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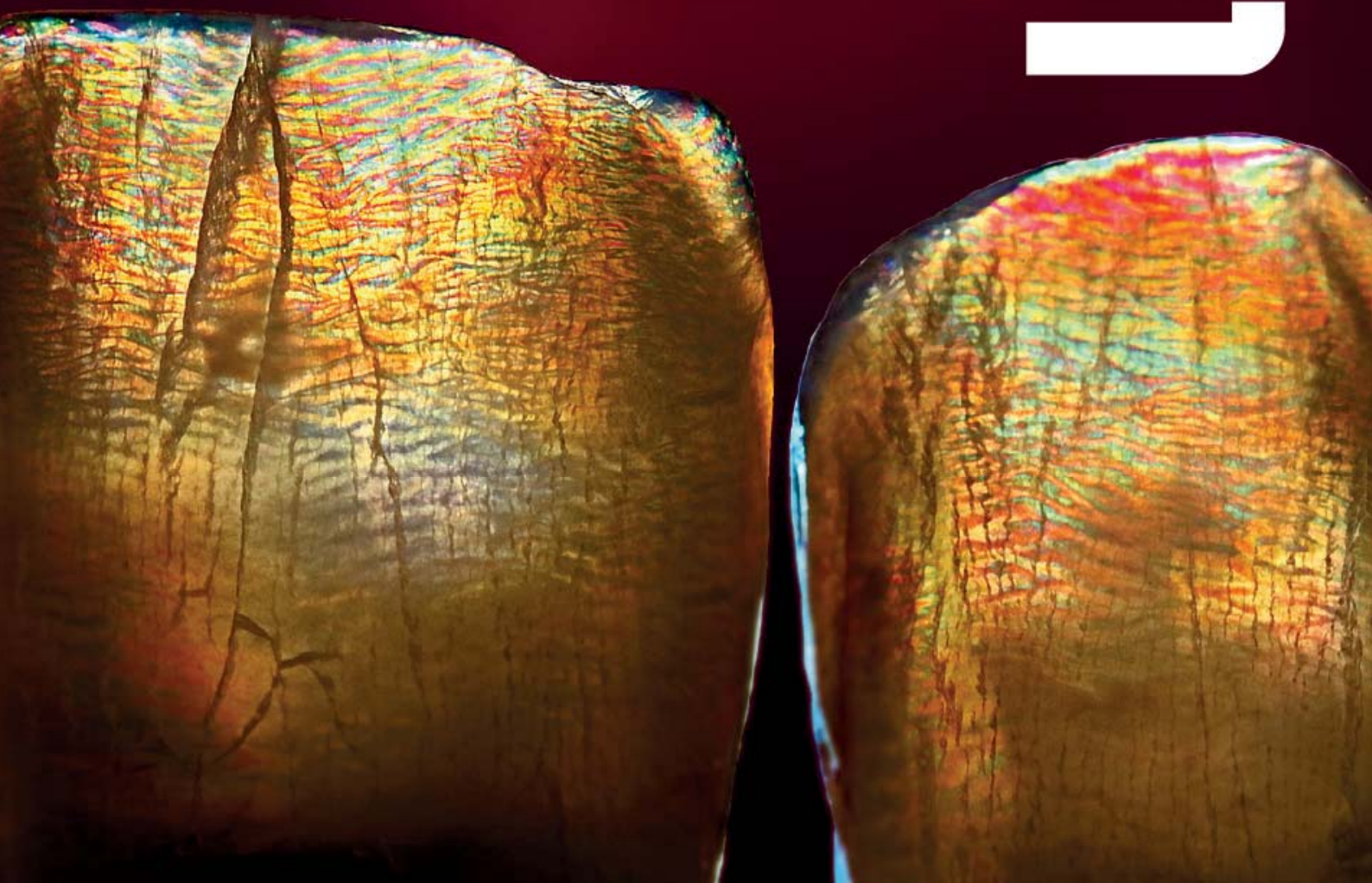

THE PLANESYSTEM® APPROACH FOR EDENTULOUS CASES

MAXILLARY PRETTAU® BRIDGE ON TITANIUM BASES MADE WITH ZIRKONZAHN'S WORKFLOW

Case realised by MDT Udo Plaster in collaboration with Dr. Siegfried Hrezkuw, both from Nuremberg (Germany)

When it comes to healing, only the best is enough! For this reason, in the field of patient analysis, Zirkonzahn decided to collaborate with the dental technician Udo Plaster, inventor of the PlaneSystem®. The PlaneSystem® is a method of transferring individual patient data based on a patient specific view that integrates perfectly and exclusively into Zirkonzahn's digital workflow. The PlaneSystem® is a transfer method that respects and recognises the patient as a whole. Regardless of the procedure chosen for the fabrication of the dental restoration – digital or traditional, with the PlaneSystem® all patient-specific information recorded can be accurately transferred from the analogue to the digital world in a 1:1 ratio without losing any information and saved in the software for further reproduction at any time. The reproducibility of the data offers a high degree of security, especially for complex implant-supported cases.

DENTAL HISTORY

Each person has his/her own dental history and solution approach. The manufacture of dental restorations requires an individual, holistic analysis of the human system. This results in the acquisition of a pool of reproducible data as an individual guideline for the reproduction of a long-lasting, accurately fitting and aesthetic dental prosthesis. The case described in the following pages deals with the treatment plan of a patient who gradually lost his teeth over the past few decades and who was provided with an implant-supported prosthesis in the edentulous mandible. When he visited the dentist, he was currently wearing a full denture in the maxilla and a fixed, implant-supported restoration in the mandible. His desire was to have the full denture replaced with a maxillary fixed prosthesis, for which six implants had already been placed to anchor a fixed prosthesis. Although the patient did not complain about functional problems, it was clearly visible that the dimensions of the existing denture did not match the patient-specific conditions and the upper jaw needed to be adapted to the lower jaw restoration (Fig. 1). First of all, it was necessary to work on the occlusal plane individually, in order to fabricate a dental restoration based on that. The restoration in the mandible had to be adjusted later to the correct plane.

Fig. 1: The patient's initial situation. The patient gradually lost his teeth over the past few decades and was provided with an implant-supported prosthesis in the edentulous mandible, which did not match the patient-specific conditions.

DEFINING THE CORRECT VERTICAL DIMENSION: ANATOMIC LANDMARKS AND PROFILE ANALYSIS

The dental technicians job started with the acquisition of the patient's 3D facial scans with the Face Hunter 3D facial scanner as well as scans of the old prostheses, in order to transfer all analysis data into the virtual world at later times. The situation models shown on the face scan reveal the high vertical dimension. The alveolar ridge in the upper jaw was severely atrophied and the occlusal plane in the mandible dropped dorsally (Fig. 2).

Fig. 2: The 3D virtual patient reproduction made with the Face Hunter 3D facial scanner and matched in the Zirkonzahn.Scan software with the old prostheses' model scans. The models reveal a high vertical dimension and the occlusal plane in the mandible dropped dorsally.

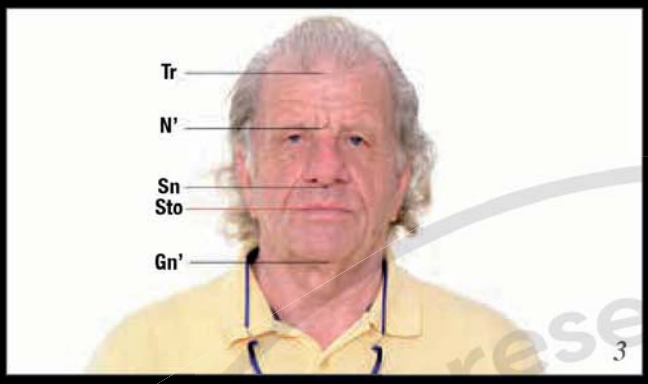

Fig. 3: Nasion and subnasal points

Fig. 4: Center of the skull and midline

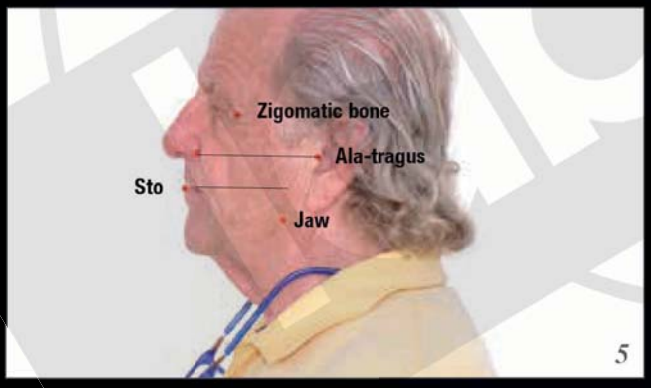

Fig. 5: The stomion plane – parallel to the ala-tragus line, the jaw angle and the zigomatic bone

Fig. 6: Holdaway line (connecting line between pogonion, upper lip point and intersection of the nose

Each intervention into the stomatognathic system after growth completion (e. g. dental prosthesis, orthodontics) is compensated by the body elsewhere. The creation of the new prosthesis were required to assess the correct dimensions (tooth position, tooth size). To manufacture completely individual prosthesis it was necessary to define the new correct vertical dimension and position. For this purpose, reference planes and anatomic orientation points reproducible at any time – even for edentulous cases – had to be defined on the patient's face and skull as well as on the model for the later reproduction on the virtual articulator. The determined landmarks and reference planes were (Figs. 3–6):

- ***Ala-tragus line, that is, the line connecting the ala of the nose to the tragus (outer auditory canal);***
- ***From a frontal view: nasion and subnasal points;***
- ***Centre of the skull, marked on the palate using a template;***
- ***Midline;***
- ***The stomion plane, that is, the contact point of upper and lower lips when articulating the "m-sound" without occlusal contact. This plane is important to determine the functional plane, which is parallel to the ala-tragus line;***
- ***Jaw angle;***
- ***Zigomatic bone;***
- ***Holdaway line (connecting line between pogonion, upper lip point and intersection of the nose).***

DEFINING TOOTH SPACES ON THE TOOTHLESS JAW

To divide the tooth spaces on the toothless jaw and to transfer the registered landmarks on the model the following steps were carried out:

- ***All previously determined landmarks were considered, in particular the stomion plane***
- ***A vertical line was then drawn from the zygomatic bone landmark to the functional plane***
- ***The upper molar's position was found at the intersection point of these two lines***

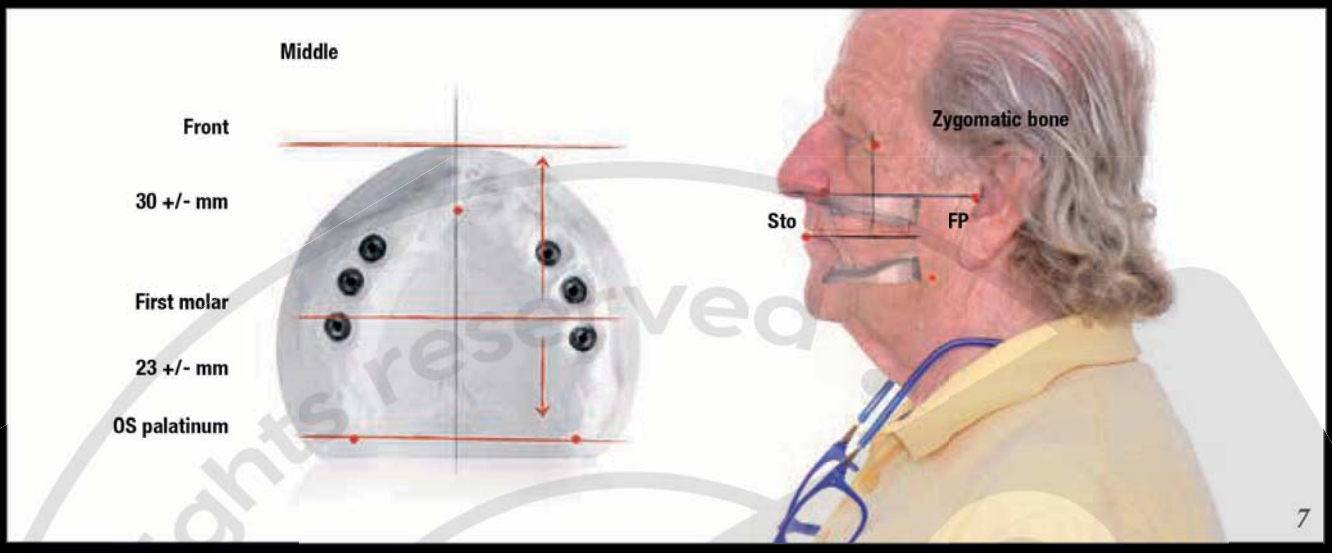

Fig. 7: Defining tooth spaces on the toothless upper jaw and transferal to the model

This information is transferred to the model taking as reference the midline as well as left and right Hamulus points (Fig. 7). Taking into consideration the data registered, it was possible to virtually position the anterior teeth and the molars in the correct places and have verifiable dimensions for the new dental prosthesis.

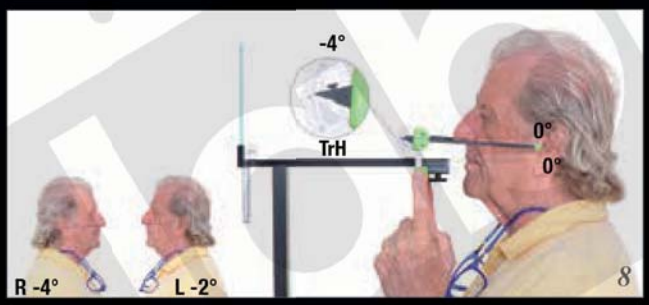

Fig. 8: The patient in his Natural Head Position with the PlaneFinder®. Based on the "0° line" and the previously defined ala-tragus line, it was then possible to define the patient's specific occlusal angle, which was measured as flat or even negative.

PLANESYSTEM® AND PLANEFINDER®: TRANSFERAL OF THE PATIENT ANALYSIS DATA INTO THE SOFTWARE

All analysis data were then imported into the software for the creation of the prototype and, subsequently, the final prosthesis according to Zirkonzahn's digital workflow. In order to transfer patient-specific information 1:1 into the Zirkonzahn.Scan software, the PlaneSystem® includes a specifically conceived tool, the PlaneFinder®. With the PlaneFinder® it is possible to fix the maxillary model in the articulator considering the centre, height and horizontal position previously acquired and according to the patient's occlusal plane. The PlaneFinder® has to be placed on a flat surface, since it utilises two zero lines as reference lines, called the True Vertical and the True Horizontal. The True Horizontal creates a reference line parallel to the floor, a so-called "0° line". The patient was asked to stand in front of the PlaneFinder®'s integrated mirror and look at himself: in this way, he positioned himself automatically according to his Natural Head Position (the natural position without exogenous influences where the patient is in equilibrium). Based on the "0° line" and the previously defined ala-tragus line, it was then possible to define the patient's specific occlusal angle, which was measured as flat or even negative (Fig. 8).

The PlaneFinder® allows the dental technician to register any occlusal asymmetries in the dental arch. In several studies (among which Xie et.al, 1993)[1] the ala-tragus line was proved to be the most parallel plane to the occlusion plane, in comparison with the Camper o Frankfurt planes generally used with dental arches. Using a tray, a template is fixed to the healing caps in the upper jaw to register and encrypt the maxillary arch: the upper jaw model could now be transferred to the articulator in the correct three-dimensional position.

Fig. 9: The patient with the Aqualizer in the mouth. The Aqualizer is used to neutralise and "reset" the occlusion between the upper and lower jaws, to find the correct lower jaw position. When the temporomandibular balance is restored, the patient's face appears more relaxed. With a jig, the patient-specific information is transferred to the physical articulator.

DEFINING THE MANDIBULAR ARCH ACCORDING TO THE MAXILLARY

To create a set-up for the mandible, the occlusal height was necessary. In order to define it, the jaw angle landmark as well as the molar positions were considered: indeed, if the angle opens towards the front like a fan, growth can be expected in this area. If the angle opens only slightly towards the front, the growth is more pronounced in the posterior area. Together with the occlusal height information, an Aqualizer was also used. The Aqualizer, composed of two cushions filled with liquid connected and linked with each other after interocclusal placement, is used to neutralise and "reset" the occlusion between the upper and lower jaws. Indeed, with this device muscles reposition themselves automatically in their natural functional position, highlighting any bite distortions. By using a jig, such values have been recorded and transferred into the PS1 articulator together with the models. Resetting such values is essential to make the diagnosis even safer: after virtual representation of the dimensions between upper and lower jaw, it was possible to determine with high accuracy the distance that had to be filled with the tooth restoration (Fig. 10).

Fig. 10: The display of the distance to be filled with the tooth restoration

[1] *Xie J, Zhao Y, Chao Y, Chao Y, Luo W. A cephalometric study on determining the orientation of occlusal plane. Hua Xi Yi Yi Ke Ke Da Xue Xue Xue Bao. 1993, 327(24): 422-5*

Figs. 11a, 11b: The patient with the old denture (left) and wearing the diagnostic set-up (right)

THE THERAPEUTIC PROTOTYPE

First of all, a diagnostic set-up was prepared for the try-in in the patient's mouth, placing the teeth conventionally (Figs. 11a, 11b). The patient tried the set-up to check function and aesthetics together with the dentist. After patient and dentist approval of function and aesthetics, the first prototype is scanned in the S600 ARTI scanner and matched with the patient's 3D facial scans captured at the beginning of the patient diagnostics. Through a special transfer tool (Transfer Fork), the maxillary model could then be transferred in the correct position into the facial scans, in a 1:1 ratio and with no loss of information. In the Zirkonzahn.Scan software the reference planes, such as the "0° line", were captured, in order to create the restoration as if working on the real patient. Indeed, the Zirkonzahn.Scan software in combination with the PlaneSystem® allows the dental team to work on the 3D virtual patient with many advantages. Thanks to the 3D virtual reproduction of the patient's face and reference information in a 1:1 ratio, the dental technician and the dentist can work on the patient as if he was in the lab, with no time or space limitations, whilst the patient can benefit from the reduction of chair-side appointments (Fig. 12).

Theoretically, the digital planning of implants would have been carried out at this point. However, since the maxillary was already provided with implants, the CBCT data together with the facial and model scans were imported into the Zirkonzahn.Implant-Planner software and matched for analysis purposes only (Fig. 13).

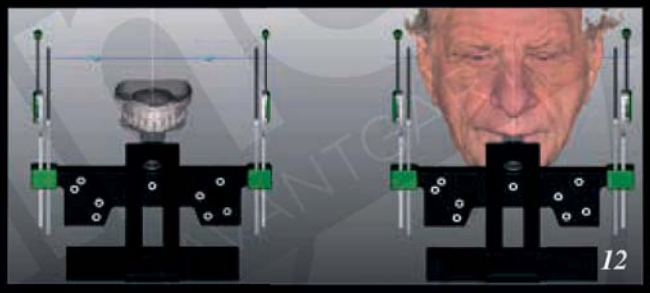

Fig. 12: In the Zirkonzahn.Scan software, all patient data captured with the PlaneFinder® can be transferred 1:1 into the virtual world with no loss of information, for a realistic preview of the final, custom-made restoration.

Fig. 13: The patient's CBCT and STL data matched with the 3D facial scans in the Zirkonzahn.Implant-Planner software. The therapeutic prototype was designed on the diagnostic set-up (white teeth).

Fig. 14: The maxillary therapeutic prototype corresponded to the registered, physiological occlusal plane, unlike the mandibular restoration, which was still reflecting the old, incorrect occlusal plane. In order to adjust the mandibular restoration to the new occlusion, table-tops were created and applied to the existing mandibular restoration.

Taking the old fixed mandibular restoration into account as well as the diagnostic set-up previously created, the new maxillary restoration was planned and milled in resin (polychromatic Multistratum® Flexible resin, with natural tooth shade gradient, veneered with composite on the gingival area only). The prototype was then occlusally screwed onto the six implants in the patient's mouth.

ADJUSTING THE MANDIBULAR RESTORATION TO THE OCCLUSAL PLANE

The maxillary therapeutic prototype corresponded to the registered, physiological occlusal plane, unlike the mandibular restoration, which was still reflecting the old, incorrect occlusal plane (Fig. 14). In order to adjust the mandibular restoration to the new occlusion, the restoration had to be increased in the molar area. For this purpose, table-tops were manufactured and glued onto the existing lower restoration. The patient wore the therapeutic prototype and the table-tops for about six months, checking comfort, hygiene, functionality, speech motor skills and aesthetics.

Fig. 15: The patient wearing the therapeutic prototype made with the Multistratum® Flexible resin in the maxillary arch and the table-tops in the mandibular existing restoration.


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THE FINAL RESTORATION

After the test phase, the therapeutic prototype turned out to be optimal under all aspects. All acquired data could then be reproduced in the final restoration design. The final restoration was milled in Prettau® zirconia. Before sintering, the structure was individually coloured with Colour Liquid Prettau® Aquarell and Intensive colours. After the sintering process, the prosthesis was veneered with ceramics in the vestibular sectors, leaving functional areas monolithic (Figs. 16–20).


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Figs. 16–20: The Prettau® zirconia restoration milled and cut-back reduced; coloured with Colour Liquid Prettau® Aquarell and Intensive colours; sintered and veneered with ceramics on non-functional, vestibular areas.

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At the patient's request, also the mandibular restoration was later renewed (Fig. 21). The existing titanium framework was newly veneered with composite in order to achieve the correct occlusal plane.

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