

Full-arch: Full rehabilitation of the upper jaw—Part 2



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The complete rehabilitation of a compromised residual dentition represents a major challenge in terms of implant treatment as well as function and aesthetics. In particular, there is great demand for fixed restorations that both achieve aesthetics and restore function. In addition, patients are increasingly interested in biocompatible restorations and surgical concepts that take biological criteria into account. Biological dentistry employing metal-free implants and zirconia dentures can meet this demand effectively. In the first part of this case report, we dealt with the diagnosis of the patient and the case's special features, the preparation of the patient for surgery and the surgical procedures of tooth extraction and immediate implant placement.¹ In this second part, the prosthetic restoration will be described.

From Part 1, recall that the 41-year-old patient wanted a biologically neutral and metal-free comprehensive rehabilitation of his compromised residual maxillary dentition and caries treatment of his mandibular teeth. In the maxilla, the patient retained tooth #17 and part of tooth #25, as well as the roots of teeth #13 and 15, and had a bridge replacing teeth #12 to 22. The remaining maxillary dentition had already undergone endodontic treatment and was not worth preserving. In the mandible, teeth #47, 45, 36 and 37 had carious lesions, and tooth #46 was devitalised and decayed and showed extensive apical whitening radiographically. The remaining mandibular teeth were vital. Moderate chronic periodontitis was diagnosed in both the maxilla and mandible.

Prosthetic restoration

The success of restoration is highly dependent on careful planning, requiring the exchange of information between the dentist, patient and dental technician. Planning revolves around the following questions: What are the patient's expectations? What is realistic and technically feasible? It is extremely important to involve the patient in the entire decision-making process; after all, it is the patient who will have to live with the finished work. Once all the important matters have been clarified, we first fabricate the planned prosthesis as a prototype (temporary restoration) and then have everything checked in the mouth.

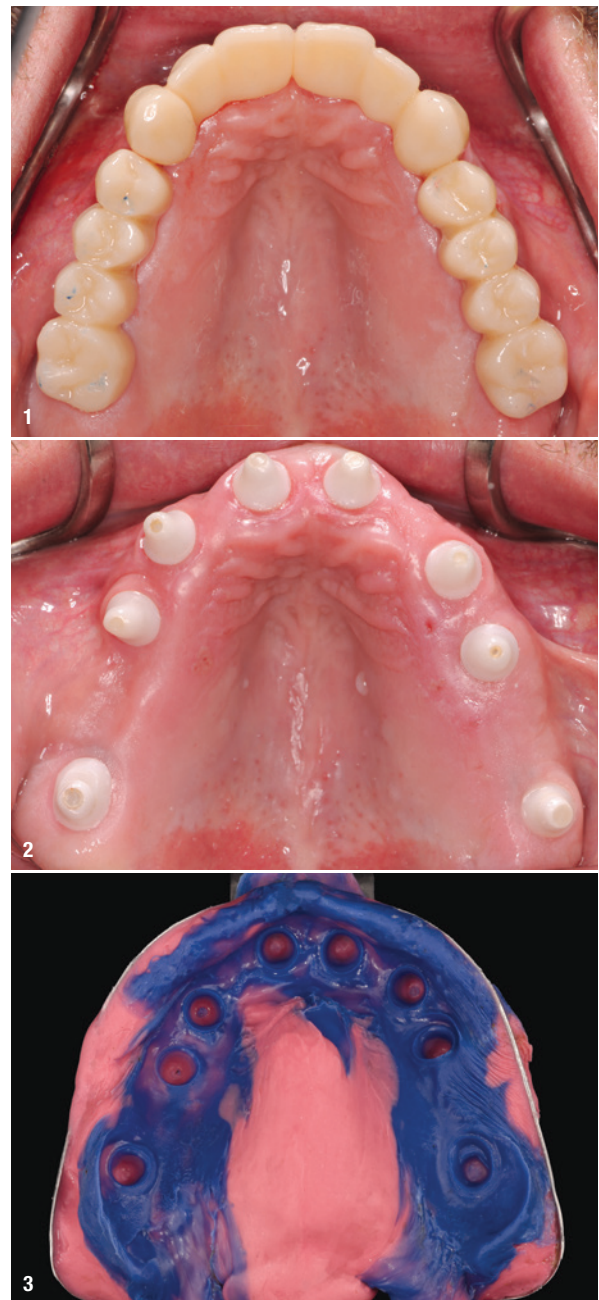


Fig. 1: Prototype *in situ* after about three months of healing. **Fig. 2:** Completely irritation-free gingiva with beautifully healed implants after about three months of healing. **Fig. 3:** Silicone impression of the situation with the temporary restoration removed.

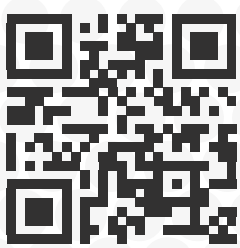
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Fig. 4: After replacement of the temporary restoration on the implants.

Our focus is always on the whole person. Therefore, the patient's posture and, most importantly, his or her comfortable occlusion are central role to our approach. Particularly with such a compromised residual maxillary dentition, it is important to consider that the patient may have adapted to an incorrect occlusion over the years. We therefore check posture to determine whether we need to intervene therapeutically in advance with the help of splint therapy. We then discuss the patient's wishes and select the desired tooth shape together.

Based on all this information, we create a prototype in our laboratory that corresponds to the final restoration in terms of shape and design. The prototype in this case was made of acrylic based on the intra-oral scan of the patient with and without his existing bridge and a conventional fully adjustable articulator. From this data, we first generated a virtual wax-up, from which we also prepared the various surgical aids—the surgical guide and various transparent verification templates—as shown in the first

part of this article. Practice has shown us time and again that, despite immense technical, instrumental and computer-assisted effort, there is always a discrepancy between the appliance and the biomechanical system of hard and soft tissue. The true measure is in the patient's mouth, not in the precise, mathematically calculated condylar paths and eccentric excursions of a virtual articulator.

An occlusal restoration is always a compromise. Occlusion is not something that can be measured. Occlusion is something individual. Even at the beginning of articulation research, dental technology greats such as Dr Alfred Gysi, Rudolph L. Hanau and Dr Rudolf Thielemann recognised that a biological system cannot be implemented on a mechanically and mathematically precise mastication simulator. Carl Hildebrand, the founder of VITA Zahnfabrik, said in the 1930s: "Occlusion cannot be understood from observation of the morphology of individual teeth but rather from the living structure (cybernetics) of the entire organism."² Following this guiding principle, we use our patient as the best articulator a dental technician could wish for. During the osseointegration of the implants, the prototype serves to record the eccentric movements manifesting in patient-specific wear facets, which we can then transfer directly to the final restoration. The dental practice scans the prototype *in situ* when the patient visits the practice for a check-up and follow-up care and sends the data obtained in this way to the laboratory for transfer of the wear facets directly to the final restoration.

Follow-up appointment in the practice

The patient came back to the practice after a healing period of around three months. After scanning the prototype,

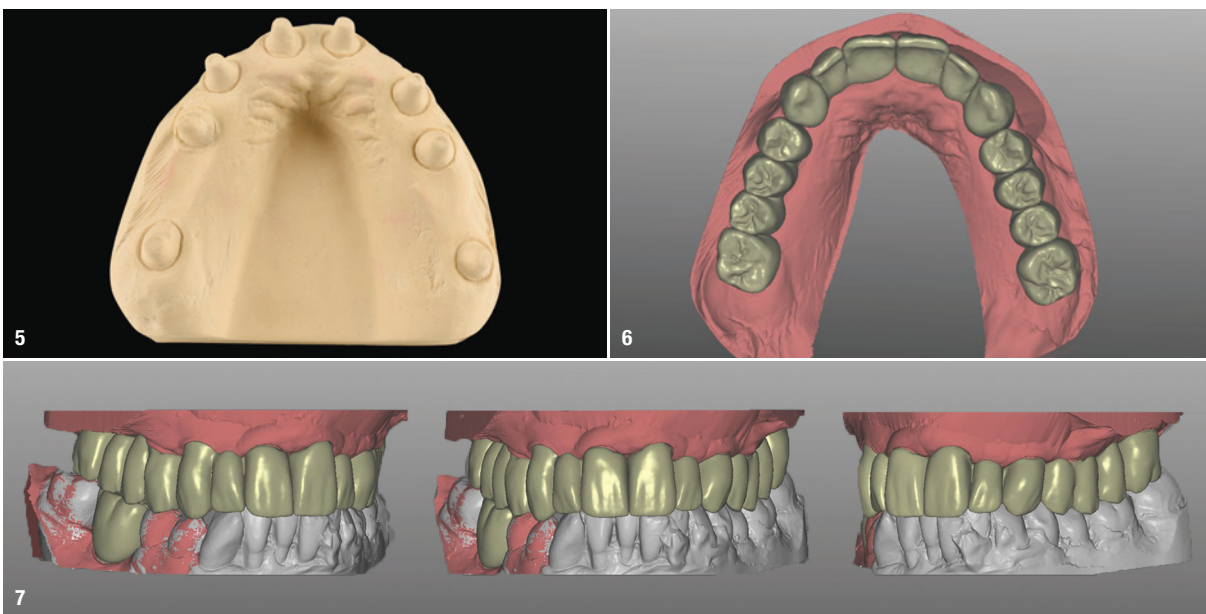


Fig. 5: Plaster model created based on the silicone impression. **Fig. 6:** Digitised model. **Fig. 7:** Design of the three bridges.

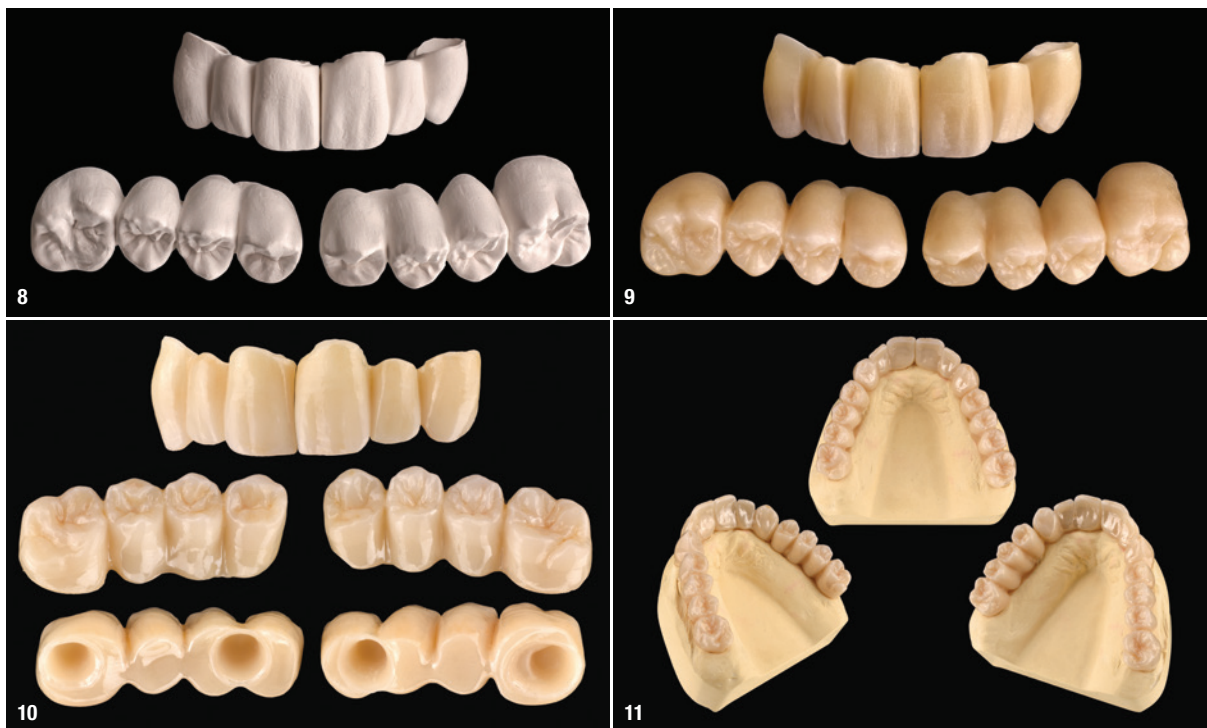


Fig. 8: Three milled bridges prior to processing. **Fig. 9:** Impressive aesthetics of the zirconia after the first firing. **Fig. 10:** Bridges after the final glaze firing and polishing. **Fig. 11:** Bridges on the model after the final glaze firing and polishing.

we removed it and found a completely irritation-free gingiva underneath with beautifully healed implants (Figs. 1 & 2). We then took an impression of this situation using silicone and then replaced the temporary restoration on the implants (Figs. 3 & 4). We thereafter submitted the scan and silicone impression to the laboratory for completion of the final restoration.

Principle of cranial respiration

It used to be assumed that the skull was a kind of bony steel helmet that only served to protect the underlying brain. Today, we know that the bony structures of the skull are a vibratory element within the organism. The skull is

made up of a very complex structure of cranial bones which form a 3D interlocking mechanism. Each cranial bone can move along all three planes, allowing movement in six directions (anterior to posterior, superior to inferior, medial to lateral). The cranial bones as a whole oscillate in a kind of breathing motion referred to as "cranial respiration". They move rhythmically, alternating between shortening, expanding, lengthening and narrowing over a period, without the volume of the skull changing quantitatively. Not only can this rhythm of movement be pathologically altered, that is, increased or decreased, but individual cranial bones can also become stuck or displaced in such a way that their mobility and thus that of the entire system is restricted.³



Figs. 12 & 13: Situation before placement of the final restorations.

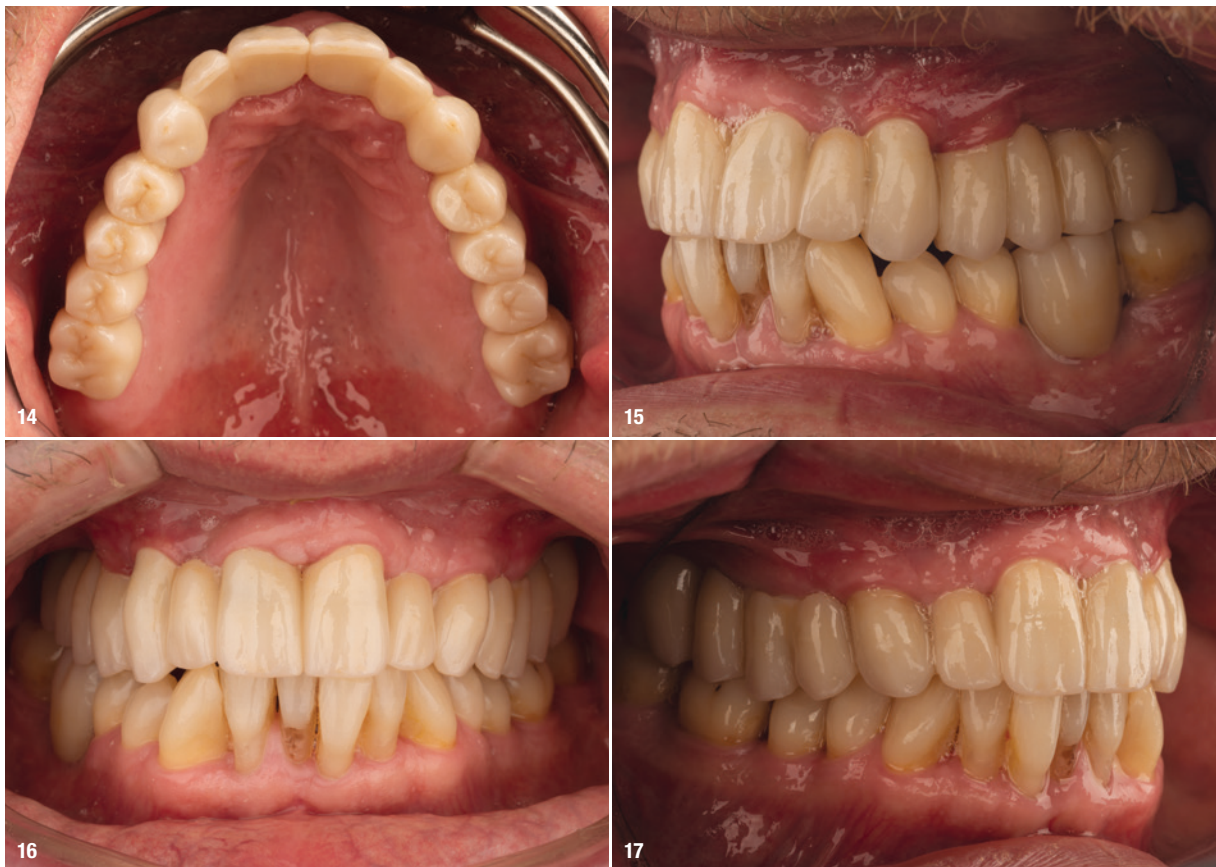
Fabrication of the final maxillary restoration

We regard zirconia as a material with the greatest possible benefit for the patient. Compared with conventional titanium implants, zirconia offers several advantages. One of the main advantages of implants made of zirconia is their excellent biocompatibility. Zirconia is considered hypoallergenic, making it an ideal choice for patients with metal sensitivity or allergies. Unlike titanium, zirconia does not trigger any adverse reactions in the body, ensuring a comfortable and stress-free dental implant experience. In addition, zirconia implants have remarkable resistance to corrosion and plaque build-up, reducing the risk of peri-implantitis. The non-porous surface of zirconia prevents the adhesion of bacteria, resulting in healthier gingivae and greater longevity of the implant.⁴ In order to avoid compromising the advantages of the zirconia implants placed, the dental team jointly decided on zirconia for the prosthetic restoration as well. Therefore, after receiving the data from the practice, we fabricated the final restorations in zirconia. Our laboratory has preferred monolithic restorations since 2005.

The restoration was constructed as three bridges. This approach takes into account cranial respiration, ensuring that no pressure is exerted on the delicate masticatory and cranial bone system. Based on the silicone impres-

sion, we produced a plaster model according to the usual procedure (Fig. 5). We scanned this and digitally designed the desired bridges (Figs. 6 & 7). In our approach, we always design all basal surfaces that rest on the gingiva to be fully sealed from the outset. We then sent the data collected in this way to our milling centre, which sent us the three unprocessed milled bridges (Fig. 8).

After the first firing, the advantages of the zirconia chosen (VITA YZ ST, VITA Zahnfabrik) were already evident from the impressive aesthetics (Fig. 9). The shade characterisation of the bridges was then carried out using the VITA AKZENT Plus stains. For even better aesthetics, additional individualisation was carried out with the VITA YZ EFFECT LIQUID infiltration shades. After the final glaze firing, we polished the aesthetically important areas and all the areas that would be in contact with the gingiva to a high gloss like we usually do (Figs. 10 & 11). In our opinion, this creates a restoration that is supportive of gingival health, having the advantage of what is described in bionics as the lotus effect, which refers to the low wettability of a surface, as can be observed on the lotus plant. Water gathers on the leaves in spherical droplets or slides off the leaves, taking all dirt particles on the surface with it.⁵ In principle, this surface not only improves aesthetics, but also reduces plaque adhesion to the restoration, promotes long-term stability and reduces abrasion on the



Figs. 14–17: Final restorations in place.



Figs. 18–21: Harmonious integration of the restorations into the oral and facial situation and pleasing aesthetics of the anterior teeth.

(natural) antagonist.⁶ Our procedure enables us to avoid any cleaning niches. We regard this as a significant advantage, as constant interdental cleaning often irritates the gingiva unnecessarily and poses a risk of recession. Finally, the restorations were disinfected and packaged according to the standard plasma cleaning protocol we follow (Highfield Clean Prosthetics)⁷ and handed over to the practice for the placement appointment.

Placement appointment

Once the final restorations have been received from the laboratory, the bridges were placed on the implants and

firmly cemented in, and the fit was visually checked (Figs. 12–17). It was gratifying to see how harmoniously the restorations integrated into the patient's mouth and face, and the optimised aesthetics of the anterior teeth were particularly notable (Figs. 18–23). Finally, the situation was checked radiographically (Fig. 24).

The patient had been delighted with the appearance of his temporary restoration. Because we had transferred his individual masticatory behaviour from the temporary restoration directly to the final zirconia restorations blended harmoniously into the overall oral structure and did not feel foreign to the patient.



Figs. 22a–c: Visual summary of the workflow from the implants (a) via the digital design (b) to the integrated restoration (c).



Fig. 23: Patient delighted with the natural-looking aesthetics of the final restoration.

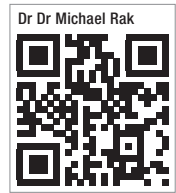
Conclusion

In our opinion, this case demonstrates the impressive results that are possible when the dentist, dental technician and patient work together and all the tools available to us are used at the appropriate time. We regard disinfection using plasma as essential, whether during implant placement or in the fabrication of restorations. The cleaner the materials used, the more healthy tissue is supported and the lower the risk of contamination of the materials jeopardising the longevity of the entire implant–restoration system.

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about the authors

Dr Michael Rak qualified as a dentist from Heidelberg University in 2008 and then went on to study human medicine at LMU Munich, both in Germany, and in 2014 gained his licence to practise medicine. While still studying human medicine, he completed his dentistry residency at Dr Georg Hägler's practice for oral and



Fig. 24: Final radiograph.

maxillofacial surgery and at Susanne Berthold's practice for holistic dentistry, both in Munich. Since 2014, he has continued his education and training in biological dentistry with Dr Karl Ulrich Volz at the SWISS BIOHEALTH CLINIC in Kreuzlingen in Switzerland. Between 2015 and 2019, he specialised in biological dentistry and ceramic implantology at the SWISS BIOHEALTH EDUCATION CENTER. Dr Rak has also studied environmental dentistry and dental hypnosis.

Norbert Wichnalek passed his journeyman's examination in 1987 and then his master's examination as a dental technician in Munich in Germany in 1993. One year later, he opened his own dental laboratory. From 1996 to 2014, Wichnalek taught specialist dental technology practice at Berufsschule 2 in Augsburg in Germany. He has been a pioneer and developer in the use of plasma technology in dental technology since 2013 and a speaker on environmental dental technology for the German society for environmental dentistry (Deutsche Gesellschaft für Umwelt-ZahnMedizin) since 2012. Wichnalek is the author of more than 100 specialist publications in Germany and abroad. His laboratory focus is on dental restorations in harmony with the human body, metal-free dental restorations and plasma technology.

Arbnor Saraci began training as a dental technician in 2014 after completing an internship at the Wichnalek dental laboratory in Augsburg in Germany and attending Zirkozahn's Military School beginners' training programme in Mühlen in Taufers in Italy. After passing his journeyman's examination in 2016, he attended Zirkozahn's advanced training programme. In 2017, he completed intensive training at the Novadent international training centre in Manila in the Philippines under Shoji Sasaki from the Osaka Ceramic Training Center in Japan. In 2018, he completed the curriculum of the German society for environmental dentistry (Deutsche Gesellschaft für Umwelt-ZahnMedizin) to become an environmental dental technician and then advanced training at the Novadent centre in Manila. Saraci continues to pursue his education at home and abroad on dental technology topics and dental photography. In 2018, he took joint first place with Lukas Wichnalek in Zirkozahn's 10 Years of Prettau Zirconia competition and published his first article. In addition, he serves on the editorial board of a journal for young dental technicians.

Lukas Wichnalek started his training as a dental technician in 2014 and attended Zirkozahn's Military School beginners' training programme in Mühlen in Taufers in Italy in 2015 and Zirkozahn's Ranger School in Bruneck in Italy one year later. This was followed in 2017 by intensive training at the Novadent international training centre in Manila in the Philippines under Shoji Sasaki from the Osaka Ceramic Training Center in Japan. He sat for his journeyman's examination in 2018, then completed the curriculum of the German society for environmental dentistry (Deutsche Gesellschaft für Umwelt-ZahnMedizin) to become an environmental dental technician and thereafter undertook further intensive training at the Novadent centre in Manila. Wichnalek regularly attends continuing education courses at home and abroad on dental technology topics and dental photography. In 2017, he won first place in the Kuraray Noritake Award's Level 2 CAD category, and in 2018, he took joint first place with Arbnor Saraci in Zirkozahn's 10 Years of Prettau Zirconia competition. He has been publishing articles in professional journals since 2018 and serves on the editorial board of a journal for young dental technicians.

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