8 Zygoma clinical cases from renowned experts

Straumann® Zygomatic Implant System

Used by experts with the patient in mind.

straumann

Dear colleagues,

Population aging is poised to become one of the most significant social challenges of the twenty-first century, with consequences for a myriad of societal fields like laborand financial markets, delivery of goods and services (housing, transport, health), as well as family and intergenerational ties.

Globally, the population aged 65 and over is growing faster than all other age groups. This generation of seniors wants to lead an active and independent lifestyle, while maintaining a high quality of life.

It has to be considered, that a significant proportion of this senior population has previously been treated in a non-conservative manner. Moreover, the likelihood of developing lesions requiring avulsive and ablative resections increases with age, contributing to edentulism, which further develops into a chronic disease associated with significant rates of morbidity and other health issues and ultimately in full disability.

While complete dentures benefited from a high level of acceptance prior to the era of dental implants, with the advent of implant-supported prostheses, few patients nowadays remain content with conventional dentures.

Restoring the edentulous maxilla when adequate bone is present is effectively accomplished with conventional endosseous root form implants. The Oral Health Quality of Life index (OHQOL) is greatly improved when immediate prostheses are used, and patients generally prefer this approach. In some clinical scenarios of severe maxillary atrophy, surgical resection, or trauma, conventional implant placement may not be possible. Resorption of the maxilla in posterior areas and enlarged pneumatized sinuses create the need for large volumetric replacement of the dentoalveolar complex, associated with multiple grafting procedures to obtain suitable bony tissue in terms of volume and quality, presenting greater difficulties for rehabilitation.

Thus, dental professionals are presented with two surgical options: grafting or graftless. The grafting approach relies on well codified surgical procedures, routine postoperative attention and recovery, and implants located inside the final tooth-alveolar bone envelope. This approach is associated with increased treatment time, multiple surgical procedures, morbidity of the donor site, and instability of the removable denture during the prolonged bone graft maturation period, which renders immediate loading impossible.

The advent of zygomatic implants first introduced by Per-Ingvar Brånemark in 1988 led to a graftless treatment modality for patients with severely resorbed maxillae.

Since the 1990's, the procedure has benefited from increasingly comprehensive dedicated documentation in the international literature. The initial protocol involved the placement of zygomatic implants and additional root form implants splinted together, supporting a screw-retained fixed dental prosthesis.

In principle, it is crucial that the zygomatic implants emerge within the tooth-alveolar bone envelope, thus yielding a more anatomically accurate and functional prosthesis that fulfills the esthetic expectations of our patients.

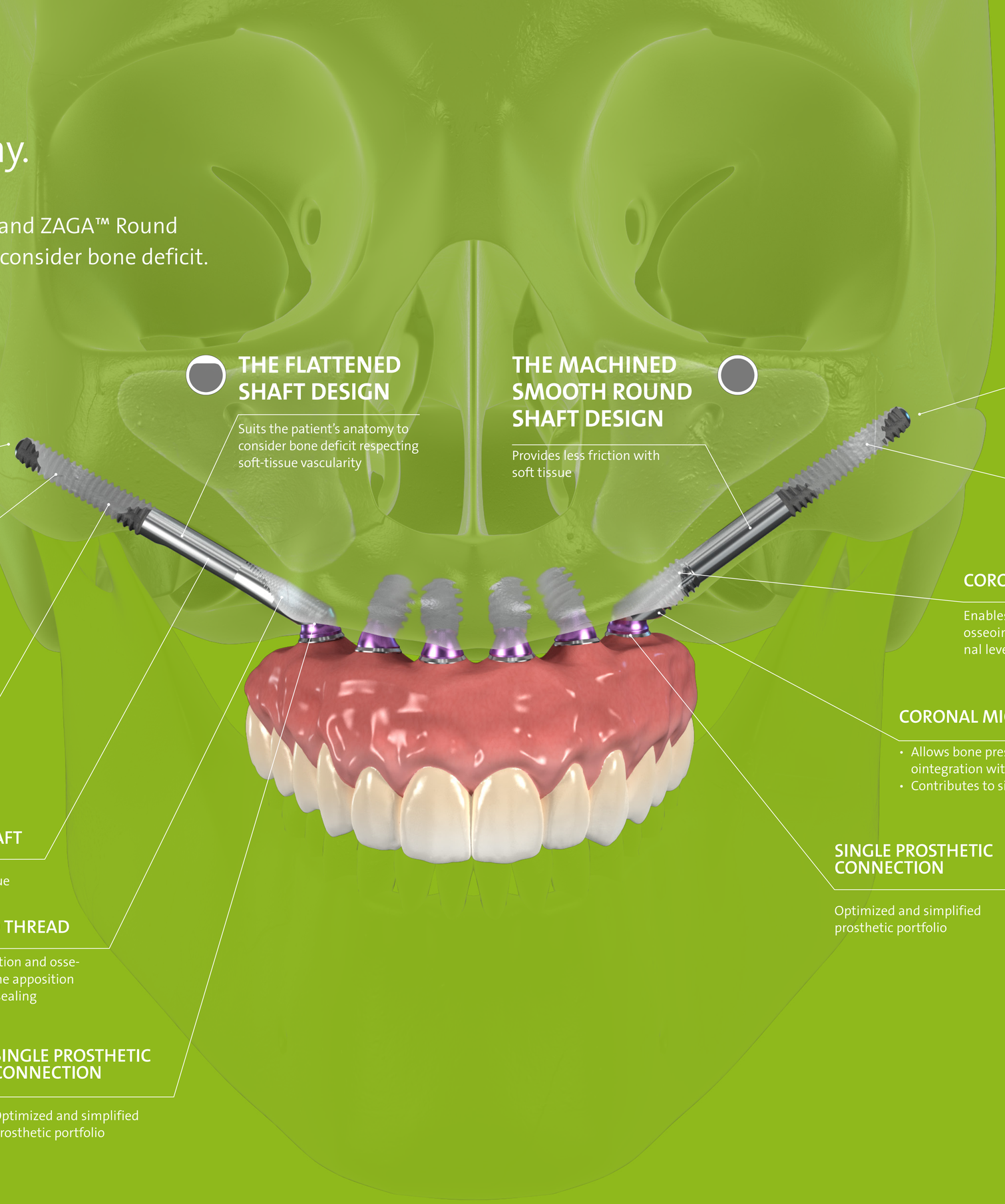
Zygomatic implant placement is associated with a low morbidity and high success rates, avoids the need for grafting and sinus elevation, and therefore contributes to a shorter, comfortable treatment with immediate placement of a fixed screw-retained interim prosthesis.

Over the past two decades, advances have been made in implant design and treatment, improving the planning, placement, and restoration of these severely atrophic maxillae, and making zygomatic implants a first-line treatment option in these situations. Straumann®, as a patient-centered company, was a leader in this field, creating the Straumann® Zygomatic Implant System, developed by experts with the patient in mind. Entering the zygomatic field was the rational step for the treatment of complex cases of patients with severe maxillary atrophy. Greater maturity of the surgical techniques supports graftless modalities and the need to develop innovative implant solutions.

The Straumann® Zygomatic Implant System offers end-to-end solutions: surgery, prosthetics, workflows, and digital enablement, designed to optimize the accuracy and efficiency of treatments, and provide our patients with the greatest clinical needs with an immediate and predictable fixed solution.

Designed to adapt to patient's anatomy.

Two implant designs, ZAGA™ Flat and ZAGA™ Round to suit the patient's anatomy and consider bone deficit.



THE FLATTENED SHAFT DESIGN

Suits the patient's anatomy to consider bone deficit respecting soft-tissue vascularity

THE MACHINED SMOOTH ROUND SHAFT DESIGN

Provides less friction with soft tissue

ROUND AND SMOOTH APICAL END

Protects soft tissue

TAPERED DESIGN

- Maximized zygomatic anchorage
- Thread pitch optimized to 0.8 mm for controlled and fast implant insertion

REDUCED DISTAL DIAMETER (3.4 MM)

Designed for a less invasive osteotomy and implant placement in patients with smaller anatomy

MACHINED SMOOTH SHAFT

Provides less friction with soft tissue

CORONAL MICRO THREAD

- Allows bone preservation and osseointegration with bone apposition
- Contributes to sinus sealing

SINGLE PROSTHETIC CONNECTION

Optimized and simplified prosthetic portfolio

ROUND AND SMOOTH APICAL END

Protects soft tissue

SANDBLASTED ROUGH SURFACES

Optimizes osseointegration in the zygomatic bone

CORONAL THREAD

Enables bone anchorage and osseointegration at the coronal level

CORONAL MICRO THREAD

- Allows bone preservation and osseointegration with bone apposition
- Contributes to sinus sealing

SINGLE PROSTHETIC CONNECTION

Optimized and simplified prosthetic portfolio

The objective of this e-book is to provide anyone interested in using Straumann® Zygomatic implants with a set of illustrations and guidance on how to place zygomatic implants, and also to stimulate this community to engage in a fruitful dialog.

Accordingly, world-renowned authors with high expertise in zygomatic implant-based rehabilitations share this expertise through the proposed collection of clinical cases. They illustrate the usefulness of Straumann® Zygomatic Implants in a wide range of clinical indications that appear to complement each other.

Unilateral rehabilitation with a Straumann® Zygomatic implant is illustrated by Dr. Verdino, and the bilateral placement of two implants by Dr. Zarrine.

Dr. Chow address the combination of Straumann® Zygomatic implants with regular implants inserted by means of guided surgery.

The ZAGA™ concept definitely applies to the Straumann® implant portfolio, as lucidly demonstrated by Dr. Aparicio.

Dr. Davo explains when to use four Straumann® Zygomatic implant, ZAGA™ Round, according to the "quad zygoma" concept, while Dr. Polido demonstrates the usefulness of inserting four Straumann® Zygomatic implants, ZAGA™ Flat, according to the same concept.

Dr. Bedrossian shows how to combine analog principles and digital technology for a treatment plan associating Straumann® Zygomatic implants with Straumann® BLX implants.

Looking forward, Dr. Wu shares his experience on real-time navigation for the placement of Straumann® Zygomatic implants using a synthetic anatomical model.

We hope that, with the aid of this e-book, the readers will be able to appreciate and obtain an understanding of zygomatic implant indications, placement, restoration, and recent and future technological advances.

We would like to sincerely thank all the authors for their outstanding contributions that illustrate daily situations whose lessons are essential, as they correlate directly with real-world practice.

Michel M. Dard, *DDS, MSc, PhD*
Andres Montero Ortiz, *MBA, MSc*

The drafting of this introduction found its roots in the reading of the following authors who are deeply acknowledged for being so inspirational:

- Al-Rafee M J Family Med Prim Care, 2020
- American College of Prosthodontists. Position statement on Zygomatic Implants (Tuminelli F, Balshi J), 2016
- Migliorança R, et al., Dent Oral Craniofac Res, 2019
- Quimby A., Salman S. Atlas Oral Maxillofacial Surg Clin N Am, 2021

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UNILATERAL REHABILITATION AT MAXILLA

DR. JEAN BAPTISTE VERDINO

MEET THE EXPERT

DR. JEAN BAPTISTE VERDINO

DDS, MS Former Clinic Director (University Aix-Marseille, France). Private practice in implant dentistry (Hyeres, France). Lecturer at NYU Implantology PG Program (New York, USA). President of “Graftless Solution Institute”. President of “Zygo Implant Global Organisation”. ITI Member (Basel, Switzerland). Member of Association Française d’Implantologie (AFI, Paris, France). Moderator (France) for “Zygoma Implant Group”.

PATIENT SUMMARY

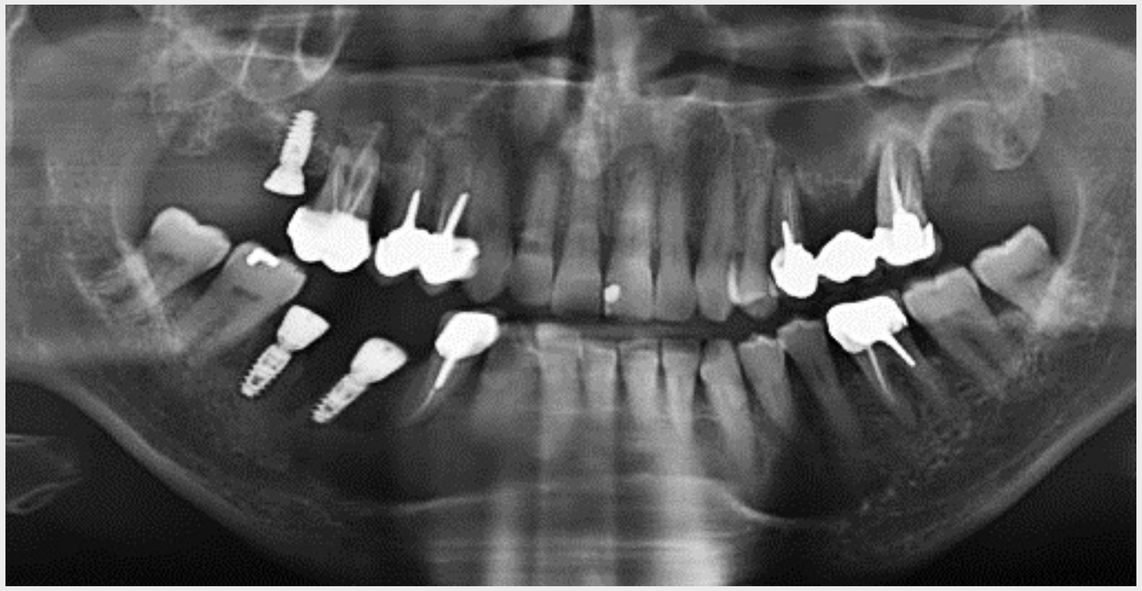
Gender	Male
Age	52
General condition	In good general health conditions
Smoker	Non-smoker
Medication	No medication
CLINICAL AND XRAY EXAMINATION	
Maxillary teeth	Present at positions: 16–25 & 27 hopeless at positions: 24, 25 & 27
Maxillary bone	Resorption:advanced res./severe res. quality: D2–D3
Opposite arch	Restoration necessary: previsiouly performed
TMJ	Disfunction: No
Complaints	Pain & infection
Expectations	Straight-forward restoration avoiding grafting or staged procedures

PATIENT FACE

PATIENT PROFILE

RADIOGRAPHIC EXAMINATION

OPG



An 52 year-old patient presented in our clinic with a chief complaint of severe pain in the upper left pre-molar and molar area.

The patient presented in good health conditions without any relevant conditions that would have prohibited implant placement.

The oral and periodontal status assessment revealed a severe infection at teeth 25 and 27, associated with increased probing depth, bleeding on probing, purpulent discharge, Miller Class I tooth mobility, and pain during palpation.

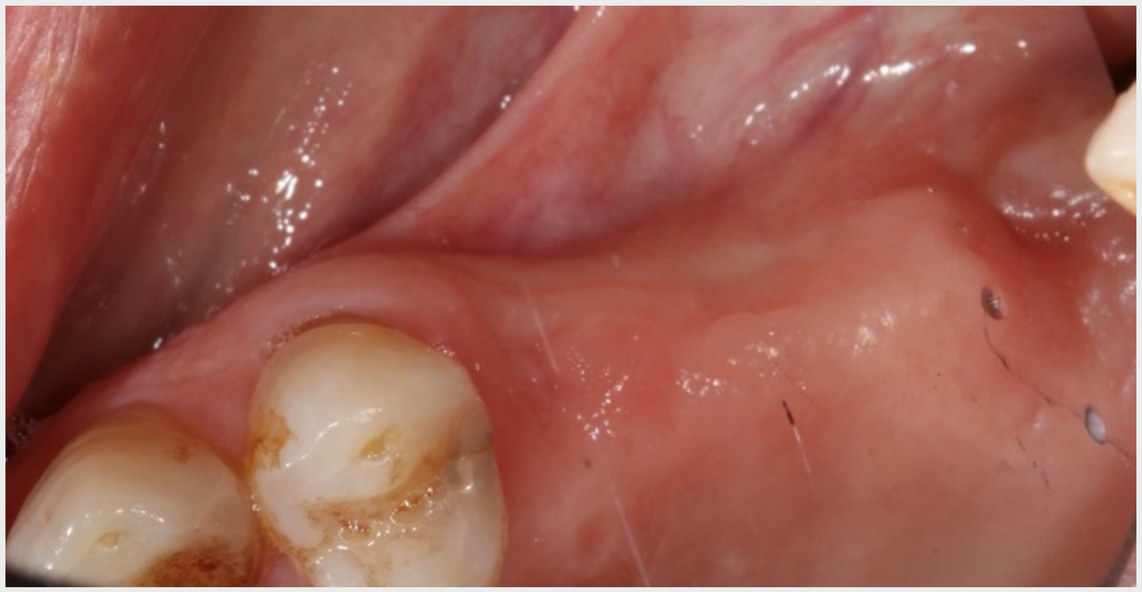
Panoramic radiographs revealed significant vertical bone loss down to the apex and a radiopaque cortex around tooth 27, potentially indicating the presence of a periapical cyst.

TREATMENT SCHEDULE

DECISION PARTIAL ARCH	
Unilateral implants	X
ZYGOMATIC IMPLANT(S)	
Type	Round
Length	45 mm
Position	25/26
REGULAR IMPLANT(S)	
Length	12 & 10 mm
Diameter	3.4 & 4 mm
Position	24 & 27
ABUTMENT(S)	
Type	SRA
Heigh	1.5 mm

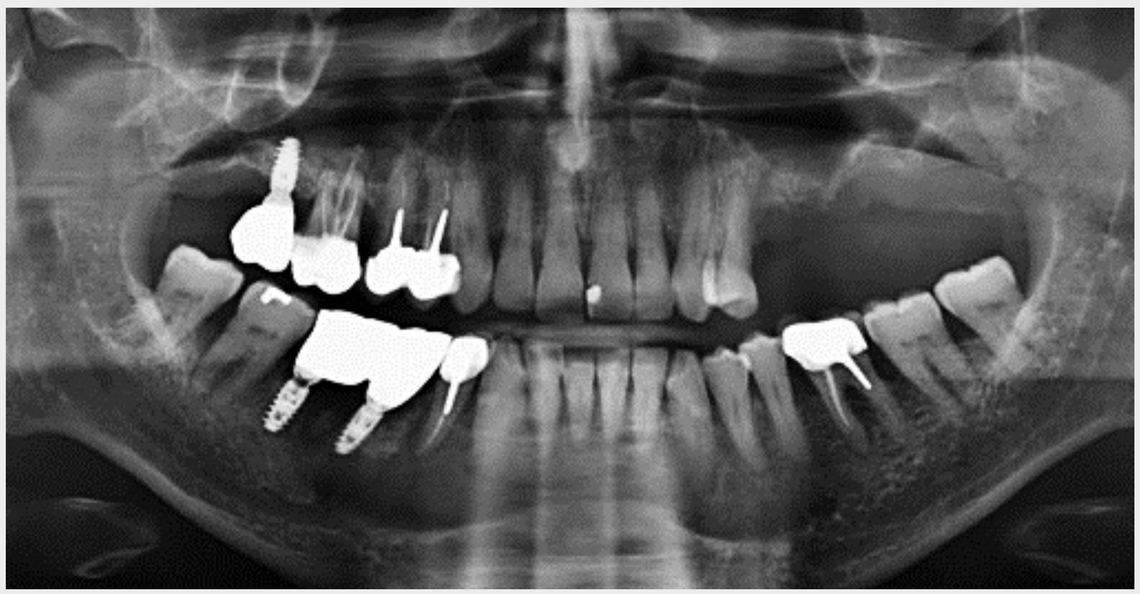
INITIAL THERAPY

Situation after extraction



Based on this diagnose, teeth 25 and 27 were extracted, and oral hygiene measures of the patient were reinforced.

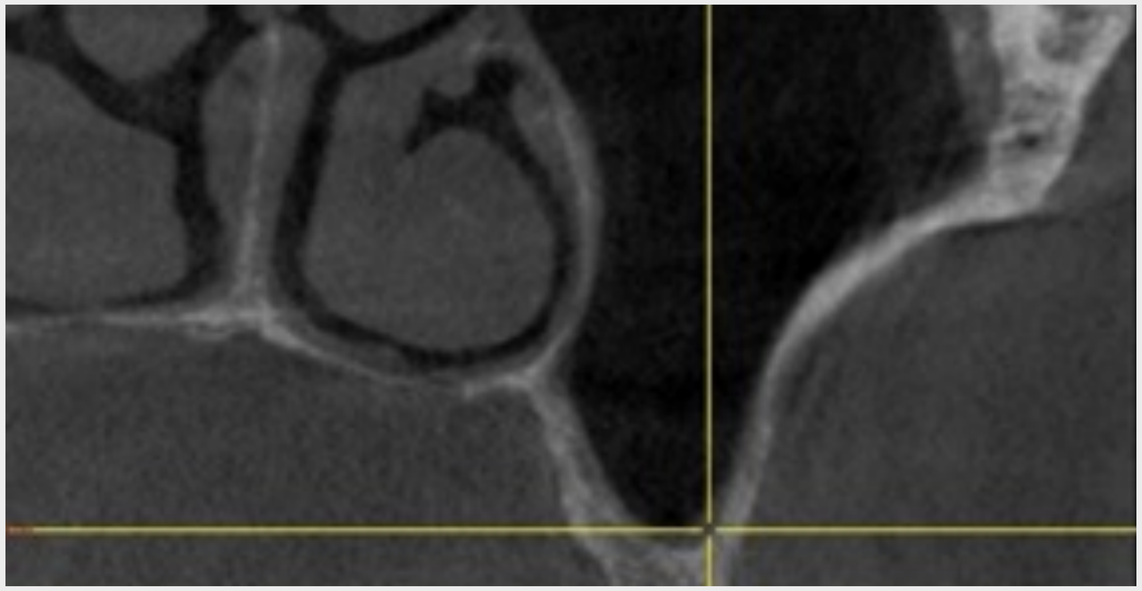
Healing of the extraction sites progressed uneventfully.



Panoramic radiographic examination at 6 weeks post-extraction confirmed the significant vertical bone loss and a severe atrophy of the left distal maxillary arch.

CBCT AND TREATMENT PLANNING

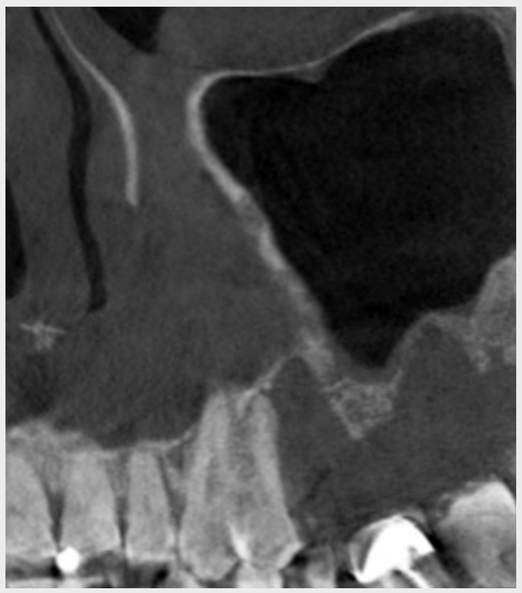
CBCT



CBCT diagnosis revealed a pronouncedly pneumatized sinus and a thin sinus floor in the extracted area.

Detailed CBCT analysis also revealed complete resorption of the distal alveolar support of tooth 24 down to the apex, classifying this tooth as hopeless and indicated for extraction.

CBCT also confirmed the lack of significant vertical osseous dimensions between the left first premolar area and the tuberosity impeding patient rehabilitation with a fixed prosthetic restoration supported by regular implants.

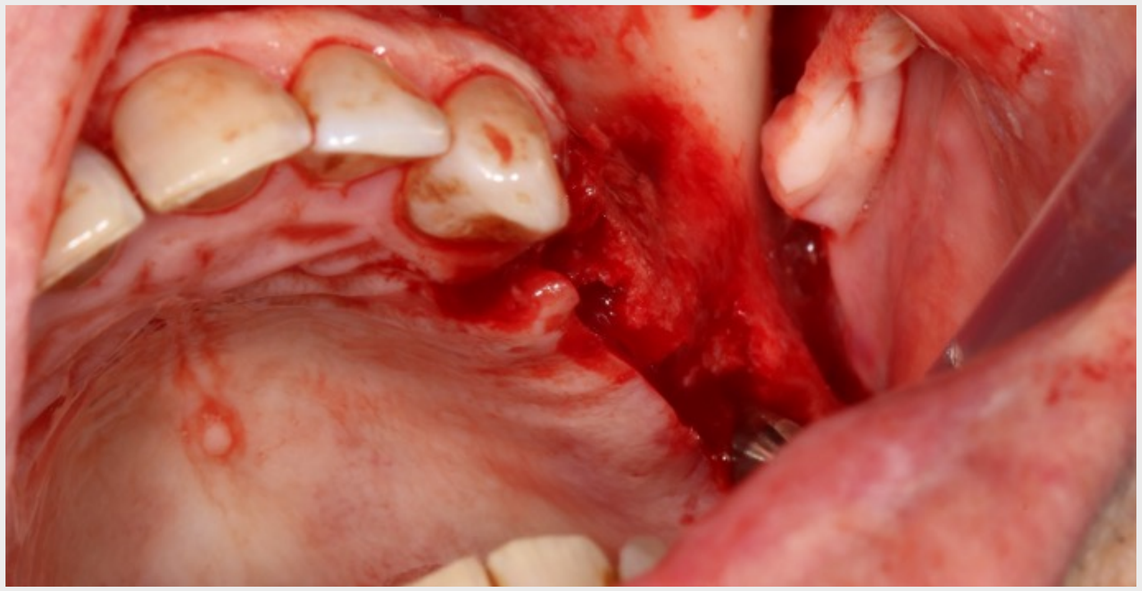


After discussing the benefits, risks, and alternative treatment options, the patient consented to an immediate, fixed first-premolar to second molar rehabilitation supported by two lateral, regular implants and one central Straumann® zygomatic implant without bone grafting.

Treatment planning as performed conventionally. The anatomical situation in the posterior area was classified ZAGA 1–2. The patient displayed thick and abundant keratinized mucosa considered appropriate to support the planned treatment concept.

ANESTHESIA, INCISION AND FLAP ELEVATION

Incision and flap elevation



Surgery was carried out following local infiltration anesthesia using Alphacaine SP. Antibiotics were administered 2 days before surgery until 8 days after surgery (Amoxicillin/clavulanate potassium).

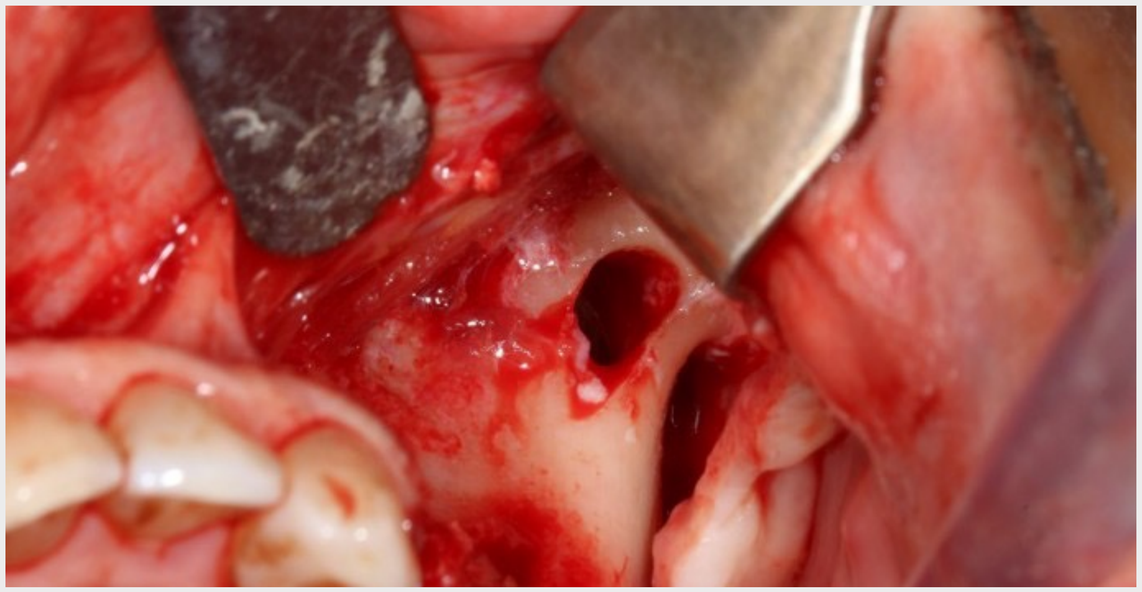
The anesthetic was injected at the tuberosity, infraorbital nerve, anterior palatine nerve, mucogingival junction behind the canine, and anterior zygomatic buttress.

After extraction of the premolar in position 24, a mucoperiosteal flap was elevated by a midcrestal surgical incision between the lingual side of the maxillary tuberosity and the distal aspect of the canine. Vertical buccal and oral releasing incisions were performed at the distal aspects of the canine.

Care was taken to preserve the integrity of the mucoperiosteal flap and its vascularization

OSTEOTOMY PREPARATION

Sinus Window

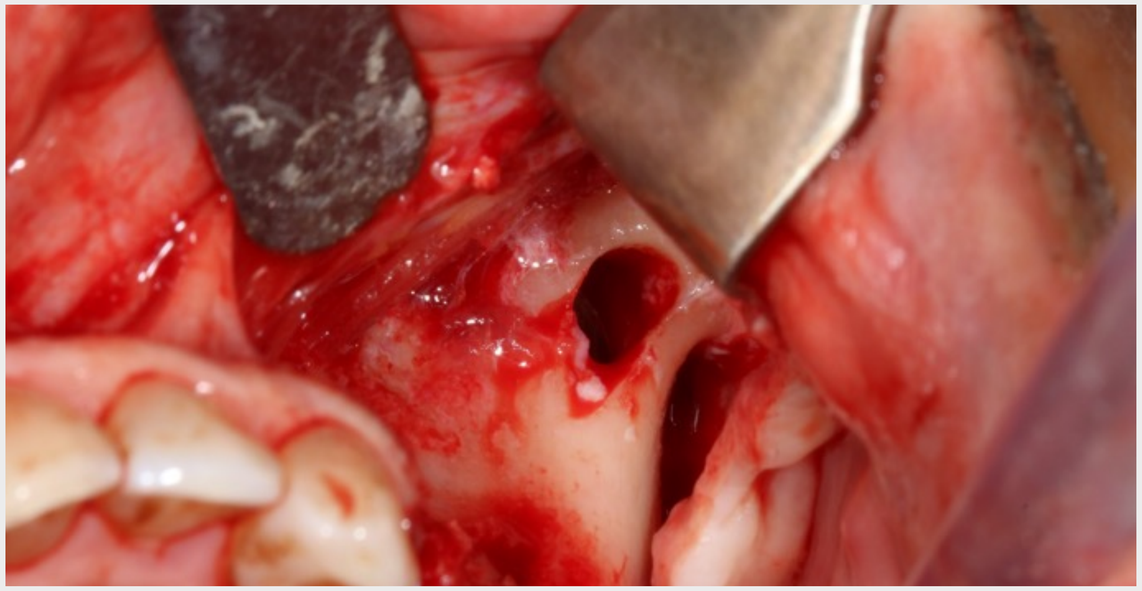


The residual alveolar ridge, the lateral maxillary sinus wall and the zygomatic bone were exposed by retracting the soft tissues up to the frontozygomatic notch.

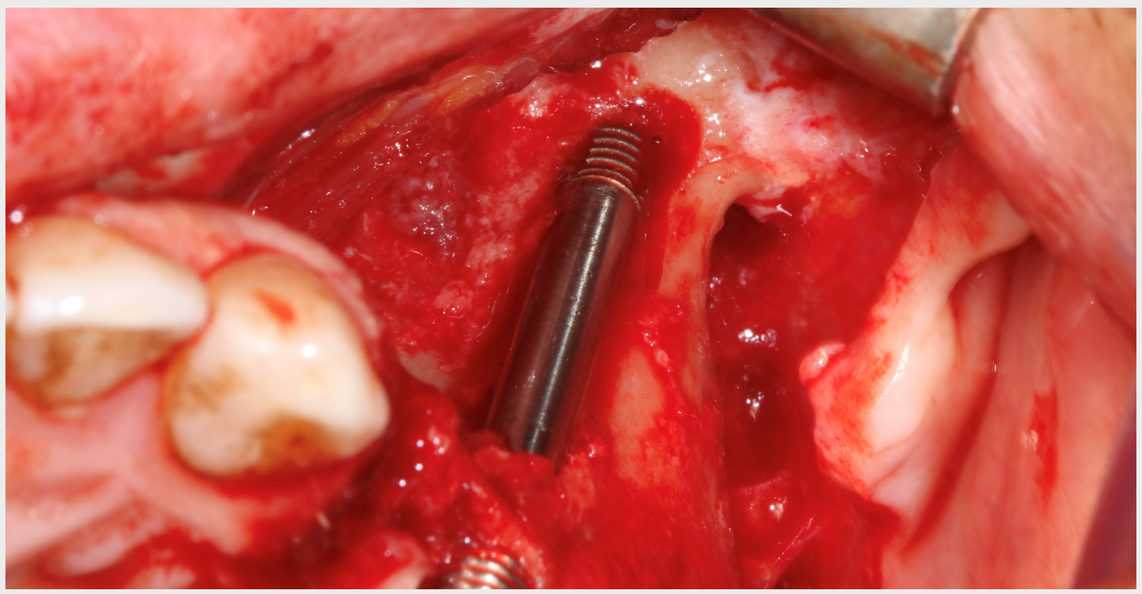
The osteotomy was prepared with a sinus window at the anterior roof of the sinus and by exposing the inferior aspect of the zygomatic bone (antrostomy zone).

OSTEOTOMY PREPARATION

Osteotomy preparation/slot



Exposure of the surgical site revealed a slightly concave lateral sinus wall and a buccal extension of the remaining bone crest (ZAGA™ ½). This anatomy allowed for a bicortical stabilization of the implant platform in the alveolar crest. The connecting geometry could be positioned midcrestally for optimal integration into the prosthetic restoration.



Next, a “slot” thorough the lateral maxillary sinus wall was prepared up to the zygomatic buttress region as proposed by Stella and Warner [1]. The slot was widened, and the osteotomy was extended into the zygomatic bone for implant insertion.

An alternative implant trajectory would have oriented the implant through the maxillary sinus. However, such trajectory would result in a distinctly more palatal emergence of the implant platform and render the prosthetic restoration more complex and potentially anatomically less ergonomic for the patient.

PLACEMENT OF ZYGOMATIC IMPLANTS

Drilling sequence

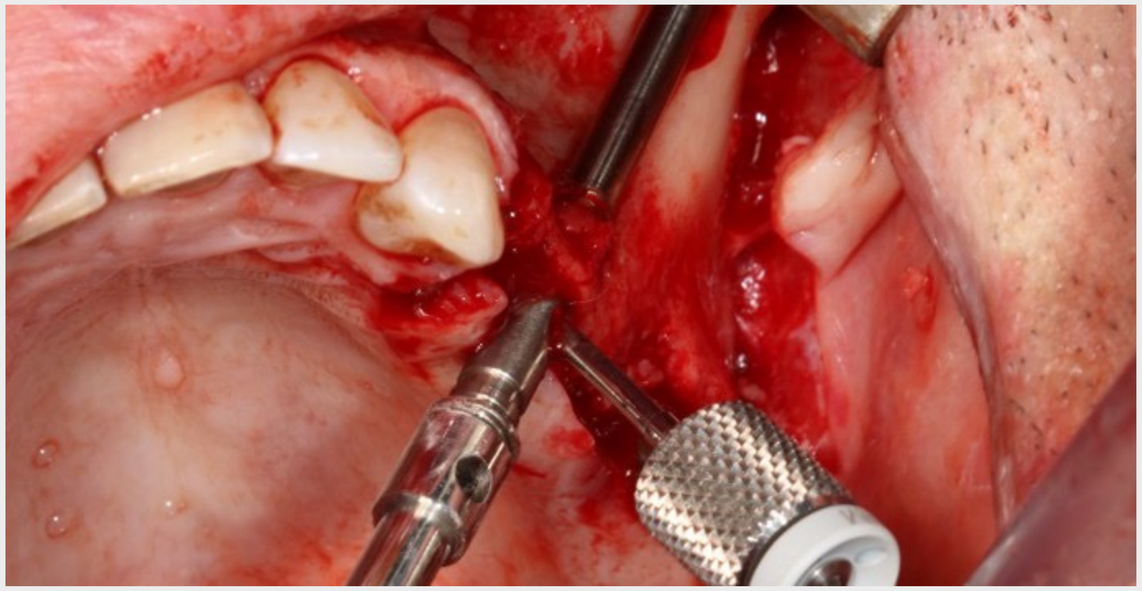
To ensure integrity of the alveolar ridge a Straumann® Zygomatic implant, ZAGA™ Round, length 45 mm was chosen.

The drilling sequence was performed according to the following sequence:

DEVICE	Dimensions
Needle drill	diameter = 1.6 mm, length = 33 mm
Round burr	diameter = 2.9 mm,
Twist Drill	diameter = 2.9 mm
Twist Drill	diameter = 3.5 mm, length = 15 mm

PLACEMENT OF ZYGOMATIC IMPLANTS

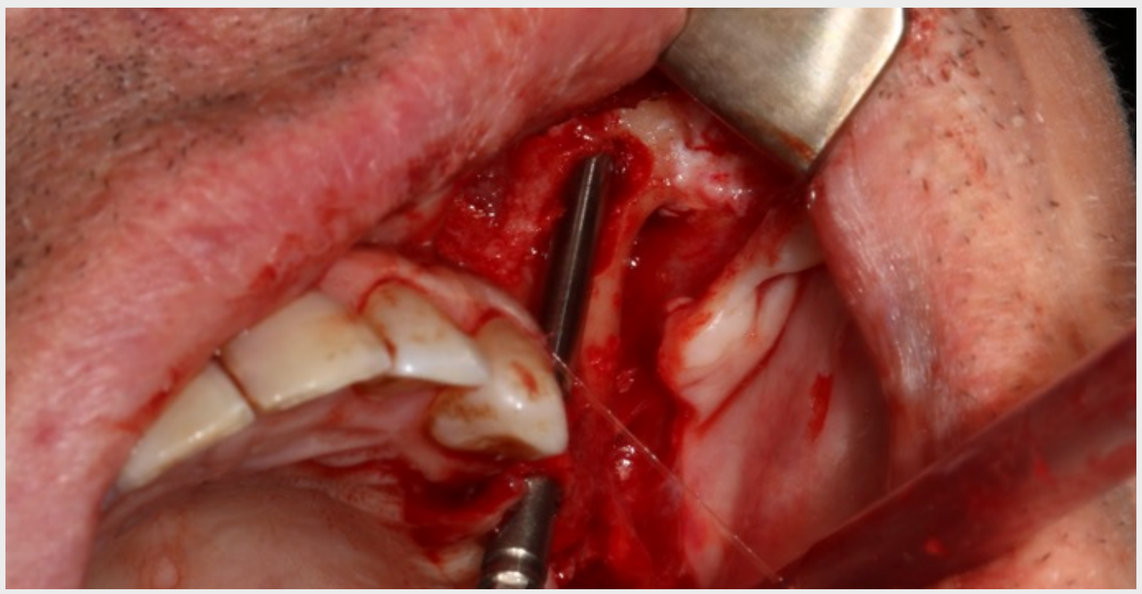
Insertion



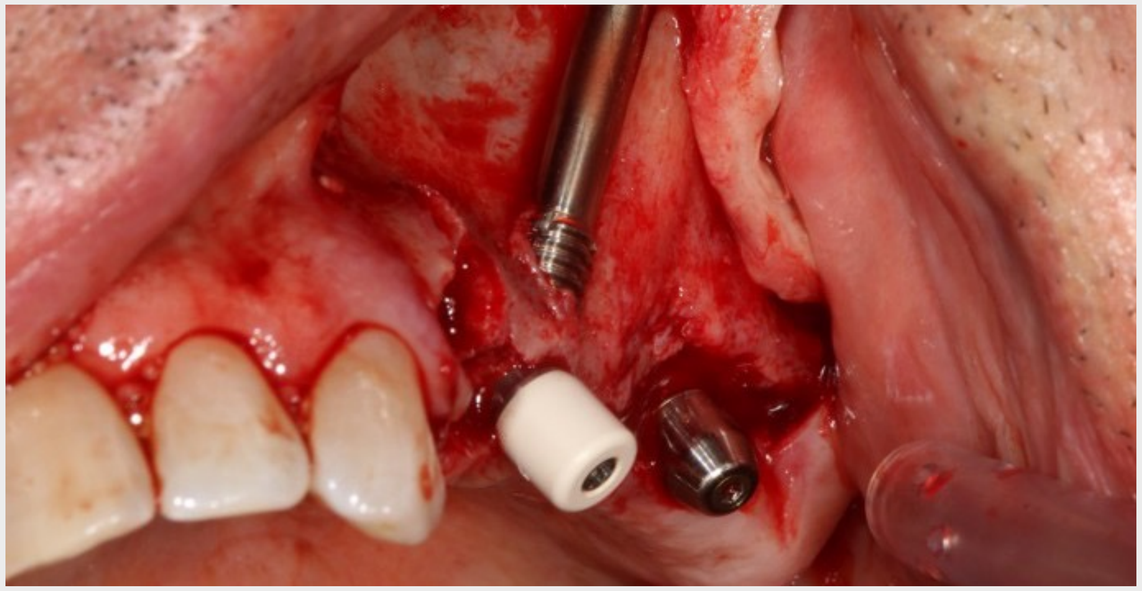
Implant placement was performed using a motorized hand piece followed by manual adjustment.

The implant's proper orientation and positioning were controlled using the fixture mount screw connected to the mount Hex Driver until reaching a position perpendicular to the alveolar ridge.

This procedure allowed for an ideal emergence of the implant platform relative to the alveolar crest and a suitable alignment of all 3 implants. Primary stability above 35 N/cm was reached, confirming solid anchorage in the zygomatic bone.



PLACEMENT OF REGULAR IMPLANTS

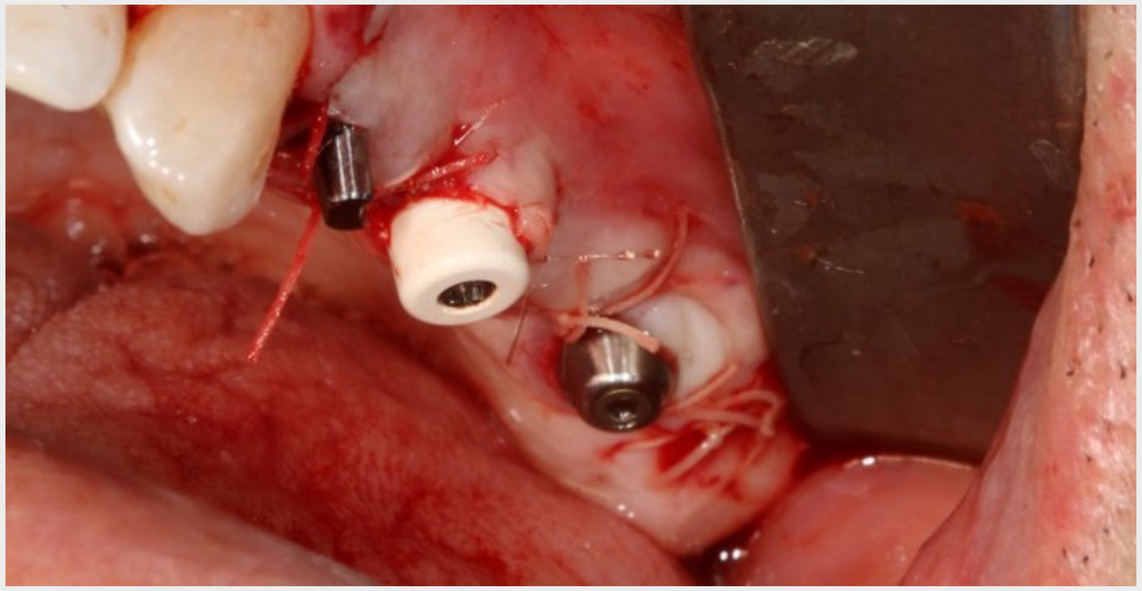


Subsequently, a Ø 3,4 x 12 mm implant was inserted in the extraction socket in position 24 after preparing the osteotomy with an entry point located 5 mm distal to the canine. The implant was tilted mesio-palatally for adequate engagement with residual bone and under consideration of the tooth root of tooth 23. The implant was restored with an aesthetic abutment (Anthogyr® 15°/4 mm) to support a single temporary crown.

A second Anthogyr® 10 x 4 mm PX implant was placed in the distal position close to the tuberosity. The implant was restored with a 1,5 mm regular multi-unit abutment and covered by a healing cap.

The zygomatic implant was restored with a 1,5 mm SRA abutment and a short healing cap for unloaded transgingival healing.

WOUND CLOSURE AND POST-SURGICAL CARE



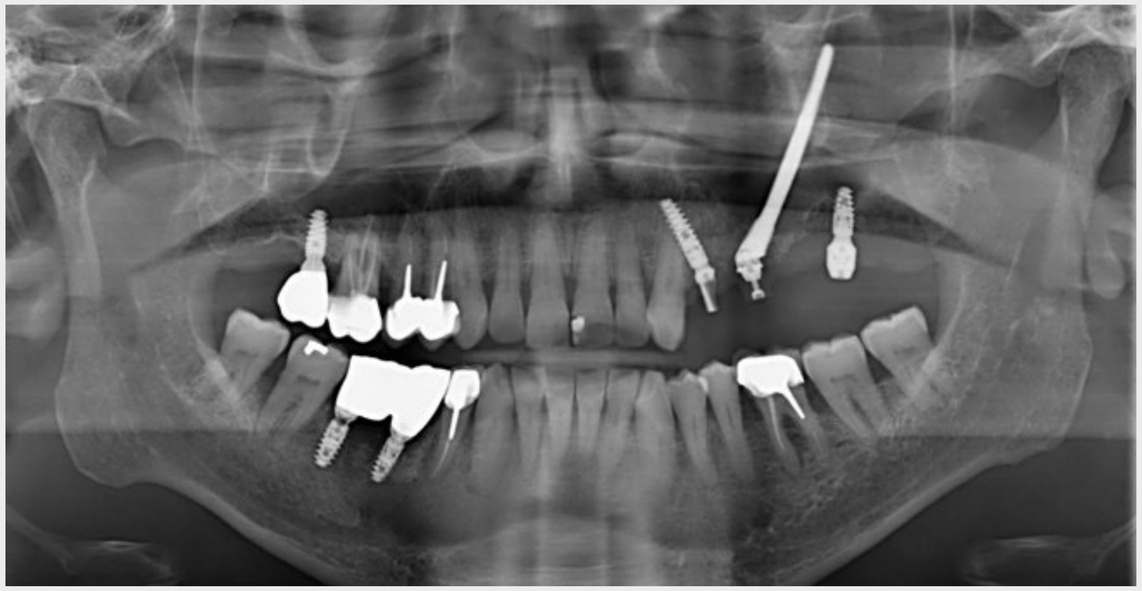
The flap was closed with a 3.0 monofilament resorbable suture. Special attention was paid to repositioning the keratinized gingiva at the buccal aspect of the implants and around the respective abutments.

The patient was instructed to clean the abutments carefully and recalled every 3 weeks until final restoration. The patient was examined for implant stability and any signs of inflammation or pain.

Post-surgical healing was uneventful.

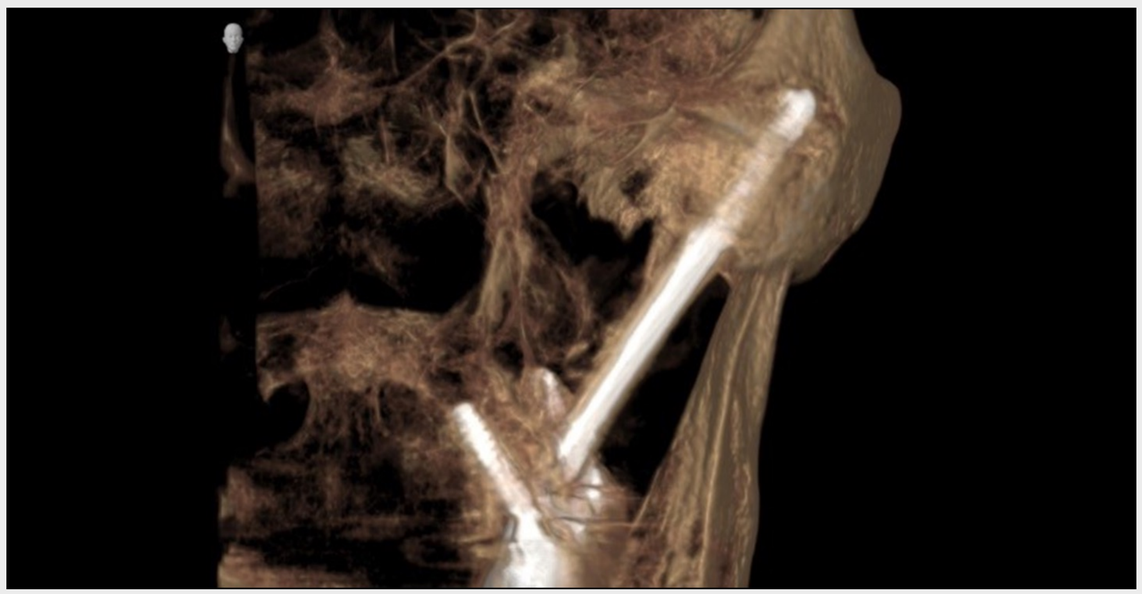
RADIOGRAPHIC EXAMINATION

OPG



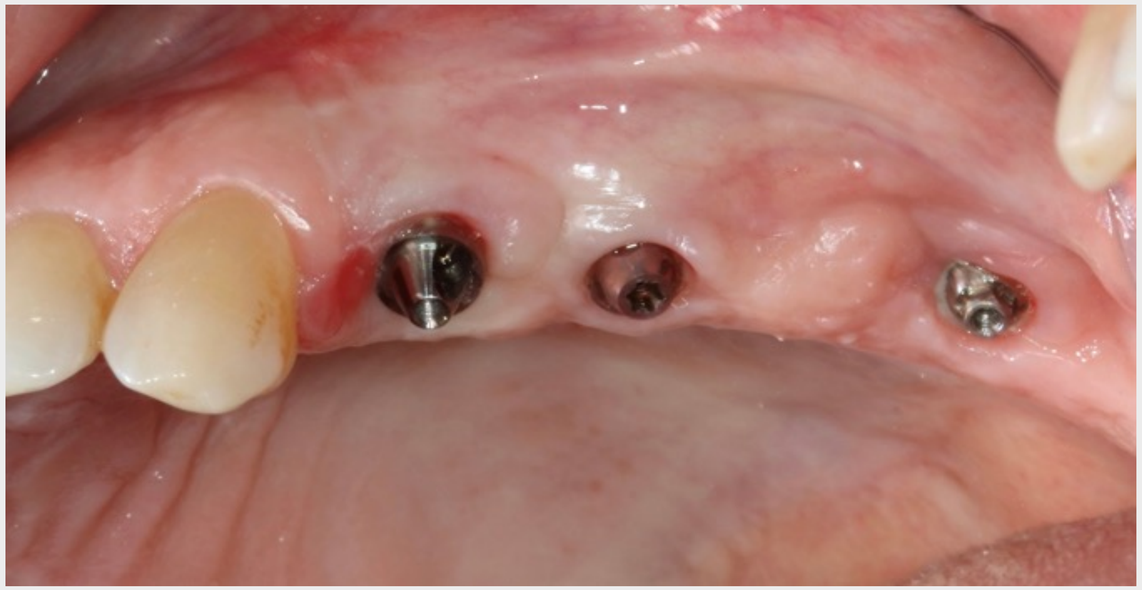
A post-operative panoramic radiograph was recorded to verify the adequate placement and positioning of the implants.

CBCT



A CBCT scan of the patient was obtained at the time of final restoration, i.e., 4 months post-surgery, to confirm the adequate integration of the implants in bone.

IMPRESSION



After 4 months of healing, a clinically stable and good soft tissue integration of the abutments was observed, allowing to progress into final restoration. The healing caps were removed, and each abutment was tightened at 35 Ncm for the zygomatic implant and 25 Ncm for the regular abutments.

A milled zirconia bridge was obtained using conventional laboratory techniques. In brief, impression posts were mounted on the abutments, and open tray impressions were performed using a combination of light-bodied and heavy-bodied polyvinyl siloxane impression material. Bite registration was performed after testing the passivity using a verification jig.

PROSTHESIS

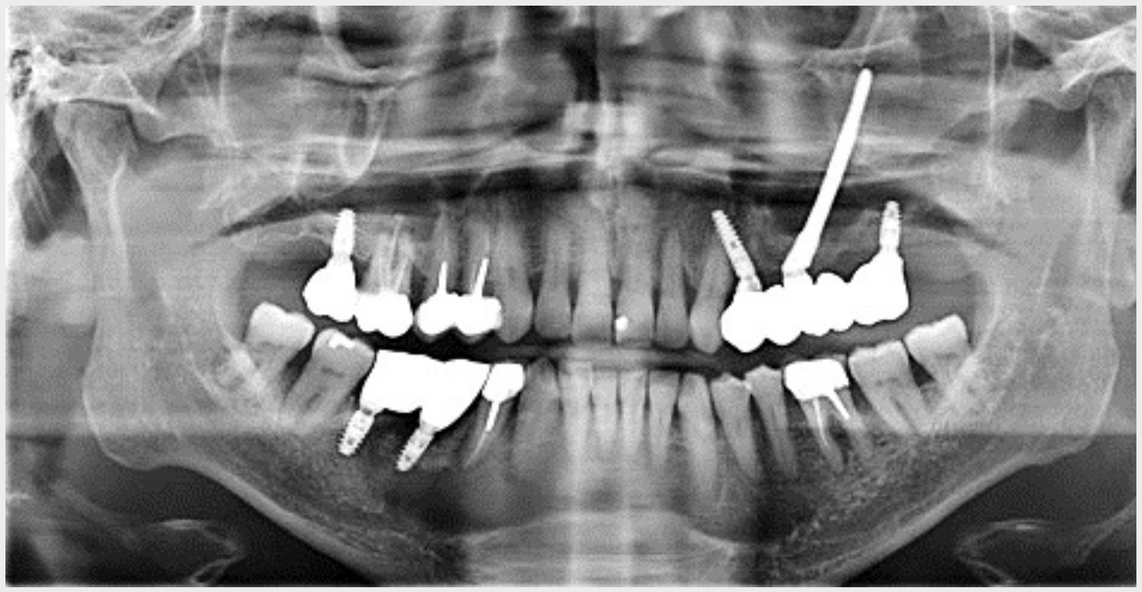
Before placement

A final full zircon bridge was milled and delivered two weeks later It was tightened at 15 Ncm, and the occlusion was checked and carefully adapted to avoid any lateral interferences and overload.

After insertion

CLINICAL OUTCOME

OPG



Panoramic radiographs after final restoration confirmed adequate passive fit of the prosthetic bridge and the implant restoration.

CLINICAL OUTCOME

This technique allowed the patient to receive a 4 unit screw-retained bridge following a single surgical intervention with high predictability. The patient expressed his satisfaction with the achieved aesthetic and functional results.

TAKE HOME MESSAGES

The treatment concept was based on a single surgical intervention without requiring a staged surgical approach including extensive bone regeneration. Careful surgical adaption of the implant trajectory of the zygomatic implant to the patients anatomy was essential to ensure adequate stabilization and straightforward prosthetic integration. Careful consideration of the residual alveolar crest and management of the alveolar soft tissue architecture to prevent post-surgical soft tissue dehiscences was considered important.

LITERATURE REFERENCES TO REMEMBER

Stella J. Warner M. Sinus slot technique for simplification and improved orientation of zygomaticus dental implants: a technical note, Int. J. Oral
Maxillofac. Implants, 2000, 15: 889-893

Araújo PPT, Sousa SA, Diniz VBS, Gomes PP, da Silva JSP, Germano AR. Evaluation of patients undergoing placement of zygomatic implants using sinus slot technique. Int J Implant Dent 2016; 2: 2.

Acknowledgements

The author acknowledges Dr Nicolas Renou and Mr Gilles Giordanengo, Dental Prosthetic Technician for their outstanding contribution.

BILATERAL PLACEMENT OF TWO ZYGOMATIC IMPLANTS COMBINED WITH STRAUMANN® BLX IMPLANTS

DR. SEPEHR ZARRINE

MEET THE EXPERT

DR. SEPEHR ZARRINE

DDS, MFS. Private practice in implant dentistry (Saint Dié, France).

Chairman of ITI France.

ITI Fellow & speaker.

Director of Surgitech Studies.

PATIENT SUMMARY

Gender	Female
Age	55
General condition	Healthy, no medical problems
Smoker	Yes
Referral	Yes
Oral hygiene status	Acceptable
Medication	No
Recent dental checkups	Yes, Treatment decided: Implant rehabilitation in maxilla in my office/dental restoration and removable prosthesis in mandible by the general dentist
CLINICAL AND XRAY EXAMINATION	
Low smile line	
Maxillary teeth	Present at positions: 13, 21, 22, 24 hopeless at positions: 13, 21, 22, 24 decayed roots with infection
Maxillary bone	Advanced resorption in sinus areas/severe resorption quality: D3
Opposite arch	Restoration necessary: Yes performed
TMJ	Disfunction: No
Complaints	Pain, infection & mobility
Expectations	Fixed teeth without grafting grafting or staged procedures

PATIENT FACE

PATIENT PROFILE

INITIAL INTRAORAL EXAMINATION

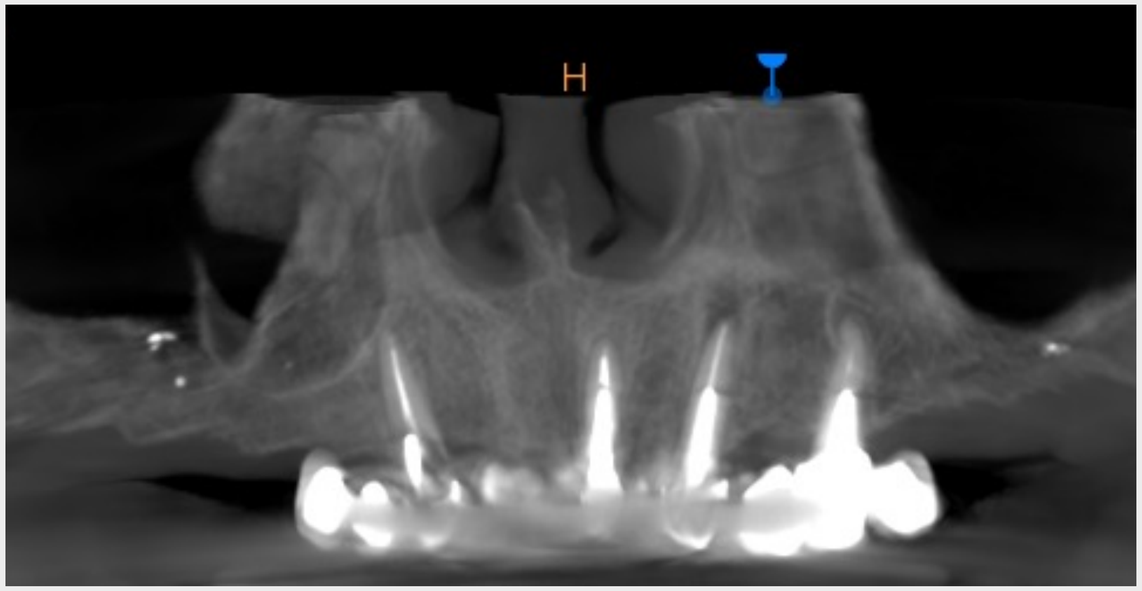
Situation prior-treatment

A 55 years-old patient was referred in our clinic with a chief complaint of severe pain in the upper jaw and severe mobility of the dental bridge.

The oral and periodontal status assessment revealed a a decayed teeth 13, 21, 22, 24, associated with increased probing depth, bleeding on probing, purpulent discharge, severe dental bridge mobility, and pain during gingiva palpation.

RADIOGRAPHIC EXAMINATION

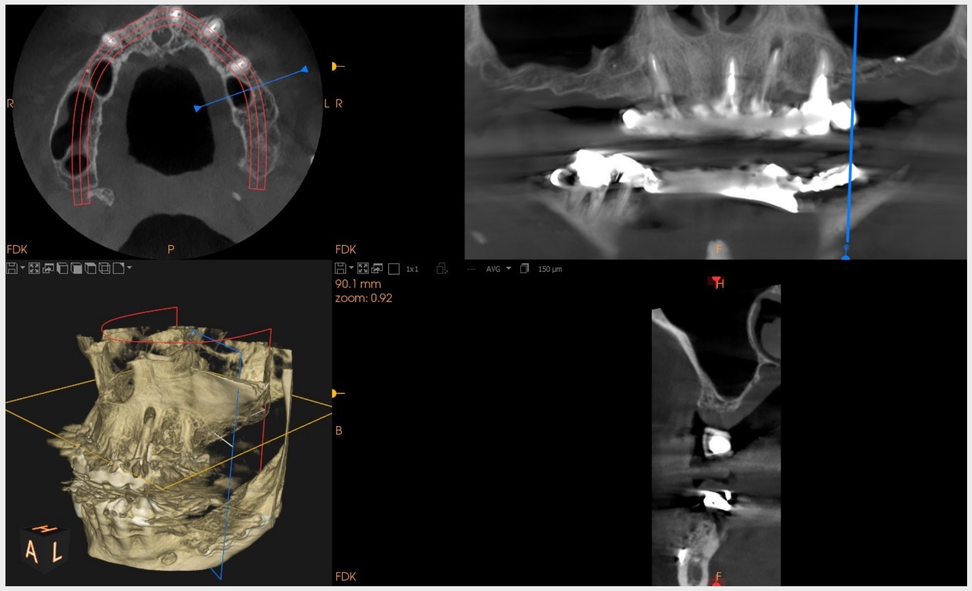
OPG



The X-ray has confirmed decayed roots 13, 21, 22, 24, associated with peri-apical infection of 22 and 24.

RADIOGRAPHIC EXAMINATION

CBCT

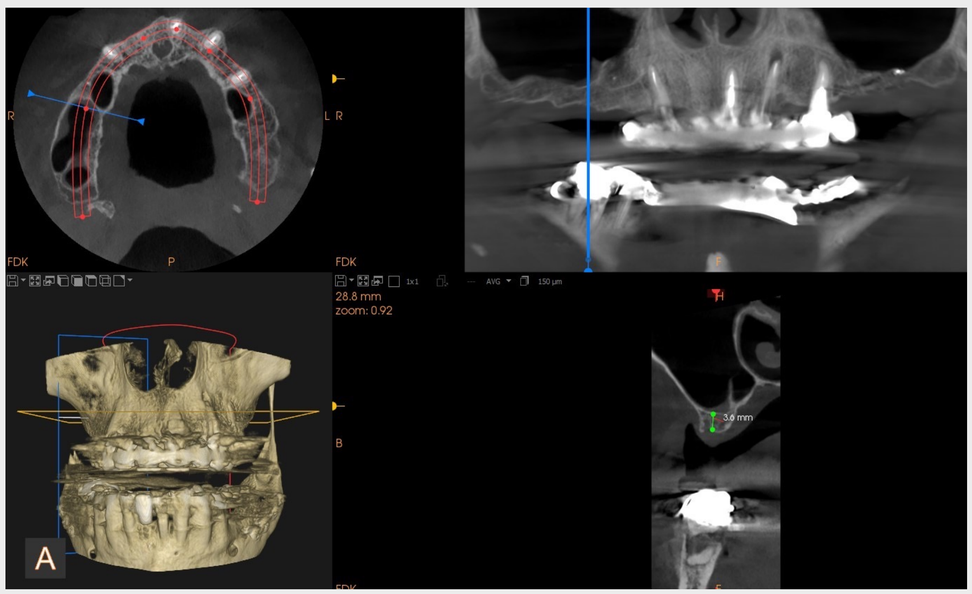


CBCT diagnosis revealed an important pneumatized sinus and a thin 3 mm sinus floor.

In position of second premolar and first molar the bone was not sufficient for conventional or tilted implants without sinus grafting and also doesn't allow a fixed temporary bridge and immediate loading.

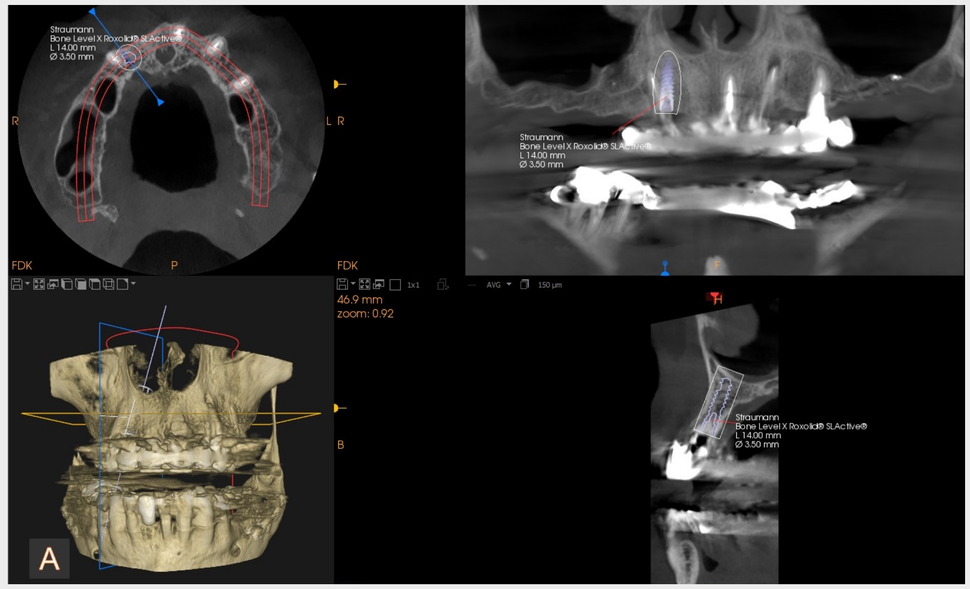
No sinus pathology.

Insufficient height of bone in sinus areas. Good bone thickness in first molar positions.



RADIOGRAPHIC EXAMINATION

CBCT and treatment planning

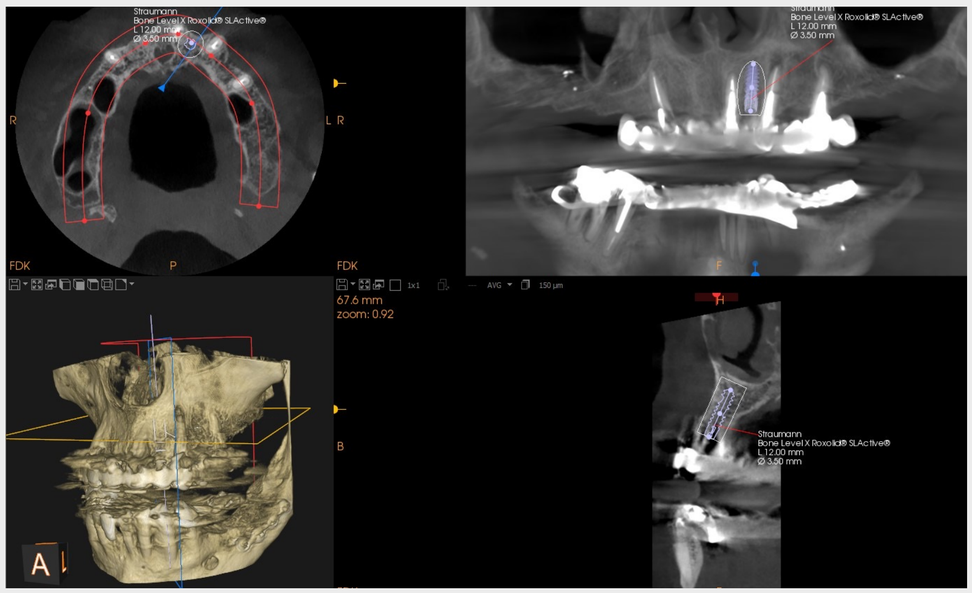


The dental bridge and the 4 roots would be removed.

2 conventionnal implants were planned in anterior site by immediate placement. Straumann® BLX were chosen allowing a high primary stability.

The diameter would be 3.5 mm to respect the bone volume.

After discussing about the alternative bone grafting treatment option, the patient has preferred immediate conventional and zygomatic implants allowing a immediate loading with fixed temporary bridge.



TREATMENT SCHEDULE

DECISION FULL ARCH

1/Maxillary full arch rehabilitation
Upper teeth removing
Immediate implant placement
Immediate loading

ZYGOMATIC IMPLANT(S)

2 Straumann® zygomatic implants in posterior areas
Position 15 / 26

BIOMATERIALS

No biomaterials
No bone grafting

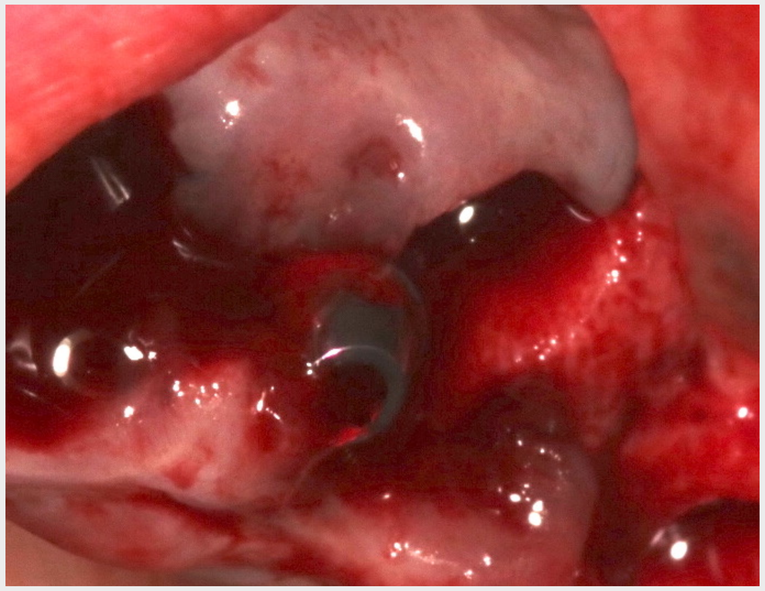
ABUTMENT(S)

2 BLX SRA abutments
2 Zygomatic SRA abutments
Provisional screwed bridge screwed on SRA abutments

PROSTHESIS

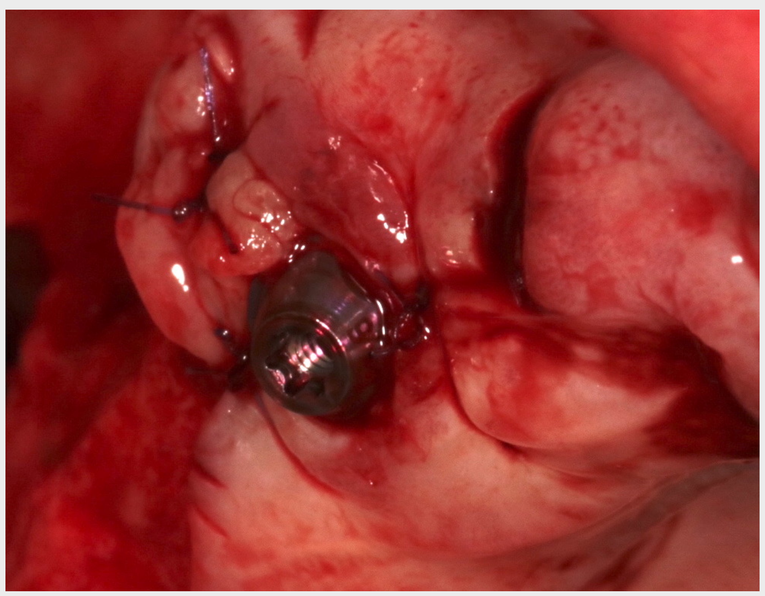
Final acrylic fixed prosthesis screwed on SRA abutments
Titanium cadcam framework
Low composite gingiva height to create a nice height of teeth and papillae
No cantilever

REGULAR IMPLANTS PLACEMENT



Surgery was carried out with local anaesthesia infiltration and conventional maxillary blocks using Alphacaine SP without sedation.

Ø 3,5 x 12 mm BLX Straumann® implant was inserted in position 22 in a bone between two extraction sockets after realising a small flap. High primary stability > 50 N/cm + SRA abutment 2,5 mm with 35 N/cm torque.



Ø 3,5 x 14 mm BLX Straumann® implant was inserted in the extraction socket without flap in position 13 after preparing the osteotomy with an entry point in mesio-palatal bone for adequate axis and high primary stability + SRA abutment 3,5 mm with 35 N/cm torque. The buccal keratinized gingiva has been reinforced by papilla rotation.

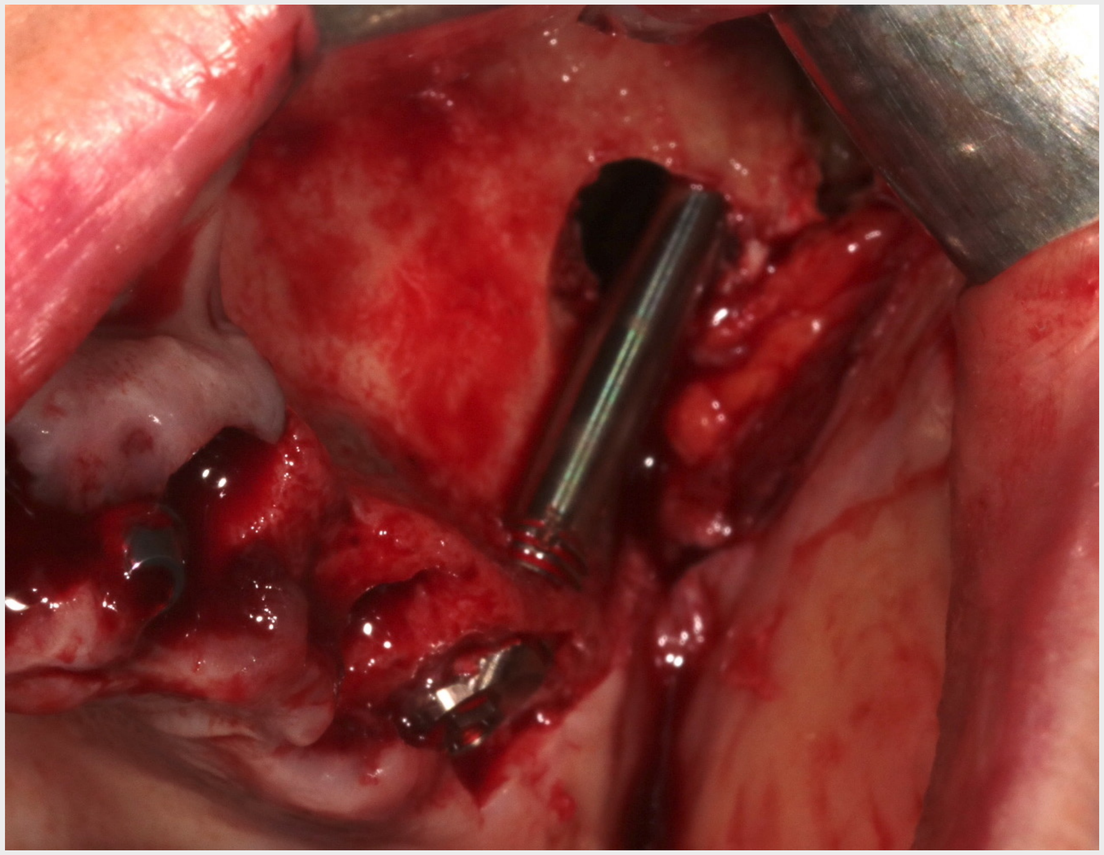
FLAP ELEVATION AND SINUS WINDOW

After extraction of the 4 decayed roots, a mucoperiosteal flap was released by a mid-crestal surgical incision from the maxillary tuberosity to the distal side of the canine with 2 vertical releasing incisions.

The angled retractor is placed in the fronto-zygomatic notch. A lateral window was opened to see the roof of the sinus and the base of the zygoma bone. It’s not necessary to keep the Schneiderian membrane intact.

An indentation with round bur was made on the roof of the sinus preventing the drill from slipping.

ZYGOMATIC IMPLANT PLACEMENT



The osteotomy was made trough the crestal bone ridge to keep bone around the implant platform.

2 entry points were defined: on the crestal ridge and on the base of the zygoma bone.

The two points were connected with 2.9 mm drill and the lateral sinus bone was retrieved during the drilling. The apex of the drill had transfixed the lateral cortex of zygomatic bone.

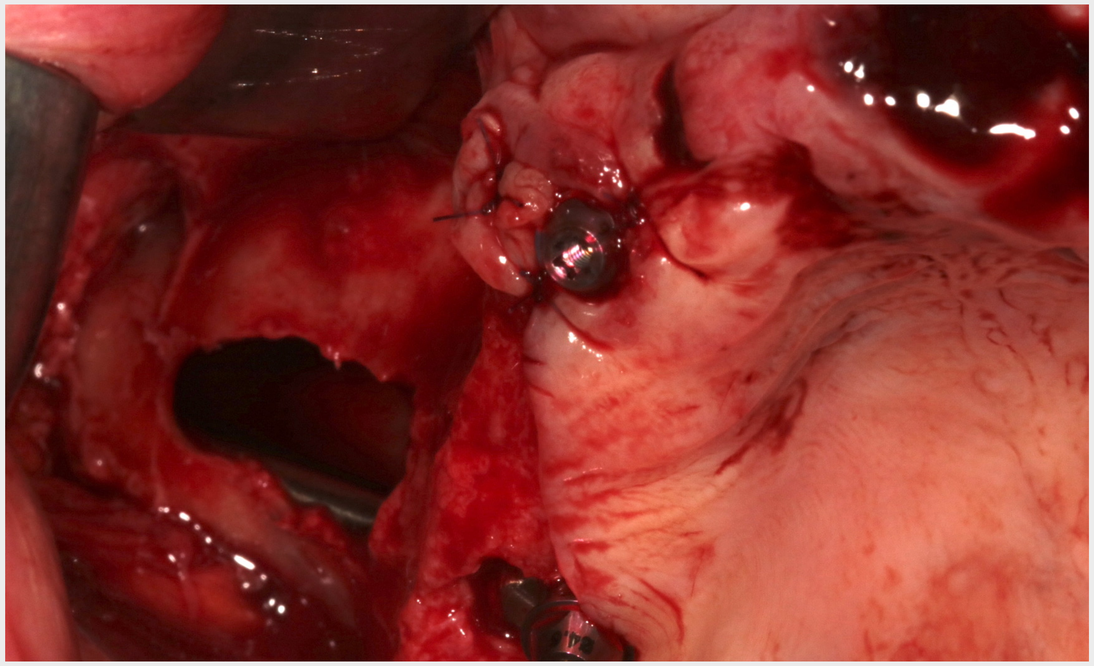
The whole procedure was conducted free-hand and the direct visualisation allowed to see the apex of the drill, the tip of the deep gauge and the apex of the implant.

The trajectory of the middle part of the implant was located extra-maxillary.

Ideal emergence of the implant relative to the alveolar crest was achieved as high primary stability with solid anchorage in the zygomatic bone.

Position 26: Straumann® Zygomatic implant, ZAGA™ Round, 40 mm
SRA Zygomatic abutment 2,5 mm was torqued at 35 N/cm

ZYGOMATIC IMPLANT PLACEMENT



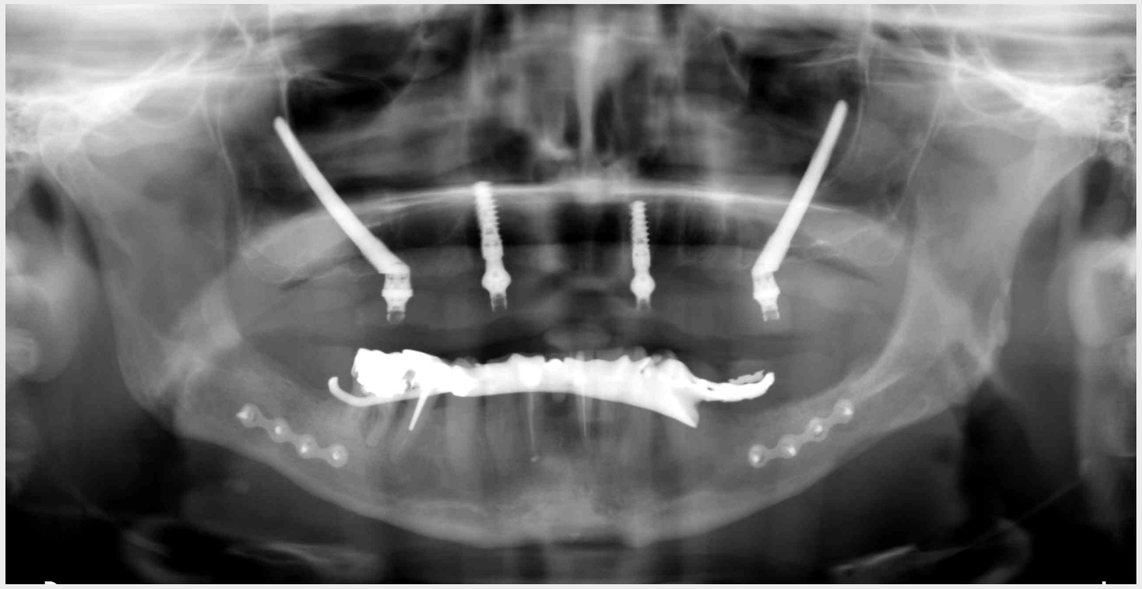
Osteotomy preparation and implant insertion were carried out in an anteroposterior order. The crestal position of the anterior and posterior implants was defined in the zones of the canines or lateral incisors and the zones of the molar or premolar areas, respectively.

Further implant positions were planned to respect an even distribution in the zygomatic bone and adequate spacing.

Implant osteotomy preparation started at the palatal aspect of the alveolar ridge using a round bur.

POST-OPERATIVE RADIOGRAPHIC EXAMINATION

OPG



The flap was sutured with resorbable monofilament suture 6.0 and was correctly placed to protect the implant platforms with a large keratinized gingiva.

A post-operative panoramic radiograph and a CBCT were recorded to verify the adequate placement and positioning of the implants. The AP distribution of the 4 implants was ideal for the mechanical distribution.

The provisional bridge was screwed the same day afternoon on the SRA abutments.

CLINICAL OUTCOME

2 weeks after the surgery

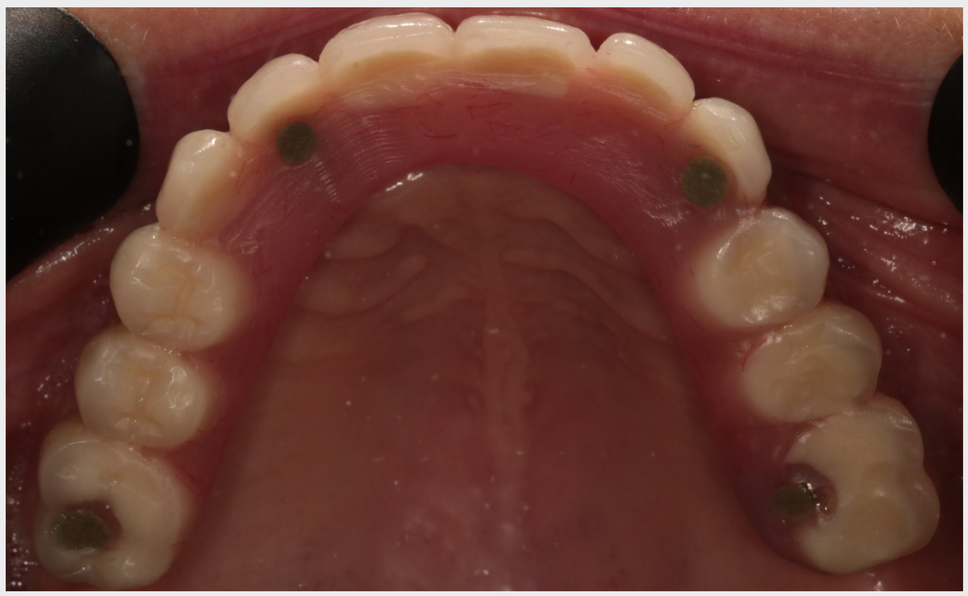
No more edema and no more hematoma after 2 weeks.

The face was completely normal .

CLINICAL OUTCOME

After 2 healing months

Intraoral view
After 2 months of healing, a clinically stable and good soft tissue integration was observed.



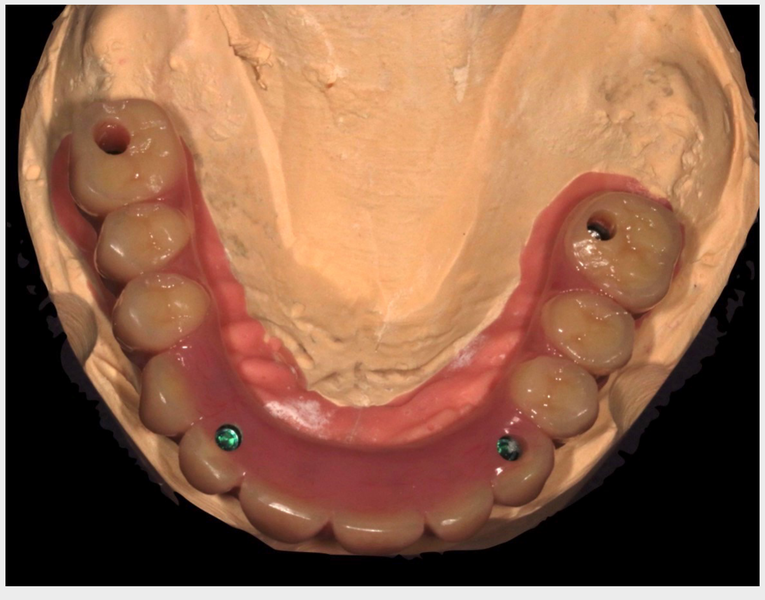
Occlusal view
Showing the adequate position of the screw holes.

PROSTHESIS

Before placement

A final titanium framework was milled by Createch.

The contact on the gingival ridge is only with the titanium framework without any concavity that could trap the food.

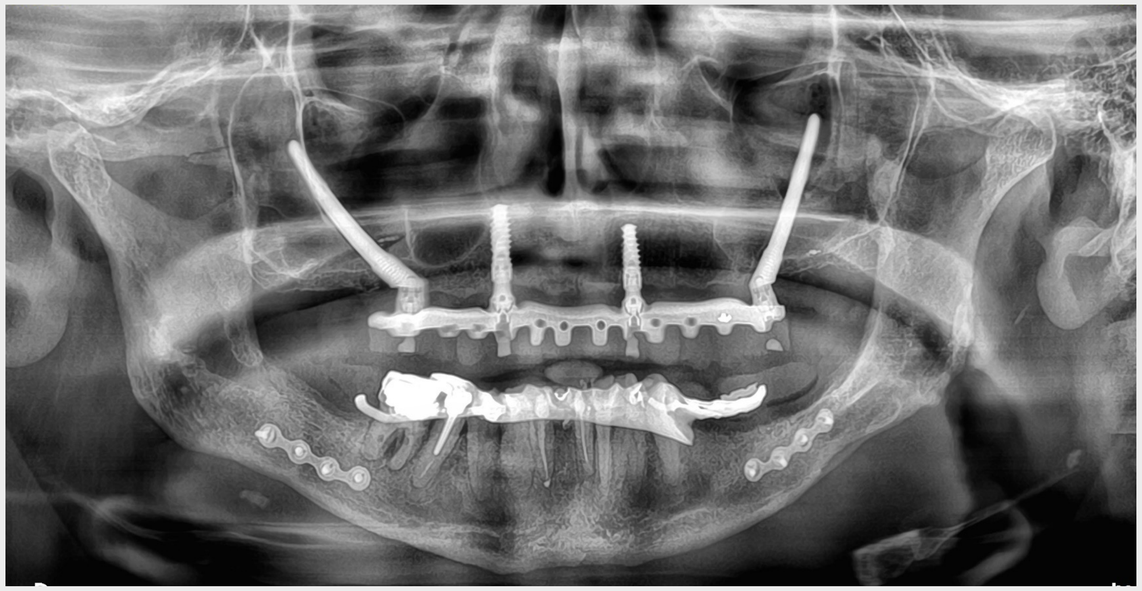


The nice AP distribution made the prosthesis-stress-distribution was rationally distributed over the entire maxilla.

The nice position of the 2 zygomatic implants allowed to have 12 teeth without cantilever.
All the screw’s access holes came out in the occlusal side of the teeth.

CLINICAL OUTCOME

CBCT



Panoramic radiographs at the 6-month follow-up indicated adequate healing and integration of all placed implants into the bone.

CLINICAL OUTCOME

2 conventional implants combined with 2 zygomatic implants permited a full arch rehabilitation with fixed temporisation and without bone grafting with high predictability.

Low composite gingiva height was created a nice height of teeth and papillae. The transition line was not exposed due to a low smile line.

The treatment period with fixed provisional bridge allowed for a normal social and professional life.

The patient expressed his satisfaction with the achieved aesthetic and functional results.

COMBINING STRAUMANN® BLT IMPLANTS GUIDED SURGERY AND ZYGOMATIC IMPLANTS

PROF. JAMES KWOK FAI CHOW (BDS, MDS)

MEET THE EXPERT

PROFESSOR JAMES KWOK FAI CHOW

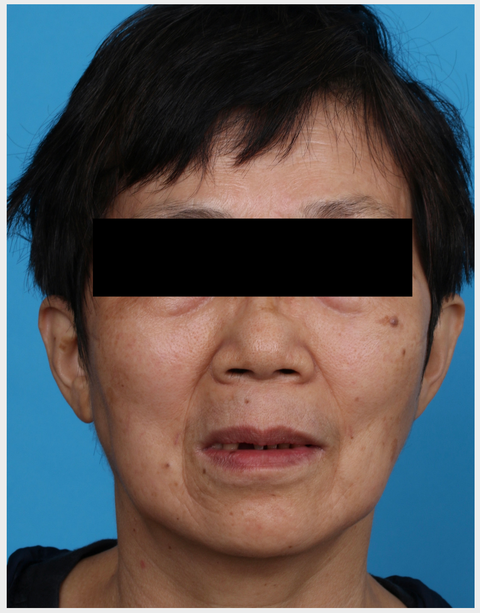
Bachelor of Dental Surgery, University of Hong Kong. Specialist in Oral and Maxillofacial Surgery. Fellow in Dental Surgery, Royal College of Surgeons of England. Master of Dental Surgery, University of Hong Kong. Fellow in Oral & Maxillofacial Surgery, Royal College of Dentists of Canada. Fellow of the College of Dental Surgeons of Hong Kong. Bachelor of Medicine and Bachelor of Surgery, University of Hong Kong. Fellow of the College of Dental Surgeons of Hong Kong (OMS). Fellow of the Hong Kong Academy of Medicine (Dental Surgery). Diploma in Implant Dentistry, Royal College of Surgeons of England. Fellow of the International College of Dentists. Fellow of the Royal College of Surgeons of England.

Chairman, Specialty Board in Oral & Maxillofacial Surgery, College of Dental Surgeons Hong Kong. Honorary Clinical Associate Professor, Oral & Maxillofacial Surgery, Faculty of Dentistry, University of Hong Kong. Honorary Professor, Shanghai Jiao Tong University. Board Member, Foundation of Oral Rehabilitation. Past President, Chinese Academy of Esthetic Dentistry. Vice-chairman, Hong Kong Association for Oral and Facial Rehabilitation. Founder & Director, Dental Implant & Maxillofacial Center. Director, Brånemark Osseointegration Center Hong Kong. Director, Brånemark Osseointegration Center Shanghai.

PATIENT SUMMARY

Gender	Female
Age	69 years
General condition	Good general health
Smoker	Non-smoker
Medication	No regular medication
CLINICAL AND XRAY EXAMINATION	
Maxillary teeth	Present at positions: 12 to 25 Hopeless at positions 24, 25 & 27: All remaining maxillary teeth with poor prognosis because of malocclusion, periodontal disease, attrition and abrasion.
Maxillary bone	Resorption: bone available in the anterior maxillary region; moderate to advanced resorption in the posterior regions bilaterally. Bone quality: D2 to D3
Opposite arch	Planned for implant-supported fixed prosthesis performed
TMJ	Disfunction: No
Complaints	Poor masticatory function and poor fit of her conventional partial dentures
Expectations	The patient wanted to undergo full mouth rehabilitation to solve her dental problems and improve oral function and esthetic appearance.

PATIENT FACE



PATIENT PROFILE

A 69-year-old partially edentulous female with a record of periodontal disease presented at our clinic. Clinically, this patient suffered from multiple missing posterior teeth in her upper and lower jaws. Her chief complaint was related to poor masticatory function and poor fit of her conventional restoration.

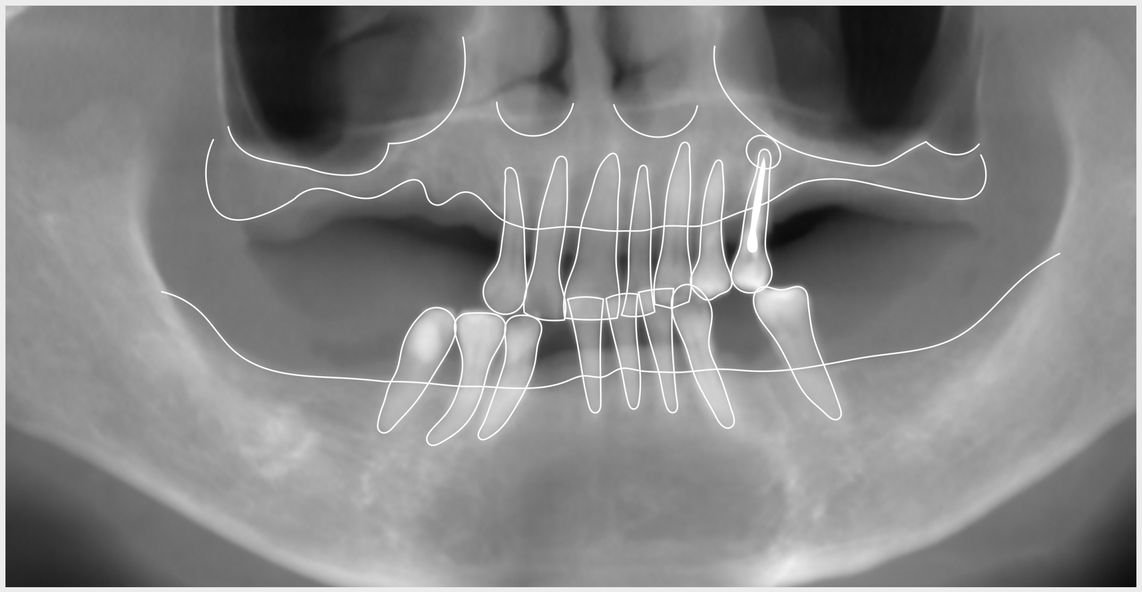
INTRAORAL EXAMINATION

Clinical examination revealed an increased lower facial height, a bimaxillary protrusion, and deviated dental midlines - the remaining teeth presented with poor to guarded prognoses involving advanced periodontitis associated with advanced gingival recession. Multiple teeth showed cervical abrasion. The oral hygiene status of the patient was evaluated as poor.

Intraoral scanning was performed to acquire data to build the virtual patient model for virtual teeth setup and surgical guide design.

RADIOGRAPHIC EXAMINATION

CBCT



Radiographic examination using diagnostic CBCT further revealed a generalized horizontal alveolar bone loss. Additionally, an apical lesion was identified at the previously endodontically treated upper left second premolar. Further radiographic examination revealed a severely atrophied posterior maxilla with insufficient residual bone height, impeding the placement of regular implants.

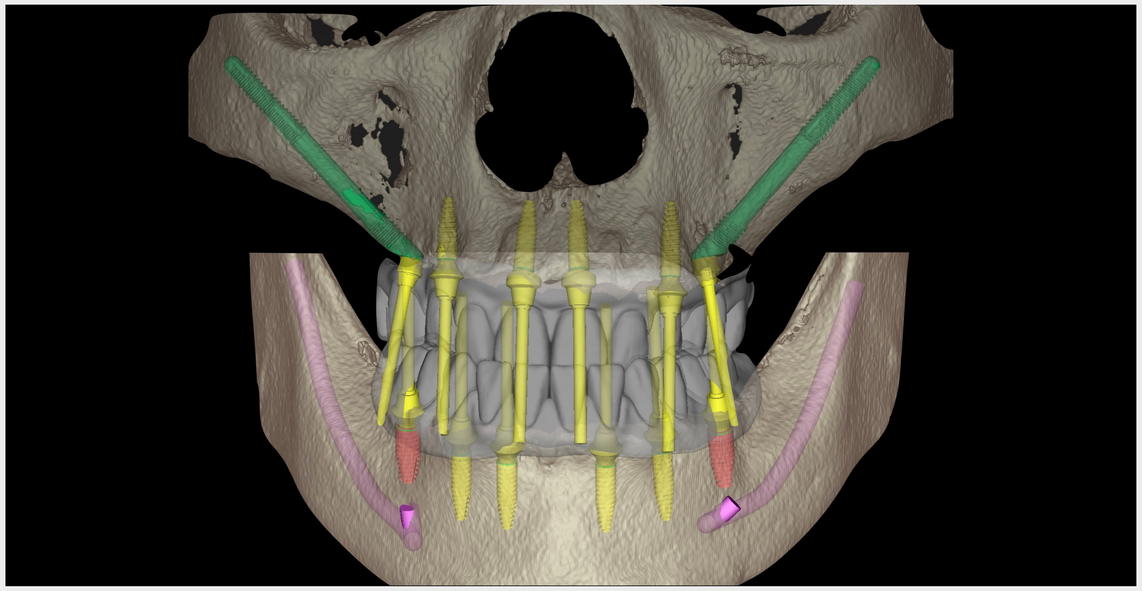
After discussing the benefits and risks of individual treatment options, the patient consented to dental clearance and rehabilitation with a fixed, implant-borne full-arch prosthesis.

TREATMENT SCHEDULE

DECISION FULL ARCH	
Bilateral implants	X
DECISION PARTIAL ARCH	
Unilateral implants	X
ZYGOMATIC IMPLANT(S)	
Type	Round
Length	#16 – 45 mm; #26 – 40 mm
Position	Posterior
REGULAR IMPLANT(S)	
Type	BLT
Length	#36 – 10 mm; #34 – 12 mm; #32 – 12 mm; #42 – 12 mm; #44 – 12 mm; #46 – 10 mm
Diameter	#36 – RC 4.1 mm; #34 – NC 3.3 mm; #32 – NC 3.3 mm; #42 - NC 3.3 mm; #44 – RC 4.1 mm; #46 – RC 4.1 mm
Length	#12 – 12 mm; #14 – 10 mm; #22 – 12 mm; #24 – 12 mm
Diameter	#12 – NC 3.3 mm; #14 – NC 3.3 mm; #22 – NC 3.3 mm; #24 – NC 3.3 mm
BIOMATERIALS	
Type	Bio-Oss® Collagen 250 mg x 4 packs (Geistlich, Switzerland)
Location	Bilateral sinus graft
ABUTMENT(S)	
Type	Both #16 and #26 – SRA straight Ex Hex
Heigh	#16 – GH 1.5 mm; #26 – GH 2.5 mm
Diameter	Both #16 and #26 – 4.6 mm
Type	#12 – RODO abutment 17 degree; #14 – RODO abutment straight; #22 – RODO abutment 17 degree; #24 – RODO abutment straight
PROSTHESIS	
Provisionalisation	Metal-reinforced acrylic
Final	Milled titanium framework with monolithic zirconia overlay

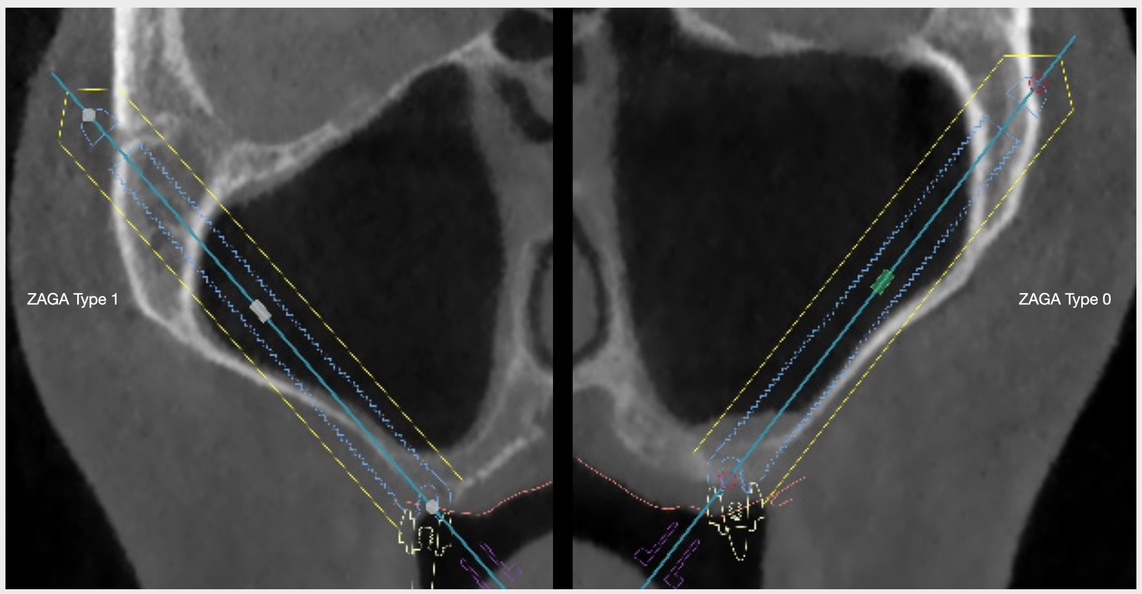
CBCT

Virtual planning model and zaga classification



Dual scan CBCTs were used to derive a virtual planning model allowing the design of the future rehabilitation, starting from a diagnostic prosthetic wax-up. The planning of the implant restoration was prosthetically driven and based on the upper and lower prosthetic wax-ups consisting of a first-molar-to-first-molar combined bridge in both arches. The implant restoration consisted of a combination of four straight anterior BLT implants and two posterior zygoma implants.

The surgery was planned as a fully guided placement for the BLT implants. Zygomatic implants were planned using conventional, state-of-the-art freehand placement.



According to the computer-aided plan, zygomatic implants on the right and left sides were classified as ZAGA™ types 1 and 0, respectively.

ANESTHESIA, INCISION AND FLAP ELEVATION

Flap elevation

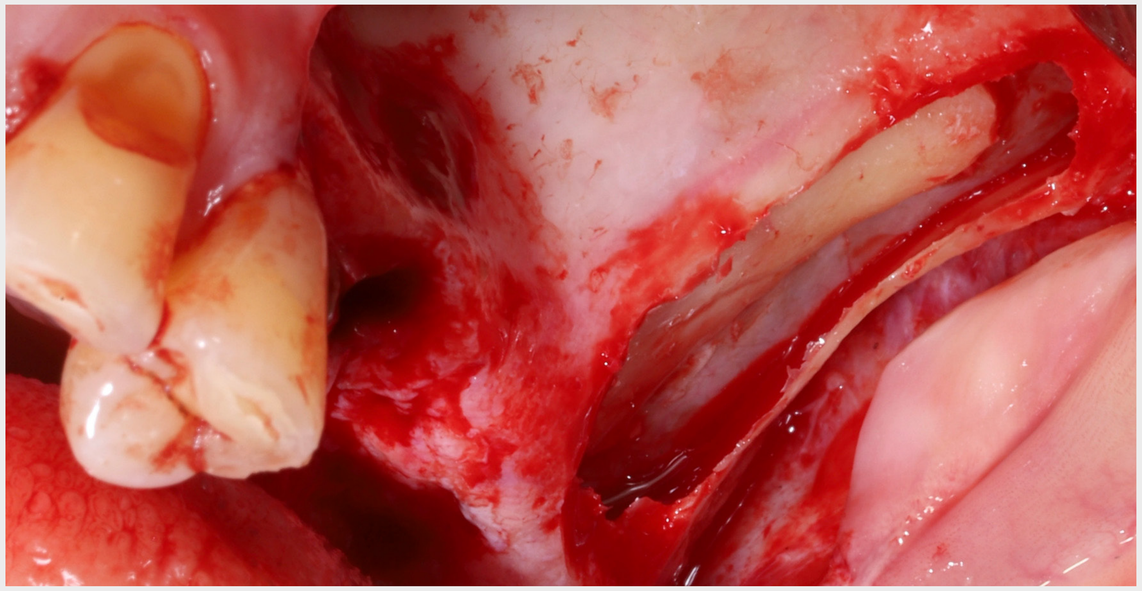
Surgery was performed under general and local infiltration anesthesia and naso-endotracheal intubation and after disinfection and draping to define the surgical field. Antibiotics were concomitantly administered from two days before to eight days after surgery.

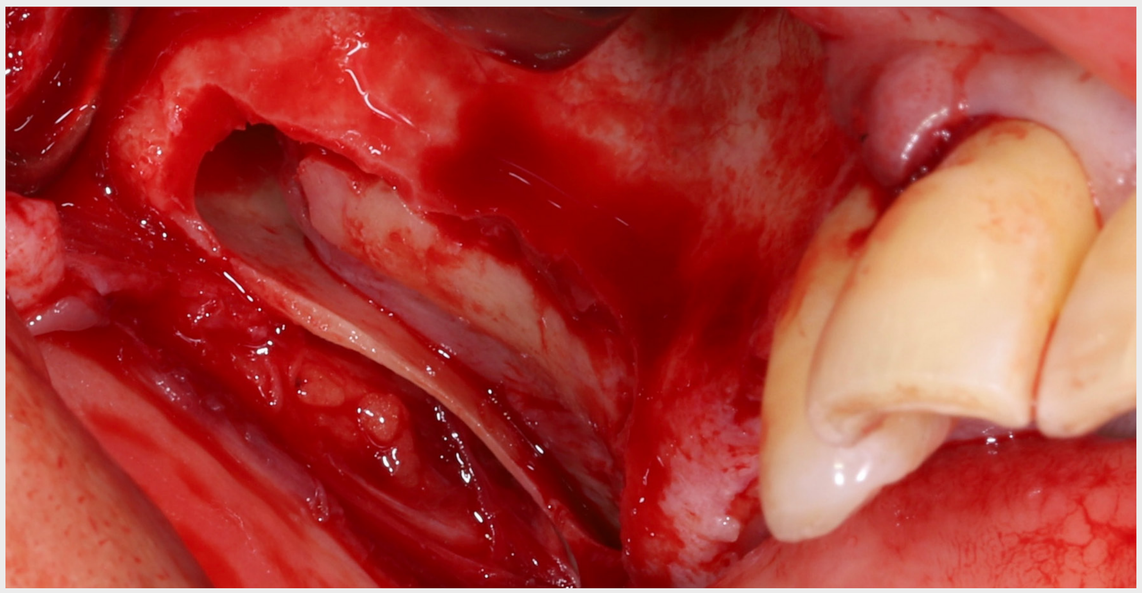
The maxillary procedure was initiated after the placement of mandibular implants and primary wound closure.

The tooth-supported positioning guide was correctly seated and used to define anchor pin locations to support the surgical guides during the subsequent procedure. After removing the guide, a mucoperiosteal flap was raised after a crestal, slightly palatal, incision followed by vertical buccal and oral releasing incisions. Surgical access and visualization of the zygomatic complex for osteotomy preparation and implant placement were realized by retraction of the soft tissues up to the frontozygomatic notch.

OSTEOTOMY PREPARATION

Extended sinus lift

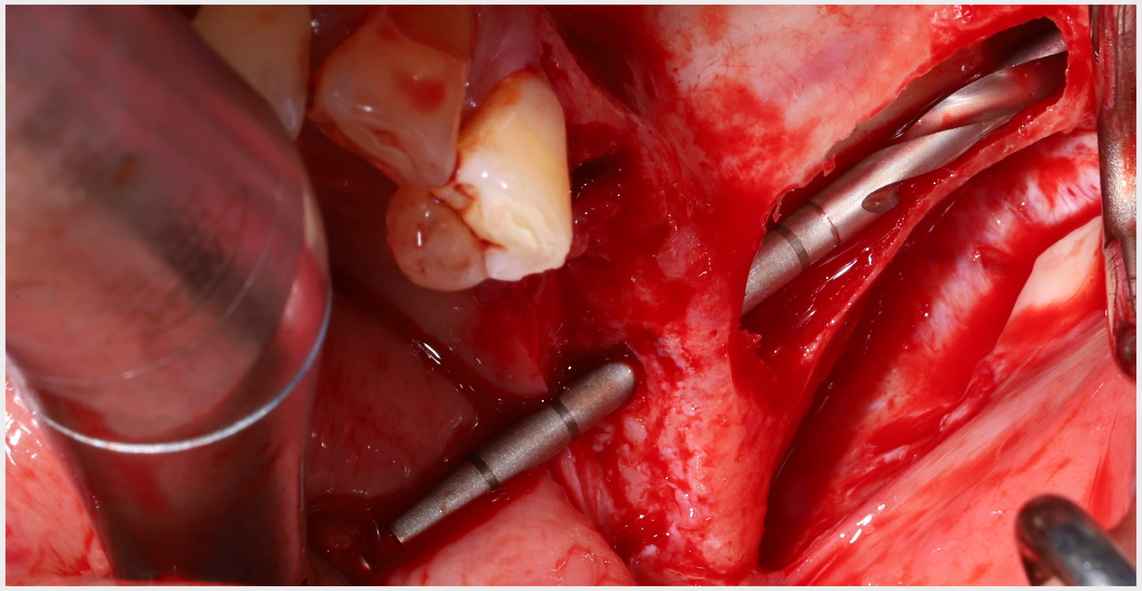




The treatment strategy included the application of an extended sinus lift, which was suggested by the authors of this case report to reduce the risk of maxillary sinusitis in zygomatic implant patients.[1] In ZAGA™ type 0 and 1 classified anatomies, the application of the extended sinus lift technique allowed the realization of an extra-sinus placement of the zygomatic implants despite its intra-sinus trajectory. The same procedure was carried out on both sides.

Specifically, extended lateral windows were prepared, and the maxillary sinus membranes were elevated by leaving the bone window attached to the Schneiderian membrane.

OSTEOTOMY PREPARATION

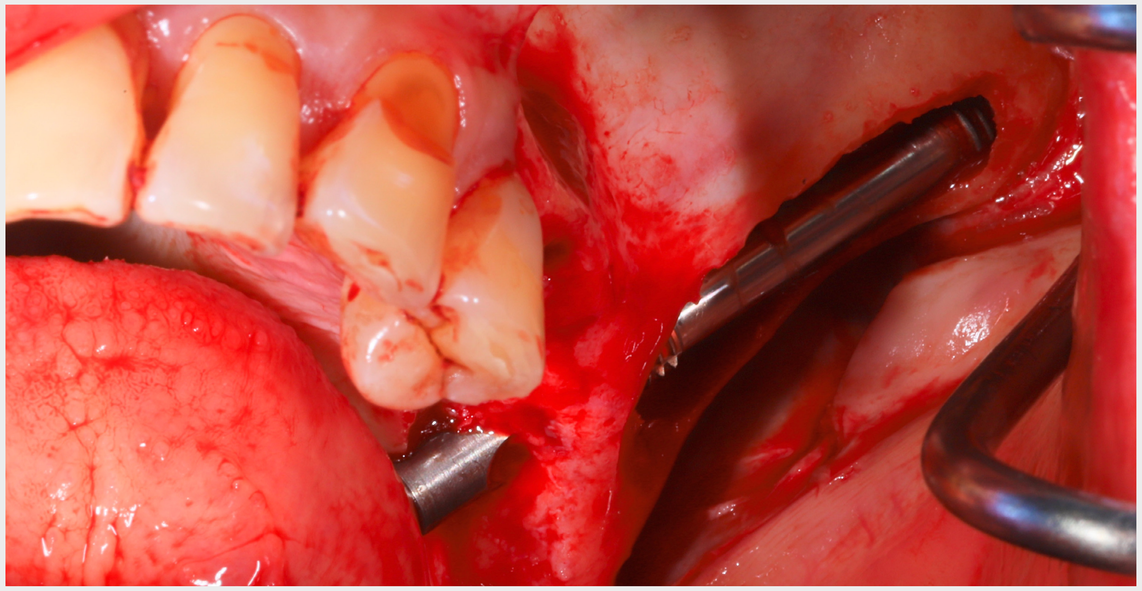


The tooth-supported drill guide was used to define the coronal starting points for the zygomatic implant osteotomies on either side of the maxilla. A conventional implant drill for BLT implants was used. Starting points were located buccally, aiming for bicortical stabilization of the implants in the remaining alveolar crest.

Implant osteotomies through the lateral maxillary sinus wall into the zygoma were finalized without the surgical guide and using a 2.9 mm twist drill.

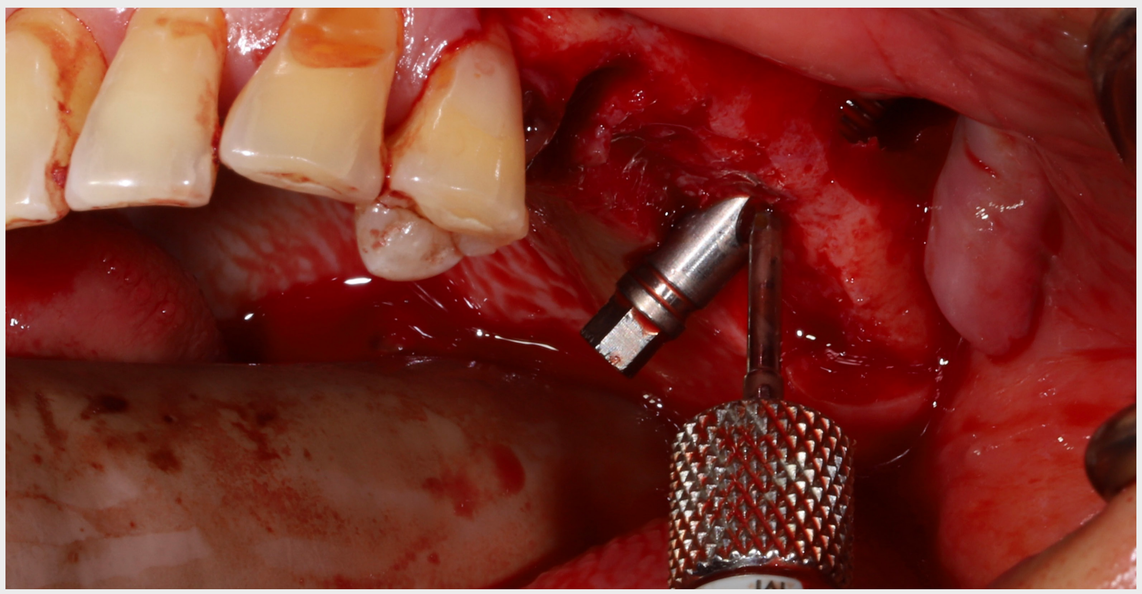
PLACEMENT OF ZYGOMATIC IMPLANTS

Right side



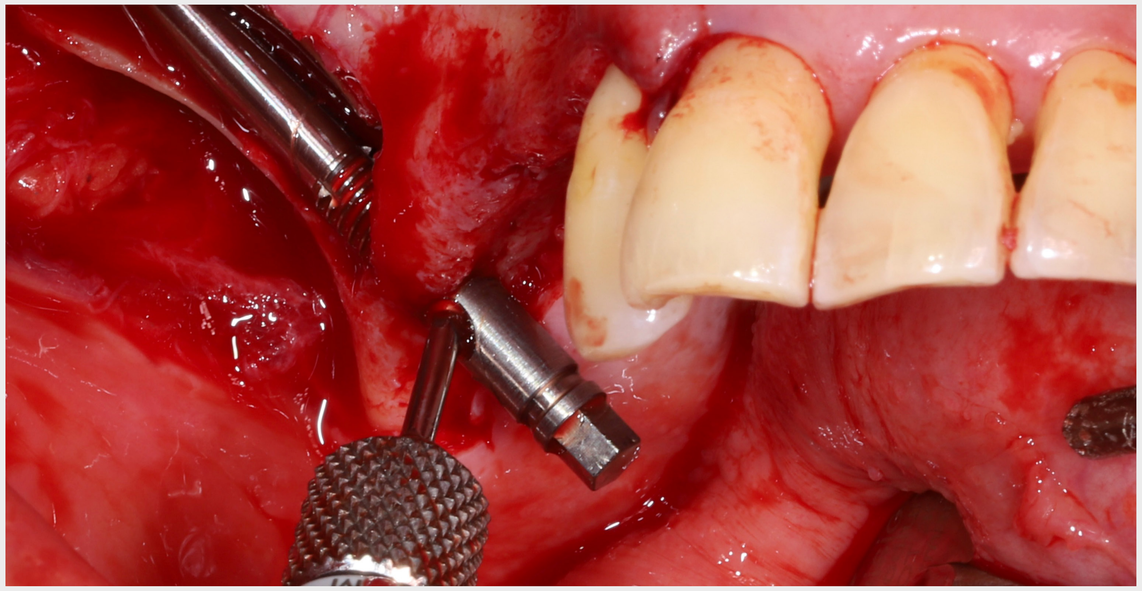
The placement of the Straumann® Zygomatic implant, ZAGA™ Round, was performed freehand.

The correct orientation of the connecting geometry of the implant platform was verified using the fixture mount screw.



PLACEMENT OF ZYGOMATIC IMPLANTS

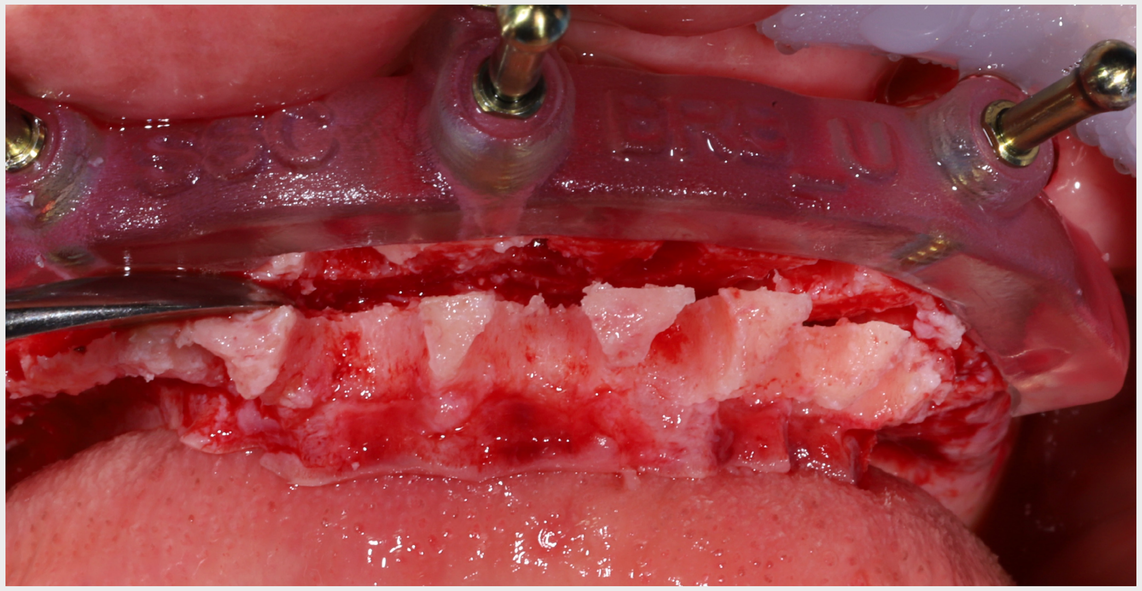
Left side



Placement in the contralateral side was performed accordingly using a Straumann® Zygomatic implant, ZAGA™ Round (45 mm). Both implants reached adequate primary stability in the zygomatic bone as indicated by an insertion torque of at least 35 Ncm.

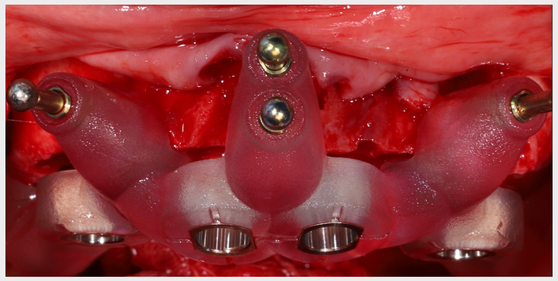
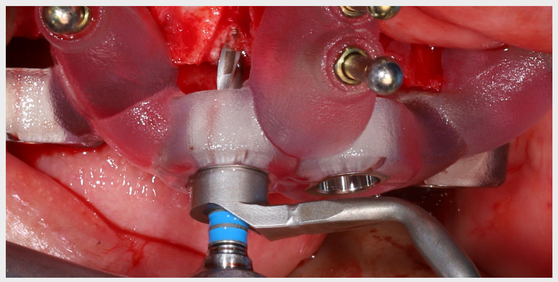
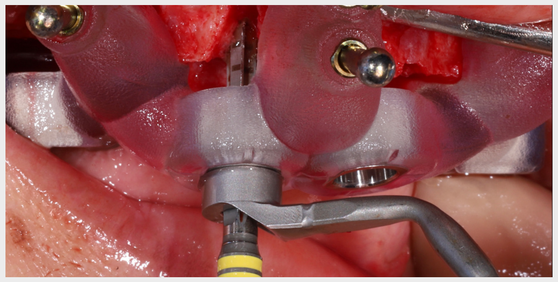
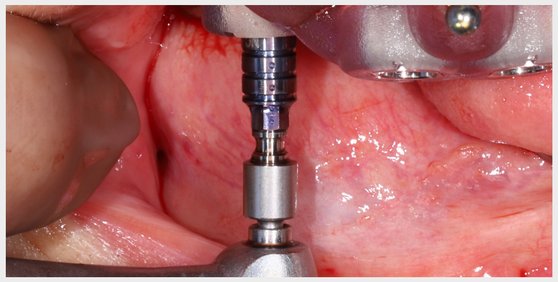
The sinus floor and the coronal portion of the Straumann® Zygomatic implants, ZAGA™ Round, were grafted using (Bio-Oss® collagen).

PLACEMENT OF REGULAR IMPLANTS



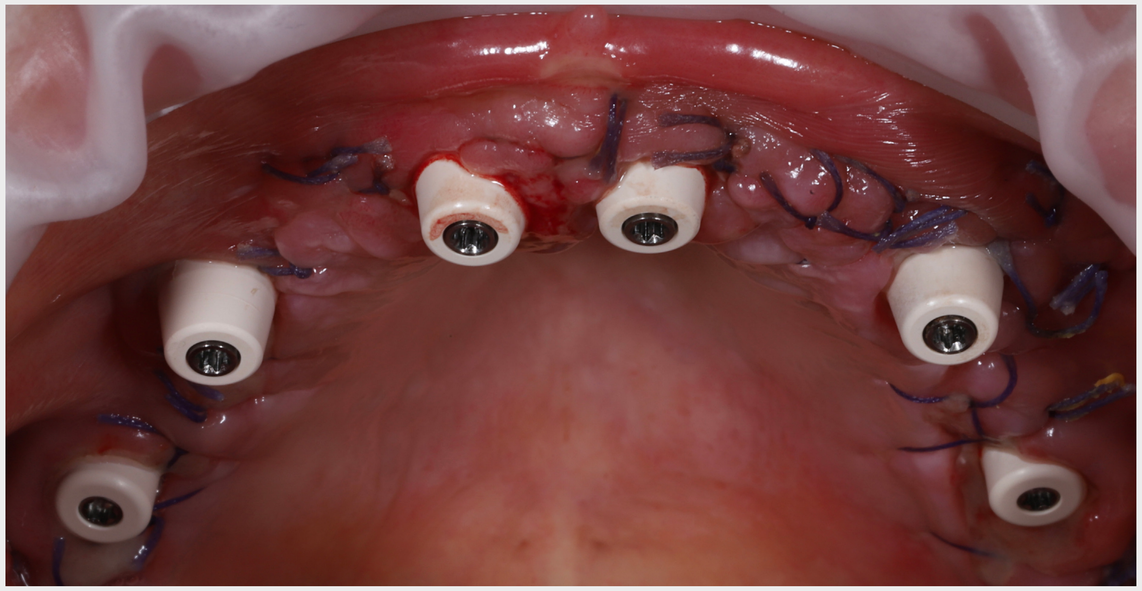
Placement of the zygomatic implants was followed by the removal of residual anterior dentition and the reflection of a mucoperiosteal flap. Next, the anterior alveolar crest was reduced and flattened using a piezoelectric cutter and the corresponding bone reduction guide.

PLACEMENT OF REGULAR IMPLANTS

Subsequently, osteotomies were prepared, and BLT implants were placed in the anterior regions of the maxilla using the corresponding surgical guides. All implants reached sufficient primary stability.

WOUND CLOSURE AND POSTOPERATIVE CARE

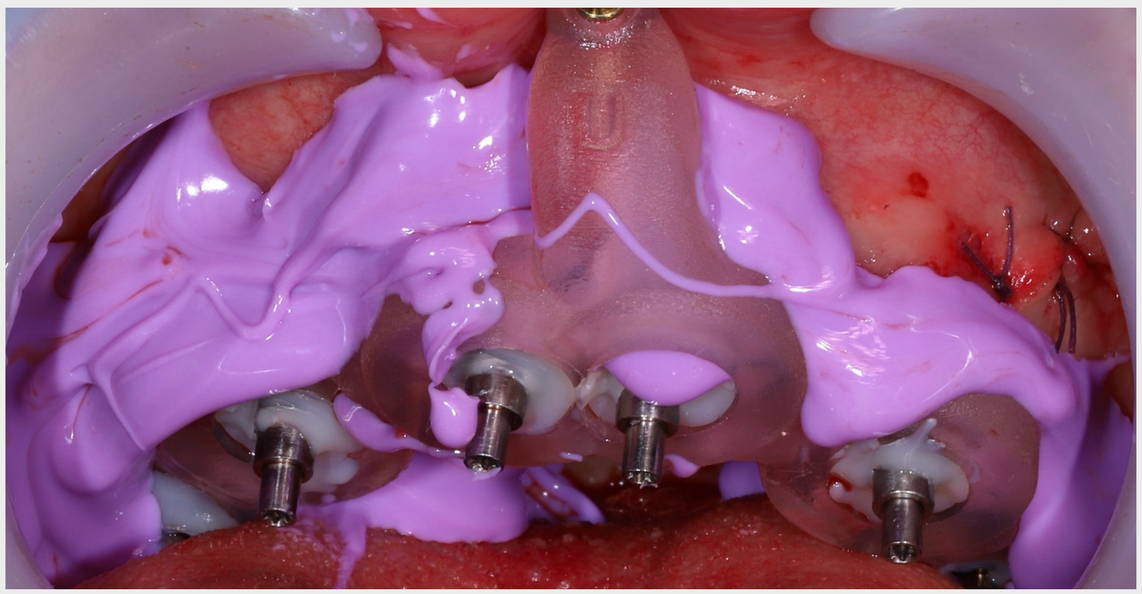


All implants were subsequently restored with definitive screw-retained abutments and healing caps. Primary wound closure was performed using resorbable sutures. Great care was paid to repositioning the keratinized gingiva on the implants' buccal aspects, with adequate contouring of the abutments. All implants displayed sufficient primary stability to proceed with immediate loading.

IMPRESSION

Analog

The resulting maxillomandibular relationship and bite were registered using the prefabricated bite registration guides. Open tray impression copings were mounted on the abutments and bonded to the transfer guide with light-cured composite resin. The mucosal contour was registered using silicone impression material.



PROSTHESIS

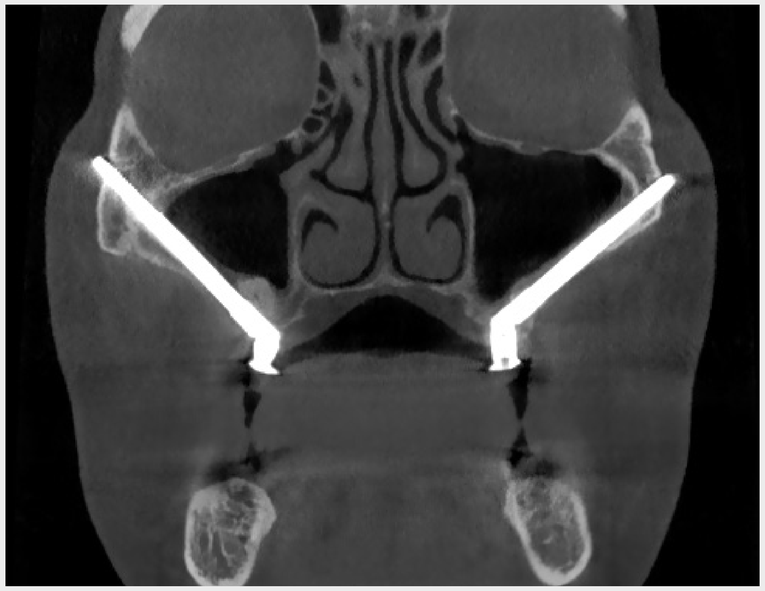
The maxillary and mandibular screw-retained provisional metal-reinforced resin prostheses were fabricated using conventional laboratory techniques based on the bite registration and transfer impressions.

These provisional screw-retained prostheses were delivered one week later for immediate loading. The patient was given a soft nightguard to wear at night.

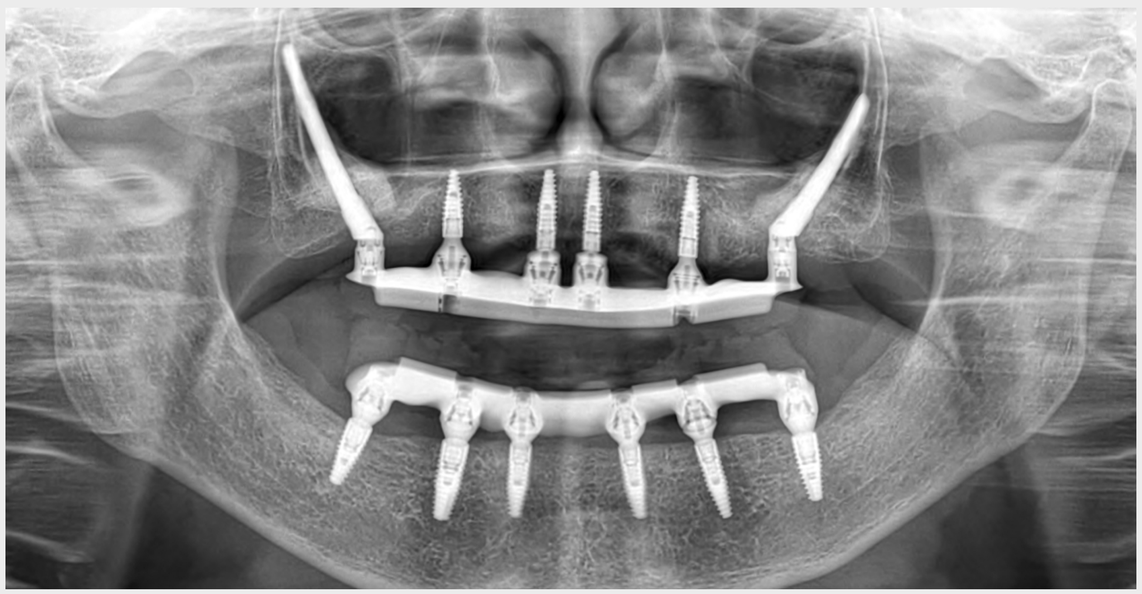
The patient was scheduled for regular review for wound healing and occlusal adjustment.

RADIOGRAPHIC EXAMINATION

Postoperative evaluation



2D sectioned follow-up CBCT confirmed the zygomatic implants' positioning and trajectory, leaving the maxillary sinuses intact and healthy. CBCT taken 3 months after surgery did not evidence any sinus membrane thickening or obstruction of the ostium.

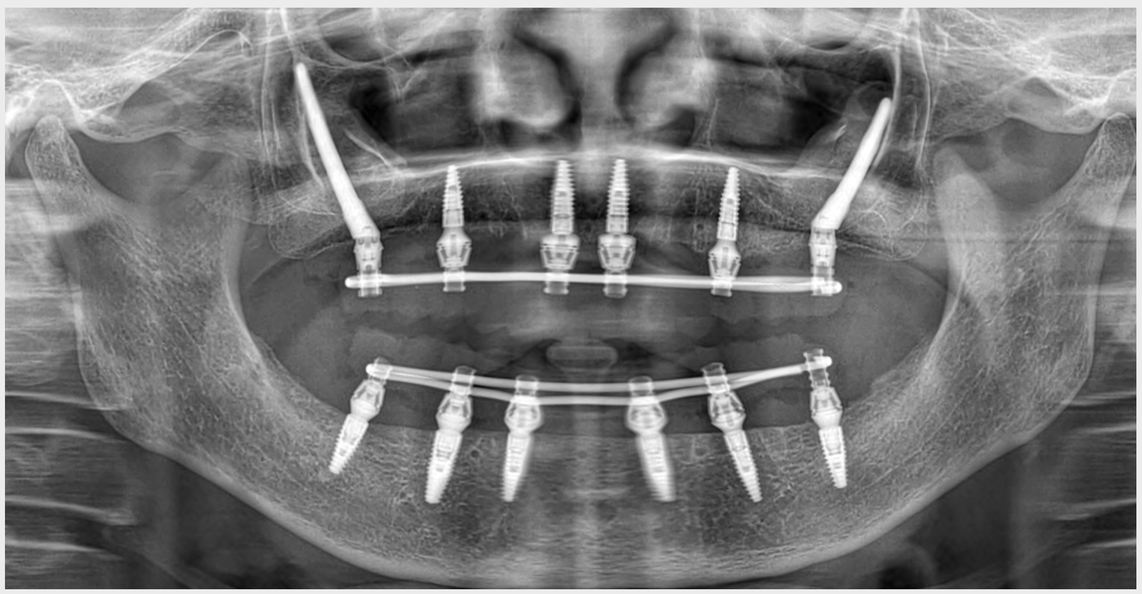


Panoramic radiographs were used to document and confirm the restoration after immediate loading.

CLINICAL OUTCOME

Visual evaluation and OPG

The definitive prostheses consisted of a milled titanium framework with a monolithic Zirconia overlay and were delivered to the patient four months after surgery.



An OPG taken at the framework try-in visit confirmed adequate and stable integration of the implant restoration and correct fit of the prosthetic framework.

CLINICAL OUTCOME

The patient expressed her great satisfaction with the functional and esthetic outcome of the procedure.

TAKE HOME MESSAGES

Immediate implant placement and immediate loading using zygomatic implants may help patients undergo implant treatment with minimal stress and inconvenience related to the edentulous phase.

An implant trajectory external to the maxillary sinus can help reduce the risk of maxillary sinusitis.

CBCT examination represents a useful tool to evaluate the sinus reaction after zygomatic implant treatment by means of the sinus membrane thickness and patency of the ostiomeatal complex.

LITERATURE REFERENCES TO REMEMBER

Chow J, Wat P, Hui E, Lee P, Li W. A New Method to Eliminate the Risk of Maxillary Sinusitis with Zygomatic Implants. 2010; 8.

USING THE ZAGA™ CLASSIFICATION

DR. CARLOS APARICIO

MEET THE EXPERT

DR. CARLOS APARICIO

MD, DDS, MSc, MSc, DLT, PhD. Barcelona, Spain.
Summa Cum Laude in Medicine & Surgery, 1978 Navarra U. (MD). Dentist 1983 Barcelona U. (DDS). Dental Laboratory Technician,1983 Ramon y Cajal School Barcelona (DLT). Diploma in Implant Dentistry at Gothenburg U. Sweden 1984. Master's degree in science of Materials in 1990 Barcelona U (MSc). Diploma in Periodontics at Gothenburg U. Sweden 1995. Master's in biomedical research in 2010 Barcelona U (MSc). PhD Summa Cum Laude, international mention on "Zygomatic Implants: the state of the art and zygomatic criteria for success" 2013. Visiting professor at different universities. Editor of the book "Zygomatic implants: the anatomy-guided approach". Fellow researcher within the Handicap Research Group, Department of Biomaterials at the U. of Gothenburg. Referee at European Journal of Oral Implantology and Journal of Clinical Implant Dentistry and Related Research. Past-President of the Osseointegration Foundation of the American Academy of Osseointegration. Board member European Academy of Osseointegration EAO 2004-2006, Founder president of the Spanish Society of Minimally Invasive Dentistry. Fellow of the Royal Society of Medicine England. Nominated as Academician at The Royal European Academy of Doctors in 2016. Founder of the Zygoma ZAGA centers Network. Currently is sharing his knowledge as Zygomatic Implants Senior Consultant at Hepler Bone Clinic, Barcelona Spain.

PATIENT SUMMARY

The patient comes to the clinic presenting terminal dentition with advanced generalized periodontitis, multiple decay, and absent teeth. He also refers to a "lump" at the level of the anterior palate that is growing over time and his desire for a deep intervention in its aesthetic aspect (Figs. 1).

He had no remarkable antecedents or known allergies. The radiological examination confirmed periodontitis and a large bony defect in the anterior area of about 5 x 2,5 cm with clear limits associated with odontogenic infection. Both sinuses were pneumatized with insufficient residual alveolar bone.

Treatment plan: complete exodontia, emptying of the cystic area, and histological analysis of the specimen (Figs. 2). Removable upper denture for 4 months, after which 4 zygomatic implants and immediate upper prosthesis will be placed. In the mandible, regular immediate implants and immediate prostheses will be placed. The final prosthetic rehabilitation will be done jointly in both jaws.

INITIAL INTRAORAL EXAMINATION

Situation prior-treatment

Fig. 1a Intraoral occlusal picture of the patient´s palate showing among other pathologies an oval protrusion of the anterior mucosa.

Fig. 1b Intraoral frontal picture of the patient showing overbite, diminished vertical dimension, absence of posterior teeth, multiple decay, periodontal disease and aesthetic problems.

RADIOGRAPHIC EXAMINATION

OPG

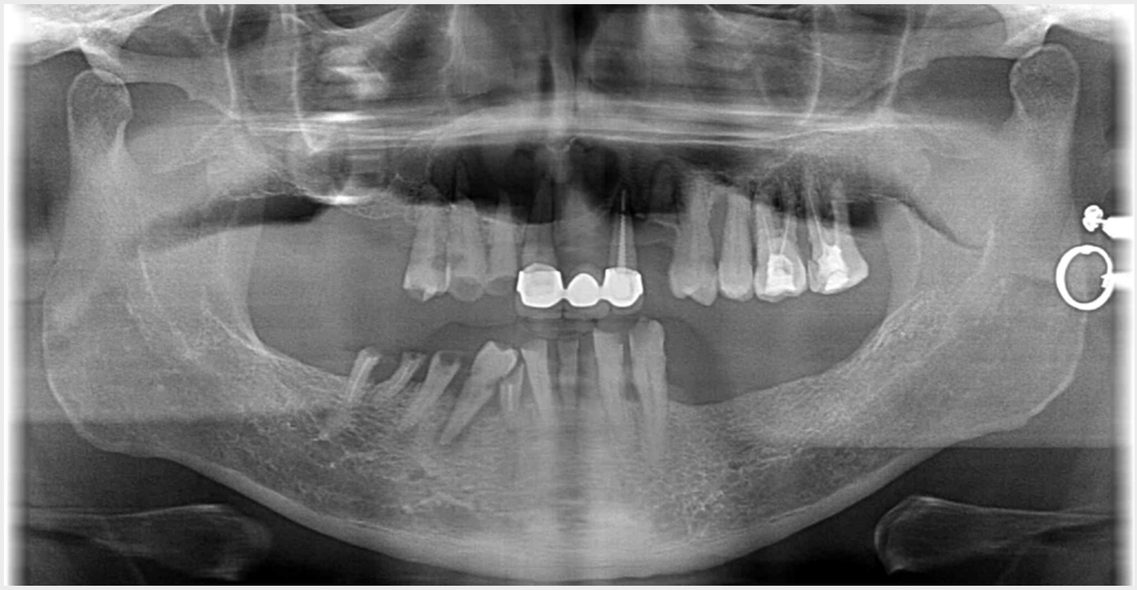


Fig. 2a The orthopantomography is previous to the treatment. Note the terminal periodontal disease, multiple apical radiolucency, and the cystic image extended from the first right premolar to the apex of the left canine.

RADIOGRAPHIC EXAMINATION

CBCT

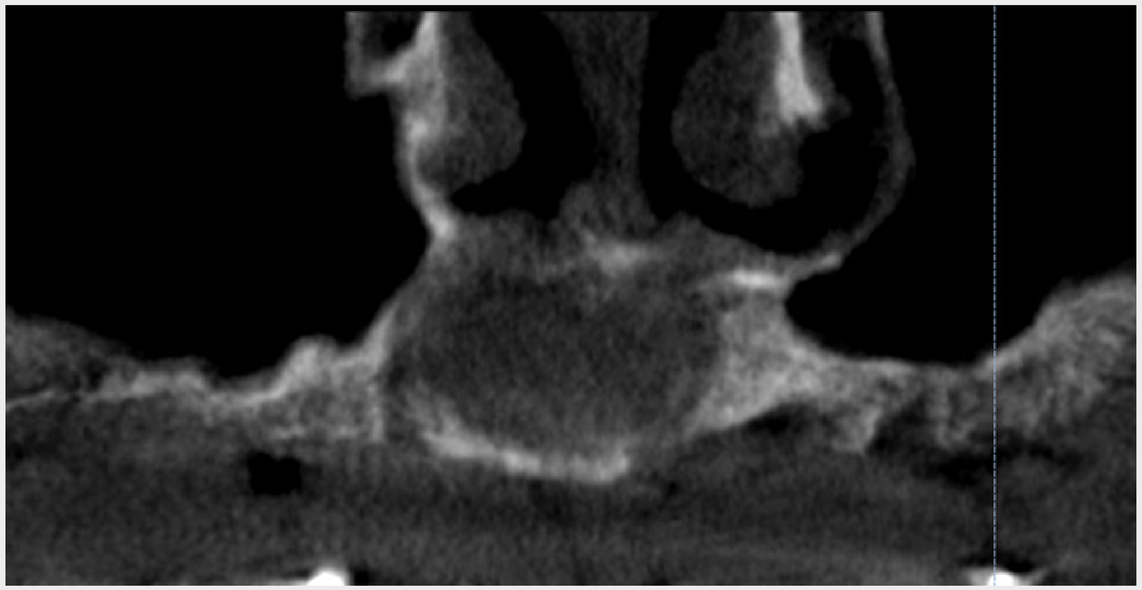


Fig. 2b CBCT panoramic cut after teeth extraction and emptying of the cystic area.

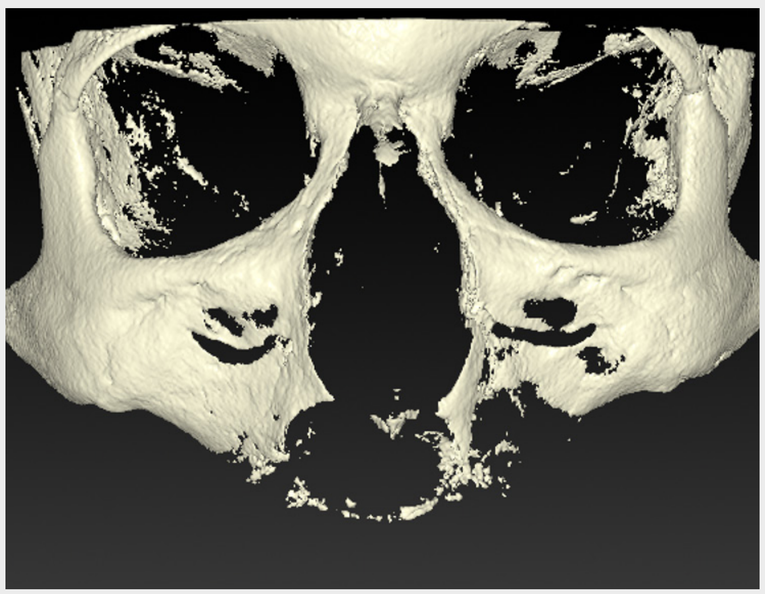


Fig. 2c CBCT 3D frontal vision 4 months after teeth extraction and emptying of the cystic area.

ZAGA™ CLASSIFICATION

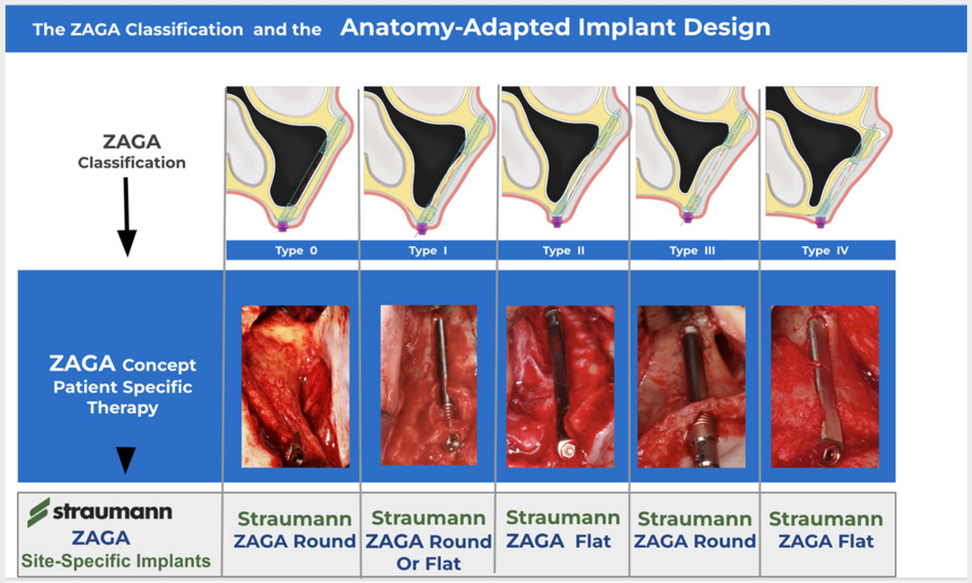


Fig. 3 The image shows the different anatomies forming the ZAGA™ classification. Those differences lead the surgeon to understand the necessity for choosing a patient-specific therapy that will be completed by the possibility to choose a site-specific Straumann® Zygomatic implant, ZAGA™.

Implant trajectory and design is chosen accordingly, in the present case:

Right side of patient:
Anterior - ZAGA™ Type 2/3
Posterior - ZAGA™ Type 4

Left side of a patient:
Anterior - ZAGA™ Type 3
Posterior - ZAGA™ Type 4

CBCT & TREATMENT PLANNING

CBCT

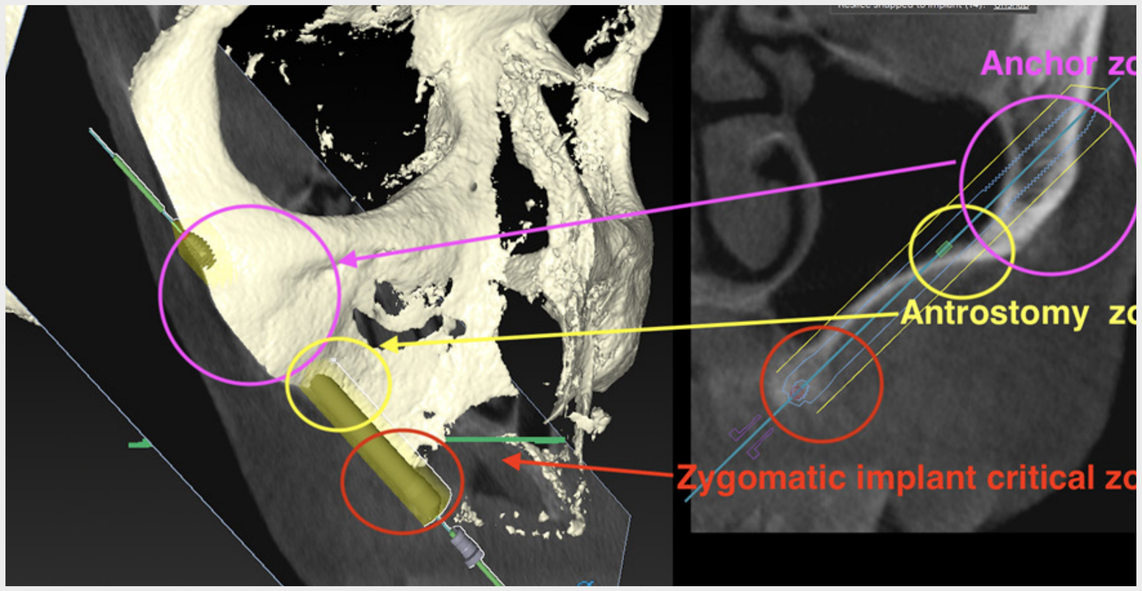


Fig. 4a Virtual planning for the anterior right implant. The ZICZ site is located between canine and first premolar avoiding the defect. The ZAGA™ zones are depicted with colored circles and arrows.

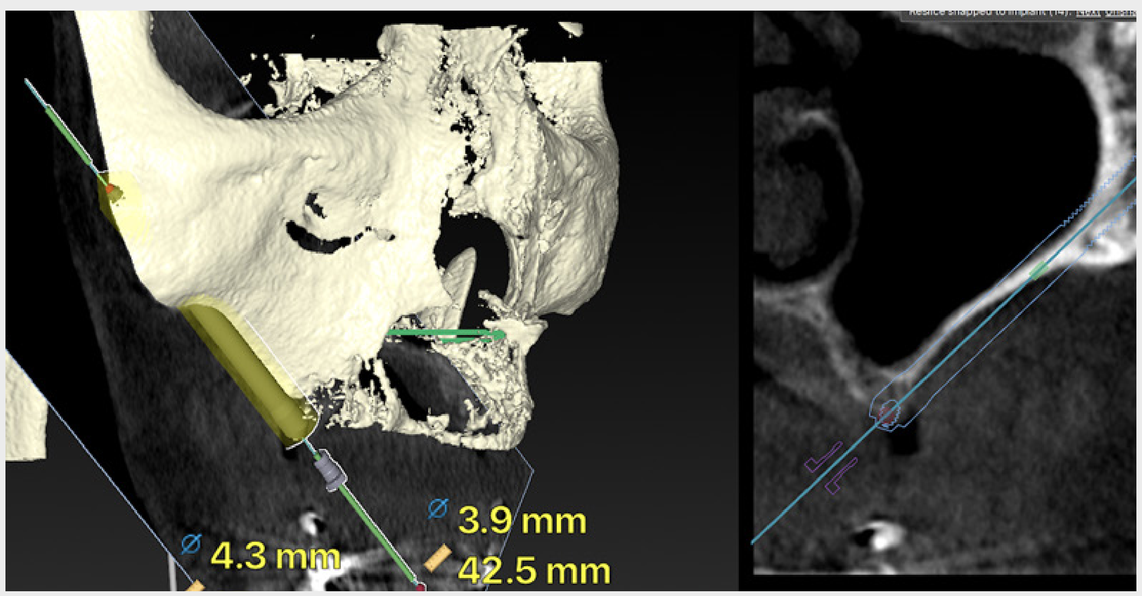


Fig. 4b Virtual planning for the posterior right implant. The ZICZ site is located between the second premolar and first molar. A Channel type osteotomy was planned.

CBCT & TREATMENT PLANNING

CBCT

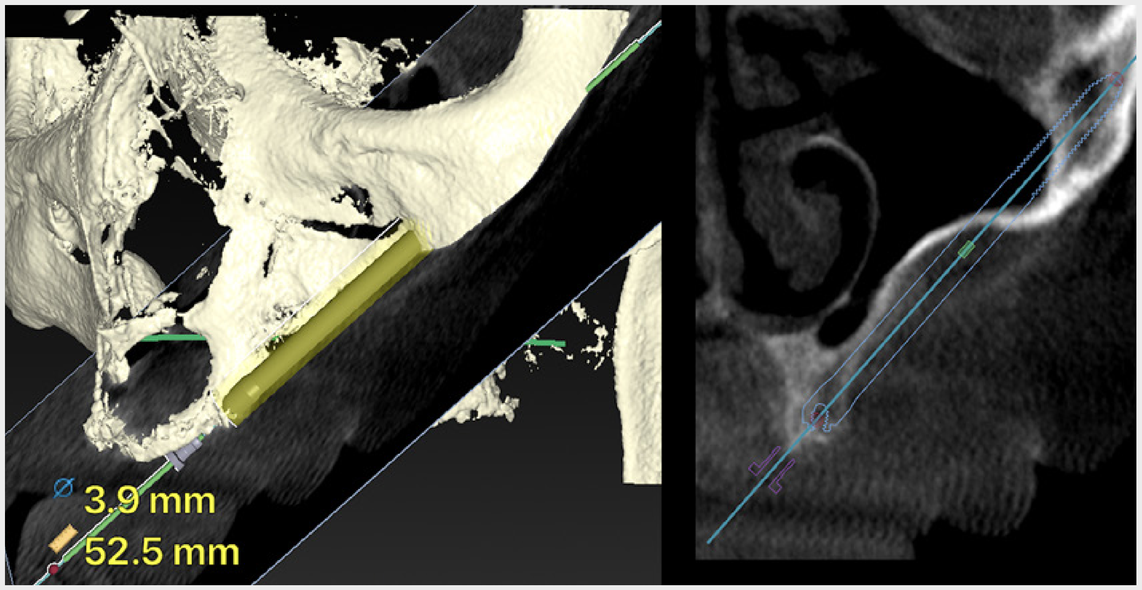


Fig. 4c Virtual planning for the anterior left implant. The ZICZ site is located between lateral and canine avoiding the defect. A Tunnel type osteotomy was planned.

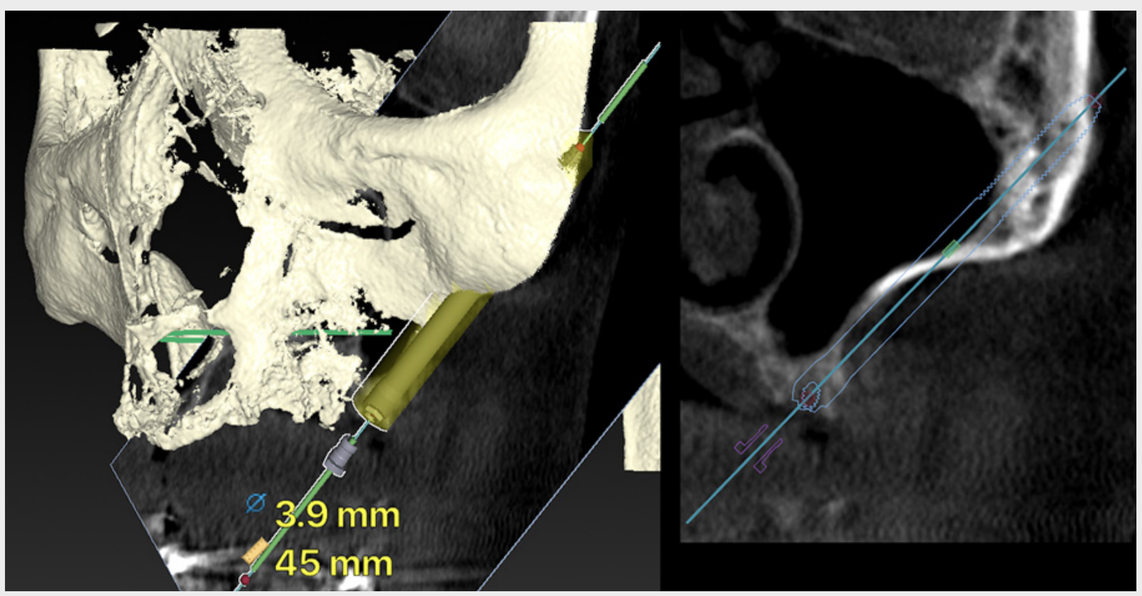


Fig. 4d Virtual planning for the posterior left implant. The ZICZ site is located between the second premolar and first molar. A Channel type osteotomy was planned.

USE 3D MODEL

CBCT

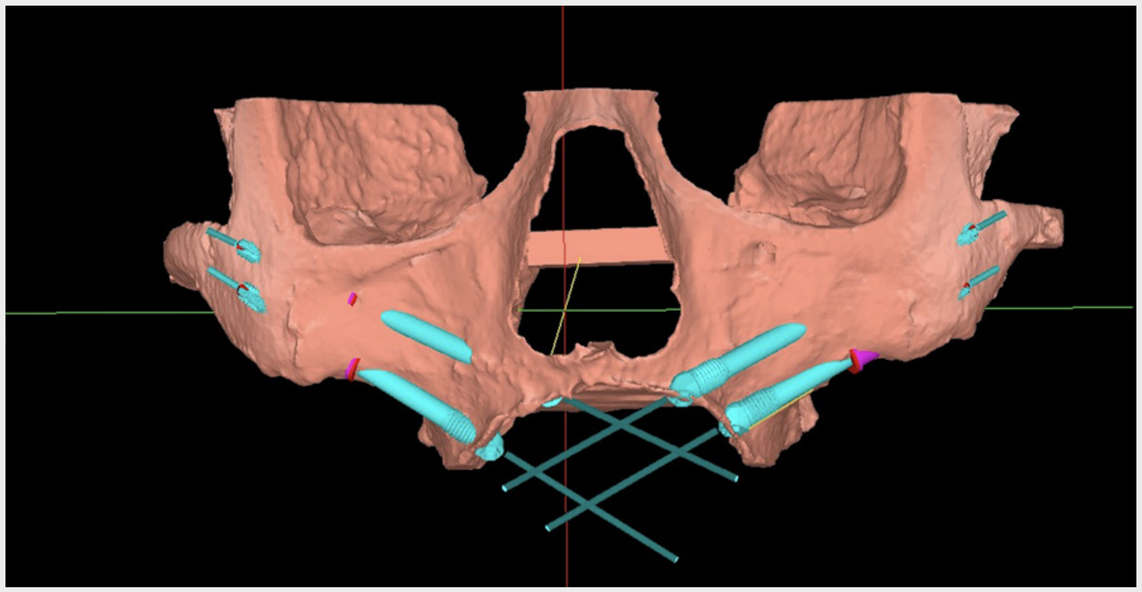


Fig. 5a We may use a 3D model of the patient to familiarize ourselves with the anatomy and practice a rehearsal of the surgical procedure.

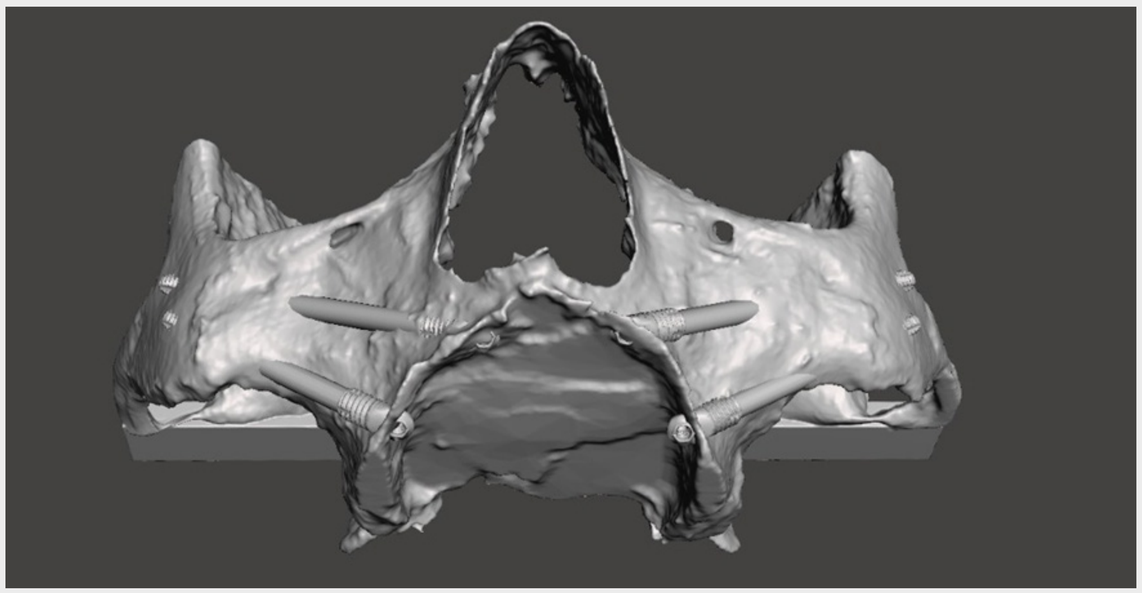


Fig. 5b Should we prefer the help of an expert in the planning, we will receive not only the original “3D model” but also a second “3D model” that incorporates the implants in their ideal positioning.

ZYGOMATIC IMPLANT PLACEMENT

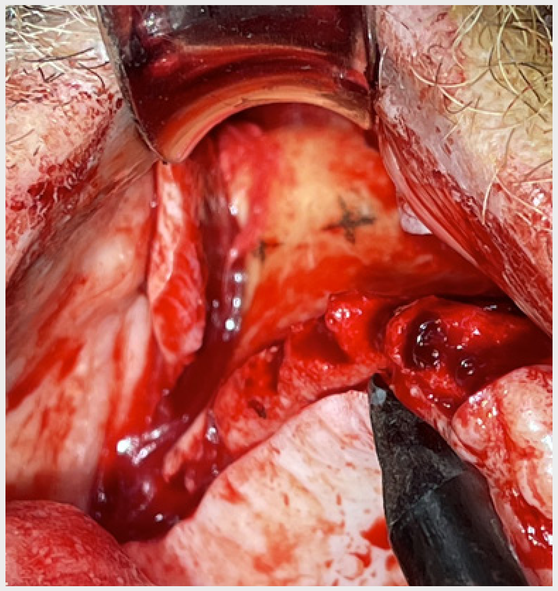


Fig. 6a

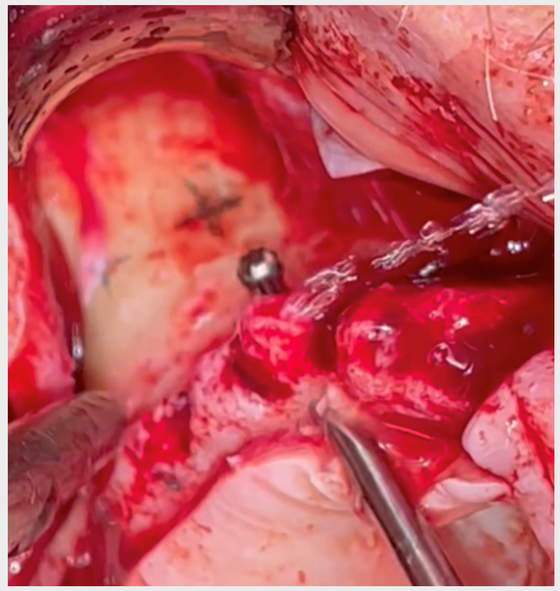


Fig. 6b

Fig. 6a The intraoral clinical picture shows the transferring of the planning using a simple pencil and the “3D model”.

Fig. 6b A ZAGA™ “Tunnel type Osteotomy” was chosen for the anterior right implant. The round bur is perforating the remains of alveolar bone at this position.

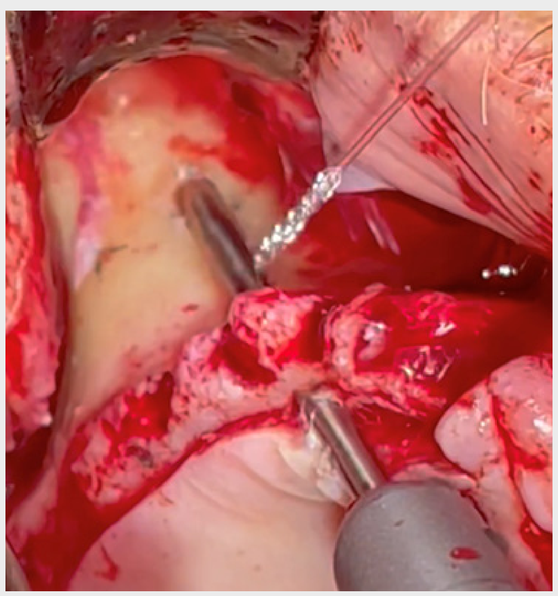


Fig. 6c

Fig. 6c The position of the anterior antrostomy is illustrated. Note the round bur is being used in a ZAGA™ Type 3 situation.

ZYGOMATIC IMPLANT PLACEMENT

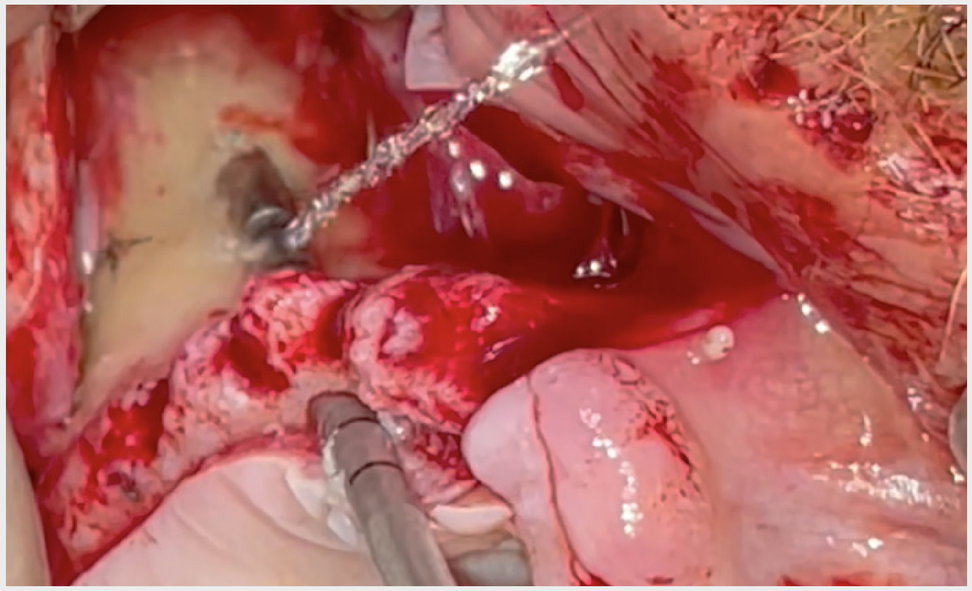


Fig. 6d Use of the stepped 2,9 mm diameter twist drill that precisely maintains the direction of the previous one.

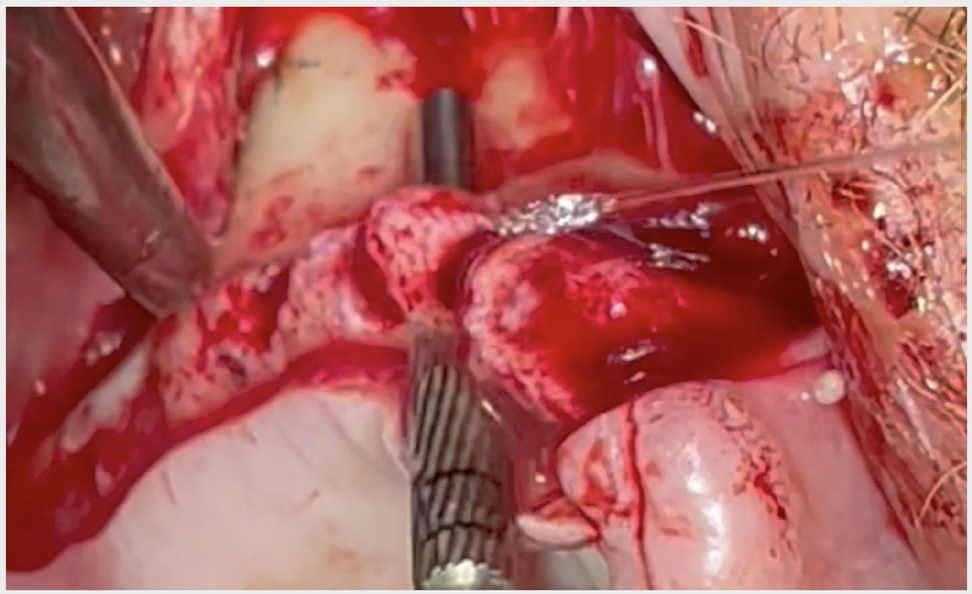


Fig. 6e The pilot lateral cutting drill is enlarging the alveolar crest to adequate it to the implant neck diameter.

Note that all drills are used under profuse irrigation with cold sterile saline.

ZYGOMATIC IMPLANT PLACEMENT

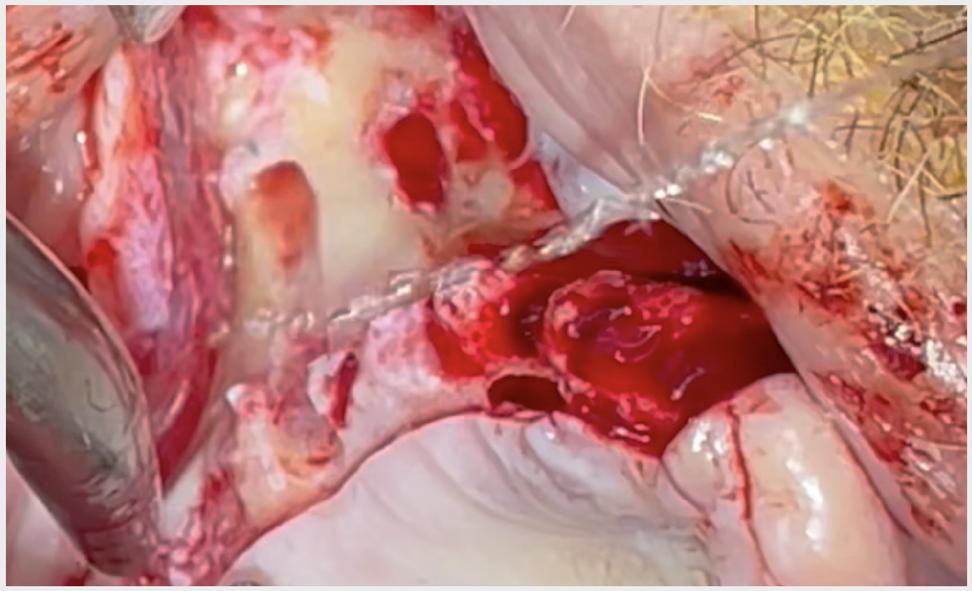


Fig. 6f Clinical image showing the two osteotomies, tunnel and channel, on the right side.

Note the precision, under-preparation and preservation of the sinus lining in both preparations.

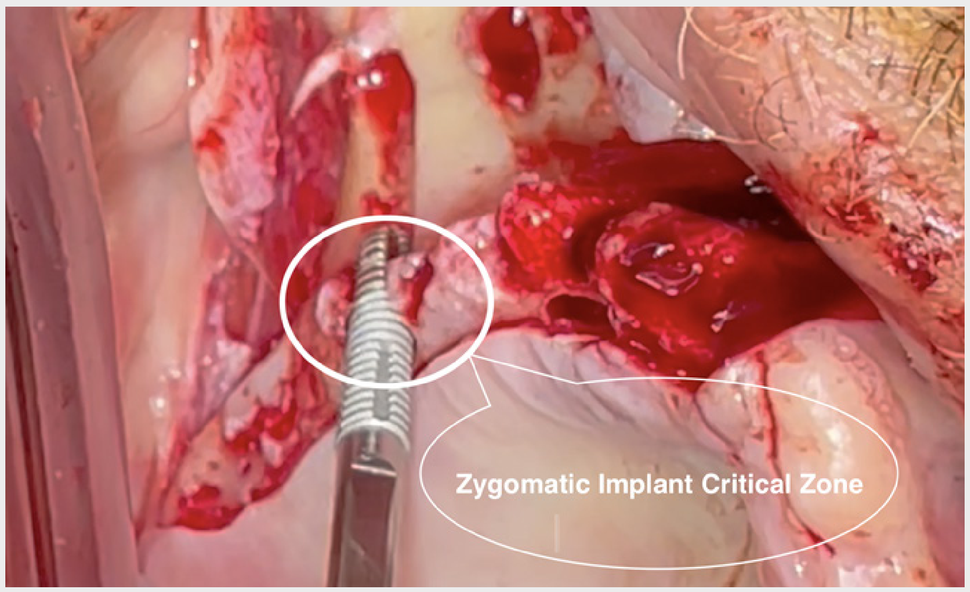


Fig. 6g The position of the Straumann® Zygomatic™ implant, ZAGA™ Flat, illustrates the first contact of the implant with the alveolar bone determining the ZICZ at that site.

ZYGOMATIC IMPLANT PLACEMENT

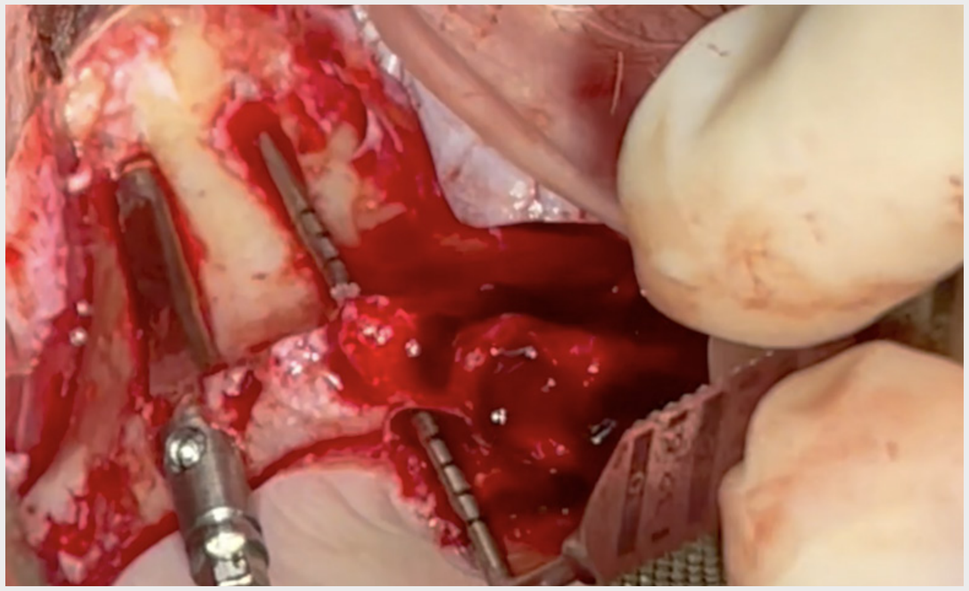


Fig. 6h We customarily prepare first the anterior osteotomy closest to the orbit and then the posterior osteotomy. When it comes to implant placement, we first place the posterior, then we measure the anterior osteotomy and finally we place the anterior implant.

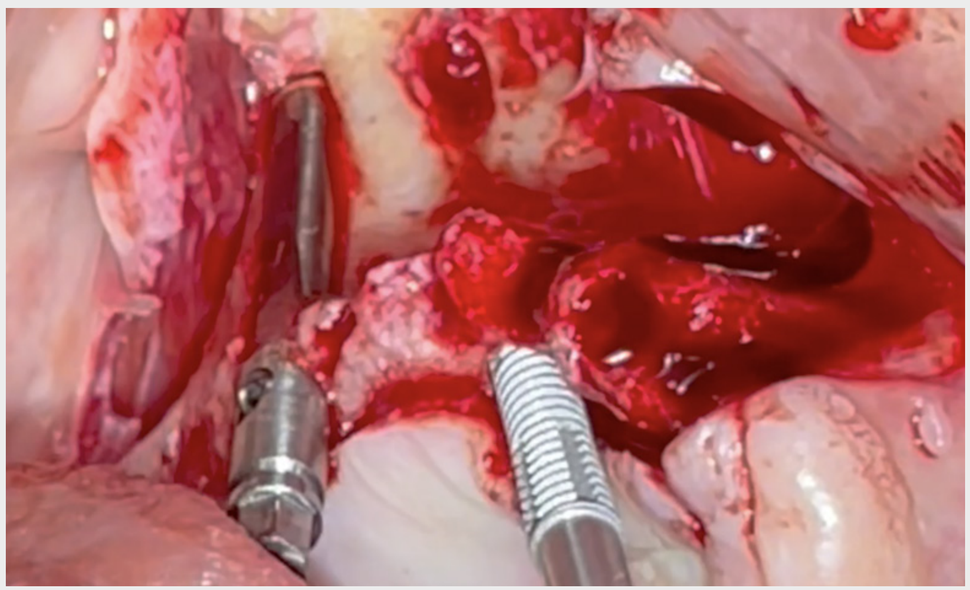


Fig. 6i The anterior circular tunnel type osteotomy is being sealed with the circular section of the Straumann® Zygomatic implant, ZAGA™ Round.

ZYGOMATIC IMPLANT FINAL POSITION RIGHT SIDE

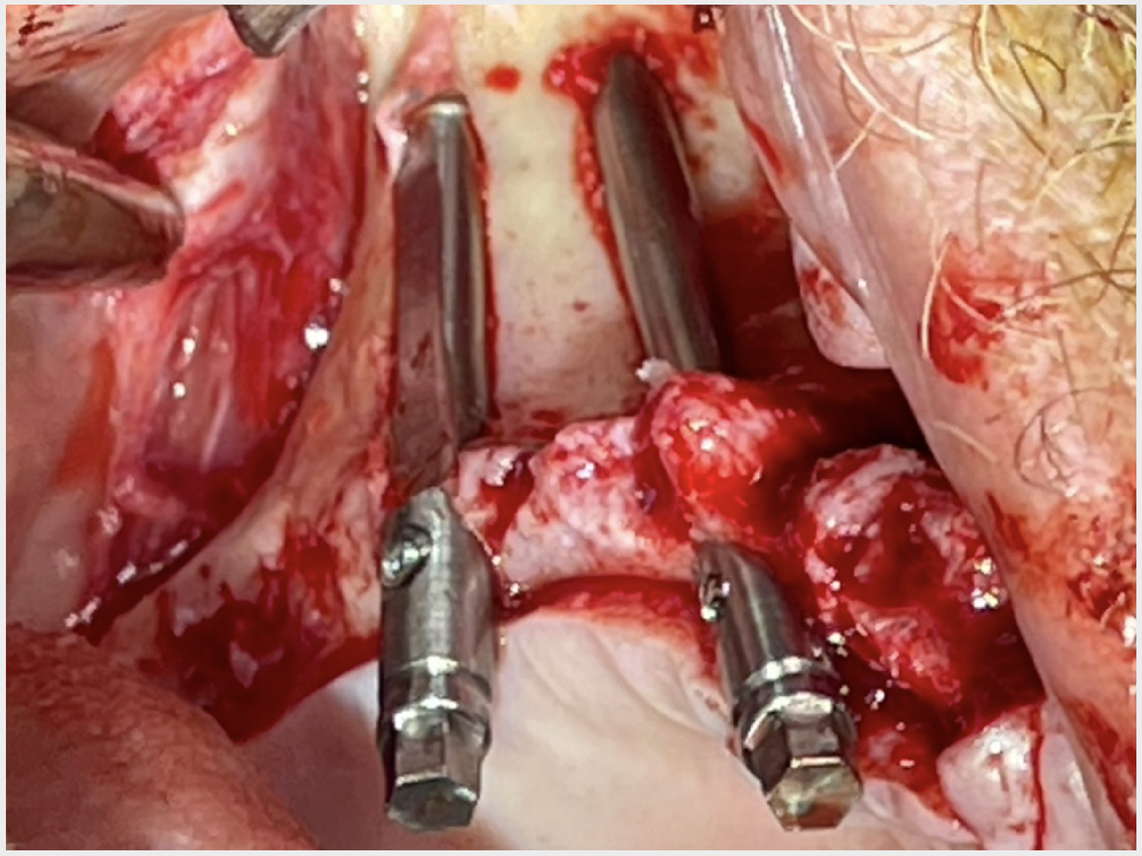


Fig. 7 Photo illustrating the two types of minimally invasive preparations, the posterior in a channel and the anterior in a tunnel type have been sealed with absolute precision by a Straumann® Zygomatic implant, ZAGA™ Flat and a Straumann® Zygomatic implant, ZAGA™ Round, respectively.

ZYGOMATIC IMPLANT PLACEMENT LEFT SIDE

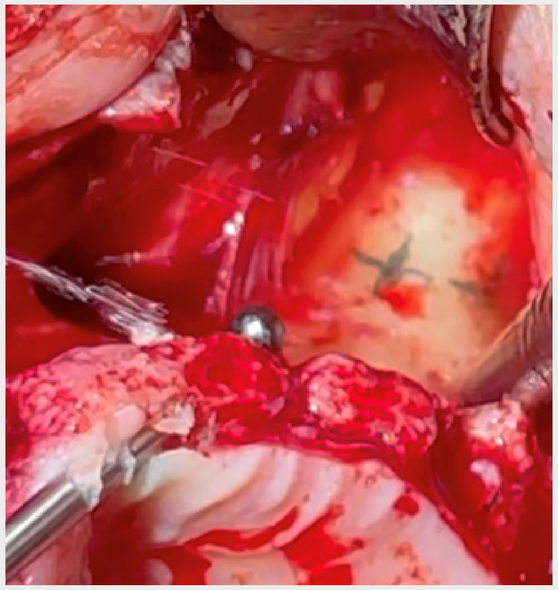


Fig. 8a

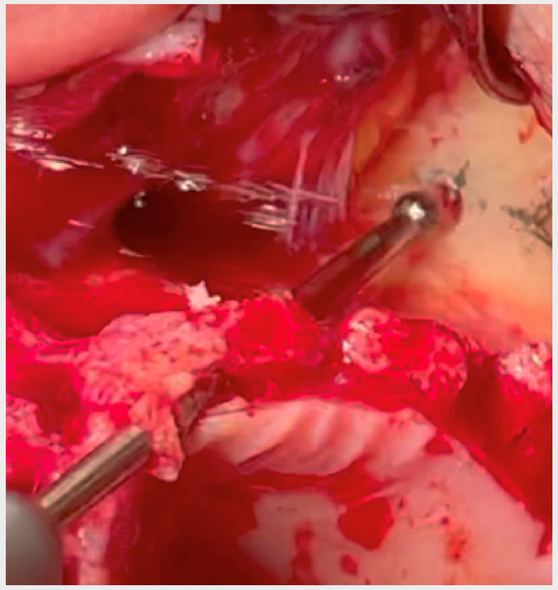


Fig. 8b

Fig. 8a On the left anterior side, a more anterior tunnel osteotomy is chosen because the cystic defect only reaches mesial to the canine. Note that the position of the antrostomy at the approximate level of the zygomaticomaxillary suture has been clearly marked according to the planning.

Fig. 8b The round burr is drilling the site chosen for the anterior left antrostomy.

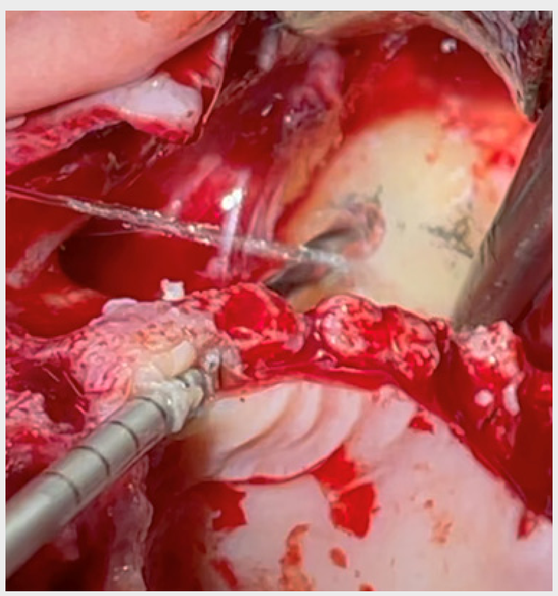


Fig. 8c

Fig. 8d

Fig. 8c Maintaining the previous direction and under abundant irrigation, the twist drill ends the anchor zone osteotomy.

Fig. 8d Clinical image of the two minimally invasive ZAGA™ osteotomies tunnel and channel on the left side.

ZYGOMATIC IMPLANT FINAL POSITION LEFT SIDE

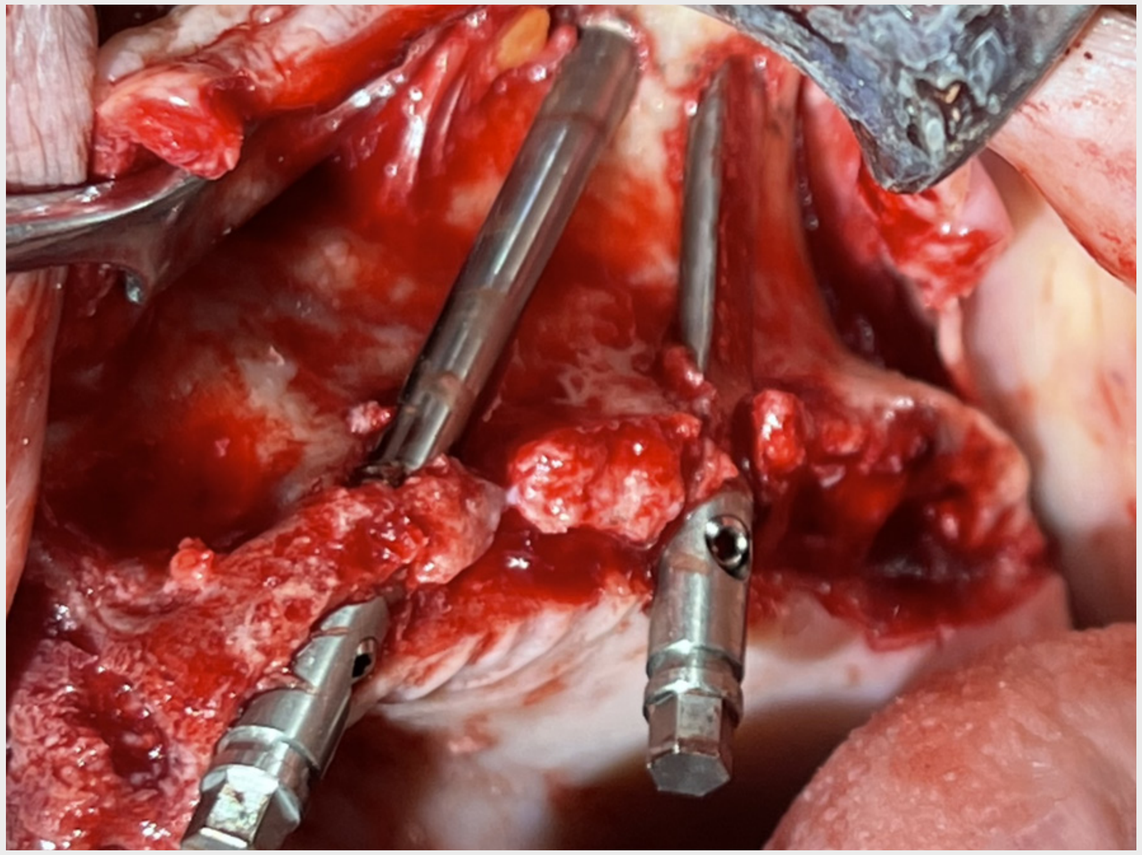


Fig. 8e Clinical image of the two implants Straumann® Zygomatic implants, ZAGA™ Round and ZAGA™ Flat, placed without using “windows” and/or “slots« respectively in anterior and posterior position on the left side.

Note the angled arrangement between the two implants which achieves a better AP distribution of the masticatory loads.

ZYGOMATIC IMPLANTS FINAL POSITION BOTH SIDES

Fig. 9a Final implant positioning combining ZAGA™ concept protocols and Straumann® Zygomatic implants, ZAGA™.

ZAGA™ minimally invasive osteotomy. Prevents oro antral communication.

Remains of crestal alveolar bone are maintained to provide soft tissue connective fibres anchorage.

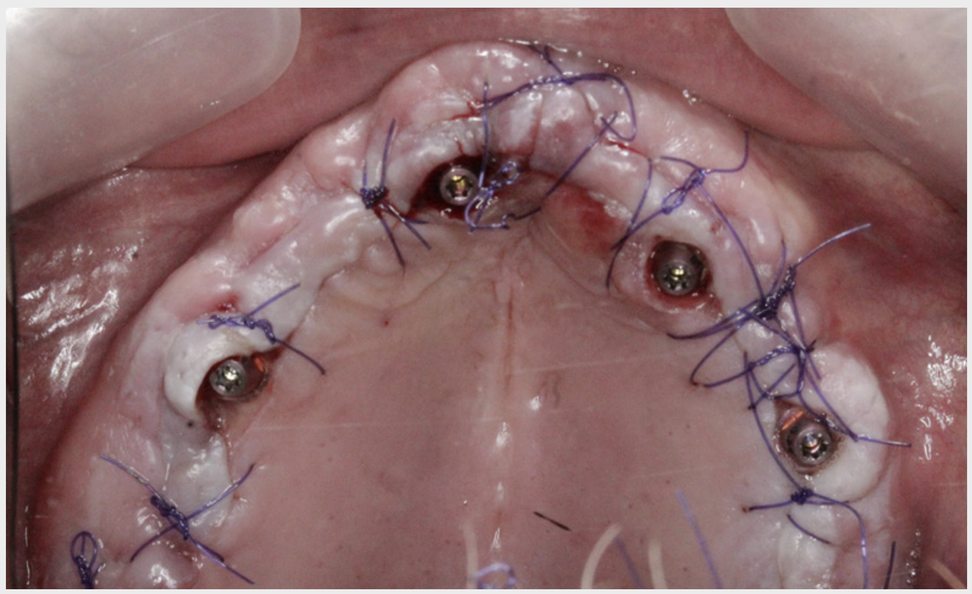


Fig. 9b Mirror image of the incision closed with resorbable stitches. Note that the Straumann anatomical abutments are already in place. Note also how the palatal incision allows to create more keratinized tissue on the buccal side of the implant head.

PROSTHESIS

Fig. 10a Immediate prosthesis in place.

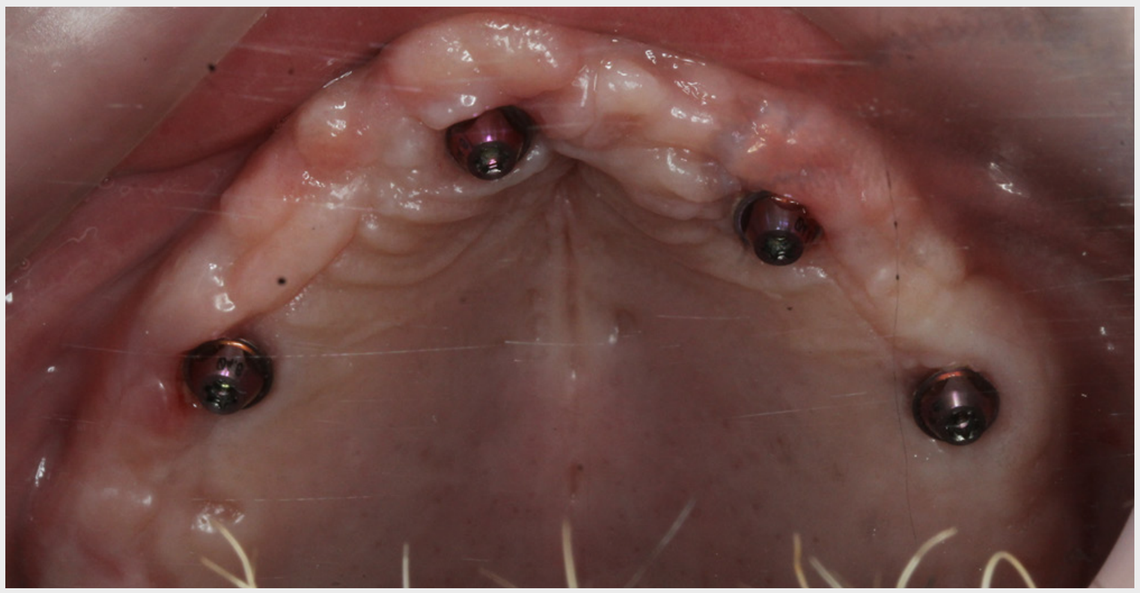


Fig. 10b Occlusal view showing excellent soft tissue healing.

POST-OPERATIVE X RADIOGRAPHIC EXAMINATION

CBCT

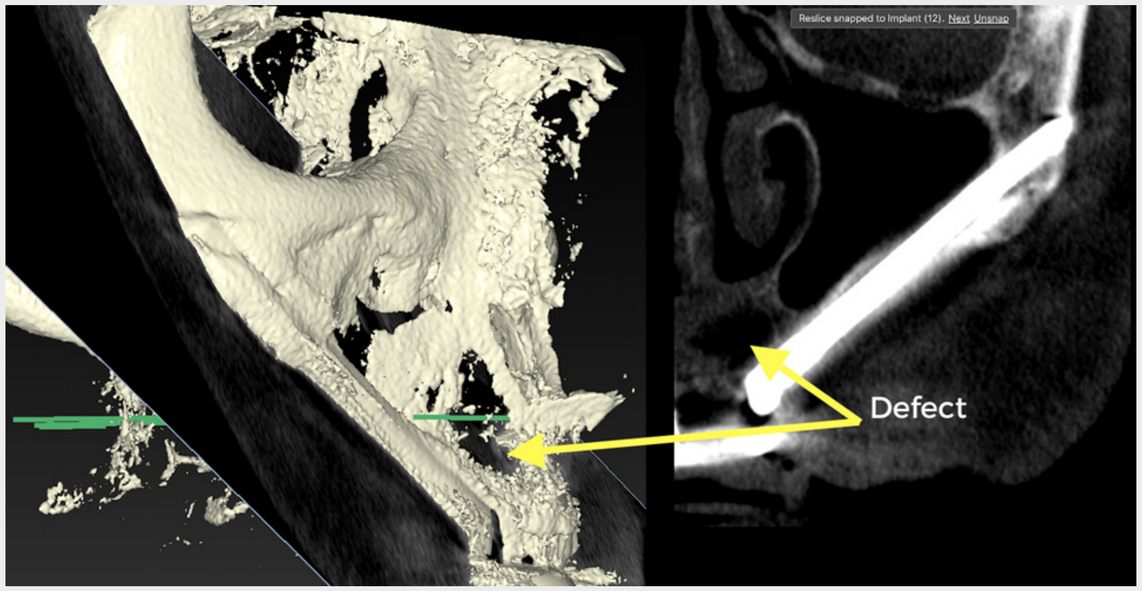


Fig. 11a CBCT cut through the anterior right implant (ZAGA™ Type 2–3 - Straumann® Zygomatic implant, ZAGA™ Round,) showing the state of the maxillary sinus after one year. Compare with the pre-surgery status shown in figure 4a.

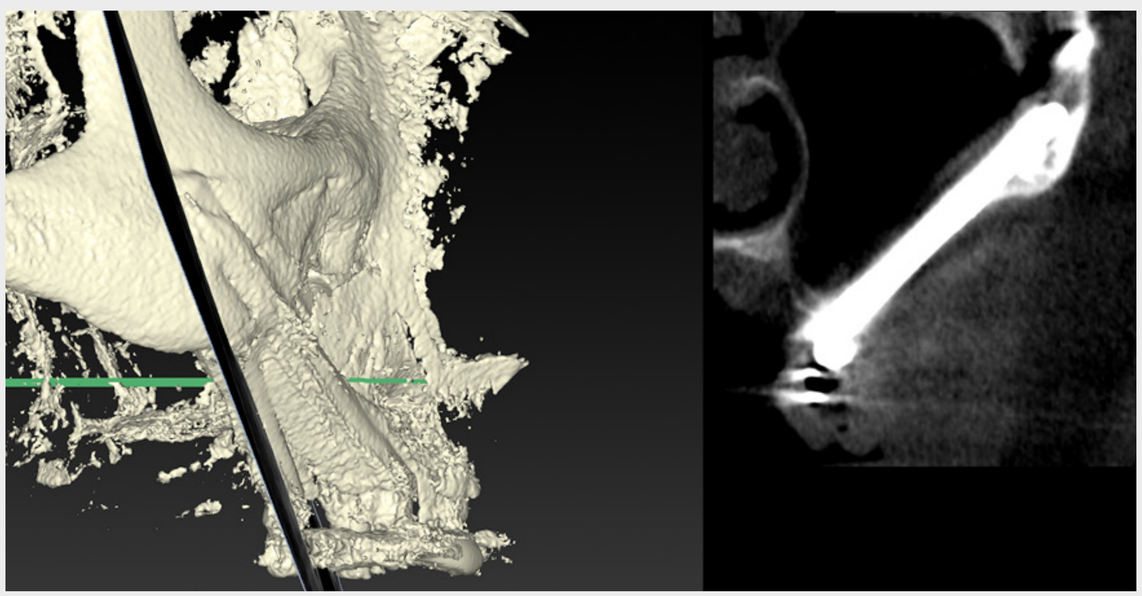


Fig. 11b CBCT cut through the posterior right implant (ZAGA™ Type 4 - Straumann® Zygomatic implant, ZAGA™ Flat,) showing the transparency of the maxillary sinus after one year. Compare with the pre-surgery status shown in figure 4b.

POST-OPERATIVE RADIOGRAPHIC EXAMINATION

CBCT

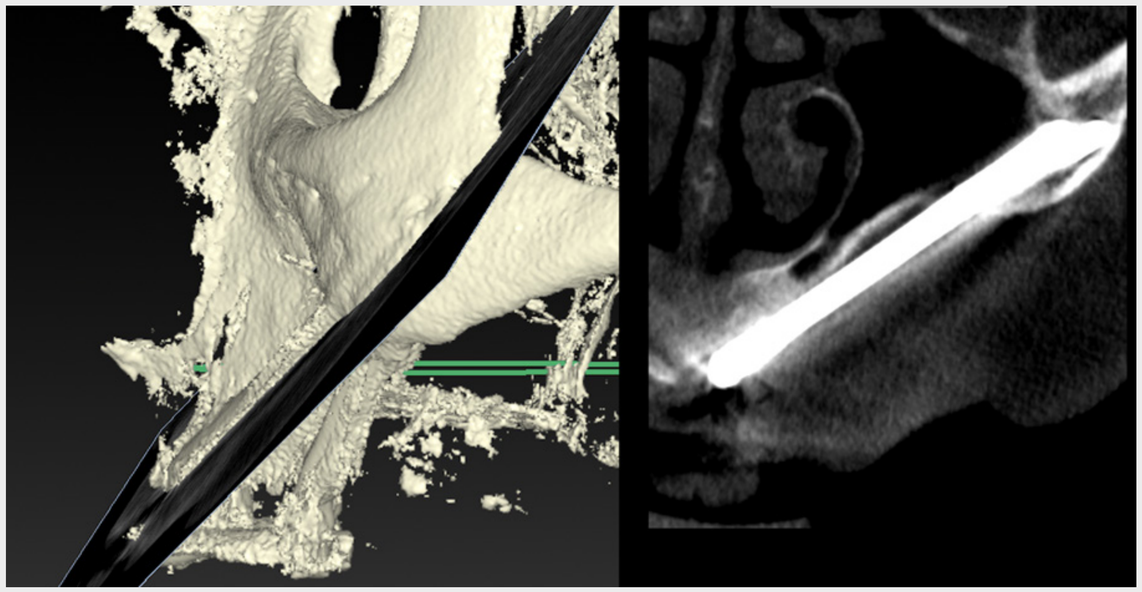


Fig. 11c CBCT cut through the anterior left implant (ZAGA™ Type 3 - Straumann® Zygomatic implant, ZAGA™Round,) showing the state of the maxillary sinus after one year. Compare with the pre-surgery status shown in figure 4c.

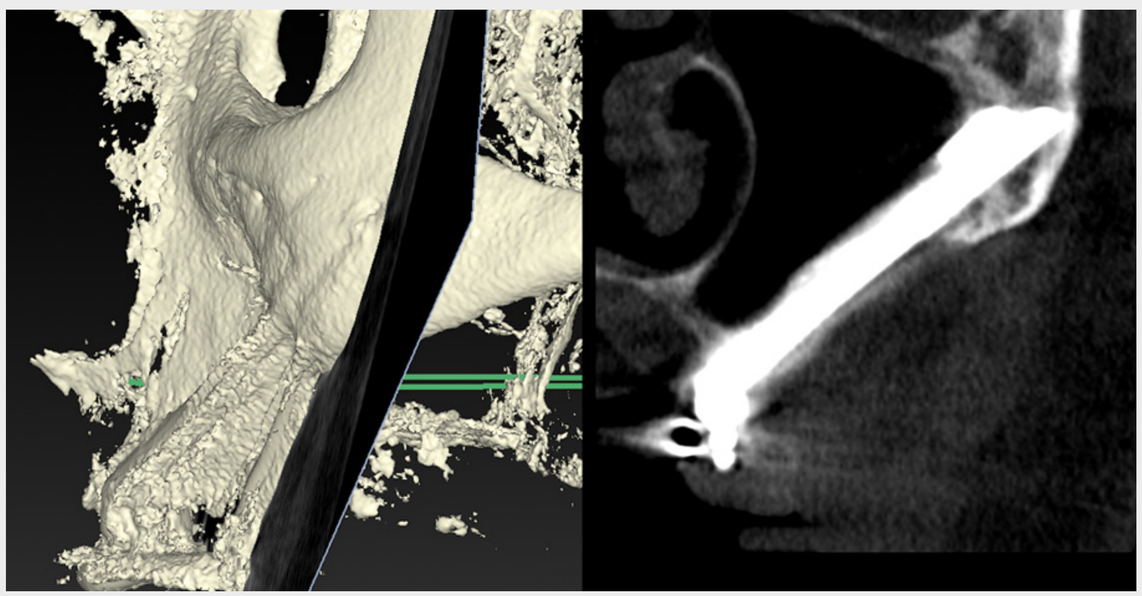


Fig. 11d CBCT cut through the posterior left implant (ZAGA™ Type 4 - Straumann® Zygomatic implant, ZAGA™Flat,) showing the transparency of the maxillary sinus after one year. Compare with the pre-surgery status shown in figure 4d.

CLINICAL OUTCOMES

The patient received 2 Straumann® Zygomatic implants, ZAGA™ Flat, in the second premolar/first molar sites. Due to the preservation of the sinus membrane integrity in both ZICZ's and the flat implant design no sinus and soft tissue complications are expected in the area.

Two Straumann® Zygomatic implants, ZAGA™ Round, were placed in the right and left lateral canine sites and the alveolar bone overlying the implants was preserved. Thanks to the minimally invasive osteotomies and the tapered design of the implants, all implants achieved primary stabilities of more than 55 Ncm. After placing anatomical abutments that were tightened to 35 Ncm, the palatal incision was closed with discontinuous resorbable sutures to protect the head and neck of the implants with extra keratinized tissue. Measurements were then taken, and an immediate provisional prosthesis was made. The aspect of the mucosa is favorable as well as the annual radiographic control that shows absolute transparency of both sinuses.

TAKE HOME MESSAGES

The present «one clinical case» presentation showed that the combination of the ZAGA™ protocols plus the Straumann® Zygomatic implants, ZAGA™, portfolio allows offering the patient a predictable long-term oral rehabilitation while reducing or eliminating potential complications and improving esthetics.

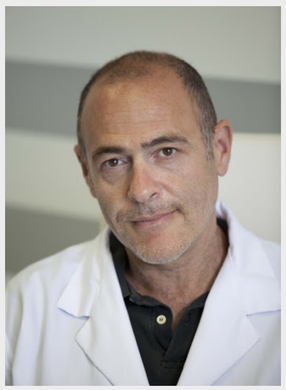
These outcomes were confirmed by recent clinical results* which demonstrated that the ZAGA™ philosophy of individualizing and sequencing the zygomatic implant osteotomy according to the patient's anatomy and not vice versa is completed by our newly designed implants capable of adapting to each anatomical position.

*Aparicio C, Polido W, Zarrinkelk H. The Zygoma Anatomy-Guided Approach for Placement of Zygomatic Implants: Atlas Oral Maxillofac Surg Clin North Am. 2021 Sep;29(2):203-231.

USE OF FOUR STRAUMANN® ZYGOMATIC IMPLANTS, ZAGA™ ROUNDS, QUAD PROCEDURE

DR. RUBÉN DAVÓ RODRÍGUEZ MD PHD MSC

MEET THE EXPERT



DR. RUBÉN DAVÓ RODRÍGUEZ

Dr. Davó received MD, MSc, PhD and MFS degrees during his formal training and education. He is currently the Director of Instituto Davó at the International Hospital Medimar in Alicante where he serves as Chief of the Oral, Maxillofacial and Implant Surgery Department. He has focused his patient care on dentofacial deformities, guided surgery, rehabilitation of patients with atrophied bones and quality of life issues. He is a member of the faculty at the Barcelona University Hospital. He lectures worldwide and provides international educational courses and programs at Instituto Davó. His PhD dissertation focused on “Immediate function in atrophic maxilla using zygomatic implants.”

INTRODUCTION

Zygomatic implants have been established as a predictable treatment option for rehabilitating patients with severe alveolar atrophy. The treatment is based on exploiting alternative anatomical structures of different embryological origins for implant placement and stabilization. High implant survival rates may be achieved with the absence of bone resorption and atrophy in these implant locations.

Zygomatic implants represent an attractive alternative to treatment strategies that require major bone augmentation. Based on the extent of the anatomical structures that need to be reconstructed, these procedures are associated with an elevated risk of complications, the disadvantage of long treatment times, and staged procedures.

They are also potentially associated with comorbidities related to the harvesting of autologous bone. Consequently, these procedures are less and less accepted by the patients, who may resort to other options. Both treatment options were recently compared in a randomized control clinical trial, which demonstrated a superior outcome for zygomatic implants with respect to prosthetic complications and implant failures compared to sequential treatment strategies involving bone regeneration and the placement of regular implants.[1]

The "quad zygoma" concept has been developed to rehabilitate patients presenting insufficient bone height in the anterior and posterior maxilla. This concept is based on the placement of four zygomatic implants. An adequate anteroposterior spread and the correct inclination of the implants are important to ensure an even load distribution across the implants as part of a cross-arch splinted configuration. The concept has been clinically tested for immediate function with promising short- and long-term results.[2–4]

The following case report illustrates the use of the "quad zygoma" concept as a viable option for the immediate rehabilitation of a patient with severe maxillary atrophy.

LITERATURE REFERENCES TO REMEMBER

1. Davó R, Felice P, Pistilli R, Barausse C, Marti-Pages C, Ferrer-Fuertes A, Ippolito DR, Esposito M. Immediately loaded zygomatic implants vs conventional dental implants in augmented
atrophic maxillae: 1-year post-loading results from a multicentre randomised controlled trial. Eur J Oral Implantol 2018; 11: 145–61.
2. Davó R, Pons O. 5-year outcome of cross-arch prostheses supported by four immediately loaded zygomatic implants: A prospective case series. Eur J Oral Implantol 2015; 8: 169–74.
3. Duarte LR, Filho HN, Francischone CE, Peredo LG, Brånemark P-I. The Establishment of a Protocol for the Total Rehabilitation of Atrophic Maxillae Employing Four Zygomatic Fixtures in an Immediate Loading System—A 30-Month Clinical and Radiographic Follow-Up. Clin Implant Dent Rel Res 2007; 9: 186–96.
4. Stiévenart M, Malevez C. Rehabilitation of totally atrophied maxilla by means of four zygomatic implants and fixed prosthesis: a 6–40-month follow-up. International Journal of Oral and Maxillofacial Surgery 2010; 39: 358–63.

PATIENT SUMMARY

Gender	Female
Age	52 years
General condition	Normal
Smoker	No
Medication	No
CLINICAL AND XRAY EXAMINATION	
Maxillary teeth	Edentulous
Maxillary bone	Edentulous, severely resorbed
Opposite arch	Restoration necessary: Yes
TMJ	Disfunction: No
Complaints	The main complaints of the patient were related to the impairment of Oral Health-Related Quality of Life (parameters)

PATIENT FACE

PATIENT PROFILE

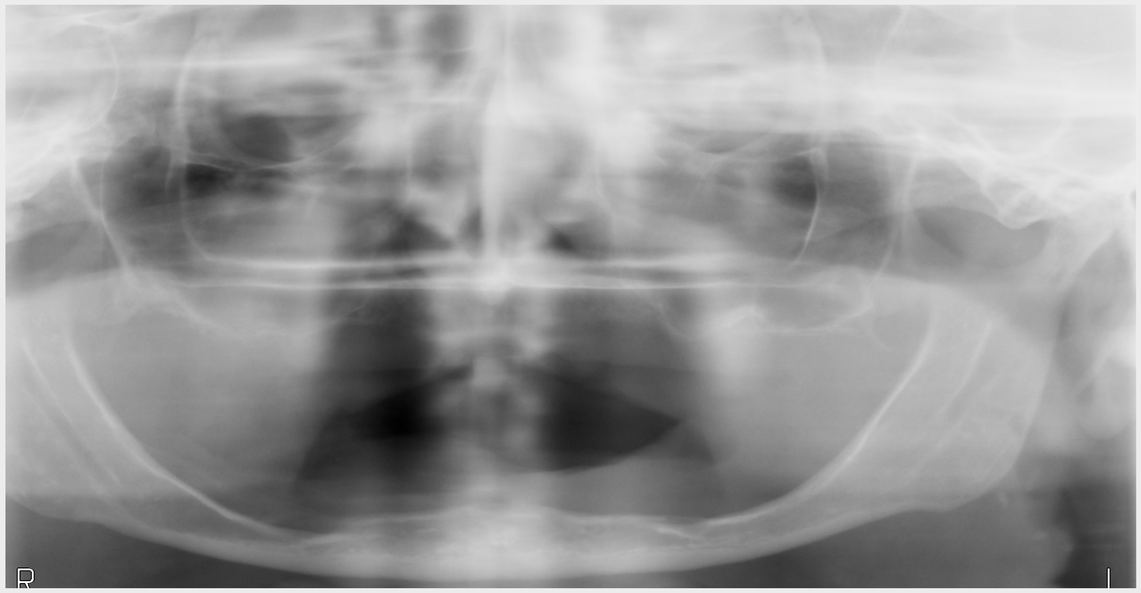
INTRAORAL EXAMINATION

Situation prior to treatment

Intraoral examination indicated a severely atrophied state of the maxilla and mandible. The maxilla was characterized by the presence of abundant healthy keratinized tissue.

RADIOGRAPHIC EXAMINATION

OPG situation prior to treatment



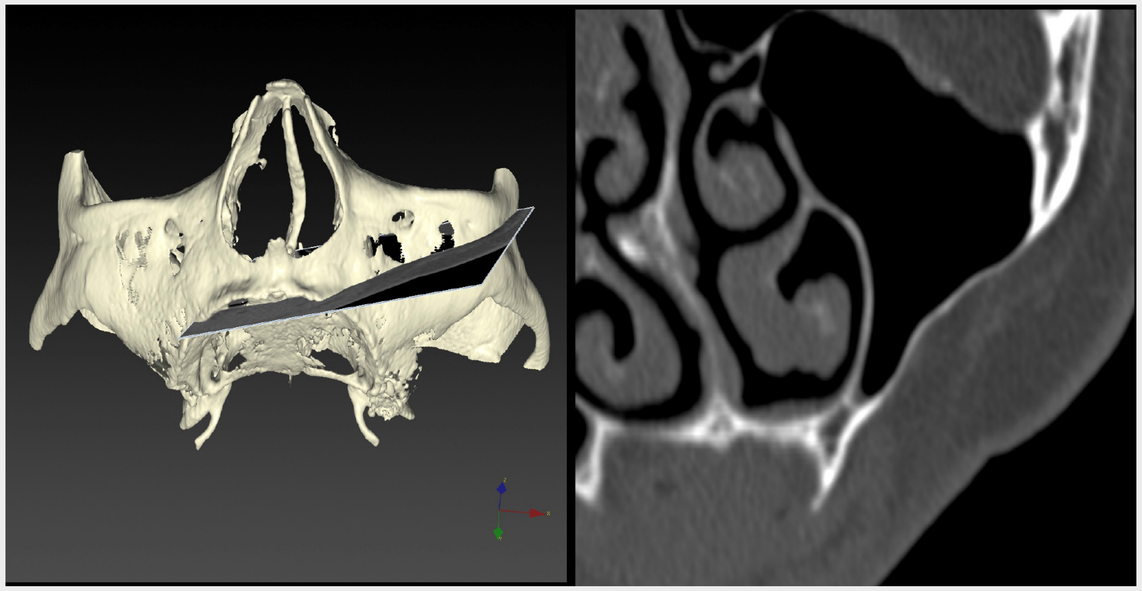
Radiographic panoramic examination revealed severe anteroposterior resorption of the edentulous maxillary and mandibular arches.

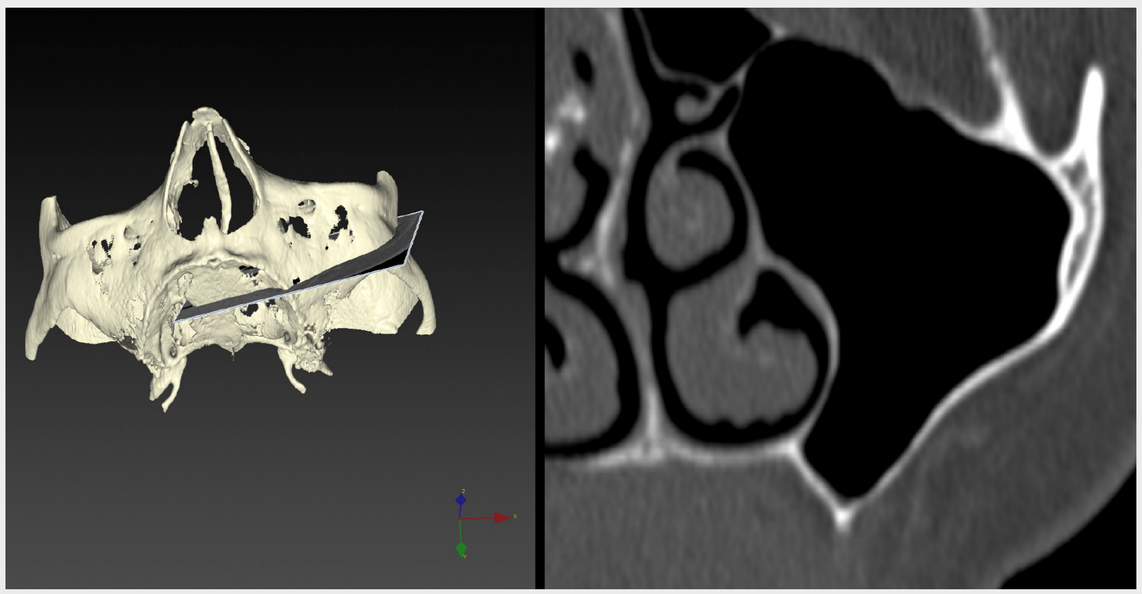
TREATMENT SCHEDULE

DECISION FULL ARCH	
Bilateral implants	x
ZYGOMATIC IMPLANT(S)	
Type	(CH-ZT) STRAUMANN® REGULAR ZYGOMATIC IMPLANTS
Length	40 / 47.5 / 40 / 50
Position	15 / 13 / 25 / 23
REGULAR IMPLANT(S)	
Diameter	4.3
ABUTMENT(S)	
Type	STRAIGHT 0
Heigh	3.5 / 2.5 / 3.5 / 2.5
Diameter	4.6
Position	15 / 13 / 25 / 23
PROSTHESIS	
Provisionalisation	Yes

CBCT AND TREATMENT PLANNING

CBCT left side



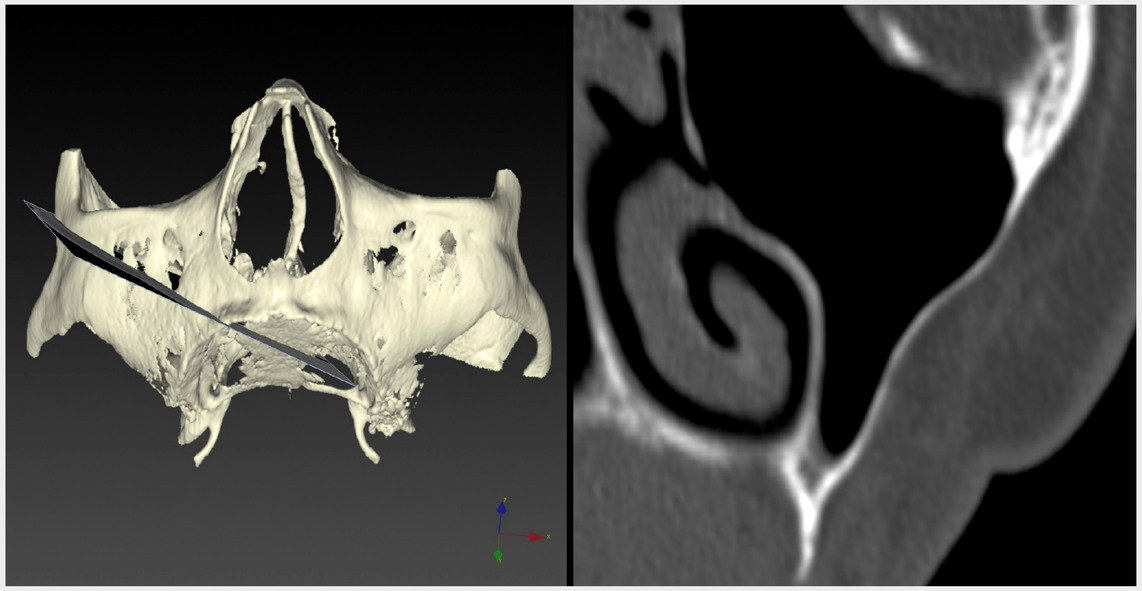


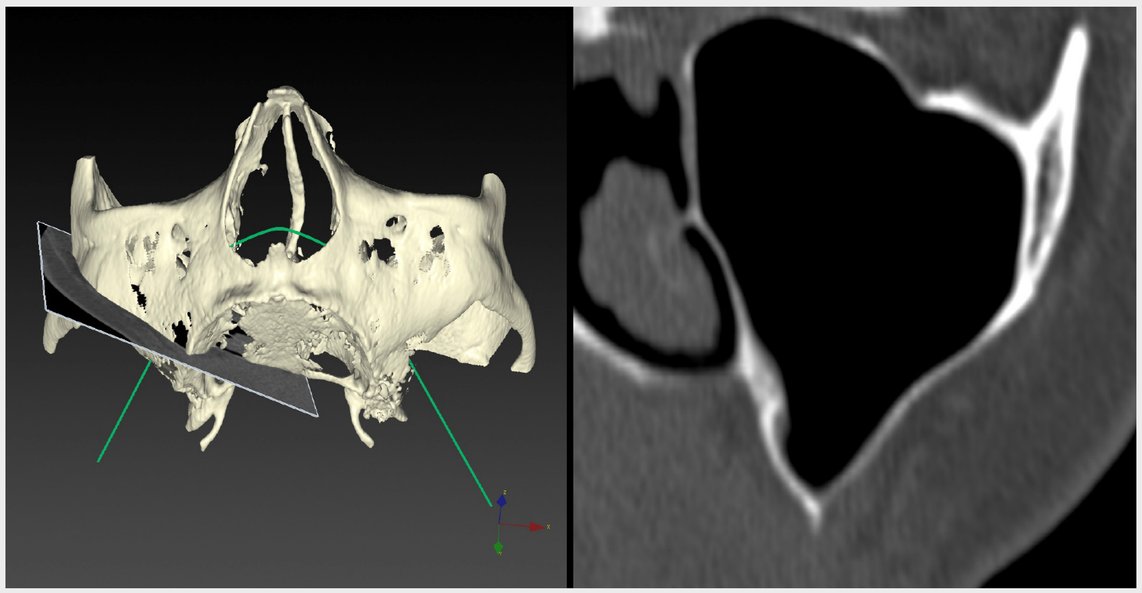
After discussing the alternative treatment options and associated benefits and risks, the patient expressed her wish for an immediate, fixed rehabilitation supported by a “quad zygoma” concept.

CBCT diagnostic evaluation confirmed the severe resorption of the alveolar crest impeding the placement of regular implants. The osseous anatomical situation was bilaterally symmetric, indicating ZAGA™ classifications of 1–2 and 0 in the anterior and posterior implant positions, respectively.

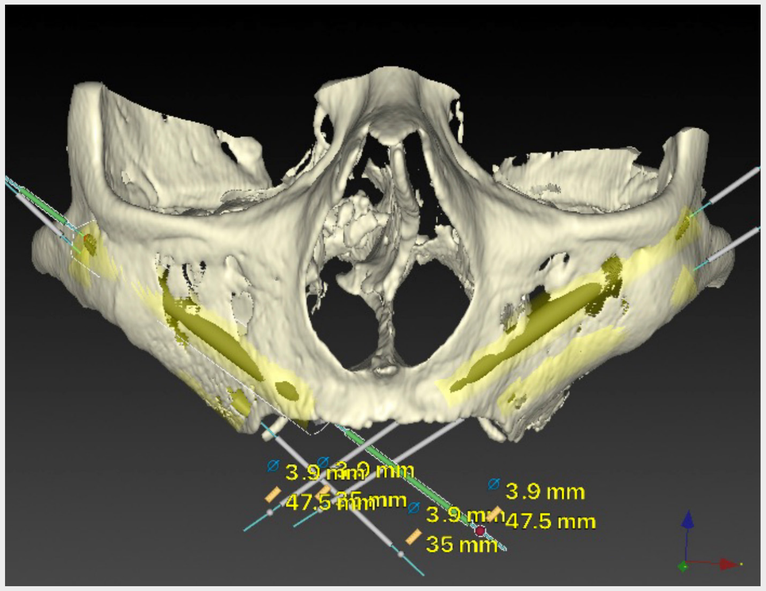
CBCT AND TREATMENT PLANNING

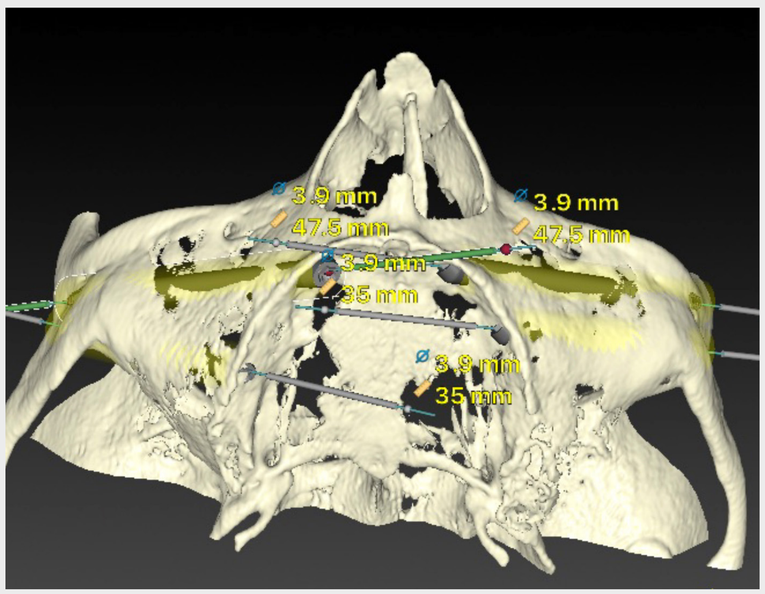
CBCT right side





CBCT AND TREATMENT PLANNING





Implant planning was based on a first-molar-to-first-molar maxillary rehabilitation conducted digitally with the help of planning software.

The planned implant restoration consisted of the following four Straumann® Zygomatic implants:

- Position 23: 50 mm Straumann® Zygomatic implant, ZAGA™ Round
- Position 26: 40 mm Straumann® Zygomatic implant, ZAGA™ Round
- Position 13: 47.5 mm Straumann® Zygomatic implant, ZAGA™ Round
- Position 16: 40 mm Straumann® Zygomatic implant, ZAGA™ Round

ANESTHESIA, INCISION AND FLAP ELEVATION

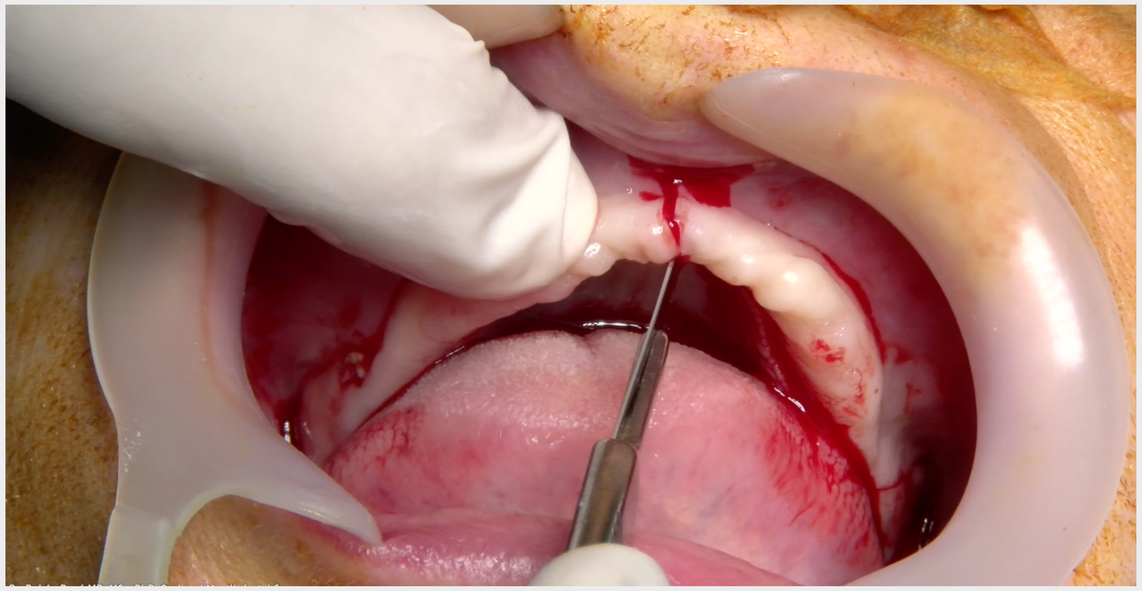
Anesthesia

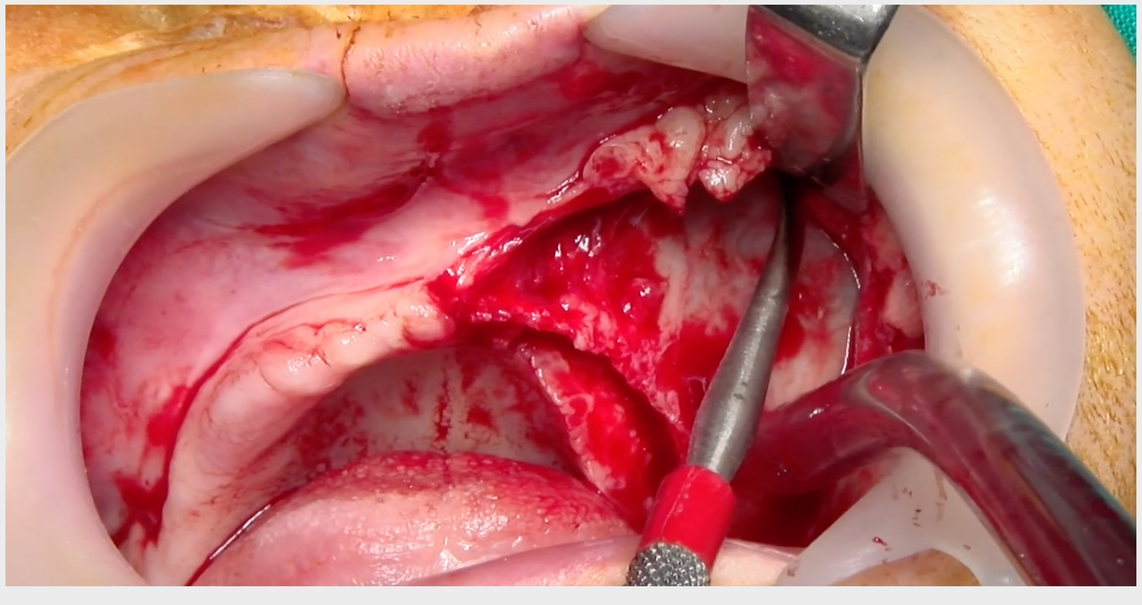
Surgery was performed under general anesthesia. Local infiltration anesthesia was applied to support hemostasis in the surgical area and reduce the required analgesia.

Prophylactic antibiotic therapy was administered from the day before surgery until 10 days after surgery to reduce the risk of infections, particularly in the sinus area. 750 mg amoxicillin and 125 mg clavulanic acid were administered three times a day. The patient was draped so that the sterile surgical area was identifiable, and the infraorbital rim, lateral orbital rim, and body of the zygoma were readily accessible during the procedure.

ANESTHESIA, INCISION AND FLAP ELEVATION

Flap elevation





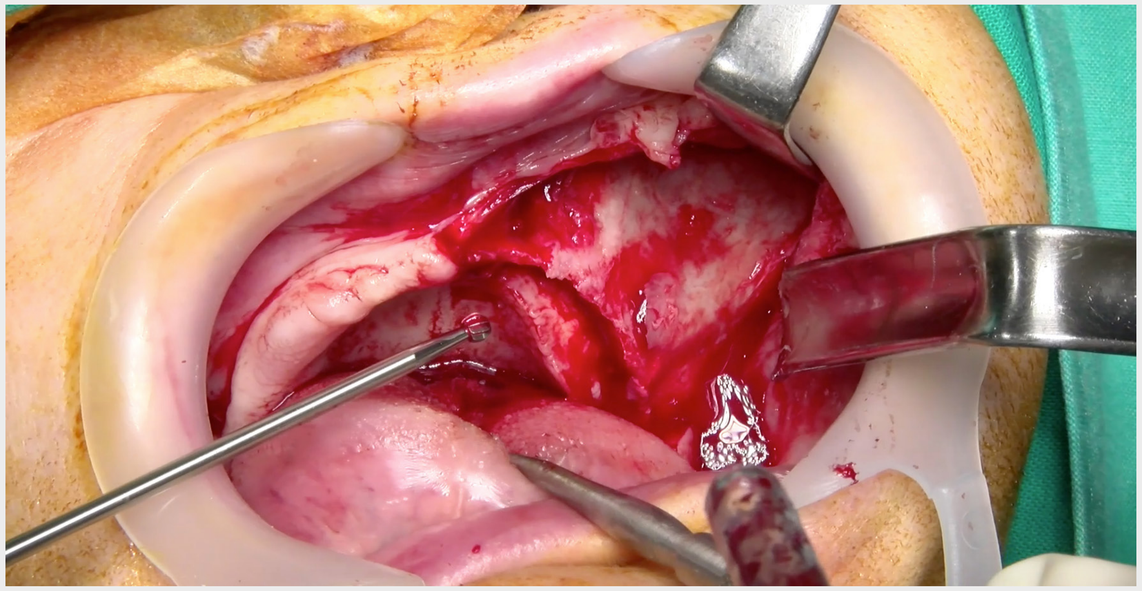
Surgical access was obtained after the palatal incision by elevating a full-thickness flap in the region between bilateral first molars. This incision design was essential to ensure a good labial and buccal keratinized tissue width after wound closure. Distal vertical releasing incisions were made bilaterally to enable a good visualization of the surgical site.

Subperiosteal dissection was performed in a superior direction along the zygomatic buttress and up to the frontozygomatic notch to allow visual access to the following essential anatomical structures:

- The maxilla from the piriform apertures up to and including the zygomatic buttress
- The infraorbital foramen
- The malar bone
- The palate adjacent to the incision
- Special care was taken to identify, preserve, and protect the infraorbital neurovascular bundle.

ANESTHESIA, INCISION AND FLAP ELEVATION

Surgical access

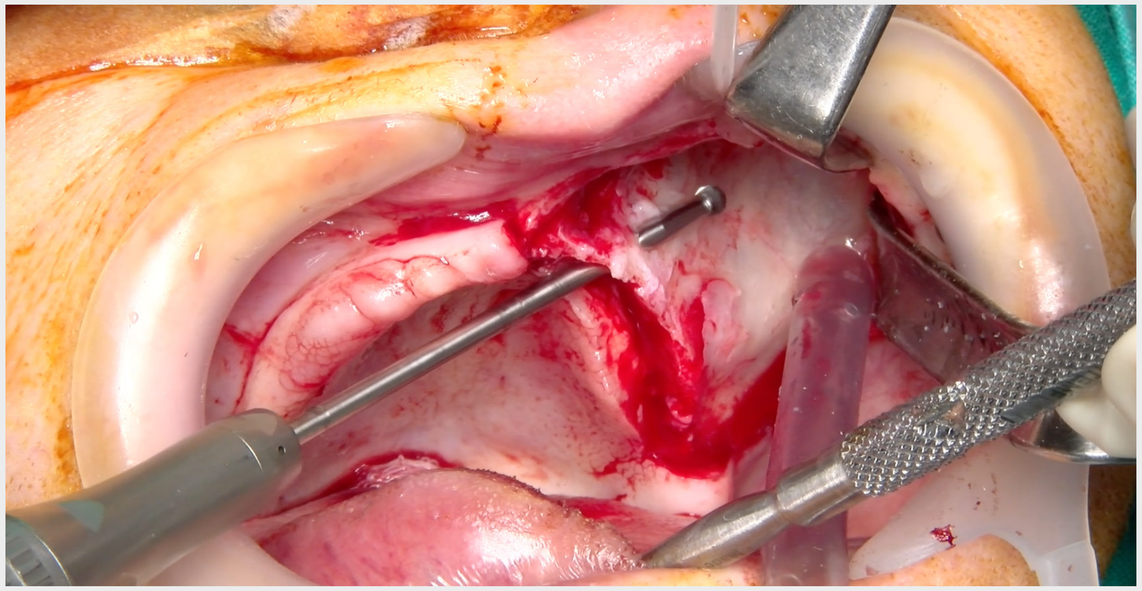


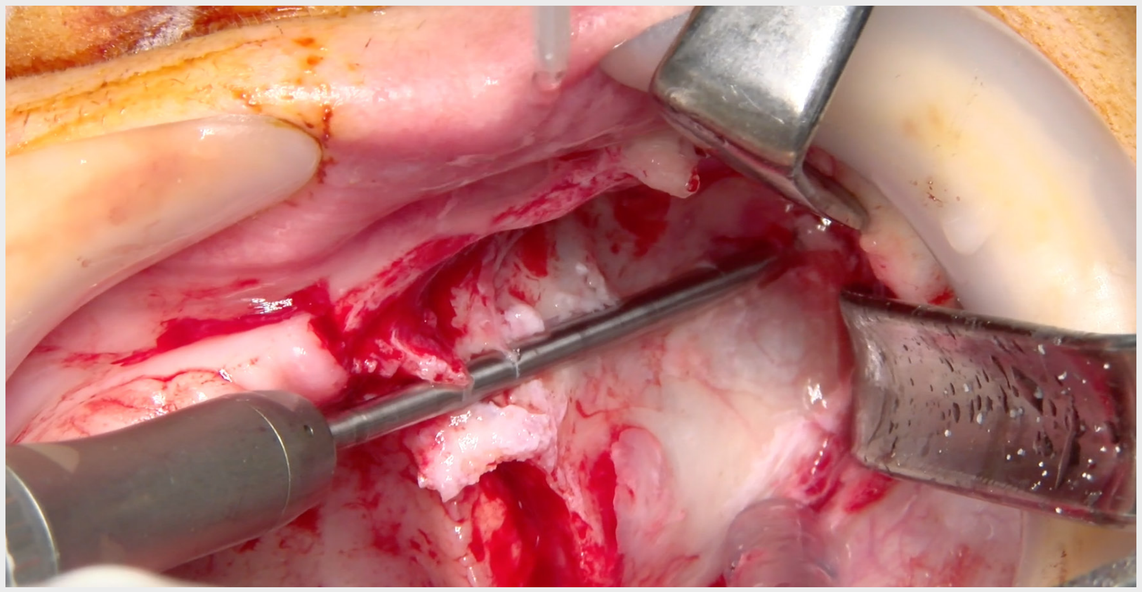
After the definition of the surgical access, a retractor was placed in the area of the frontozygomatic notch to ensure adequate visualization of the malar bone during osteotomy preparation. This visual access was also essential to define and plan the detailed path of the osteotomy based on the actual anatomical structures and conditions.

Positioning of the implants considered the anatomy of the maxillary zygomatic complex with the aim of placing two implants into a finite space by simultaneously ensuring appropriate prosthetic and mid-crestal emergence of the implant platforms.

OSTEOTOMY PREPARATION

Position 23



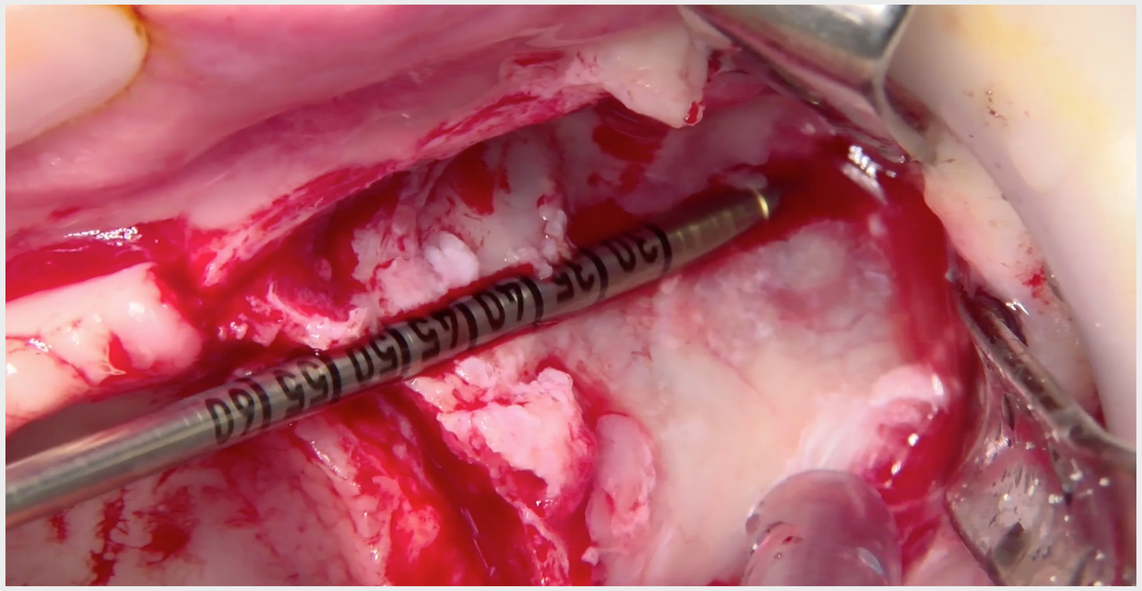


Osteotomy preparation and implant insertion were carried out in an anteroposterior order. The crestal position of the anterior and posterior implants was defined in the zones of the canines or lateral incisors and the zones of the molar or premolar areas, respectively. Further implant positions were planned to respect an even distribution in the zygomatic bone and adequate spacing.

Implant osteotomy preparation started at the palatal aspect of the alveolar ridge using a round bur.

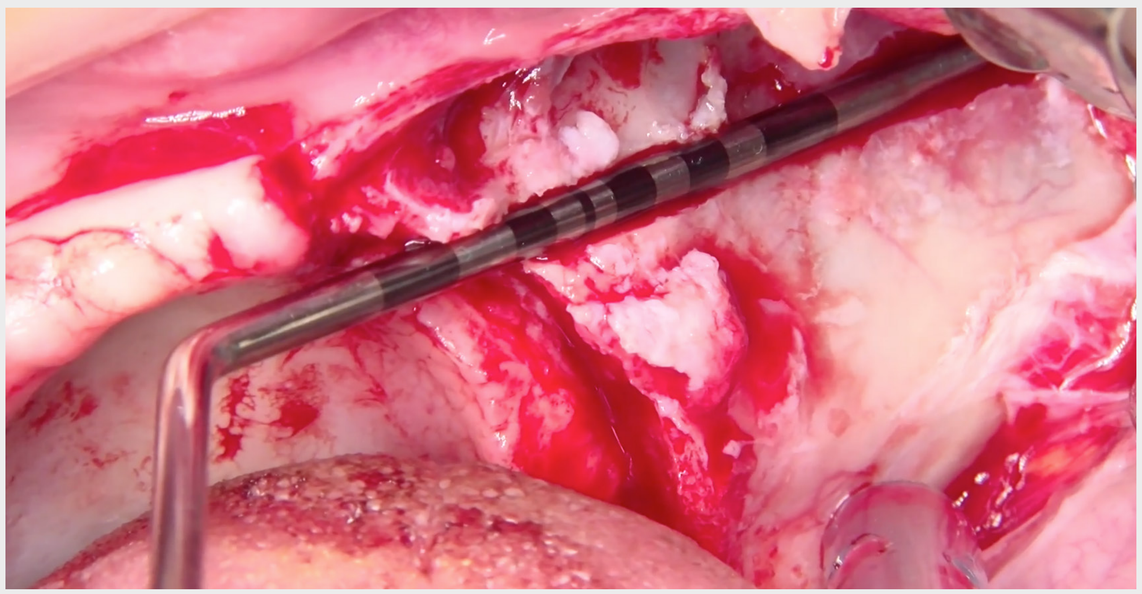
OSTEOTOMY PREPARATION

Position 23



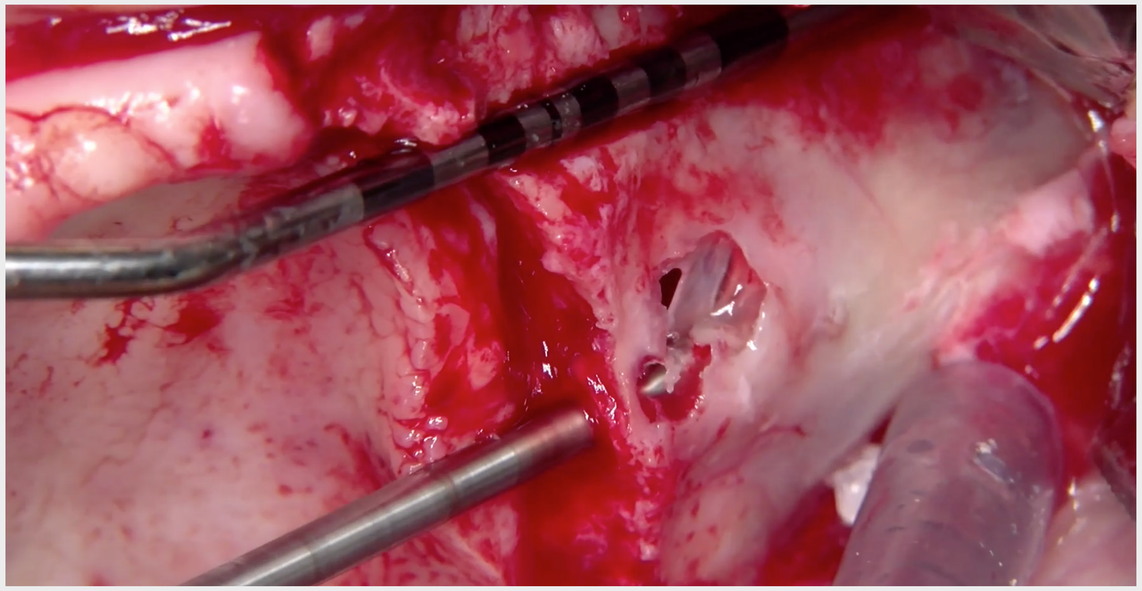
In the present case, the implant trajectories of the mesial zygomatic implants (#23 and #13) were oriented in the direction of the lateral wall of the maxilla. Cortical engagement and stabilization of the implant platform with the thin alveolar crest were attempted by performing a tunnel osteotomy.

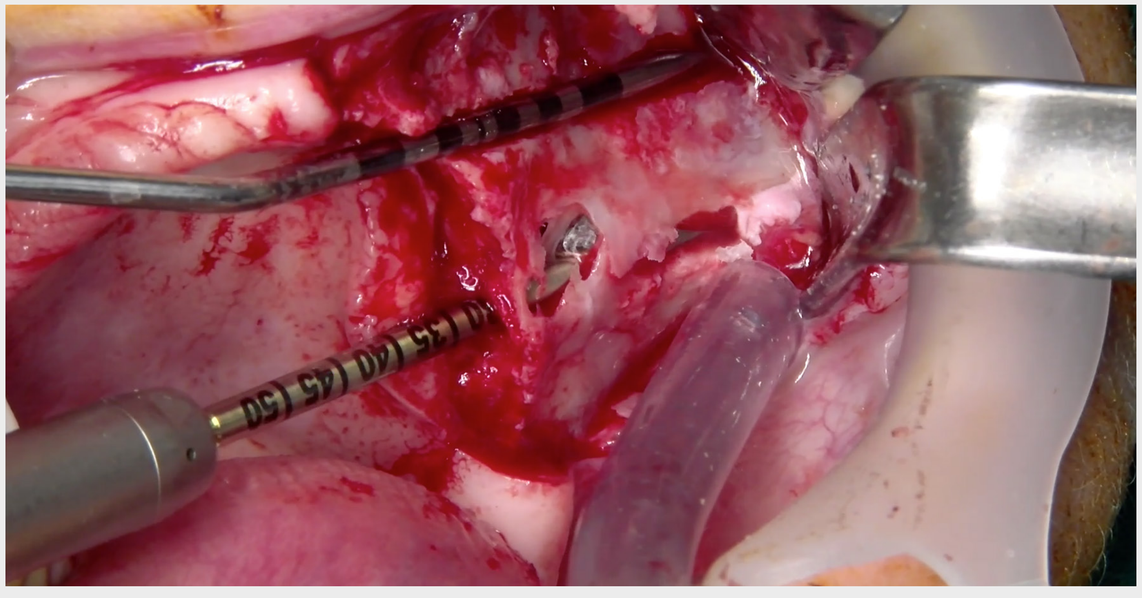
Position 13



OSTEOTOMY PREPARATION

Position 25





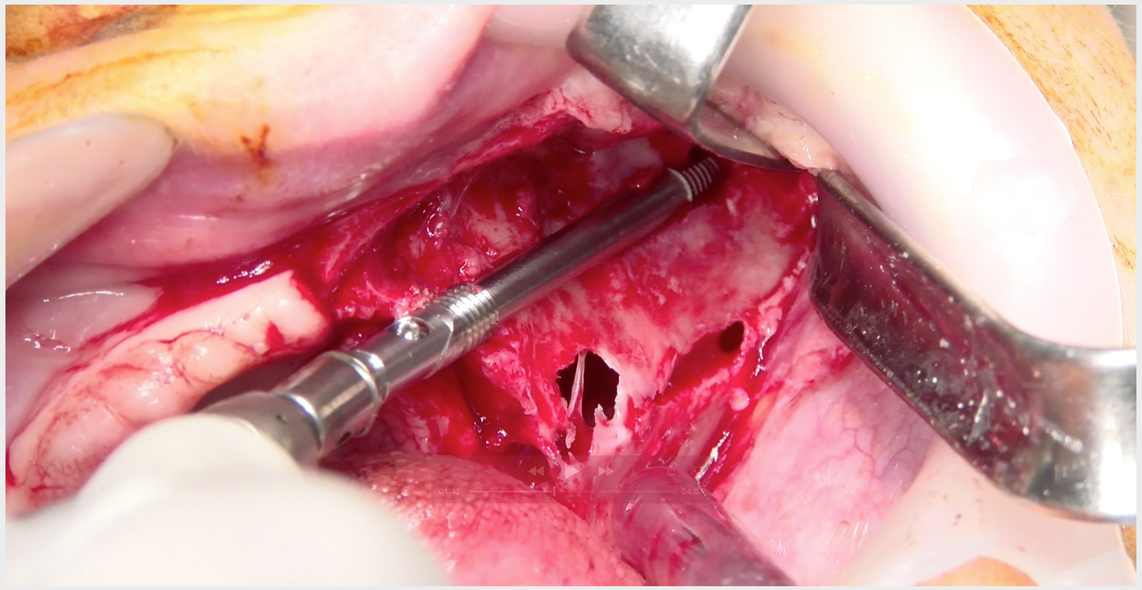
Both distal zygomatic implants were oriented from the palatal aspect of the alveolar crest to the zygoma bone following an intrasinus trajectory. A channel osteotomy was not considered due to the extreme weakness of the lateral maxillary wall.

Osteotomy preparation into the zygoma bone was achieved using a 2.9 mm round drill followed by a twist drill of the same diameter.

Drilling procedures were performed with thorough irrigation to avoid overheating. Irrigation was considered essential at both the alveolar crest level and the implant apex in the malar bone. The malar bone was also constantly examined by extra-oral palpation during the osteotomy preparation.

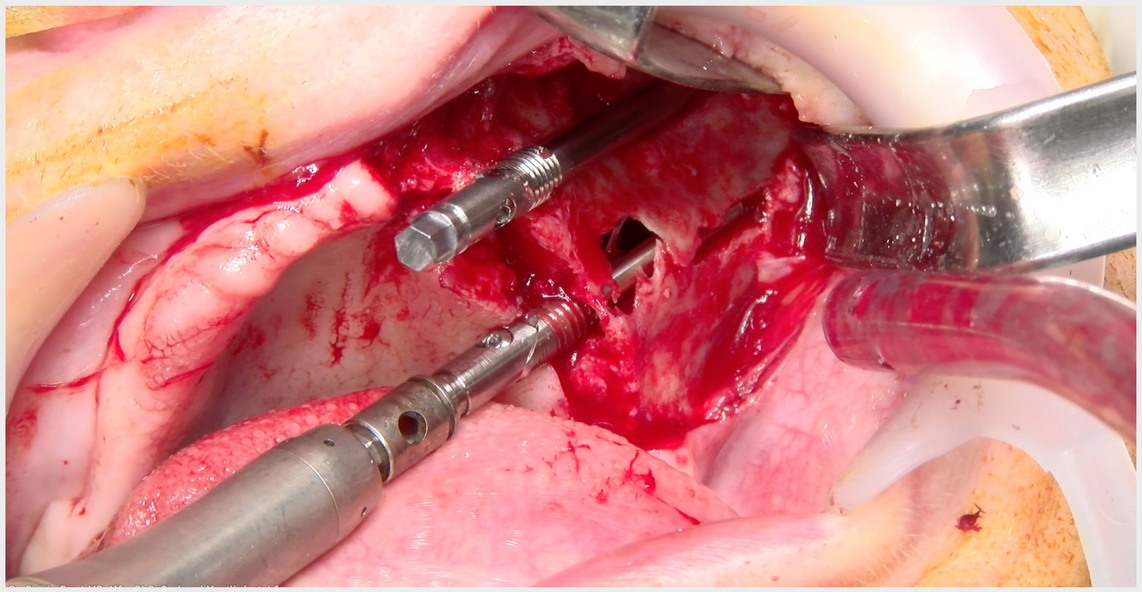
PLACEMENT OF ZYGOMATIC IMPLANTS

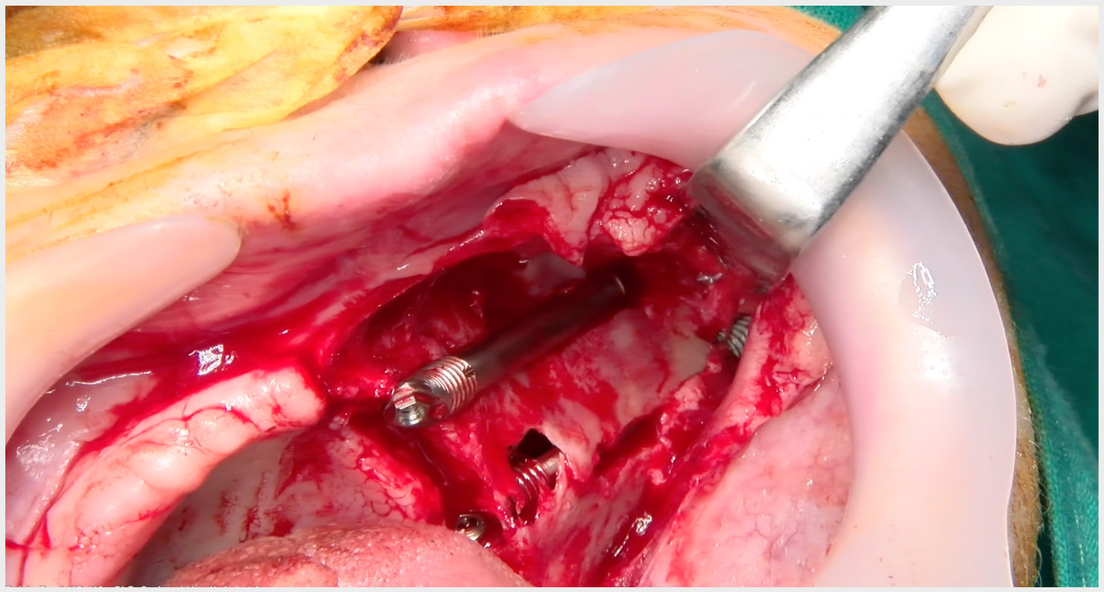
Position 22 and 25



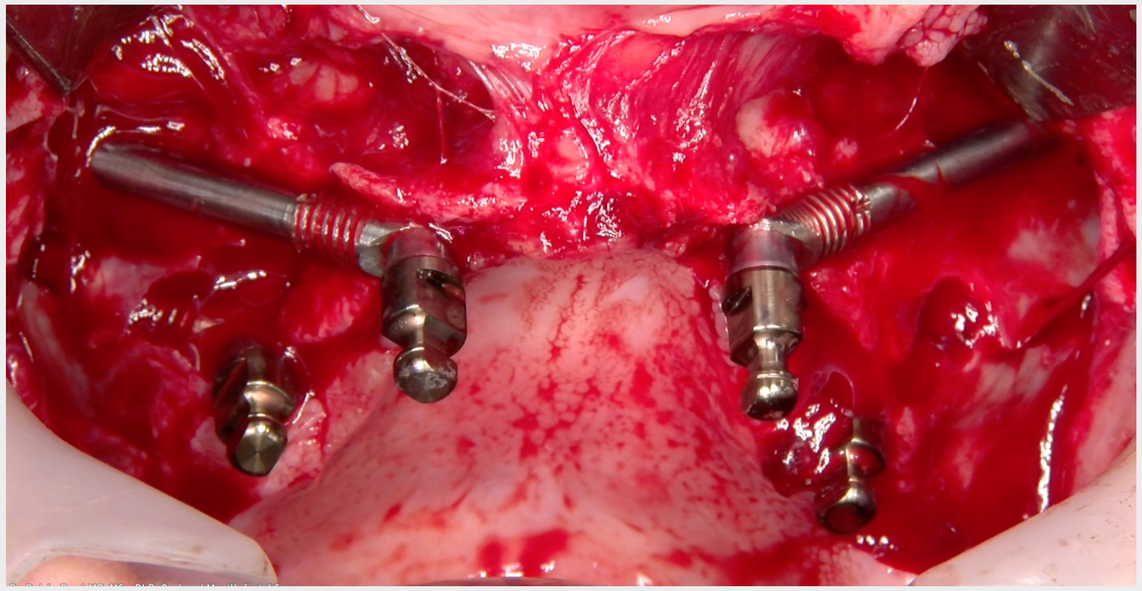
Appropriate primary stability was achieved for all the implants (≥35 N/cm) by anchoring the apical parts in the superficial cortical aspect of the zygomatic bone.

Osteotomy preparation and implant placement on the contralateral side were performed accordingly.



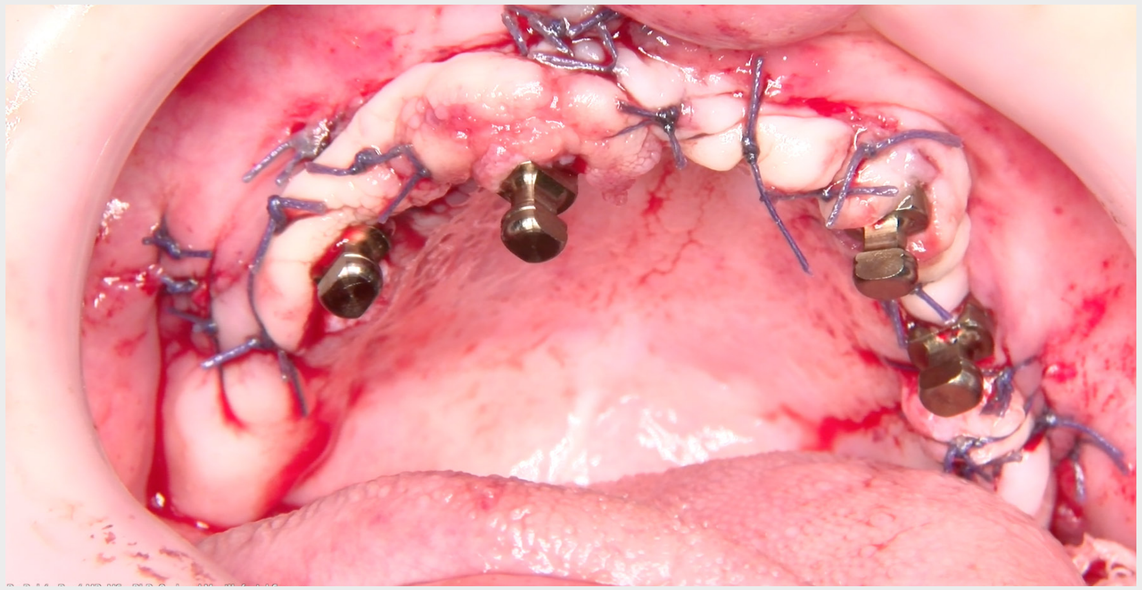


PLACEMENT OF ZYGOMATIC IMPLANTS



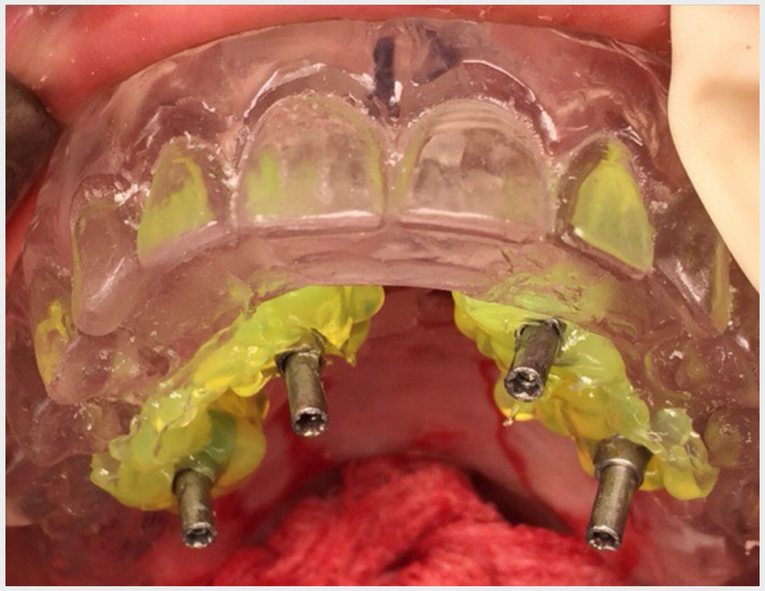
After implant insertion, multi-unit abutments (CH-SRA-4.5, Ex Hex, straight, diameter= 4.6 mm, GH= 4.5 mm) were placed to support the prosthetic rehabilitation. The flap was thoroughly adapted around the abutments to ensure an excellent collar of keratinized tissue around the implants.

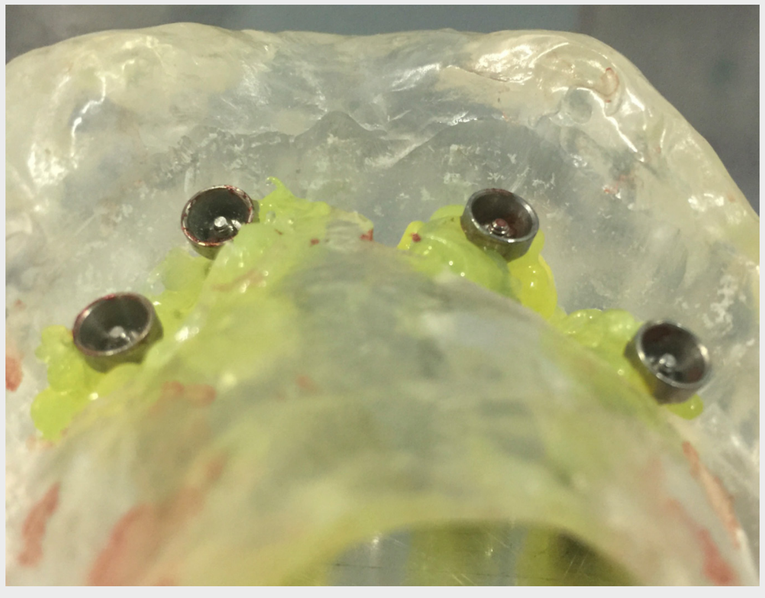
WOUND CLOSURE AND POSTOPERATIVE CARE



The flap was thoroughly adapted around the abutments to ensure an excellent collar of keratinized tissue around the implants. Primary wound closure was accomplished with a 3.0 monofilament resorbable suture.

IMPRESSION



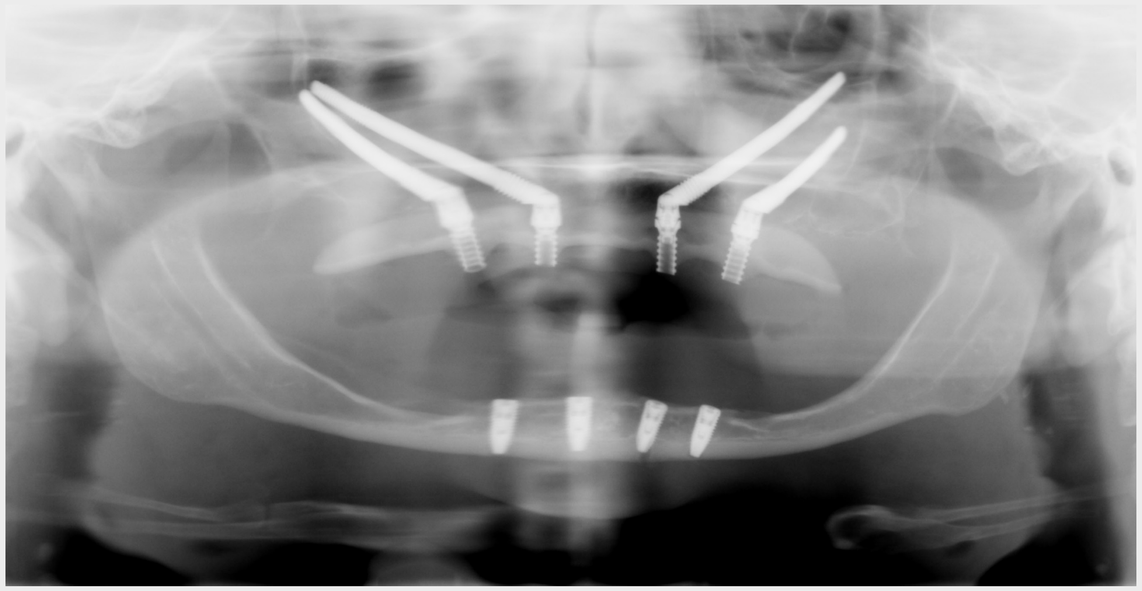


Impressions were taken a few hours after surgery and after the patient had fully regained consciousness. Impression copings were attached to the implant abutments, and a custom-made transparent tray was used for impression transfer. The same tray was also used to register the patient's occlusion and jaw relationship by filling the space between the impression copings and the tray with liquid silicone and subsequent trimming. The tray and copings were picked up, and the transgingival abutments were covered with healing caps.

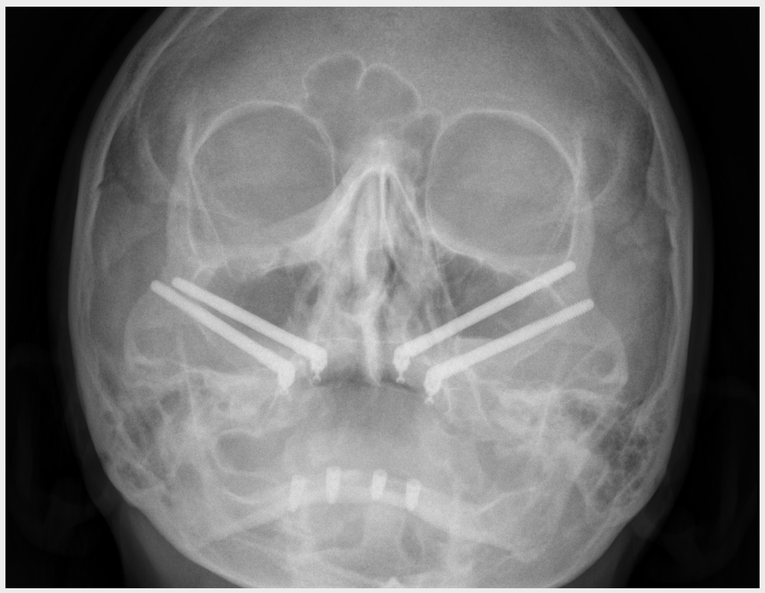
A provisional prosthesis was fabricated by conventional laboratory techniques on a master cast using laboratory analogs. The implant base was restored with temporary titanium copings, the provisional was placed and fused to the copings using cold-curing acrylic. Temporary copings were trimmed after pickup from the patient's mouth, and occlusal surfaces were finalized. Occlusion was subsequently controlled and adjusted to avoid any lateral interferences and overload.

RADIOGRAPHIC EXAMINATION

OPG



A post-operative panoramic radiograph and a CBCT were recorded to verify the adequate placement and positioning of the implants and passivity of the restoration.



PROSTHESIS

Post-restorative evaluation confirmed the adequately restored prosthetic function and correct vertical and horizontal maxillomandibular relationship.

CLINICAL OUTCOME

Visual, esthetic evaluation

The treatment outcomes were evaluated at three different levels, i.e., at the patient level, referral level, and by the treating surgeon.
The patient expressed her complete satisfaction from the functional, psychological, and social perspectives. The patient-level outcome was also quantitatively evaluated objectively using an OHIP 14 test (Oral Health Impact Profile) with a high level of 1.4.
The referring clinician expressed a high level of satisfaction based on the effectiveness of the surgical procedure and the synergistic interactions between her and the surgeon.
The initial expectations of the referring clinician were met, and even exceeded, considering the difficult starting situation, which rendered the Quad Zygoma concept the last option for this patient.

TAKE HOME MESSAGES

The quad zygoma concept represents a predictable and efficient treament modality for the immediate fixed rehabilitation of patients displaying severe maxillary atrophy. The procedure requires appropriate training, careful planning, and meticulous surgery to minimize treatment risks. If these conditions are met, the quad zygoma concept might represent a preferred alternative to regenerative staged treatment protocols.

LITERATURE REFERENCES TO REMEMBER

Davó R, Felice P, Pistilli R, Barausse C, Marti-Pages C, Ferrer-Fuertes A, Ippolito DR, Esposito M. Immediately loaded zygomatic implants vs conventional dental implants in augmented atrophic maxillae: 1-year post-loading results from a multicentre randomised controlled trial. Eur J Oral Implantol 2018; 11: 145–61.

Davó R, David L. Quad Zygoma. Oral and Maxillofacial Surgery Clinics of North America 2019; 31: 285–97.

USE OF FOUR STRAUMANN® ZYGOMATIC IMPLANTS, ZAGA™ FLAT, QUAD PROCEDURE

PROF. WALDEMAR D. POLIDO, DDS, MS, PHD

MEET THE EXPERT

PROF. WALDEMAR D. POLIDO, DDS, MS, PHD

Professor and Acting Chairman, Oral and Maxillofacial Surgery, Indiana University School of Dentistry, Indianapolis, USA; - Co-Director of the Center for Implant, Esthetic and Innovative Dentistry, Indiana University School of Dentistry, Indianapolis, USA; - Oral and Maxillofacial Surgeon, with an MS and PhD degrees from the PUCRS School of Dentistry, Porto Alegre, RS, Brazil - Residency in Oral and Maxillofacial Surgery, University of Texas, South-western Medical Center at Dallas, USA - Fellow of the ITI - International Team for Implantology.

INTRODUCTION

The presented case illustrates the Quad Zygoma Concept using four Straumann® Zygomatic implants, ZAGA™ Flat, to rehabilitate a patient with a severely atrophic maxilla. This case was highly complex as the defect was related to previous implant failures and bilateral sinus infections. The presented case specifically illustrates the advantages of the Straumann® Zygomatic implants, ZAGA™ Flat, to anatomically support the extra-sinus/extra-maxillary implant trajectory in this severely atrophied patient (ZAGA™ Type 4). Implants were cross-arch splinted, and the patient was successfully restored with a bar-retained overdenture.

PATIENT SUMMARY

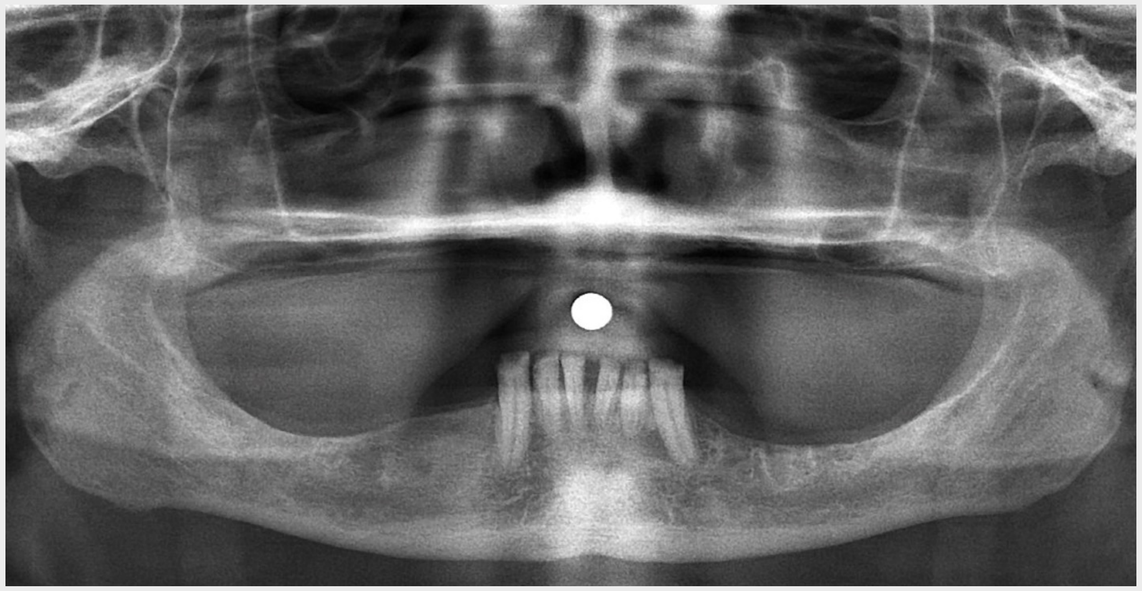
Gender	Male
Age	63
General condition	Healthy, ASA 2
Smoker	Former smoker
Medication	For hypertension
CLINICAL AND XRAY EXAMINATION	
Maxillary teeth	Severe atrophy; previous failed zygomatic implants and anterior maxillary implants
Maxillary bone	Severe resorption; history of lost implants in anterior maxilla; bilateral zygomatic implants removed secondary to repeated episodes of sinusitis. Had two procedures for closure of oro-antral fistula.
Opposite arch	Overdenture over two implants using locators
TMJ	Disfunction: No
Complaints	Wants to have stable teeth
Expectations	Moderate

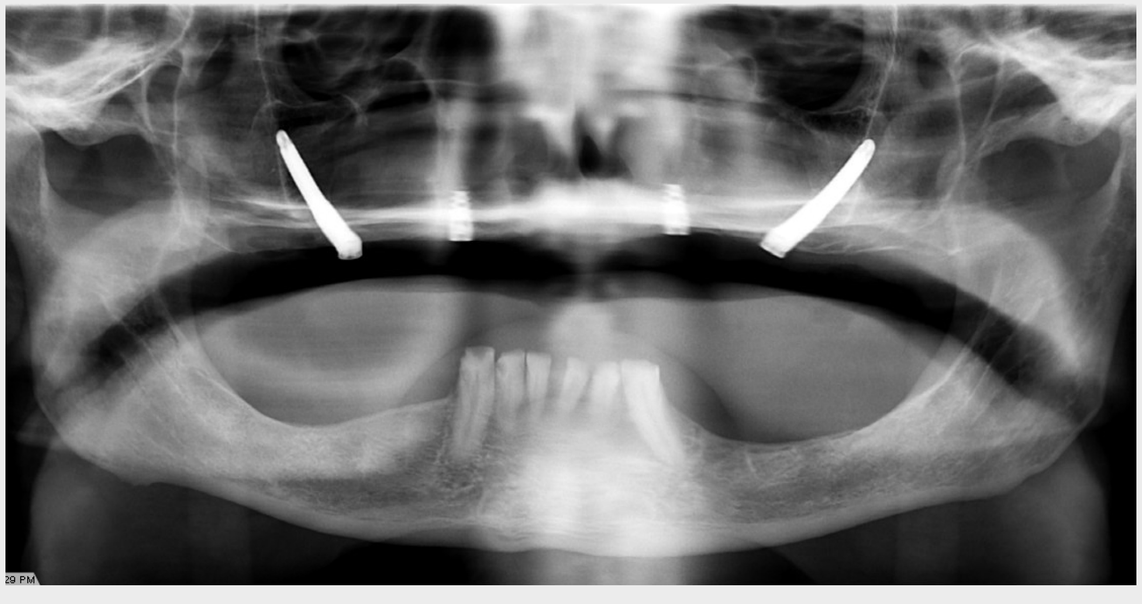
PATIENT FACE

PATIENT PROFILE

RADIOGRAPHIC EXAMINATION

Initial restoration March 2015





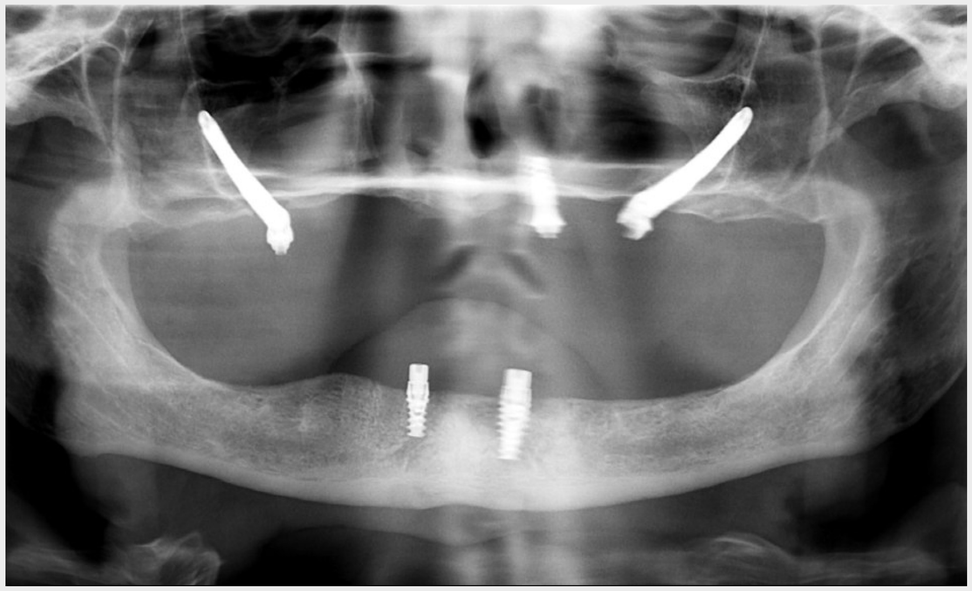
Patient's initial presentation
A 63-year-old male patient presented at the IUSD OMFS Clinic in March 2021 with the following request: "I would like to be able to wear my upper denture". His past medical history was non-contributory, except for high blood pressure controlled with medication.

The panoramic radiographs from 2015 illustrate the patient's situation prior to and after first treatment. As illustrated, the patient displayed a highly atrophic maxilla prior to first treatment, resulting in the classification of his case as complex according to the ITI SAC Classification.

In March 2015, the patient underwent treatment with two zygomatic implants and two regular implants from another implant manufacturer inserted by another team.

RADIOGRAPHIC EXAMINATION

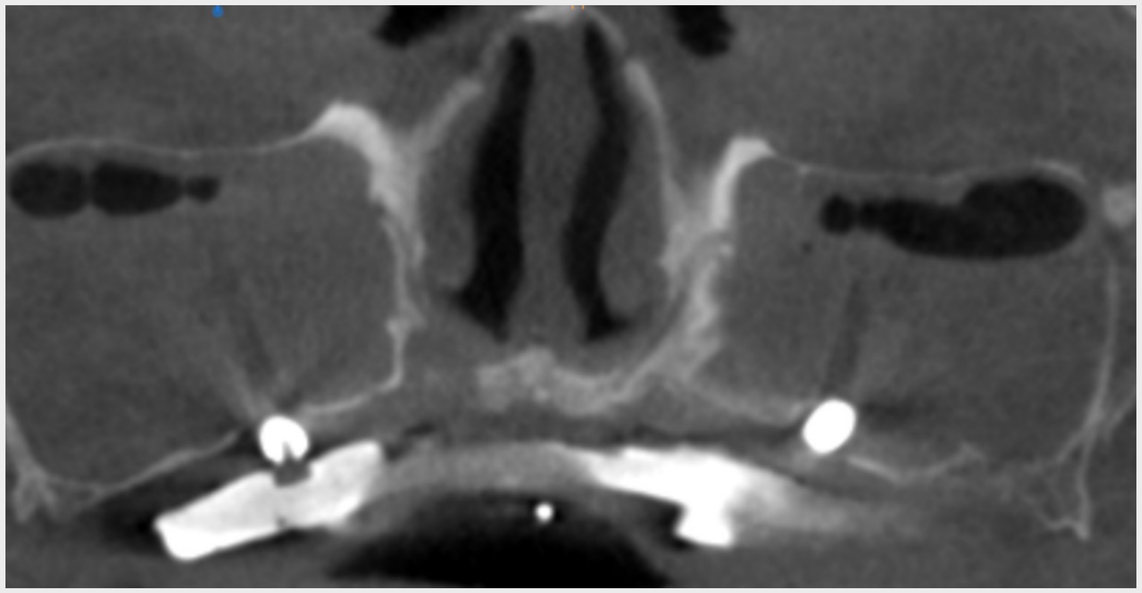
Situation January 2016



In November 2015 he lost the left anterior regular implant and, in March 2016, he suffered the loss of the remaining anterior regular implant.

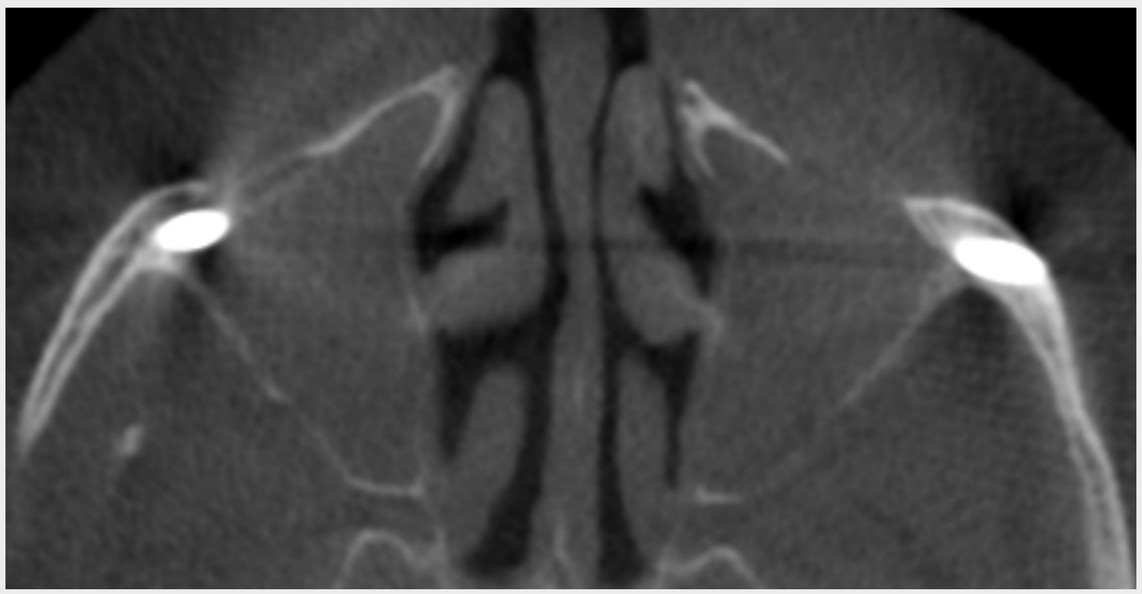
RADIOGRAPHIC EXAMINATION

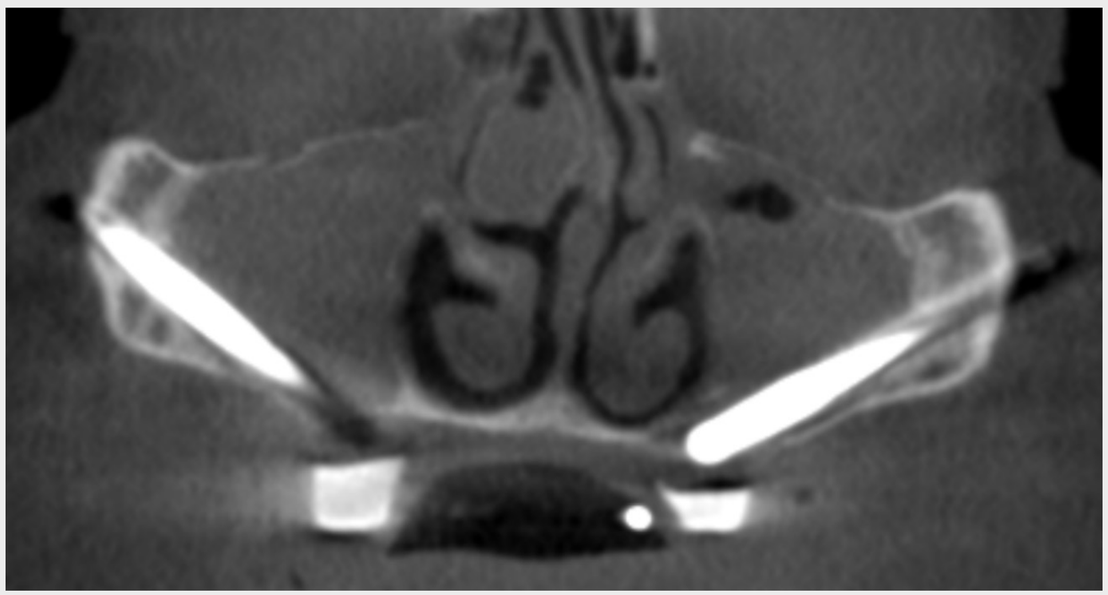
Situation April 2018



In April 2018, after several episodes of severe acute maxillary sinus infections, the previous team decided to remove the zygoma implants, which showed exposed threads at the most coronal aspect.

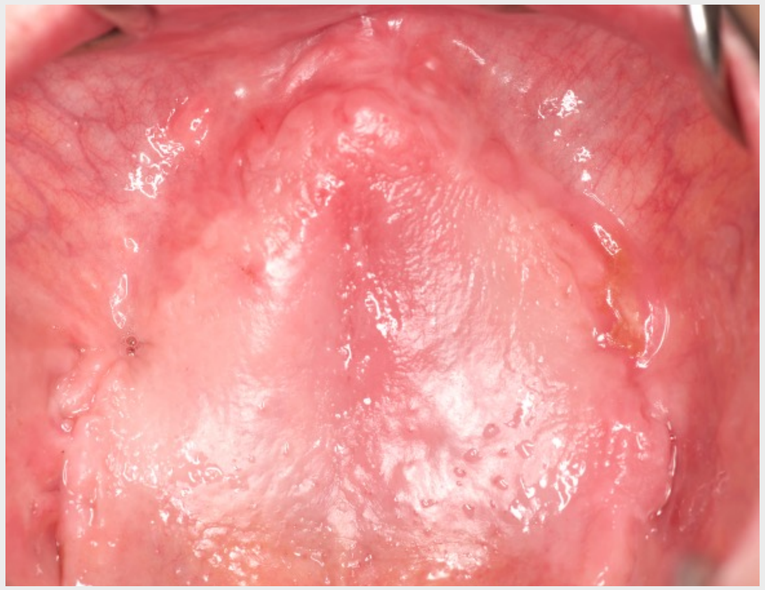
The patient underwent two additional surgeries for closure of oro-antral fistulas in April and December 2019.





INTRAORAL EXAMINATION

Situation March 2021



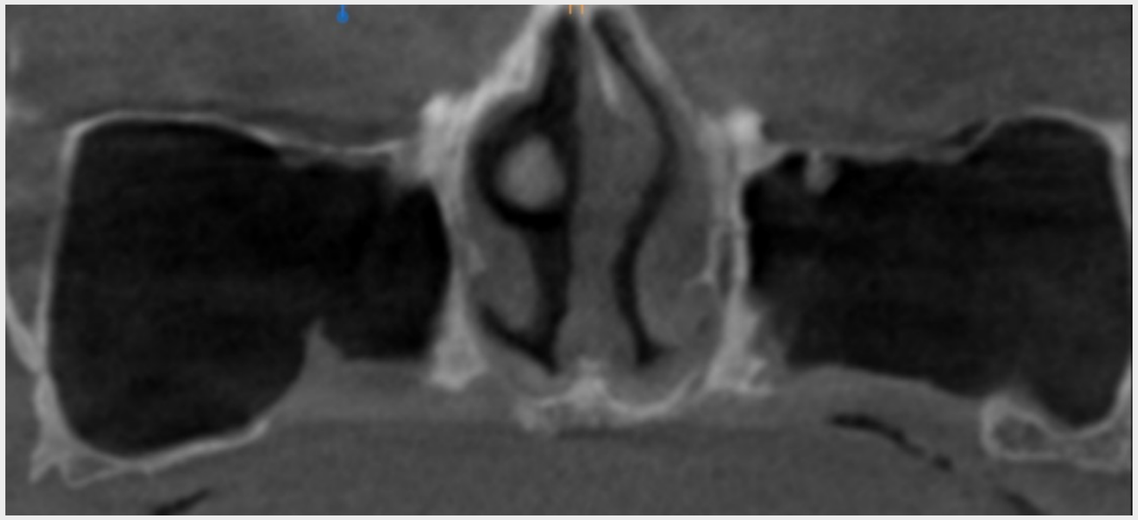
In March 2021, the patient presented to our team with clear sinuses and no symptoms. Intraoral examination revealed a severely resorbed maxillary alveolar crest and generally healthy soft tissue conditions.

TREATMENT SCHEDULE

DECISION FULL ARCH	
Quad implants	x
ZYGOMATIC IMPLANT(S)	
Type	Straumann® ZAGA™ Flat
Length	40, 50, 45, 50 mm
Position	15, 11, 23, 26
REGULAR IMPLANT(S)	
Diameter	4.3
ABUTMENT(S)	
Type	SRA
Heigh	4.5 mm
Diameter	4.6 mm
Position	All
PROSTHESIS	
Provisionalisation	Conventional, unloaded, submerged
Final	Bar-retained removable milled acrylic, locator-retained

CBCT AND TREATMENT PLANNING

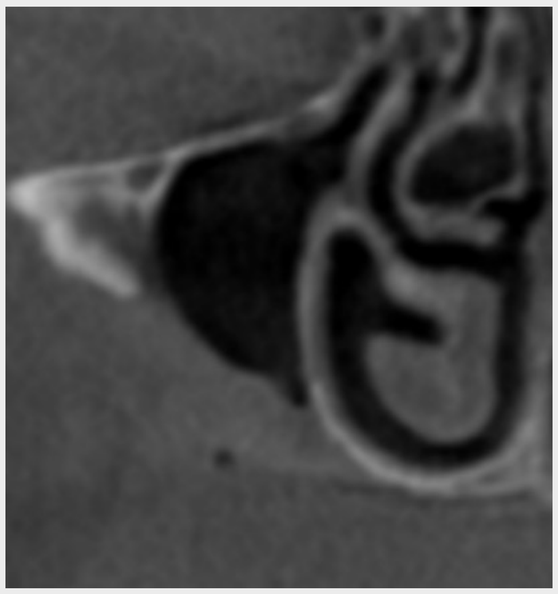
OPG

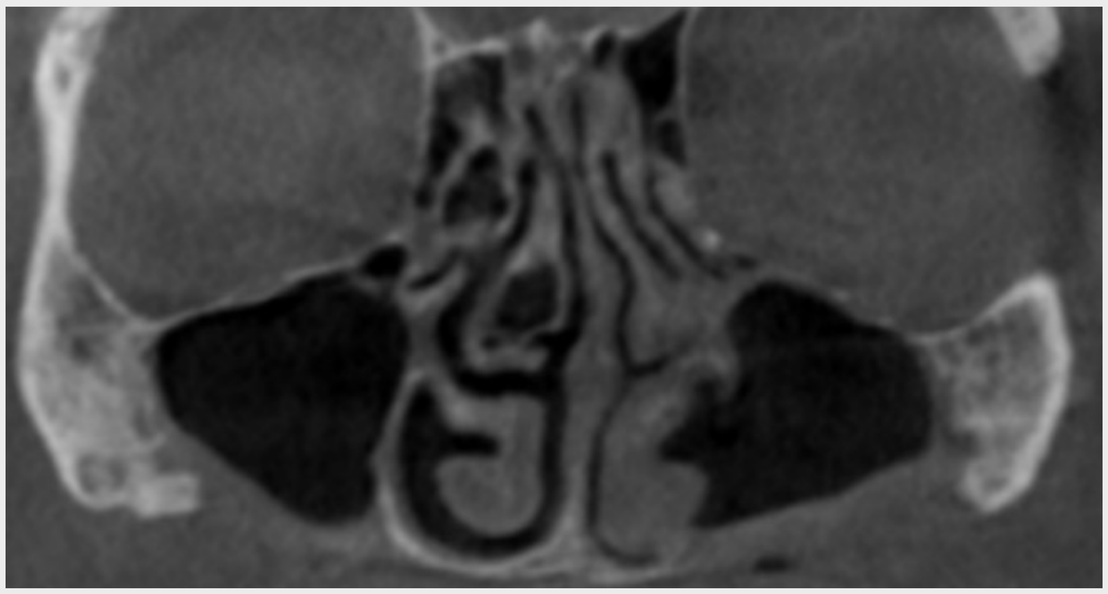


After extraction of the 4 decayed roots, a mucoperiosteal flap was released by a mid-crestal surgical incision from the maxillary tuberosity to the distal side of the canine with 2 vertical releasing incisions.

The angled retractor is placed in the fronto-zygomatic notch. A lateral window was opened to see the roof of the sinus and the base of the zygoma bone. It’s not necessary to keep the Schneiderian membrane intact.

An indentation with round bur was made on the roof of the sinus preventing the drill from slipping.





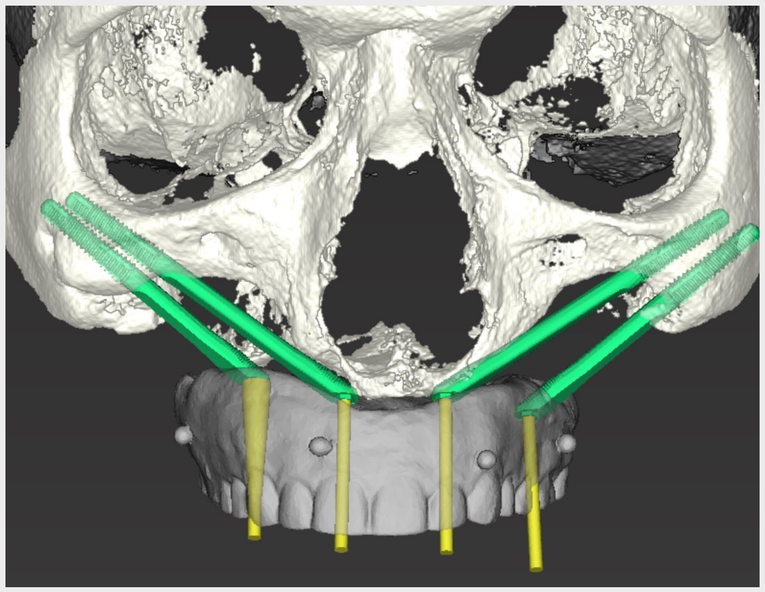
CBCT AND TREATMENT PLANNING

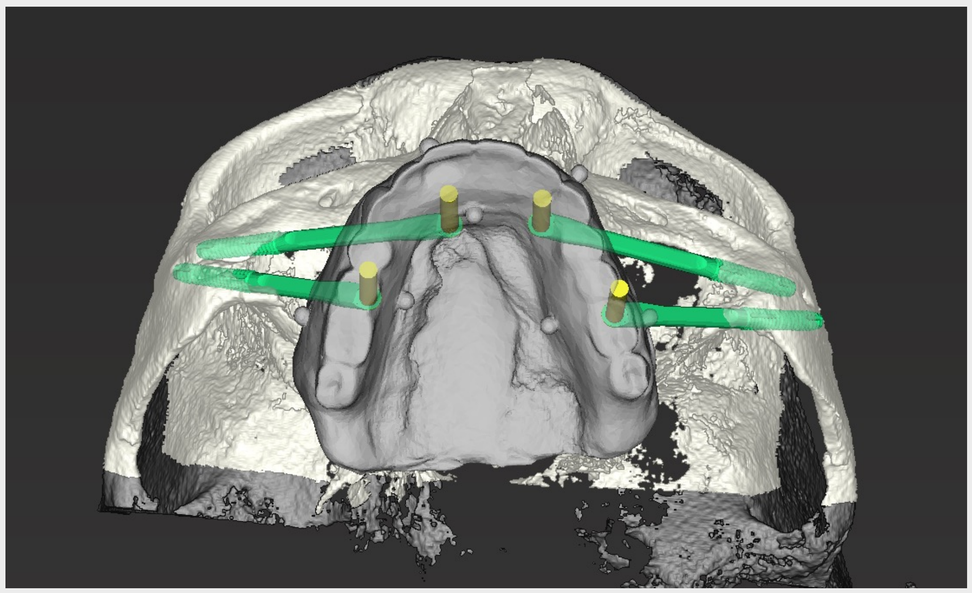
3D Anatomical model

DICOM files from CBCT were imported into coDiagnostiX® software for virtual surgical planning. Next, a three-dimensional model of the patient's maxilla was 3D-printed to visualize the patient's anatomy (Formlabs 3D printer). As nicely illustrated by this model, no residual anterior alveolar bone was present.

CBCT AND TREATMENT PLANNING

Virtual planning – coDiagnostiX®

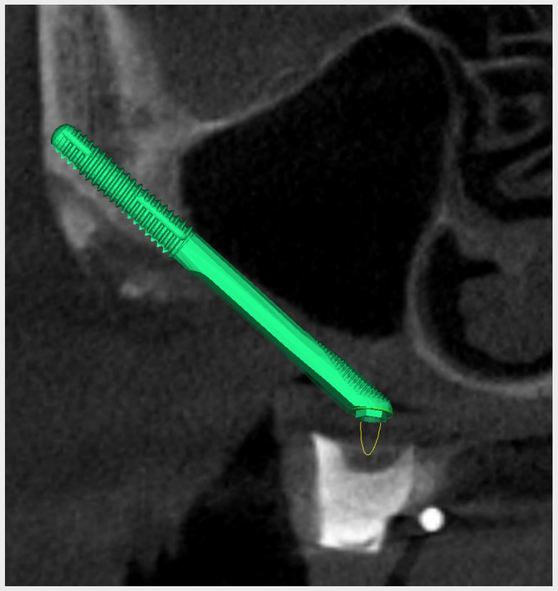


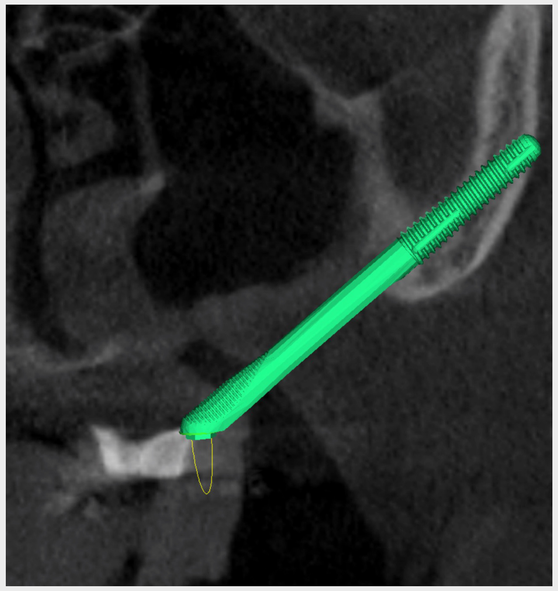


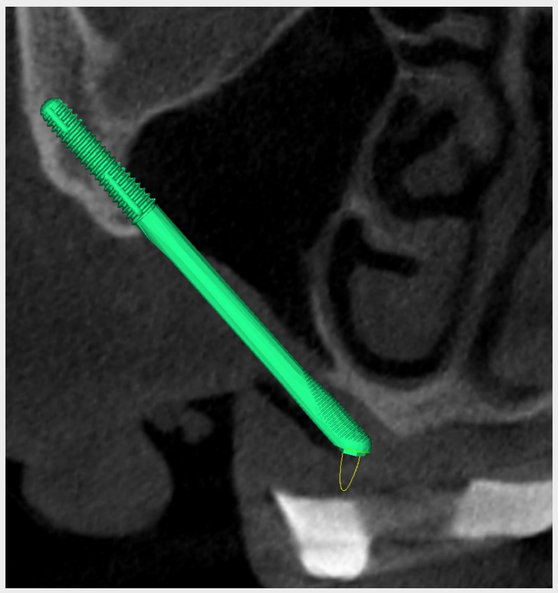
After careful 3D analysis of the patient's anatomy, a restorative concept consisting of a bar-retained overdenture supported by four Straumann® Zygomatic implants, ZAGA™ Flat, was defined. The decision was also taken to mobilize a buccal fat pad to cover the implants and apply a standard loading protocol to reduce the risk of healing complications.

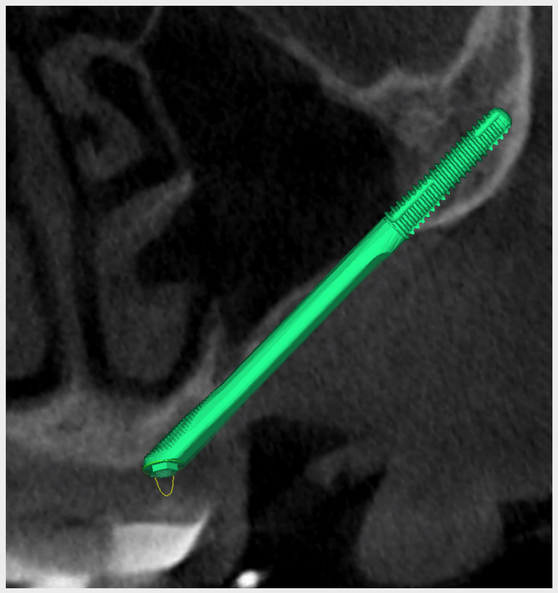
CBCT AND TREATMENT PLANNING

Virtual planning – CoDiagnostiX®



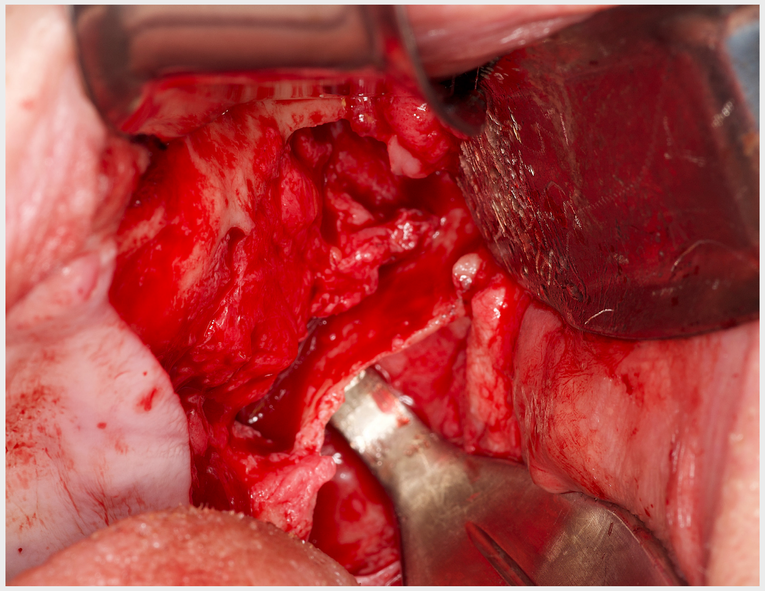






Implant positions and trajectories were carefully planned to ensure appropriate biomechanical support for the implants by the residual maxillary structures. Specifically, anterior implants were butted up against the nasal crest and residual frontal inferior maxillary process. Distal implants were stabilized mainly apically in the zygoma and oriented to support the prosthesis with an adequate anteroposterior spread. Implant trajectories were extra-sinusal.

ANESTHESIA, INCISION AND FLAP ELEVATION



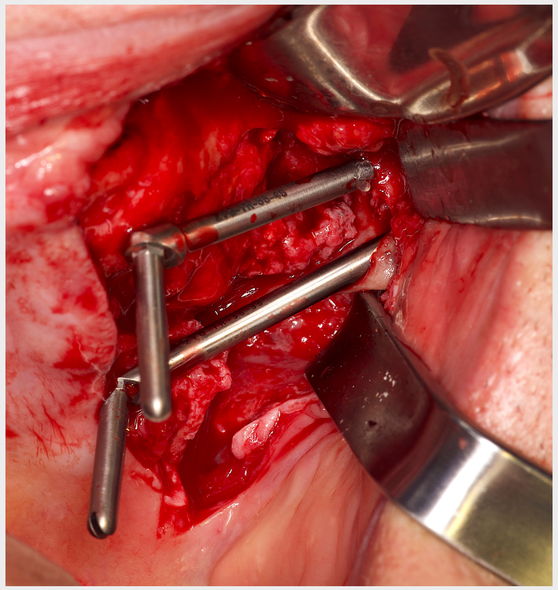
Surgery was performed in an ambulatory setting (IU-OMFS Clinic), with local anesthesia and deep intravenous sedation. Local anesthesia was applied using infra-orbital nerve blocks with bupivacaine 0.5% 1:200:000, and local infiltration along the maxillary arch and palate with articaine 4%, 1:100:000. Intravenous sedation was achieved with a combination of midazolam, fentanyl, and a limited dose of propofol.

A surgical template in the form of a replicated denture with an opening palatal to the teeth was used as an orientation reference.

A bucco-crestal incision followed by a mid-line releasing incision was first performed on the left side. Careful subperiosteal dissection was performed to raise a mucoperiosteal flap. The main anatomical landmarks, including the infra-orbital nerve, zygomatic maxillary buttress, and the eminence of the zygomatic bone, were identified after complete exposure.

The lateral maxillary wall appeared completely resorbed and was replaced by fibrous connective tissue. This tissue did not show signs of infection and was left in situ to continue functioning as a fibrous barrier to the sinus. Bone was present at the zygomaticomaxillary buttress.

OSTEOTOMY PREPARATION



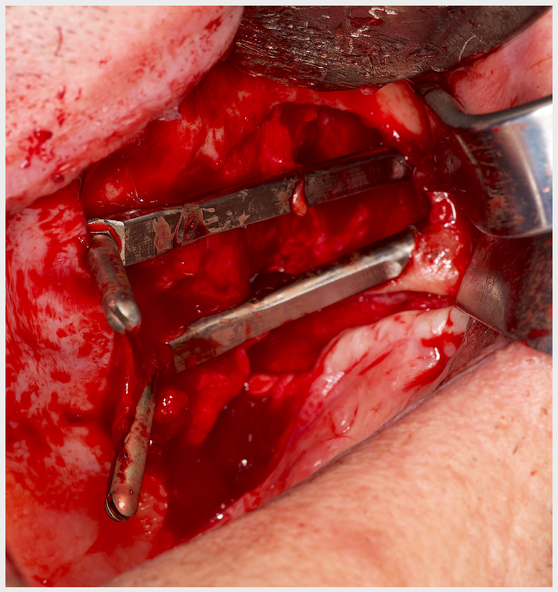
The entry point into zygoma bone was identified following a protocol proposed by Aparicio et al. in 2021. The complete lack of buccal bone and the extremely resorbed maxilla rendered the definition of the correct osteotomy trajectory challenging. Initial marking was performed with the zygomatic round bur. Drilling was then performed to the required depth with the 2.9 mm multi-use drill.

Additional drilling was not required due to the absence of the maxillary lateral wall. Direction indicators (Try-In Implant 55° x 45 mm) were utilized to identify and validate the position of the implants. The anteroposterior spread of the implants was assessed using the try-in instruments in relation to the surgical template.

Aparicio C, Polido WD, Chow J, David L, Davo R, De Moraes EJ, Fibishenko A, Ando M, Mclellan G, Nicolopoulos C, Pikos MA, Zarrinkelk H, Balshi TJ, Peñarrocha M. Identification of the Pathway and Appropriate Use of Four Zygomatic Implants in the Atrophic Maxilla: A Cross-Sectional Study. Int J Oral Maxillofac Implants. 2021 Jul-Aug;36(4):807-817.

PLACEMENT OF ZYGOMATIC IMPLANTS

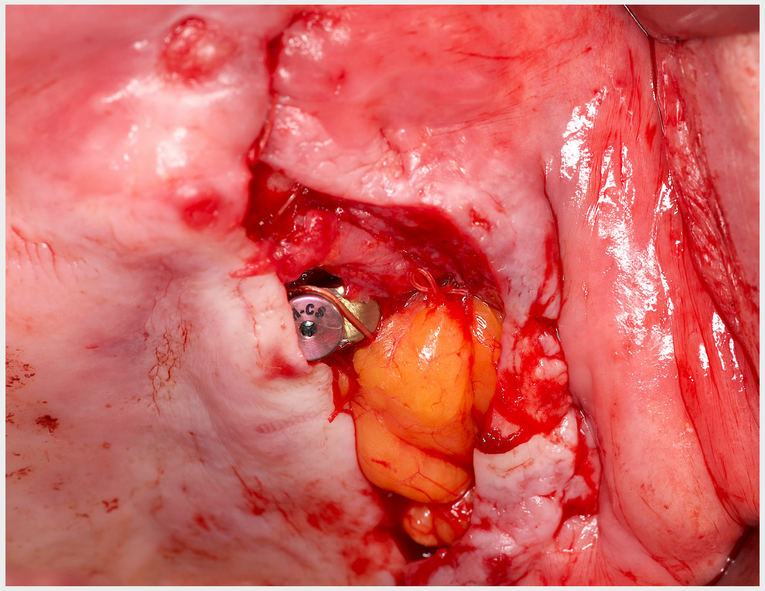
Implant placement



Straumann® Zygomatic implants, ZAGA™ Flat, were placed starting from the posterior position (40 mm, anterior 45 mm). Final torques of 45 Ncm were achieved, indicating good primary stability. The axial orientation of the implants' connecting geometry was verified by mounting the screw-retained segment of the try-in instrument.

PLACEMENT OF ZYGOMATIC IMPLANTS

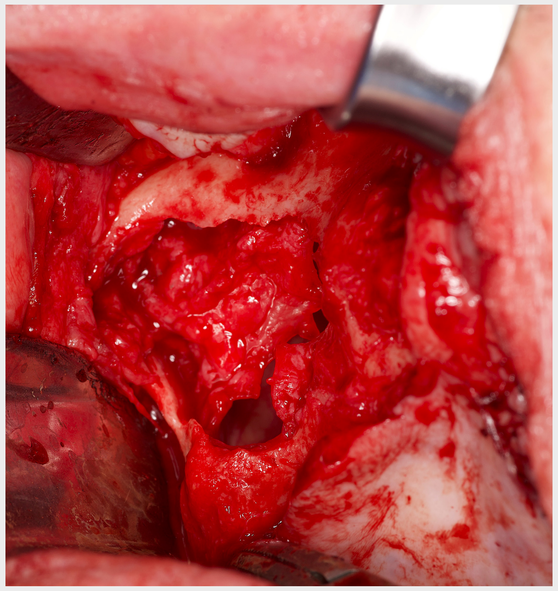
Buccal fat pad mobilization

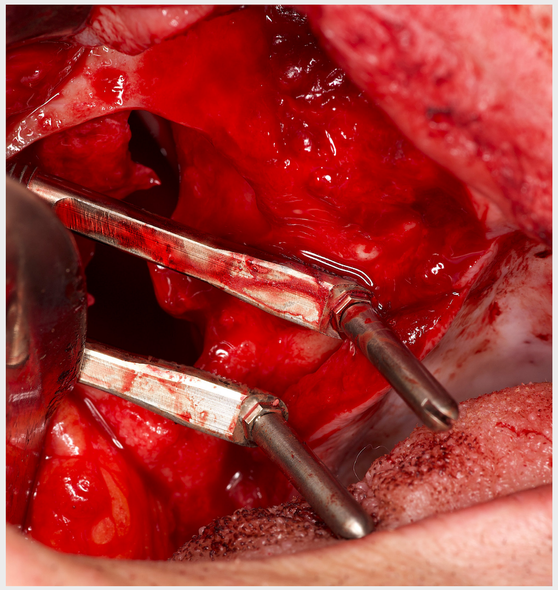


A cover screw was placed, and the coronal aspect of the implant was covered with a mobilized buccal fat pad sutured in place with Vicryl 4–0 sutures to reduce the risk of an oro-antral communication. Primary wound closure for submerged healing was performed using 4–0 Vicryl.

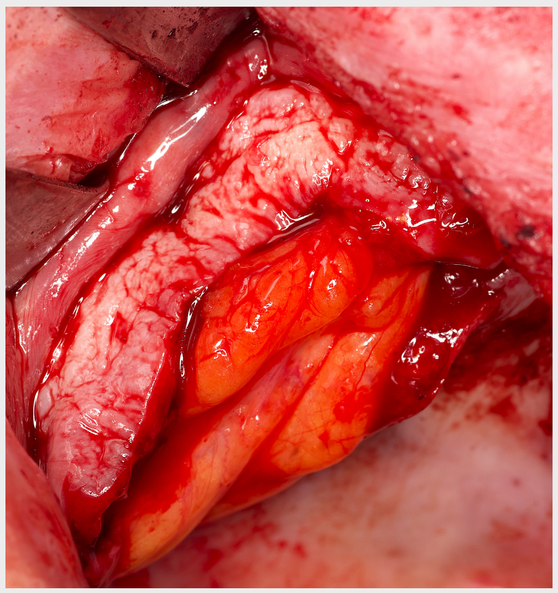
PLACEMENT OF ZYGOMATIC IMPLANTS

Procedure on the contralateral side



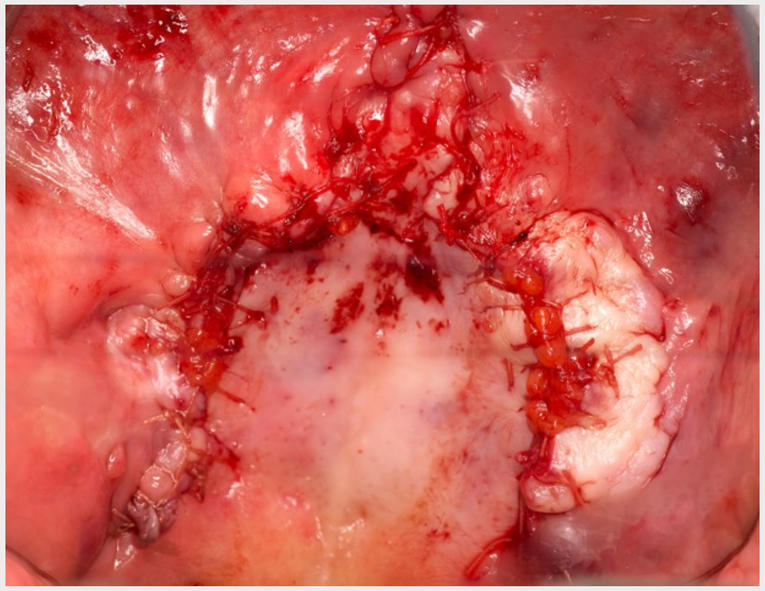


The contralateral side was treated similarly using Straumann® Zygomatic implants, ZAGA™ Flat, with lengths of 40 and 50 mm for the posterior and anterior positions. Again, the implants were covered with a mobilized buccal fat pad.



PLACEMENT OF ZYGOMATIC IMPLANTS

Flap closure



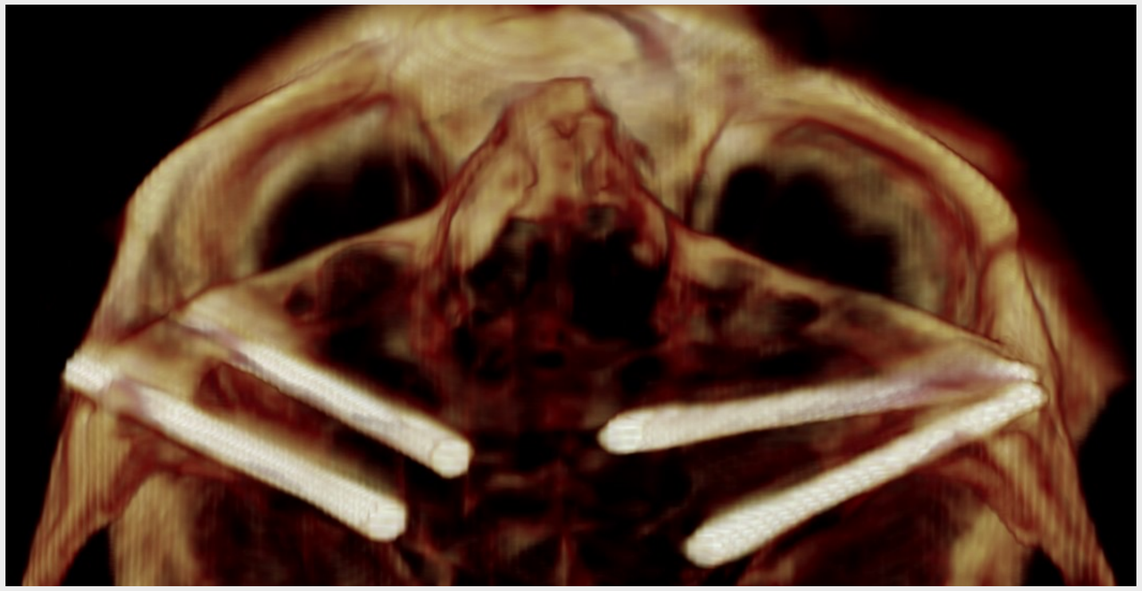
Primary wound closure for submerged healing was performed using 4-0 Vicryl. 1 g cefazolin and 10 mg dexamethasone were administered intravenously at the start of the procedure.

Treatment with 325 mg amoxicillin and 125 mg clavulanic acid (Augmentin 500 mg) was continued every 8 hours until 7 days post surgery. 600 mg ibuprofen every 8 hours was prescribed for 4 days post surgery. 500 mg acetaminophen (paracetamol) every 6 hours was prescribed as an analgesic.

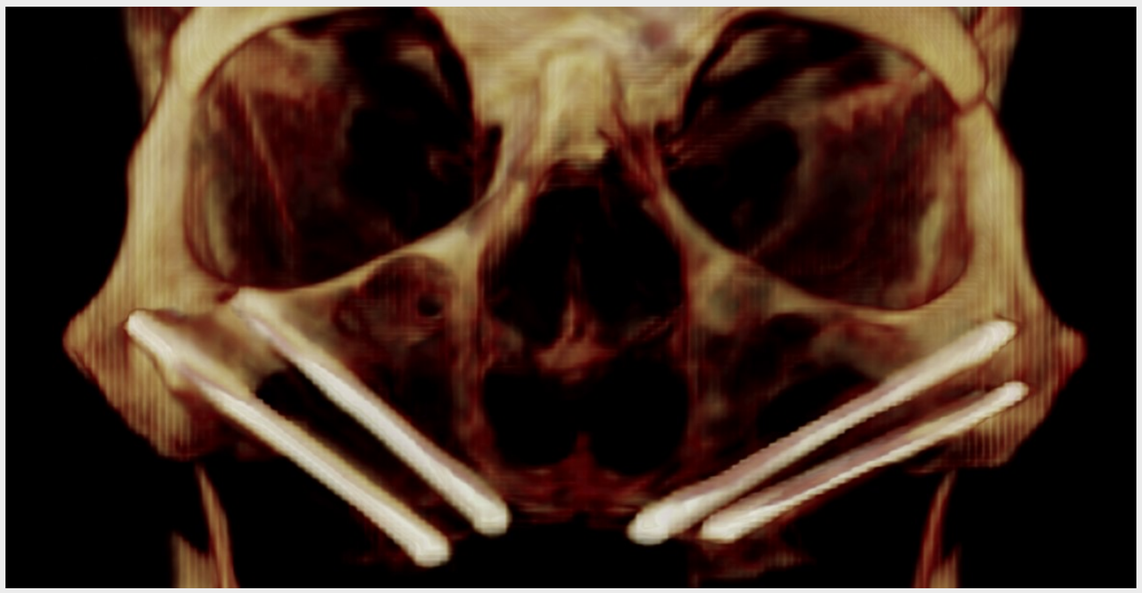
Postoperative care also involved sinus precautions, and the patient was instructed to cool with ice packs and adhere to a liquid/cold diet for 3 days. The patient was instructed not to wear dentures for the first 21 days after surgery.

RADIOGRAPHIC EXAMINATION

CBCT immediate postoperative imaging

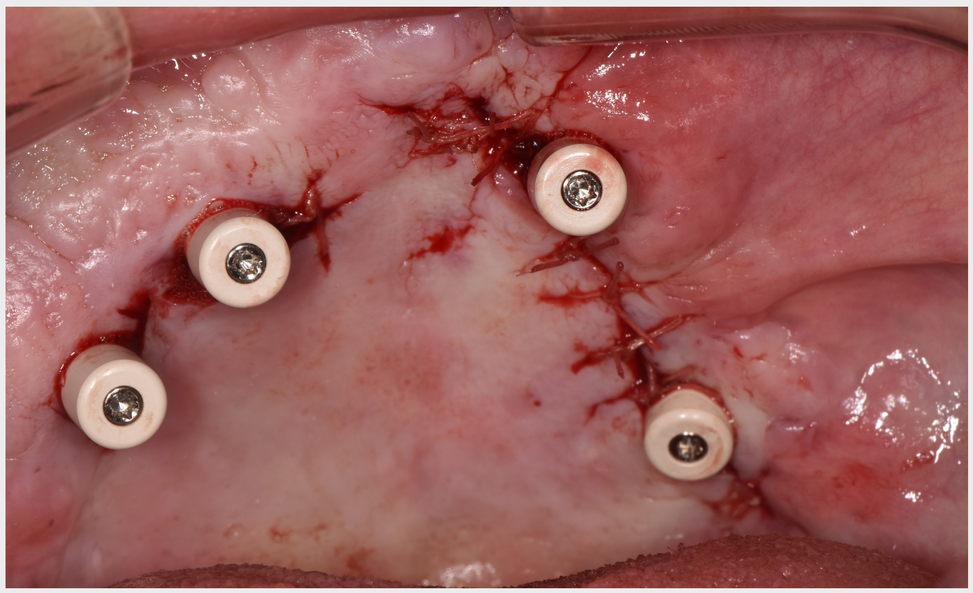


The correct positioning of the implants was verified immediately after surgery by CBCT scans. Postoperative healing was uneventful.



PROSTHESIS

Uncovering and OPG imaging

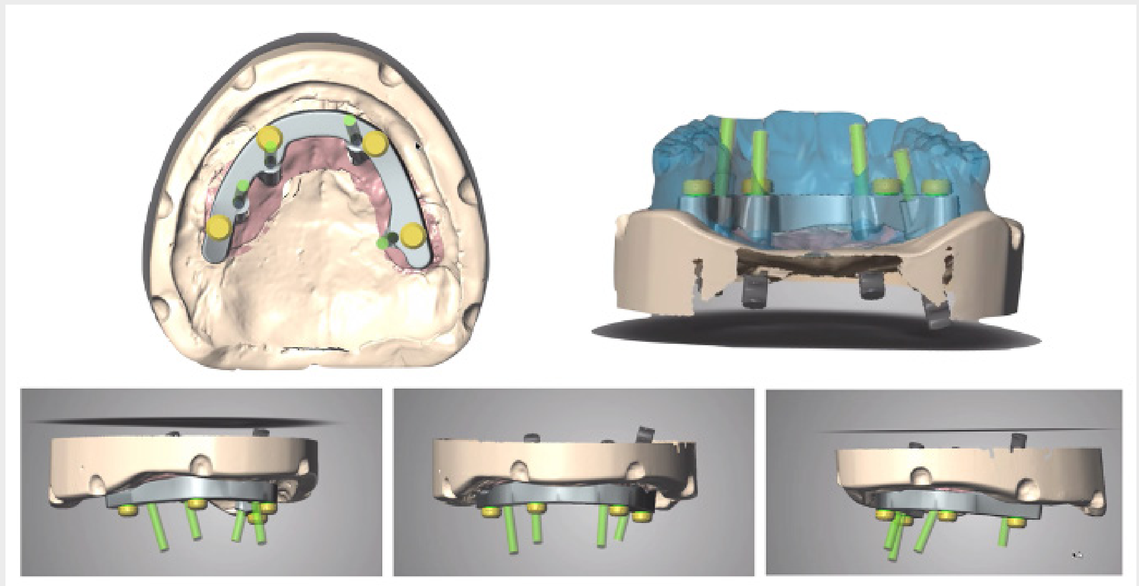


Four months after the intervention, the implants were exposed under local anesthesia by raising a mucoperiosteal flap. Care was taken in mobilizing the thick keratinized tissue on the buccal aspect of the implants. SRA abutments (diameter 4.6 mm x height 4.5 mm) were mounted, followed by protective caps.

Two weeks later, a follow-up consultation confirmed uneventful healing, and the patient was referred to the IUSD Prosthodontics Clinic for impression-taking and the restorative procedure.

PROSTHESIS

Design of milled bar (CARES®)



An open-tray impression and inter-occlusal records were taken using a 3D-printed custom tray designed from CBCT scan data (P30, Straumann®). These were articulated on an adjustable articulator (Stratos 300, Ivoclar-Vivadent) and scanned with a bench scanner for digital waxing (3 Shape Dental System®). Next, a milled PMMA denture prototype was produced. After verifying the fit on the master cast with a jig, a titanium milled bar with threaded locator abutments and attachments was digitally designed and fabricated. The accuracy of the bar was verified chairside and mounted onto the SRAs, followed by delivery of the denture. The patient was instructed in hygiene routines.

The quad zygoma procedure was performed in May 2021; the restorative procedure was started in September 2021, with the delivery of the final restoration in November 2021.

CLINICAL OUTCOME

This case illustrates the successful rehabilitation of a severely atrophied patient with challenging anatomical conditions related to failed past treatments. Specifically, the patient experienced previous implant loss of implants and sinus infections related to oro-antral fistulas, resulting in a severely atrophic maxilla and missing maxillary sinus walls. The patient presented in a healthy condition and was cooperative and compliant. His expectations focused mainly on the restoration and functional retention rather than esthetics.

Careful digital planning was essential in this case and was accomplished with coDiagnostiX® and by visualizing the patient's anatomy using a 3D printed model. Although the case may have been indicated for guided surgery, the patient did not display an adequate anatomy allowing guide stabilization.

Nevertheless, a good implant distribution and anteroposterior spread were achieved for stable cross-arch splinting with a bar. The decision to opt for a removable bar-retained overdenture was mainly related to hygiene aspects, which would have been unfavorable in a fixed prosthesis with relatively large flange dimensions.

Furthermore, a conservative healing regimen and careful soft tissue management procedure were applied in view of the challenging anatomy and the patient's treatment history. The soft tissue management included buccal fat pad mobilization and the preparation of a dense, thick band of keratinized tissue around the implants. Tight soft tissue sealing is considered a key requisite to increase long-term peri-implant health.

TAKE HOME MESSAGES

Straumann® Zygomatic implants, ZAGA™ Flat, can be used for restorations in patients with a severely atrophic maxilla secondary to failure of previous implant treatments.

Digital planning and preoperative visualization of the patient anatomy are essential for realizing the planned restorative concept in complex anatomical situations.

Careful soft tissue management in highly atrophied patients is essential to prevent the recurrence of biological complications due to oro-antral communication

LITERATURE REFERENCES TO REMEMBER

Stella J. Warner M. Sinus slot technique for simplification and improved orientation of zygomaticus dental implants: a technical note, Int. J. Oral Maxillofac. Implants, 2000, 15: 889-893

Acknowledgements

The author would like to thank Dr Nicolas Renou and Mr. Gilles Giordanengo, Dental Prosthetic Technician for their outstanding contribution.

ANALOG PRINCIPLES AND DIGITAL TECHNOLOGY

DR. EDMOND BEDROSSIAN

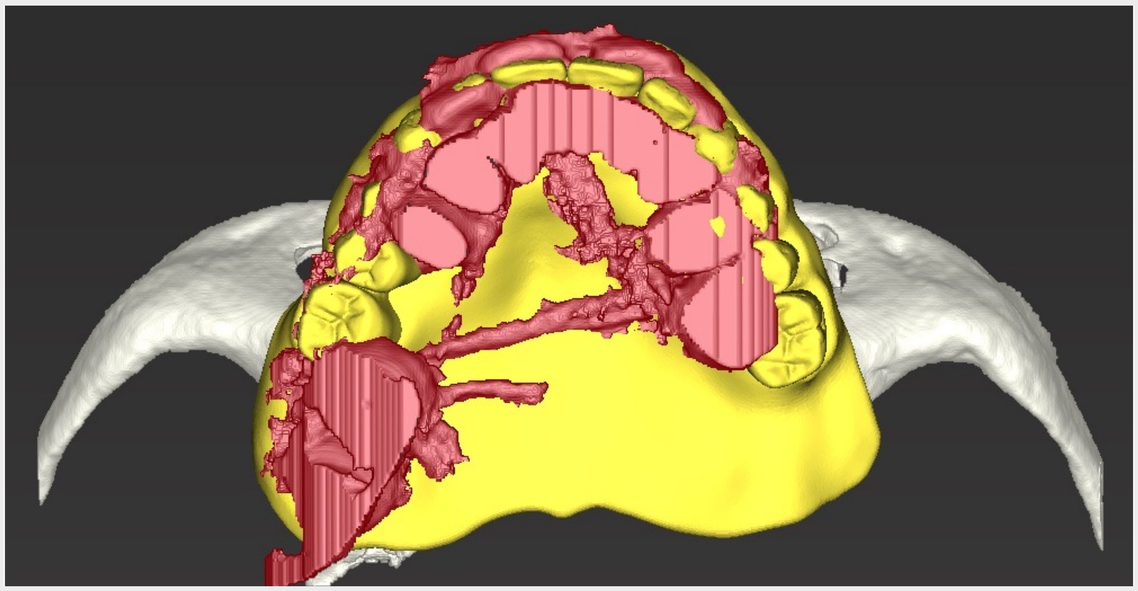
MEET THE EXPERT

DR. EDMOND BEDROSSIAN

Dr. Edmond Bedrossian graduated from the University of San Francisco in 1981. He completed his training in 1986 at the University of The Pacific, School of Dentistry and completed a four-year Oral & Maxillofacial Residency training program at the Alameda Medical Center. In addition to private practice, Dr. Bedrossian is recognized as an expert in the field of dental implants and has given numerous presentations on the subject both nationally and internationally between 2004 and the present. He has also led several long-running study clubs related to this topic. In addition, he has lectured internationally with Professor Brånemark on various topics, especially the rehabilitation of patients with maxillofacial defects.

DIGILOG™ APPROACH

The use of analogue principles and digital technology for treatment planning zygoma patients.



PATIENT SUMMARY

Gender	Female
Age	67
General condition	Healthy, ASA 2
CLINICAL AND XRAY EXAMINATION	
Low smile line; transition line is hidden	
Maxillary teeth	Non restorable periodontally involved teeth
Maxillary bone	Advanced maxillary alveolar resorption with lack of bone in ZONES 2 and 3
Opposite arch	Restoration necessary: yes
TMJ	Disfunction
Complaints	Painful, mobile periodontally involved teeth
Expectations	Fixed teeth

PATIENT FACE

PATIENT PROFILE

CLINICAL EXAMINATION

Situation prior-treatment

No display of maxillary incisal teeth Preoperatively.

In maximum animation, there is no cervical gingival display.

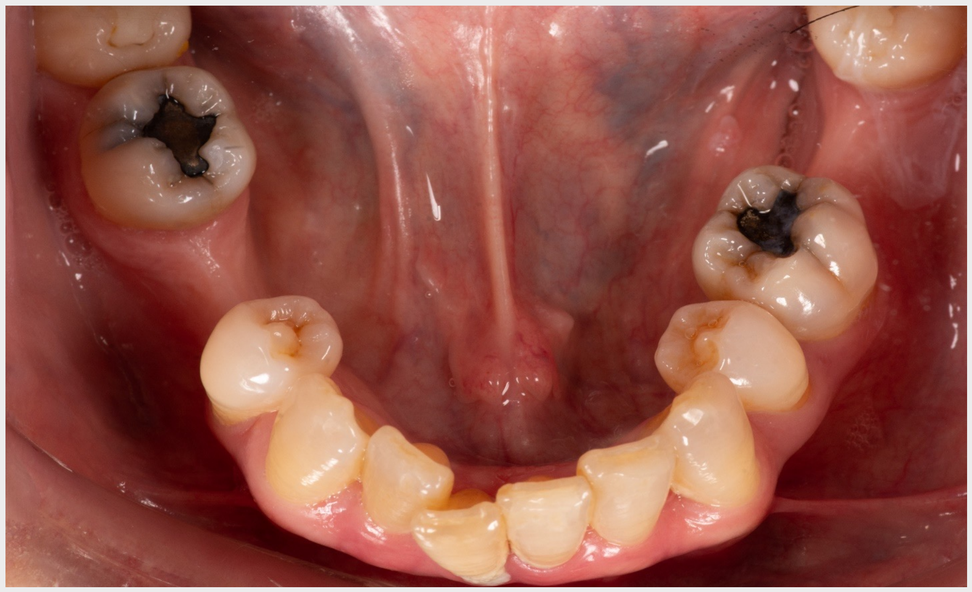
CLINICAL EXAMINATION

Situation prior-treatment

Non restorable maxillary dentition.

CLINICAL EXAMINATION

Situation prior-treatment



Non restorable mandibular dentition.

RADIOGRAPHIC EXAMINATION

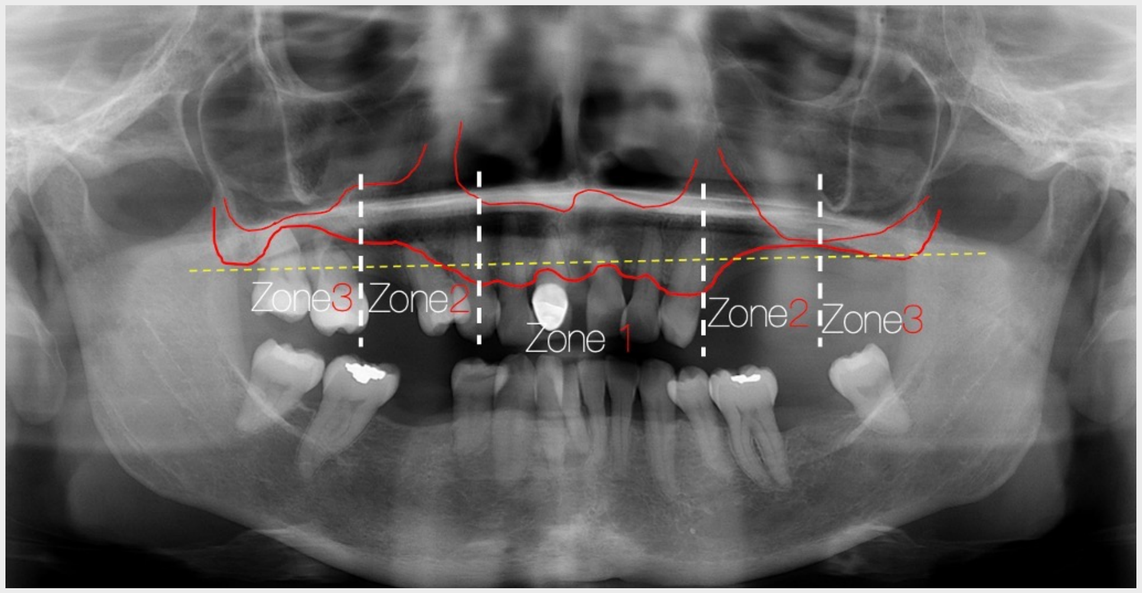


Fig. 1a Patient presents with terminal dentition as shown of the Panorex. The Zones of the maxilla are studied with lack of bone in Zones 2 and 3. Therefore, the patient is treatment planned for two premaxillary axial implants and zygoma implants for posterior support.

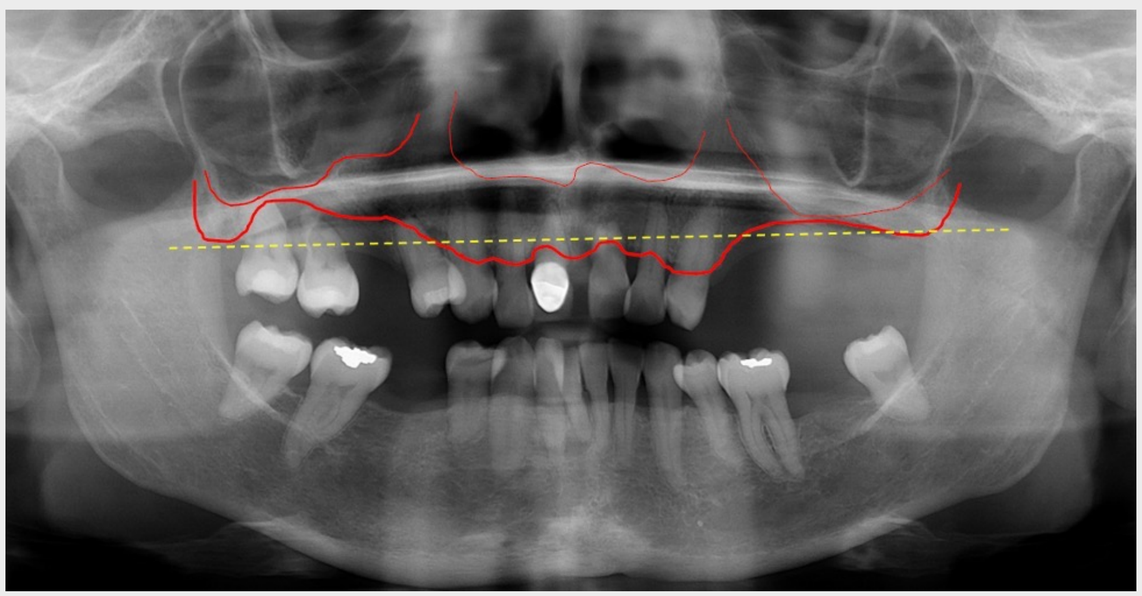


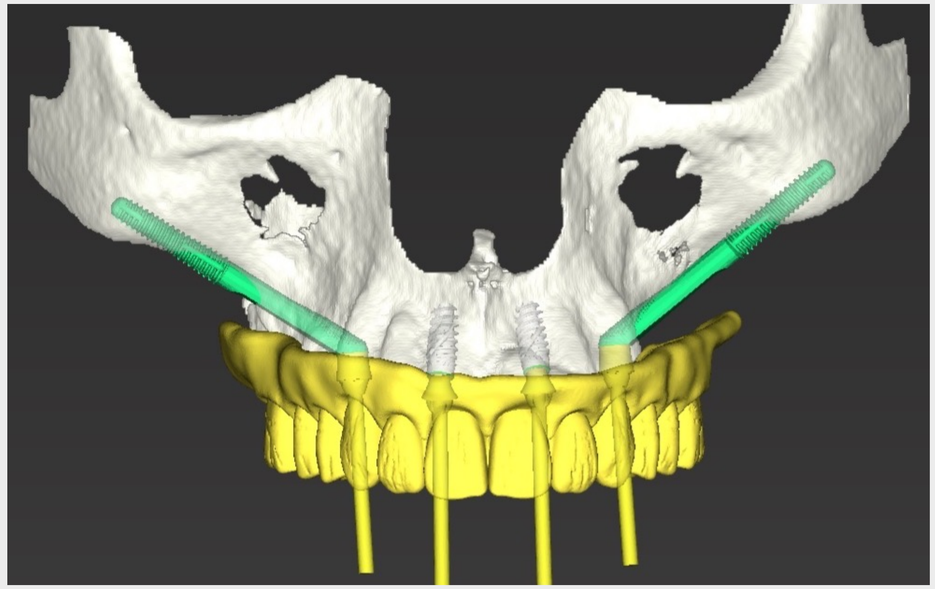
Fig. 1b After the clinical examination of the patient in maximum animation, the level of alveoloplasty is determined on the Panorex taking into considerationthe “transition line”.

TREATMENT SCHEDULE

Removal of the failing maxillary terminal dentition.

- Placement of axial implants in ZONE 1, premaxilla.
- Placement of one zygoma implant in each posterior maxillary quadrant for establishing AP-Spread and minimizing posterior cantilevers.
- 10 mm BLX 4.0 implants were used in the pre-maxilla.
- Right posterior maxilla was diagnosed as having a ZAGA™ 3 anatomy and therefore a 40 mm Round Straumann® Zygomatic implant, ZAGA™ Round,was used.
- Left posterior maxilla was diagnosed as having a ZAGA™ 4 anatomy and therefore a 40 mm Straumann® Zygomatic implant, ZAGA™ Flat, was used.
- BLX implants received 17 degree SRA abutments.
- Zygoma implants received 1.5 mm z-SRA abutments.
- The provisional conversion, hybrid prosthesis was stabilized to the abutments using SRA temporary titanium cylinders.

The coDiagnostiX® program can be used to treatment plan patient for placement of the zygoma implants. Conversion of the DICOM files after planning to STL files allows for printing the patient's model. The "Practice Model" further adds confidence for the surgeon confirming the treatment plan before the actual surgical appointment.



CBCT DIAGNOSIS

CBCT

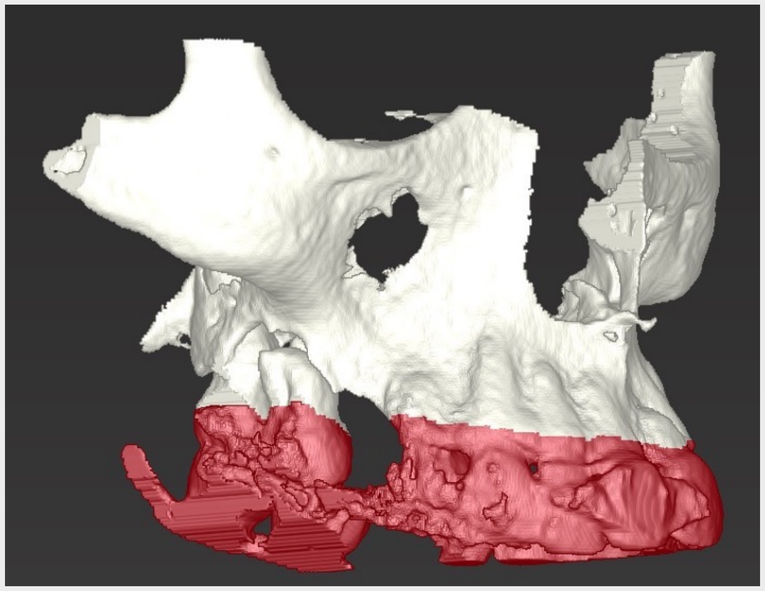


Fig. 2a Using coDiagnostiX®, the level of alveoloplasty is segmented and studied.

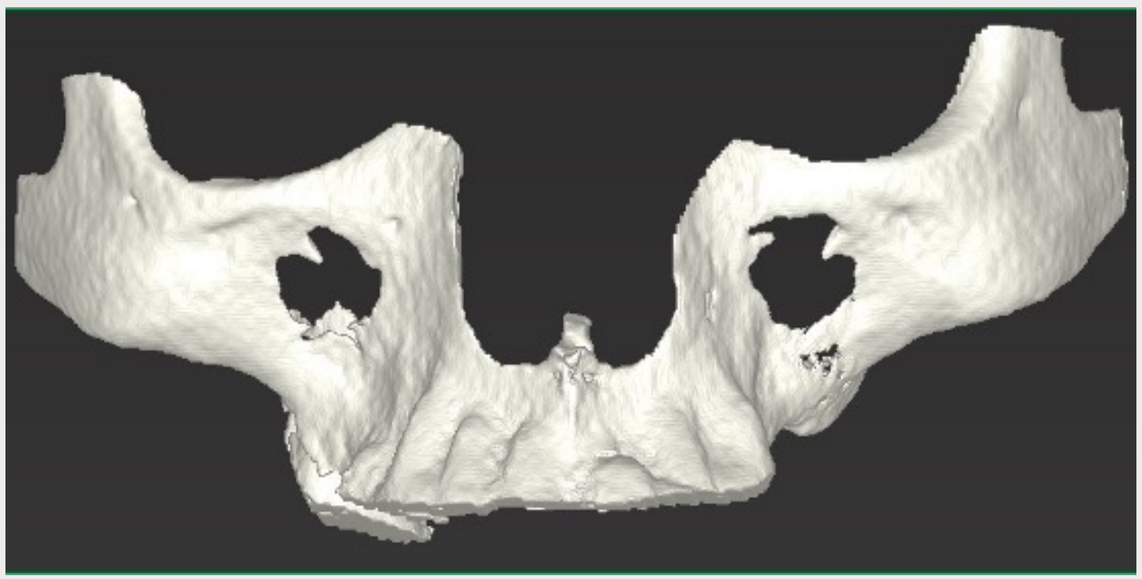


Fig. 2b The segmented maxilla is now ready for treatment planning.

CBCT DIAGNOSIS & TREATMENT PLANNING

CBCT

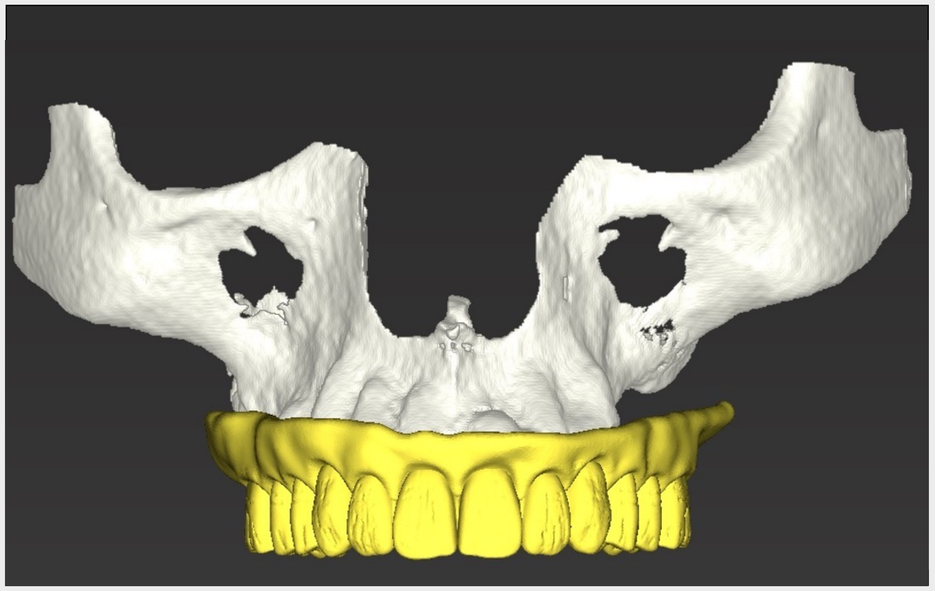


Fig. 3a The STL file of the planned immediate provision prosthesis is imported and super-imposed on the segmented maxilla of the patient.

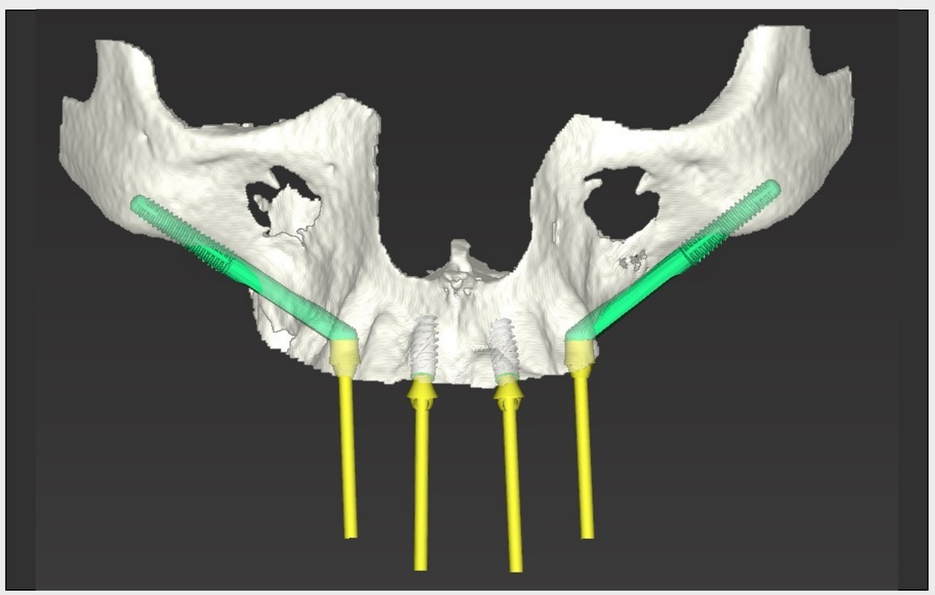


Fig. 3b The position of the implants is planned using SRA abutments for the promaxillary implants and z-SRAs for the posterior zygoma implants.

CBCT DIAGNOSIS & TREATMENT PLANNING

CBCT

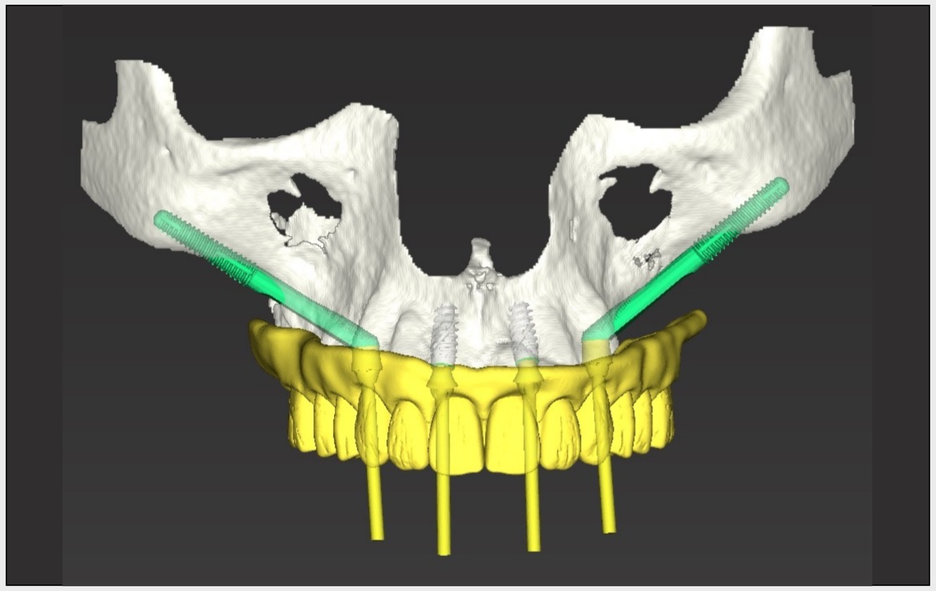


Fig. 3c The trajectory of the screw access holes are studied by “clicking-on” the STL file of the provisional on the planned implant positions.

DIGILOG™: USE OF DIGITAL TECHNOLOGY TO ENHANCE ANALOGUE SURGERY

Fig. 4a A clear copy of the digitally printed denture is superimposed over the printed model of the maxilla.

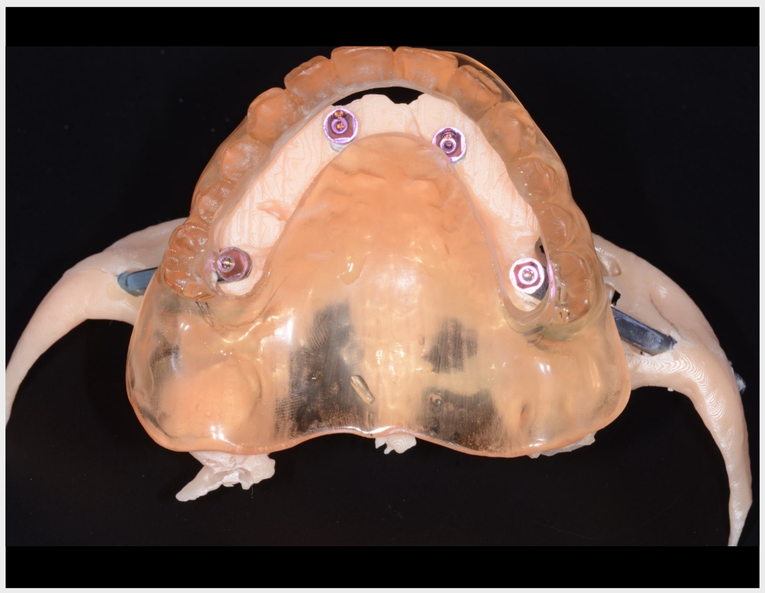


Fig. 4b The surgical stent is superimposed over the printed maxilla model with the proposed implant positions and z-SRA abutments.

DIGILOG™: USE OF DIGITAL TECHNOLOGY TO ENHANCE ANALOGUE SURGERY

Fig. 4c The titanium cylinder openings are positioned into the conversion prosthesis using the maxillary model surgery.

REGULAR IMPLANT PLACEMENT

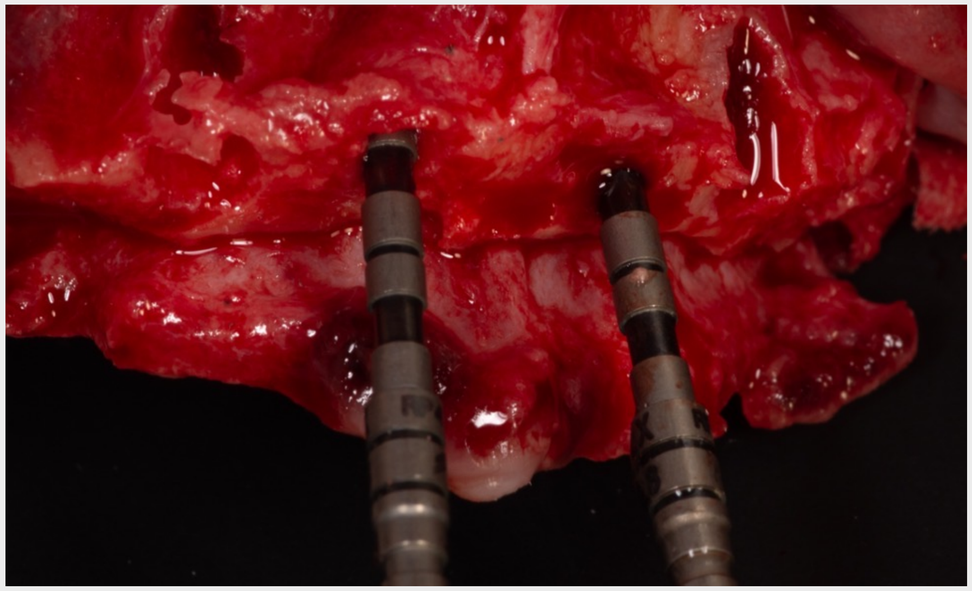


Fig. 5a The premaxillary implants are 4.5 mm BLX implants.

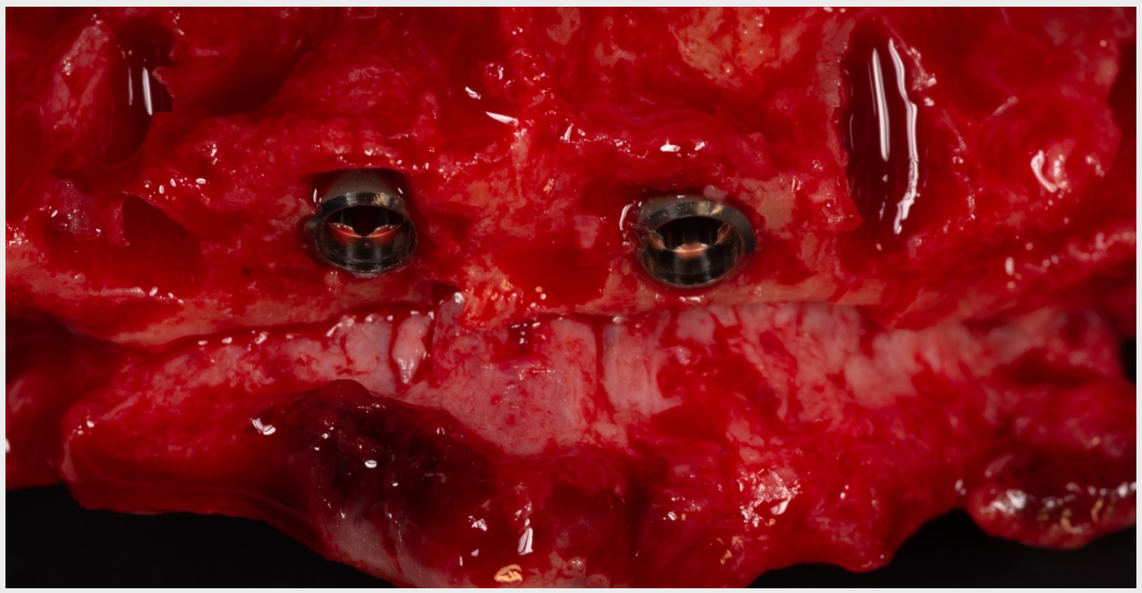


Fig. 5b The implants are placed with 40 NCM of insertion torque.

ZYGOMATIC IMPLANT PLACEMENT

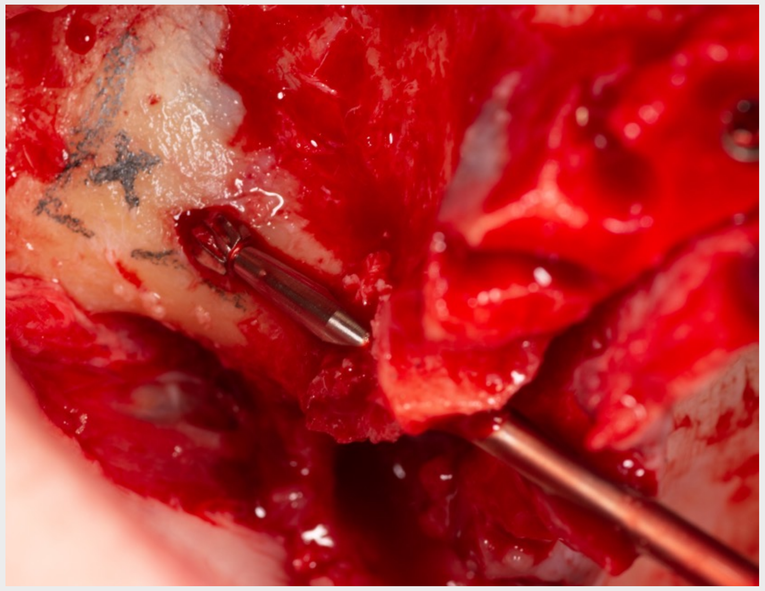


Fig. 6a The right planned zygoma is placed using the printed model of the patient.

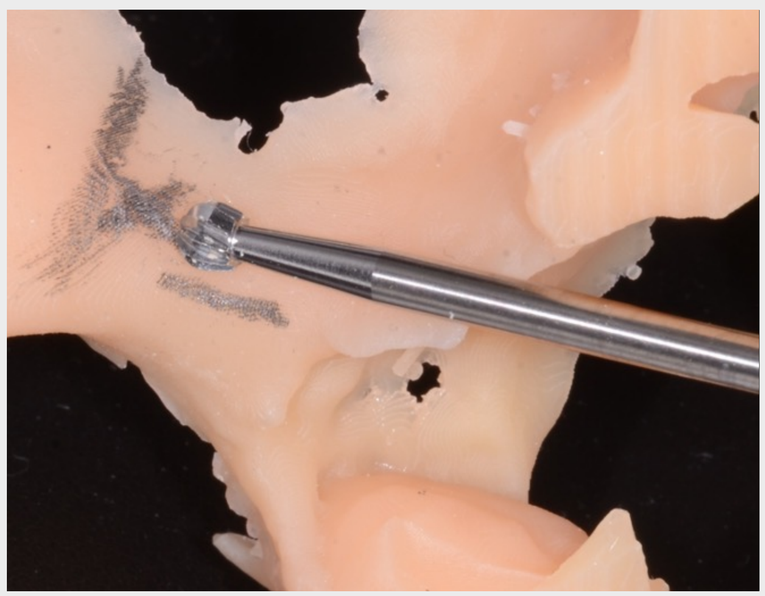


Fig. 6b The trajectory of the implant t as planned on the model is duplicated at time of surgery.

ZYGOMATIC IMPLANT PLACEMENT

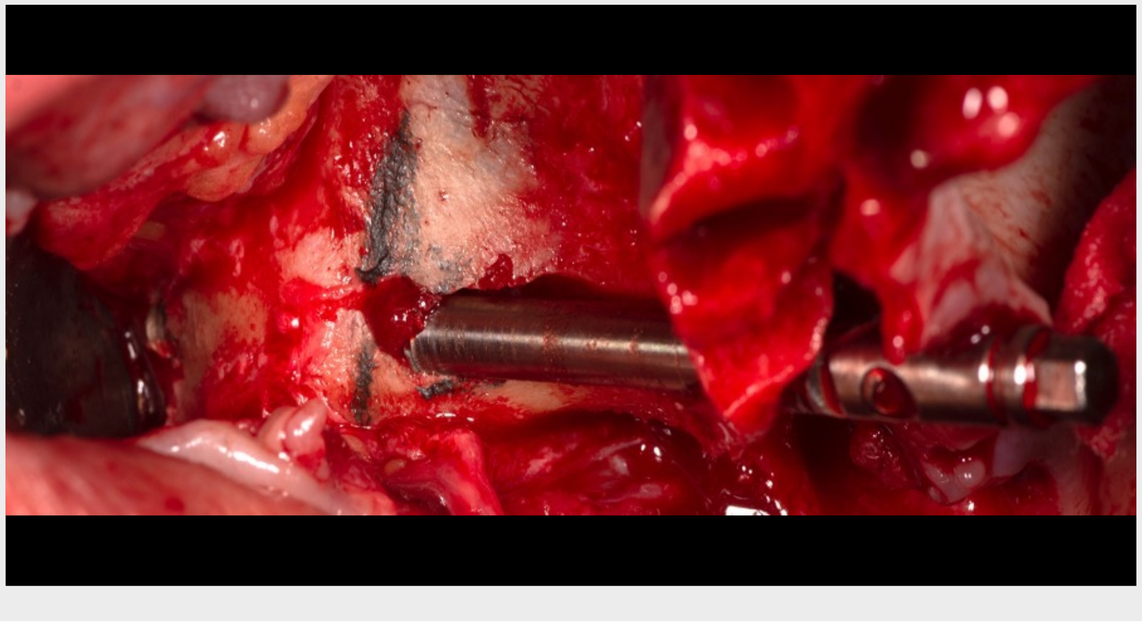


Fig. 6c The planned Straumann® Zygomatic implant, ZAGA™ Round, is Quad-Cortically stabilized in the ZAGA™ 3 clinical presentation.

ZYGOMATIC IMPLANT PLACEMENT

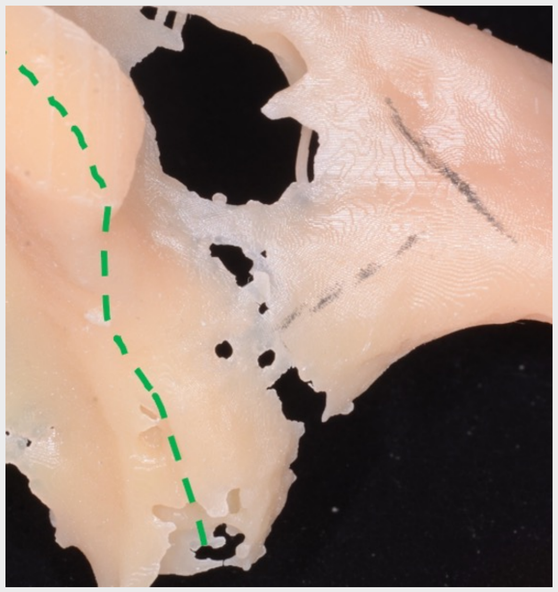


Fig. 6d The maxillary alveolar crest, the “Black-dotted line” as well as the base of the zygoma bone is marked on the patient’s printed model in the ZAGA™ 4 presentation.

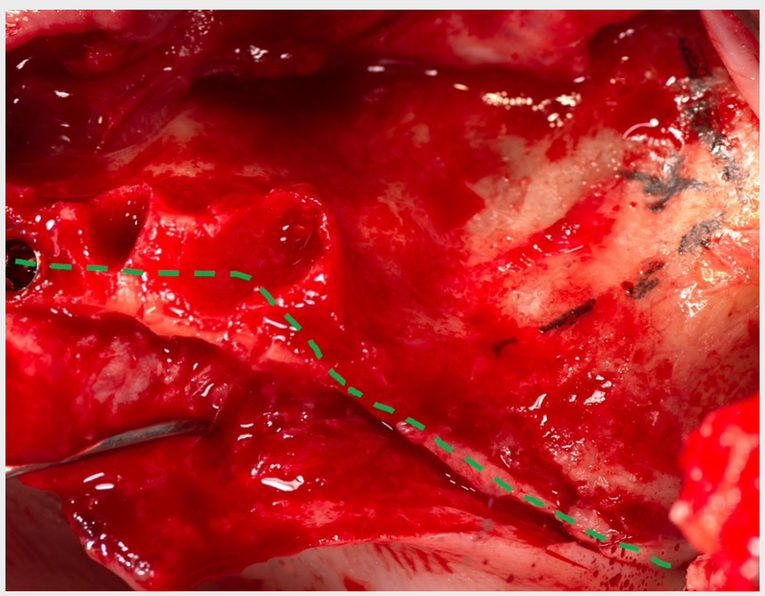


Fig. 6e The information gained from the model surgery is transferred to the patient’s left maxilla.

ZYGOMATIC IMPLANT PLACEMENT

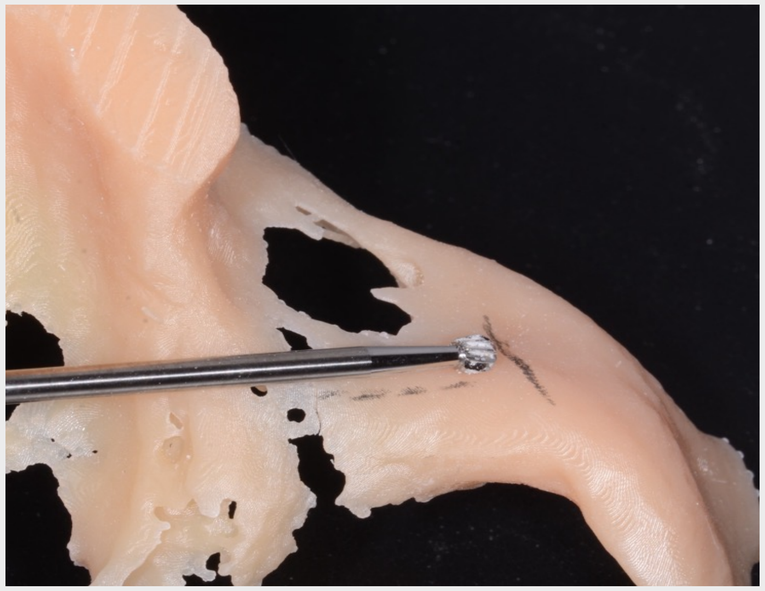


Fig. 6f During model surgery, the trajectory of the round drill was studied.

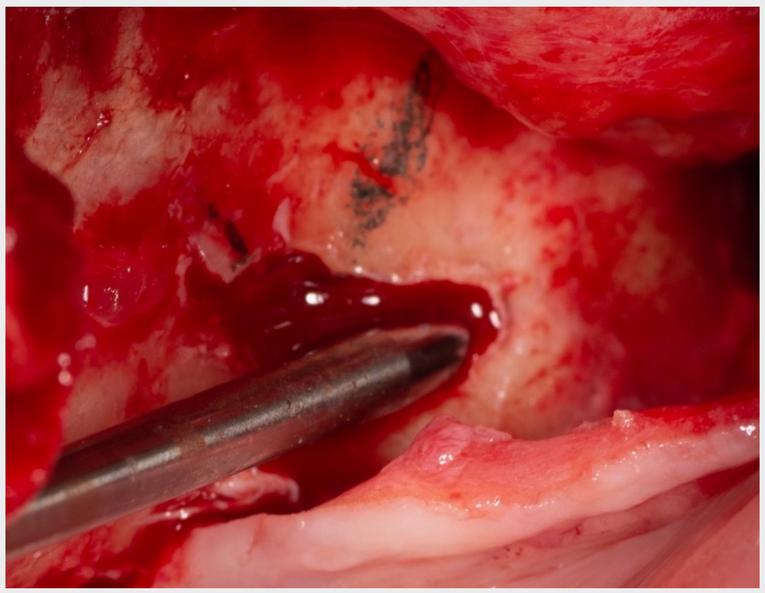


Fig. 6g The proper trajectory of the implant determined using the patient's model is used to establish the round drill mark at the base of the left zygoma bone.

ZYGOMATIC IMPLANT PLACEMENT

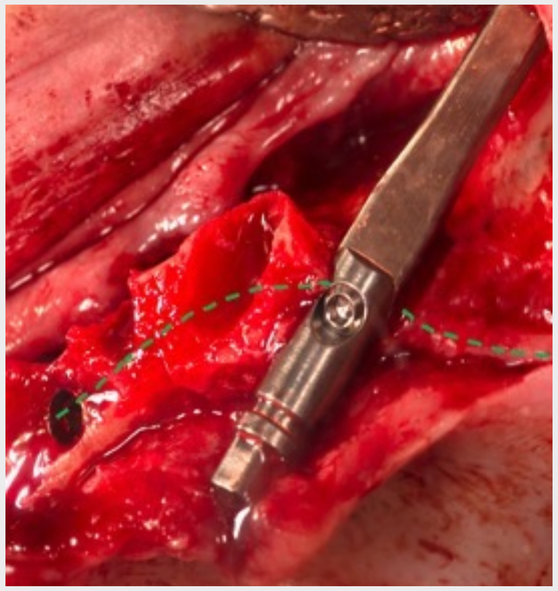


Fig. 6h Completed Zygoma Flat implant positioning in this ZAGA™ 4 clinical presentation.

ZYGOMATIC IMPLANTS, FINAL POSITION

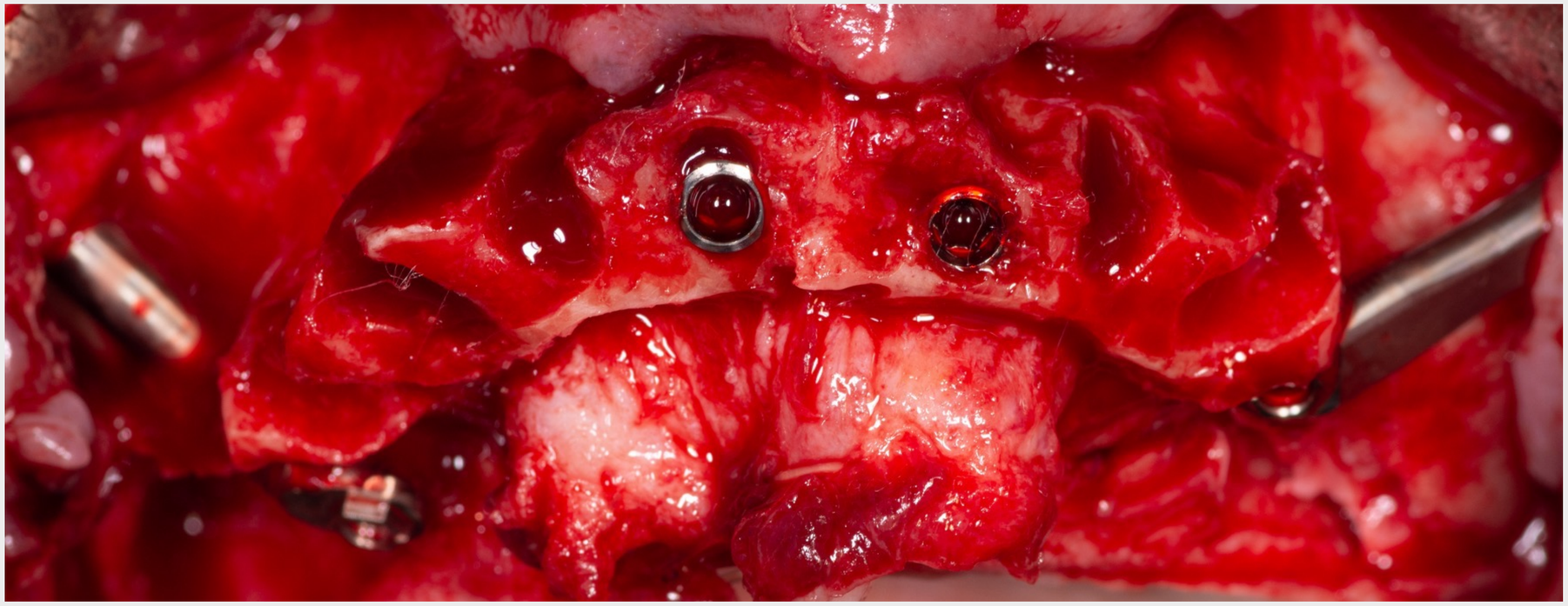


Fig. 7 Proper AP-Distribution ready to receive the SRA abutments for the anterior implants and the z-SRA abutments for the posterior zygoma implants.

All implants were placed with 40 NCM of insertion torque.

SRA ABUTMENT

Fig. 8a z-SRA abutments torqued to 35 NCM on the patient's right ZAGA™ 3 anatomy ready for direct intra-oral conversion of the immediate denture to a fixed immediate load provisional.

Fig. 8b z-SRA abutments torqued to 35 NCM on the patient's left ZAGA™ 4 anatomy ready for direct intra-oral conversion of the immediate denture to a fixed immediate load provisional.

All abutment screws were torqued at 35 NCM.

RADIOGRAPHIC EXAMINATION

OPG post-operative

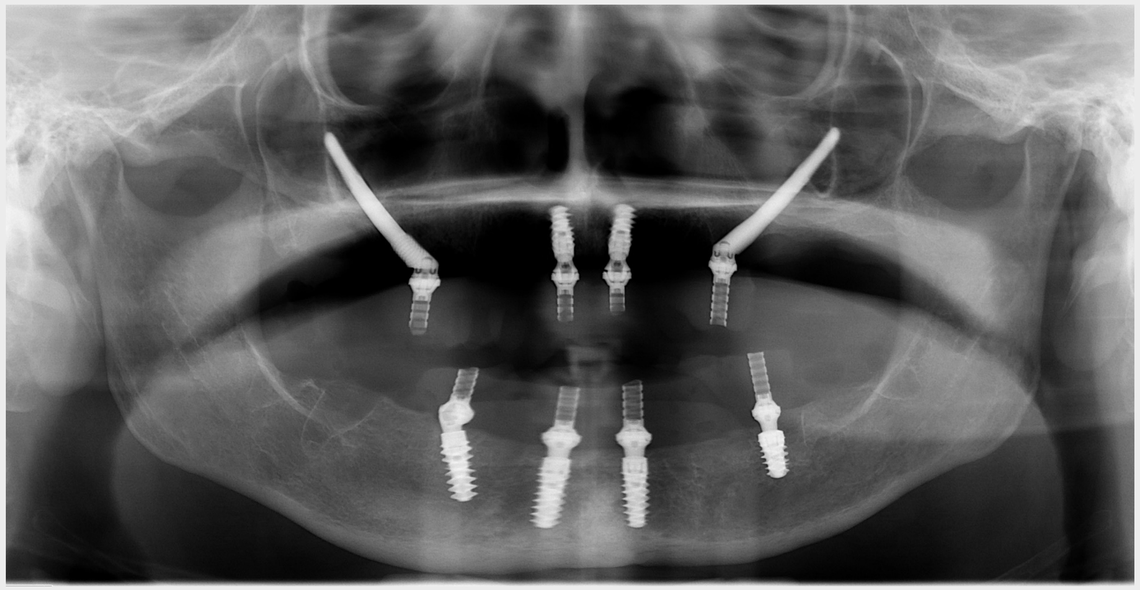


Fig. 9a A post-operative panoramic radiograph was recorded to verify the adequate placement and positioning of the implants. The AP distribution of the 4 implants was ideal for the mechanical distribution.

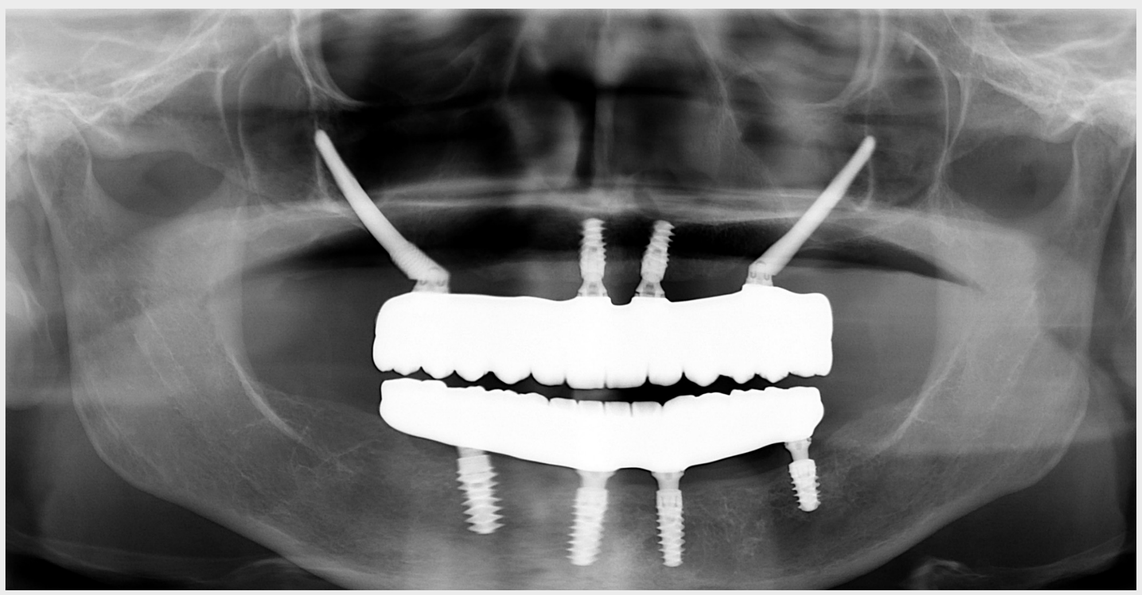


Fig. 9b Post-operative panoramic radiograph at final restoration placement.

CLINICAL OUTCOME

Completed treatment

Fig. 10a

Fig. 10a Increased incisal display
Fig. 10b Reduced nasio-labial angle
Fig. 10c Buccal corridor fill

Fig. 10b

Fig. 10c

CLINICAL OUTCOMES

DIGILOG workflow: Combining free hand surgery with the elegance of digital planning

1. Studying and planning the patient treatment using coDiagnostiX®
2. Printing the patient’s maxillary model and performing free hand model surgery
3. Identifying the type of implants and abutments which may be used during the procedure on the patient’s model pre-operatively
4. Identifying the probable temporary titanium cylinder trajectories and making the openings in the printed conversion prosthesis preoperatively

The DIGILOG workflow allows for better communication between the members of the implant team and adds to the confidence of all members for their ability to deliver the proposed treatment plan.

TAKE HOME MESSAGES

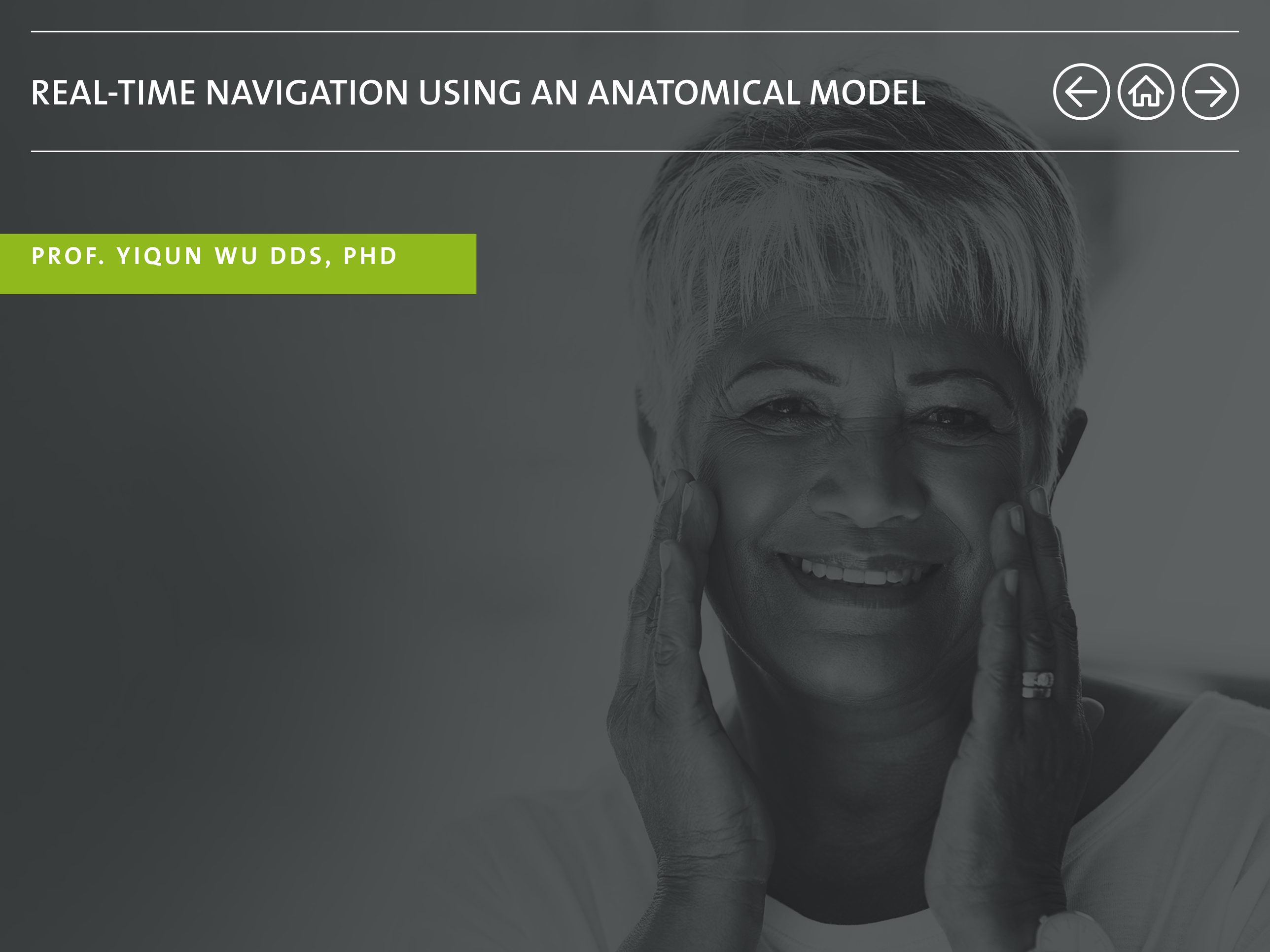
DIGILOG workflow: Combining free hand surgery with the elegance of digital planning

1. Digital technology can be used in the following way
2. Studying the patient anatomy in 3D coDiagnostiX®
3. Planing the implant and abutment positions in coDiagnostiX®
4. Printing the patient's model in-house with the P20 or P30 printer
5. Printing a surgical guide
6. Printing a provisional

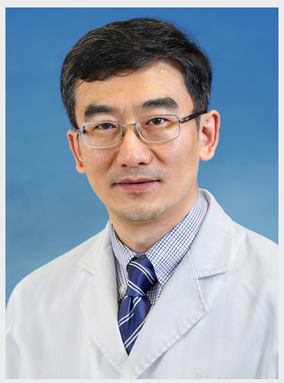
The clinician, may pick and choose whether they would like to use the entire portfolio offered by the digital workflow or a portion of it.

REAL-TIME NAVIGATION USING AN ANATOMICAL MODEL

PROF. YIQUN WU DDS, PHD



MEET THE EXPERT



YIQUN WU DDS, PHD

Department Chair, Second Dental Clinic, Ninth People's Hospital affiliated to Shanghai Jiao Tong University.
Vice Chairman of the Chinese Society of Oral Implantology;
Education Delegate of the ITI China Section; ITI fellow; ITI study club director; and Chair of ITI Scholarship Center Shanghai.

INTRODUCTION

Fostered by the rapid increase in computing power and significant improvements in imaging modalities, the clinical application of computer-assisted systems (CASs) has made tremendous progress. In dental implant technology, CASs can be classified into two major types: computer-guided (static) and computer-navigated (dynamic) systems.

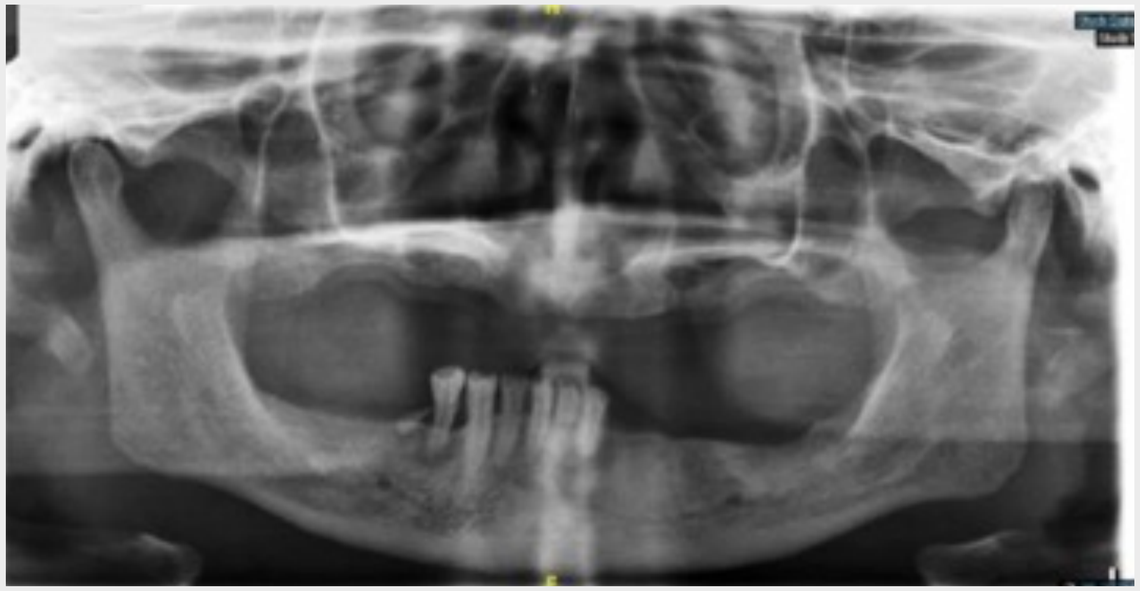
Static CASs are based on surgical guides and have proved to be highly accurate and reliable in guiding the placement of conventional implants in partially edentulous patients. However, they have failed to show comparable results when applied to zygomatic implants (ZIs) in fully edentulous and severely atrophied conditions due to the inability to control the drilling trajectory adequately.

Surgical navigation systems allow visual monitoring and adjustment of the entire procedure in real-time relative to the surgical plan. Highly accurate motion-tracking technology dynamically tracks the positions of the dental drill and the patient throughout surgery, offering freehand navigated implant surgery. Computer navigated systems represent an attractive candidate for transferring surgical plans to patients in complex craniomaxillofacial procedures as they may help
avoid pertinent anatomical injuries.

In this case report, we illustrate the workflow of real-time navigation for the placement of zygomatic implants as part of a mock surgery using an anatomical model (ZI)[1].

RADIOGRAPHIC EXAMINATION

OPG



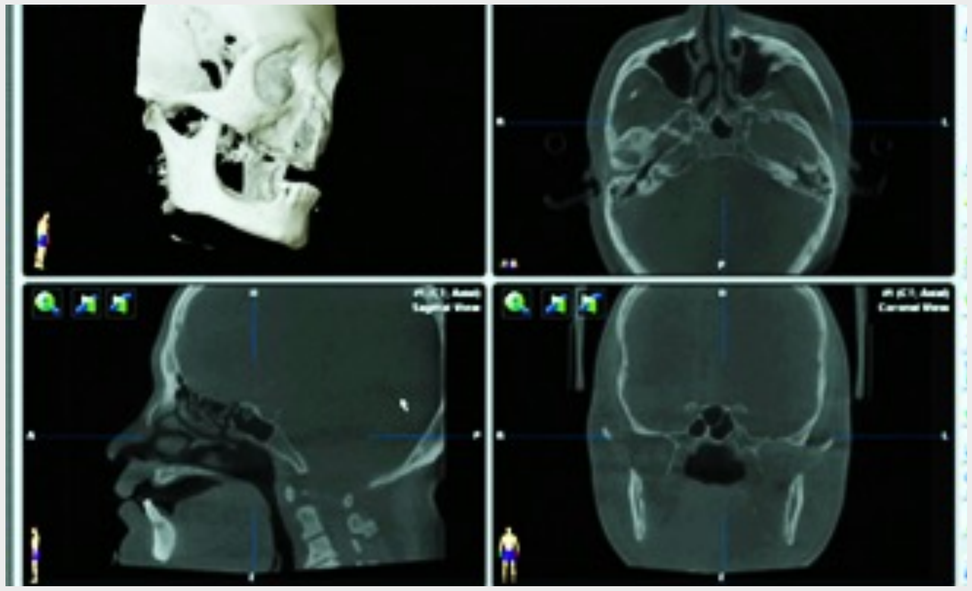
The procedure is illustrated using a mock surgery on anatomical models derived from CBCT scans of a real patient.

The treated patient displayed an edentulous severely atrophied maxilla and was scheduled to undergo implant-based full-arch reconstruction. Preoperative panoramic radiographic examination revealed a severely resorbed maxilla (Cawood & Howell Class V) and pronounced pneumatization of the maxillary sinuses. The horizontal and vertical alveolar ridge dimensions did not allow regular implant treatment.

After discussing the risks and benefits of the different treatment options, the patient consented to immediate rehabilitation with four zygoma implants (quad zygoma).

CBCT AND TREATMENT PLANNING

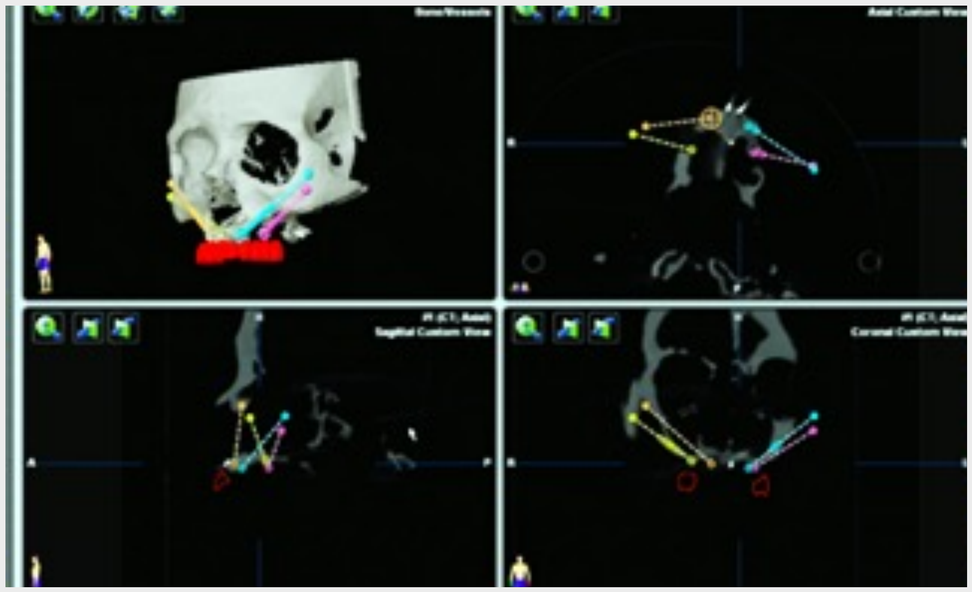
Preoperative



A Cone Beam Computed Tomography (CBCT) scan of the patient wearing prefabricated maxillary dentures was recorded. The residual maxillary bone and the volume and morphology of the zygomatic bone were analyzed in detail.

CBCT AND TREATMENT PLANNING

Preoperative

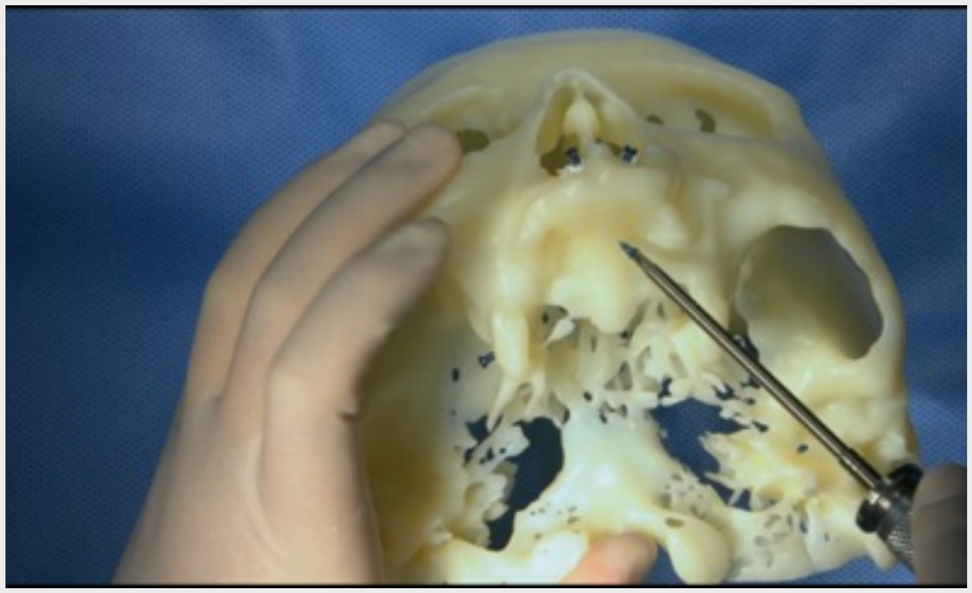


Treatment planning was based on a quad zygoma concept. Planning software was used to display the prefabricated maxillary dentures and design a provisional wax-up. The implant restoration, i.e., the length and apical anchorage areas of the zygomatic implants (ZIs) in the zygomatic bone, were also determined.Spacing of 3 mm between adjacent implants was planned to ensure a sufficient amount of bone around each implant.

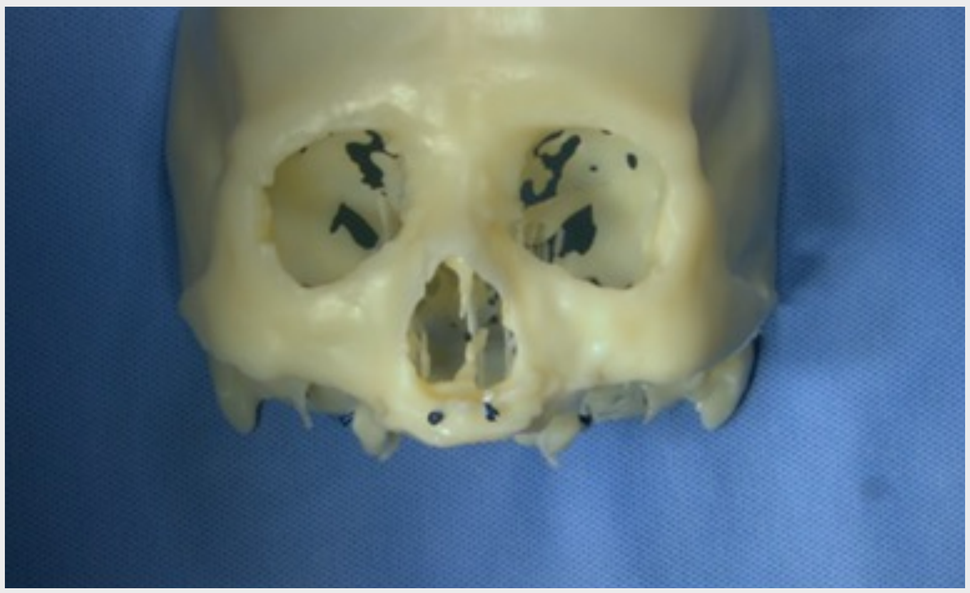
Cylindroid trajectories simulating the drilling path for ZI placement were displayed in the navigation software.

PATIENT PREPARATION FOR NAVIGATED SURGERY

Fiducial marker placement



On the day of surgery, bone-anchored titanium micro-screws were placed in the upper arch under local anesthesia. These micro-screws served as fiducial markers for the registration of the patient model and the surgical field.

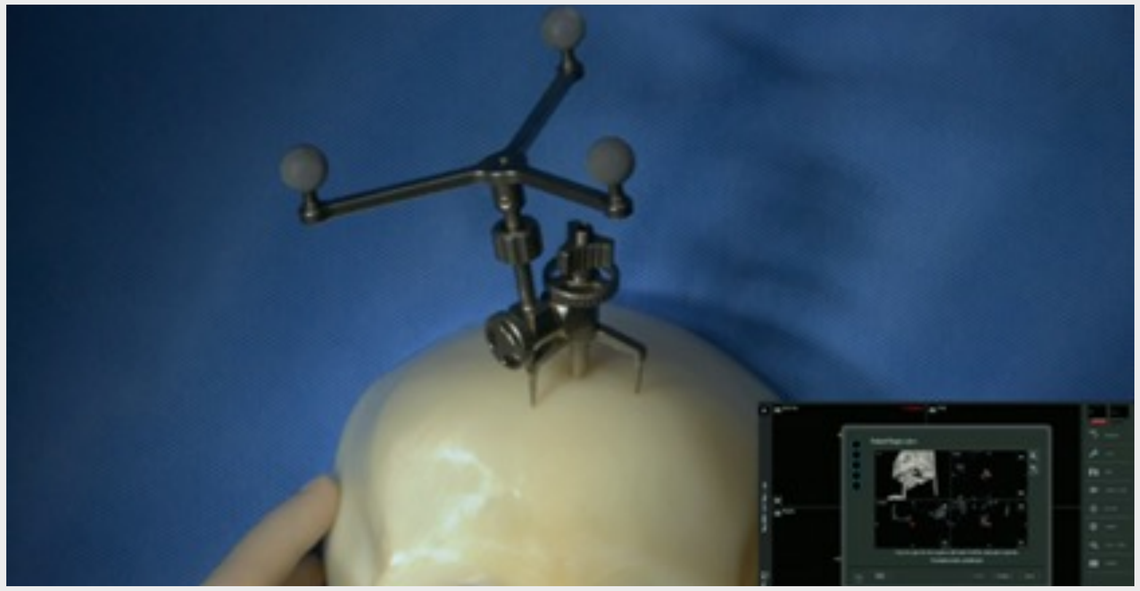


Six fiducial markers were placed intraorally in a polygon arrangement and distributed as broadly as possible. Markers were placed near the anterior nasal spine, maxillary tuberosity, and mid-palatal suture.

Next, a CBCT scan of the patient with fiducial markers was recorded, the data were imported into the navigation software and registered with the diagnostic planning model.

PREPARATION FOR NAVIGATED SURGERY

Navigation references



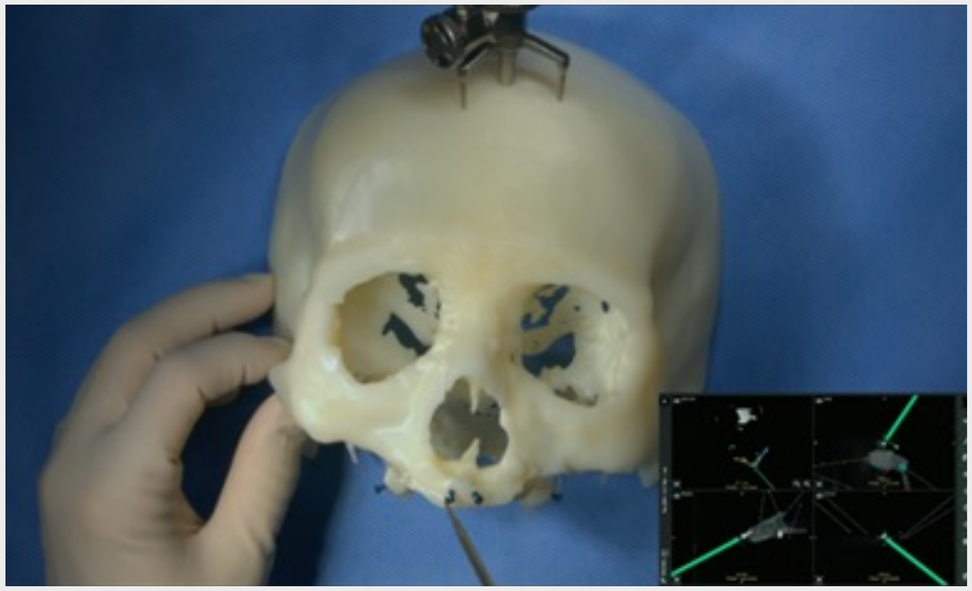
Navigation-based surgery employs three different instruments to navigate the surgical field: A headset to trace the patient position, a reference array to trace the drill handpiece, and a navigation probe for calibration.

The headset with reflective spheres for camera detection was firmly secured on the skull using a single self-tapping titanium screw.

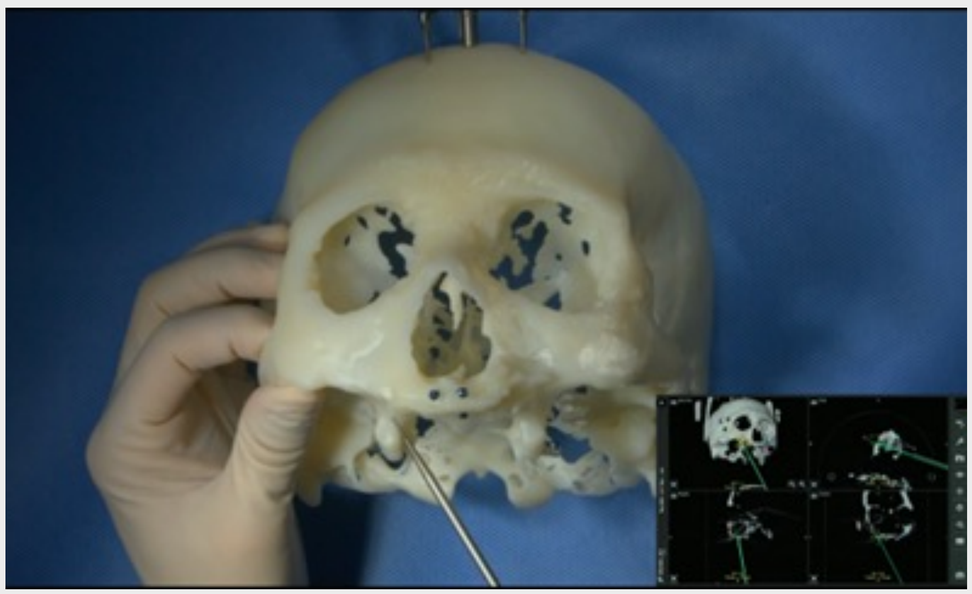
Light-reflecting spheres on the surgical handpiece were used to detect the 3D position and orientation by the camera.

PREPARATION FOR NAVIGATED SURGERY

Registration



The registration procedure establishes a relationship between the virtual patient model and the surgical field. This registration procedure was performed by individually contacting the fiducial markers with the navigation probe. Once the registration was completed, the sagittal, coronal, axial, and 3D reconstruction images can be displayed in real-time relative to the probe's position.



The positioning probe was used to identify the osteotomy's crestal and zygomatic entry points. These points were displayed on the monitor according to the preoperative planning.

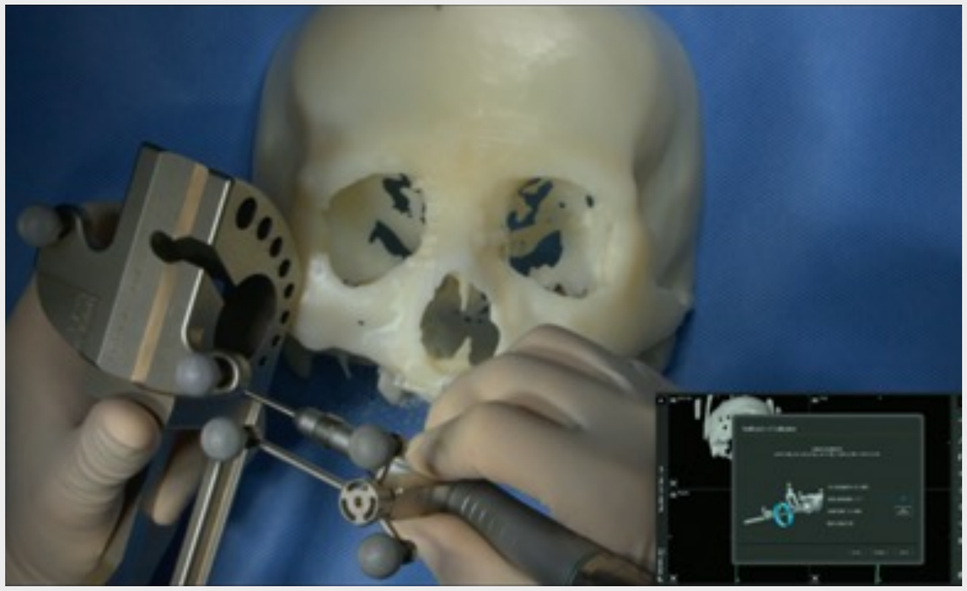
PREPARATION FOR NAVIGATED SURGERY

Registration

Navigated surgery was carried out using the surgical kit of the Straumann® Zygomatic Implant System.

PREPARATION FOR NAVIGATED SURGERY

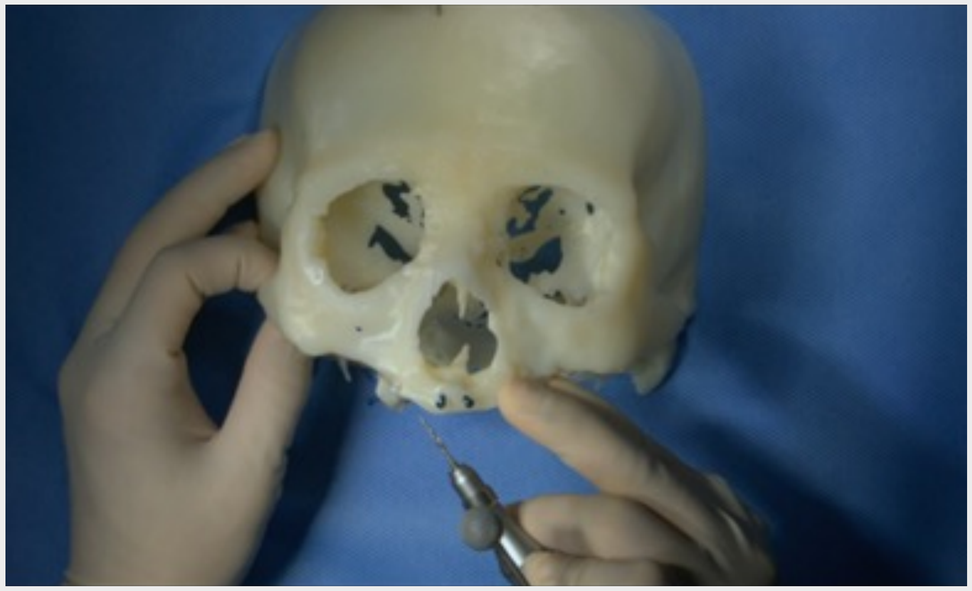
Drill calibration



Due to the different drill diameters and lengths, a calibration was required each time the drill was changed. These calibrations ensure that the directional vectors of the drills relative to the coordinate system of the reference frame are registered.

PREPARATION FOR NAVIGATED SURGERY

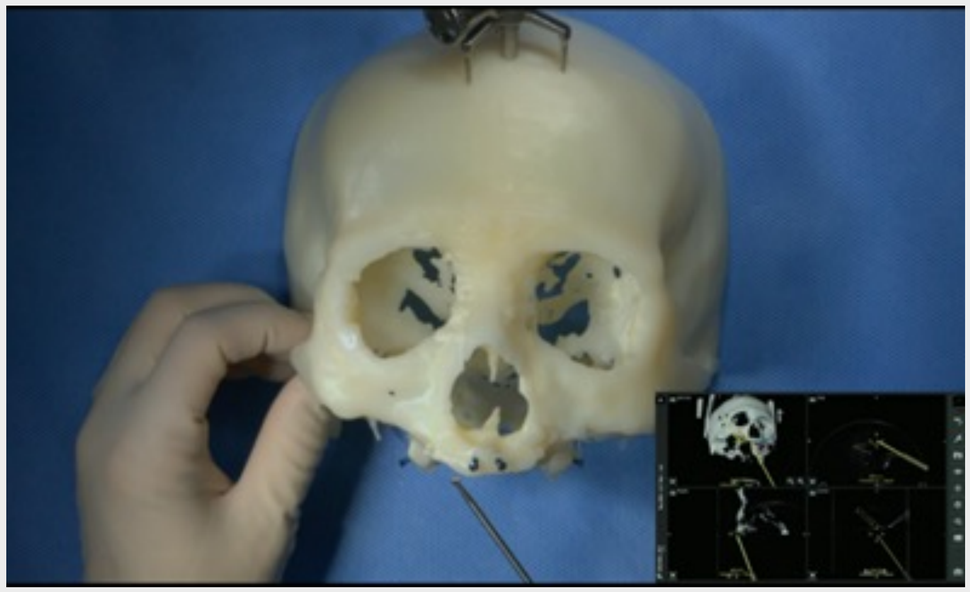
Pilot drilling



To facilitate osteotomy preparation in the thin and firm alveolar crest, pilot drilling through the alveolar ridge was first employed using a needle drill.

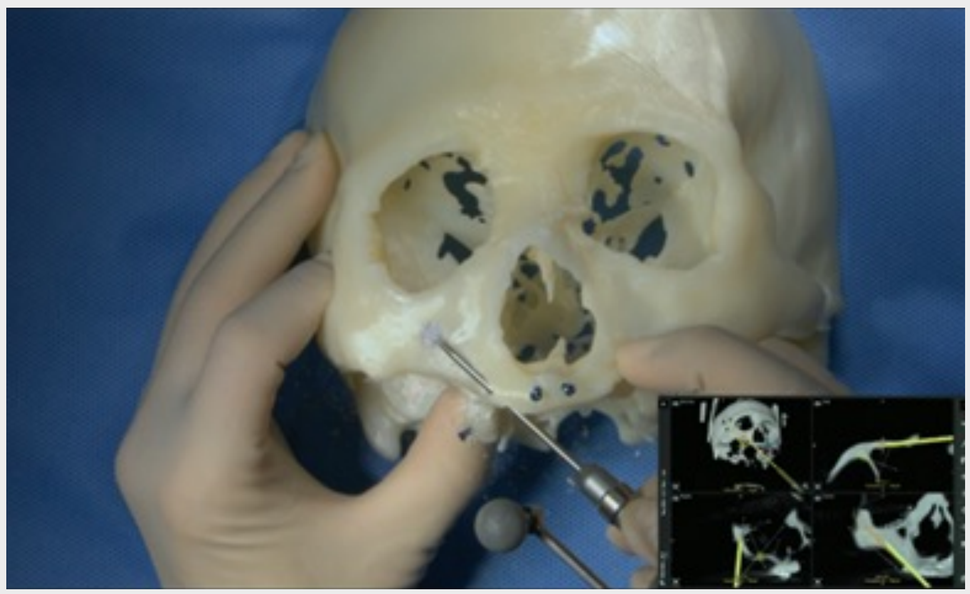
OSTEOTOMY PREPARATION

Extension of osteotomy



A round bur was subsequently used to enlarge the implant entry point and osteotomy.

The exact drill path and position were displayed on-screen in real-time and verified relative to the planned osteotomy trajectory simultaneously with the drilling procedure.

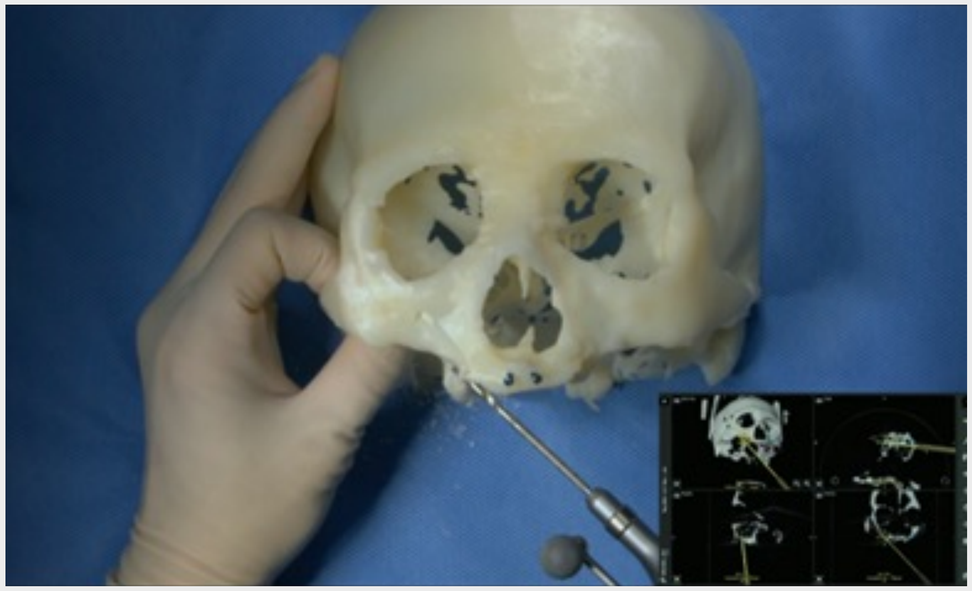


The osteotomy up to the bottom of the zygomatic bone was prepared using the round bur.

The osteotomy was prepared according to plan by reorienting the drill when deviating from the planned trajectory.

OSTEOTOMY PREPARATION

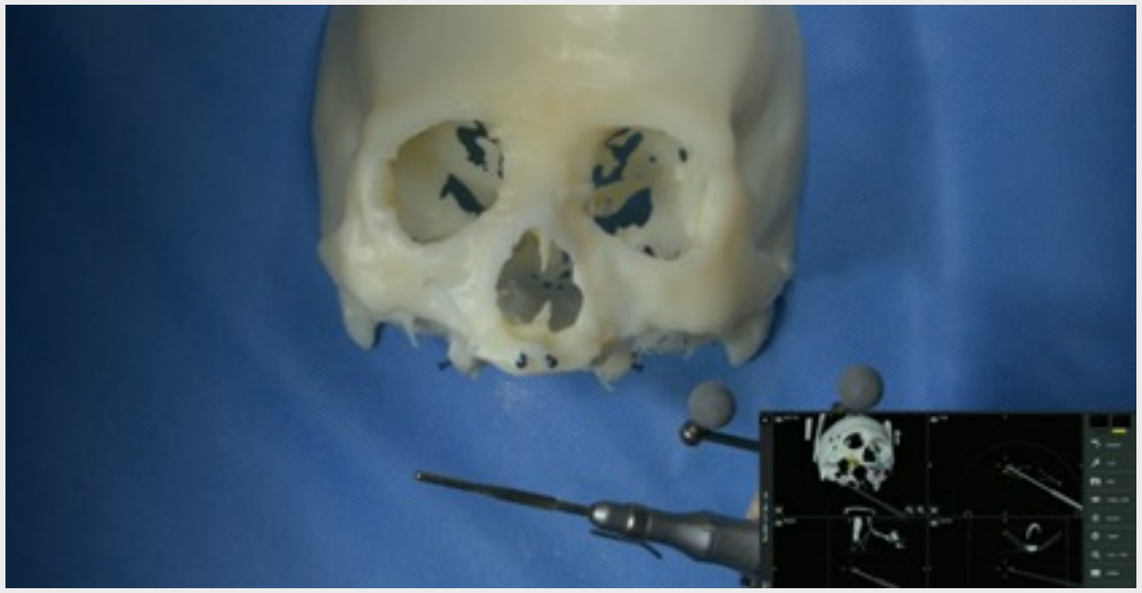
Zygomatic osteotomy



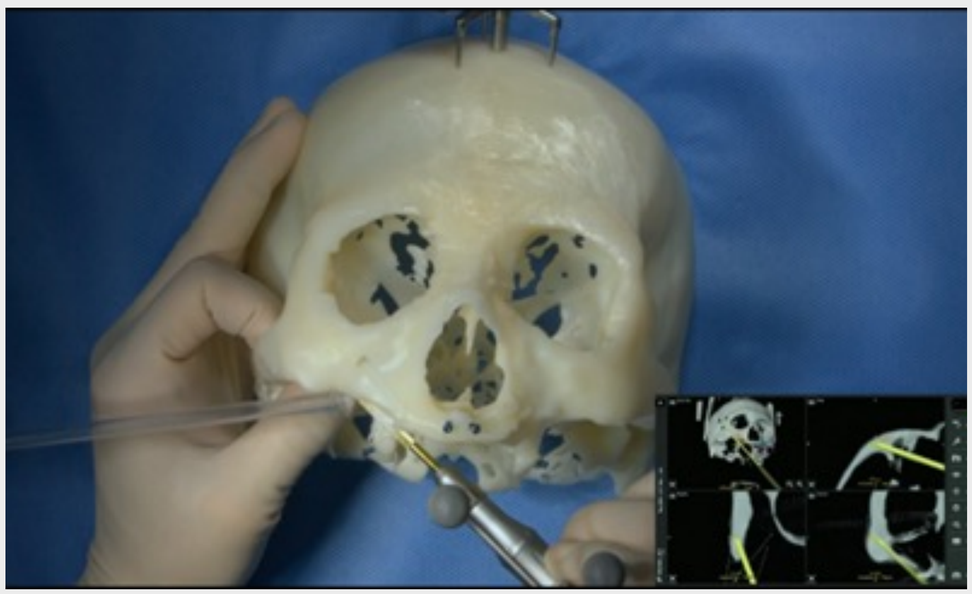
The zygomatic osteotomy was prepared using the 2.9 twist drill. The drilling trajectory was constantly monitored on-screen, allowing the exact path and depth of the osteotomy to be controlled. The implant trajectories were carefully planned and controlled for optimal primary implant stability respecting a 2-3 mm safety margin to critical anatomical structures.[2]

OSTEOTOMY PREPARATION

Zygomatic osteotomy

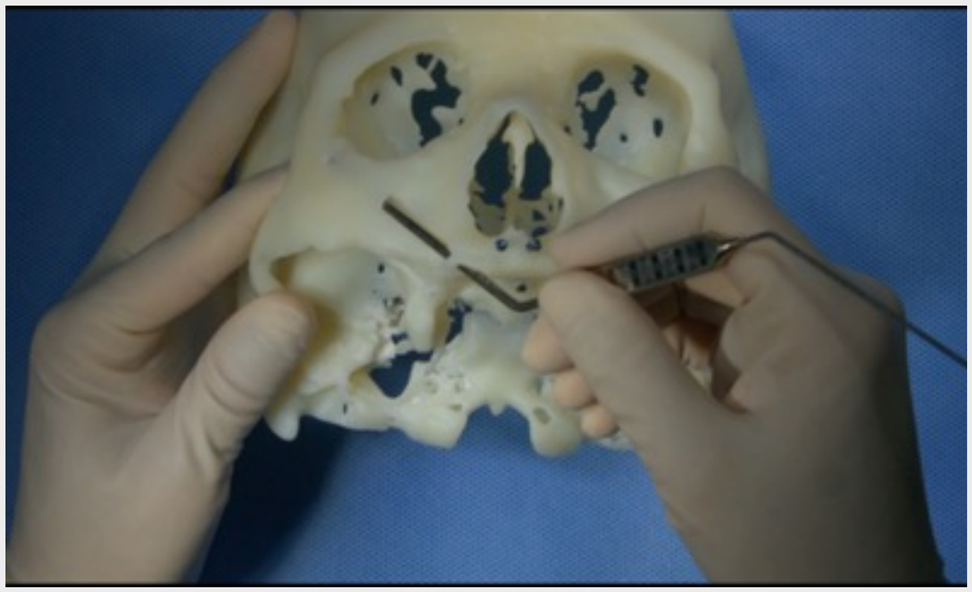


The posterior osteotomy passage through the alveolar ridge and sinus bone was widened to accommodate the Straumann® Zygomatic implant, ZAGA™ Flat. The 3.5 mm twist drill was used for the same pathway of the anterior osteotomy to place the Straumann® Zygomatic implant, ZAGA™ Round. Calibration was repeated for every drill change.

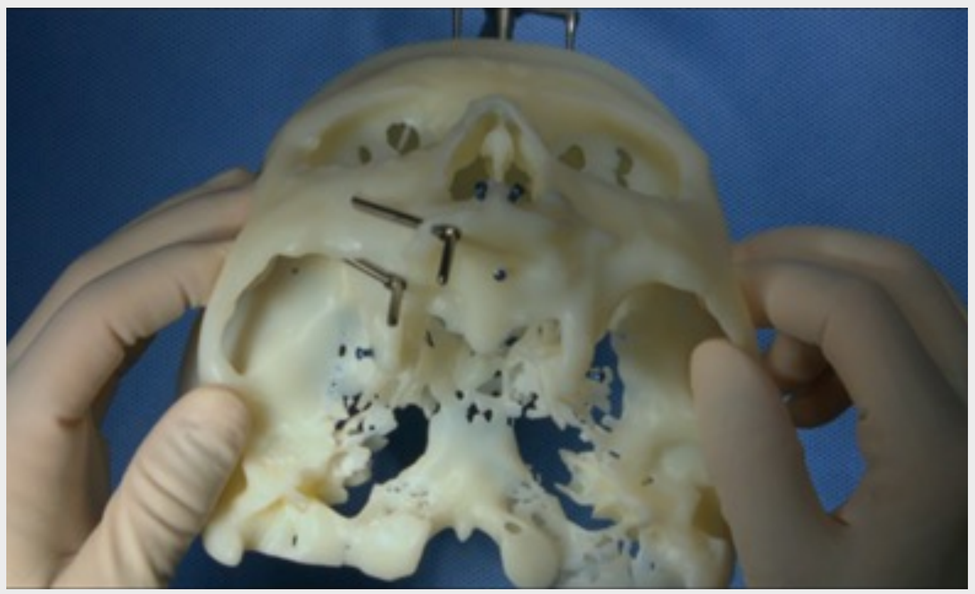


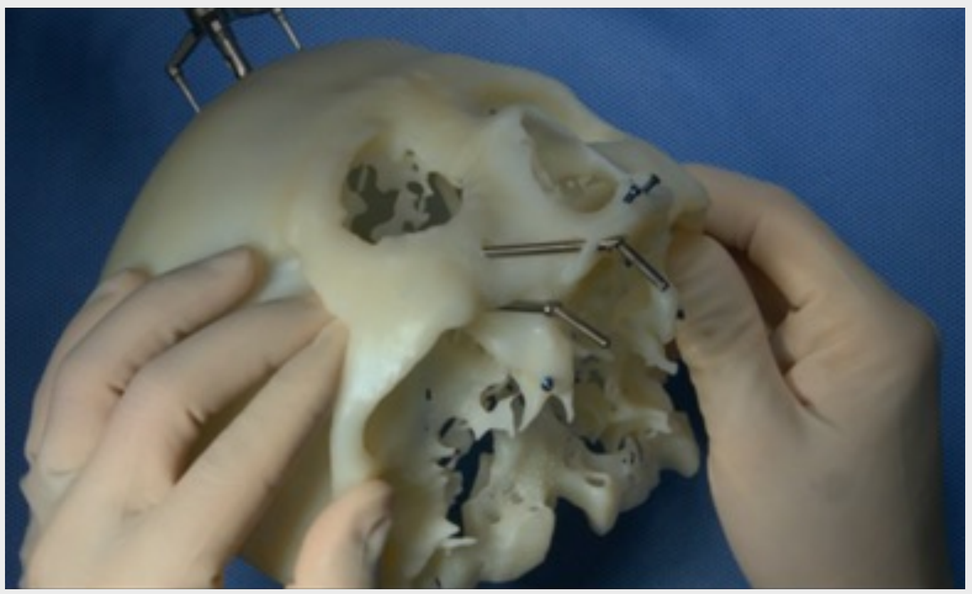
OSTEOTOMY PREPARATION

Osteotomy verification



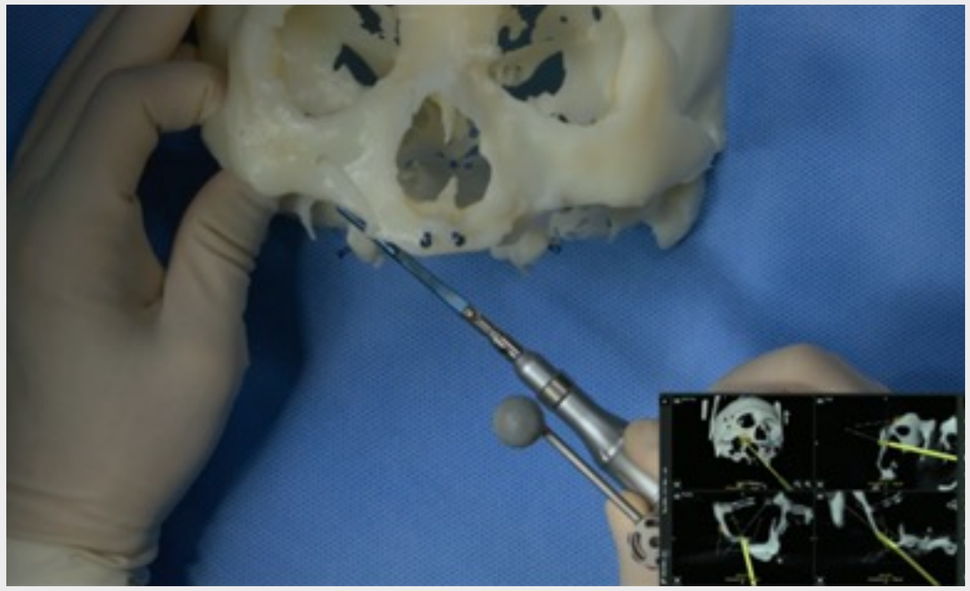
After implant bed preparation, the length of the drilling path was verified with the depth gauge. Next, the implant angulation was verified using try-in implants. In the author's experience, the application of navigated surgery generally results in a highly accurate transfer of the preoperative plan to the patient.



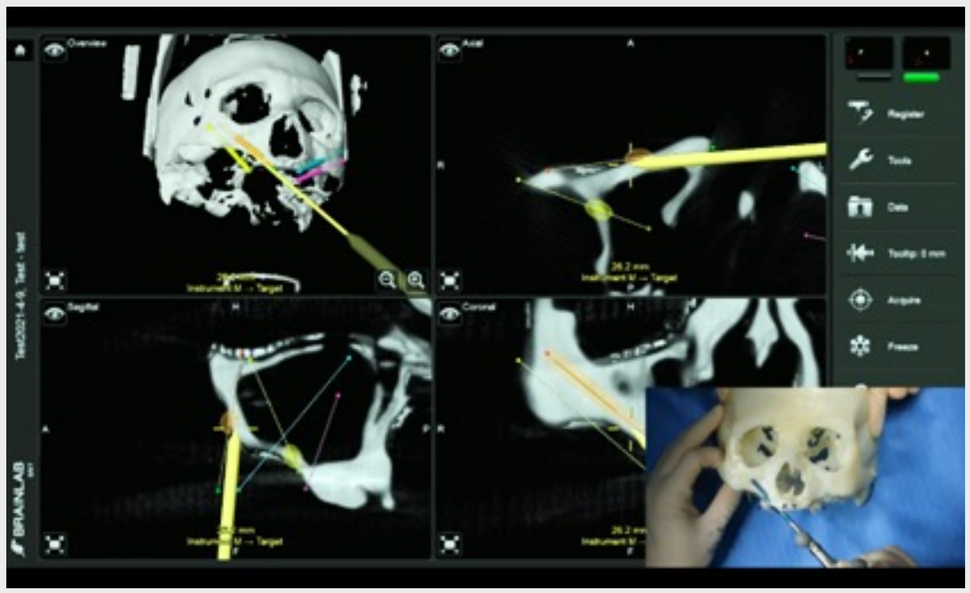


PLACEMENT OF ZYGOMATIC IMPLANTS

Navigated placement



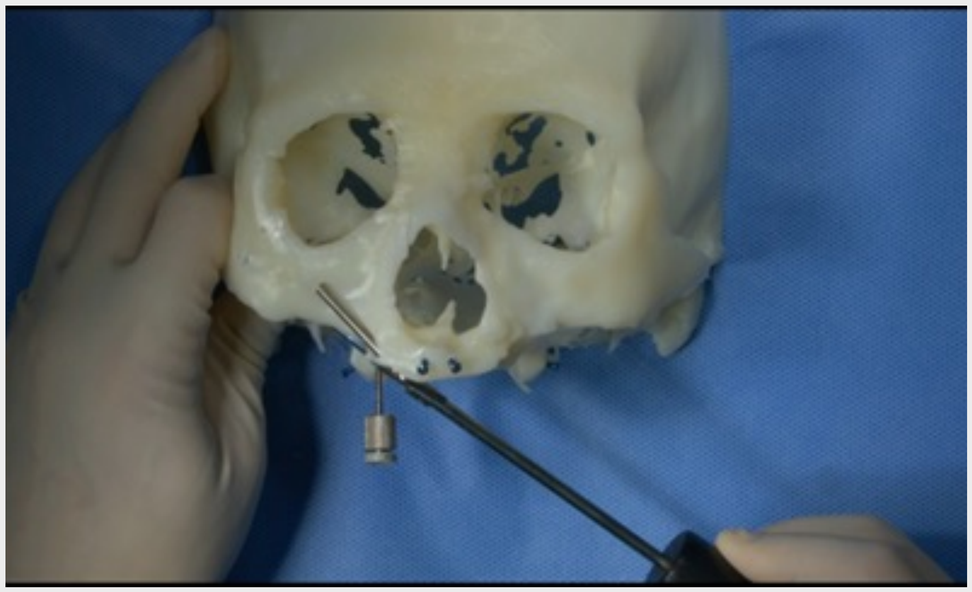
ZI placement was performed using the navigation-guided handpiece.



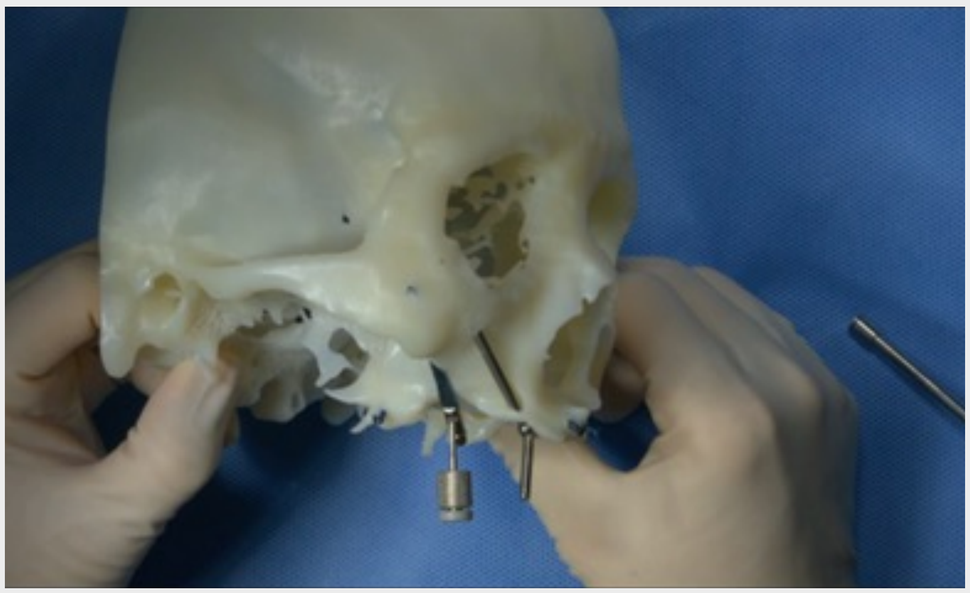
The insertion process was followed on-screen and in real-time until the apex of the implant reached the exit point in the zygomatic bone.

PLACEMENT OF ZYGOMATIC IMPLANTS

Orientation of prosthetic platform

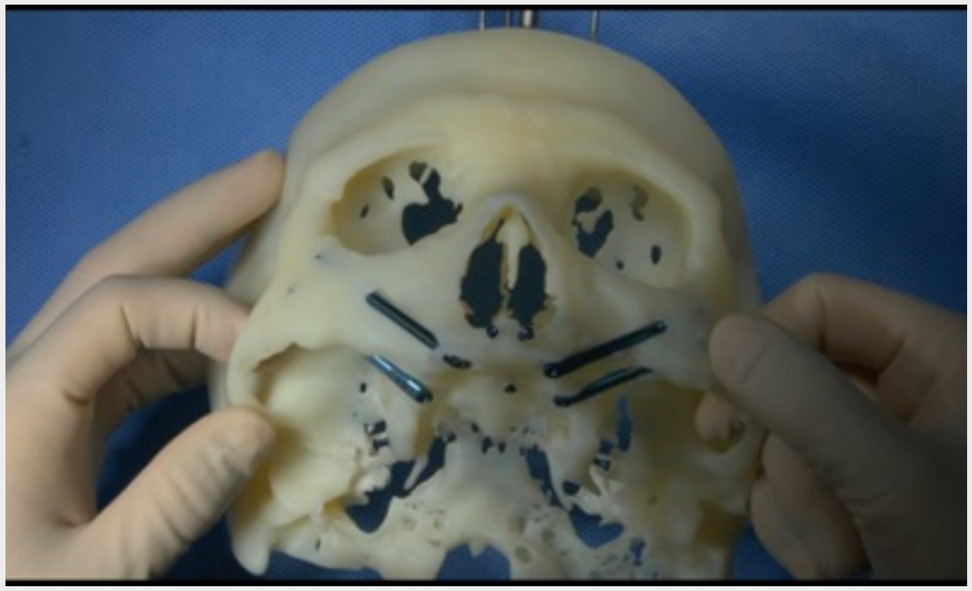


The angulation of the implant platform and the prosthetic connection were adjusted with the hand instrument using the screwdriver.



TREATMENT EVALUATION

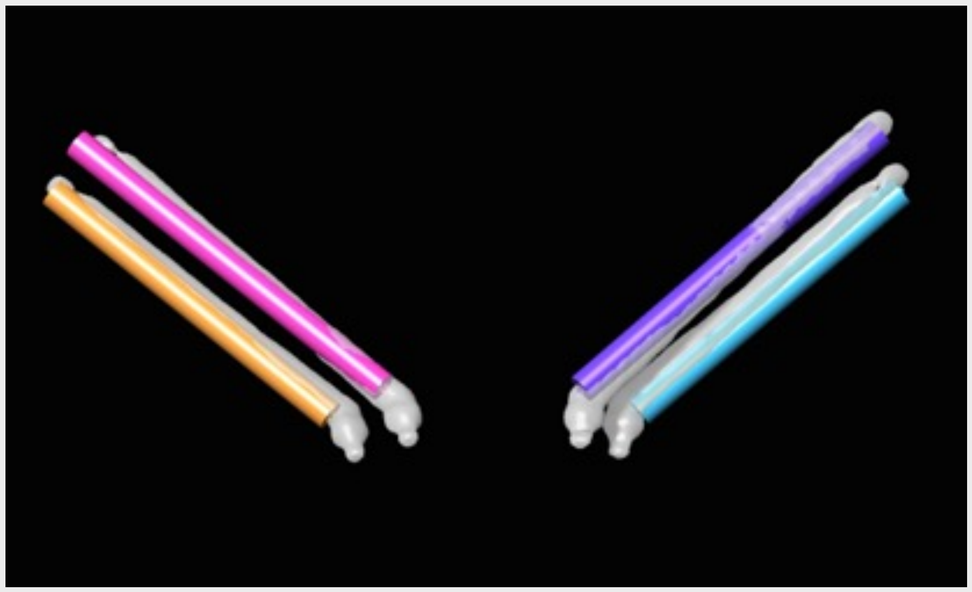
Visual evaluation



Four ZAGA™ ZIs were placed according to the preoperative planning. Three Straumann® Zygomatic implants, ZAGA™ Flat and one Straumann® Zygomatic implant, ZAGA™ Round, in the right anterior position were distributed uniformly in the alveolar crest.

TREATMENT EVALUATION

CBCT Comparison to plan



A postoperative CBCT scan was recorded after the mock surgery and overlaid with the preoperative planning model in the navigation software. The distances between the planned and measured apical and coronal implant tips were quantified. Next, the angular deviation between the planned and measured longitudinal axes was assessed. The precision was very satisfactory.

	ENTRY POINT ERROR(MM)	TARGET POINT ERROR(MM)	ANGLE ERROR
Left Mesial	0.8	1.5	2.4
Left Distal	0.7	1.6	2.9
Right Mesial	0.9	1.8	2.5
Right Distal	0.8	1.1	2.6

TAKE HOME MESSAGES

Because of the limited bone width and anatomical intricacy of the zygomatic bone anatomy, it is challenging for clinicians to place ZIs. Static surgical guides have been shown to be ineffective in the placement of ZIs, whereas dynamic navigation has proved to be a reliable and accurate technique.

In the Quad Zygoma placement protocol, the potential risk of surgical complications may be minimized by navigation. However, errors in ZI navigation may occur and need to be taken into consideration by the treating surgeon. The registration of the patient model and the surgical field can be considered a key step of navigated ZI placement. Optimal configurations of fiducial markers are crucial to maximizing the placement accuracy of ZIs.

LITERATURE REFERENCES TO REMEMBER

Wu Y, Wang F, Huang W, Fan S. Real-Time Navigation in Zygomatic Implant Placement. Oral and Maxillofacial Surgery Clinics of North America 2019; 31: 357–67.

Hung K, Ai Q, Fan S, Wang F, Huang W, Wu Y. Measurement of the zygomatic region for the optimal placement of quad zygomatic implants. Clin Implant Dent Relat Res 2017; 19: 841–8.

International Headquarters
Institut Straumann AG
Peter Merian-Weg 12
CH-4002 Basel, Switzerland
Phone +41 (0)61 965 11 11
Fax +41 (0)61 965 11 01
www.straumann.com

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