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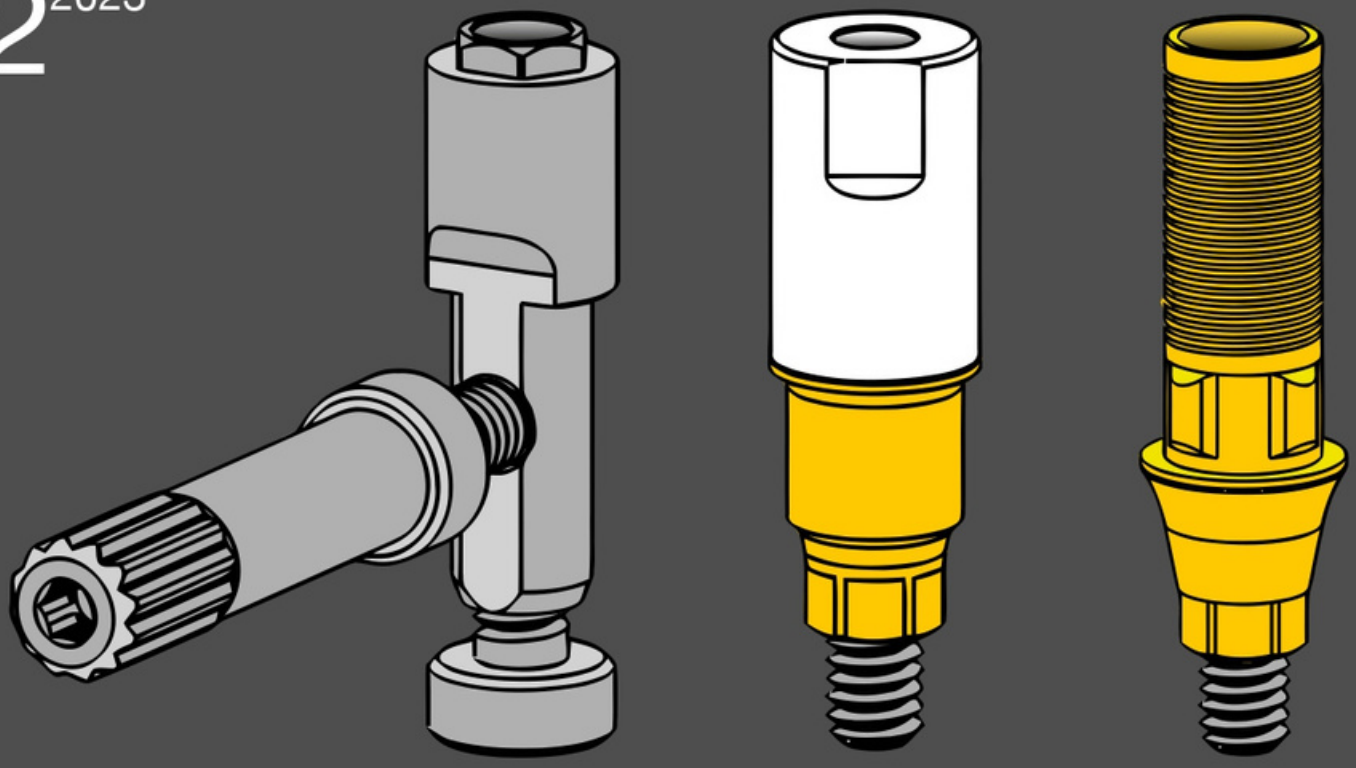


| case report

Digital Support 'Free-Hand' Surgery in the Rehabilitation of Atrophic Jaw

| expert article

Applications of Artificial Intelligence in Orthodontics

| case report

Solution of a Frontal Agenesis Case with 3D Navigation Surgery and 3D Color Printing in DFAB with TSLA Technology

dti Dental Tribune International

Multi-dimensionality of errors in intraoral scan: can we now finally claim to have the validation and verification protocols of our intraoral acqisitions in place?

Author Francesco Polito, Nicola Palladino

_Introduction

I belived that the circle was closed, I hoped the die had been casted and the games were done and over. Instead everything is still in motion and changing.

Virtualized planning of the operation, guided surgery with templates, intraoral scanning, immediate or deferred loading.

This is the most advanced and validated work protocol that we have reached in modern implantology, however one of the work phases is still too young and too critical: The intraoral scan.

This, as Francesco Mangano explains very well in his publications and courses, inevitably suffers from operator dependency and the learning curves are still often incomplete or inconsistent.

The industry is offering us the first forms of artificial intelligence in guided surgery software (see Jarvis by Medialab) and in 3D acquisition software, but unfortunately or fortunately a significant part of the acquisition/scanning phases is operator dependent with the consequent possibility of introducing errors and distortions into the scan acquisition process.

For some time we have been using the IPD ProCam system (AbutmentCompatibili.com IPD Dental Group) for intraoral scans, which allows the correction of light aberrations located around the scan body; it also allows, with a double screw system, to precisely and repeatably fix the analog in its precise position in the printed models.

All this allows us to reduce the "micro localized" error, the error present in the vicinity of the implant and the relative scanbody, but it does not allow you to validate the entire topography of the scan and the connecting sections between one scanbody and another.

The veracity of the entire triangle map is often invalidated by areas of scan welding such as scan interruptions and resumption from the last known point, and distortions due to the scanner's inability to fully understand what the operator is acquiring and where the camera is located spatially, a classic example is the passage on the canine from posterior and anterior sectors and consequent rotations of the scanner horizon.

Once again the industry and the IPD Dental Group and AbutmentCompatibili.com come to our aid with a product of embarrassing simplicity: Scan|Transfer (AbutmentCompatibili.com IPD Dental Group) (Fig. 1). We have introduced this system of scanbodies and protocols dedicated to complex cases on MultiUnit into our daily clinical practice (Fig. 2**)**.

Scan|Transfer allows you to easily connect all scanbodies to each other via rigid structures, firmly locked to scanbodies, and practice one or all 3 scanning protocols referring to scanning and validation.

- Protocol 1 CSS|Strategy: scanning technique published by Mangano, Imburgia and Kois which highlights the increased "accuracy" and "precision" in the scanning phase, preventing the creation of fractures in the point cloud with inevitable welding lines, Kintsugi Concept in complex volumetric reconstructions (Fig. 3).
- Protocol 2 De|Bug: possibility of using the arc of firmly connected scanbodies for the creation of a plaster key, a master model, on which to validate the implant positions and therefore the prosthetic structures before arriving to the patient (Fig. 4).

Fig. 1

Fig. 2

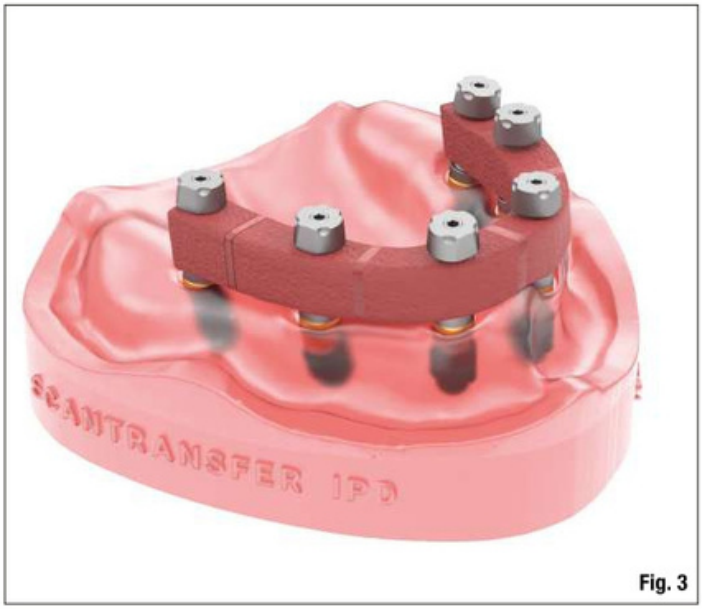


Fig. 3

- Protocol 3 Re|Scan: the most surprising for its simplicity. It is based on the possibility of scanning only a part of the arch intraorally, the area of greatest ease, accessibility, precision and accuracy, and therefore the anterior area, to finish or repeat the scan completely outside the oral cavity in a situation of enormously greater comfort and/or with better performing benchtop scanners.

I believe that today the use of Scan|Transfer really allows you to increase the learning curve by compressing it enormously; and which guarantees clinicians to find the necessary safety already present in analogue procedures.

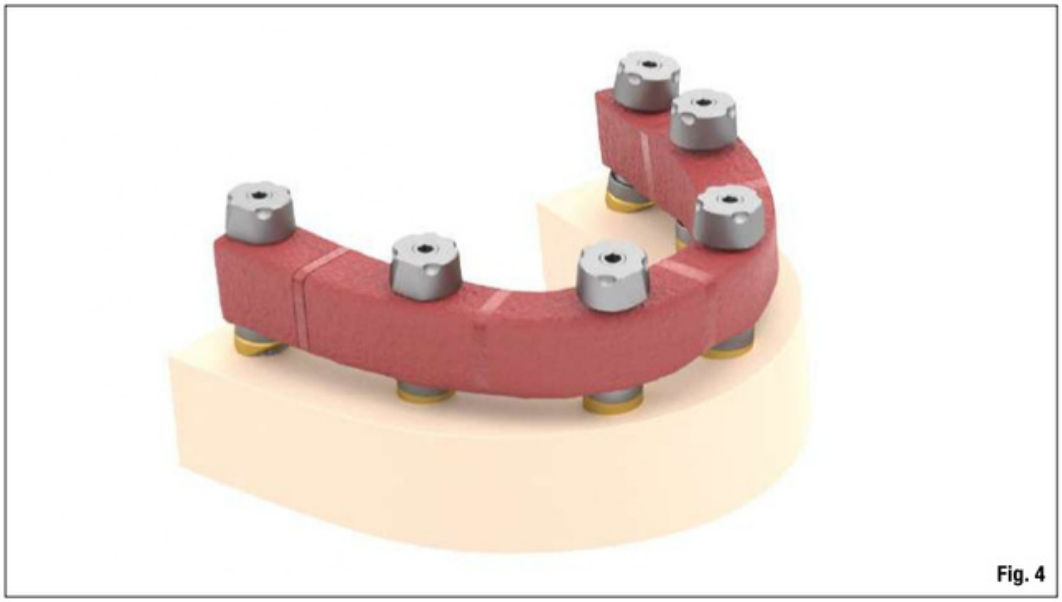


Fig. 4

_Case report

This case report is an example of how today we approach digital flows from planning to delivery of prosthetics.

It all starts with an edentulous patient, from the surgical planning done on Implant 3D (MediaLab) and its artificial intelligence Jarvis, the surgery guided by Stackable Guides, printed in 3D, and Five implants (Leader Medica) (Figs. 5, 6) .

The deferred prosthetic load was able to exploit the Stackable Guide concept to also guide the positioning of the first model, also a result of the surgical planning, a model that would have validated aesthetics, mastication, vertical dimension at time 0, and reprinted with the small changes made at the time of insertion four months earlier (Fig. 7).

The intraoral scanning phase and therefore the detection of the implant positions was carried out with the new ferulised, blocked

In place with a PMMA arch milled in the laboratory, also extrapolated from the implant programming carried out on the Implant 3D software (MediaLab) and milled with ease thanks to a 5-axis Evolution Plus milling machine (Santabarbara Dental) (Fig. 8).

The application of “Protocol 1 CSS|Strategy” allowed us to run on a structure easily acquired by the PrimeScan scanner (Dentsply Sirona) avoiding any form of interruption of the scan; thus reducing stitching deformations of the meshes and reducing their torsional deformations (Figs. 9-11).

Once the scans arrived in the laboratory: lower, upper, scanbody, byte and the model, we immediately began assembling starting from digital byte and the model. Upon physical arrival in the laboratory of the PMMA arch with the Scan|Transfers blocked, the plaster key/model was created and the scan was repeated to validate the first done intra orally.

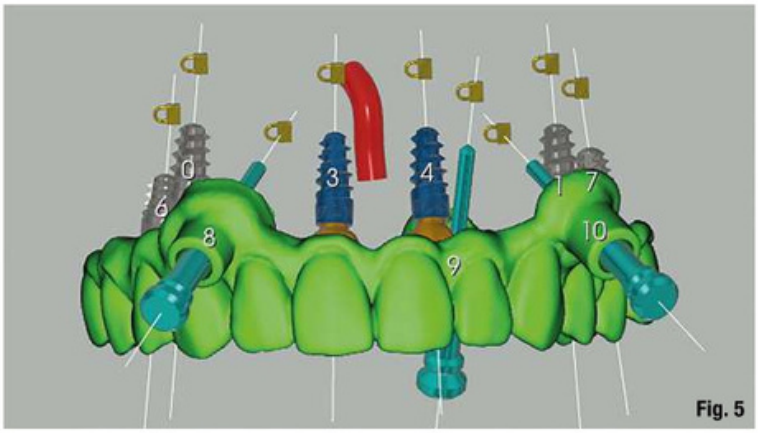


Fig. 5

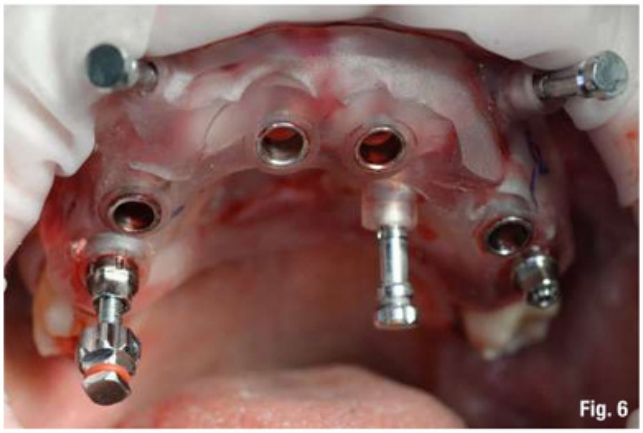


Fig. 6


Fig. 7


Fig. 8

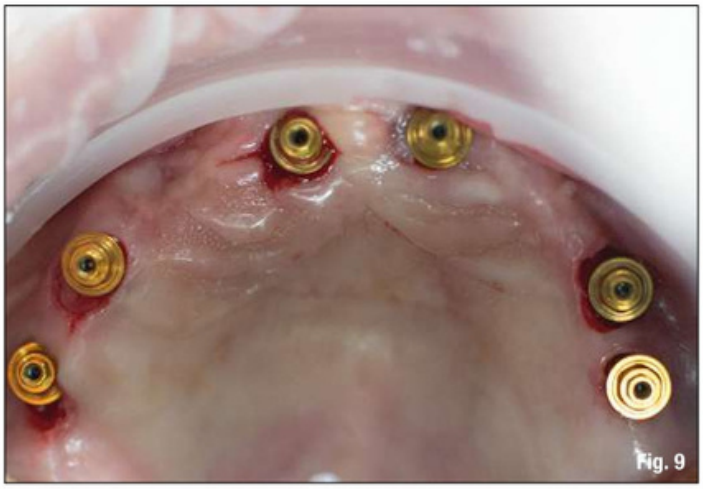


Fig. 9

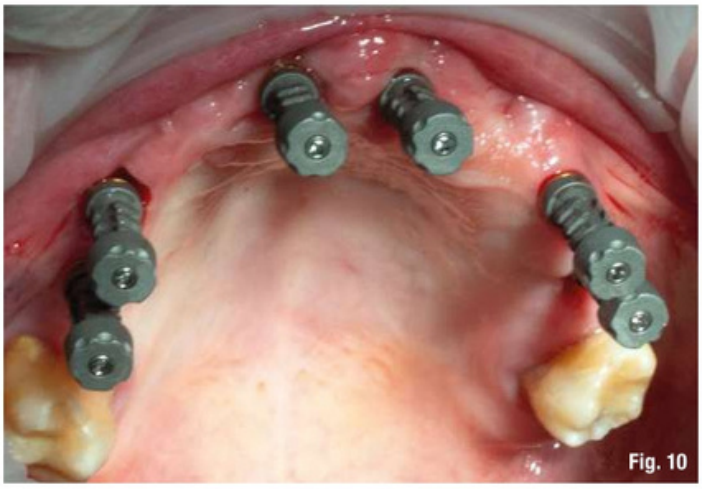


Fig. 10

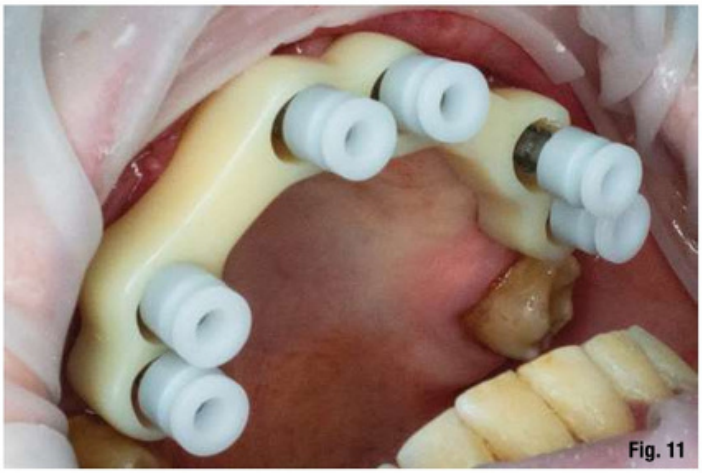


Fig. 11

Protocol 2 De|Bugg: The small inconsistencies are corrected by adopting the positions obtained in the laboratory and repositioned on the model started previously thanks to the first scans and the model's byte registration(Figs. 12-15).

In this case we did not use Protocol 3 Re|Scan given that the patient had excellent opening and access to the oral cavity and to the scanbody was optimal.

With the validation of implant positions

It was possible to proceed with the design of a definitive bar subsequently milled in gr5 titanium using a 5-axis Evolution Plus milling machine, very well polished on the parts that would interact with the tissues, and an anatomical structure for chewing validation (Fig. 16).

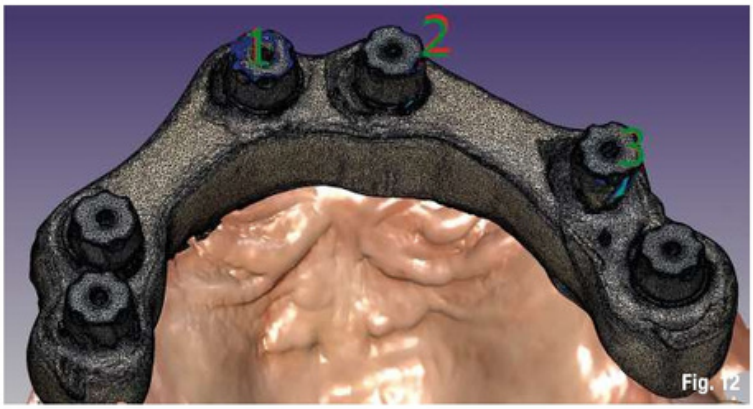


Fig. 12


Fig. 13


Fig. 14

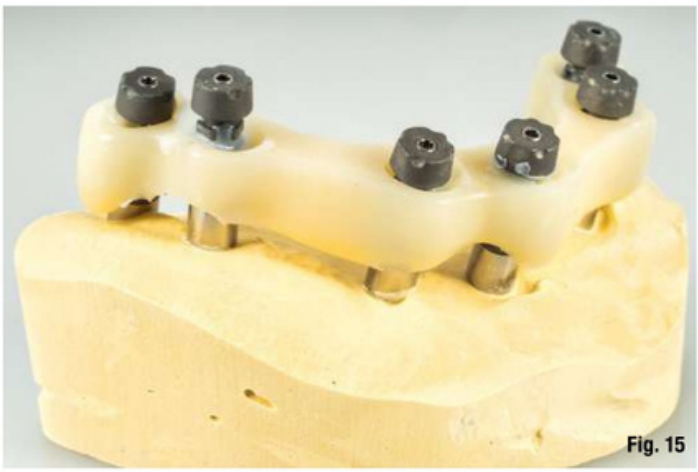


Fig. 15


Fig. 16

Once chewing was tested and validated, the same DMAX Smart (D-Max) zirconia file was replicated on the same metal substructure. The aesthetics necessary for the completeness of the case were guaranteed by the Vintage ZR (Shofu) ceramic micro-layering on the "White" parts and layering on the pink components (Figs. 17-19).

DMAX Smart zirconia has the unique characteristic of variable absorption of immersion colors and a hardness of 1100 Mpa. Today we can always keep this disc ready in the milling machine to cover 90% of the zirconia cases that appear in the laboratory: monolithic, layered, micro-layered.

Fig. 17

Fig. 18


Fig. 19

_Conclusion

Precision and accuracy must be measured and evaluated around the scan body and in the overall scan, in the overall picture of the entire scan. As it happens in a Mercator map you could have all the cities, provinces and nations in the right place but you will than have some inevitable distortions at the continental level.

The correction of aberrations and the ability of scanners and software to read small objects more and more accurately and precisely cannot, in such an obvious way, contain possible errors on large volumes, on entire arches, and on the edentulous and poorly characterized segments of the lower arch.

The "compliance" and experience of the operator is essential.

Reasonable protocols such as those used with Scan|Transfer undoubtedly make it possible to reduce operator dependence on intraoral scanners, standardizing, validating and simplifying the critical phases of acquisition of implant positions, allowing an indispensable passivity of the protected structures. (Figs 20)

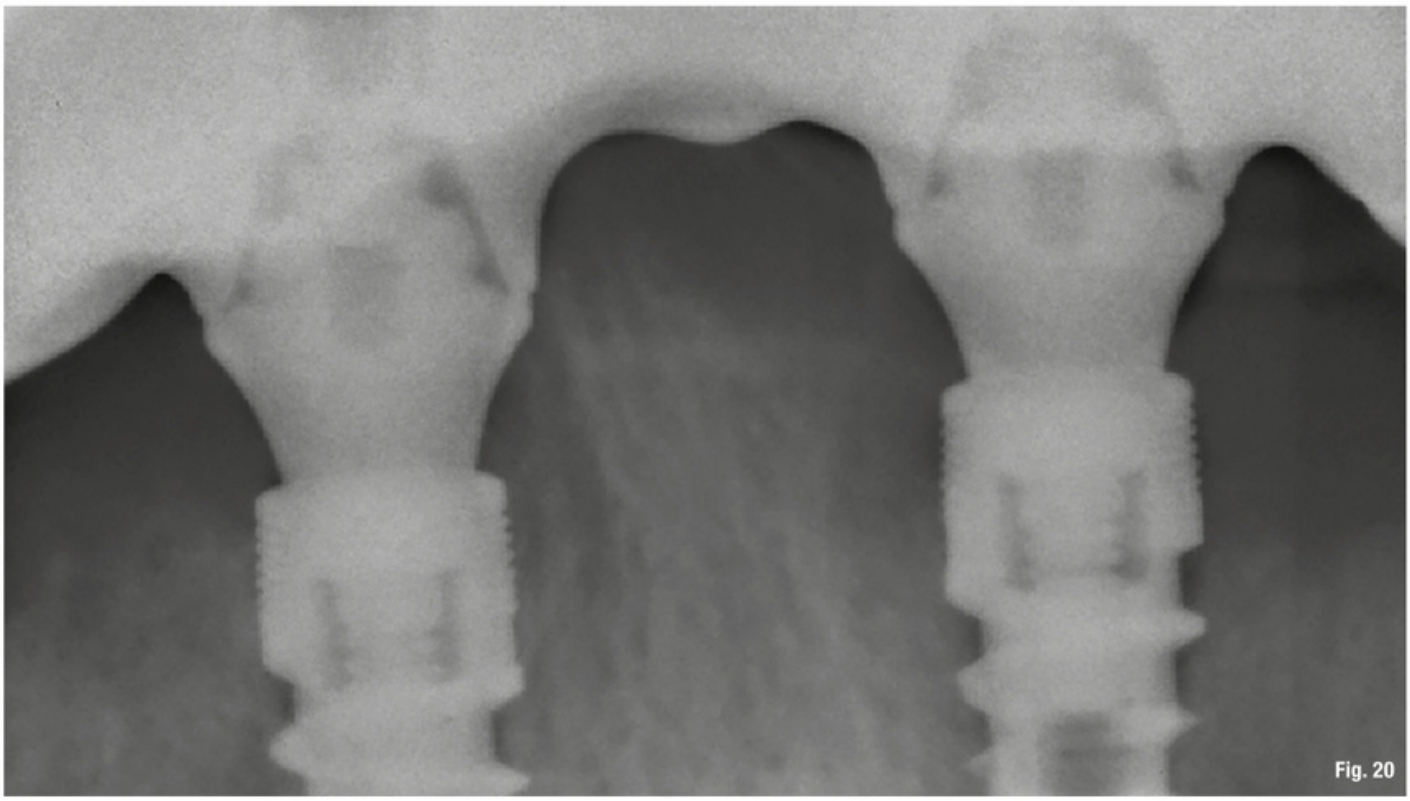


Fig. 20

DENTAL TECH
DIGITAL DENTISTRY
PAGES 2023

By the Digital Dentistry Society International

THE CLINICAL CASE
Scan|Transfer

THE INSIGHT
Making predictions is very difficult, especially when it comes to the future

THE INTERVIEW
How to Correct, Validate, and Certify an Intraoral Scan on Implants?

#digital-implant-scanning

Dr. Francesco Mangano
DDS, PhD

Associate Professor, Digital Dentistry, Sechenov University, Moscow, Russia. Editor of the Digital Dentistry Section of the Journal of Dentistry (Elsevier), a Q1 journal with an impact factor of 4.4 and a CiteScore of 7.0. Founding Member, Active Member, Member of the Board of Directors, and President-Elect (2024-2025) of the Digital Dentistry Society (DDS) International. Director of the Mangano Digital Academy (MDA), an academy dedicated to promoting education in Digital Dentistry. Creator of the "#ZEROMICRONS: Precision in Digital Dentistry" course. Author of 140 publications in PubMed-indexed international journals with a high impact factor, with an h-index of 50 (Google Scholar) and 38 (Scopus). He practices independently in Gravedona (Como), focusing exclusively on Digital Dentistry, and the development and application of innovative technologies in Dentistry, such as artificial intelligence, augmented reality, and robotics.

Intraoral Scanning on Implants:
New Workflow Protocols

Dear friends and colleagues,
Welcome back to DentalTech, the column that Infodent dedicates to the digital world in Dentistry. In this October 2023 issue, we discuss digital workflow and intraoral scanning in implant-prosthetic rehabilitations, specifically #digital-implant-scanning. Once again, to address this topic, we involve two friends and experts in the field: dental technician Nicola Palladino and the creative and revolutionary mind, Francesco Biaggini. In this issue, in particular, Nicola and Francesco discuss three new and revolutionary protocols designed to make implant scanning simple and predictable: CSS1Strategy, De1Bug, and Re1Scan. These are innovative protocols that can be of great clinical assistance, especially in guiding less experienced users in intraoral scanning towards clinical success. I am truly delighted to have made a modest contribution through some of my international scientific studies to the development of these winning protocols under the IPD ProCam brand. I, therefore, leave the readers in the capable hands of Nicola and Francesco, who will guide them through these innovative protocols. Personally, I must say that it has been fortunate for me to meet such competent individuals who have provided valuable inspiration for my growth in this field. Thanks to the contributions of these experts, DentalTech continues to grow and represent a beacon of knowledge in the midst of the chaos that the digital world of dentistry has become today. It's a world filled (unfortunately) with snake oil salesmen, both unknown individuals offering training courses without the necessary scientific background and well-known names attempting to "reinvent" themselves in this field without any real understanding.
Knowledge doesn't happen overnight; it's always the result of hard work and dedication. Therefore, I am happy to celebrate my first five years of collaboration with INFODENT in the DentalTech project in February 2024. For me, this holds significant value because we have helped many dentists - and will continue to do so - in facing a fascinating and complex challenge: the transition from analog to digital.
Happy reading!

Francesco Mangano

#digital-implant-scanning

Odt. Nicola Palladino
Dental Technician specialized in Dental Aesthetics and Digital Workflows.

SCAN|TRANSFER, THREE PROTOCOLS FOR SIMPLIFYING, CONTROLLING, AND VALIDATING INTRAORAL SCANS.

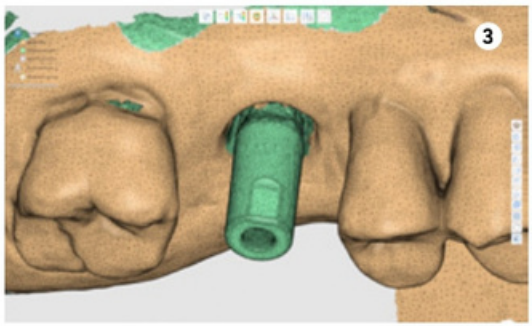
There is never just one path to reach the same destination, patient satisfaction. Choosing the path is our freedom.

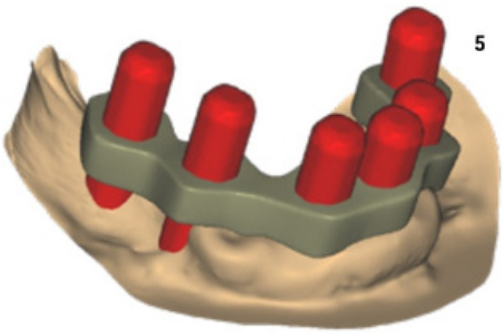
We have never been the same, always living in a diverse, multiracial, multidisciplinary society, yet inevitably pigeonholed into rules and protocols. Recently, I attended a conference by Gioacchino Cannizzaro, an explosive personality with strongly divisive ideas, and the eloquence of a skilled storyteller. Still, he has a lot, a lot of valid points.
We have never been the same, and yet we apply unified, standardized protocols to all patients, and Cannizzaro contests this. We have never been the same, and yet we often use identical products and procedures regardless of our experience or specific needs. Today, I contest this. In our laboratories and offices, we use the best scan bodies available in the market: IPD ProCam (IPD AbutmentCompatibili.com - IPD Dental Group) with an extraordinarily powerful and innovative system for correcting light aberrations **(Fig. 1,2)**. But we, dental technicians and dentists, are not all the same. Our learning curves differ, our experiences are different, the number and frequency of scans are different, yet we persist in buying the same technological solutions.
When I first saw Scan|Transfer, I immediately understood that it was not my scan body, and perhaps not even Antonino's or Giacomo's scan body, but it would be the perfect scan body for Marco, Francesco, Carlo, and many other doctors who deal daily with intraoral scans that are wonderfully imperfect and dramatically imprecise **(Fig. 3)**.

Fig. 1,2. Example of intraoral scanning performed with IPD ProCam ScanBodies equipped with libraries for dimensional aberration correction.

We now know that intraoral scanning is still highly operator-dependent; posterior areas, and especially lower ones, suffer from distortions, errors, and accessibility issues (**Fig. 4**). A skilled operator can contain the error, but eliminating it entirely is challenging. However, reducing it brings imprecision within an acceptable range. An operator less accustomed to scanning full arches or with an incomplete learning curve needs dedicated tools. After all, a rear-wheel-drive car without traction control can be more fun and high-performing, but you need to know how to handle it well; otherwise, it's better to have ABS and traction control engaged. The three procedures associated with Scan|Transfer, partly derived from publications by Francesco Mangano, Mario Imburgia, and John Kois on the scanning technique called CSS|Strategy, provide clinicians with a guided, repeatable acquisition path that can even be performed without the patient in the chair and validated by the laboratory.

Let's start with the first guided procedure: CSS|Strategy. Typically, we take an initial position of the implants from the guided surgical planning, which is increasingly performed by clinicians. From there, we design a "splint," a rigid structure that is dimensionally appropriate and will be 3D printed or milled during the intraoral scan (**Fig. 5**). CSS|Strategy allows the intraoral scanner to easily recognize this structure by aligning the scan head planes of the scanbodies with the splint's plane, reducing the focus jump and preventing the scanner from losing its position and breaking the scan into multiple pieces to be joined together. The concept of the Kintsugi Effect (rebuilding a fragmented whole) creates welding lines, and as described in the previously mentioned publications, it offers the possibility to distort, deform, or alter the shape of the arch you are scanning (**Fig. 6, 7**). Therefore, the error will no longer be micro-localized around the scanbody, as analyzed and corrected with progressive correction libraries, but it will be a macro-localized error generated in the overall volume and shape of the mandibular or maxillary arch. The absence of a palate in the lower arch, the often reduced width of keratinized gum, and the difficulty of containing the excess of the tongue and cheeks' floor make the mandible a highly critical arch for intraoral scans (**Fig. 8**). The use of the





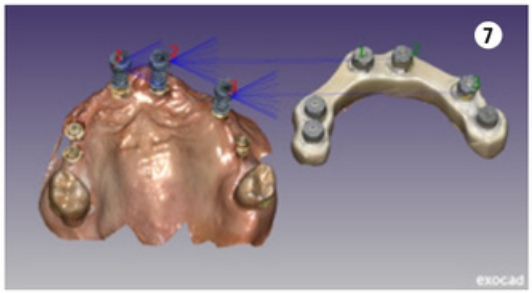


Fig. 3. Scan|Transfer IPD Dental Group - AbutmentCompatibili.com
Fig. 4. Example of a complex intraoral scan, lower arch with implant spacing. Image courtesy of Dr. Antonino Cacioppo.
Fig. 5. Example of a locking splint design by importing position data from guided surgical planning.
Fig. 6. Milled and placed splint with Scan|Transfer.
Fig. 7. Difference between "classic" scanning and scanning with the CSS|Strategy technique.
Fig. 8. Example of a complex scan in the lower arch with no stable references.

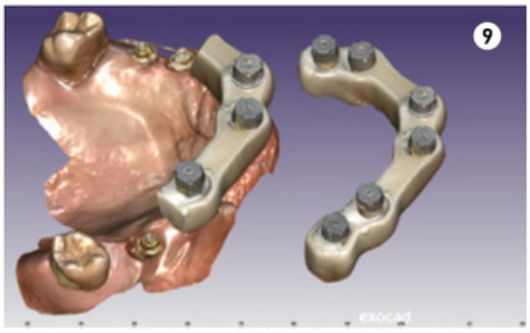
The technique of splinting the scan bodies allows for a significant reduction of the Kintsugi Effect, allowing us to move away from the limits and complications listed above. In support of this, two additional procedures have been developed.

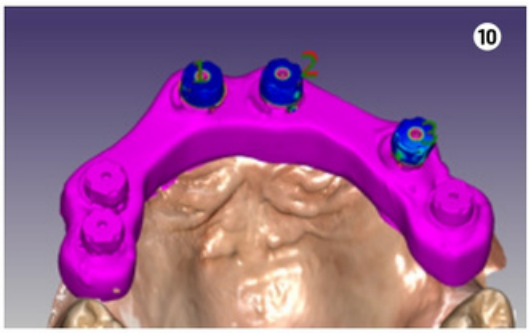
Re|Scan allows the operator to take a partial scan in the patient's oral cavity and complete it later. The posterior area is less accessible, and often the tongue and cheek interfere, preventing proper volume acquisition. Going back over already acquired areas would introduce errors into the point cloud, errors that would add to the initial ones. Partial scanning of the front group, which is considerably easier to capture correctly, allows for repeating the scanning of only the arch/splint.

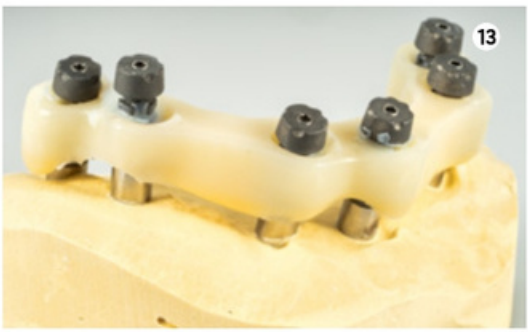
Outside the oral cavity, in the absence of the patient, in vitro, without all the previously described complications, and without the time or procedure repetition anxiety.

The second in vitro scan will simply be repositioned on the first partial in vivo scan, ensuring the best possible implant position detection (**Fig. 9, 10, 11**).

The last procedure to aid digital workflows is De|Bug. This allows the dental technician to create a plaster key with analogs in place. The De|Bug procedure is not intended to be a complete working model but rather a key for verifying implant connections, which can be placed on the partial in vivo scan.







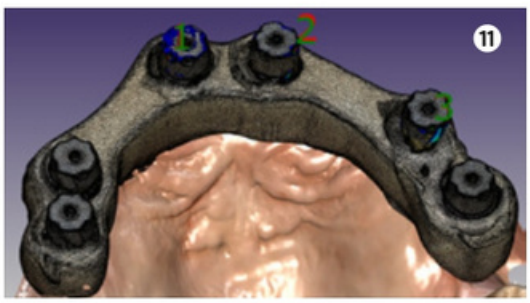


Fig. 9. Example of the Re|Scan technique, where partial intraoral data and complete extraoral data are combined.
Fig. 10, 11. Example of mesh overlay, elimination of incomplete meshes, and saving the new assembly without distortions or errors.
Fig. 12, 13, 14, 15. Example of the De|Bug technique, creating the master plaster key for rescans, mechanical keying, or validations of milled components, and attachment to the TiBase.

being able to repeat a scan or mechanical keying to validate the intraoral scan or, more simply, to validate the milled component and its attachment (**Fig. 12, 13, 14, 15**).
Attaching to a plaster key allows for better control of offsets. The cement space, inserted during zirconia milling, allows for controlling zirconia contractions and validating the milled component on a direct connection (**Fig. 16, 17, 18**).
Having a plaster key restores a level of confidence to the laboratory that had been lost in the complexities of digital workflows.

CONCLUSIONS

My entire team and I believe that the three procedures

My entire team and I believe that the three described procedures allow us to close a gap left open by the rush towards digitalization that is taking place in dental practices. Intraoral scanning had left us without our master model, preventing us from validating the laboratory phases and bringing the final test to life on the patient. This creates stress on both the laboratory and clinical sides. In cases of inaccuracies, the clinician must repeat some or all of the procedures, delaying the delivery of prosthetics and trying to justify the failure to the patient, something that wouldn't have happened with a master model or plaster key.
Scan|Transfer finally simplifies, repeats, and validates our scans, restoring the serenity and confidence we have always had in the past.

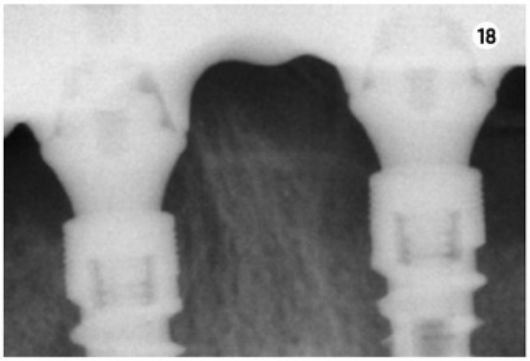


Fig. 16, 17. Examples of work validated on a plaster key generated by the Re|Scan procedure.
Fig. 18. An example of radiographic validation in a case report using the CSS|Strategy, Re|Scan, and De|Bug procedures with IPD Dental Group's Scan|Transfer abutment.

#digital-implant-scanning

Francesco Biaggini
CEO of IPD
AbutmentCompatibli.com

MAKING PREDICTIONS IS VERY DIFFICULT, ESPECIALLY WHEN IT COMES TO THE FUTURE

Sometimes I long for that period when dentistry was "simpler," when almost everything was analog, tied to the skill of the clinician and the craftsmanship of the dental technician who followed. Few products, few instruments, much skill, less marketing, less speed. Today, everything is very immediate, virtual, digital, and fast. Nowadays, too often, the patient arrives with their treatment plan based on bits of information from YouTube and Facebook tutorials; they come with certainties, not hopes; they come with demands, not questions. Sometimes I don't understand if we are riding the wave of digital and social networks or if we are being overwhelmed and carried away by it. The complete digital flows, Full Digital Workflow, which are increasingly rushing in from medical practices, driven by the powerful winds of innovation and marketing, suffer from a significant lack of experience on the part of many operators.
Unfortunately, there has been a great deal of confusion in.

comunicazione di vendita di alcuni prodotti digitali, spesso è stato compreso che questi avrebbero risolto tutti i problemi inerenti costi, velocità, semplicità e precisione. Sicuramente, come quasi sempre ac- cade, la verità sta nel mezzo, parole confuse alla fonte arrivate distorte all'operatore che non cerca risposte ma conferme. Ora la tecnologia e l'industria devono trovare una soluzione che in parte è nella formazione e nella curva d'apprendimento verso gli utilizzatori; e in parte è in soluzioni tecniche e procedurali efficaci. Accademie e società scientifiche come DDS, Aiop, Sipro, CAI Academy e altri sono inevitabilmente dei fari di conoscenza da seguire sempre più da vicino soprattutto in questi periodi di confusione e cambiamenti. Nella più classica Curva di Rogers sulla diffusione di una nuova tecnologia siamo nella fase iniziale di sviluppo mentre nella medesima curva inerente l'adozione siamo oltre la metà della fase denominata "Early Adopter" (primi adottanti utilizzatori di una tecnologia) (**Fig. 1,2**).

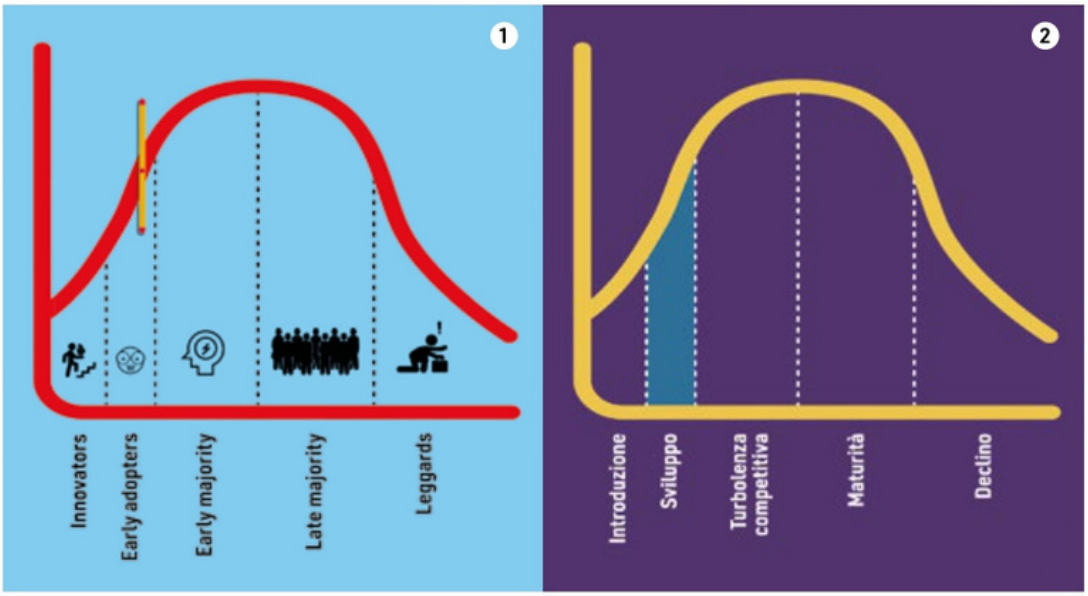


Fig. 1. Chart explaining when and how many users adopt a new technology (Time/Quantity Ratio).
Fig. 2. Chart depicting the development of the innovative digital product's life and its market expansion (Time/Quantity Ratio).

Fig. 3. Scan|Transfer with a protection system during work phases.

Researchers, clinical professionals, and the industry must now make products and clinical procedures easily accessible to the mass of future users who may be less inclined to handle procedural novelties and usage complexities. The future user, the majority, demands a "Ready To Go" product that doesn't involve significant effort or difficulty. Software, algorithms, and AI are making a crucial contribution, while specialized training centers and academies are laying the groundwork for a solid learning curve. The industry is weaving it all together with products that enable the transition towards "Full Digital" for the Early Majority and the future Late Majority. Of particular note are the three protocols developed by IPD Dental Group: CSS|Strategy, Re|Scan, and De|Bug. These three procedures, closely tied to the Scan|Transfer scanbody (IPD Dental Group - IPD AbutmentCompatibles.com), serve as accelerators for the penetration of digital technologies among the defined Early and Late Majority (**Fig. 3**). Simplification, safety, and precision restore certainty to the operator, which has been challenged by the incomplete maturity of digital products and the still evolving knowledge of these products by clinical operators and, at times, even by salespeople. Rediscovering familiar reference points such as:

- The keys in plaster or master models
- The peace of mind to be able to replicat

• Scanning without the need to have the patient in the chair.
• Knowing that there is a validation and correction procedure for all scans performed.
• Eliminating production errors in the laboratory.

These factors make the full digital workflow the solution often described by scanner and printer salespeople but rarely found in medical practices and laboratories. Therefore, it is essential to understand that to adapt to the new technology standards, it is necessary to implement procedures that increase the knowledge and understanding of the hardware and software products we will use and adopt protocols that help mitigate human or technological errors. The learning curve and adoption of digital technology have begun, and the resilience of operators is reaching its maximum stress points. The choices we make today will shape our work and profession for the coming years.

The questions we must continue to ask ourselves are:
Are we ready for all of this?
Am I using the best technological products? Am I influenced by old habits? What can I do to improve and grow?

Let each one find their own answer.

#digital-implant-scanning

Francesco Biaggini
CEO of IPD
AbutmentCompatibli.com

How to correct, validate, and certify an intraoral scan on implants?

DentalTech interviews Francesco Biaggini, one of the leading experts in intraoral scanning and digital dentistry in Italy.

Francesco Mangano

Good morning Francesco, first of all, I want to thank you for this interview, I know how busy you are, and how much you travel around the world.

Francesco Biaggini

Yes, indeed, these have been very intense months. Since Biaggini Medical/AbutmentCompatibili.com merged into IPD Dental Group, the travels have become international, and the pace has become increasingly hectic.

Francesco Mangano

How is this partnership going for you? Italians typically have a saying, "one partner is not enough, but two are too many." How is it to work in a group like yours?

Francesco Biaggini

We are living very well. When you decide to reach

Fig. 1. Miguel Angel Nieves (CEO IPD Dental Group) e Francesco Biaggini (Fondatore AbutmentCompatibili.com).

It's a very good experience. When you decide to enter into a partnership, it means that you find common values, vision, and goals in your partner, and that the time spent together is stimulating and enjoyable. I believe that the fundamental values that have always characterized my family and my company are shared within IPD Dental Group and form the backbone of the group (**Fig. 1**).

Francesco Mangano

You've unified production and the research and development center. Now everything is in a single facility in Premià, is that correct?

Francesco Biaggini

Yes, that's correct. Technological challenges, research and development, and CE, MDR, and FDA certifications require significant investments and dedicated personnel. Achieving CE and MDR certification was a tremendous challenge. European quality standards are now extremely high, and for us, it's a daily challenge that motivates us to work better and give 100% of our abilities. Making investments scalable and sharing them across international production is certainly the right path.

Research and development are the most intellectually rewarding and stimulating aspects of our daily work. Brainstorming sessions with clinicians, technicians, and company personnel lead to experimenting, testing, and certifying truly intelligent and smart prosthetic solutions.

Think about the introduction of the concept of correcting light aberrations on scanbodies, the introduction of the "one screw,

one precision; two screws, double precision" concept for 3D printing analogs, and finally, the creation of a product/procedure like Scan|Transfer. It was developed based on the insights provided by you, Francesco, along with Mario Imburgia and John Kois, in your enlightening publications and research on the CSS|Strategy.

Scan|Transfer is indeed like the invention of the wheel for its simplicity and its ability to drastically change work standards (**Fig. 2**).

Francesco Mangano

Let me understand better... we're talking about your new scanbody... what kind of innovation have you introduced to make it so different?

Francesco Biaggini

Scan|Transfer is the culmination of the last five years of digital innovation. It's the distilled result of clinical, dental, and industrial experiences. It serves as a bridge between the new digital world and the old, reassuring analog world.

Francesco Mangano

But isn't it enough to choose a high-quality intraoral scanner and use your scanbodies with aberration correction? Why Scan|Transfer?

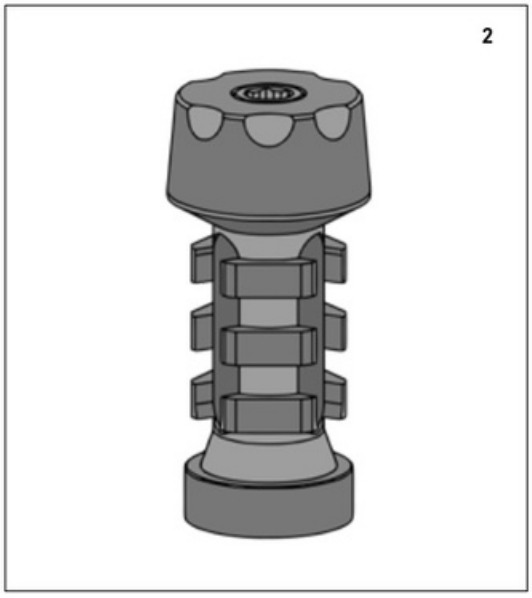
Francesco Biaggini

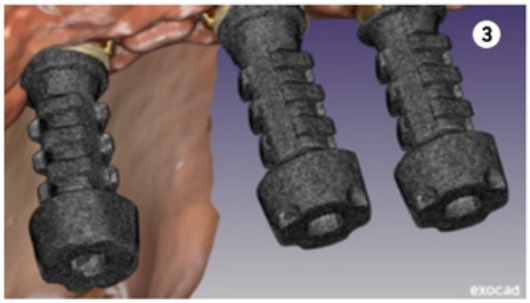
You see, intraoral scanners are still highly operator-dependent tools.

While the level of expertise in intraoral scanning is increasing, there are still gray areas where errors and problems can accumulate. Scan|Transfer is a tool for simplifying the scanning process and for validating and verifying the scan itself. Let me explain this in more detail (**Fig. 3**). There are three digital protocols officially recognized with Scan|Transfer, three protocols that involve using Scan|Transfer as a ScanBody. In reality, there is also a fourth protocol for using it as a transfer for analog impression that can be digitized. But today, I would like to talk to you about the digital ScanBody protocols.

Protocol 1: CSS|Strategy

From the studies conducted by you, Mario Imburgia, and John Kois, we've learned that by connecting the scanbodies together, you can create a highway that is easily readable and consistently interpretable by intraoral scanners. These scanners, when they find extended areas of coherence and information, are able to maintain uninterrupted data acquisition. Fractures are like "Kintsugi," as the Japanese say, areas where two separate portions of the scan are joined and fused together. Scan|Transfer has the capability to guide the scan with bridge connections that are very close to the scanbody's head and are extremely easy to reconstruct in point clouds (**Fig. 4**). The basis of CSS|Strategy is to ensure continuity during the scanning process.





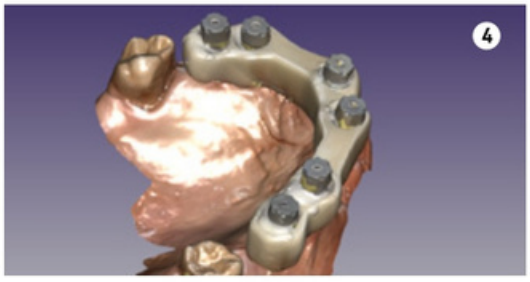


Fig. 2. Scan|Transfer
Fig. 3. Example of intraoral scanning with Scan|Transfer.
Fig. 4. Scan with stabilization of Scan|Transfer.

never breaking, a single stretch of data, a single, uninterrupted surface of triangles. This is the foundation of CSS|Strategy and its related protocol. The second protocol, on the other hand, is based on the concept of De|Bug. Debugging is that phase in software development or coding where you check if there are errors or inconsistencies in the lines of code, debugging. This is where the second Scan|Transfer protocol originates.

Protocol 2: De|Bug

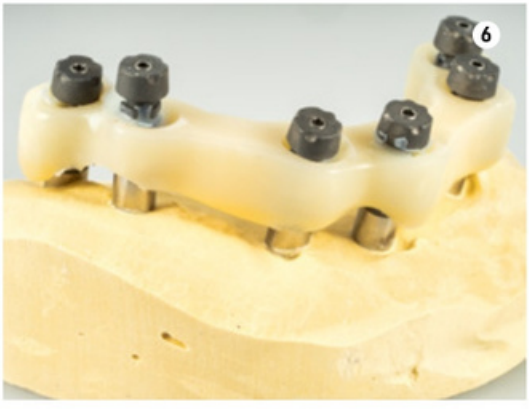
Experience in digital workflows leads us to pause and validate the intraoral scan before proceeding with the final work. This moment usually coincides with a preliminary project created in the lab and a metal try-in sent to the clinic for validation (**Fig. 5**). Depending on whether the try-in fits, doesn't fit, closes, or doesn't close, it may or may not be cut to bring back to the lab as proof of the validity of the first digital impression taken with an intraoral scanner.

Now, if we think about it, this is a waste of time for several reasons:

- If the try-in does not fit properly, and you have to proceed with cutting and subsequent placement in the mouth, you would have wasted time in the lab and the clinic, inconveniencing the patient to avoid arriving with an ill-fitting final product.
- Often, the try-in is milled or printed with less expensive materials than the final material, and sometimes they can give false positives, false authorizations to proceed. They may deform, be difficult to analyze through X-rays, or present partial coupling planes, potentially leading to confusion.

Starting a project without the certainty that the fundamental data is reliable creates uncertainty and frustration, in addition to likely wasting time in the lab, which will be added to the final product's time. More time is wasted in the clinic with a chair, a clinician, and an assistant trying everything on the patient. The De|Bug protocol allows you to anticipate and/or eliminate this phase. We leave our patient with the scanbodies locked together. The rigid and stable connections have allowed us to scan all the scanbodies present with extreme simplicity and security. If we remove the intact arch from the patient's mouth, we can create a plaster key, a position model with plaster analogs. This model allows us to repeat the scan in the lab with a benchtop scanner and/or validate the milled or bonded work on a "Master" support with the plaster model (**Fig. 6**).
Protocol 2, De|Bug, allows us to reuse analog validation procedures within digital workflows, providing great confidence and precision when moving towards a final product with minimal interruptions and changes in direction.

Fig. 5. Splinting of Scan|Transfer.
Fig. 6. Key/positioning model created through the splinting of Scan|Transfer.

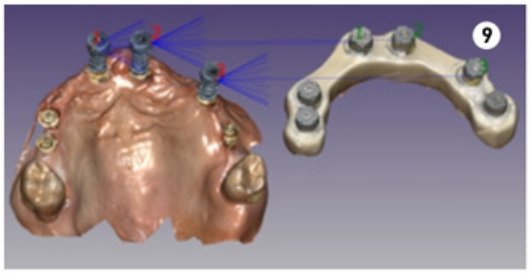


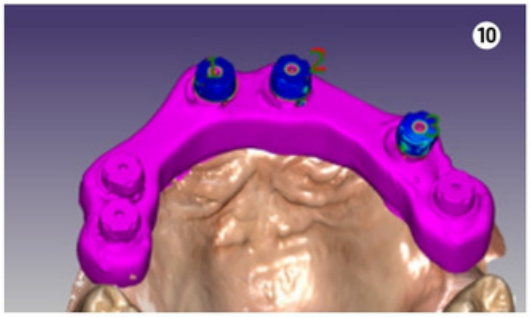
The third protocol linked to Scan|Transfer is based on the objective challenges that can arise when scanning posterior areas or mouths with limited access. Posterior sectors often have a reduced field of view, making scanning difficult and resulting in a higher distortion rate. Re|Scan addresses this issue.

Protocol 3: Re|Scan

Starting from the objective difficulty of the molar area in scanning scanbodies, we thought about how to avoid this complication. We prepared all the scanbodies to perform CSS|Strategy (protocol 1), meaning we connected the scanbodies in a stable, secure, and fixed manner. We created a solid bridge on which the scanner can run. This bridge allows us to remove all the locked scanbodies from the patient's mouth with extreme stability and certainty to perform De|Bug (protocol 2).
Now, follow me in the Re|Scan protocol, and let's use a bit of imagination.

Let's imagine having difficulty scanning the posterior sectors, so we decide not to acquire them during intraoral scanning. We proceed to capture the tissues and subsequently a partial arch in relation to the necessary soft peri-implant tissues to connect the partial scan with that of the tissues and intermaxillary relationships. Now, imagine removing the entire arch from the patient's mouth without detaching the scanbodies or deforming them (**Fig. 7, 8**). Imagine scanning the arch with the scanbodies on a bench, with the patient no longer in the chair but in a more comfortable and easier situation. Imagine merging the tissue scan with the partial arch scan and then merging the repeated scan outside the oral cavity with the partial scan taken on the patient (**Fig. 9**). Now, imagine retaining the tissue scan and the extraoral scan and discarding the partial scan. What have we achieved? A perfect scan in the correct relationship with soft tissues and antagonists (**Fig. 10, 11**). We have just used Protocol 3, Re|Scan.





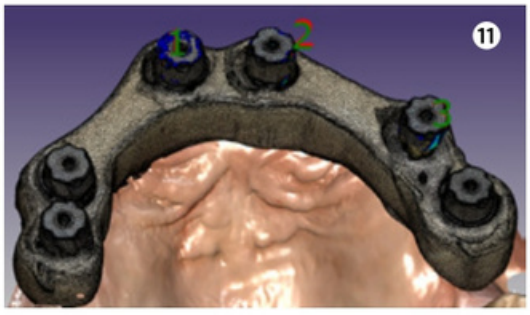


Fig. 7 Locking splint in PMMA ready to be secured with Scan|Transfer, with POM caps for protecting the scannable head of the component.
Fig. 8 Splint locked with Scan|Transfer and ready to be fully scanned by the clinician or laboratory.
Fig. 9, 10, 11 Scan management and protocol applications with Scan|Transfer.