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EDITORIAL

Our Top Ten Intraoral Scanners of 2019

June 3, 2019 by Hsuan

We originally wrote this article back in March, immediately following the International Dental Show this year. However, at the time we chose not to release this for reasons I will describe at the very end of this whole article. But due to popular demand, we're now releasing our original text. Everything until the ***Last Three Questions*** *section was written in March, but we've read it over numerous times, and our opinion stands. Enjoy!*

Hsuan. June, 2019.

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Foreword: Learning from Our Mistakes

Two years ago, I wrote a piece called *Review of Intraoral Scanners at IDS 2017*, comparing 14 intraoral scanners at the dental show in Cologne. Based on hands-on first impression data gathered by the CEREC Asia team, we rated each scanner using four criteria: **speed**, **size**, **ease of use**, and **scan completion.**

Amazingly, that article has since garnered over 200,000 views to date, drawing plenty of comments and questions from dentists and dental technicians around the world. It also spawned a bunch of similar review articles and, more importantly, helped generate discussions on intraoral scanners around the world, particularly in Asia.

At CEREC Digest we pride ourselves in writing investigative articles based on factual evidence. While we are actually not affiliated with Dentsply-Sirona in any way, we are acutely aware of the presumptions that people have based on the “CEREC” in our name. However, we do not consider this a handicap. Instead, it is a constant reminder to go the extra mile and ensure the validity of our claims.

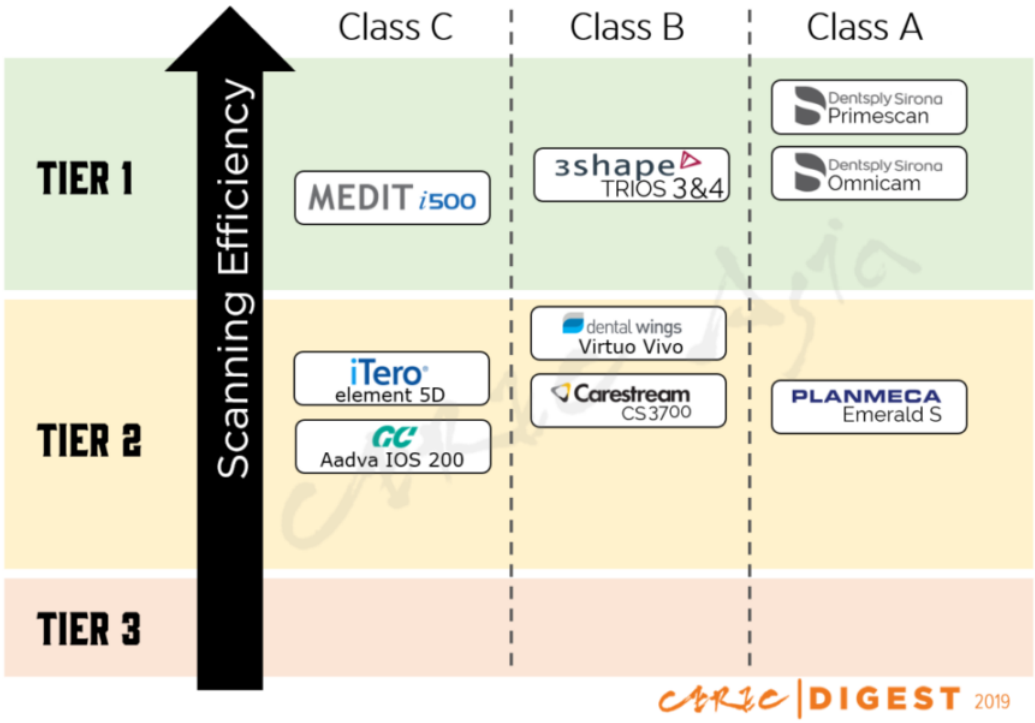
But we are human after all, and some of our decisions, even after all things considered, are still somewhat subjective. Unsurprisingly, the same 2017 article that was so popular also attracted a fairly large wave of criticism, especially from the manufacturers who were ranked low on the list. While most of the complaints were unproductive and self-serving, we acknowledge that a few of them were legitimate concerns.

Over the last year, we’ve discussed internally to see how we can do better, and perhaps make the whole review process more meaningful. So far, we’ve recognized a few places that could be improved, and in this article, we are pleased to show you a new system of rating intraoral scanners that is more clinically relevant.

Cutting to the Chase

If you’re in a hurry and just want a quick summary, here’s the section for you. Since there are many important complications and nuances in our analyses, however, I recommend reading the whole article before you do anything rash, like sending me a stern letter of disagreement.

Without further ado, here are the our overall ratings for the intraoral scanners shown at IDS 2019:



Our choice of top ten intraoral scanners of 2019.

The vertical positions indicate the rankings from top to bottom. The classes do not affect ranking, and are simply for categorical purposes. Read on for more information.

The Big Picture

To say that the intraoral scanner is very important to my work is an understatement. At our modest clinic with 10 dental chairs, we fabricate an average of 500 chairside CADCAM restorations per month. With clinical experience in CEREC, 3Shape, and Planmeca (though substantially less than the other two), I have first-hand accounts of the best (and worst) of these different systems.

Back in 2017 when I last visited IDS with our CEREC Asia team, it felt as if there were only two intraoral scanner systems that were truly clinically viable: the Omnicam from Dentsply-Sirona and the Trios 3 from 3Shape. This is not to say that other scanners are unusable, but they really did leave a lot to be desired. While part of this was reflected in their overall score, there were definitely little things that bothered us, and yet were difficult to quantify in our review.

Has this changed in 2019?

As you would expect, the overall hardware and software quality of intraoral scanners have improved over the last two years. That being said, the overall ranking of the scanners relative to each other, for the most part, did not see drastic changes. This is, after all, complicated technology, and so it's understandable for development to be incremental. The 3Shape Trios 4 is the prime example of the difficulty in upgrading from a scanner that was already one of the best, the Trios 3.

That is why I was very excited to see new scanners designs showing up at IDS this year, whether they performed well or not. Because it shows that these manufacturers have at least received sufficient demand from the market, or at least enough positive reinforcement to make the investment. I'm talking about scanners such as the Virtuo Vivo from Dental Wing, the Aadva IOS 200 from GC, the X Pro from Kavo, and the Primescan from Dentsply-Sirona. I think it's quite risky to reinvent new tech, and applaud these companies for trying.

The Difficulty of Rating Scanners

The point system that we used in 2017 provided a quick and easy way to gauge how one IOS performed relative to each other. Here was our 2017 summary.

CEREC Digest	SPEED	SIZE	EASE	CAPTURE	Total	Touch Screen	Powderless	Remote Control	Color Acquisition	Shade Selection
3shape Trios	5	4	5	5	19	✔	✔	✔	✔	✔
Sirona Omnicam	5	4	5	5	19		✔		✔	✔
Carestream CS3600	4	3	4	5	16		✔		✔	
Planmeca Emerald	4	3	4	5	16		✔		✔	
Dental Wings DWOS	3	5	4	4	16	✔	✔	✔		
3M True Definition	3	5	3	2	13	✔				
GC Aadva IOS	3	3	3	4	13	✔	✔			
Align iTero	4	1	2	4	11	✔	✔		✔	
Condor	1	5	1	3	10		✔		✔	
Fona MyCrown	2	3	2	1	8	✔			✔	
Adin VIZ	1	2	1	1	5					

Our previous ranking list for 2017.

The system that we used was suitable for a superficial comparison, but consider this: the Planscan Emerald, Carestream CS 3600 and Dental Wings DWOS all received 16 points, so are they e*qually good?*

The DWOS was significantly slower than the other two scanners, yet won serious brownie points for being the smallest of the three. This raises an interesting question: does the size matter if the scanning speed is inadequate?

Carestream CS3600	4	3	4	5	**16**
Planmeca Emerald	4	3	4	5	**16**
Dental Wings DWOS	3	5	4	4	**16**
3M True Definition	3	5	3	2	**13**
Align iTero	4	1	2	4	**11**

In our 2017 article, iTero got punished hard for being a big scanner, yet has the biggest market share of these five scanners.

I would argue that if the scanning speed makes a scanner unsuitable for clinical use, then size is kind of irrelevant. But you don't have to take my word for it. Of the three scanners that have received the top score of "5" for size, the DWOS was discontinued, and the 3M True Definition was nowhere to be found at IDS. Meanwhile, the iTero scanners are still rapidly gaining market share around the world despite getting punished hard for its size in our rating system. Why? Because it's actually a decent scanner overall, numbers notwithstanding.

Now what about the CS3600 and the Planscan Emerald, both of which I've used on real patients. After spending some time with them, I think Carestream scans are a bit more consistent. However, the design software on the CS 3600 workflow is *significantly handicapped* when compared to the Planmeca. So if you're looking to scan, design, and mill your own restorations, Planmeca is actually the better choice between the two. And this nuance is lost with our previous rating system

Once we start factoring in things like scanner weight, touch screen, caries detection, and other supplementary features, the whole pictures becomes something of a mess. Faced with this same struggle last time around, we decided to abandon the complexity in the end. Instead, we went with a generalized but easy to comprehend approach. Clearly, it wasn't perfect, and a new method of rating scanners was needed for a more meaningful discussion real clinical settings.

A Rating System that is Clinically Relevant

We began by asking ourselves: What do we care most about an intraoral scanner? After our last review article, many people messaged me to complain about the fact that the price wasn't factored into the rating. Clearly, people think pricing is important, but *is it the most important*? Would you rather buy a cheap machine that is barely usable, or invest in an expensive one that actually increases clinical productivity?

From my own experience, I argue that usability is the most important. In other words, being able to complete a scan with ease and efficiency is the most basic requirement for an intraoral scanner. Everything else, in comparison, is secondary.

Instead of using arbitrary numbers, however, our team compared notes, analyzed our scanning videos and picked the top scanner based on the three components of scanning efficiency: scanning speed, data capture, and software intelligence. Using our top choice as a reference, we then rated all the other scanners based on these criteria.

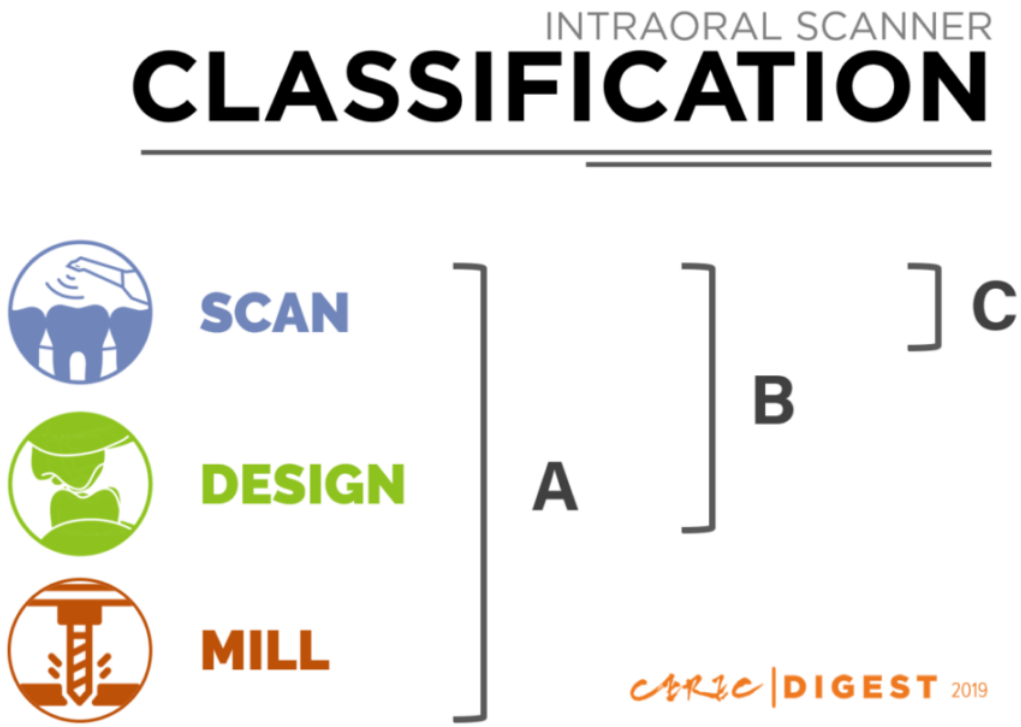
> *...being able to complete a scan with ease and efficiency is the most basic requirement for an intraoral scanner.*
>
> *Me. Just Now.*

Since our rankings are qualitative, we wanted to provide a visual aid for clinicians to reference. Digital scanners are used to replace traditional impressions, so we developed a three-tiered system based on traditional timings for easy reference.

- **Tier 3:** The scanner is able to complete a full-arch scan and export an STL model successfully, without time limit.
- **Tier 2:** The scanner is able to complete Tier-3 tasks faster than silicone impressions (around 5 minutes).
- **Tier 1:** The scanner is able to complete Tier-3 tasks faster than alginate impressions (around 1 minute).

How are the classes defined?

Not all scanners have the same set of functions, and we wanted to show this explicitly in our review. Therefore, we've divided them into three different classifications based on system capabilities. However, the intraoral scanners are rated purely on their own merits, and their **classifications are not taken into account**. The classifications are as follows:



Our classification of intraoral scanners. Most of scanners available now are either Class C or Class B.

- Class **A** = The manufacturer offers its own scanner, CAD software, and CAM (milling) unit.
- Class **B** = The manufacturer offers its own scanner and CAD software only.
- Class **C** = The manufacturer offers its own scanner only.

It's like buying a computer: all of them can do word processing, web browsing, and Youtube shenanigans, but some of them are also able to play games, render 3D models, and perform parallel computing. Whether these additional specializations are important to you will depend on what you're looking for.

Similarly, if you are simply looking to buy a scanner to replace traditional impressions, then any of the classes A, B, and C will do. If, however, you are also thinking of designing your own surgical guides, then you'll need at least a Class B system. For us here at CEREC Asia, one of our primary focus is on single-visit restoration, and so having a Class A system is imperative for clinical efficacy.

A Word on Scanning Efficiency

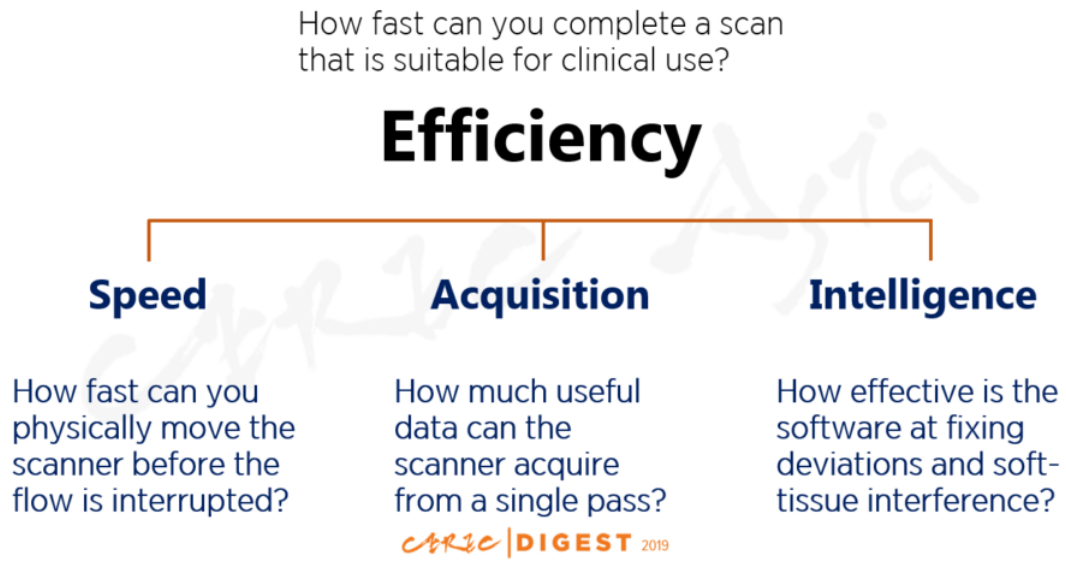
The current world record holder for fastest speed achieved by a street-legal car: the Koenigsegg Agera RS.

The Koenigsegg Agera RS, seen above, holds the current Guinness World Record for fastest street-legal car, capable of reaching an incredible 278 MPH (447 KM/H). But in the real world, getting from A to B is more than just raw horsepower. Instead of a straight road, we have to navigate sharp turns, traffic issues, and weather conditions to reach

our destination in one piece. A similar logic can be applied when testing intraoral scanners.

Completing an intraoral scan is not simply a matter of whipping the scanner around as fast as you can. The scanner needs to also consistently acquire useful data for 3D model reconstruction. In the event that the scanner has captured bad data (i.e. tongue, cheeks, fingers, etc...) it needs to be able to fix them, preferably on the fly and without user intervention.

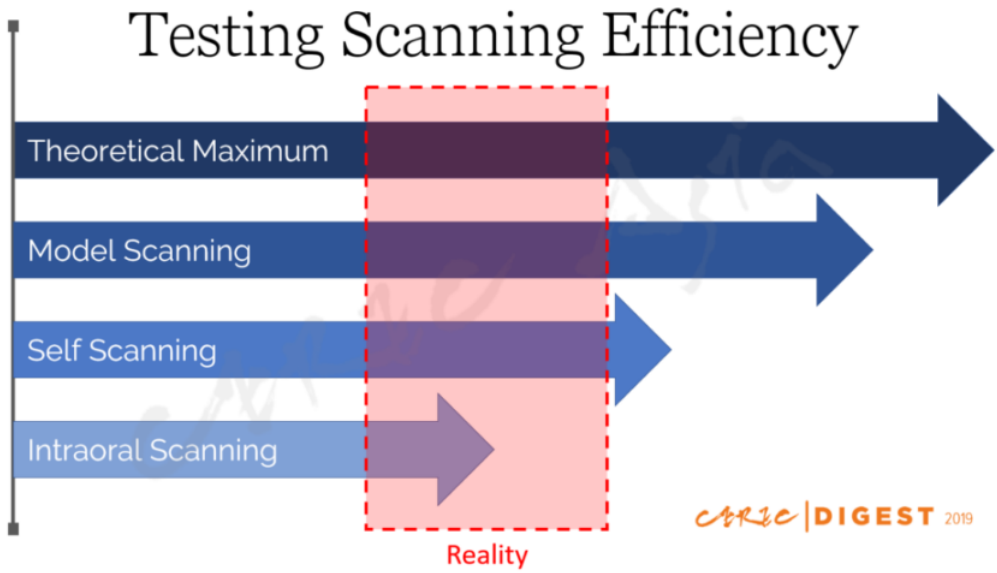
In short, scanning efficiency can be divided into three parts: **speed**, **acquisition**, **intelligence**.



Our basic comparison criteria for intraoral scanners.

This idea of being able to ***efficiently*** complete a scan is so integral to the our clinical experience that we've placed it above all else in rating intraoral scanners. In other words, we prefer a scanner that does what it was meant to do, and does it well.

While we're still on the topic of scanning efficiency, I would like to address a fundamental problem with testing on a model as opposed to a real oral cavity.



Different ways to test scanners and how closely they approximate real-world results.

As shown at the top in the above graphics, each digital scanner has a theoretical maximum speed that is limited only by its hardware. Unfortunately, this number is meaningless to clinicians because it represents an ideal condition that's unattainable in real life.

At dental shows, we often go for the easy option: scanning dental models. Digital scanners are particularly good at scanning homogeneous and opaque surfaces, so if you have a hard time scanning models, that's not a good sign.

Dr. Li trying out a scanner on a model.

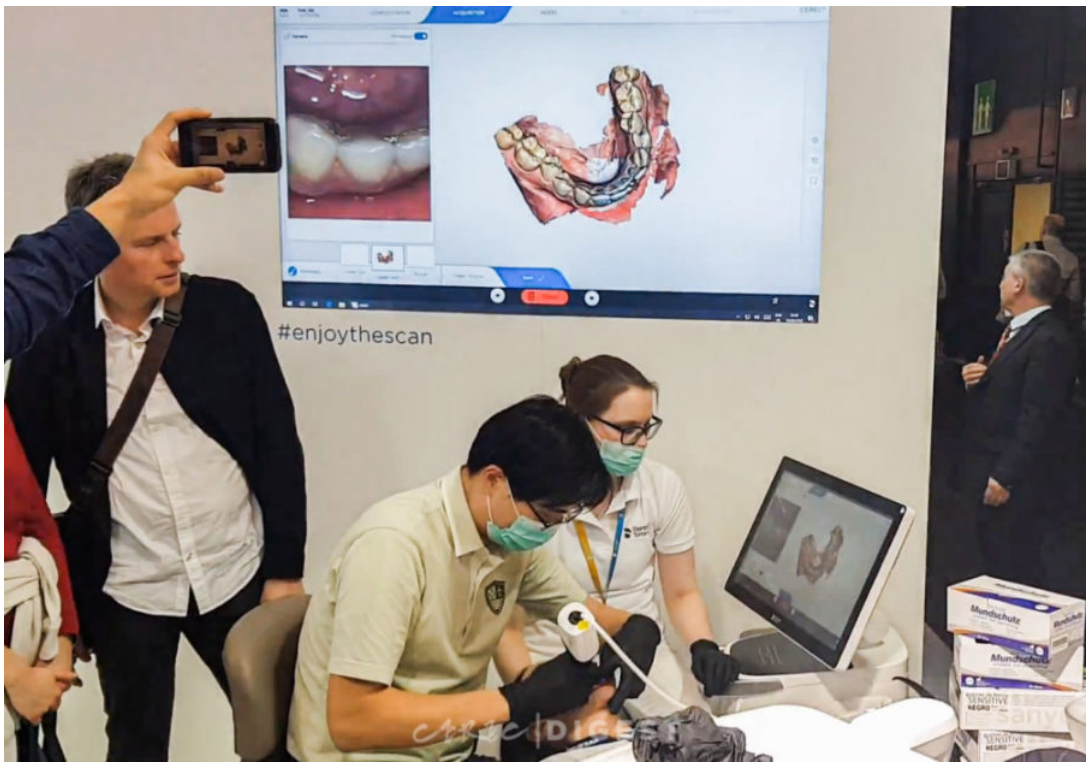
Unfortunately, our teeth and restorations are not homogeneous and opaque, but translucent and opalescent. So what can we do to test the scanning efficiency on a heterogeneous mixture of enamel, ceramics, resin, and metal? When you see sales reps scanning themselves at dental shows, that's essentially what they're doing. Self scanning shows you how well the scanner is able to pick up real-world data, so it's a slower but better representation of reality than model scanning.

Translucent materials, such as the enamel, presents a challenge to intraoral scanners, due to physics and technological limitations.

But that's not the whole story either. With self-scanning, you can minimize the impact of soft-tissue and environmental interference through a lot of repetitive practice in the same mouth. When we scan a new patient, however, these issues are unpredictable and will inevitably slow you down. You might need to pause scanning and delete some unwanted parts of the 3D model. You might need to stop for fluid evacuation or lens clearing. Some teeth might be hard to reach for certain patients, and you'd have to make adjustments on the fly. In the office, there are plenty of little problems here and there to significantly impact your scanning efficiency.

Demonstration of intraoral scanner on a live-person at Dental Wings.

As far as we could see, the only booth at IDS 2019 with a dental chair setup and actively encouraging visitors to try scanning a real person (other than themselves) was the Primescan at Dentsply-Sirona. Unlike live demonstrations, hands-on scanning cannot be practiced ahead of time, and is the only reliable method to evaluate both the clinical performance and learning curve of an intraoral scanner.

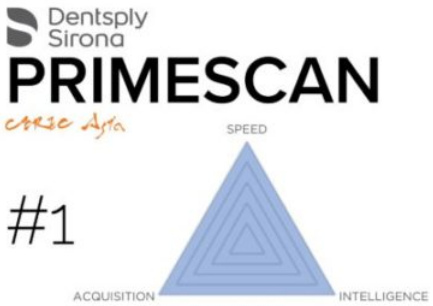


Dr. Tsao taking advantage of the full chair-side intraoral scanning experience at Dentsply-Sirona.

Unfortunately, since most of the manufacturers only offered model scanning, we will stick with that for controlled comparison. As you read the review here and others on the

interwebs, however, keep this important detail in mind.

CEREC Primescan



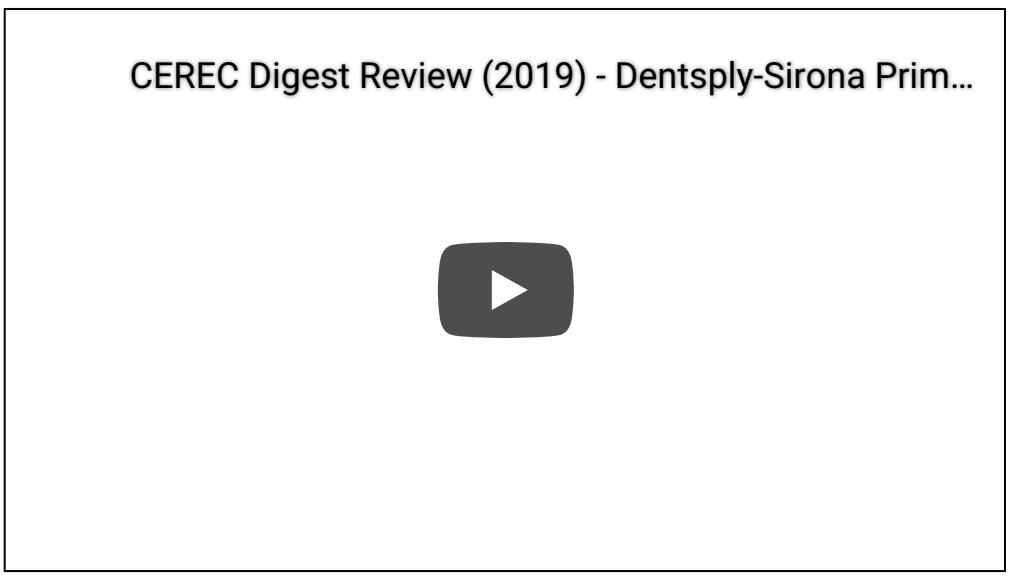
Tier 1
Class A
Cost $$$$$

#Disclaimer 2019-06: I wrote this review immediately following IDS in March, but have since used the Primescan routinely at CEREC Asia and our clinic. I've decided to not add any additional feedback and experience to my original text so as to be as fair as possible to other scanners.

Primescan is the brand new scanner from Dentsply-Sirona. I've written an analytical article on it when it was first announced back in February. In it, I discussed our hands-on experience and tested the manufacturer's claims on accuracy. For anyone interested, here is the link to the article:

New Kid on the Block: Primescan and What It Means for Current and Potential Users

The claims for Primescan were *fast, accurate,* and *easy to use*. We've dealt with accuracy quite thoroughly, so just exactly how fast and how easy to use was it to use? Here's a video followed by our impressions.



Efficiency

- **SPEED**: Scanning traversal speed was definitely one of the fastest compared to all the other scanners at IDS.
- **ACQUISITON**: Data capture also feels significantly faster than the Trios 4 and the Omnicam in a single pass, thanks to the Primescan's large scanner head and depth of field.
- **INTELLIGENCE**: The AI powering the Primescan is simply amazing. Its ability to fix soft tissues, and other mistakes, makes for scanning experience that is significantly less stressful.

Addressing the Elephant in the Room

Yes, Primescan is a big scanner. When you hold it, the pen grip also feels quite different due to the wider girth, and the size of the scanner head felt almost comically large, especially if you're comparing it to an Omnicam. If I'm being honest, I thought it looked like a fat Omnicam.

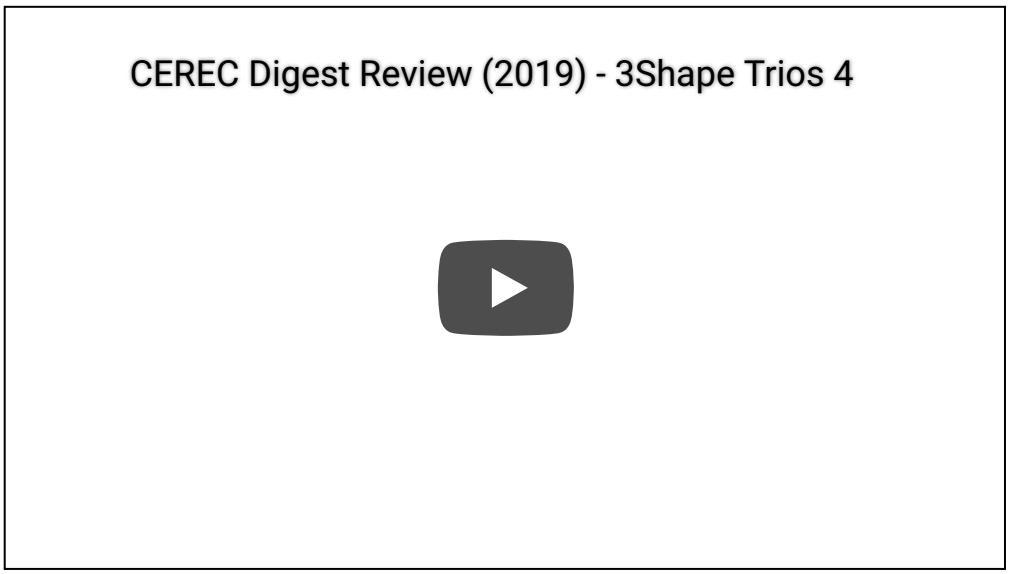
But since we were able actually scan someone intraorally at the booth, it was easy for us to see that the size was not an issue at all. Instead of trying to convey this through paragraphs of exposition, I encourage our readers to try the scanner on a real person and see for yourself. In our opinion, the decrease in mobility is more than made up for by the image capture capabilities and the AI in the software.

Our Verdict

As much as we've agnoized over how partial our decision will look, we have concluded that the Primescan is, without a doubt in our mind, the #1 scanner of 2019. While the Omnicam was already one of the fastest scanners available, the clinical efficiency of Primescan is simply unmatched in our tests, especially considering that we also tested on real people. Keep in mind, however, that its price is also unmatched, and not in the good way.

3Shape Trios 4

The Trios 3 tied for top score the last time we were at IDS in 2017. It was fast, relatively easy to use, and was definitely one of the best options available at the time. With the release of Trios 4, we were curious to see how much of an improvement 3Shape was able to make on such a great scanner. The short answer: not much.



Efficiency

- **SPEED**: The reps kept telling me that the new Trios 4 is faster than Trios 3, but once I pressed them on the details, they weren't able to pinpoint exactly what made them faster, other than "new hardware and software". We tried scanning with both generations back to back and I honestly could not tell the difference.
- **ACQUISITION**: Data capture was on par with the Omnicam in a single pass, and I'm much more proficient with the Omnicam, so extra points to the Trios 4.
- **INTELLIGENCE**: The AI was very impressive but not as aggressive as the AI in the Primescan. I actually had a special opportunity to scan a live person with the Trios

4, and it was able to remove most, but not all, of the soft tissue interference. Unfortunately, we were supervised and not allowed to film this extra test.

What's the difference between Trios 4 and Trios 3?

In terms of the core scanning capability, Trios 4 is essentially the same as the Trios 3, but with a bigger battery (if wireless), new scanning tips, and caries detection. During the exhibition, we were told by a sales rep that the Trios 4 is faster and more accurate than the Trios 3, but we couldn't find anything to support that claim.

		TRIOS 4	TRIOS 3	TRIOS 3 Basic
Scanner generation		4th	3rd	3rd
Scanner features	Wireless	✓	✓	N/A
	AI scan	✓	✓	✓
	3Shape accuracy	✓	✓	✓
	Real colors and shade measurement	✓	✓	✓
	Smart tips	✓	N/A	N/A
	Caries diagnostic aid*	✓	N/A	N/A
Software and apps	TRIOS Patient Monitoring	✓	✓	Upgrade to TRIOS 3
	TRIOS Treatment Simulator	✓	✓	Upgrade to TRIOS 3
	TRIOS Smile Design	✓	✓	Upgrade to TRIOS 3
	TRIOS Patient Specific Motion	✓	✓	Upgrade to TRIOS 3
	In-house apps	Add-on option	Add-on option	Add-on option

After doing some online digging and looking up relevant patents, we are convinced that the Trios 4 is a rehashed Trios 3 with more bells and whistles. Yes, the fluorescence detection was interesting and the infra-red diagnostics was pretty cool, but I would've like to see more improvement on the the scanning latency and stability issues.

Our Verdict

The Trios 3, the Trios 4 and the CEREC Omnicam are tied at #2 on our list. In terms of clinical efficiency, the Trios 4 continues the 3Shape legacy of great scanners. As a Class B scanner, 3Shape's biggest advantage, in my opinion, is actually not just its superb scanner, but also the sheer number of clinical indications covered by their CAD software and modules. The best part is that for €10,000 less, you can get essentially the same scanning experience with the Trios 3.

Changes to the New Omnicam 5.0

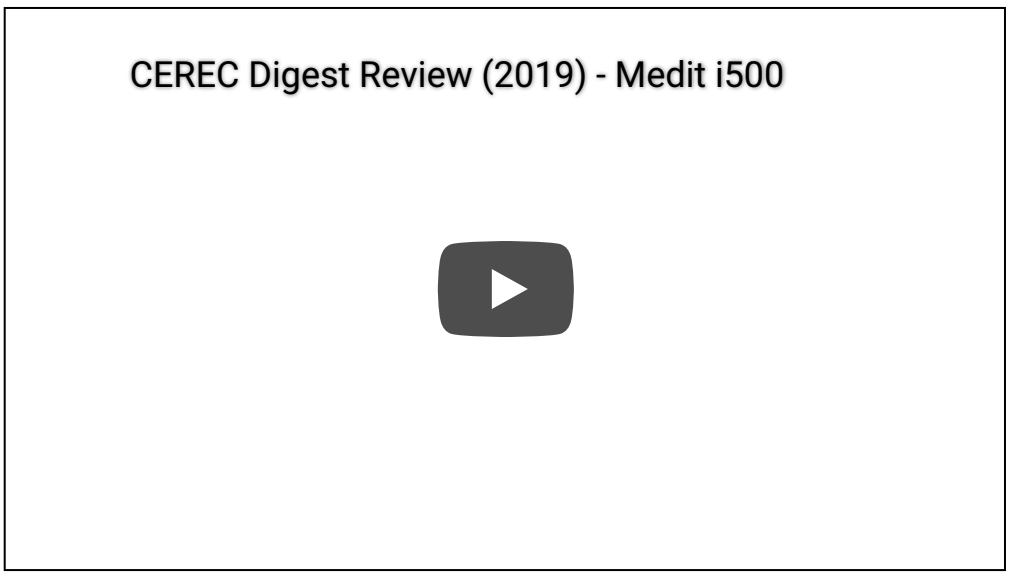
During our last review in 2017, we rated the Omnicam and the Trios 3 with the same overall score. This year, with our focus on scanning efficiency, we have given a slight

edge to the Omnicam. While the the Trios 3 did receive new software updates, they were not drastic changes. Even the 3Shape sales reps weren't able to clearly articulate how the Trios 3 had improved, which is understandable as their marketing was heavily focused on the Trios 4.

The Omnicam, on the other hand, has received the new CEREC 5.0 update, powered by the same AI as the Primescan. Not only is acquisition considerably more reliable, but the software is noticeably more intelligent in fixing stitching errors and soft-tissue issues as well. Whereas the Trios focused on extra features like motion jaw tracking and caries detection, Omnicam 5.0 improved its core function. However, since this new version of the Omnicam has yet to be publicly released, we will rank the old Omnicam on our list for now.

Medit i500

Released in 2018, the Medit i500 is the new scanner coming out of South Korea, and is definitely a game-changer in terms of the kind of performance you can get without breaking the bank.



Efficiency

- **SPEED**: Very impressive scanning speed on the model (see video).
- **ACQUISITION**: The small scanner head means less data capture overall on every pass pass. The capture speed makes up for this deficiency and is very smooth, but seems to be missing a bit more data than 3Shape and CEREC scanners.
- **INTELLIGENCE**: We sometimes ran into stitching problems if we didn't follow the recommended scanning strategy (see video).

Small Reservations About the Medit i500

During our tests, I thought the i500 performed just as well as the Trios 4 in terms of scanning speed and acquisition. In some respects, it almost seemed to scan faster and smoother than the 3Shape scanners. Its software did not seem quite as polished or intelligent, but it did give us decent results for the most of our tests. We've placed the i500 in Tier 1, albeit with reservations. As we've mentioned earlier, intraoral efficiency is drastically slower than model scanning, and we haven't been able to test this scanner intraorally (unlike the other scanners in the same tier).

Our Verdict

We've decided to place the Medit i500 at a respectable #5 in our Top Ten list. Since there is a three-way tie at #2, the Medit is really #3 in our minds. At €16,000 and without subscription fees, its value is currently unbeatable by any other scanner, especially given its Tier 1 scanning efficiency. If you are on a budget and looking for a no-frills replacement for traditional silicon, the Medit i500 is the perfect balance of cost and performance.

Dental Wings Virtuo Vivo

If we could give out imaginary awards, the Virtuo Vivo would get my vote for Best Newcomer. This was a completely redesigned scanner that looked nothing like the previous iteration, the DWOS. Not gonna lie, I was personally very surprised at how well the Virtuo Vivo actually performed. There was also a live demonstration of intraoral scanning, and it gave us a very good reference for its acquisition capabilities and software intelligence.

Efficiency

- **SPEED**: The maximum travel speed was surprisingly fast on the Virtuo Vivo. It's not at the Medit or 3Shape level, but it's definitely one of the faster and smoothest Tier 2 scanners we tested.
- **ACQUISITION**: The scanner was able to capture most of what its camera saw, and the scanning field also seemed a bit bigger than average.

- **INTELLIGENCE**: The software was able to fix basic stitching issues. The live demonstration also showed how it was able to remove some software interference by repeatedly scanning over the same area.

To the Top of Tier Two!

It's always a difficult call to review a brand-new scanner. On one hand, the Virtuo Vivo had very good speed, smoothness, and acquisition capabilities. Upon first use, we had a feeling that it would probably be ranked right behind the Medit i500. But is it Tier-1 material? The live demonstration did nothing to convince us one way or the other, because it showed good acquisition, but the operator was moving at such a slow pace that there was no way to gauge the actual efficiency. In the end, we asked ourselves: we would be able to scan a full arch in one minute? And the answer was not definitive.

We would be happy to be proven wrong, however. Let us know in the comments below.

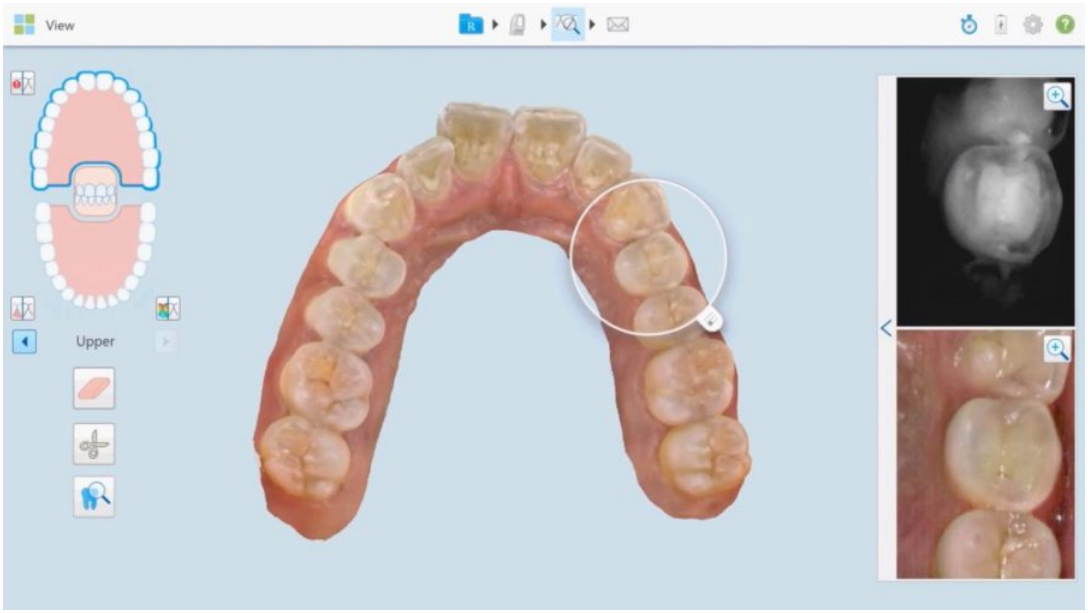
Our Verdict

We rank the Virtuo Vivo from Dental Wings at #6 on our list. With its design software and milling unit, this scanner seemed to be a Class A system at first. However, since the milling unit is actually manufactured by Amann-Girbach, it's technically a similar setup to 3Shape, where part of the workflow is dependent on a third party. At €19,000, it's a cheaper alternative to 3Shape, albeit at lower but decent performance. If you are already invested in the Dental Wings ecosystem, the Virtuo Vivo is a promising front-end to your CAD/CAM workflow.

iTero element 5D

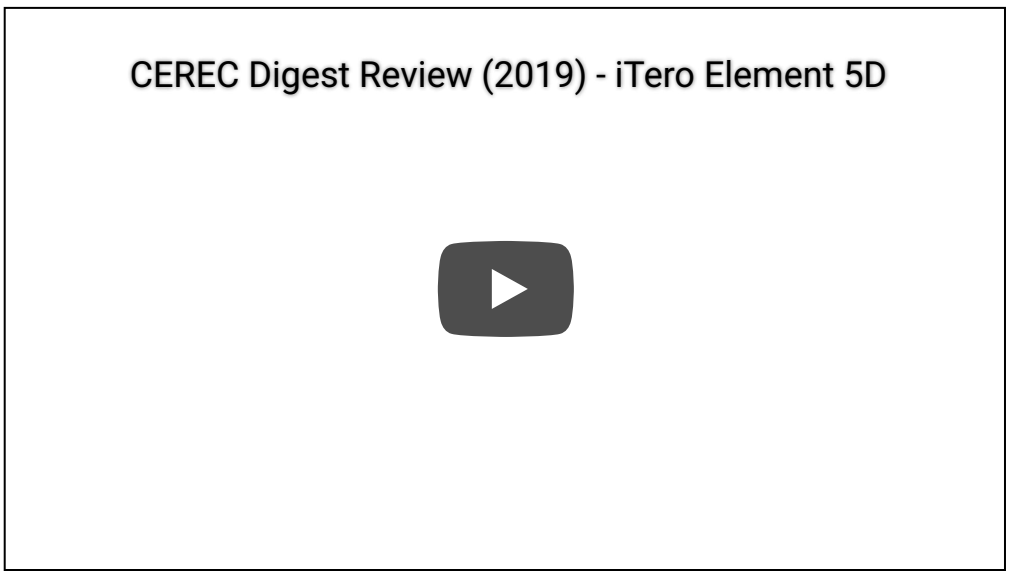
The iTero element 5D is an incremental update from the previous generation, the iTero element 2. The wand looked very similar to the old design, and there didn't seem to be much changes made on the actual scanning capabilities. The primary selling point of the

element 5D was its ability to perform near-infrared imaging (NIRI). Unlike the 3Shape Trios 4 infrared capture, which requires you to activate image capture individually, the element 5D records all the NIRI data so that you can view it at a later time. Pretty neat!



The Trios, Emerald S, and the iTero Element 5D (above) are the three intraoral scanners with caries detection.

But what about the core scanning function? Here's a video



Efficiency

- **SPEED**: The element 5D uses the essentially the same hardware as the element 2, so there was no appreciable speed improvement. The scanning speed is decent,

but not quite at Tier 1 level.

- **ACQUISITION**: Latency during the scan was very noticeable (see video), but seems to only be a visual effect with no actual negative impact on data capture. The large and deep scanning field of the iTero have always been its strength.
- **INTELLIGENCE**: The software is able to correct minor stitching problems, but does not seem to have the ability to remove soft-tissue interference. (see video)

Its Ranking Explained

If you saw the iTero scanning video above, you might have noticed that its scanning speed seemed to be a bit slower than other scanners around its rank. In our prolonged tests, we found that the iTero, although not exactly a speed demon, was much more consistent in its data acquisition than Carestream and Planmeca.

Our Verdict

The iTero Element 5D is #7 on our list of top ten scanners. While its definitely clinically viable, the Element 5D's core scanning efficiency is still not quite Tier 1 level. Unfortunately, its quoted price of over €36,000 puts it in the same price range as the 3Shape Trios 4 and the Omnicam, which are both higher class and higher tier. Even if we're comparing within the same class, the Medit i500 represents another tough competition for the iTero.

The iTero does, however, have one saving grace, and that is its association with Invisalign. Due to the marketing efforts of from Align Technology, this scanner has done better in sales than its performance would suggest.

Carestream CS 3700

The CS 3700 is yet another evolutionary update to the CS 3600. Unlike the big jump in hardware between the CS 3500 and the CS 3600, this new scanner is essentially the same scanner with a different design for the handles.

Efficiency

- **SPEED:** It was very difficult to tell the difference between the 3700 and the 3600, even with a side-by-side comparison. The speed was still decent, mind you, but it was definitely one of the slower scanners on our Top Ten list.
- **ACQUISITION:** For the most part, data capture was very good on the 3D printed model they provided. The scanner produced only a few holes on a single pass, and most of them were embrasures so that was understandable.
- **INTELLIGENCE:** The software is able to correct minor stitching problems, but does not seem to have the ability to remove soft-tissue interference.

About that Porsche Design

One of the selling points about the CS 3700 is the fact that its new design was by the same minds who designs for Porsche, the sports car manufacturer. But... why? Consider the fact that other companies are adding clinically-relevant functions such as caries detection, fluorescence, and motion capture of occlusion, or just straight up rebuilding a better scanner from scratch. I'm not saying that Porsche engineers have no chance of

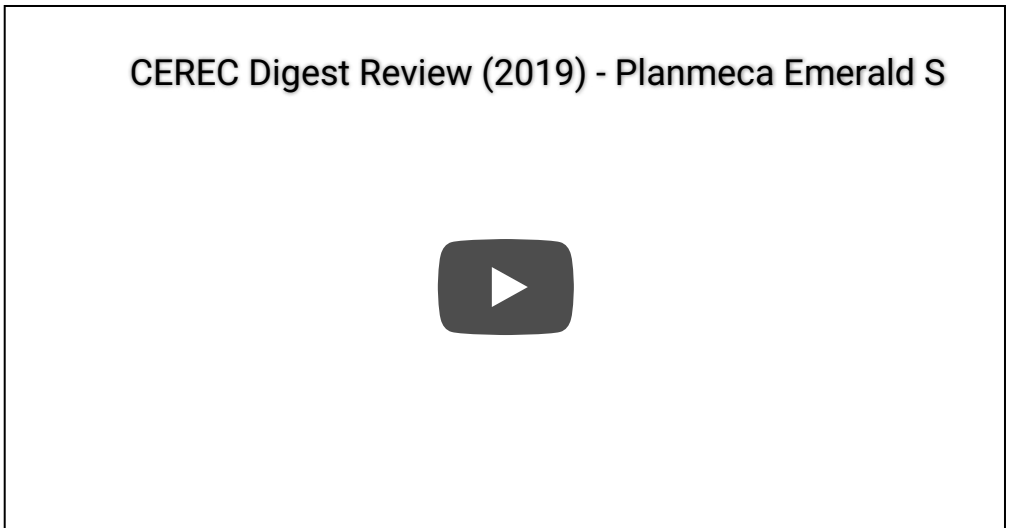
coming up with a better handle design for an intraoral scanner. In fact, we quite liked it, but is it really the critical detail that's holding the scanner back?

Our Verdict

We give the new scanner from Carestream the #8 spot. It might seem like the CS 3700 is a step down from the CS 3600, which was ranked at #3 in our 2017 review, but it's all relative; since most other manufacturers came out with more tangible improvements to their scanner, the CS 3700 felt about exactly the same. However, this device is scheduled for release later this year, so it's possible that they make last-minute changes for the better.

Planmeca Emerald S

A few years ago, I got to scan, design, and fabricate an onlay for the first time on a class A system. It wasn't the CEREC Omnicam, but rather the Planscan, the last-gen scanner from Planmeca. However, the nostalgia did nothing to dampen my disappointment when I saw the Emerald S. In keeping with the trend set by 3Shape, iTero, and Carestream, the Emerald S is also an evolutionary update to the previous scanner, the Planmeca Emerald. In other words, don't expect to see significant changes to the core scanning functionality.



Efficiency

- **SPEED**: The Emerald S is a fast scanner on the model, and the speed is also very respectable in the mouth. We are able to vouch for its intraoral speed because we've used the previous generation, the Emerald, on numerous real patients.
- **ACQUISITION**: For the most part, the Emerald has very good data capture, both on model and enamel.
- **INTELLIGENCE**: The ability of the software to fix stitching issues was quite poor. The scanner also had a bit of difficulty resuming a scan once the flow was broken.

The Achilles Heel

For the gamers out there, the Emerald S is the build where the player invested equally on every other stat except for intelligence. So while you have decent hardware, robust design functions, and a very comprehensive workflow, somehow the scanning software gives you the most trouble. The inability to fix some basic stitching errors wouldn't have been such a big problem if the scanning deformations were rare, but these problems occur quite frequently during our clinical tests with the Emerald (not the "S").

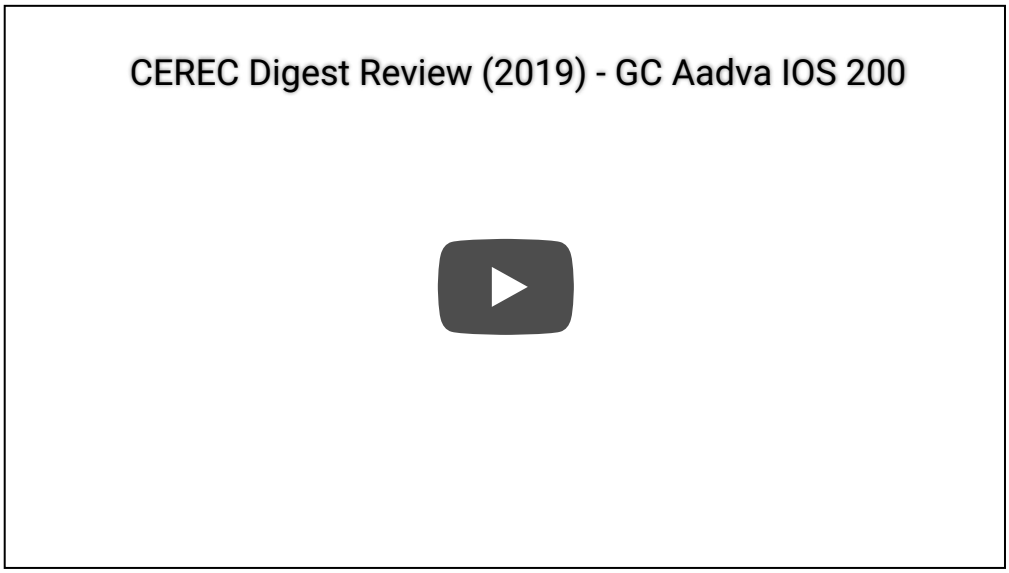
We wanted to see if things have improved with the new scanner, but were instead told that the scanning issues were due to improper scanning technique. Perhaps. Thought we'd like to note that there were other scanners that performed just fine using the identical scanning techqniue.

Our Verdict

We give the Planmeca Emerald S the #9 spot on our Top Ten list. The scanning speed is almost the same as the iTero, but due to its software issues, you are sometimes forced to stop, delete, and re-scan certain portions. Despite our complaints, however, these are not frequent issues, and we feel that the Emerald S is a about the same efficiency as the Carestream CS 3700. On the plus side, it's also a decent and less-expensive alternative to the other Class A systems in our list, the CEREC Primescan and the Omnicam.

GC Aadva IOS 200

Out of the top 10 scanners that we've reviewed, the new Aadva IOS 200 from GC had the most interesting design. The tip of the scan head sports a simple mirror that's not completely enclosed, giving the whole thing a very minimalist look. So how well does the scanner perform? Here's one of our tests during IDS 2019.



Efficiency

- **SPEED**: The Aadva IOS 200 can reach about the same speed as the Carestream CS 3700 before breaking the scan flow.
- **ACQUISITION**: The data capture was fairly decent on the stone model, but during a self-scan demonstration the number of holes in each pass increased significantly.

- **INTELLIGENCE**: The nice lady at the booth mentioned software artificial intelligence, but it looked like basic clean-up capabilities of noisy data.

How does the Aadva IOS 200 compare with the last generation from GC?

The Aadva IOS 200 is definitely a much more efficient scanner overall. It's faster and has better data capture. The software doesn't seem to have improved too much, but it's sensible for manufacturers to use the same software for different hardware. We also gave the last-gen GC scanner, the Aadva IOS, another try this year, and it didn't really improve very much, at least not enough to enter Tier 2.

Our Verdict

The GC Aadva IOS 200 is a solid #10 on our top-ten list. I can appreciate the new design, but at the moment this device does not seem to have too much advantage over other competitors. As a Class C scanner, it can only perform the most basic functions of an intraoral scanner: scan and export to a third party. Yes, at around 16,000 Euros, the Aadva IOS 200 is one of the less expensive scanners. Unfortunately, the Medit i500 is also around 16,000 Euros, and is a significantly better scanner of the same class. But I wouldn't count GC out yet, seeing as how they were willing to take a risk and invest in a totally new scanner. Let's see what they have to offer in 2021.

Last Three Questions

Why was this review article published so late?

I remember sitting in a hotel in Maastricht a few days after IDS in March, proofreading the final draft of this article. More than 5000 words of what our team set out to do, and yet it didn't feel right. As I was doing additional research to support my claims in the article, I constantly questioned if I was biased in favor of Primescan. Maybe because it's new and exciting? Maybe because I'm much more familiar with CEREC ecosystem? My draft was able convince everyone on the team except for myself.

In the end, we decided that if we were going make a claim, we'd better be able to prove it. So we waited until after receiving our Primescan, and I tested the crap out of it over the next week. The results were even better than I expected, but by that time a few other websites had copied our format from 2017 and released their review. We didn't

agree with their findings, because all of them seemed have made the exact same mistake we did, but alas it seemed that the window of opportunity had closed.

In the month following IDS in March, I had received a large number of requests online for the 2019 version of our article. As I lectured in many different countries, a lot of the audience member had asked me about our thoughts on different intraoral scanners. Many of them are in the market but don't have any headway on how to choose. You can probably guess the rest.

Which is the right scanner for me?

Isn't this the ultimate question? Right now, the choices are becoming diverse and there is a scanner for every need.

Just to list a few: If you are looking for an inexpensive scanner that is easy and efficient, there is the Medit i500. But if you also want to do your own design on a lot of different indications, then the 3Shape TRIOS series are a good choice. For the ultimate system for accurate scanning and chairside restoration, the Primescan currently has no competition, but there's literally a high price to pay.

But whether it is price, accuracy, or how many indications you can use it for, the one thing that most people overlook is the availability of training and education. Maybe you don't need too much training for Class C scanners, but if you are considering Class B and A systems, a good community that can support you is paramount.

At CEREC Asia we do a lot of technical and clinical training, but our most popular courses are actually the *Marketing and Management* lectures for CEREC. People are interested to join the world of digital impression, but are unsure of what to do and how to start. As dentists, most of us don't have the time to figure stuff out, and having access to good education can help you immensely on riding that learning curve.

What about (INSERT NAME) Scanner?

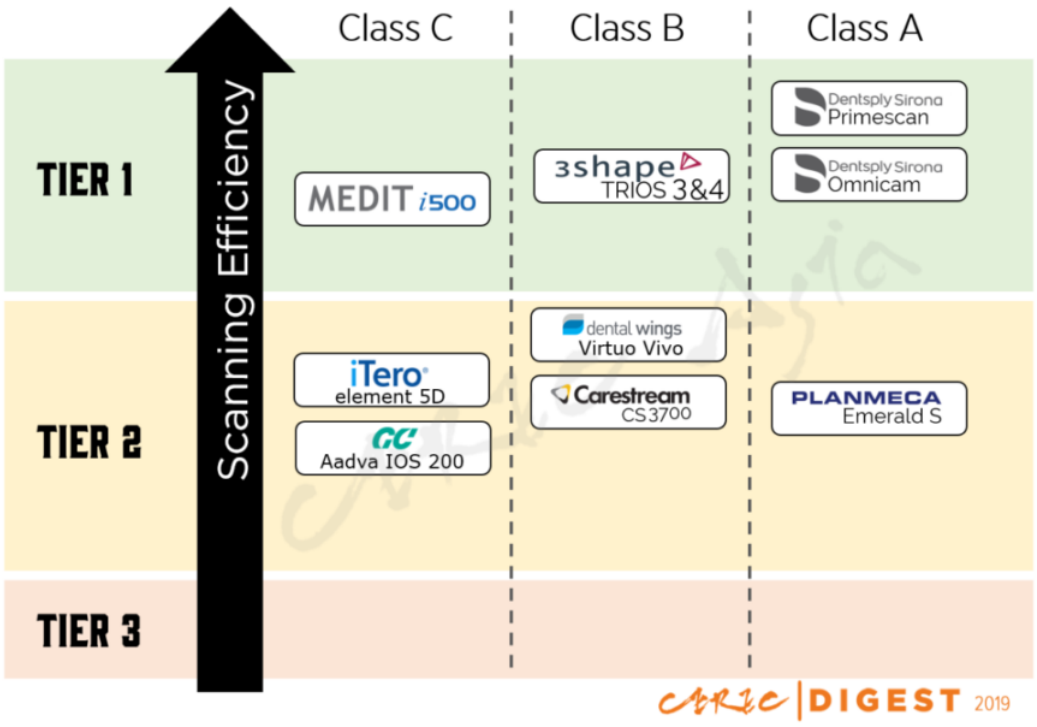
As I've mentioned at the very beginning, our last review article in 2017 has gained over 200,000 views so far. This means 200,000 good exposures for the top scanners, but also 200,000 bad exposures for the bottom scanners.

When my colleague and I planned this project last time, we simply wanted to see how the Omnicam that we use everyday performed relative to other scanners. It was not our intention to damage the reputation of anyone, but rankings dictate winners and losers, and for the latter we frankly didn't work hard enough to ease the pain.

The fact is, intraoral scanning is not just one kind of technology, but consists of several different approaches to reaching the same goal. Through years of competition, some newer methods have begun to mature while others have been made obsolete. Right now confocal technologies reigns supreme, but who knows what the future will bring.

As both an engineer and a dentist, I can appreciate the manufacturers pouring time and resources for the betterment of patients. This is why for this year, even though we've tested almost every single intraoral scanner at IDS, we've decided to list only the top ten. For the scanners that did not make it into our review, we sincerely wish them the best of luck and look forward to what they bring to the table next time around.

Conclusion



Thank you for taking the time to read our review and analysis. We've tried to be as fair as we could, but I'm sure we've made mistakes somewhere. Let us know what you think in the comments below, or contact me some other way, and I will make sure to respond to each of your concerns.

Hsuan

Hsuan is a lecturer at CEREC Asia Training Facility. He is from Vancouver, Canada, and is a big fan of prosthodontics and profanity.

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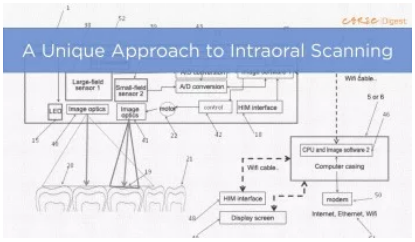
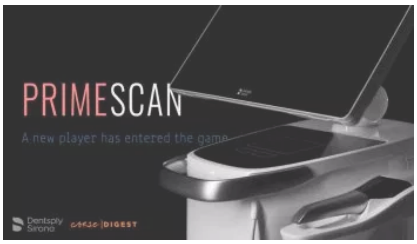


A Unique Approach to Intraoral Scanning
June 30, 2017
In "Editorial"



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