3Sixty

MANDIBULAR ARCH REHABILITATION: FROM REMOVABLE TO FIXED PROSTHESIS

FULLY-GUIDED IMPLANT PLACEMENT PROTOCOL



CASE REPORT BY

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INTRODUCTION

There are numerous options available when it comes to restoring the oral health of patients who have lost all their teeth. Traditional removable dentures still serve as a suitable option in certain cases. Patients who would like a permanent solution can take advantage of the CAD/-CAM technology accessible in the dental profession today. It is essential to have a comprehensive understanding of oral anatomy and proper implant positioning. That said, the most crucial aspect is recognizing the required emergence profile to ensure the maintenance of a screw-retained, fixed implant prosthesis. Paying attention to this will result in an exceptional final outcome, a satisfied patient, and a positive long-term prognosis.

Completely edentulous patients experience progressive bone resorption; both height and width are diminished over time. This results in a compromised facial appearance, reduced support for the lips, and potential decrease in the vertical dimension of occlusion. Full-arch reconstruction using implants has emerged as a practical option, offering an alternative to traditional methods, and it is now well within the capabilities of general dentists. Key elements in successful implant dentistry today include precise implant placement, effective management and maintenance of soft tissues, and the expertise of dental laboratory technicians who possess a thorough understanding of design principles as well as form and function.

INTRODUCTION

Nowadays, permanent fixed dental prostheses have become increasingly popular, especially in cases where the patient's oral anatomy is suitable, and there is adequate implant spacing to accommodate a well-designed prosthesis. Advanced technology and materials enable the utilization of CAD/CAM design and precise milling techniques to create prosthetic appliances made from solid zirconia. These options for full-arch restoration through implant-supported prostheses offer outstanding functionality, straightforward maintenance, pleasing aesthetics, and long-term durability against wear. Furthermore, the zirconia material is compatible with the natural enamel of the opposing natural teeth.

The prosthesis is attached to the implants underneath, which are integrated within the bone using custom abutments. These abutments allow the prosthesis to be either cemented in place or, if multi-unit abutments (MUAs) are used, screwed into position.

Accurate diagnosis and comprehensive treatment planning play a pivotal role in determining the long-term success of the implant-supported prosthesis. Conventional radiographs are used to assess vital anatomical structures, while CBCT analysis provides a three-dimensional visualization of the available bone in the sagittal view. Moreover, advancements in technology allow for virtual implant placement before any surgical procedures are performed. In many cases,

surgical guides can be created to assist the practitioner in strategically positioning the implants for optimal outcomes. Understanding the shape of the dental arch is crucial for achieving ultimate stability.

Once the dental implants have been strategically placed during surgery to support a full-arch prosthesis held in place by screws, there are prosthetic considerations that clinicians must fully comprehend. Implant angulation within the existing hard tissue will determine whether the prosthesis can be directly attached to the implants themselves or connected to MUAs if the position of the access holes for the abutment screws is unfavorable. The selection of abutments has a significant impact on the connection, strength, periodontal health, and overall esthetic outcome of the prosthesis.

CASE HISTORY

A 67-year-old patient presented to the clinic with a fully dentate maxillary arch and a completely edentulous mandible which showed signs of severe bone resorption. The patient had been wearing a complete removable lower denture for 10 years, and was seeking to replace it with a fixed, implant-supported prosthesis. According to the American Society of Anesthesiologists Physical Status (ASA PS) Classification, the patient's medical history showed only a mild systemic disease (ASA II), namely Psoriasis. The treatment options were discussed with the patient, which included a full rehabilitation of the lower arch, involving guided placement of four short dental implants, which would support a screw-retained bridge. The patient preferred a less invasive, relatively short surgical procedure with no bone grafts in order to limit postoperative complications including discomfort, pain, bleeding, and swelling. Also, due to the patient's desire for an aesthetic and long-lasting fixed restoration, the patient opted for the All-on-4 treatment option.

CBCT assessment revealed the patient's bone volume and position of vital anatomy. Some clinical challenges presented themselves including atrophy of the lower jaw as well as proximity of the inferior alveolar nerve and mental foramen. However, by analyzing the scan, the number and positions of dental implants were appropriately determined. The information obtained from the CBCT scan could be used to virtually plan the position and angulation of each implant as well as a prefabricated surgical guide according to the final prosthetic design.

CASE HISTORY

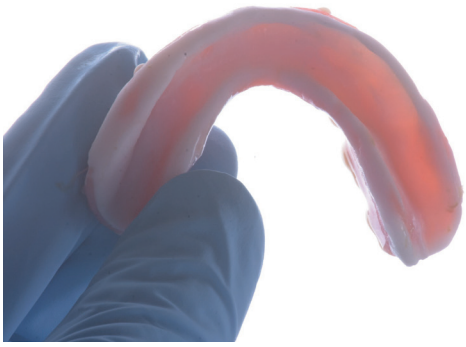
Clinical research clearly suggests that the surgical placement of four properly spaced implants has a successful prognosis for this All-on-4 type of prosthesis.

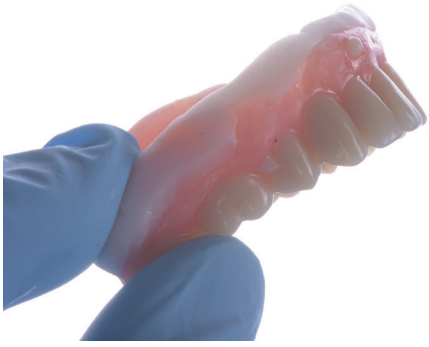


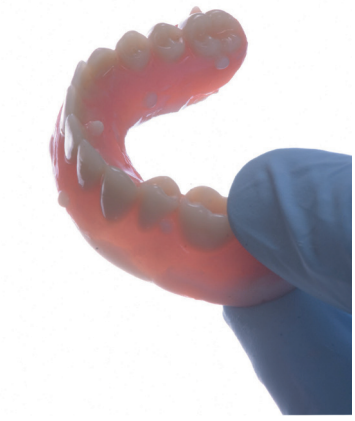
FIRST APPOINTMENT: PRESURGICAL PHASE

The goal was to deliver treatment from beginning to end with a fully digital workflow using 3Sixty Anatomic Guide® protocol (3Sixty, Atlanta, GA, USA) for lower full-arch rehabilitation. This protocol incorporates 3Sixty Treatment Planning services provided by 3Sixty Dentists* and Atomica Implant Planning Software (Atomica.ai).

In order to ensure a well-fitting restoration, COE-COMFORT™(GC America Inc., IL, USA), a self-curing, chairside edentulous tissue conditioner, was used to reline the existing denture and restore the underlying soft tissue. In preparation for the dual scan protocol, a few composite dots were attached to different surfaces of the denture in order to act as reference points. Dual scan technique simply involves taking two CBCT scans; one of the patient wearing the scan appliance (i.e. the existing denture or a duplicate), and one of the appliance itself. Both scans should be with either radiographic fiduciary markers or composite dots attached to the prosthesis.

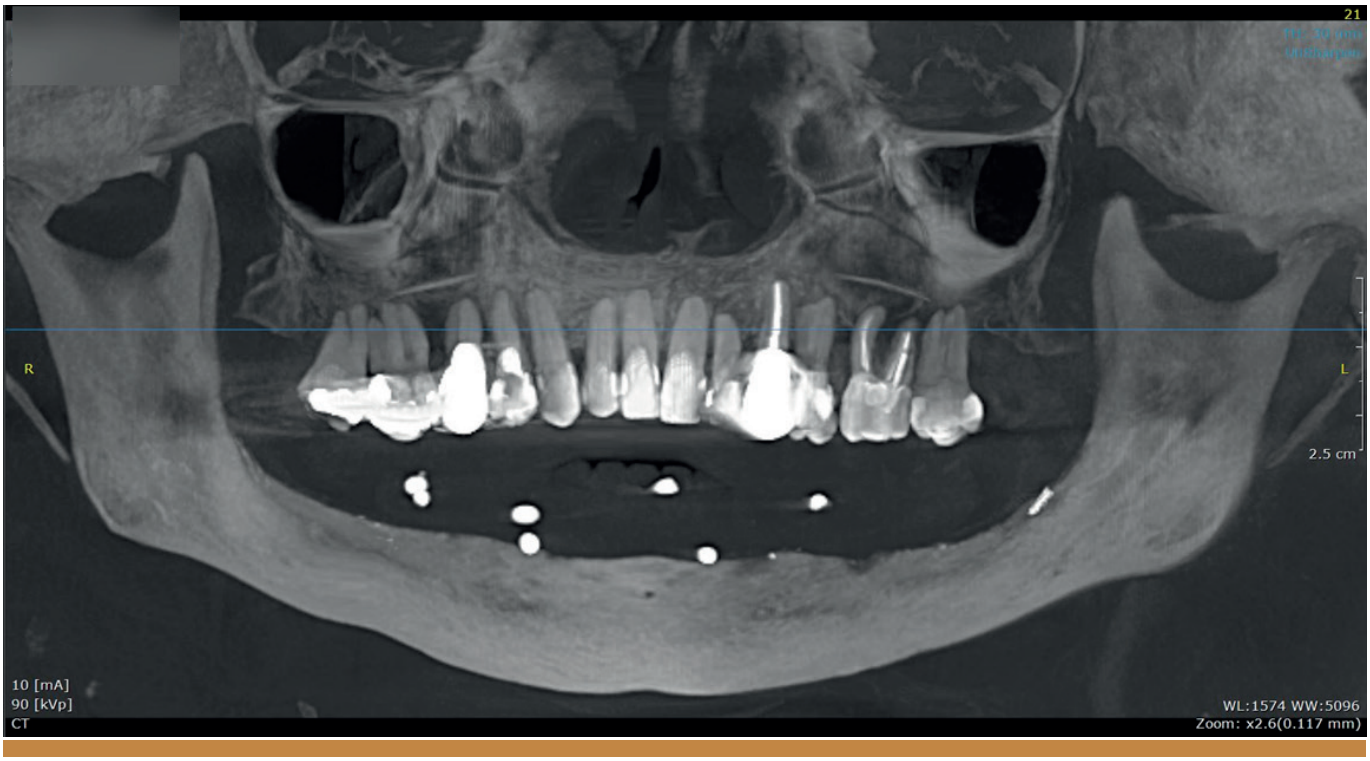






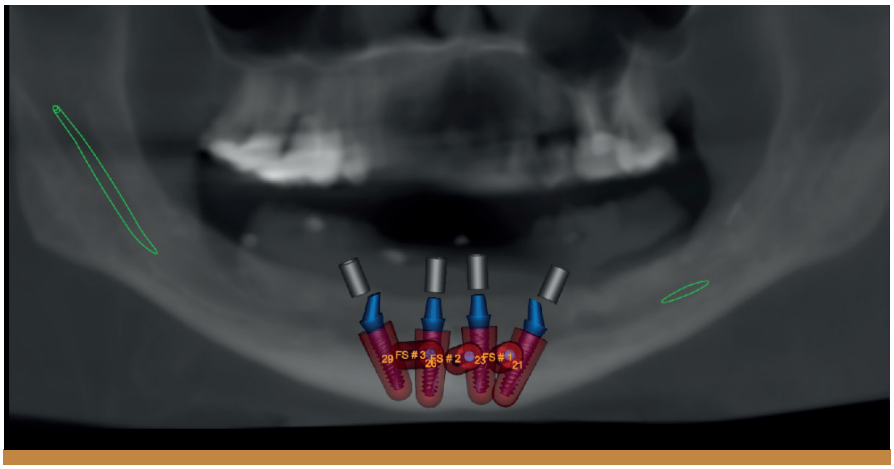


This data compiled from the CBCT and intraoral scans was imported into Atomica Implant Planning Software (Atomica.ai, Atlanta, GA, USA) and merged together with the digital wax-up. Combining these layers of data into one image enabled 3Sixty Dentists to plan the treatment according to the patient's restorative needs following the fundamentals of prosthetically-driven implant placement and guide design. This approach establishes the correct implant position early on during the diagnostic or presurgical phase based on requirements of the pre-planned final restoration.



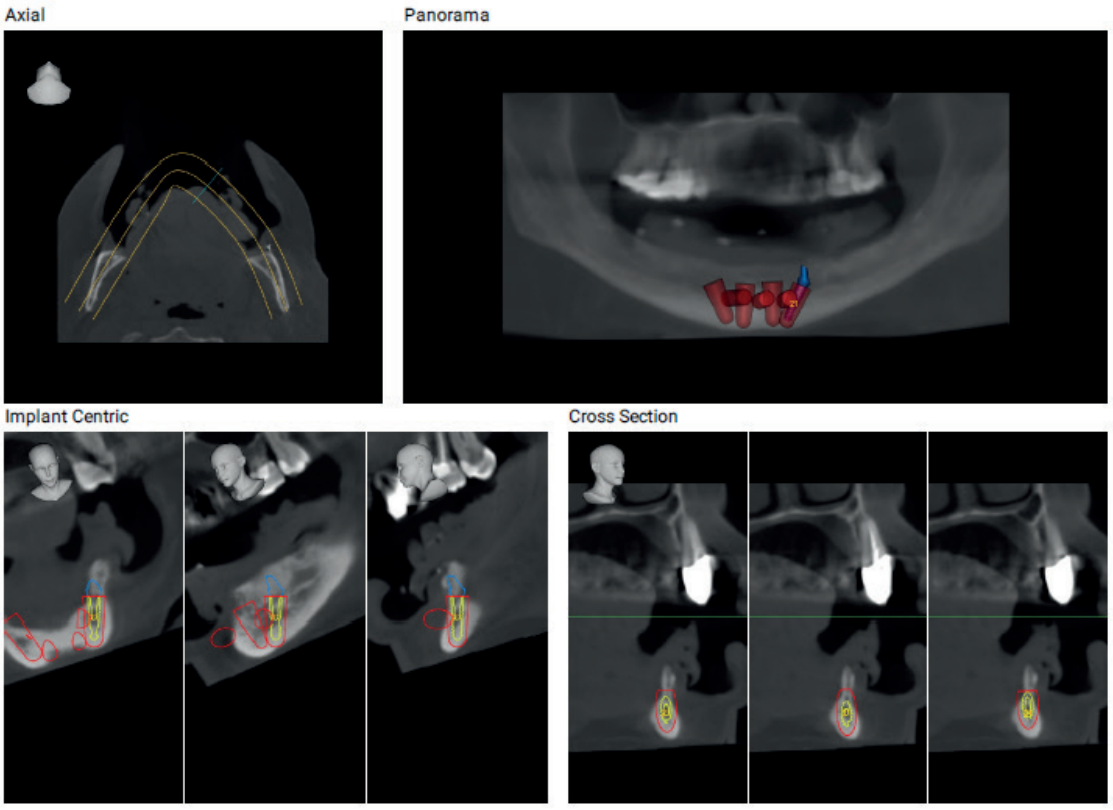
Atomica Implant Planning Software was used to create an accurate guided surgery plan for a lower All-on-4 fixed complete screw-retained prosthesis. During this process, four 3.3 mm x 11.5 mm Ritter SB/LA Spiral implants (Ritter Implant Production, Tuttlingen, Germany) were virtually placed in the lower arch to provide support for the final restoration. By analyzing every radiographic segment of the mandibular bone, the implants' positions, diameter, and length were selected. The ideal angulation of the fixtures was verified. Similarly, the proper height and angulation of the four abutments were determined. To fix the Anatomic Guide® in place, three fixation screws (1.9 mm x 13 mm) were virtually planned in the lower arch. Special care was given to avoid any interference between their positions and those of the implant fixtures.

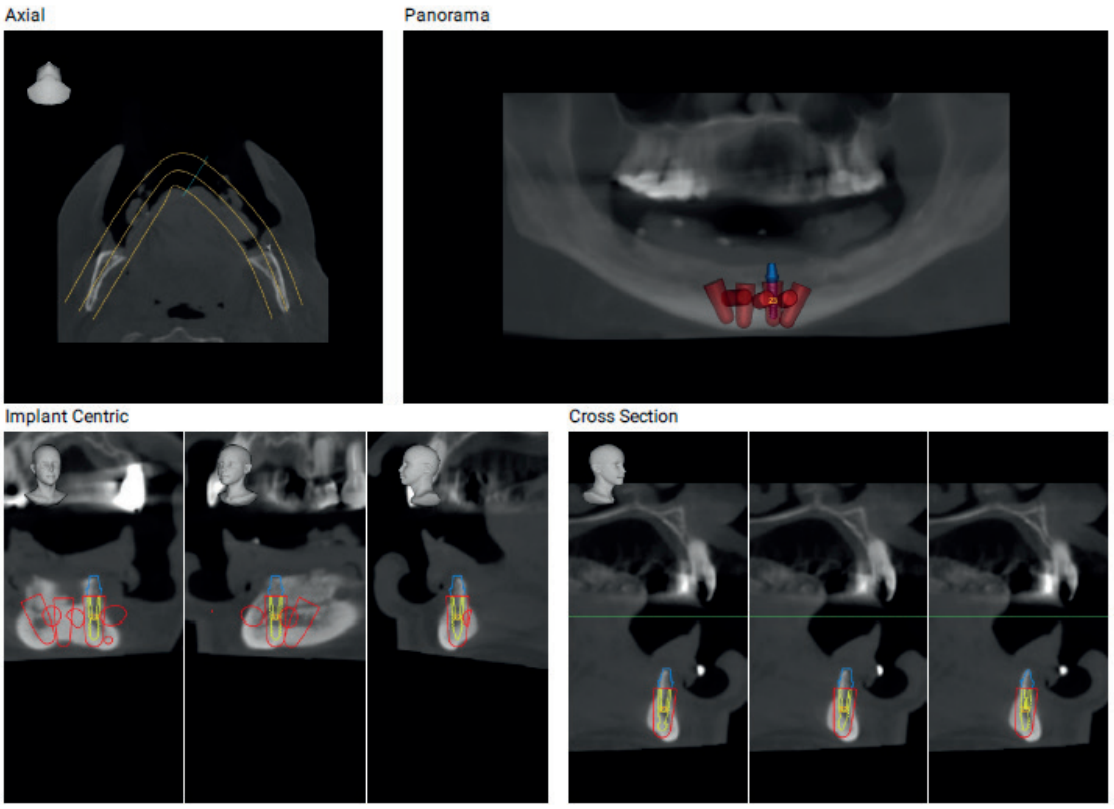
Treatment Planning



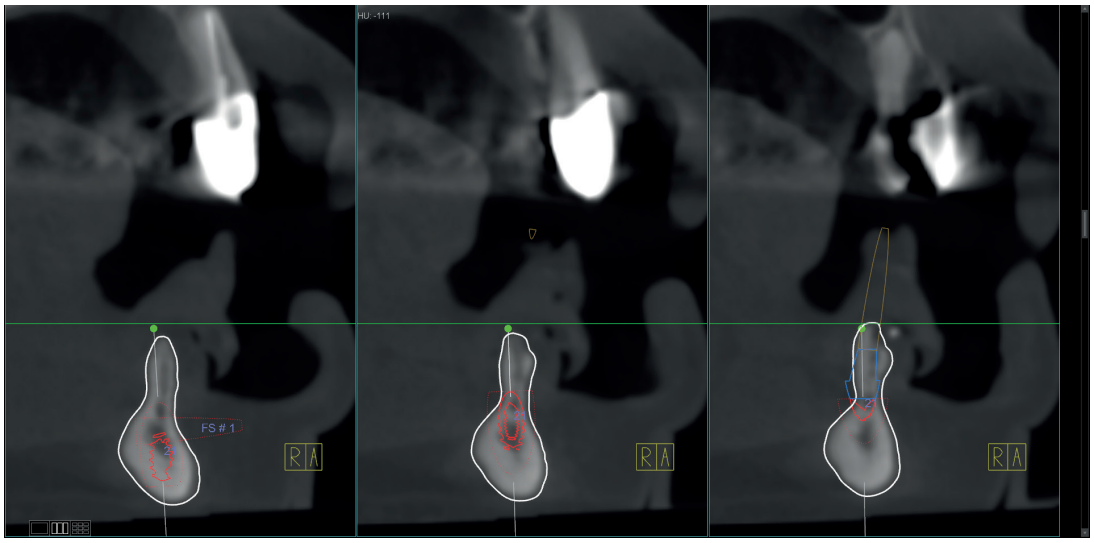


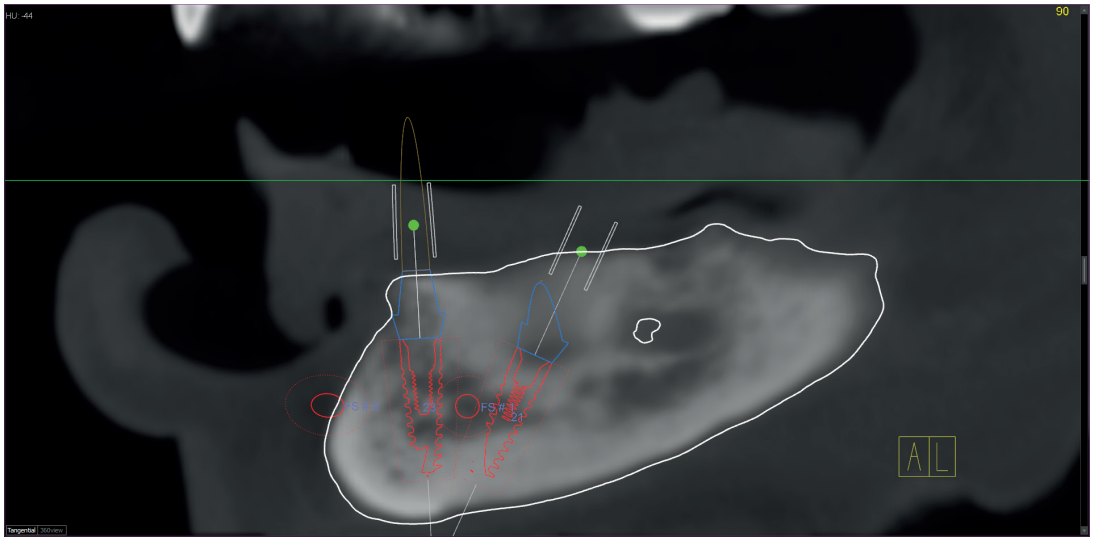
FIRST APPOINTMENT: PRESURGICAL PHASE

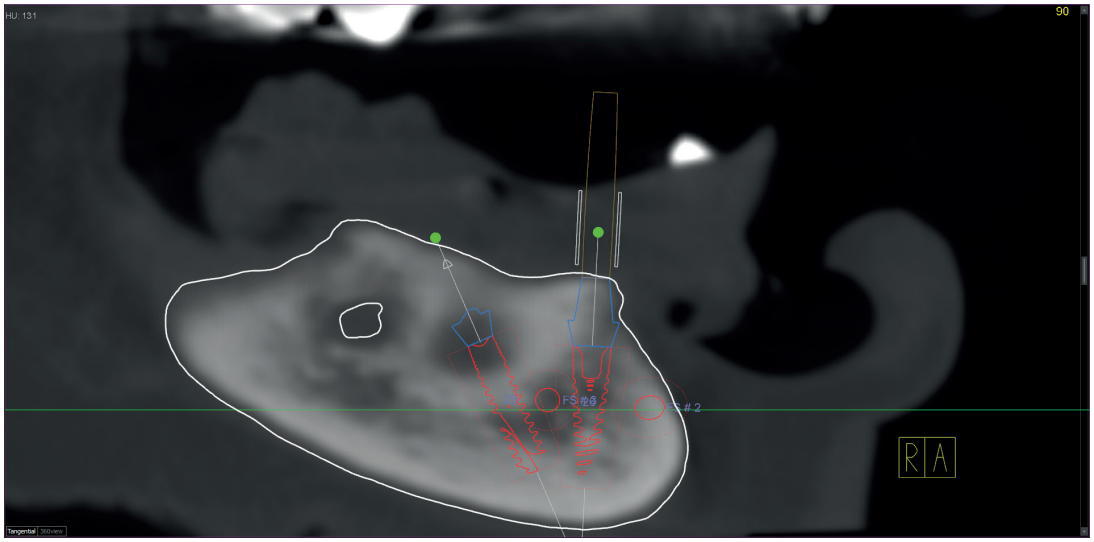




FIRST APPOINTMENT: PRESURGICAL PHASE

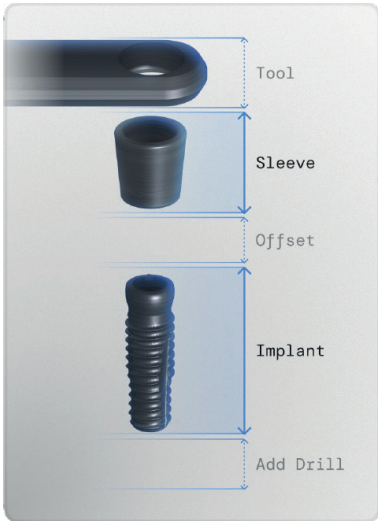






Drill Protocol

3Sixty Drill Protocol was then generated, outlining the diameter and length of each Ritter implant, the length and offset of each sleeve, as well as drill tool height, total drill depth, and which drill to use.



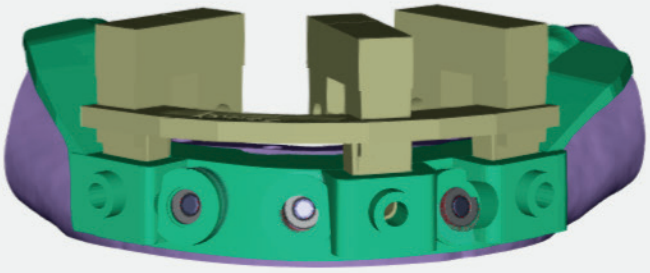
Generic Drilling Protocol

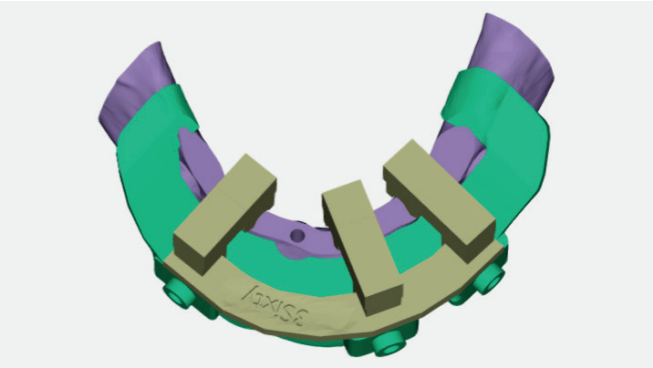
Implant Information		
Tooth Number	21	23
Vendor	Ritter Implants	Ritter Implants
Family	SB/LA Spiral implants	SB/LA Spiral implants
Product Number	Spiral SB/LA-3.3/11.5	Spiral SB/LA-3.3/11.5
Diameter	3.3	3.3
Platform Diameter	2.3	2.3
Length	11.5	11.5
Inner HU	898.92	982.68
Outer HU	985.67	1064.25
Sleeve Information		
Name	Generic 3 - 6	Generic 3 - 6
Kit	Generic	Generic
Offset	6.5	6.5
Height	6	6
Drill Information		
Drill to use		
Drill Depth Control	✕	✕
Implant Placement Control	✕	✕
Total Depth	24	24
Free Hand	0	0
Driver	N/A	N/A
Tool	N/A	N/A

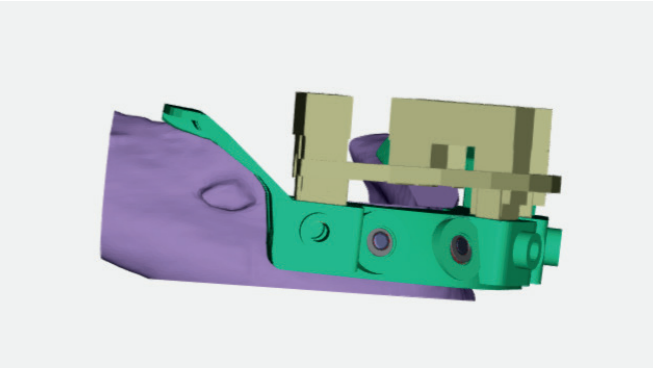
Anatomic Guide® Design

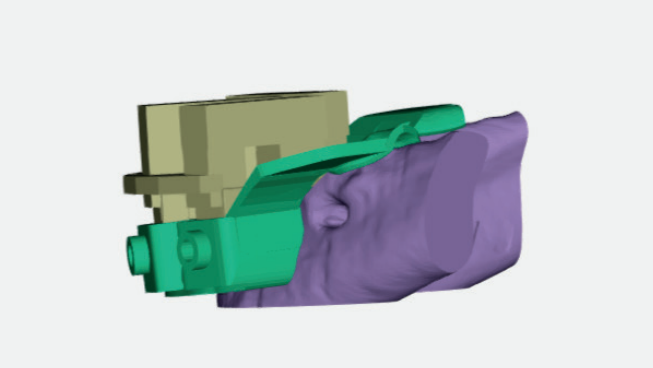
After planning the implant and abutment positions in Atomica Implant Planning Software, the Anatomic Guide® and Implant Placement Guide were digitally designed by 3Sixty Dentists. This stackable system for guided full-arch rehabilitation consists of the Anatomic Guide® which is screwed into the bone.

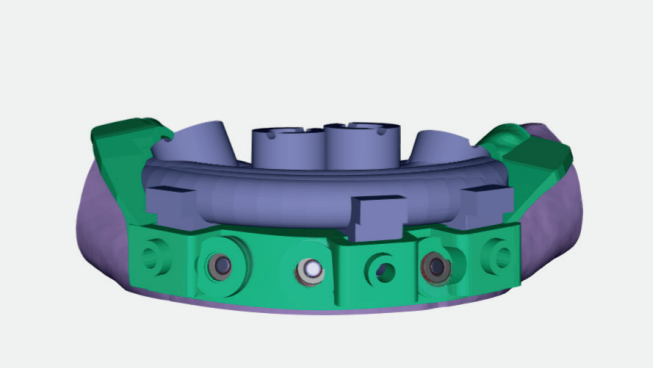
Through the latch system, additional pieces can be attached to the guide including the Crest of the Ridge Verification Mount and Implant Placement Guide. In this case, the Crest of the Ridge Verification Mount was used due to the absence of remaining teeth in the lower arch.

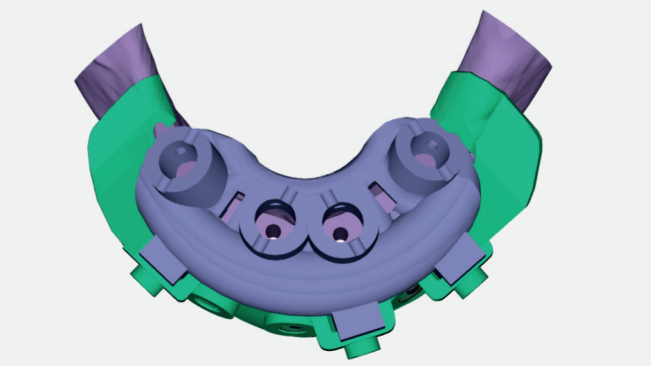


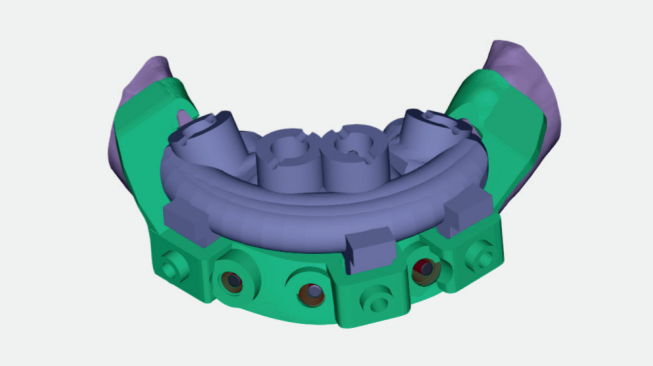










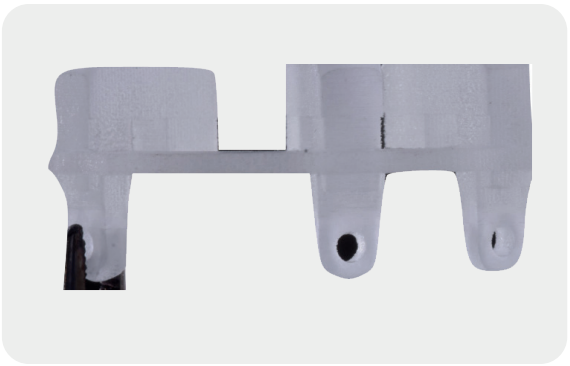


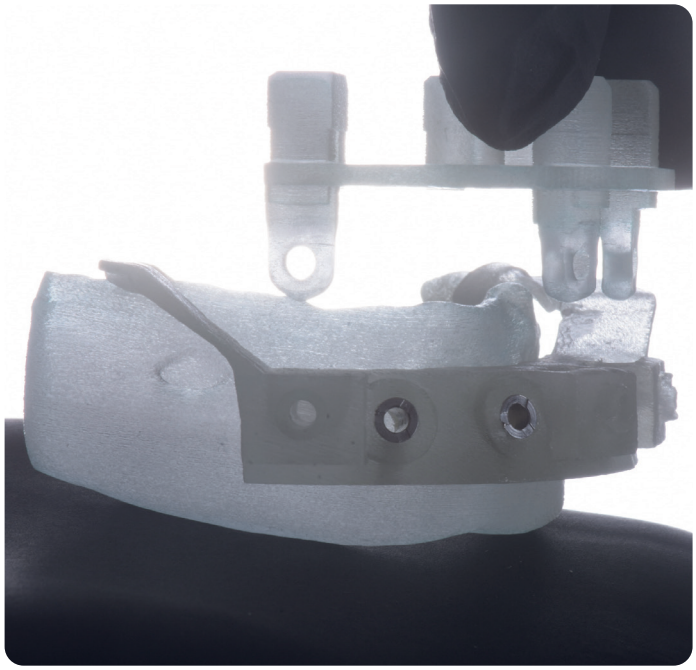
Flap Design and Seating the Anatomic Guide®

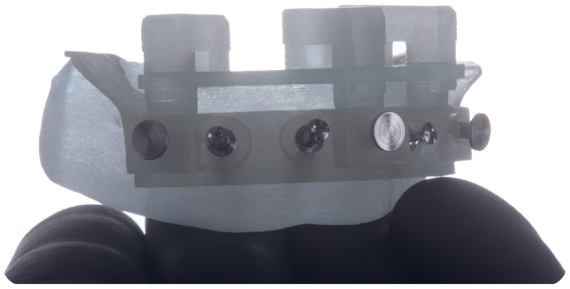
After verifying the Anatomic Guide Surgical Kit components, the surgery began with a crestal incision and and a full-thickness (i.e. mucoperiosteal) flap reflection to expose the available bone where the Anatomic Guide® should be seated. The Anatomic Guide® was initially placed guided by the Crest of the Ridge Verification Mount. The accurate seating of the Anatomic Guide® is facilitated by the Verification Mount which is placed on top of the ridge as there were no remaining teeth to use to verify the accurate seating of the Anatomic Guide®. Once in position, three intraosseous holes were drilled to help secure it in place by means of titanium screws.

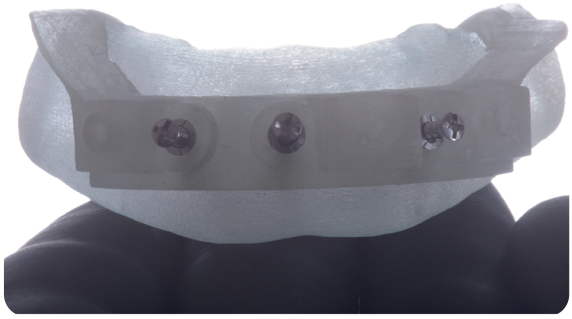




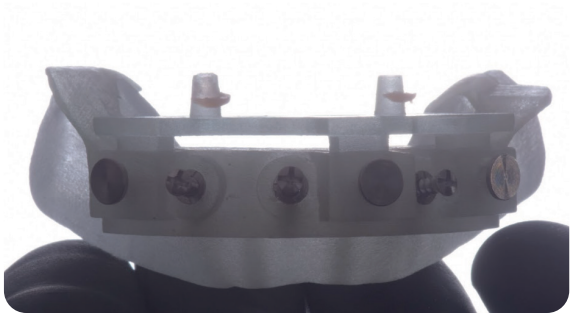


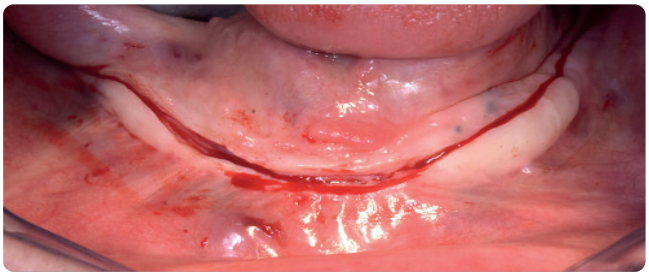


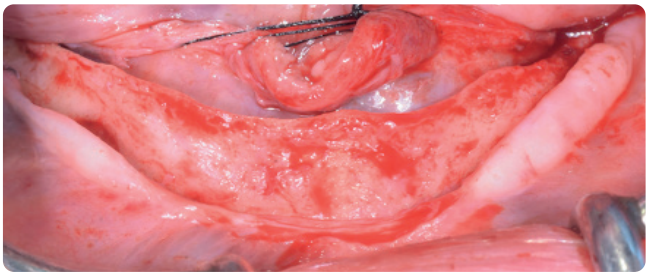


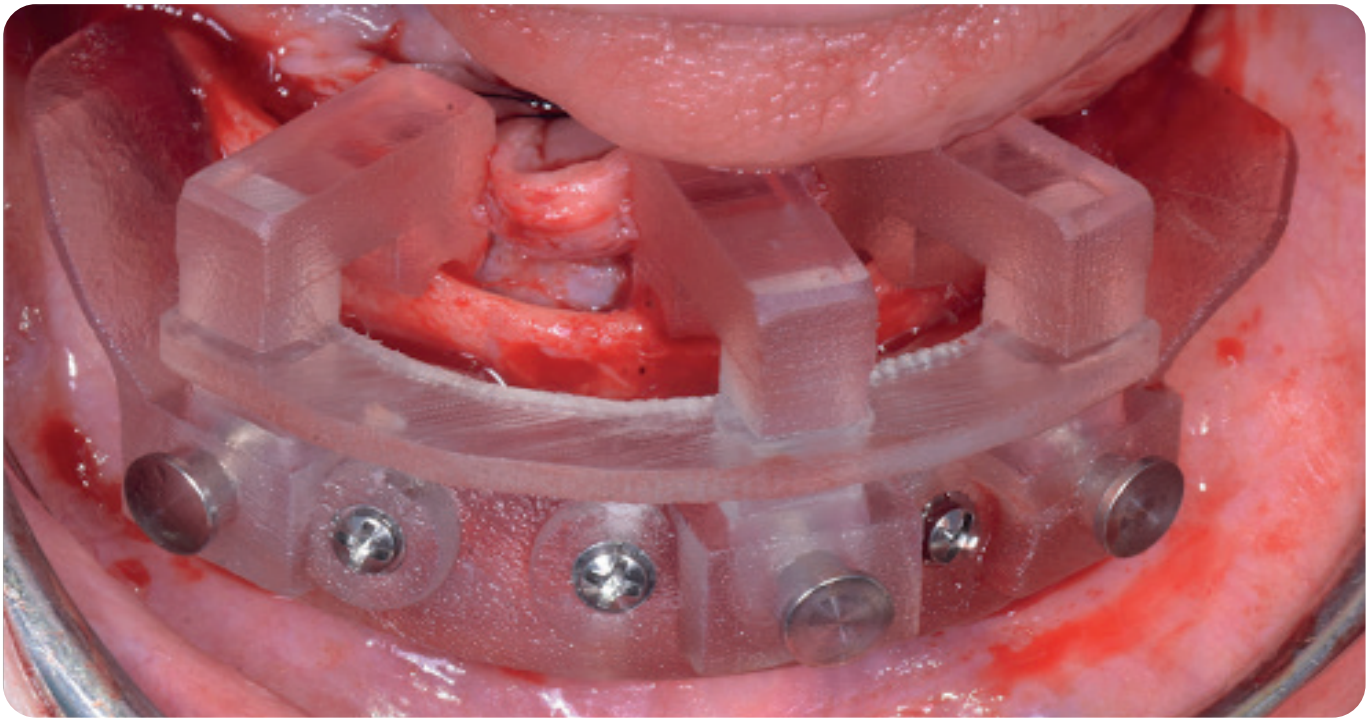






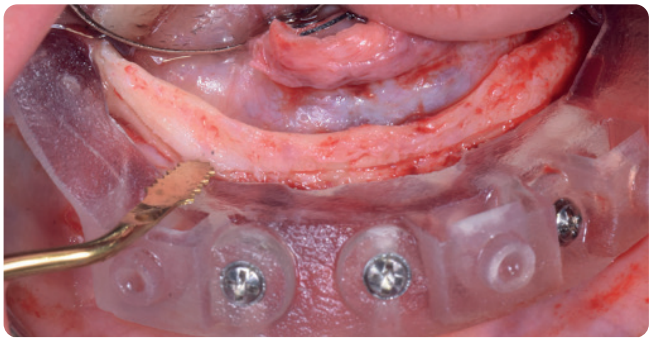
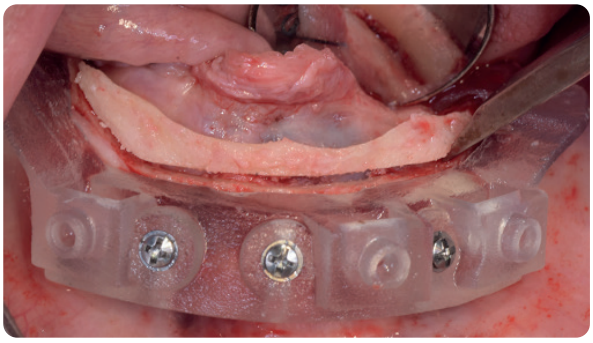
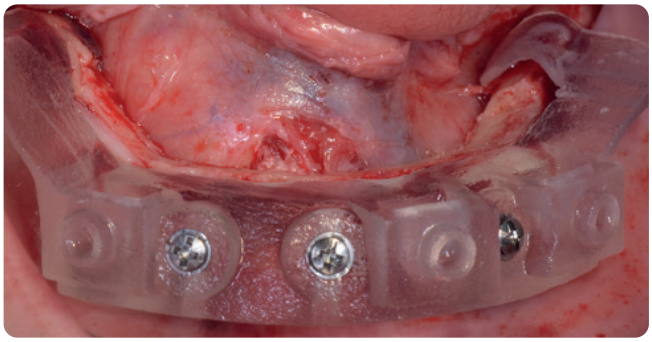
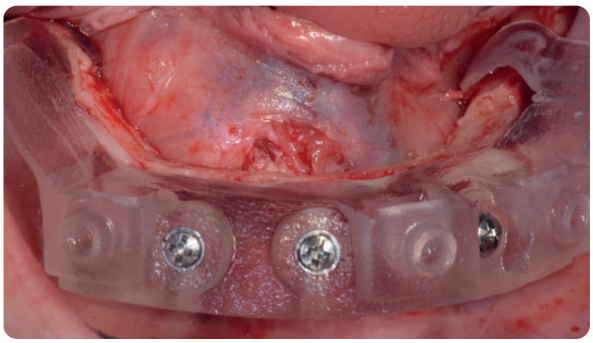




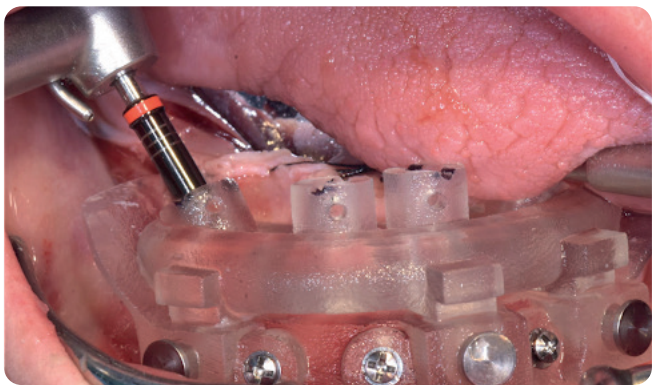
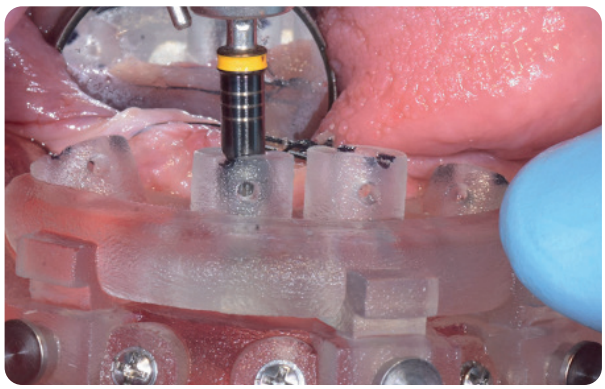


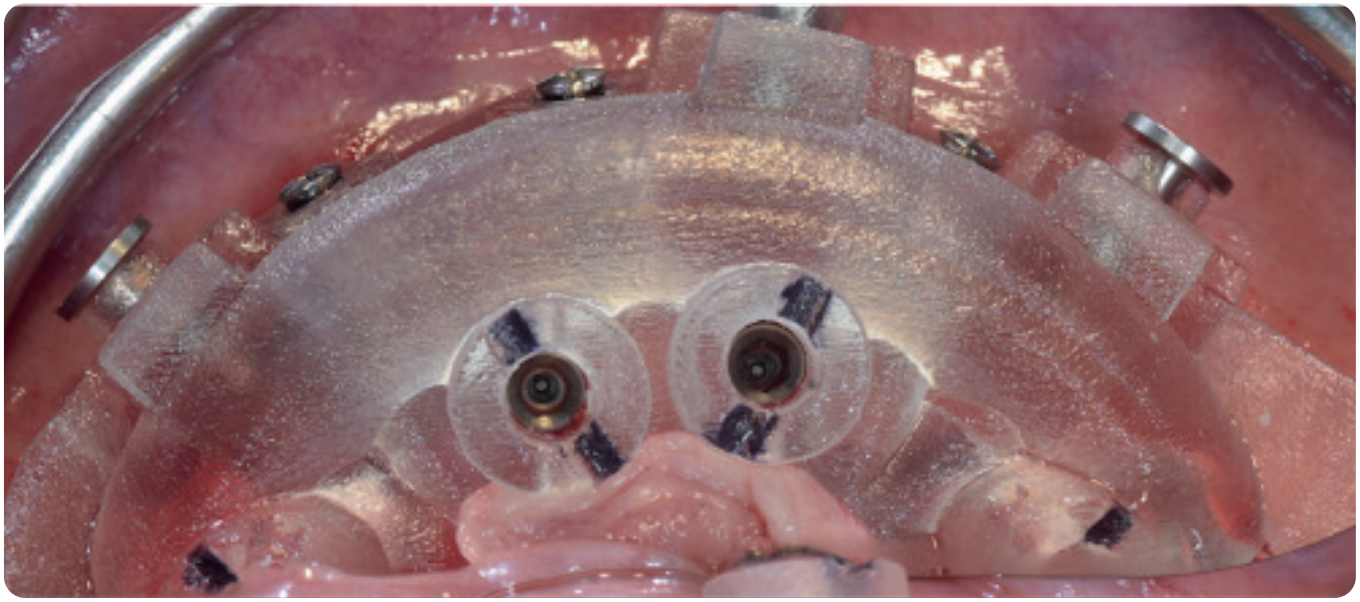
Ridge Recontour and Implant Placement

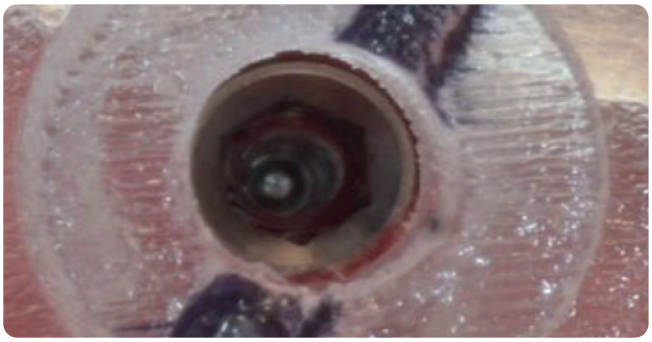
After the Anatomic Guide® was screwed into the bone, the Verification Mount was removed and recontouring was carried out using Piezotome® CUBE (Acteon® Group, Norwich, UK) following the contour of the Anatomic Guide® to ensure a well-prepared restorative space. A chisel was also used to break the bone block accordingly. Once the implant-recipient area was adequately prepared, the Implant Placement Guide was attached to the Anatomic Guide® using metal pins.

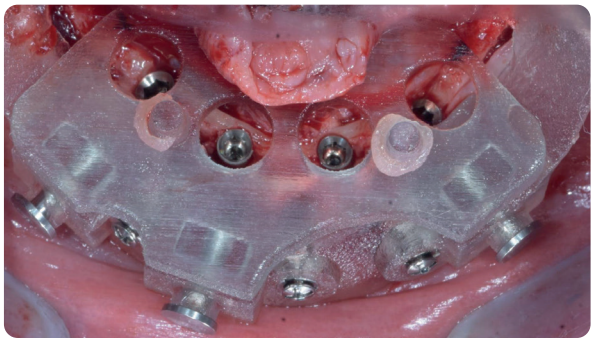





3Sixty Drill Protocol was followed and a total of four Ritter implants were placed through the Implant Placement Guide's sleeves with implant timing (i.e. depth control). The All-on-4 protocol necessitates correct positioning of the teeth which allows the patient to not only accept the occlusal scheme but also properly position the implants and prevent stress-inducing forces on both the prosthesis and underlying implant components.

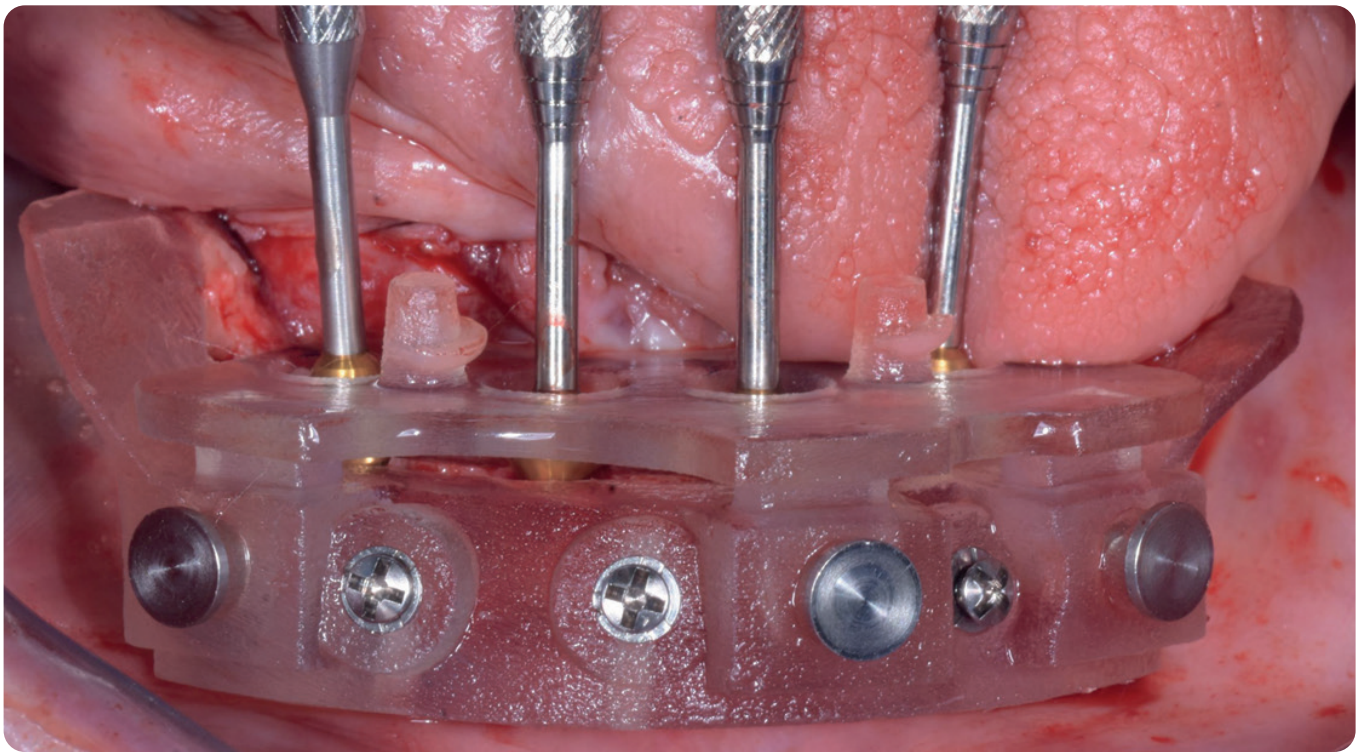



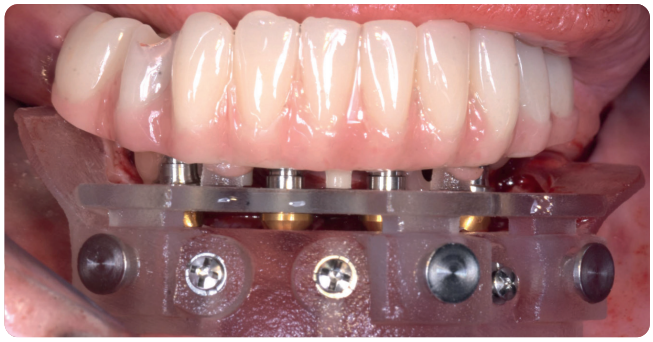


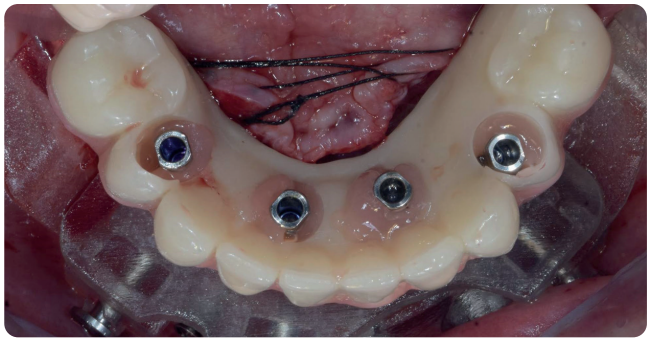




Four multi-unit abutments (MUAs) were attached to the implants and pick-up was carried out using CHAIRSIDE® Attachment Processing Material (Zest Dental Solutions, California, USA); tissue-colored, dual-cure and self-adhesive composite.





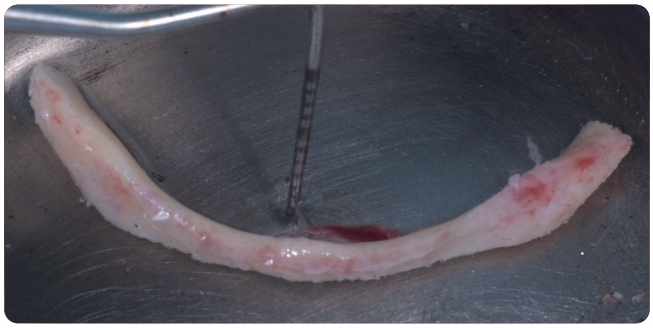
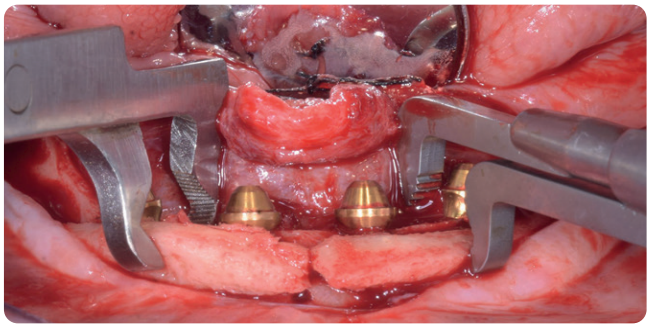
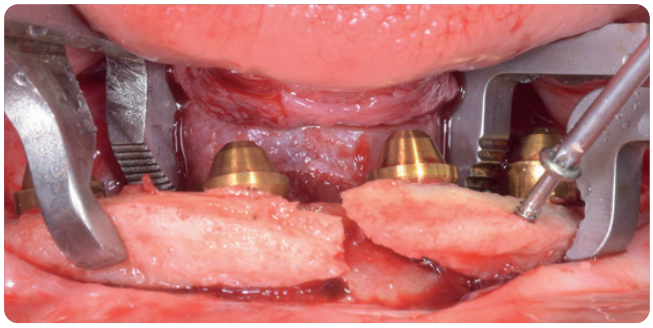
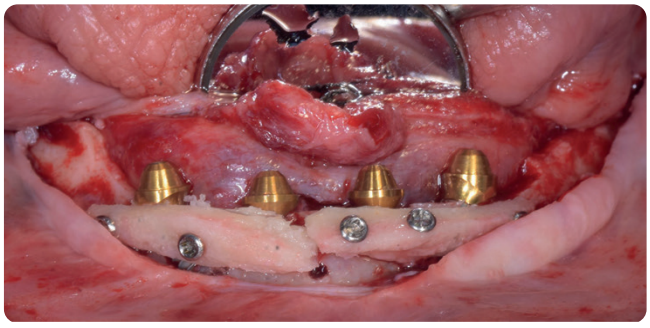
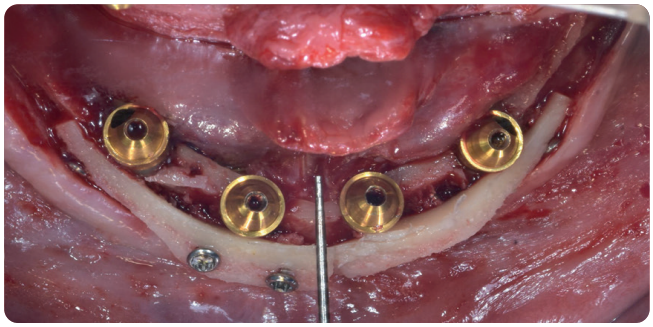
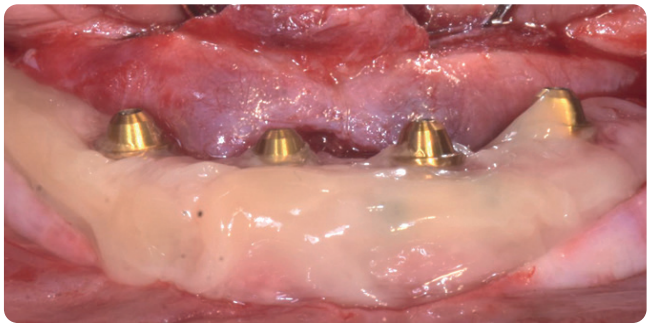


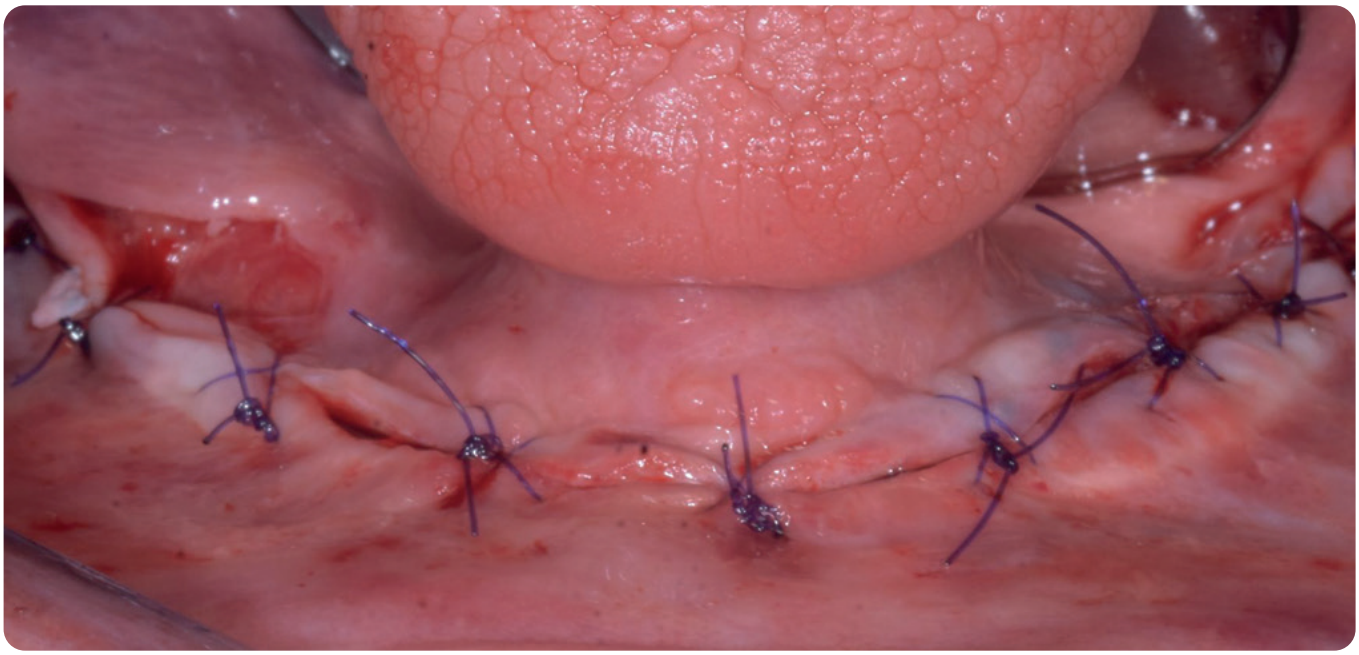




Bone Grafting

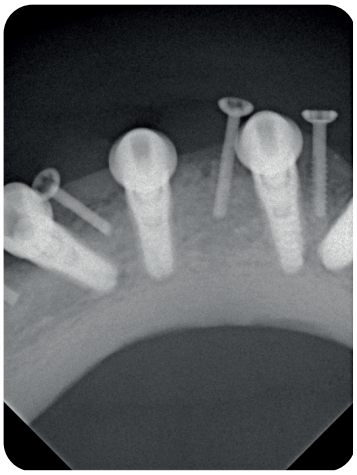
Autogenous bone block graft technique was employed to augment the residual alveolar ridge. An autogenous block graft was segmented into two parts and two screws were used to stabilize each segment. Following that, Plasma Rich in Growth Factors (PRGF) mixed with particulate bone graft was used to reconstruct the mandibular ridge. Monofilament, resorbable sutures, Monoglyc 5-0 (Ritter), were used to close the incision.

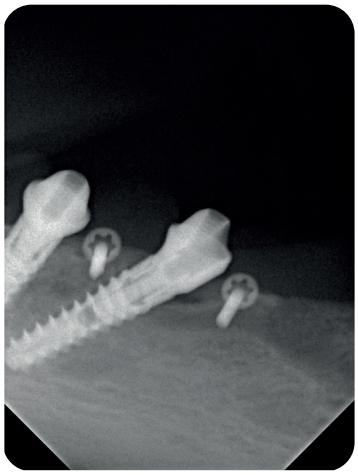









Postoperative radiographs were taken to check the accuracy of the implants' placement. Finally, the milled PMMA provisional prosthesis was loaded to serve the patient as a temporary appliance during the osseointegration period.







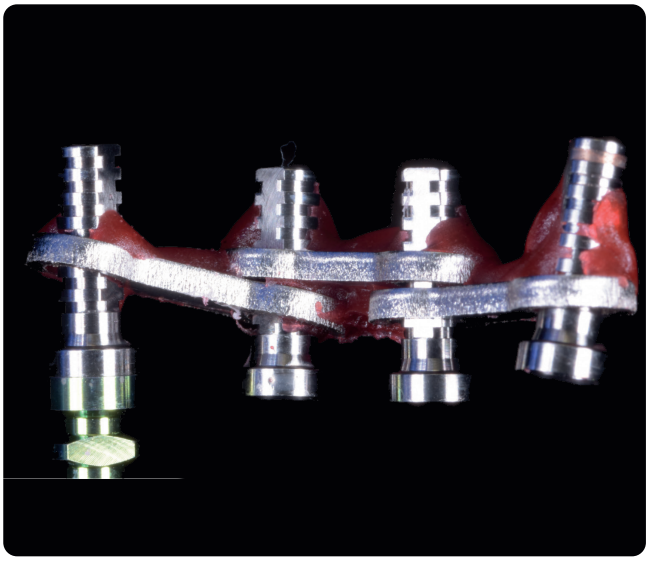
SECOND APPOINTMENT: SURGICAL PHASE

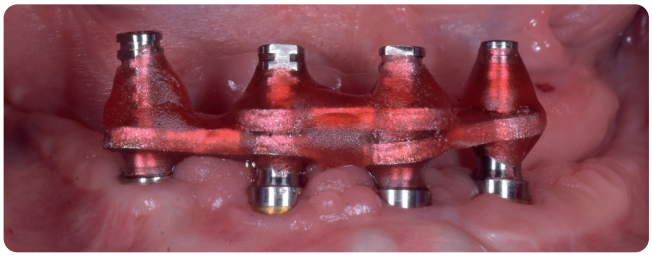


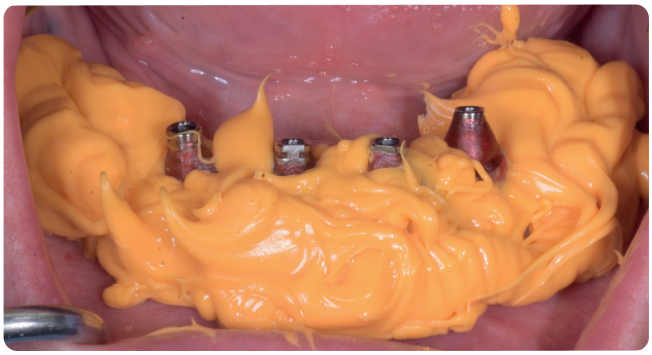


After a period of five months, a final impression of the soft tissue was needed in order to design and fabricate the final restoration. The Fast Protec Easy Bar System (XPdent Corp., Florida, USA), was utilized to provide reinforcement to the structure of the definitive prosthesis. The appropriate bar sizes were selected and verified; the bars were then fitted to the temporary titanium cylinders over the MUAs. A space was left between the bars and the soft tissue to allow the impression material to flow under the bars.











A self-curing, general-purpose acrylic resin was utilized to make the connection stronger and an impression was taken using light body PVS material. All records were sent to the dental lab where the design and fabrication of the final monolithic zirconia prosthesis took place using Exocad Software (Exocad, Darmstadt, Germany). Ideally, a final zirconia "All-on-X" restoration requires a restorative space of 12 mm at minimum in order to achieve the desired strength, esthetics, durability, and tissue integrity. Conventionally, it is recommended that the interocclusal space should be between 11-14 mm, measuring from the soft tissue to the opposing occlusal table



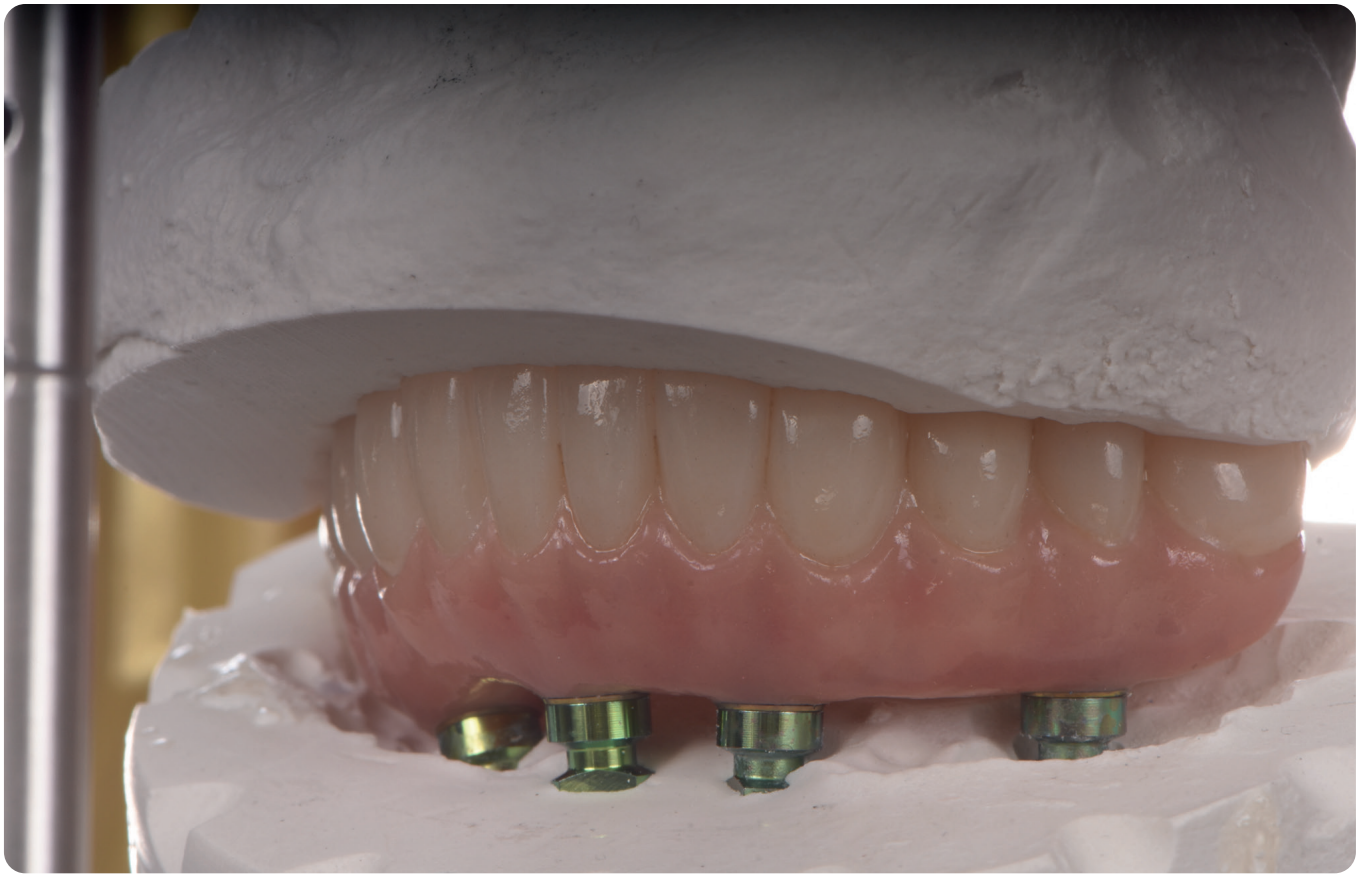


To ensure ideal treatment outcomes and long-term success of the prosthesis, the principles of Protection Design were followed.

Protection Design

1. Full monolithic zirconia in functional areas and incisal edges.
2. Occlusal guard is mandatory.
3. Minimum of 2 mm thickness around screw channels.
4. Incisal edge thickness should be maximized.
5. Shallow anterior guidance should be provided.
6. Maximum cantilever length of 7-9 mm.

The passive fit of the final restoration is in direct correlation with the accuracy of the impression and master cast fabrication. While a perfect passive fit might not be possible, having as little fit discrepancy between the implants and prosthesis as possible should be the primary aim. Lack of passive fit can result in various prosthetic and biomechanical complications that compromise the long-term success of the implant treatment. Regardless of the impression technique used, whether physical or digital, it is highly recommended to always verify the master cast with a stone (type IV) verification jig before going to the next step in the finalization.



During the provisional phase, the prosthodontic parameters were assessed before fabricating the final restoration. This assessment involves hygiene, functional, and esthetic considerations. Any adjustments in the final zirconia can induce micro-fractures in the material, reducing the mechanical strength of the prosthesis. Therefore, testing the vertical dimension of occlusion, centric occlusal contacts, and dynamic occlusion in the transitional phase is critical.

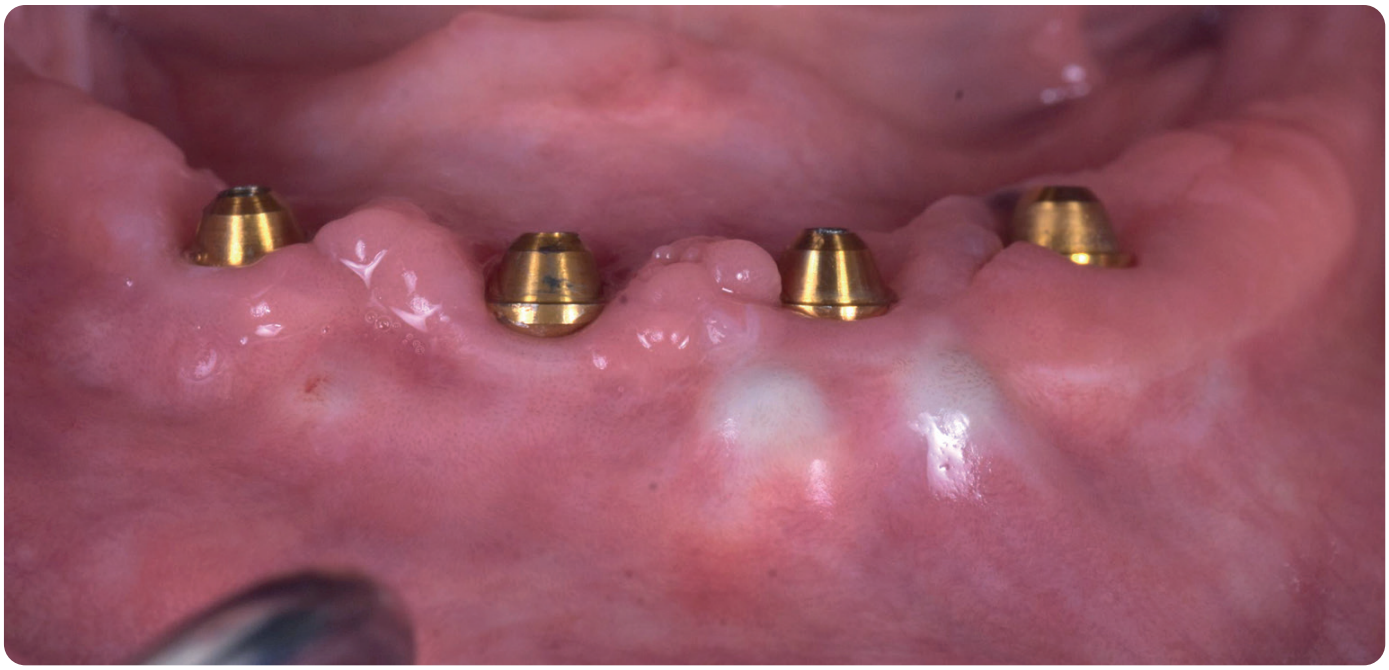
Throughout this period, the patient produced functional wear patterns and Pressure Indicating Paste (PIP) was used to locate areas of discomfort on the PMMA provisional restoration.

All the adjustments needed were recorded and sent to the dental lab by scanning the PMMA duplicate to modify the design in the CAD software.



Additionally, the five-month period gave the patient the chance to test-drive and approve the proposed esthetic design, phonetics, and the oral hygiene regimen through the mostly convex intaglio surface of the prosthesis.

Finally, after the soft tissue was conditioned and healthy attachment around the MUAs was verified, the complete fixed implant-supported monolithic zirconia prosthesis was finished, polished, and screwed in.





Full-arch rehabilitation remains a significant challenge for dentists. However, advancements in science and technology have made it possible to implement protocols that allow for less invasive implant surgery and prosthetic solutions that effectively address rehabilitation needs while conserving healthy tissues. This combination of advancements translates into the surgical phase by utilizing an adequate number of implants with the proper length, which helps reduce surgical risks, minimize patient discomfort, and better manage cases involving bone resorption commonly seen in completely edentulous patients. In the restorative phase, high-performance materials like zirconia are preferable since they offer numerous benefits including reduced number of implants, improved durability, biocompatibility, enhanced esthetics, and cost-effective treatment. Furthermore, these advancements are facilitated by a digital workflow, as proven by this clinical case.

About Dr. Maurice Salama



Dr. Maurice A. Salama completed his undergraduate studies at the State University of New York at Binghamton in 1985, where he received his BS in Biology. Dr. Salama received his DMD from the University of Pennsylvania School of Dental Medicine, where he later received his dual specialty certification in Orthodontics and Periodontics, as well as implant training at the Branemark Center at Penn.

He was awarded the George Coslet and Richard Chase Scholarships at the University of Pennsylvania during his post-doctoral studies. Dr. Salama is currently on the faculties of the University of Pennsylvania and the Medical College of Georgia as Clinical Assistant Professor of Periodontics.

Dr. Salama has completed an ADA accredited hospital-based General Practice Residency at Maimonides Medical Center in New York City. In 1988 he had the opportunity to further broaden his clinical horizons through externships at Hebrew University in Jerusalem and Beth Israel Hospital in New York City. His very unique background includes specialized training in Orthodontics, Periodontal Surgery, and Implant Dentistry.

About Dr. Marcelo Silva



Dr. Marcelo Montenegro Silva was born in São Paulo, Brazil where he attended dental school and acquired his first degree in dentistry. After graduation, Dr. Silva relocated to the US and received his second DDS degree at the University of Southern California.

He then went on to pursue post-doctoral training in prosthodontics at Augusta University. Following his residency, Dr. Silva started a fellowship at the Ronald Goldstein Center for Esthetic and Implant Dentistry directed by the world-renowned Dr. Gerard Chiche.

About Dr. Toni Salama



Dr. Toni Salama earned her bachelor's degree in biological sciences at Binghamton University and received her Doctor of Dental Surgery at Stony Brook University School of Dental Medicine.

She then went on to complete a 3-year post-graduate residency at New York University where she specialized in Periodontics and Implant Dentistry. During her residency, she received world-class training in treating complex cases, implant placement, and full mouth rehabilitation.

Dr. Salama is a diplomate of the AAP and an active member of the ADA. She has successfully completed advanced training through Live Patient Surgical Mini-Residency at UNIMES Metropolitan University and DentalXP Online Implant Fellowship Program. In 2021, Dr. Salama was recognized as one of the Top Female Doctors in the country.

ABOUT 3SIXTY

3Sixty has been a steadfast pioneer in the field of digital dental technology since 2007. Based in Atlanta, Georgia, we provide market-leading implant planning and guided surgery solutions for dental professionals across the US. We have improved the oral health of more than 100,000 people by delivering treatment planning services, cutting-edge treatment planning, guided surgery, full-arch rehabilitation, and restorative solutions to thousands of dental practices and labs.

Anatomic Guide®

The Anatomic Guide® is a highly accurate, minimally invasive stackable guide for full-arch cases that require rehabilitation using All-on-X treatment modalities.Thanks to its accuracy , it can be secured to the patient's distinctive anatomy by short metal screws providing more stability and eliminating cantilever effect.

The Anatomic Guide® Workflow is a team-oriented, step-by-step process that is practical, preplanned, and predictable. It helps you streamline both the pre- and post-surgical phases of the full-arch treatment. Supported by a team of experts, you will feel confident in your practice and get rid of any undue stress on surgery day.

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We offer a full range of integrated high-tech services and products that can either be used together or separately:

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- **Full-Arch Systems (e.g. Anatomic Guide®, Scalloped Guide)**
- **Restorative Solutions**
- **Radiology Reports**
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