Prosthetic management of implants in the aesthetic zone

A digital workflow for the provisional restoration

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Implant-supported restorations to replace a central incisor in the aesthetic zone is the supreme discipline within modern implant prosthetics. One question that arises is how a digital workflow can contribute to predictable results and, possibly, a simplified treatment protocol. The present article focuses on the provisional restoration, presenting a feasible method illustrated by a case presentation.

When an anterior tooth is to be replaced by an implant-supported restoration, various issues arise that are inseparably linked. For example, the planned surgical procedure should be precisely tailored to the prosthetic objective. The surgical approach, already difficult enough to define, will be additionally dominated by expectations regarding the prosthetic treatment success. One important prerequisite is for the dental technician to already support the early stages of the treatment by furnishing a high-quality provisional restoration – having it ready, if possible, already for the surgical session.

Classic treatment protocols call for different provisional restoration options, such as clasp-retained restorations, Valplast restorations or similar. Removable or retrievable restorations may be an economical alternative but usually do not ensure stable or predictable soft-tissue conditioning. The challenge lies in using the provisional implant-supported restoration to maintain the existing emergence profile, that is, the natural shape of the peri-implant tissue. The aim should be to start supporting the hard and soft tissues right from the beginning, providing optimum conditions for tissue maturation.

In principle, the success of an implant therapy correlates closely with the success of the provisional prosthetic solution. Integrating digital techniques at this stage may help simplify the requisite processes. Digital intraoral scanning following implant placement and

CAD/CAM fabrication of a custom implant abutment (the healing abutment) facilitate a sophisticated process chain. In the case presented here, a Maryland bridge made of monolithic zirconia was the high-quality provisional solution chosen. The bridge was fabricated in the laboratory based on data obtained intraoperatively using a contactless intraoral scanner, and inserted after connecting a custom healing abutment (Dedicam; Camlog, Wimsheim, Germany). (Note that the provisional restoration can - in theory - be fabricated before the implant surgery: based on three-dimensional CBCT data, the custom healing abutment can be designed in advance and ordered from the manufacturing service provider.)



1 and 2 | Baseline situation. Transverse fracture of the root of tooth 11, clinical and radiological view.

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	Dentist	Dental tech- nician	External	Process steps	Digital	Analogue
1	х			Baseline situation		Alginate impression
		х		Optical model scan	Laboratory scanner (3Shape)	
		х		Virtual design of Maryland bridge I/PMMA or zirconia Efficient production	Design software (3Shape) and CAM unit	Finishing/polishing
2	Х			Intraoperative scanning	Trios 3	
		х		Virtual model	Design software (3Shape)	
		х		3D-printed model	Formlabs	
		х		Designing the healing abut- ments	Implant Designer (3Shape)	
		х		Adapting the Maryland bridge design to the healing abutment.	Implant Designer (3Shape)	
			Central production	Fabrication in titanium	Camlog Dedicam	
		х		Fabricating the Maryland bridge II in multilayer zirconia	Design software (3Shape) and CAM unit	Finishing/staining/polishing
	×			Delivery		Delivering the custom healing abutment Cementing the Maryland bridge II
3		х		Virtual design of two-piece abutments	Implant Designer (3Shape)	
			Central production		Camlog Dedicam	
		х		Design and manufacture of the crowns on a two-piece abutment	Design software (3Shape) and CAM unit	
		х		Hybrid abutments		Adhesive connection in the dental lab
		Х		Finishing the crowns		Finishing/staining/glazing
	х			Delivery		Delivery of the hybrid abut- ments and ceramic crowns

Table 1 Overview of the digital and analogue steps of the implantological/prosthetic protocol presented.

The healing abutment with its provisional restoration are delivered directly on the day of implant placement.

Table 1 gives an overview of the digital and analogue steps of the implantological/prosthetic protocol presented.

Case report

The patient presented with a fractured root of the upper right central incisor (tooth 11). The tooth was endodontically pre-treated and had been restored using a post-and-core (Fig. 1). The radiograph showed a deep transverse fracture in the root area (Fig. 2). To achieve the best possible outcome, it was decided to proceed with timely implantological therapy with immediate placement and the option of immediate restoration.

In addition to clinical and radiological diagnostics, a detailed prosthetic analysis was performed at the time of treatment planning. The baseline situation turned out to be favourable. The bony socket and the buccal lamella at site 11 were well preserved. Regarding soft tissue, the baseline situation was considered ideal for an implant-supported restoration. The gingival phenotype was comparatively thick. The risk that the expected buccal recession after extraction would result in a visible implant shoulder or an adverse vestibular aspect ratio was small.

Fabricating the Maryland bridge

Based on radiographic measurements (OPG) and the initial model, a Maryland bridge with two wings to be cemented onto to the adjacent teeth was fabricated (Fig. 3). Provisional Maryland bridges for immediate restoration can be made of PMMA or zirconia. The basal aspect exactly mimicked the emergence profile of the original tooth 11 (as per the diagnostic model). The basal aspect was made of resin and placed approximately 2 mm submucosally, providing the intraoperative flexibility to reline or reduce the basal region as needed. The CAD-designed Maryland bridge was milled from a multicoloured secondgeneration zirconia material. A major advantage of the digital workflow is that a virtual tooth or framework shape, once designed, can be re-milled repeatedly and cheaply in different materials as needed during the prosthetic phase.

Surgical procedure

The existing crown was removed together with the post-and-core abutment (Fig. 4) and the residual root was gently and atraumatically extracted. The goal was to preserve the integrity of the vestibular bone lamella and the surrounding soft tissue (Fig. 5). To this end, a mechanical extruder was used. Its screw was inserted into the root segment and firmly anchored, and the root was carefully removed using a pulley-like contraption. The extraction was carried out by axial tensile force, avoiding expansion of the alveolar bone. The vestibular bone



3 I Maryland bridge milled from monolithic zirconia as immediate restoration. The initial provisional can also be efficiently milled from a suitable PMMA material.

wall was completely preserved. This procedure might seem somewhat timeconsuming at first. But the effort pays off further downstream as it helps preserve the bone and soft tissue.

In the interest of preserving the extraction socket, the authors prefer – wherever indicated – to place the implant immediately. The prerequisites for an immediate implantation include a thick gingival phenotype, an implant bed free of inflammation and an intact buccal bone lamella. Arguments in favour of immediate implant placement include instant aesthetic rehabilitation (patient comfort) and maximum preservation of existing structures (biological comfort).

After removal of the residual root, the implant bed was prepared with the appropriate instruments and the implant (Conelog \emptyset 3.8; Camlog) was inserted (Figs. 6 and 7). The orientation of the

implant followed the socket axis, and its position provided for a slight palatal offset. Buccal angulation may result in recession, potentially jeopardizing the aesthetic outcome.

The vestibular gap between the implant and the socket wall was augmented with a mixture of autologous bone and bone replacement material (Fig. 8). Provisionalization could now proceed promptly in the interest of maximum soft-tissue conditioning. All the requirements for immediate restoration (such as primary stability) described in the literature were met.

Digital workflow

The associated scanbody was placed on the inserted implant (Fig. 9). When selecting the corresponding scanbody, a precise match with the external service provider's CAD library is needed. Scanbodies are delivered sterile and are ready



4 I Residual root of tooth 11 following removal of the crown and the post-and-core.



5 I Careful extraction of the residual root with a mechanical extruder.



6 | Preparing the implant bed at site 11.



7 | Inserting the implant (Conelog, Camlog).



8 I Incisal view with filled vestibular gap between the implant and the socket walls. The root profile of the tooth is easily recognizable. This situation should now be preserved by the provisional restoration.



9 | Intraoperatively mounted scanbody for contactless intraoral scanning.

for immediate intraoral use. Moving towards reusable scanbodies would be a worthwhile goal.

The scanbody was used to facilitate three-dimensional intraoral optical scanning of the implant. The contactless "impression" maximally protects the newly inserted implant and the surrounding soft tissue (Figs. 10 and 11).

The intraoral scanner used was the Trios 3 (3Shape, Copenhagen, Denmark). In the authors' experience, this device currently offers the greatest available precision of intraoral data acquisition. At the same time, the close-to-nature shade visualization simplifies the task. This digital workflow made it possible to intraoperatively visualize the implant



10 I Inserting the immediate provisional for initial stabilization of the emergence profile.



11 | Control radiograph after the surgical session.



12 I Visual representation of the data obtained by contactless intraoperative scanning. The clinical design of the preliminary treatment plan is copied precisely and refined. The custom healing abutment is easy to recognize and forms the connection to the implant.



13 I The two-part provisional restoration. Shortly after implant placement, the provisional restoration (Maryland bridge made of zirconia) was delivered.



14 I Creating an ideal residual roughness in the basal area using a special rotating tool.

position on a virtual model without the need for a conventional impression of the implant (Fig. 12). The data were transferred to a manufacturing service provider (Dedicam; Camlog) commissioned to produce the healing abutment.

Provisionalization

Within two days, the CAD/CAM-milled titanium healing abutment was delivered (Fig. 13). Note that even with central production, the submucosal or basal area of a healing abutment requires some finishing of the surface topography. Care should be taken to maintain a certain degree of residual roughness, as the objective goal is optimal tissue apposition. The desired residual roughness of 0.32 µm was achieved with special rotating tools (Panther smooth; Sirius Ceramics, Frankfurt, Germany) (Fig. 14). For maximum infection control, a three-stage cleaning procedure followed a washing protocol in antibacterial cleaning fluid (Finevo; Sirius Ceramics) (Fig. 15). This procedure is an integral part of the authors' procedures in implant prosthodontics. CAD/ CAM components have been shown to contain surface contaminants that could pose risks to tissue integration. The healing abutment was delivered to the practice in sealed packaging and intraorally connected to the implant (Figs. 16 and 17). The Maryland bridge of monolithic zirconia was adhesively cemented and the patient was released with an aesthetic provisional restoration (Figs. 18 to 20). The soft tissue can be conditioned over the subsequent course of therapy by relining with resin in the basal area of the bridge.



15 | All CAD/CAM components for implant prosthodontics including CAD/CAM abutments are cleaned in a three-stage ultrasonic protocol (Finevo cleaning protocol).



16 | Inserting the Camlog Dedicam custom healing abutment.



17 I Sealing the screw access channel with PTFE tape.



18 | The course of the emergence profile is exactly recorded and supported.



19 I The Maryland bridge is cemented with a drop of Panavia V5 (Kuraray Europe, Hattersheim, Germany).



20 I View of the high-quality provisional restoration three days postoperatively.

Case summary

Shortly after the implant insertion, the patient received a Maryland bridge made of monolithic zirconia as an aesthetically pleasing provisional restoration. The bridge was fabricated in the laboratory based on intraoperative data and inserted via a custom healing abutment. Over the coming months, the implant will heal and the hard and soft tissue will consolidate.

Conclusion

The treatment goal in implant therapy is to provide the patient with a high-quality

restoration, right from day one. Based on optimal bony support, the emergence profile is shaped to provide permanent stabilization of the peri-implant structures and a natural transmucosal profile for the implant. This also preserves and stabilizes the interdental papillae. Digital technology opens up new paths for this. Contactless intraoperative optical impressions and the early integration of the dental technician into the treatment procedure are initial factors for predictably good surgical outcomes and highquality immediate restorations.

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