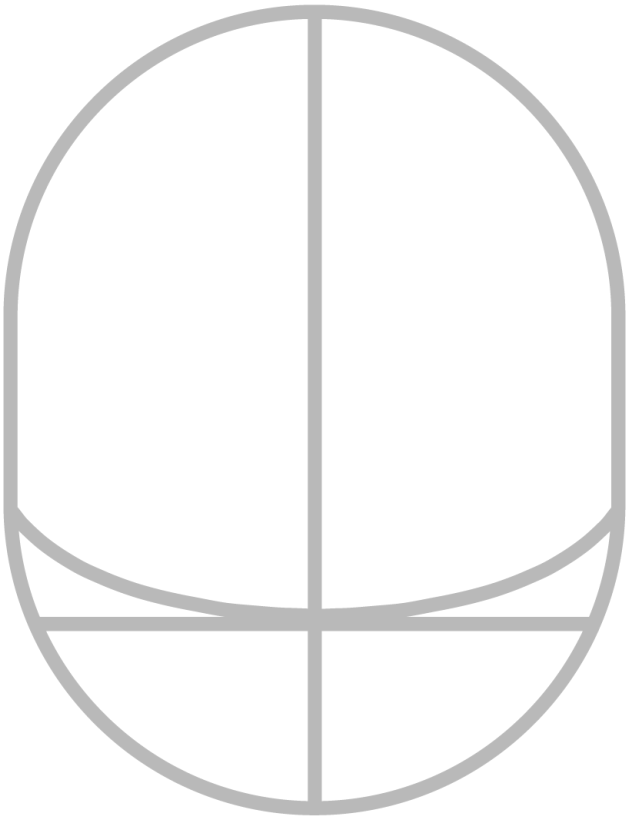

THE DIGITAL SMILE DESIGN CONCEPT

Documenting, Designing, and Communicating in Interdisciplinary Dentistry

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INTRODUCTION

The Future now!

The Digital Smile Design Concept (DSD) seeks to present to the world a new face of Dentistry, more human, emotional and artistic, but also more efficient and precise through digital technology, further enhancing our noble profession in society, because after all there are not many things in this life that are more important than a healthy, natural, confident and beautiful SMILE.

Digital Smile Design is a multi-use conceptual dental treatment planning tool that is used in interdisciplinary esthetic dentistry to strengthen diagnostic vision, improve communication/education and enhance predictability throughout the course of the treatment.

Nowadays having a mouth free of biological and functional problems is not sufficient for modern day dental patients. They desire to own beautiful smiles that are integrated with their physical characteristics but more so in harmony with their emotional aspects. Modern dentistry has evolved further to meet highly esthetic demands and expectations of the modern day patient. To achieve this, today's dentists need to go beyond their boundaries of traditional dentistry and acquire set of artistic/communication skills and vision to become “Smile Designers” and this is where DSD plays a pivotal role.

The development of the DSD concept started in 2007 and over the years has evolved markedly. Recently, it has already made its way in the global market of Esthetic Dentistry and thousands of dentists / dental technicians have been trained to use it across the globe.

Main goals of the DSD Concept:

1. Improving the Smile Design process and transforming the patient into a co-author of his/her own new smile. Utilising Morpho-Psychology

2. Developing a Communication protocol that facilitates real and daily Interdisciplinary Dentistry.

3. Increasing the perceived value of a dental treatment and consequently case acceptance through the Emotional Dentistry approach.

4. Integrating Technology to generate efficient and predictable clinical procedures. Making the final outcome more similar to the initial project presented to the patient.

The DSD workflow starts with specific videos of the patient that will allow the development of a “Facially Guided Smile Frame” that will suggest the ideal 3D position of the upper jaw (teeth and gingiva) according to lips and face in motion. This initial 2D frame will be translated into a interdisciplinary software platform that will connect the smile design project into function, digital orthodontics, orhtognathic software, guided surgery and CAD/CAM, allowing the team to use this digital tool to improve the decision making process during treatment planning and also develop all kinds of devices to perform the treatment according to this plan. Obviously that this process decreases drastically the amount of esthetic intra oral adjustments and also works as an amazing educational tool to improve the communication between dentists and patient.

The Concept also brought some paradigm shifts, changing the way we do traditional procedures as:

1. **Dynamic Dento-Facial Analysis**. The advantages of analysing the smile in Motion for better smile design and treatment planning decisions and patient communication.

2. **Taking photos of videos** (snap shots) instead of taking photos directly from the patient.

3. Simplified **documentation with smart phones**.

4. **Digital Ruler**. Simple tool to make measurements over photos utilising simple softwares as PowerPoint and/or Keynote.

5. **The 3 views of the facially guided Smile Frame**. Visualising the Esthetic Potential and developing a 3D understanding of the case by creating a simple 2D smile frame over 3 photos in specific angles of the patient.

6. **Online Asynchronous Communication** protocol. Combining popular softwares (slide presentation software + dropbox/cloud sharing + whatsapp/messaging app) to make the smile design, treatment planning and interdisciplinary communication possible on a daily basis.

7. **Buccal Wax-up** concept. Linking the facially guided smile design to the functional treatment plan. The dental brainstorm and negotiation between Esthetic, Function, Biology and Structure to generate the most simple and minimally invasive facially guided treatment plan.

8. 2D to 3D link and the **Digital Wax-up**. The concept of a Digital Wax-up software and the DSD Connect software to link 2D into 3D.

9. **Complete Digital Workflow**. Connecting the facially guided digital wax-up to 3D ortho, Guided surgery and CAD/CAM softwares. 100% digitally designed models, guides, appliances, components and restorations.

10. **Interdisciplinary Dental Software Platform**. One software for all specialties.

11. Natural looking **anterior monolithic CAD/CAM restoration**. Bringing natural morphology and texture to CAD/CAM systems. Creating natural morphology and texture without handmade wax-ups and/or layering.

12. **Digital Quality Control** Procedure after ortho, crown lengthening, direct composites, wax-ups and indirect restorations.

13. **Emotional Dentistry Approach**. Increasing the perceived value and case acceptance of the treatment through the motivational mock-up (test drive) and treatment plan presentation strategy.

I strongly believe that Digital Dentistry will help good dentists to do even better but will not save the ones that are still doing poor dentistry. The basic principles of high quality dentistry are still the same and professionals still have to invest on their career to become good professionals.

This technology will change our professional lives for better and will definitely help democratize esthetic dentistry.

WHY DSD?

Clinical information, study models and photographs have been used to establish a correct treatment plan for esthetic dentistry. Although these data provide relevant information for diagnosis, they do not offer all the information necessary for analysing the smile. Dento-labial parameters vary according to lip dynamic, therefore a posed smile differs from the smile in motion captured on video. This article describes documentation with smartphone videos to improve the analysis, smile design decisions and digital smile design process. The use of dynamic documentation of the smile allows esthetic rehabilitative planning from a facial perspective, improves communication with the patient and between the specialists and increases predictability of the treatments.

Oral rehabilitation and esthetic dentistry has always been faced with 3 great challenges: i) relate the face to the working models, ii) multidisciplinary communication and planning, iii) interaction with the patient. Drawing reference lines and forms on extra- and intra-oral photographs have been used to broaden the diagnostic view, and help the restorative team to evaluate esthetics, function and make correct clinical decisions.[1-3] Digital Smile Design (DSD) is a conceptual tool that allows esthetic rehabilitative planning from a facial perspective, improves communication between the specialists and increases predictability of the treatments.[1]

There are parameters that guide smile evaluation and design, such as the midline, height and curve of the smile, intra and interdental proportion, among others.[4-8] Although many studies have measured the static smile[9-13] it is always difficult to capture the ideal frame in a photograph.[14] As the beauty of a smile comes from motion and the dynamic integration of teeth, gingiva, lips and face, it doesn't make sense to make smile design and treatment planning decision only based on static photos. The perception of esthetics in motion is different than the static perception. Photography is a small piece of reality and can create illusions that sometimes transform pleasant in unpleasant and vice-versa. Each second of video footage covers approximately 30 frames, thereby increasing the chance of finding the spontaneous smile.

Dynamic evaluations with videos have been used in orthodontics for some years,[14-20] however few studies of the smile in motion have been conducted in esthetic dentistry. The aim of this study was to describe the smartphone video protocol making the photo documentation by taking snap shots of the video, and show the advantages of using video documentation for better facial analysis, smile design, team communication, treatment planning and patient education.

SMARTPHONE VIDEO PROTOCOL FOR DSD

8 videos (4 videos for the technical smile design process and 4 complementary videos)

It is important to highlight that making photos with DSLR cameras are still the golden standard when the goal is to fabricate beautiful documentation for lectures and publications. When it comes to image quality, smartphone images are not as good as DSLR cameras but are good enough to perform ideal smile design, treatment planning and to be utilized on the digital workflow allowing the team to deliver high end dentistry on a daily basis.

The key to generate acceptable quality videos with a smartphone is to have intense light coming from LED panels (fig. 1). When filming with the smartphone one has to make sure ideal framing and zoom are adjusted to the face and ideal exposure and focus adjusted to the mouth (fig. 2). A monopod and a smartphone holder are used to stabilize the phone and a glove box is placed behind the patient to avoid head movement (fig. 3).

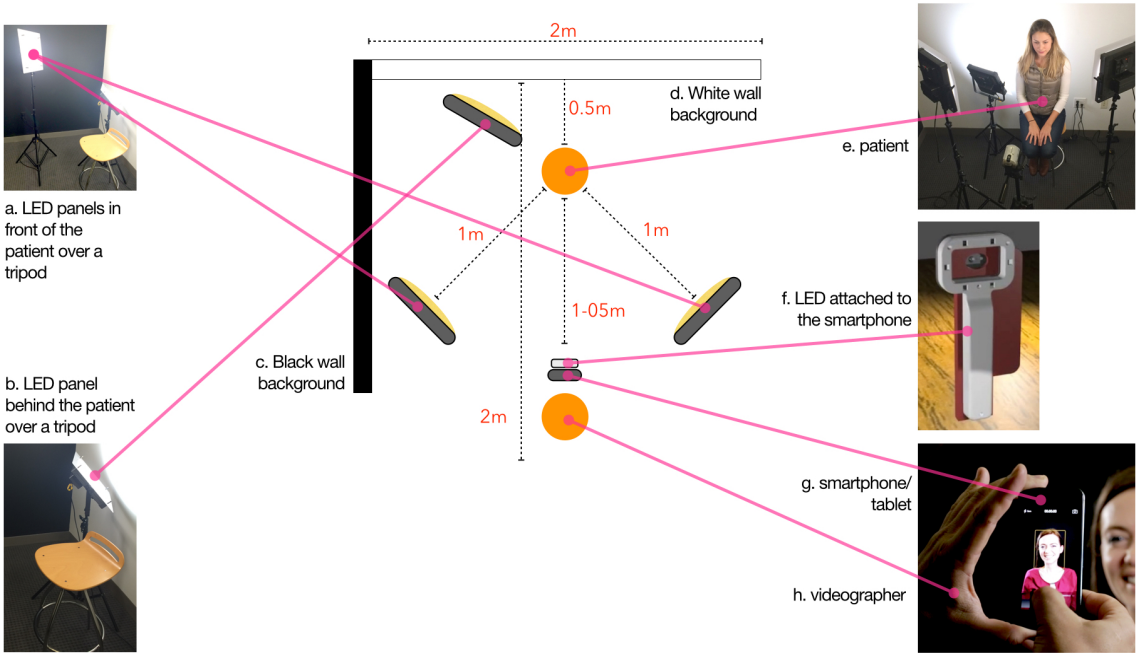

Figure 1: Suggested studio for smartphone videos: a) 2 LED panels in front of the patient will generate the ideal light to create videos with enough quality. b) an extra LED panel placed on the back when using white background to remove the shadows. c and d) a room with a black and white walls used for background. e) patient approximately half meter away from the wall. f) extra LED light attached to the phone to reduce the intra oral shadows in the close up images. g and h) a smartphone or tablet used to film the patient. The device shouldn't be too close to the patient to avoid big distortions.

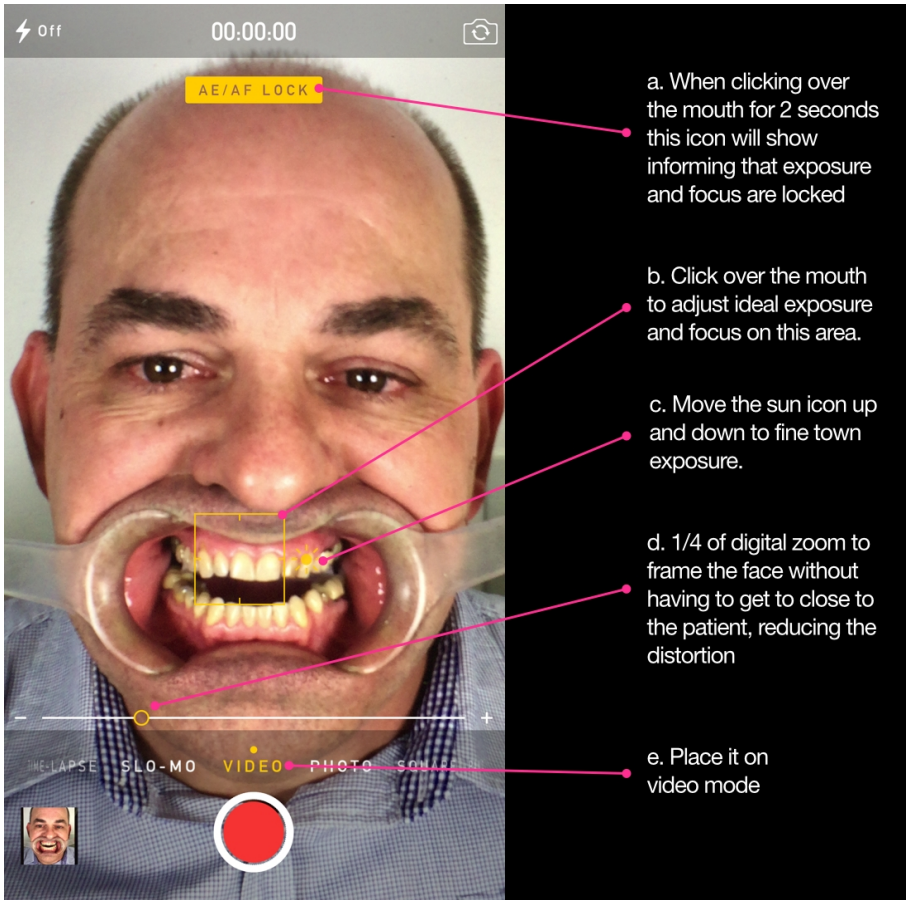

Figure 2: Adjusting the smartphone

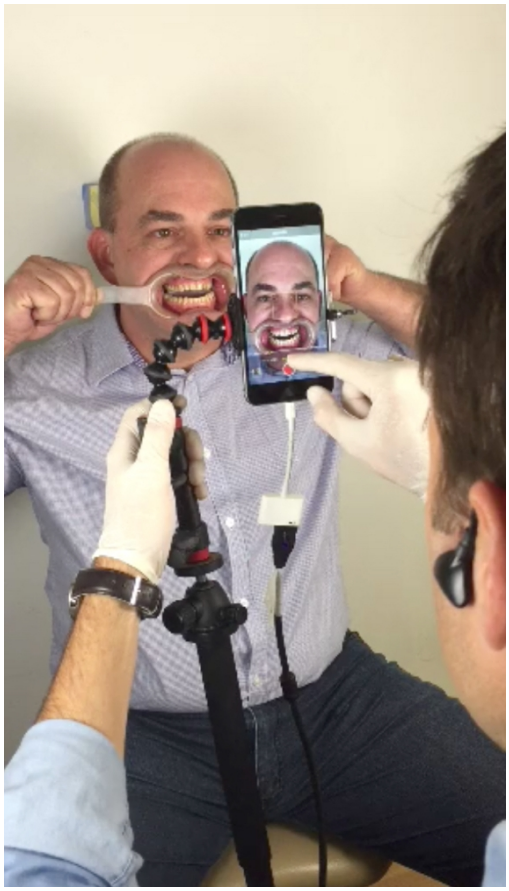

Figure 3: Stabilization of the smartphone and the patient's head

Four technical videos for developing the facially guided smile frame:

1. Facial frontal video: with retractor and without retractor smiling (fig. 4). The key is to keep the camera and patient's head still so one can create photos with and without retractor with similar, distances, angles and distortions so both images can be overlapped on the DSD process linking the facial analysis into the intra oral analysis. The camera should be levelled with the eyes. That means that the camera will be slightly above the mouth creating a natural smile curve. Smartphone lenses are not macro, so a bigger distortion will happen, the closer you get to the patient the bigger the distortion of the image. To minimize this distortion, it's better to keep one meter distance and slightly zoom in digitally. Both frontal videos should have the teeth apart for better visualization of the esthetic issues, visualization of lower teeth, visualization of drawings and simulation. To keep the teeth apart similar on both photos, the patient should bite a jig on the molar area, made of silicone or the disposable flexible plastic suction.

2. Facial profile video (fig. 5): lips at rest and wide "E" smile. The key is to have a total profile view and the reference should be the filtrum.

3. 12 o'clock video (fig. 6): from the top of the head with the most coronal angle possible that allows one to visualize the incisal edge of the 6 anterior upper teeth with the patient retracting the upper lip with both thumbs. This image should show the relationship between the facial midline, inter-pupilar line, comissural line, Angles of the mandibule, mentum, arch form and vermilion of the lower lip.

4. Anterior occlusal (fig. 7): film without a mirror and perpendicular to the occlusal plan. The goal is to capture from bicuspid to bicuspid having the palatine rafe as straight line.

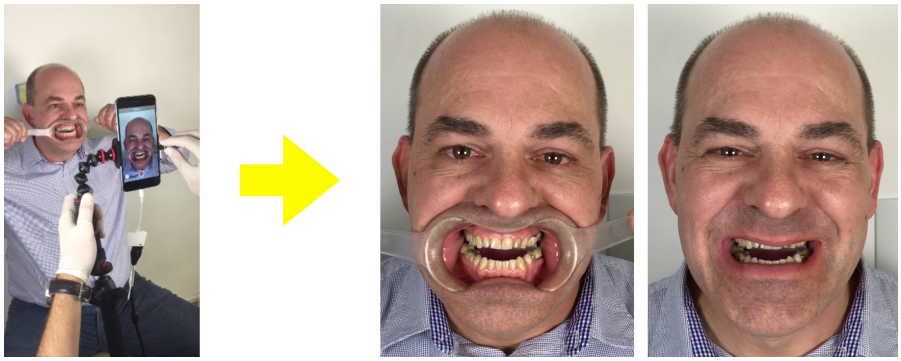

Figure 4: Facial frontal video

Figure 5: Facial profile video

Figure 6: 12 o'clock video

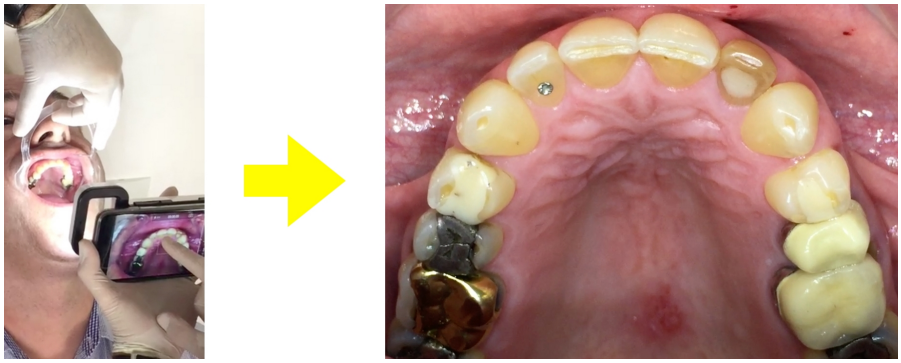

Figure 7: Anterior occlusal

Four complementary videos for facial, phonetics, functional and structural analysis (fig. 8 a, b, c, d):

5. Facial interview (fig. 8a): a short interview of the patient with basic questions can give important information about the patients desires, complains and main reasons for looking after a dental treatment. This information is vital for the dental team to develop a strategy of communication to the patient and increase the patient's confidence on the team. Four questions that we make: Why you are looking for dental treatment? What do you like and what you don't like on your smile? What are your expectations? What do you understand as an ideal smile?

6. Close up 180º phonetics (fig. 8b): the patient will count from zero to ten, pronounce the important phonetic sounds (F, V, S), give a regular smile and a stretched "E" smile. As the smile design process is also related to the speech process, dentists should include the phonetic analysis when designing new smiles. If better speech findings are necessary the video can be easily sent to a speech therapist for further analysis.

7. Intra oral functional (fig. 8c): film with retractor and ask the patient to perform the functional excursive movements (protrusion and lateral movements) and film both sides, working and non-working. By asking the patient to chew and do the functional excursive movements' one can understand their pattern of mastication movements, their occlusion type and possible interferences that are very difficult to capture on photos.

8. Intra oral structural (fig. 8d): film with retractor the occlusal surfaces of the upper and then lower arch.

Figure 8: Complementary videos: a) facial interview. b) close up 180º phonetics. c) intra oral functional. d) intra oral structural

In dentistry is very important to analyze specific moments of facial expression to understand the dentofacial disharmonies and make clinical decisions, for example, the lip rest position, the height of the smile line, the shapes of the lips, the integration of facial and dental midline, lip support, soft tissue display, buccal corridor, facial profile, etc. All these analysis can be distorted if we only look at photos. When things are moving, we change our perception and what may look good or bad in a static photo may seem the opposite when moving. A common problem for the digital smile design is that the photos are taken on the wrong angle and cannot be used ideally for the process, whereas the video can capture the specific view with slightly different angles and can be transformed into photos by pausing the video and making a print screen of the right angle. This simplifies the documentation process and save time. Also removes the responsibility of the photographer to snap the photo at the perfect moment allowing one to pick the best moment afterwards with more time. The facial analysis through video should guide the smile design process that will be done over static images in 2D and 3D.

DIGITAL SMILE DESIGN TECHNIQUE

The main goal of the DSD technique on the computer is to adjust the photos from the 3 main views of DSD (12 o'clock, frontal and occlusal) (fig. 9) with each other, assisted by the digital ruler, and to add the lines and drawings that will create the Smile Frame, always based on the video analysis. This frame is a useful extra information that together with the conventional documentation of the patient (x-rays, models, medical history, clinical exam, perio-chart, etc) helps for a better decision making process, interdisciplinary interaction and treatment planning development by guiding an interdisciplinary dental brainstorm among the team allowing all the equalize their vision and synchronize their communication. The frame is not a definitive rule that needs to be matched at any costs, because beauty doesn't mean perfect symmetry. The idea is to develop a treatment that gets as close as possible to the frame always creating the most simple, easiest and conservative treatment possible. By analyzing the video we should place the lines over the photos. This process should be performed on the slide and it is organized in 8 steps.

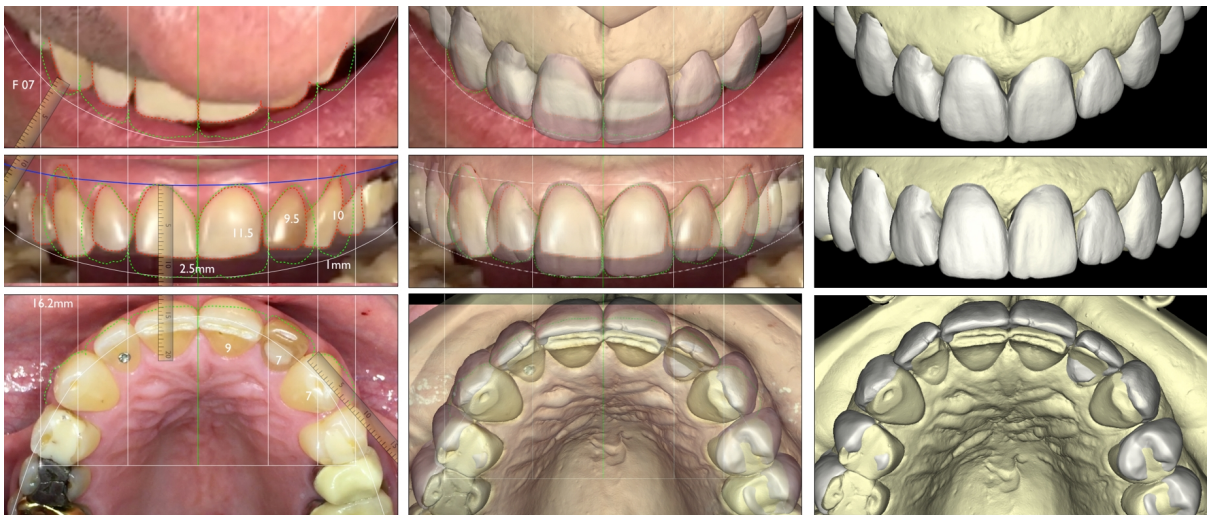

Figure 9: The 2D/3D digital workflow. The Facially Guided Smile Frame is based on the 3 views of DSD: frontal, occlusal and 12 o'clock

Creating the Facially Guided Smile Frame in 8 steps:

i) step 1- The digital face-bow. Midline and horizontal reference: The facial midline not always matches the dental midline. The idea is to find if we have a dental midline shift and/or cant and make the decision about what position we want to take in consideration to start the smile design process (fig. 10). Discrepancies between dental and facial midline 2 to 3 mm were generally not noticed in a study that observed images limited to the perspective of the smile.[21] However when full-facial images were analyzed, a minor dental midline shift such as 1 mm could be visibly perceptible in asymmetric faces depending on the direction of the shift, and it could be concluded that extraoral facial structures such as the nose and chin can have an impact on the perception of dental midline shift.[22]

ii) step 2- Smile curve: The smile curve position and shape will also depend on the facial and lips dynamic analysis through the video. The video is paused in several moment and 3 photos can be made: real rest position photo, natural smile photo and angled smile photo. In the first photo we should analyze the relationship between upper lip and incisal anterior upper edge; in the second one we should analyze the buccal corridors relationship with the cheeks and determine if we should change them by widening or narrowing the arch and in the angled smile photo we should analyze the length of the posteriors in relationship with the lower lip to see if they should be longer or shorter, that means a smile curve that is more steep or flat (fig. 11).

iii) step 3- Interdental width proportion: we recommend the RED (Reccurring Esthetic Dental) proportion[10] to determine the ideal width from the frontal perspective of the centrals, laterals and canines instead of the Golden Proportion. This proportions says that from a frontal view, if the centrals are “x”, the laterals should be “0.7x” and canines “0.5x” (fig. 12). Facial references, as inner part of the eyes, wings of the nose and/or commissurals at rest, can be utilized to help determine the outer side of this ruler that means the distal of the canines. This ruler can also be adapted to any tooth that seems to be in a harmonious position with the face and have the other lines suggest the width of the remaining anterior teeth.

iv) step 4- Central incisor width/length proportion: The ideal central incisor proportion should be around 80%.[23] We usually work with the limits of 70 to 90%. Since we already have the incisal edge position and the width, by working with the central template we will be able to analyze the relationship of the gingival margin to the other parameters (fig. 13).

v) step 5- Gingival curve: It must also be determined with the help of the video analysis. The gingival curve should be placed over the cervical of the proposed new central and the inclination of the curve towards the posteriors will be determined to create a nice and realistic relationship between the curve and the upper lip according to the posterior gingival display (fig. 14).

vi) step 6- Papillae curve: This papillae curve should be slightly closer to the gingival curve, because the height of the papillae is usually 40% of the height of the crown.[24] (fig. 15)

vii) step 7- Vermillion curve: After adjusting the image to the guidelines we can zoom in and analyze the relationship between the teeth, arch curve and the vermilion curve in the 12 o`clock view that will help determining the ideal buccal-palatal position of each anterior upper tooth (fig. 16).

viii) step 8- Arch curve: By integrating the analysis of the occlusal photo with the facial frontal video we can understand if the arch is too narrow or too wide in relationship with the face. This view is also key to analyze space distribution and plan cases with crowding or diastema and also check spacing for implants. The curve will then be placed over the occlusal view to translate this observation and also to analyze the symmetry of the arch. Also from the occlusal view we will overlap the interdental proportion guide to evaluate the space distribution (fig. 17).

Figure 10: The digital face-bow

Figure 11: Smile curve

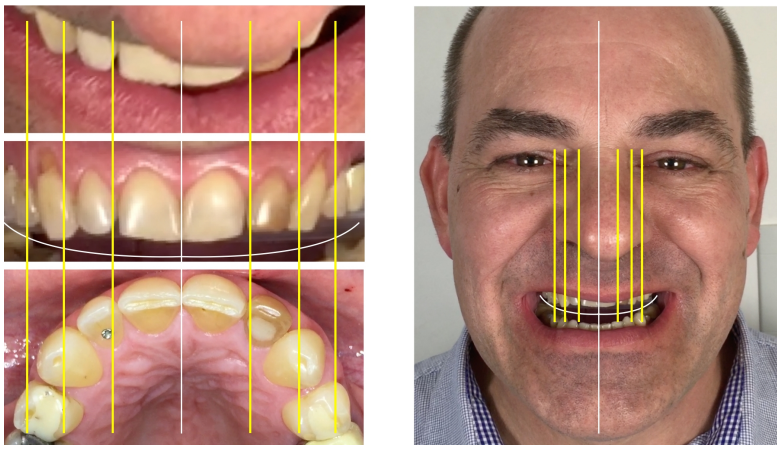

Figure 12: Interdental width proportion

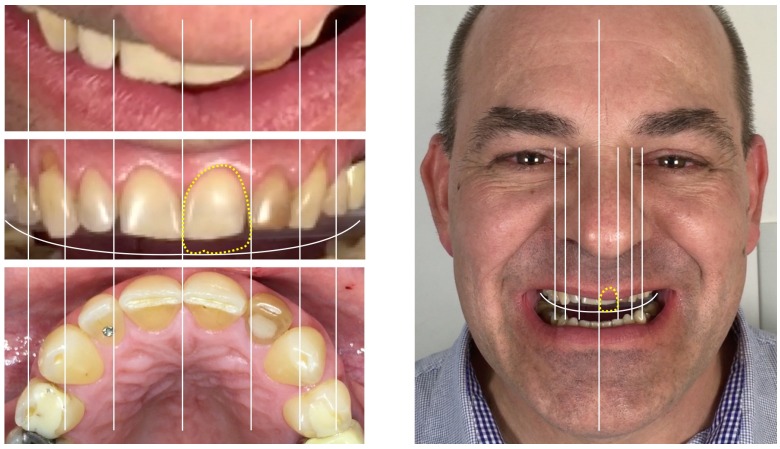

Figure 13: Central incisor width/length proportion

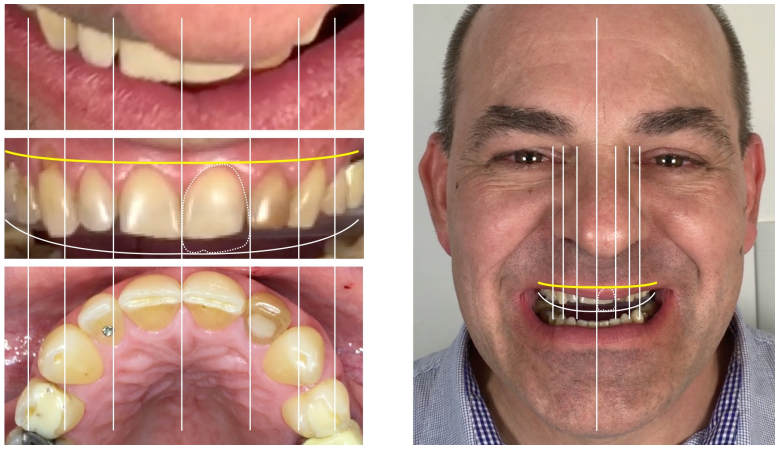

Figure 14: Gingival curve

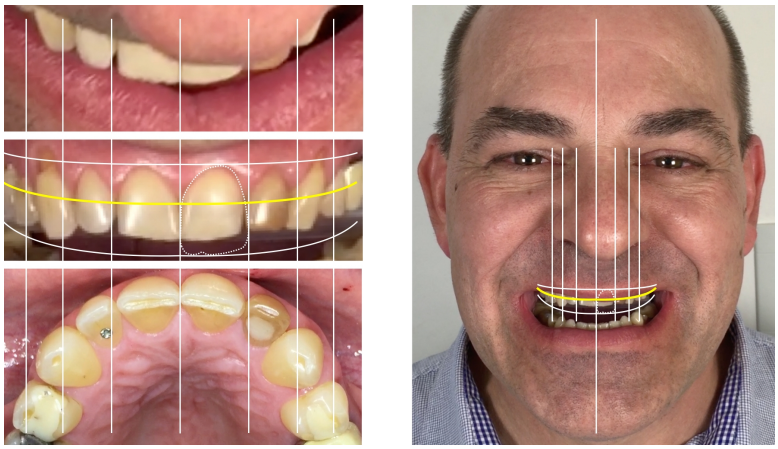

Figure 15: Papillae curve

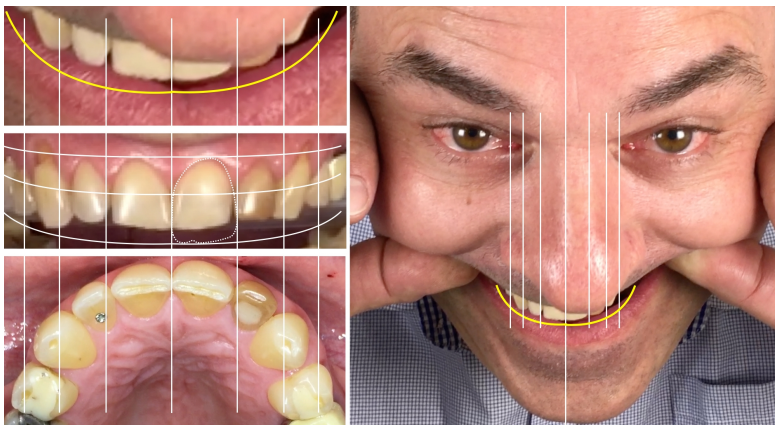

Figure 16: Vermillion curve

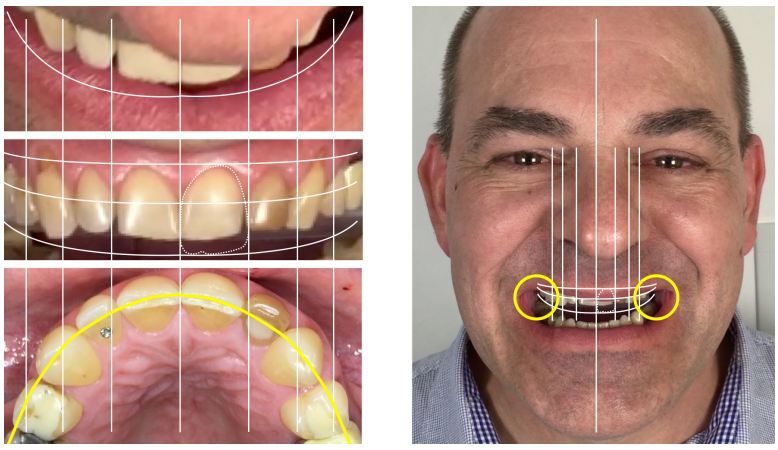

Figure 17: Arch curve

Team communication

Sharing the patients' video and smile frame slide presentation with the specialists that will probably be involved with the cases allows the whole team to know better the patient even who was not there at the first appointment with the patient. By using slide presentation software programs, combined with cloud sharing and group messaging apps, all professionals involved in the case may have access to the information, each in his/her own non simultaneous time, and communicate effectively online (online asynchronous communication) (fig. 18). With this protocol one can overcome two of the main challenges of interdisciplinary dentistry: lack of time to communicate properly at the right moment and lack of common vision among the interdisciplinary team regarding the final ideal outcome of the case. Sending a video of the first interview of the patient to the technician is also very helpful and will allow the technician to realize some emotional nuances that will be important to the process of designing the smile of the patient.

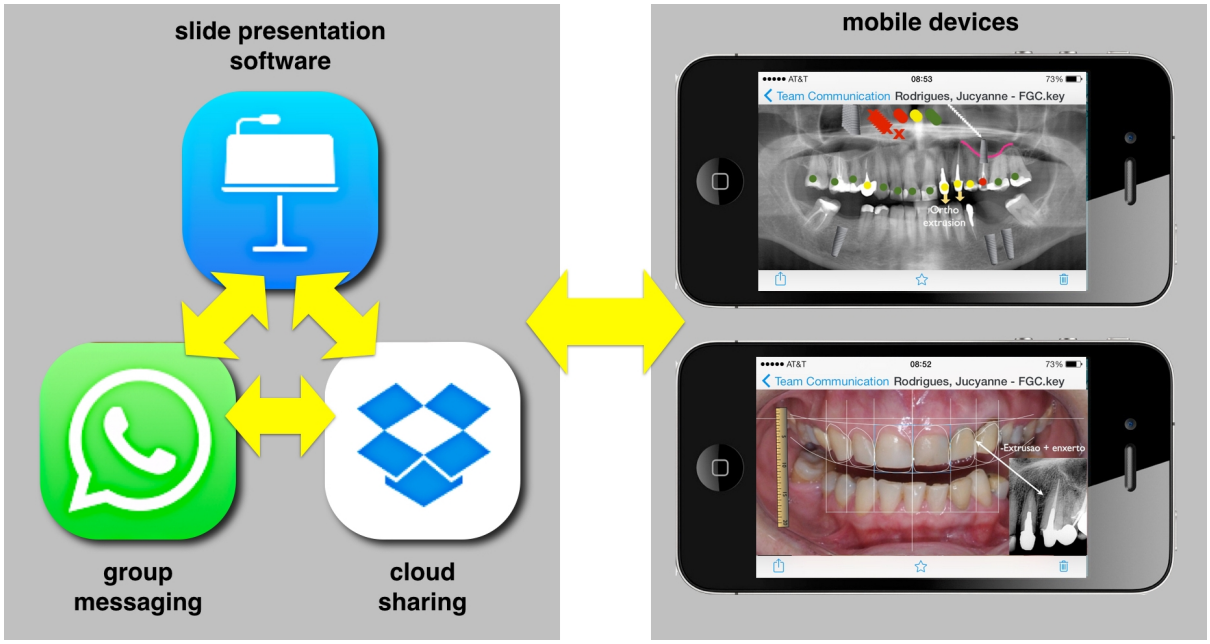

Figure 18: Online asynchronous communication

Esthetic buccal wax-up. Linking the 2D digital design into the 3D analogue wax-up.

The 2D smile frame can be translated into a 3D project, either analogue (conventional wax-up) or digital (3D digital software). When working with an analogue wax-up, the 2D project will be translated to the working model by utilizing the digital ruler on the computer and a real caliper over the model (fig. 19 a-f).

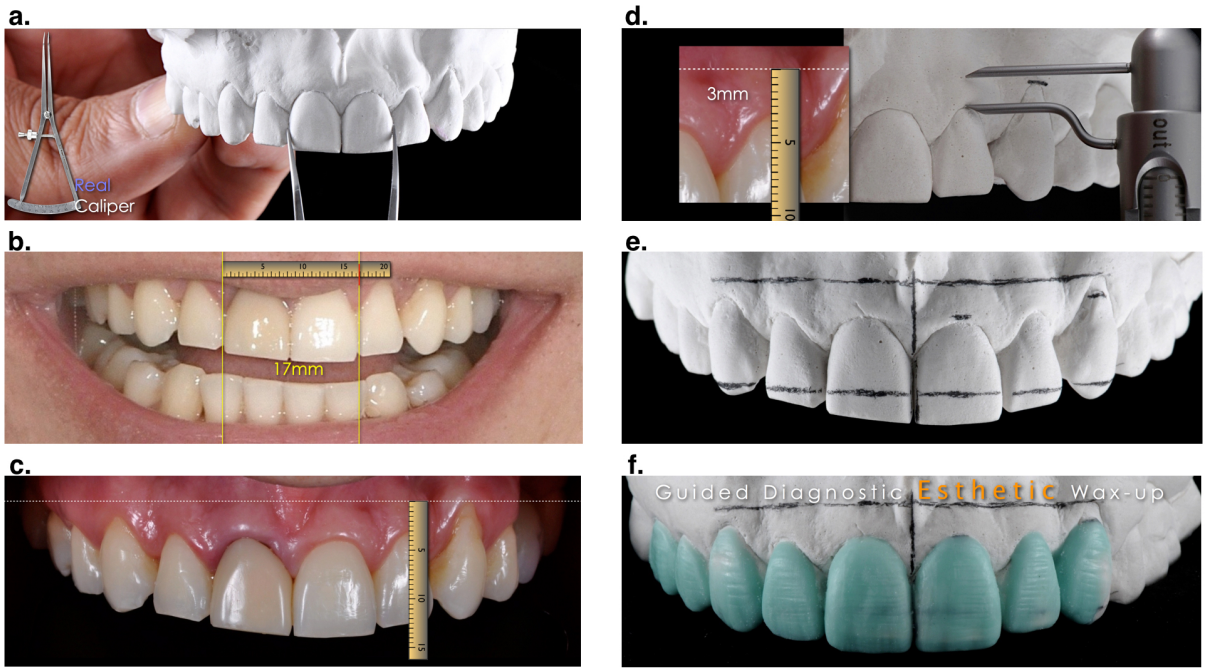

Figure 19: Esthetic buccal wax-up. a) obtaining a real reference measurement with the caliper on the working model, usually from distal to distal of the upper central incisors. b) calibrating the digital ruler to the reference measurement over the photo in the slide presentation software. c) measuring the distance between the facial horizontal plan and the gingival margins. d) translating the digital measurements to the working model using the caliper. e) drawing the reference lines that will help translate the facially driven 2D digital project to the buccal upper wax-up. f) the finished facially guided buccal wax-up ready to be replaced in the articulator for the functional treatment planning.

The buccal wax-up has the advantage of generating a more precise mockup, as it does not cover the occlusal region, facilitating adaptation in the mouth. It allows visualization of the remaining occlusal region in posterior teeth and the difference in overjet and overbite in comparison with the actual situation in the anterior teeth (fig. 20).

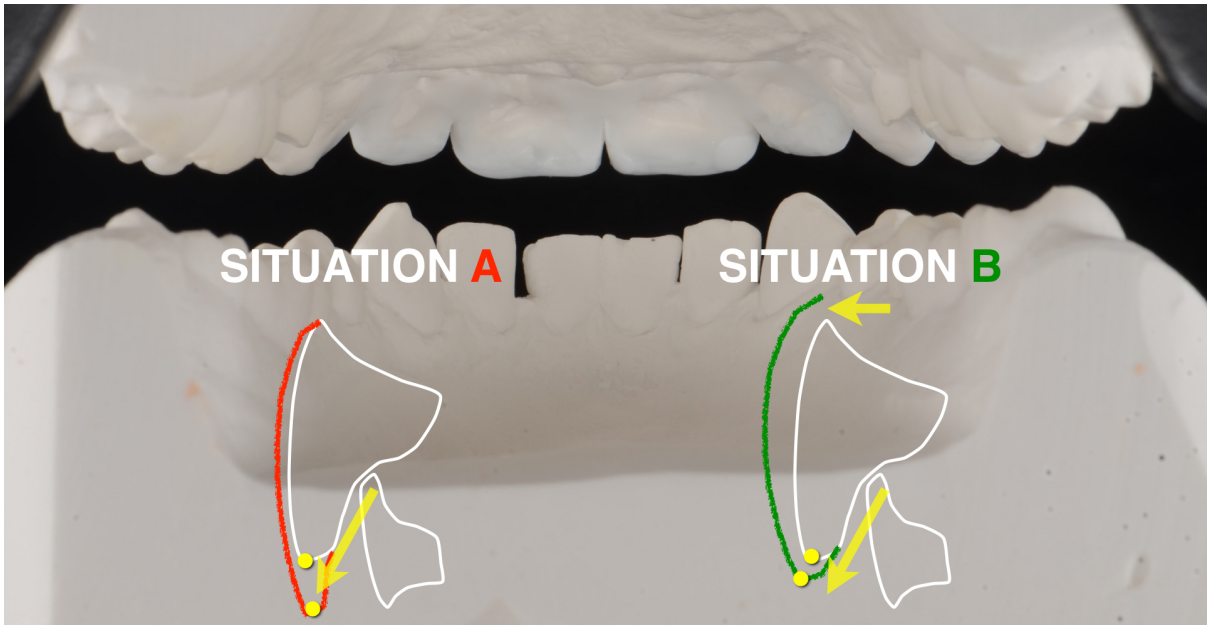

Figure 20: Situation A- crown lengthening in the incisal direction altering anterior guide. Situation B- crown lengthening in the gingival direction without altering anterior guide.

After finished, the buccal wax-up is placed back in the articulator to allow for the functional treatment planning process to start. Since there is no wax over the palatal and occlusal surface of the upper neither wax on the lower arch, one can visualize clearly the relationship between the new facially driven buccal design and the existing occlusion. The goal is to find a solution that can integrate the new design into the ideal functional project in the most minimally invasive way.

Motivational mock up and Smile Design presentation

People are not used to see themselves in videos so every time we see ourselves in videos this will catch more our attention. Showing videos for the patient of themselves smiling is a very efficient way to create awareness of problems and possible solutions.

Creating an emotional link between the patient and the possible treatment before discussing the technical and financial issues involved on this treatment are key factor to increase the educational and motivational process and increase case

acceptance (fig. 21). Showing videos of the motivational mock-up is the easiest and most simple way for daily smile design communication.

Figure 21: Motivational mock up

Digital wax-up. The 2D to 3D Digital link

The facial reference must also guide the digital 3D design. Therefore, the 2D smile frame project should be linked to 3D software programs. By utilizing the 2D/3D Connect concept software (Hack dentistry, Bucareste/Romenia) one can overlap and calibrate 2D images over well known 3D software programs (figs. 22-23). Utilizing software that already has the 2D/3D concept imbedded is also an option to develop the 3D smile design project following the facially generated 2D smile frame (NemoDSD 2D/3D, Nemotec, Madrid, Spain) (fig. 24).

Regardless of the type of 2D and 3D software utilized, the final 3D file (STL) will be exported to a printing machine to generate the physical model of the new design. This model can be utilized to fabricate matrix for mock-up, provisional and also guides for tooth preparation, crown lengthening and implant placement (fig. 25).

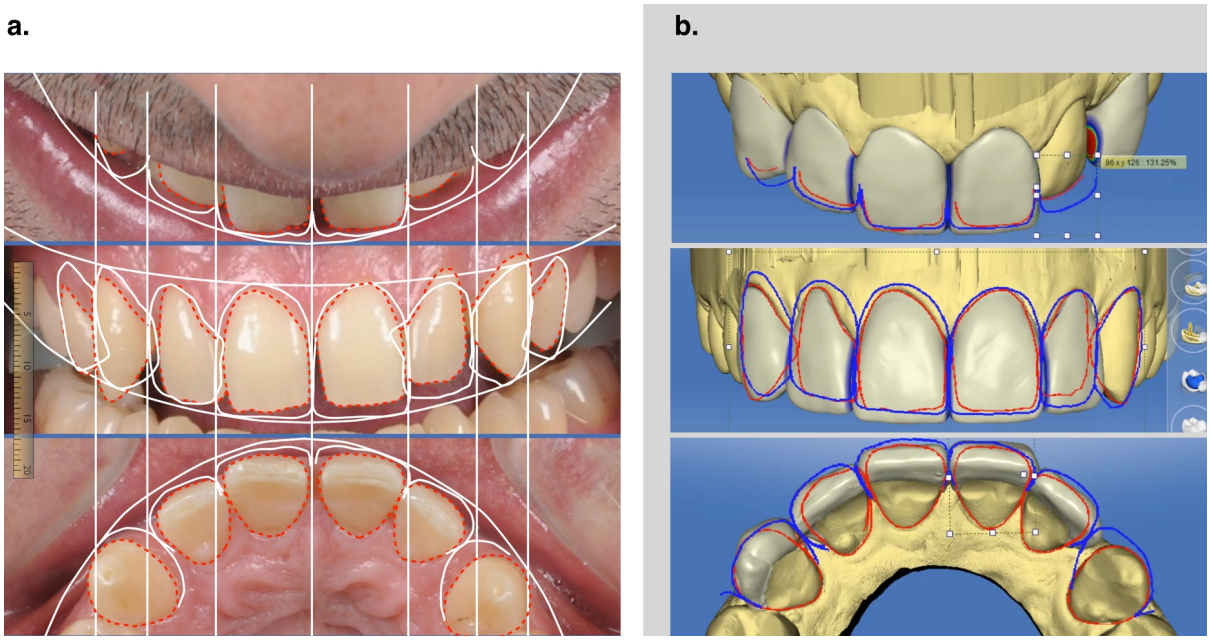

Figure 22: a) the smile frame developed on 2D software. b) the smile frame overlapped and calibrated to the 3D CAD/CAM software (Cerec, Sirona, Bensheim, Germany) guiding the shopping and arrangement of the 3D design

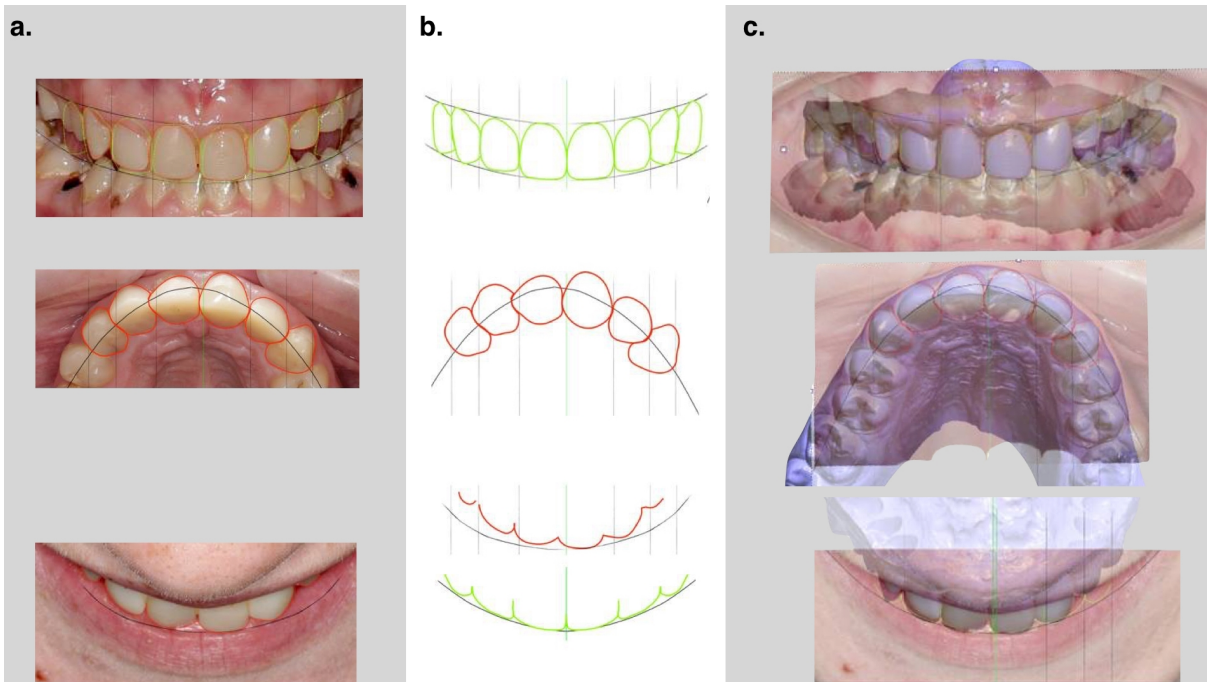

Figure 23: a) the smile frame. b) the smile frame without the images. c) the smile frame overlapped and calibrated to the 3D CAD/CAM software (3Shape, Copenhagen, Denmark)

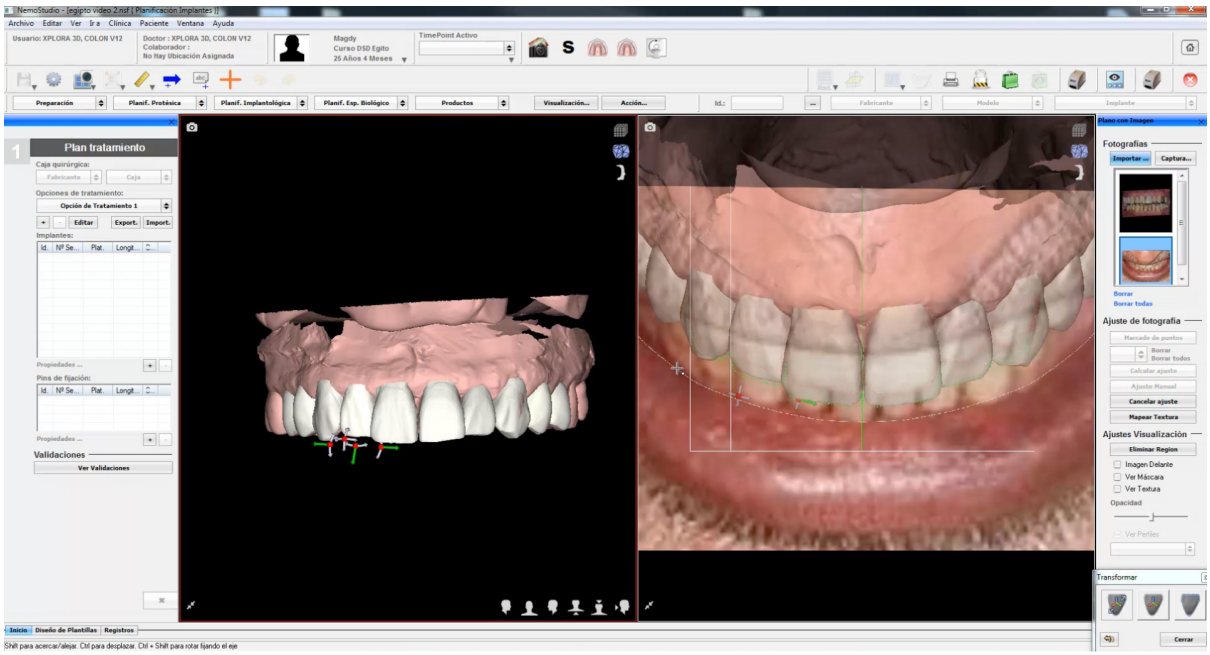

Figure 24: 3D smile design project in the software NemoDSD 2D/3D

Figure 25: Printed models and vacuum tray

The Smile Frame and Orthodontics

The same Connect software program can also be used to be overlapped to Orthodontic softwares as Invisalign (Align Technology Inc, San Jose, USA) and OrthoAnalyzer (3Shape, Copenhagen, Denmark) to guide the ortho digital setup (figs. 26-27). The smile frame can also be integrated to orthodontic digital planning by utilizing software that already has the 2D/3D link embedded as NemoDSD Ortho (fig. 28).

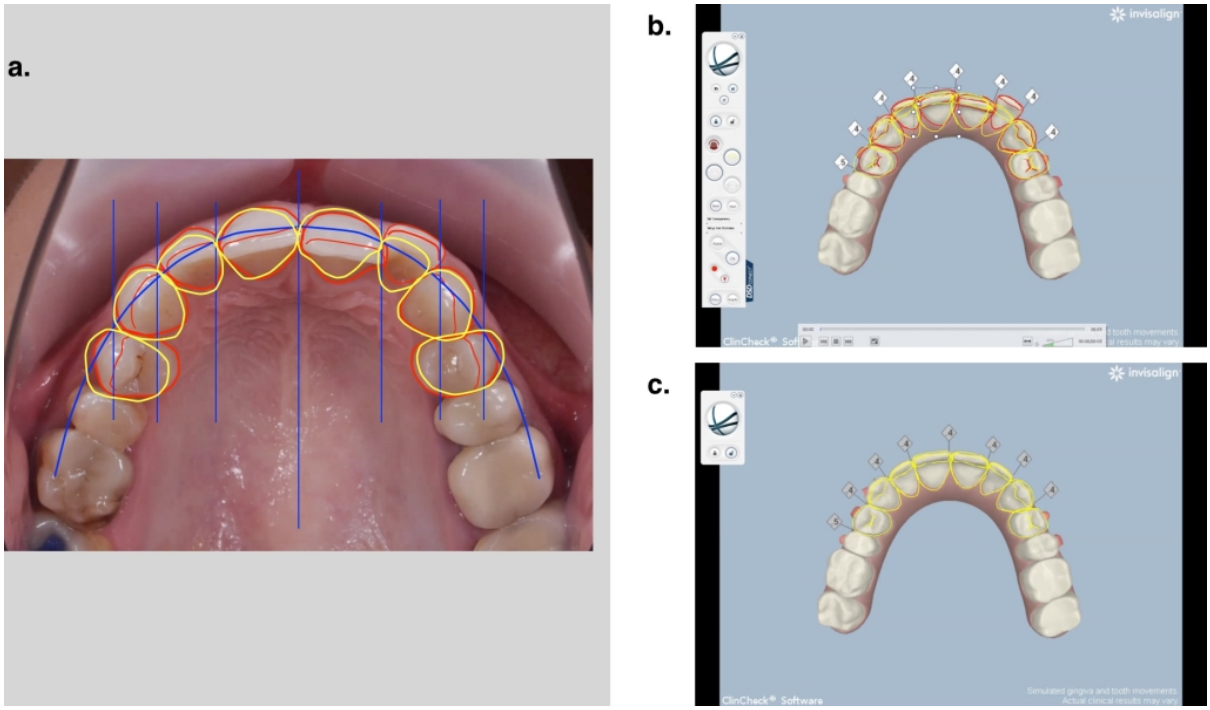

Figure 26: a) the occlusal smile frame with the drawings suggesting the orthodontic movements (yellow). b) Invisalign ClinCheck software overlapped by the smile frame. c) after the virtual orthodontic movement, matching the smile frame

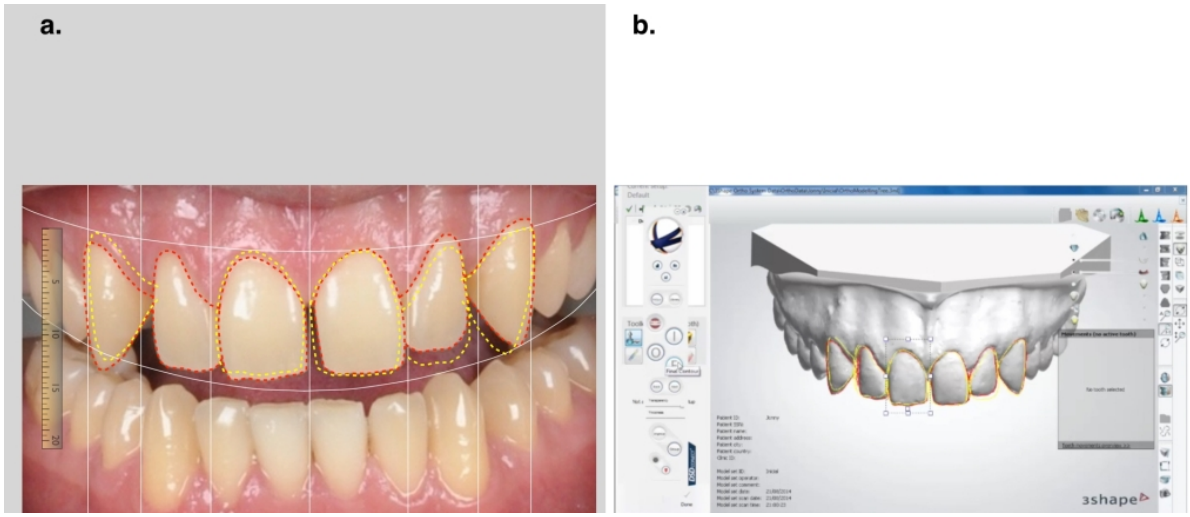

Figure 27: a) the frontal smile frame suggesting orthodontic movements (yellow). b) the 3D model calibrated to the smile frame ready to start the virtual setup procedure

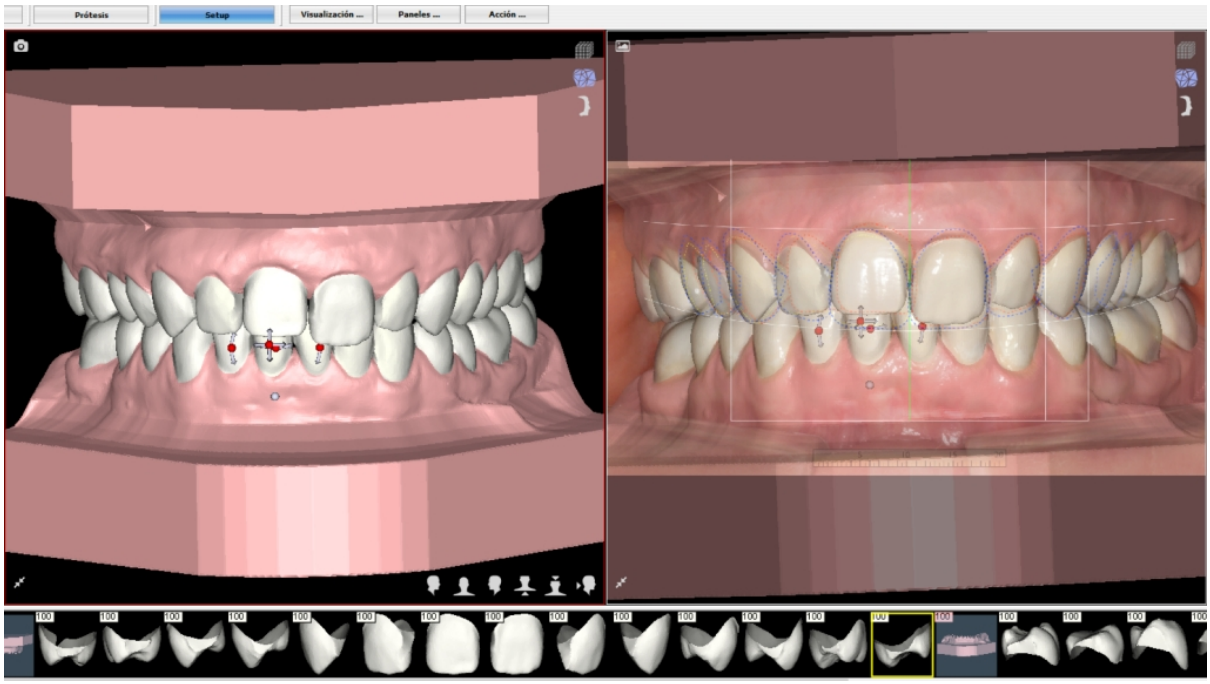

Figure 28: Digital Ortho (NemoCast/DSD software, Nemotec) with the smile frame integrated

The Smile Frame and Implants

The smile frame can be overlapped to CBCT files and guided surgery software programs. One can superimpose the smile frame over a CBCT file using the Connect software program (fig. 29), or be automatically integrated to implant software programs that have the smile frame feature (NemoDSD Guided Surgery) (fig. 30). The guided surgery software integrated to the Smile design software allows the implant planning related to the facially guided 3D design (digital wax-up).

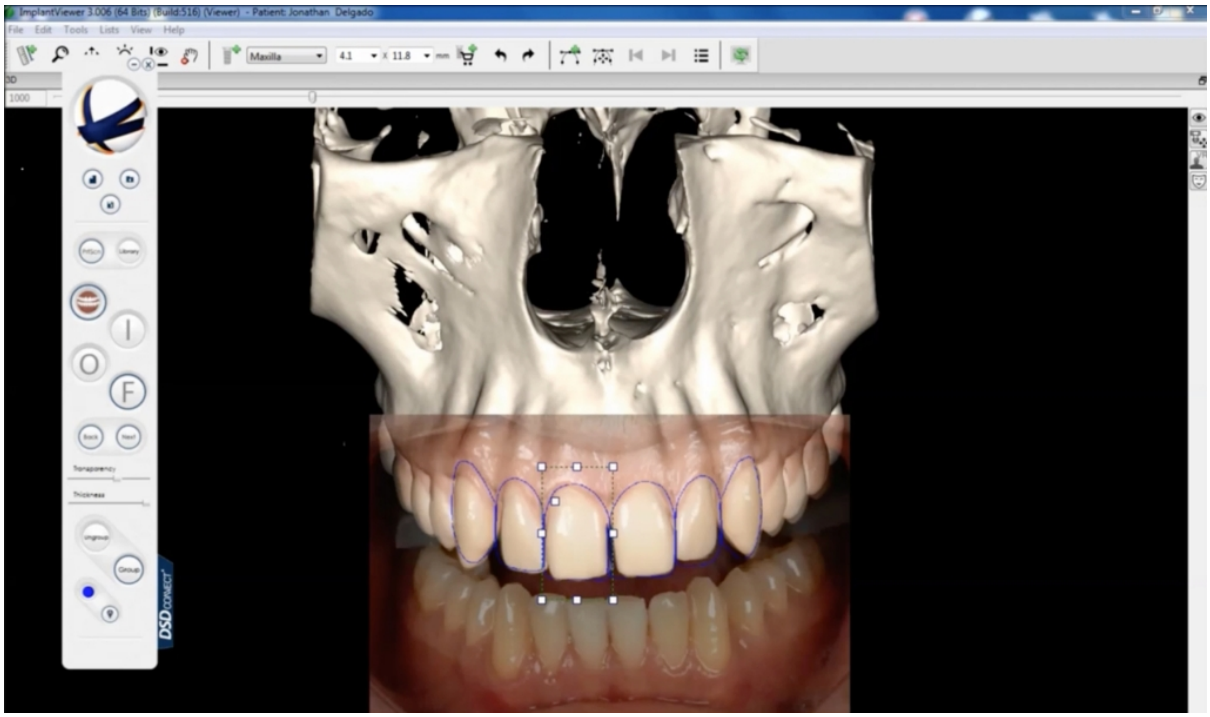

Figure 29: CBCT file and smile frame superimposition using the Connect software program

The Smile Frame and Crown lengthening

The crown lengthen procedure can also be digitally planned (fig. 31). The 3D design guided by the smile frame will be printed and then a vacuum tray will be fabricated showing the exact new position of bone and soft tissue (fig. 32).

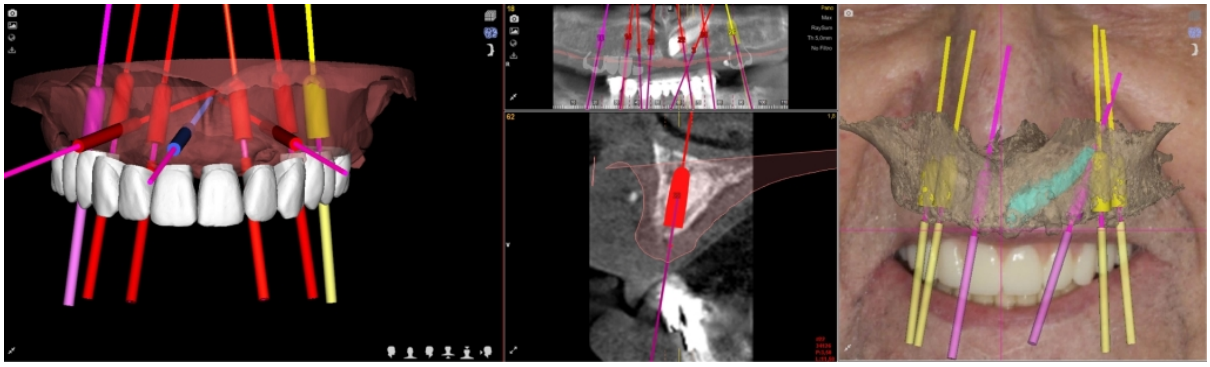

Figure 30: Smile frame, 3D scan model and CBCT superimposed in the Nemo DSD Guided Surgery software.

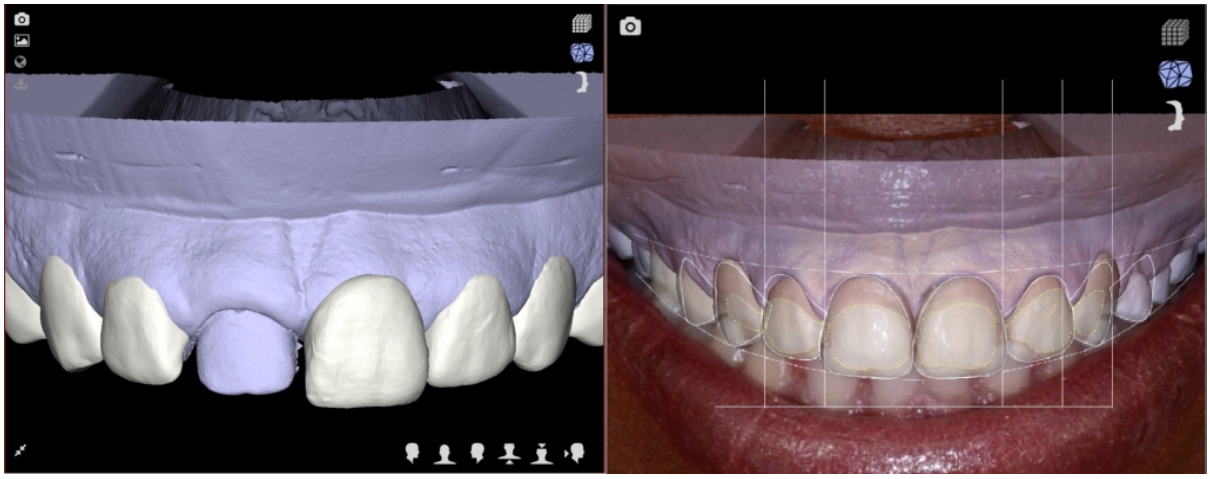

Figure 31: Overlapping the 2D smile frame of the 3D model to plan the crown lengthening procedure (NemoDSD 3D software).

Figure 32: The crown lengthening guide designed to control the bone and soft tissue reduction based on the 3D digital design

The Smile Design and Orthognathic

In cases where restorative dentistry will be integrated to Orthognathic surgery it is very important to integrate the smile frame and the 3D digital design of the restorations into the orthognathic software (fig. 33).

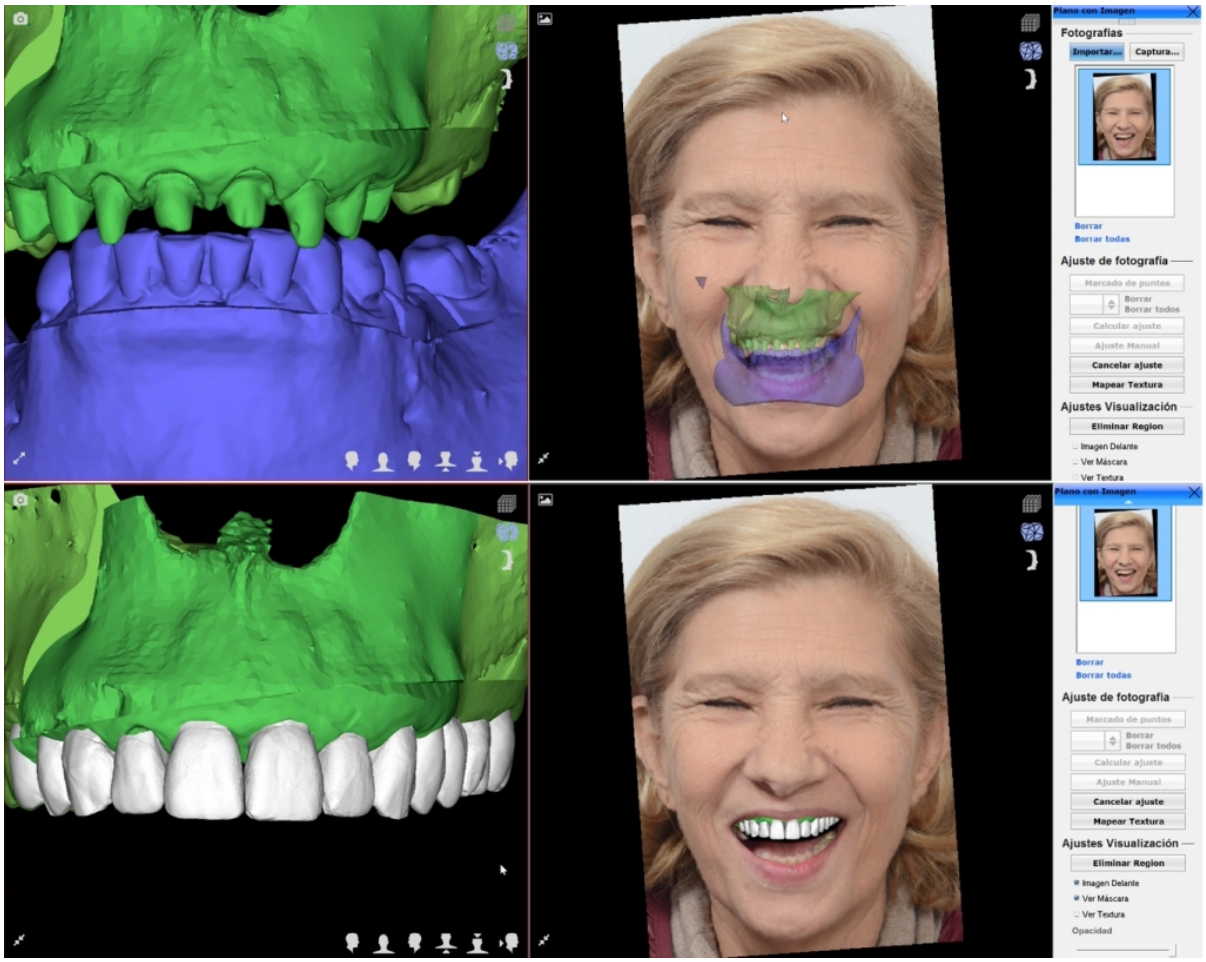

Figure 33: The Orthognathic NemoCeph software integrated to the smile design software

The Smile Design and Function

The upper facially guided smile design can be placed in the digital articulator to check the relationship between the new design and the actual occlusal situation. Adjusting the esthetics to achieve ideal function is the goal Most of the CAD/CAM softwares present a virtual articulator that works as a semi-adjustable articulator allowing for the adjustment of maximum intercuspal contacts, protrusion and lateral movements (fig. 34).

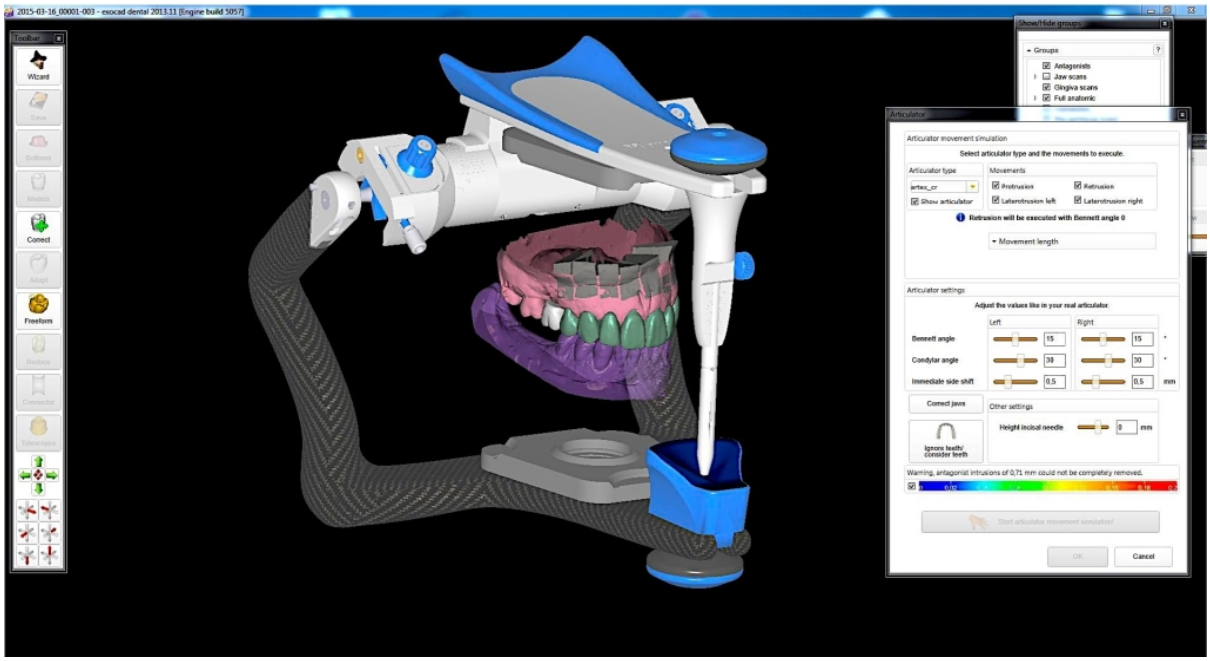

Figure 34: Facially guided smile design project (NemoDSD 3D) exported into a CAD/ CAM software (Exocad) to check the function in the digital articulator.

The Digital Wax-up and CAD/CAM restorations

When tooth preparation is done the STL file of the preps can be overlapped to the 3D design so the restorations can be designed following the exact same shape, position, arrangement and occlusion that was developed on the 3D digital design (fig. 35).

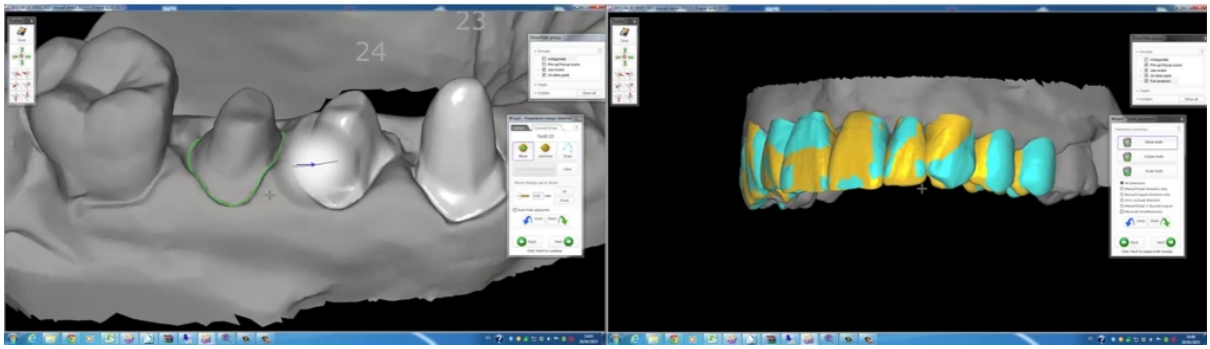

Figure 35: a) STL of the peeped model. b) the 3D restorations (yellow) are adapted to the digital wax-up (green)

Treatment Plan presentation to the patient

The presentation to the patient starts with the placement of the motivational mock-up followed by photo/video session. After presenting to the patient the motivational mock-up (fig. 36) the treatment plan presentation takes place. If the plan is approved by the patient, the rehabilitative procedures may be performed in a completely digital flow integrating the initial Smile Design project into the clinical procedures as orthodontic, periodontal, orthognathic surgery, guided implant surgery and/or restorative procedure. All the devices fabricated to perform the treatment, as guides, splints, appliances, components and restorations, should facilitate the process of maintaining precision between the initial plan and the final outcome (fig. 37).

Figure 36: Screenshots of smartphone videos-images of the patient with and without the mock-up for the motivational presentation

Figure 37: All the devices and models digitally designed and fabricated with milling and printing technology

DISCUSSION

In order to establish an esthetic rehabilitative treatment plan, a correct diagnosis is necessary, which identifies and quantifies which elements of the smile need to be corrected or improved, and which must be maintained. Clinical information, data from images, study models and photographs have been used for this purpose. Although these sources of guidance provide relevant data for diagnosis, they do not offer all the information necessary for analyzing the smile. Dynamic records of the smile on video are fast, easy and allow a more precise analysis of esthetics, phonetics and function.

It's is very difficult to capture a photo on the exact ideal moment for smile analysis. Usually when the dentist asks the patient to give a full smile, the patient shows less than the real maximum height of the smile. The same can occur on the rest position analysis. On a photo we cannot guarantee that the moment captured is the realistic rest position.

Dentist are usually not professional photographers and patients are not usually professional models so make ideal protracts is also a big challenge in dentistry. Through video documentation the patient can feel less uncomfortable and give more natural poses. The photo camera is emotional barrier for normal people that commonly feel uncomfortable on smiling in front of a camera for somebody that they just met. Even more difficult, when the patient is not comfortable with their own smile. When the photo camera is in front of the photographers face, it increases this barrier and the patient freezes or has difficulty to perform a natural smile. Usually when the photographer brings the camera down the patient will give the best smiles that unfortunately one will miss with the camera. When filming with a smartphone the camera holder can move himself from behind the camera and make direct eye contact with the patient create a much easier environment for natural poses. With proper illumination, a good smartphone camera can become a very decent camera that can generate enough quality for the smile design and treatment planning process and also for patient communication.

Facial analysis based only on photograph may give incomplete and/or incorrect information. Tjan & Miller[9] evaluated static photographs of posed smile and reported 11% of the patients in his study presented a high smile, as opposed to 21% of patients with an anterior high smile in a study with video recording.[18] Tarantili et al. [17] also evaluated the smile on video and observed the duration of a spontaneous smile was 500 milliseconds on an average, which reinforces the difficulty of recording this moment in photographs. These data have contributed to understanding the findings of Maulik & Nanda[18] who reported greater exposure of the posterior teeth and a gingival strip characterizing a high posterior smile in 42% of the patients evaluated on video. This high exposure of teeth and number of teeth visible in the smile tend to diminish with age, a fact confirmed both in photographic,[12] and dynamic[20] evaluations, however, many other esthetic parameters that have been established in photographs have not yet been defined in videos.

Creating a photo protocol from videos can save a huge amount of time for the photographer (dentist/staff) and also for the patient. An efficient and fast initial photo session will generate a positive feeling on the patient and it’s much more simple to

train the staff to take photos with smartphones that to train them to use sophisticated DSLR cameras and studios with their complex settings and possibilities.

Another great utilization for videos is to help the technician to become a better smile designer by increasing their learning by watching their own work in the patients' mouth on videos. The suggestion is to always film the patient when trying in the work and send these videos to the technician. By looking at facial videos of the patient with their work in the mouth (mock-ups, provisionals, denture set-ups, restoration try-ins, etc) the technician will understand better what really works and what doesn't and will improve their smile design decisions becoming a better smile designer even when they don't work inside the clinic and can see these things live.

All the photographic facial documentation taken from videos allows the creation of a 2D smile frame completely integrated into the face. Interdisciplinary treatments have increasingly been necessary for the esthetic and functional resolution of clinical cases in Dentistry. Photographs, videos and drawings of the DSD protocol shared online, have allowed members of the team to access this set of information, at any time, discuss, present proposals, re-evaluate decisions, compare before and after treatments, making communication and treatment plans really multidisciplinary.

CONCLUSION

The use of dynamic smile documentation associated with the DSD protocol may make diagnosis more efficient, and treatment plans more consistent, leading to more logical and direct treatment sequences, with reduction in risks and improved final results.

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