, sockets were debrided and it was established that healthy bony walls were preserved (Figure 5). The osteotomy was initiated using the 3D printed guide (Figure 6) and guided drills from OneGuide surgical kit (HiOssen,



**5**  
Figure 5: Intact sockets after atraumatic extraction showing thick biotype and abundance of keratinized tissue.



**6**  
Figure 6: Clinical photograph showing the complete seat of the 3D printed surgical guide.



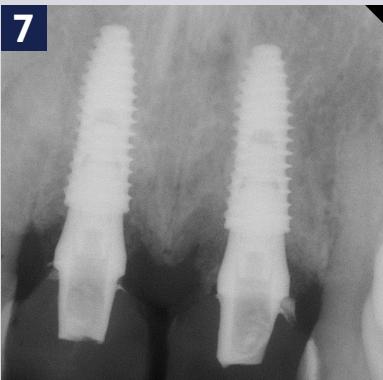


Figure 7: Immediate postoperative periapical radiograph showing the ideal implant position and abutments in place.



Figure 8: Clinical photograph of the surgical site showing healthy gingivae, ready for final restorations.

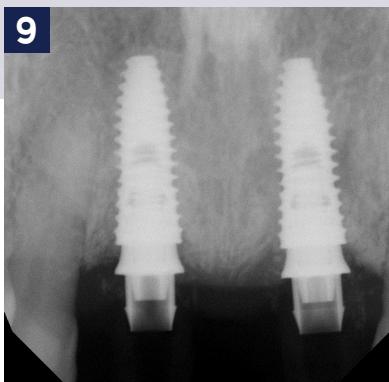


Figure 9: A periapical radiograph of the implants showing bone growth and maintenance, and verifying the full seat of scan bodies.



Figure 10: TruAbutment scan bodies attached to the implants to facilitate a fully digital workflow.

## Restorative Preparation:

Four months after guided surgical placement of the implants and provisionalization, the patient presented back for the restorative phase (Figure 8). Provisionals and temporary abutments were removed and implant stability checked again with Penguin RFA (ISQ's of 80-82 were registered). Implant scan bodies (TruAbutment, USA) were positioned onto the implants (Figures 9, 10) and an intraoral scan was taken to initiate prosthodontic procedures. 3Shape software was used to design the custom milled abutments for screw-retained restorations (Figure 11). At the patient's request, a small diastema was also incorporated in the final restorations to mimic his natural dentition before the extractions. Final crew-retained esthetic zirconia crowns (Figure 12) were fabricated over custom milled titanium abutments (angulated screw channel) and delivered according to standard restorative protocols (torque, obturation and occlusion).

## Discussion:

Dental implants can be placed using different protocols and methods, ranging from free hand to static guided to dynamic guided<sup>4,5,6,7</sup>. Depending on the comfort level and experience of the practitioner, and the complexity of the case, guided surgery should be used when more predictable and accurate results are expected. When it comes to immediate implant placement and immediate provisionalization in the aesthetic zone, static guided surgery provides for the safety, accuracy and minimally traumatic surgical experience for the patient. The surgical guides are printed using 3D printers, based on the surgical plan that was developed by merging the CT scan of the jaws with the intraoral scan of the gums and teeth. 3D printed implant surgical guides provide control and precision in all 5 dimensions of implant placement (mesio-distal, bucco-lingual, apical, arch position and cone position)<sup>15</sup>.

Due to the high accuracy of static guided surgery, implants can be placed with desired initial stability and precision. High initial stability is necessary for not only implant survival<sup>9,10</sup>, but also allows for immediate provisionalization. Studies have shown that to immediately provisionalize anterior implants, the following stability requirements must be met – torque ( $>35\text{N/cm}$ ) and RFA (ISQ's  $> 70$ )<sup>10</sup>. In this case, both those requirements were satisfied, and the patient was able to receive immediate fixed provisionals. Practitioners, however, are always encouraged to have a removable provisional ready (acrylic stayplate or essix appliance), in case other risk factors are encountered while placing the implants (poor bone quality, infection, destruction or absence of buccal plate, low torque/RFA values at placement).

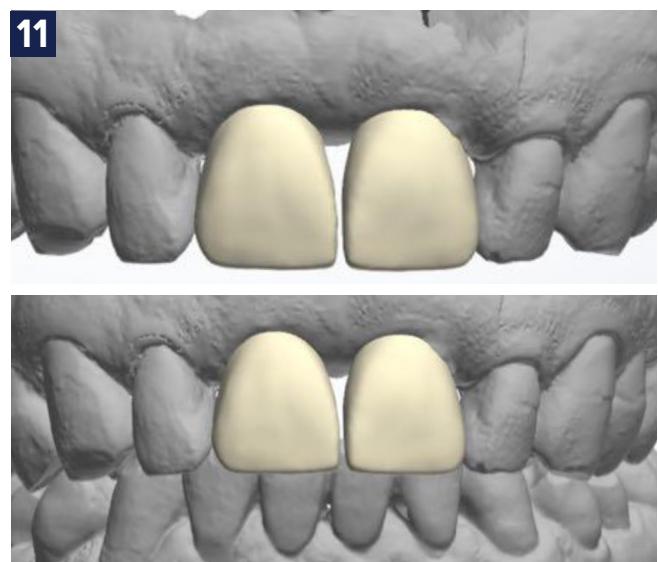


Figure 11: Restorative planning on 3Shape software for the final screw-retained implant crowns.

In summary, 3D printed surgical guides allow for a safe, predictable and precise implant placement in high-risk areas such as the aesthetic zone and allow dental practitioners to deliver immediate and high quality fixed implant restorations same day.

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Figure 12: Final delivery of the restorations. Patient requested to maintain a slight diastema between individual restorations for hygiene and mimicking his natural dentition.

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**Meet the Author -**  
**Varo Boyer,**  
**DDS, FICOI**

Dr. Boyer is a professor at UCLA School of Dentistry, as well a full time private practitioner focusing on implant surgery and restorations. He graduated from UCLA School of Dentistry in 2008, and has received additional training at VA Hospital System, Cedars Sinai Medical Center and the UCLA Dental Implant Continuum. Dr. Boyer lectures nationally on various implant topics and guided implant surgery. He is a Fellow of the International College of Oral Implantologists, and a member of the International Academy of Ceramic Implantology. He can be reached by email at [dentist@ucla.edu](mailto:dentist@ucla.edu).

*Dr. Boyer has no financial interest in any of the companies mentioned in this article and has received no compensation for writing this article.*



## A One-to-One Interview with **Vincent Silva, MDC** CEO & Founder of Virtual Healthcare Systems (VHS)

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**Q** What was the idea behind creating Virtual Healthcare Systems?

**A** After the start of my first company Digital Healthcare Computers (DHC), we wanted to stay progressive and forward thinking when it came to digital dentistry, education, and material science. With that mindset, we created a universal platform and digital ecosystem for both the dental and healthcare industry for people

to interact and communicate at the highest level.

**Q** What types of benefits can Virtual Healthcare Systems offer medical and dental professionals?

**A** Living in a world with COVID-19 and the restrictions that comes with it, we were launched into the forefront as a solution. With distance learning in place, we can help you communicate digitally in 3D using

your digital assets being video content, photos, 3D files and more. We are able to help you lower your burn rate when it comes to travel expenses and create an overhead for a better return on investment (ROI). Over this past year, there has been a 700% increase in VR users. Coming into the new year of 2021, VR will become the most used vehicle to overcome and still maintain every correspondence.

**Q** One of the greatest concerns customers have when purchasing a new software or product is available support. What type of support can customers expect to receive should they run into technical issues?

**A** Customers can email us at info@vhs-vr.com for any issues or questions they may have concerning our software or hardware issues.

**Q** Are there any plans to expand VHS outside of the US?

**A** We are already present in foreign markets. A percentage of our counterparts and affiliates are located outside of the U.S. As we know, the internet is global just like our platform. With the travel restrictions that are present, we are all able to connect through our virtual platform.

**Q** What does the future of VHS look like 5 to 10 years from now?

**A** The future of VHS is to be the cornerstone and pillar in the dental and medical community to create trust and value to everyone from doctors to manufacturers. VR is the entry level to AR as we move forward. The VHS platform will ultimately be using AR and AI as technology progresses as we continue to stay on the forefront of the digital world. This software has been validated by the

Department of Defense (DoD) and three different COVID-19 think tanks addressing COVID-19 issues at hand.



**“ VR education is transforming the way we deliver educational content in a positive and interactive manner with improved retention. ”**

**Q** Do you envision virtual reality opening new doors for education and possibly minimizing the need to travel?

**“Connecting HANDS and MINDS through Virtual Reality”**



Contact us at [info@vhs-vr.com](mailto:info@vhs-vr.com)

**A** VR education is transforming the way we deliver educational content in a positive and interactive manner with improved retention of the material that is presented. In a recent Harvard Study, VR had a retention rate of 85% compared to 2D learning via Skype or Zoom. VR technology offers a solution to minimizing the need to travel and save on business/personal expenses that are associated with that.

**Q** Any advice you would like to give to those who may be skeptical of implementing virtual reality in their practice or professional life?

**A** In a world where technology is ever evolving, we have to stay progressive and open minded when it comes to digital communications. Back in the day, the majority of us were skeptical about the internet and now it is the main highway for information. During these times of unexpected and unforeseen obstacles, sometimes we are forced to use Zoom or FaceTime for our daily communications when we typically would not need to. With VHS and VR, depending on your comfort level, you do not need to be fully immersed in a headset as you can participate on your laptop or mobile device.

# VIRTUAL HEALTHCARE SYSTEMS

## Immersing with VR Through VHS

Our world is constantly changing each day especially during the unprecedented times of the COVID-19 pandemic. This became a catalyst for us to start integrating digital technology into our daily routines. Many of us have been connecting virtually using Skype, Zoom, FaceTime and other web based video conferencing tools because of social distancing. Before we would use these types of services for our personal lives but now it is being used in a more professional setting. As the pandemic continues to affect our country, virtual and augmented reality are becoming our new reality.

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Virtual Reality (VR) is the use of computer modeling and simulation that enables a person to interact with an artificial three-dimensional (3D) visual and/or virtual environments. VR immerses the user into a computer generated



Figure 2: Oculus Quest 2 VR Headset

environment that simulates reality through the use of interactive devices. In a typical VR set-up, a user is wearing a VR headset and touch controllers that offer either 3DOF or 6DOF (degrees of freedom) which send and receive information to each other. The illusion of "being there" is experienced with the ability to see and hear in a 360 immersive environment. The user can tour a simulated suite of various rooms, experiencing the viewpoint and



Figure 1: How we communicate now.

perspective changes as if they are physically there. With the VR headset tracking technology, it is able to track the user's head movement and steps in both real time and virtually. The wireless controllers are designed to make it feel as though you are using your own hands in VR. This feature allows the user to even pick up and interact with objects that are seen in the virtual environment.

## Virtual Reality in Digital Dentistry

Imagine being able to view a dental mill and break it down into multiple parts from the spindle to the motors to troubleshoot an issue. Or view a patient's full mouth scan to educate and collaborate with other colleagues to determine the most recommended treatment plan. All of this is possible with using VR technology. It has been proven that VR has a higher retention rate when it comes to learning and understanding. The user is fully immersed with no distractions as the only thing they can focus on is what is in front of them. Combined with the interactive features of VHS-VR, it will create a more memorable learning experience.

Figure 3: User is interacting with a 3D tooth in VHS. Wireless controllers simulate their own hands in VR.





VR is limitless, you get unlimited redo's which helps build muscle memory while practicing in a socially distance, no risk environment.

There is only so much one can do through a 2D video call. With VR, you are able to collaborate with others in real time and at a higher level. VHS offers a widget board that provides the user all the tools they would have if they were in a boardroom or classroom. Our platform supports multiple users which allows them to work together fluidly and offer live feedback. Digital assets such as a presentation, .stl files or an interorral scan can be digitally imported into VR.

By eliminating the need to travel, companies are able to save money from travel expenses and still receive the same or a higher level of training or collaboration, as we are not compromising on quality.

## VHS - The New Virtual Workflow

Most of the dental industry are converting to digital technology and digital workflow environments to provide a more accurate, higher quality and efficient process for both their doctors, technicians, patients, and more. With VR, we are here to help companies, educators, doctors and labs do this but at a higher level using virtual reality by going a step further into the virtual planning process. Let us help you unleash your virtual reality content to anybody, anywhere, and at any time.

## Impacting the Dental Industry

Dental labs can now train, educate, troubleshoot, and provide solutions all within virtual reality. CAD/CAM technicians are used to handling and creating digital files

of patient's treatment plans. From converting a digital intraoral scan to printing out a 3D model to discuss with the doctor and patients, we can save you on that process. Before wasting material and time, we can import that model into VR. We can virtually view the patient's full dental model in real time in a 360 immersive environment and collaborate on the most effective recommended treatment. If there was a problem with the milling machine. Instead of waiting for the company to send out someone to troubleshoot it, we can do it virtually.

Companies in the dental industry can use this technology to train and onboard their employees. They can use this to showcase their products in a way that no one has done before.

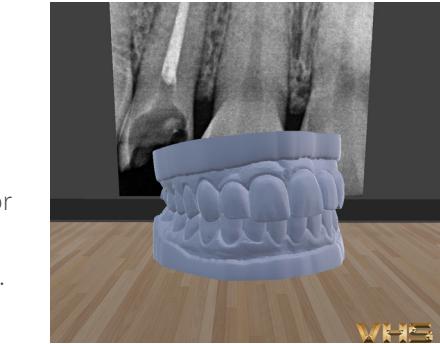


Figure 4: 3D digital full dental model



Figure 5: VR being used as a solution for dental patients to experience less anxiety and pain.

Doctors can immerse their patients in VR to help soothe their fear and anxiety during their routine exam or procedures.

Imagine attending an in person hands-on training seminar or a dental conference without ever leaving your home, office or lab. This is our new reality. The possibilities are limitless with virtual reality.



**Meet the Author - >  
Vincent Silva,  
MDC**

### CEO & Founder of Virtual Healthcare Systems (VHS)

His passion and interest for the Dental Industry was introduced by his father at an early age. He graduated from UCLA (University of California, Los Angeles) with his Master's in Dental Ceramics along with an opportunity to study abroad alongside with European Esthetic Professionals.

*"VHS is here to create an innovating and exciting new way of changing the way we learn and educate through Virtual Reality at the highest level. I am creating a path not taken through both Digital Dentistry and Virtual Reality as the possibilities are limitless."*



# FINDING YOUR CENTER



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## Tips on Starting a Meditation Practice

**Randi Sachetta**

**M**editation, the word can be intimidating. Visions of gurus seated in silence for hours, their minds empty, their bodies calm, their faces relaxed and peaceful. Just the definition of the word itself, as found in the Webster's Dictionary, "practice where an individual uses a technique – such as mindfulness, or focusing the

mind on a particular object, thought, or activity – to train attention and awareness, and achieve a mentally clear and emotionally calm and stable state" can deter you from even trying to sit in meditation. I am here to share with you tips and tricks to help you overcome this fear, the intimidation of this practice of mindfulness so that you can reap the benefits and improve your everyday life.

First let me go over the benefits of establishing a meditation practice. An article published in the New York Times states that 55% of Americans claim they are stressed. Stress can cause a number of issues in the body including high blood pressure, insomnia, a weakened immune system, headaches, body aches, and a host of other physical problems. The stress hormone, cortisol, can release inflammatory chemicals called cytokines. Meditation has been proven to reduce this chemical in the body, therefore reducing the inflammation and adverse physical side effects of stress. Meditation also promotes self-awareness, allowing you to focus more on your breath and your body becoming aware of different things going on within you. It also helps keep you focused, improve your attention span, improve breathing, and improves sleep by allowing your mind to slow down. These are just a couple benefits from taking time to slow down, and be still. There are so many more!

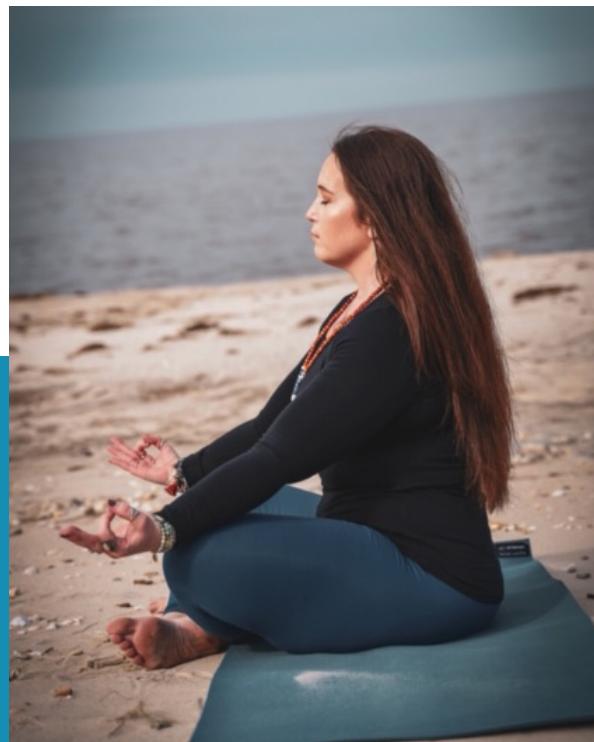
Meditation does not necessarily mean "an empty mind" either. There are many practices that can translate into meditation. Taking a walk. Reading. Sitting and just listening to music. All of these things are allowing you to focus on one task, and allowing your brain to slow down and take everything in, instead of trying to juggle four things at once. Do not allow your fear, or things you have been told about meditation to prevent you from trying to start a regular practice!

## Below I will give you some tips to help you start the process.

- ✓ Start small with 10 minutes a day, whenever you can sit alone and be still and quiet with yourself. You do not need to sit in silence for hours and hours to reap the benefits.
- ✓ Make the room dim, or dark, to allow your mind to go within and not be distracted by the light or things going on around you.
- ✓ Play "meditation" music....calming music with no lyrics to focus your attention.
- ✓ Count your breaths. This is one of the biggest helpers in trying to meditate. Count "one" as you inhale and then "2" as you exhale. Keep repeating over and over for the allotted time. This focuses your attention on your breath and again allows your mind to not wander and think of other things going on in your life.
- ✓ Let thoughts come as they will. Do not linger on them or focus on them, but allow them to come into your mind. For example: "*The laundry needs to be put in the dryer*". Allow the thought to enter your head, but then release it, do not focus on this task or thought or put any energy into it.
- ✓ LAY DOWN! This is also one of the biggest helpers, allowing your body to relax which also allows your mind to slow down and relax.
- ✓ Listen to a guided meditation. Youtube.com has so many free guided meditations. Guided means someone is talking you through a vision or scenario or helping you to count your breath. This can also help focus your mind and reduce distractions.

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It can be difficult to imagine yourself sitting for a period of time in silence and stillness, but the practice of meditation has so many benefits, many of which I have not even mentioned. But taking time for yourself, finding that self-awareness and stillness which comes from a mindfulness practice, will help you improve your everyday life, at work and at home.



### Meet the Author - Randi Sachetta



Randi Sachetta is a 200 hour certified yoga instructor, a personal trainer and group fitness instructor, Reiki Master and nutrition coach. She recently opened her own yoga and fitness studio in her home state of Delaware. Her passion is helping people become the best versions of themselves, through proper nutrition, fitness and mindfulness. She has also worked in the dental industry for 13 years.

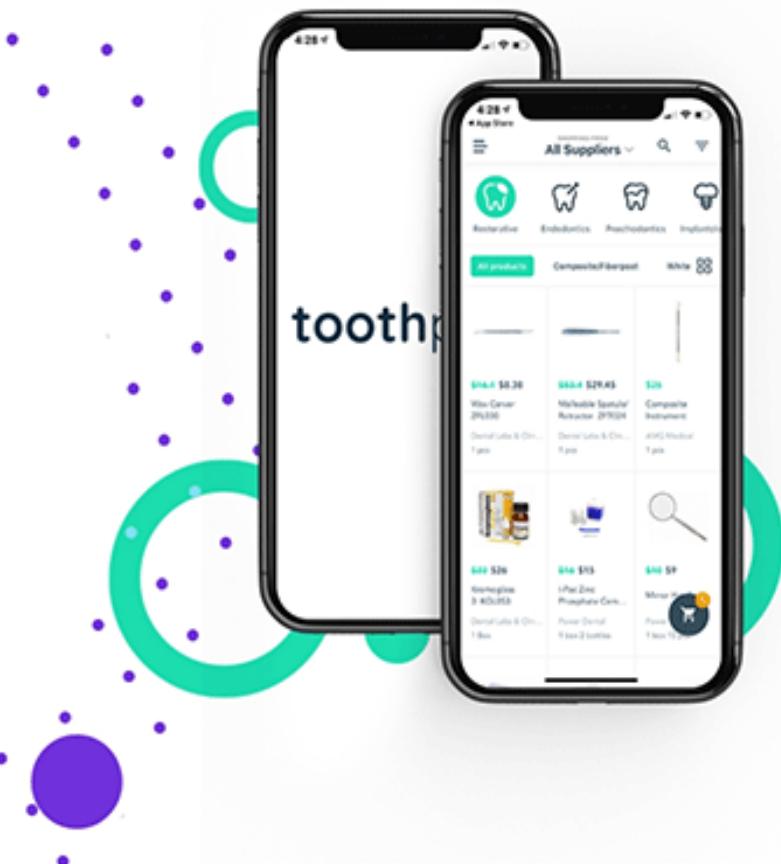
# toothpick

YOUR DENTAL ECO-SYSTEM

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**Toothpick** is a digital marketplace created to gather all the stakeholders of the dental industry onto one platform. This platform contains all key components of the industry, making it a one-stop shop and a dental ecosystem with the capability of transforming the whole dental industry into one app. Essentially, this ecosystem can alternate the industry from physical to digital.

This ecosystem was formed by three dentists; Dr. Wael Bizri, Dr. Mohamed Hammoud, and Dr. Mohammad Saad, who discovered a recurring problem in the industry, and one Technology expert; Malek Hijazi, who addressed it with the potential



solution, that derived from Dr. Bizri's and Mr. Hijazi's background in co-founding "Markit", the grocery app.

This app is called **Toothpick** and is currently operating in four countries in the MENA Region, with the impending international growth of the company, the end goal is to be present across all continents.



**Dr. Wael Bizri -**  
CEO



**Dr. Mohamed Hammoud -**  
General Manager,  
UAE



**Dr. Mohammad Saad - General Manager, Egypt**



**Malek Hijazi - CTO**

**More information about  
Toothpick can be found at:**  
[www.toothpickapp.com](http://www.toothpickapp.com)  
 IG: @toothpick.app  
 FB: @toothpickapp  
 #LetsGetDigital



# interview

**Q** What was the idea behind Toothpick being developed? What goals were in the minds of the co-founders?

**A** The idea behind Toothpick was to create a solution for Dentists, to ease their daily processes and make them more efficient.

As the Co-Founders are practicing Dentists, who have gained international experience in their fields, they have identified a common problem across the countries, of not having an existing platform which connects the local dental suppliers and continuous education course providers to the dentists. The goal was to create a One-Stop Shop for Dentists, a hub, where Dentists do not have to worry about the product delivery, payments, invoices, daily hustle of approaching dental suppliers, and can focus on their actual skill and joy to treat patients.

**Q** What will be offered to customers (i.e., dental products, software), and what customer base would this site cater to? Is it mainly for dentists or available to the public as well?

**A** Toothpick offers Dentists a wide range of products displayed by their local dental suppliers. A dentist can download the app, can find over a thousand of their daily used products, can filter the products per brand, per supplier, and will receive them consolidated in 1 Bag, for better prices. As continuous education is an essential part of every dentist,

Toothpick offers all available courses to purchase through Toothpick. Further, other services such as Toothpick Gold, a tailored dentist procurement system, where dentists can request their personalized price through a private channeled supply chain between the dentist and supplier or Toothpick Events offering all local dental events. Public: Toothpick's expansion plans in future is as well to target the public with dental products and to provide dental healthcare education. For the current phase, we are focusing on the businesses, will then shift to the public at the right time.

**Q** Are outside vendors able to sell their products on the Toothpick website?

**A** Toothpick's vendors are the local dental suppliers of the country. The dental manufactures usually give the rights to certain dental suppliers in the specific countries to sell their products. Those dental suppliers / vendors are onboarded on Toothpick.

**Q** Have there been any issues with international deliveries during the COVID pandemic?

**A** Toothpick operates Country per Country as one entity. That means that dentists in the United Arab Emirates can only purchase products from the local suppliers. International Trading is not currently an option in Toothpick, as the healthcare and dental regulations in the countries are set to support the local businesses.

**Q** What does Toothpick hope to accomplish in the industry?

**A** Toothpick hopes to digitalize the dental industry. Our goal is to make the industry more efficient, to enhance the operational workflows of every dentist, to make their life easier.

We are aiming to create a dental hub for dentists, where we connect all the components of the dental industry, products, education / courses, logistic, finance, events, showcase their cases, exchange experience and other dental related topics and services. We want to enhance the communication between dentists and their partner through technology, and create a win-win situation for every partner using and experiencing Toothpick.

**Q** Any ideas to open warehouses to reduce shipping costs in other parts of the world or for company growth?

**A** Toothpick has warehouses per country which are used as Cross-Docking hub, where we collect the daily orders of all suppliers, sanitize those, fulfill them per dentist order, and pack them in a high-quality way to achieve a great customer satisfaction. We have a partnership with Aramex as our Global Logistic Partner, which is developing as very fruitful as their professionalism and our optimized collection. Hence, we believe with Aramex, local delivery companies and our own fleet, we would be ready for company growth in the near future.



**Q** What are some of the benefits of purchasing through Toothpick compared to a competitor?

**A** Currently, there is no comparable platform such as Toothpick combining all the local suppliers, as partners, and offering great discounts. We have engaged with the vendors, not as vendors, more as partners, who will receive a new selling channel. Hence, the prices are very attractive, a dentist can order 24/7 from their suppliers, and receive them scheduled on their preferred time.

A huge benefit offered through Toothpick, is the above explained Toothpick Gold - a procurement system, created by Dentists for Dentists. A dentist

can select their products, from different suppliers, and request for their tailored prices, within 2 hours. This process would take usually a few days of calling, sending emails and asking for quotations. Through our technology, and the back-end provided to the dental suppliers, the dentist will receive their personalized prices within a short period.

Our advantage is our experience in the dental industry, and in technology, with our in-house Tech team, developing new features as per the user's feedback.

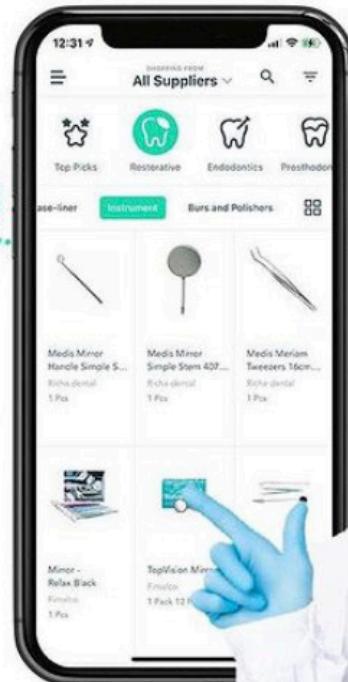
**Q** What are the future goals of Toothpick, say in the next 5-10 years?

**A** Toothpick's goal is to digitize the industry as mentioned above. We are a technology company who are not setting any limits, we will grow and expand as per market requirement. We will add features and services, per the user's experience and feedback. We want to optimize and tailor the app, in a continuous process, to provide the best quality to our customers.

Toothpick is currently developing a clinic management system, containing a patient appointment system, inventory system, lab reports, patient experience and other services.

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Kristy Montoya diving into VR!

Dr. August de Oliveira showed Kristy some of his 3D printed creations and around the office. ▼



^Kristy Montoya had a great time interviewing Vincent Silva, CEO of VHS discussing future plans of his company. VR here we come!



^ Dr. Hugh Flax is indulging his mind on Technology Trends!



Time to enjoy a nice dinner while gathering thoughts after a day filled with networking, in old town Claremont, CA

Editor in Chief, Kristy Montoya and Vincent Silva, CEO of VHS  
▼ discuss futuristic education!



Kristy Montoya spending quality time with her new pups!



Dr. Angelo Cardarelli is ready to teach his next course!

# ON THE SCENE!



^ Christopher Owens is showing off DDHK Magazine's latest issues!



Dr. Angelo Cardarelli is getting ready for surgery!



<  
Kristy Montoya and Dr. August de Oliveira discussing intraoral scanners and their capabilities.

# 3shape ▶

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# CONTRIBUTOR SPOTLIGHT



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## Welcome to the New Era of Dentistry with 3D Printing, Augmented Reality, Artificial Intelligence and Automation

### Discover What's Possible When Everything Is Connected

Year after year, a patient named Maria put off being fit for dentures because of the horror stories she had heard from peers. Yet, she couldn't put it off any longer, and so on a recent weekday afternoon, Maria found herself very gingerly walking into a prosthodontist's office to be fitted for new teeth.

Initially unsure of what to expect, Maria was pleasantly surprised after a complete and enjoyable examination. And though she anticipated waiting a few weeks for dentures that she was unsure she would like; Maria was delighted as she strolled out just a few hours later with a brand new smile that she absolutely loved.

Maria's situation is one that is not only possible but

is starting to become common thanks to tremendous advances in dental technology, which have made visits to the dentist easier, faster, less painful, more educational and more enjoyable for both the patient and the practitioner.

Consider this:

- 3D printing can quickly create a number of customized three-dimensional objects used in oral health, such as dentures, crowns and bridges, to name a few.
- Augmented Reality can bring to life intraoral scans in 2D and 3D images, plus provide an array of other fascinating dental applications.



- Artificial Intelligence allows patients to view the smile of their dreams on a computer screen and then work with a dentist to make that smile aesthetically and functionally possible.

Many people today seek a dental practice that will create new possibilities for their lives, and advances in technology are making that happen in dental offices worldwide. Dental professionals now have at their disposal digital tools that allow them to provide more accurate treatment plans, highly precise prosthetics, and lessened treatment times and visits. Dentists who invest in the right technology now have better ways of presenting treatment options and plans that engage the patient at an aesthetic, functional, psychological and emotional level. Being able to automate all these tools into a complete system - where patients want dentistry and want to come to your practice - is the new era of dentistry and can be a game changer for dentists and patients worldwide.

Mr. Paul Vigario, founder and CEO of the dental technology company, SurfCT.com, has found that dentists who have the proper technological system can grow their practices exponentially.

*"We enjoy watching our dentists grow, and can help them tremendously by putting these advanced technology pieces together into a complete system that connect a doctors' vision to their technology and treatment philosophy, ultimately elevating their practice, brand and life,"* Mr. Vigario said.

### 3D Printing Saves Time, Opens 'A New World of Possibilities'

One technology making huge waves in the dental industry is 3D printing. Also known as additive manufacturing, 3D printing is a process by which hundreds of thin individually-shaped layers of a given material are added together to produce a three-dimensional object. Almost any three-dimensional object can be created, opening a new world of possibilities. In dentistry, these objects can be models, oral appliances and provisional crowns and bridges.

3D printers come in all shapes, sizes and with differing printing technologies and price points. With the overwhelming amount of 3D printers for sale in the dental



market, it would behoove dental professionals to conduct thorough research on available products, or consult with an unbiased professional to direct them to a printer that aligns with their vision and desired results.

One great advancement in dental 3D printing is the arrival of bio-compatible resins for oral use. Such materials allow for very precise manufacturing of mouth guards, dentures, surgical guides, and temporary crowns and bridges, which can now be printed and provided on site with one-day dentistry.

There are two major reasons for the popularity of 3D printers in the dental industry. First, dental professionals can now control manufacturing and production right from their own in-office laboratory. Immediately after a patient's digital impression is captured, the file is electronically transferred to the digital laboratory technician, who will design the desired prosthetic using CAD (Computer Assisted Design) software. The file is then sent to the 3D printer to begin fabrication. Depending on the appliance being fabricated, printing will take approximately 30 to 40 minutes. Once complete, the appliances are removed from the build platform, post-processed in an alcohol bath and finished curing in a UV bath. Once the UV bath is complete, the appliance is ready to be delivered to the patient. Due to this technology, there are offices in the United States where you can walk in for an appointment in the morning, and within a few hours, leave with a brand new smile, similar to the experience "Maria" had in our aforementioned anecdote. Imagine the power of this technology in your practice.

The second reason 3D printers have gained in popularity in the dental world is the cost per appliance, which in many cases - depending on the appliance - can be as low as a couple of dollars, representing tremendous cost savings. With full control and lower costs, it is easy to see why so many dentists are embracing this technology.

Dr. Paul Zhivago, owner of Downtown Dental in Westfield, N.J., said he has worked with SurfCT.com to optimize his prosthodontic-specific system.

*"Both time and money are tremendously optimized when the proper 3D printer is chosen for your practice,"* Dr. Zhivago said. *"It has been a game-changer for ours."*





### Augmented Reality: New Frontier

Another cutting-edge technology that is gaining traction in the dental field is the use of Augmented Reality. AR is the integration of digital images or data with the real physical world via a smartphone, tablet or an AR-enabled headset. In dentistry, the most efficient way to utilize this technology is by implementing an AR headset that allows for the view of a patient's health history, 2D/3D images like X-rays or CBCT's, intraoral scans and treatment plan information, all while the doctor is simultaneously looking in the patient's mouth. This is similar to a head's up display in an airplane and it allows the doctor to be in full control of his or her environment, treatment plan and relevant information as the doctor connects with a patient.

Another exciting use for AR in dentistry is the use in guided implant surgery. By using the implant planned position, coupled with a navigation system, the practitioner is able to view the surgical area, the virtual position and the trajectory of the drill into the implant site. In real time, the doctor has the ability to view a patient's CBCT, implant planned data and drill trajectory of the implant, while concurrently performing surgery on the patient. This is truly a promising technology with many uses in the dental industry.

### Virtual Reality Calms Patients, Thereby Helping Dentists

Much like AR, Virtual Reality is also changing the experience for both doctors and patients. Virtual Reality is a three-dimensional computer generated simulation that doctors can interact with via special electronic goggles that have screens on the inside and handheld sensors. VR allows practitioners to design dental cases in a fully-immersed environment, free from distractions and interruptions.

Dr. Zhivago is one such doctor experimenting with this fascinating technology. By launching a design specific software on VR goggles, he is able to produce a mock-up design that is instantly 3D printed and presented to a patient as a realistic prediction of treatment, similar to the experience of our patient "Maria."

Speaking of improving patient experiences, VR can visually submerge an anxious or apprehensive patient into calming or relaxing scenes, which in turn permits the dentist to perform treatment with fewer interruptions and better patient cooperation.

Additionally, a couple of truly amazing byproducts of VR relaxation during dental treatment are the positive effects it has on patient blood pressure and heart rate.

### Artificial Intelligence Helps with Smile Design, Orthodontics

Artificial Intelligence is another example of technology revolutionizing the dental industry. AI is the ability for a computer or software to learn how to carry out a specific task and improve its performance with minimal need of additional programming or updating. AI has brought a couple exciting advancements in dentistry, particularly in the area of smile design. A dentist can now take a few images of a patient's smile, and within seconds, AI-driven software will generate multiple smile designs for that patient. The patient can pick out a smile he or she likes and can see in real time a very accurate depiction of what he or she will look like with that smile rehabilitation. To bring it a step further, the doctor can take that smile, 3D print it and give the patient the ability to experience the new smile in the real world.

Another area that AI is helping is in orthodontics. Dentists and orthodontists now have the ability to take an intraoral scan, import the scan file into the software and position the teeth exactly to the ideal smile. The AI software will not only calculate how many aligners are needed to reach that exact position of teeth, but will also provide the model files necessary to print and thermo-form to create each aligner.





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AI gives the dentist and orthodontist full control over the in-office production of the aligner treatment, something that has never been possible in-office and so instantly before.

These are just a couple of examples where AI is really making an impact; there are many more coming down the road as more companies start providing this amazing technology.

### Automating Technologies is a Game Changer

Perhaps one of the most intriguing aspects of this new

technological world of dentistry is what can happen when we combine all of the technologies we have explored together in this article.

When properly combined and designed, 3D Printing, Augmented Reality and Artificial Intelligence can be part of a complete system designed to serve dentists and automate dental practices. Whether you're a General Dentist, Cosmetic Dentist, Pediatric Dentist, Endodontist, Oral & Maxillofacial Surgeon, Orthodontist, Prosthodontist, Periodontist or even a Dental Laboratory, the understanding of how all these technologies connect together have led to the advent of automation in healthcare. With automation in your practice, a patient like "Maria" can schedule an initial appointment online, electronically receive the forms needed for an initial visit almost instantly after scheduling the visit, and have the choice of filling out forms on a computer, tablet or their smartphone in the convenience of her home. Once submitted, the

new patient information is digitally transferred to the patient's electronic file in the office's dental management software, allowing for a truly paperless environment and also empowering the practice to prepare the patient's individualized digital journey. Now the majority of the patient's journey can be automated, making it much easier for dentists and staff to provide excellent care while growing a practice.

Automation has also helped with taking records in the clinical area, as well. There is perhaps nothing more annoying than rifling through different SD cards looking for patient photos, only to find that they were mistakenly deleted by a coworker. With a WPTS (Wireless Photo Transfer System), like the one popularized by SurfCT.com, an image is automatically and wirelessly delivered to a designated folder on your server, while at the same time giving you the ability to have the image displayed anywhere you like. For example, it can be displayed on a nearby monitor and presented to a patient, or sent to the lab of your choice, for treatment acceptance and preparation. What happens after you click the button on the camera is a chain of events that are automated and allows you to enjoy practicing dentistry like never before. With this technology in hand, a patient like "Maria" can walk out with same-day dentistry and a smile on her face.

These four categories are only the tip of the iceberg. Technology is exponentially evolving. Patients have also evolved and can appreciate and feel confident to where they proactively say "Yes, I want this type of treatment." This happens when they are educated on the possibilities and feel confident, they are getting the most modern treatment available.

Meanwhile, "Maria" is all over town showing off her new smile and telling her family, friends and co-workers about the amazing experience she had at her dentist. And her dentist is not only thrilled that he was able to help a new patient, he is also loving all the new referrals coming his way.

If you would like to learn more about the topics written here or discuss how to implement such technologies in your practice, please email [Hello@SurfCT.com](mailto>Hello@SurfCT.com). Ready to take the next step in elevating your practice? Get a complimentary core explore technology assessment by following [@SurfCTcom](#) and DM us for more information.



## Paul Vigario

Founder & CEO of SurfCT.com  
Technology Guru, Entrepreneur,  
Speaker

Mr. Vigario started SurfCT from the ground up in 2003 after graduating from the University of Connecticut with a bachelor's degree in Management/Computer Information Systems and a focus on healthcare technology. Vigario and his company have helped expand the IT field by educating and supporting the dental community. SurfCT has been involved in over 12,000 dental practices and the technology and automation within those practices. This level of knowledge is sought out by Dentists, DSOs, Healthcare Companies, Universities and Dental meetings.

*"Technology development is escalating exponentially, changing the landscape of the dental industry, and is sure to continue its fast-paced growth as it's been proven to automate and drive practice growth. We help dentists connect their vision, technology and treatment philosophies into a complete system to elevate their practice, life, and brand."*

This deep knowledge allows Paul and SurfCT to continually offer practice growth and automated systems that are game changing, exciting, and provide a new means of modern, reliable, innovative, informative, and quality technology driven experiences for dentists and their patients.



## Juan Estrada

SurfCT.com Digital Workflow  
Engineer

Mr. Estrada specializes in constructing premium customized technology systems for dentists all over the globe. Juan is notably experienced in the area of complete digital workflow and practice automation including AI, dental records acquisition, cone beam imaging and intra-oral scanning, and how all these technologies connect together for in-office manufacturing with 3D printing and milling. A complete automated experience for both patients and doctors. Juan has a great passion for improving office workflow and practice efficiency through technology. Having worked at some of most exclusive dental practices in New York City for over a decade, this unique hands on experience gave Mr. Estrada a deep understanding over the inner workings of dental practices, and what dentists need and want for their practices to grow. This hands-on knowledge coupled with his studies, university degrees and certifications in Industrial Electronics and Networking allowed him to be at the forefront of dental technology surrounded by a strong culture that Everything Is Connected™ with the SurfCT team.

SHANNON SOMMERS, MSHI, BTDH, RDH ALICIA WEBB, MSHI, BTDH, RDH



# 3D PRINTING IN DENTISTRY

The field of dentistry is evolving in such a way that conventional methods of fabricating dental prostheses are migrating toward digital processes known as 3D printing. 3D applications and their use in dentistry offer better accuracy, larger build volume at a fraction of the cost of conventional methods, and can develop prototypes with faster processes that scan, design, print, and prepare items with consistency and high precision.<sup>1</sup> Several techniques used in 3D printing in the dental field include selective laser melting (SLS), stereolithography (SLA), fuse deposition modeling (FDM), digital light processing (DLP) and direct metal sintering (DMLS).<sup>2</sup> With the ability to address the limitations of the complexity of anatomical structures associated



Figure 2. Photo courtesy of 3D Systems

with the oral cavity, these methods and techniques combine oral scanning, 3D printing, and CAD/CAM designs with sheer accuracy and speed.<sup>3</sup> As a result, digital technology and 3D printing have significantly elevated the rate of success within dentistry to improve the quality and accuracy of dental work.<sup>2</sup> 3D printing technology is now being extensively used in orthodontics, prosthodontics, periodontics, and dental research and education.<sup>4</sup> There are several companies that develop and manufacture 3D printers and related software and offer different methods and techniques to achieve customizable dental objects to meet the needs of various dental specialties.

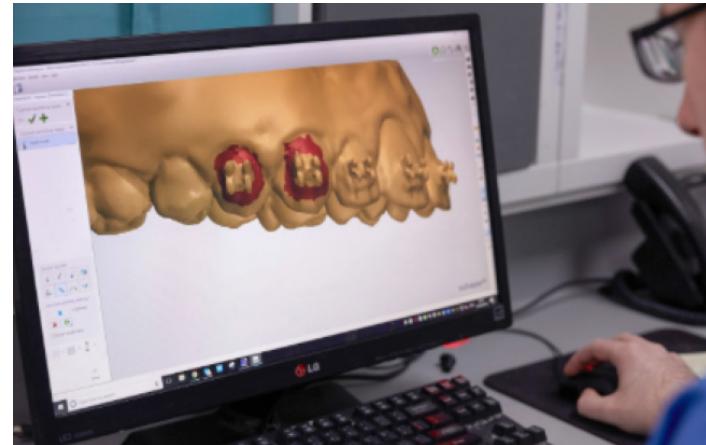


Figure 1. Photo courtesy of Formlabs

## Specialties Utilizing 3D Printing Technology

3D printing is revolutionizing the orthodontic process by providing digital advantages over the traditional workflow process.<sup>5</sup> To illustrate, once the 3D scan is complete, it is transferred to the computer to produce 3D images of the patient's teeth, where the files can be sent to a lab or created within the dental office to produce a digital model.<sup>5</sup> This process is quick, clean, and accurate, as it eliminates the need for physical impressions of the patient's teeth and reduces storage space of the subsequent models.<sup>5</sup> Additionally, the clear aligner market has seen rapid disruption in recent years due to expiring patents, lowering cost of 3D printers, and new orthodontic planning software.<sup>13</sup>



Figure 3. Photo courtesy of Formlabs

Even with these recent advancements, the production of clear aligners remains a labor intensive process; however, numerous 3D printer manufacturers are working to eliminate the need for post-processing procedures.<sup>13</sup> As a result, 3D printing software, printers, and automated post-processing tools create the perfect combination to enhance workflow in orthodontic practices.<sup>1</sup>

By and large, metallic and polymer-based materials are common in dental prosthesis fabrications.<sup>4</sup> Ongoing research based on additive manufactured materials used to fabricate removable and complete dentures has shown positive results regarding the material's physical and technical properties.<sup>4</sup> With progressing advancement in dental digital workflows, it is possible to directly print prostheses and not only provide acceptable esthetics,

but reduce the number of appointments for the patient at the same time.<sup>4</sup> A technician digitizes the model and/or wax-rim with a desktop 3D



Figure 5. Photo courtesy of Carbon

scanner, then designs the denture digitally and 3D prints a try-in denture or the final denture. This procedure is affordable and provides a consistent, seamless workflow, as it allows expansion of production without significant overhead costs, requiring fewer steps and less variability. Furthermore, digital designs are reusable, shareable, modifiable, and easy to reproduce, all while being completely patient-specific.<sup>1</sup>

The complexity of the oral environment has led to the development of additive biomanufacturing, which involves the application of 3D printing technologies; namely, a procedure called guided tissue regeneration.<sup>4</sup> It is now possible to utilize and guide multiple periodontal cell types during the healing process with the invention of 3D-printed biphasic scaffolds, specifically for bone tissue engineering.<sup>4</sup> Bone regeneration is a complex procedure, as it involves a number of molecular, cellular, biochemical and mechanical cues.<sup>11</sup> Porous bone tissue engineering scaffolds with appropriate shape, pore size,



Figure 4. Photo courtesy of Formlabs

porosity, degradability, biocompatibility, mechanical properties and desirable cellular responses are required to induce bone regeneration.<sup>11</sup> With the creation of novel bone tissue engineering scaffolds via 3D printing, the 3D printed macro-micro structure could morphologically mimic the multi-scale structure of human body tissues.<sup>11</sup>

Since bone and tissue loss are a result of periodontitis, the concept behind additive biomanufacturing is to restore periodontal tissue and bone by supplying the surrounding tissue with growth factors, genetically modified cells, or bioactive proteins over a period of time, which can assist the surgeon for implant placement.<sup>4</sup> Considering implant surgery is commonplace, the use of different 3D printing techniques can be applied to assist with the planning of complex implant or surgical treatments.<sup>6</sup> For this reason, it has been established that oral surgeries may be less invasive and more predictable with the use of surgical guides printed in resins or autoclavable nylon materials.<sup>6</sup>

## Dental Research and Education

Continued research in dentistry as well as in 3D printing technology is required to advance the methods used in dental treatments and diagnoses. Given the digital origins of additive manufacturing, there are additional factors to consider from traditional manufacturing, such as the use of data formats and guidelines for design and production processes.<sup>12</sup> For an emerging, disruptive technology like 3D printing, standards can provide the foundation needed to facilitate wider adoption of this kind technology.<sup>12</sup> As technology continues to advance and dentistry embraces new materials and methods, ensuring consistency and meeting regulatory standards are ongoing processes.<sup>12</sup> Nevertheless, 3D dental models fabricated with this technology can be used as educational tools, as they give the clinician a better subjective perception of the bone and teeth compared to the stereotypical typodont or acrylic models.<sup>4</sup> Furthermore, 3D printed models can be highly beneficial for demonstrating complex anatomical structures, providing the means to simulate final prostheses to be used as an instructional guide for the clinician, technician, and students in undergraduate programs of study.<sup>7</sup> In addition, patient education and visualization of procedures using 3D models can assist a patient's understanding of treatment plans before an informed consent is made.<sup>7</sup>

## Conclusion

3D printing has the propensity to improve precision and accuracy of dental treatments by developing customized devices via rapid prototyping of dental models and prostheses. In dentistry, available techniques and methods will increase as 3D printing technology continues to be developed; therefore, there will be a need for validation and standardization of devices, materials, and techniques to ensure better outcomes of 3D printed objects.<sup>8</sup> Considering that ceramics in dentistry have been limited to production through milling or subtractive manufacturing, production of ceramics via 3D printing is now a viable option.<sup>13</sup> As of June 29, 2020, a major development took place within dental 3D printing, as the FDA posted a 510k premarket notification for BEGO VarseoSmile Crown plus, a ceramic-filled hybrid material for the 3D printing of permanent restorations.<sup>13</sup> Regarded as “the world’s first tooth-colored, ceramic-filled hybrid material for 3D printing of permanent single crowns, inlays, onlays, and veneers,” this advancement will ensure that 3D printing remains relevant in the dental laboratory for years to come.<sup>13</sup> In all, 3D printing applications are designed to assist dentists and clinicians in providing better and more personalized services to patients, while simplifying work processes and cost reductions when delivering dental care.<sup>9</sup> 3D printing technologies, methods, and techniques have tremendous potential to transform dental treatment methodology by combining innovations in software, hardware, and materials to deliver highly functional dental pieces that can ultimately advance and improve all aspects of oral healthcare.<sup>10</sup>

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### Meet the Authors >

**Shannon Sommers, MSHI, BTDH, RDH** has a Bachelor of Technology in dental hygiene from the State University of New York at Canton and a Master of Science in health informatics from the Medical University of South Carolina. She has over 20 years' experience in dentistry and has been a dental hygienist since 2006. She aims to use her dental background and informatics skills to promote and advance dental informatics.



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# THE USE OF 3D PRINTING FOR DISTANCE LEARNING TRAINING IN DENTISTRY

## Using Technology During the COVID-19 Pandemic

Coronavirus disease (COVID-19) brought up the need for the use of technology and innovation in Dentistry in response to the raising new demands. This article presents the use of computer aided design (CAD) and computer aided manufacture (CAM), as a tool to improve the distance learning programs, using virtual patient concept and 3D printed phantom model's technology.



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### Introduction

Coronavirus disease (COVID-19), a disease caused by the new SARS-CoV-2 virus, was declared a pandemic by the World Health Organization (WHO) in March 2020<sup>(1)</sup>. The disease spreads from person to person through droplets and aerosols of saliva and respiratory fluids. To control the disease social withdrawal was determined by most governments in the world, leading dental schools to close their face-to-face classes and to start using distance learning programs<sup>(2)</sup>. All these changes made it necessary for a new approach to teach dentistry and it was an opportunity to use the 3D printing technology in the learning process<sup>(3)</sup>.

In this article different ways of using 3D technology will be presented, particularly computer aided design (CAD) and computer aided manufacture (CAM), as a tool to improve the distance learning programs.

### Training On Virtual Models in the Distance Learning Programs

There are different methods of offering distance learning concepts, you can use online resources for synchronous and asynchronous e-learning programs.

During the synchronous classes it's expected the faculties experience will be the focus and the use of technology can improve their teaching tools. One of these tools is the virtual patient<sup>(4)</sup>.

Considering the asynchronous activities, the students can have the opportunity to train virtually and hands-on using phantom models<sup>(5)</sup>.

### Virtual Patients

One of the most interesting uses of 3D technology in dentistry is the virtual model, obtained from the laboratory, intraoral, and facial scanners and from tomographic images segmentation (transforming DICOM data into an STL file)<sup>(6)</sup>. During online synchronous classes it's possible to present, discuss and plan a treatment of a real case turned into virtual, the students can perform virtual procedures on the same case and compare their results with the experienced faculty or the other students, in a virtual reality<sup>(7)</sup>.

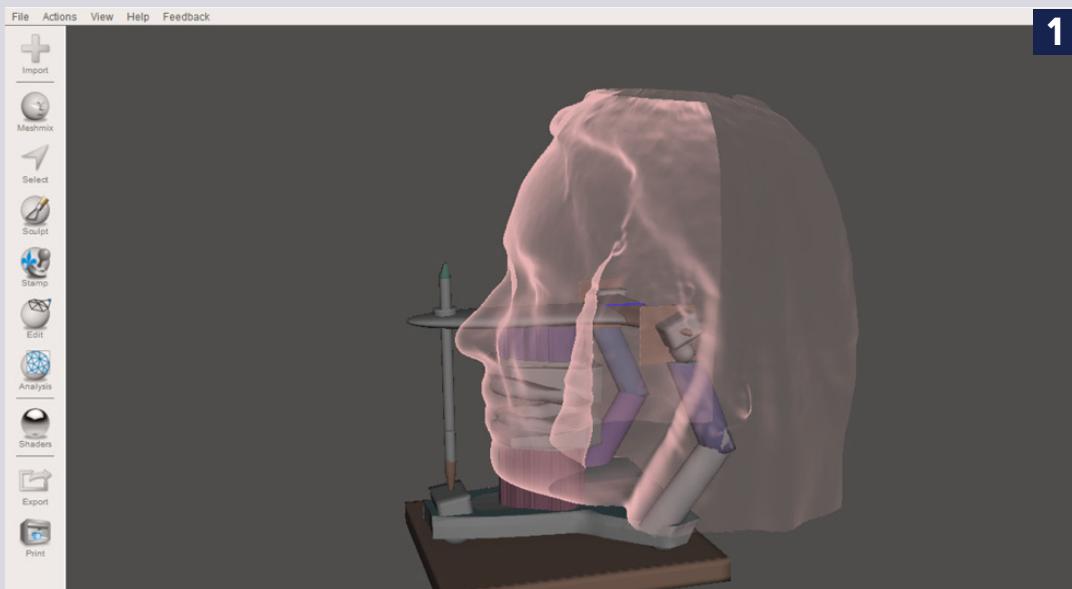
This is an interesting approach because it allows the students to become familiar with dentistry's new technologies, accelerating innovation adoption, and trends. For example, they can learn facial anatomy

connecting the theoretical knowledge with virtual models that could be 3D printed to materialize and give scale's perception to the virtual object. It's expected that, after a few experiences comparing the virtual and the real objects, the students can understand the virtual parameters and gradually reduce the need to print the models<sup>(8)</sup>.

In the future, well trained professionals will use the 3D printing technology mainly to produce prothesis and devices for intraoral uses and reduce the use

of 3D printing to produce study models. The virtual environment will turn into a familiar and realistic environment where they can interact with the patient and other professionals in-person or distant<sup>(9)</sup>.

In figure 1 it's presented a didactic material created using data from a real patient (intraoral scan and facial scan) to teach occlusal biomechanics in the articulator; each part of the articulator can be moved according to the patient's anatomy such as the traditional articulator.



1

Figure 1: Using a computer aided design (CAD) software it's possible to reproduce the parts of an articulator and its relationship with the patient's face (facial planes, jaws, and temporomandibular joints' position).

### 3D Printing A Phantom Model

Considering the asynchronous activities, new learning models are being developed to promote best interaction and performance from students in the remote programs. One concern of dental school faculties is the lack of practical activities to develop the dentists' hand skills necessary for professional qualification<sup>(10)</sup>.

3D printing technology and its different materials are an alternative to make available practical activities, particularly when creating image Phantom models. The image phantom models are models of the human body created using softwares adopted initially by radiological science community to study three dimensionally the effects of ionizing radiation dosimetry<sup>(5, 11)</sup>.

The use of Phantom model in dentistry is interesting because it reproduces a real patient, the jaws anatomy, the design, shape and size of a real tooth and its root, making it possible to perform procedures similarly with what is already done in a standard typodont. In a phantom model it's possible to check the students' performance by scanning the models or by radiographic exams in models made in radiopaque filament material, thus the faculty can overlap the images of the original model and the students' models on a CAD software and evaluate the expected results in comparison with the students' results qualitatively and quantitatively<sup>(12)</sup>.

In figure 2 there is a phantom model of an upper jaw where the students performed a training surgery to insert a screw for orthodontic proposes between the roots of the teeth. After inserting the screw, a radiography of the model was requested to verify if the correct position was achieved.



Figure 2: A radiopaque phantom model (a) made by 3D printing using a modified ABS (Acrylonitrile Butadiene Styrene) filament to train implanting orthodontic screw and (b) periapical radiography performed to evaluate the screw position.

## Conclusion

According to the new demands in Dentistry, it's possible to develop innovative approaches for the use of digital 3D technology as occurred in response to the COVID-19 pandemic. Suddenly, it was necessary to create new methods and learning models for the dental students.

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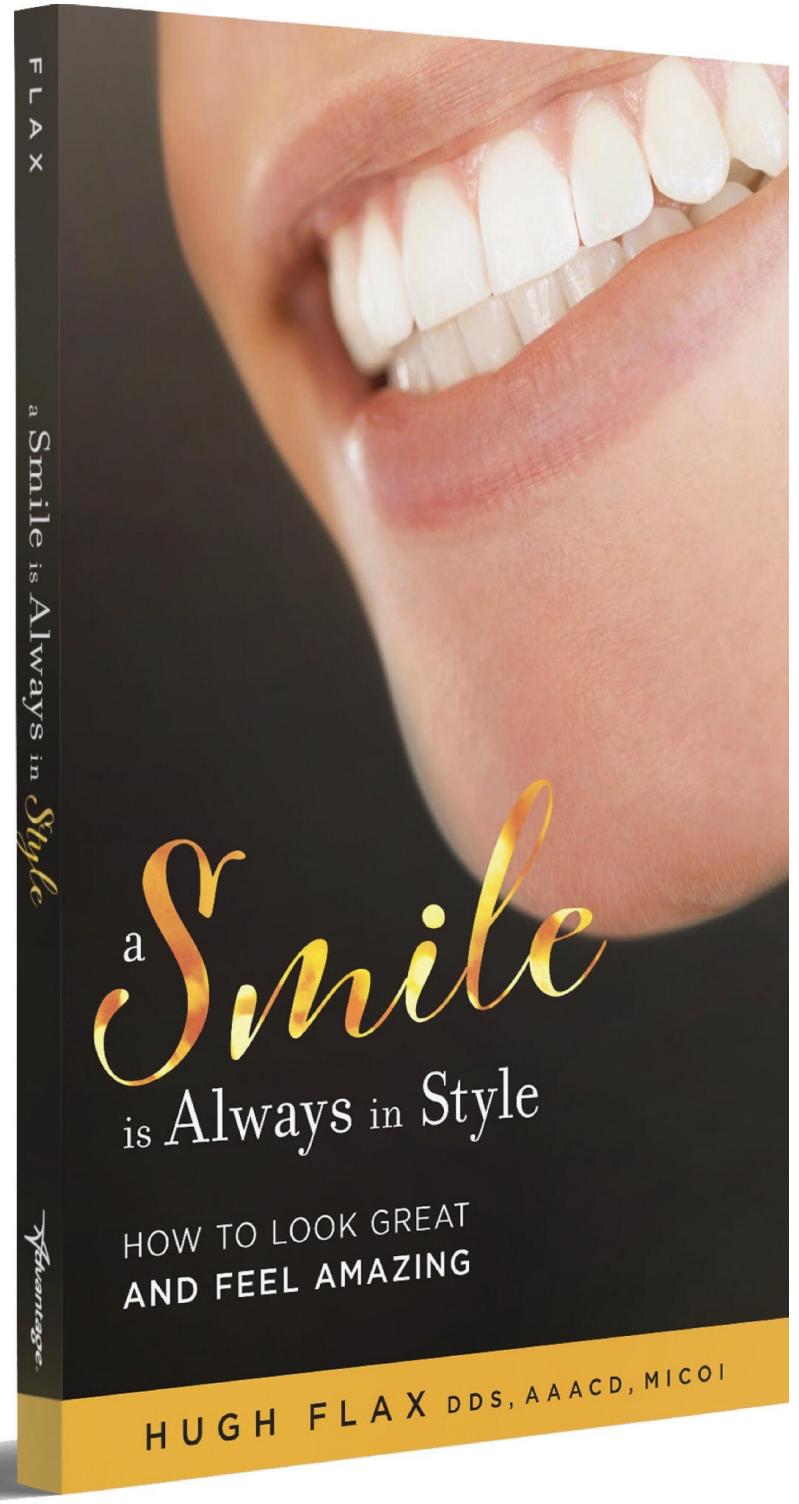
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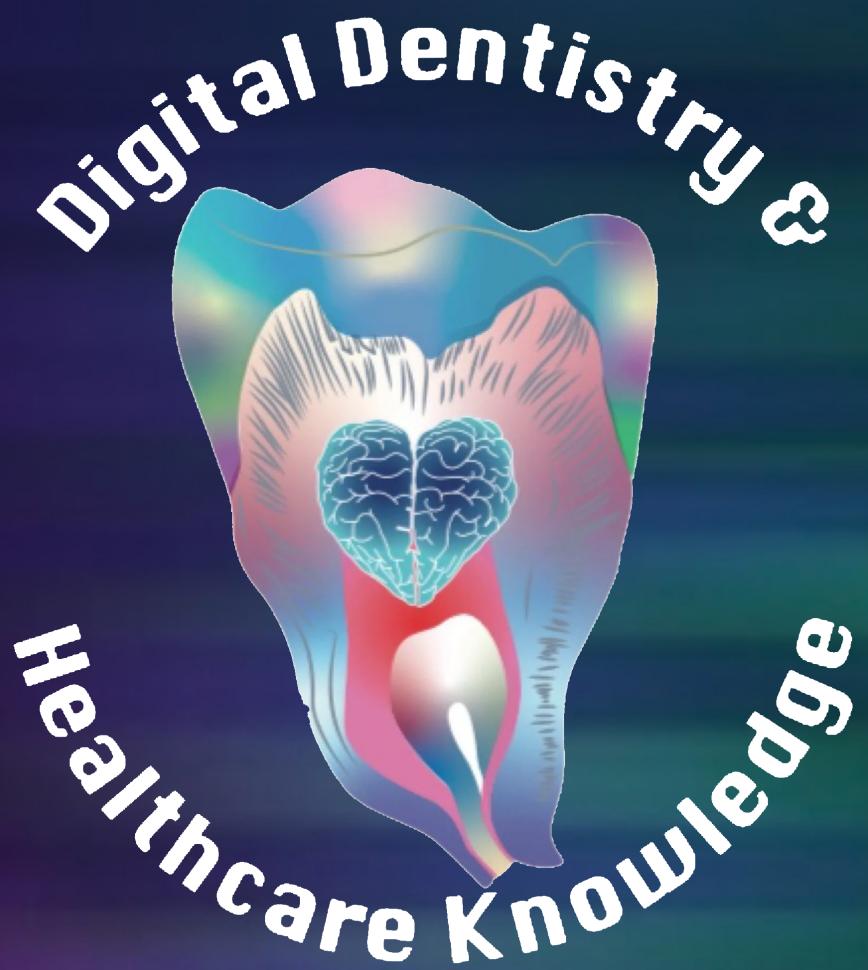
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