The Digital One-Abutment/One-Time Concept. A Clinical Report

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Abstract

The digital fabrication of dental restorations on implants has become a standard procedure during the last decade. Avoiding changing abutments during prosthetic treatment has been shown to be superior to the traditional protocol. The presented concept for implant-supported single crowns describes a digital approach without a physical model from implant placement to final delivery in two appointments. A 54-year-old man was provided with a single-tooth implant on his left mandibular first molar. Before wound closure, the implant position was captured digitally with an intraoral scanning device. After bone healing at the time of second-stage surgery the final screw-retained crown fabricated without a physical model was inserted. Soft tissue healing took place at the definitive restoration, avoiding abutment changes or changes of the healing cap. These led to stable soft tissues with a minimum of surgery. The benefits of digital fabrication and the unique way to scan the implant right after placement give an additional value that would not be achieved by analog techniques. In addition to financial benefits it represents a biologically advantageous, one-abutment/one-time approach with customized screw-retained, full-contour crowns or cemented crowns on custom abutments.

Over the last several decades, implant-supported restorations have significantly changed prosthetic treatment concepts and proven their clinical reliability.¹⁻⁴ In particular, single implants help avoid sacrificing natural tooth structure when fixed dental prostheses (FDPs) supported from adjacent teeth can be avoided; however, to achieve clinical long-term success, several clinical considerations have to be taken into account, of which the soft tissue conditions around the implant can be considered one of the most important.⁵

The established interface during soft tissue healing between the peri-implant mucosa and the implant/abutment consists of an epithelium and a connective tissue component.⁶ Berglundh et al reported a length of approximately 2 mm for the junctional epithelium and a height of 1 to 2 mm for the connective tissue zone, resulting in a total transmucosal attachment of 3 to 4 mm.⁷ Several technical factors might possibly influence the condition of this critical peri-implant mucosa. These factors include the material of the abutment, the veneering material, the fit of the abutment, or a platform switch.⁸⁻¹⁰

In contrast, some clinical procedures are known to influence the soft tissue around dental implants. Frequent probing at dental implants during the soft-tissue healing period has been shown to increase the pocket probing depths and markedly disrupt the epithelial and connective tissue attachment.¹¹ Additionally, an elevation of a full flap (periosteum) leads to a substantial loss of hard tissues and, therefore, influences the soft tissue behavior.¹²⁻¹⁴ Furthermore, the prosthetic treatment concept was reported to influence the stability of the soft tissues. Repeated abutment change was associated with a disruption of the mucosal seal and an increase of the dimension of the transmucosal barrier and an increase of bone remodeling in an animal study.¹⁵ As such, from a histological point of view, abutments should not be changed once they have been placed.¹⁶ In this context, interesting concepts (e.g., the “one-abutment/one-time concept”) have already been described. Against a control group using provisional abutments, the “one-abutment/one-time” group showed significantly less bone loss at the 18-month and 3-year recalls after implant placement.¹⁷

Today, the computer-aided design (CAD)/computer aided manufacturing (CAM) of implant abutments has become a new standard for customized abutments.¹⁺⁻³⁰ However, using digital technology for fabrication of dental restorations requires the digitalization of the oral situation. This can be done either by direct digitalization, using an intraoral scanning device,
or by indirect digitalization of a plaster model in the dental laboratory. Because of the multiple potential sources of error during the conventional way, including conventional impression, plaster model, and indirect digitalization, the direct digitalization using an intraoral scanner seems to be the most logical way to access the digital workflow and CAD/CAM. As a whole, the digital workflow offers the possibility to facilitate the daily procedures and offers new, innovative treatment strategies that provide advantages for dentists, dental technicians, and patients.

Against this background, this report introduces the Munich Implant Concept (MIC), describing the treatment of a patient with an implant-supported, full-contour crown within two appointments without any physical model, using intraoral scanning and CAD/CAM technology.

**Clinical report**

**Anamnesis and preoperative procedure**

A generally healthy 54-year-old male patient was referred to the Department of Prosthodontics at Munich Dental School with a missing mandibular left first molar (FDI position 36, Fig 1). After discussion of the alternative treatments, the patient decided to have a single-tooth implant and gave his informed consent. As he lived 2000 km from the clinic, the number of appointments necessary until delivery needed to be limited to a minimum. A cone-beam computed tomography (CBCT) of the site was made to receive 3D information about the soft and hard tissues (CS 9300; Carestream Dental, Rochester, NY) at the desired implant position.
Appointment 1: implant surgery and scanning
The intraoral situation was digitized using an intraoral scanning device (Intrascan; Zfx, Dachau, Germany) to receive a dataset of the clinical situation. This scan involved the mandible (gap and adjacent teeth), the maxilla, and a vestibular scan for bite registration.

The patient was instructed to take antibiotics (Amoxicillin, 1.000 mg t.i.d.) and 400 mg of Ibuprofen 1 hour before surgery to prevent inflammation and swelling. Ibuprofen was continued for 2 days. Immediately before surgery, the patient rinsed his mouth with a 0.2% chlorhexidine solution for 3 minutes.29 A crestal incision in region 36 was followed by sulcular incisions at both neighboring teeth without relieving incisions. A full-thickness flap was elevated, and all inflammatory and granulation tissue was debrided with a curette. For a tension-free wound closure, the periosteum was slit at the basal of the flap, right at beginning of the surgery. An implant (length 11 mm, diameter 4.3 mm, Camlog Screwline; Camlog Biotechnologies, Basel, Switzerland) was placed at the planned position according to the manufacturer’s protocol (Fig 2).

After placement, a scan body (3shape, Copenhagen, Denmark) was screwed to the primary stable implant to enable the direct digitalization of the implant position (Fig 3). The precise fit of the scan body could be controlled easily, and the scan was conducted within the “gingiva-extra” scan mode. During scanning, it was of paramount importance to also scan the adjacent teeth to enable a superimposition of the scan body dataset with the situation scan, which was conducted before surgery.

After scanning, the scan body was removed, a covering screw was placed, and the wound was closed with a deep horizontal mattress (Prolene 5.0; Ethicon, Johnson & Johnson Medical, Norderstedt, Germany) and interrupted sutures (Prolene 6.0; Ethicon). A control X-ray was made for forensic reasons, and the patient was instructed on adequate care for the next several days. Wound healing was uneventful. The sutures were removed 8 days after implant placement. Subsequently, the scan data was exported in standard tessellation language (STL) format and transferred to the dental laboratory of the Department of Prosthodontics of Martin Luther University, Halle, Germany, where the crown was manufactured during the healing period.

Laboratory
The scan data were imported into a CAD-Software (Dental Designer; 3shape) to design the final restoration (Fig 4). The bottom line of the presented concept is to prevent changes of abutments or healing caps. Therefore, two restoration options are possible: (1) a final screw-retained crown; (2) a final custom abutment made from zirconia or titanium with a provisional crown. In this case, the restorative team decided to deliver a screw-retained full-contour crown made from lithium disilicate (IPS e.max CAD; Ivoclar Vivadent, Schaan, Liechtenstein), which was stained and glazed.30 The finalized crown was adhesively bonded (Multilink Implant; Ivoclar Vivadent) to a Ti insert (Fig 5) in accordance with the manufacturer’s recommendations.31,32

Appointment 2: re-entry and delivery
After 12 weeks of healing, second-stage surgery was performed, and the final crown was inserted. Therefore, only a mucosal flap was necessary, and the periosteum remained on the bone (Fig 6). The covering screw was removed. The implant was rinsed with isotonic sodium chloride solution and dried. The screw-retained crown was tried in, and occlusal and proximal contacts were checked and adapted. The crown was polished in the dental laboratory according to the manufacturer’s recommendations and was cleaned in an ultrasonic bath. Before placing, the restoration was disinfected in 0.2% chlorhexidine solution. The crown was placed, and the screw was fixed with a torque moment of 20 Ncm (Fig 7). The soft tissue was adapted to the crown with two papilla sutures (Prolene 6.0). Sutures were removed after uneventful healing after 6 days.

Discussion
Today, the CAD/CAM-supported fabrication of abutments and implant-supported restorations can be considered as the new standard.33,34 In consideration of the industrial quality of the applied materials and the almost unlimited design opportunities regarding the emergence profile, the dimensions and angulation of the restorations have to be considered as the major advantage of this digital procedure. In addition to the higher mechanical stability that can be achieved by CAD/CAM-fabricated restorations,30 concepts that offer additional value to patients and practitioners mean further advantages of digital implant-supported prosthodontics.

Regarding the MIC, the fabrication of the restoration during the (closed) healing-phase of the implant rationalizes the treatment procedure. The accuracy of the transfer of the implant position by an intraoral scan seems to be sufficient for single-tooth implants.35 Also, the adjacent teeth and antagonists are directly digitized, which facilitates the transfer of the situation to the dental laboratory. The scanning device allows the export
of STL data, which allows importing the data in all major CAD programs. Based on the authors’ experience, physical models are not necessary for that kind of single-tooth restoration.

The question of screw retention or cementation is controversial; however, the presented concept allows both protocols. The primary objective of omitting detaching of the epithelium from the abutment or healing cap can easily be followed when a screw-retained restoration is placed. The gingival line represents no esthetic limitation, as abutment and crown are one part, made from a tooth-colored material (e.g., lithium disilicate). If a cemented approach is used, the part in direct contact with the soft tissue must be final. Abutments fabricated from zirconia or titanium are treatment options of choice. If a cemented restoration is used, the gingiva line becomes more important, as visible Ti, in particular, might be an esthetic drawback. Therefore, provisional crowns are cemented on the final abutments at the time of re-entry. After soft tissue consolidation, the preparation margin of the abutment can be adjusted without removing the abutment in the patient’s mouth. An additional (conventional or digital) impression is made for the fabrication of the final crown.

After placement of the restoration at the time of uncovering the implant, the healing of the soft tissue takes place at the definitive restoration instead of at a healing abutment. Consequently, the emergence profile heals immediately toward an optimal shape. In contrast, standard healing abutments exhibit a round profile, which means that the cross section of the emergence profile has to be modified from round-shaped toward root-shaped before placement of the definitive restoration. This is achieved by repeated change of interim prostheses or continuously individualized healing abutments to apply gentle pressure on the emergence profile. However, too much high pressure might cause a change of the mucosa that can lead to a loss of attached gingiva and recessions.

Additionally, the immediate placement of the definitive restoration enables the formation of a long junctional epithelium between the restoration and soft tissues that should not be separated again. This sealing between the oral environment and the alveolar bone is an important factor for the long-term success of implant-supported restorations. In consideration of these findings, less peri-implant inflammation can be expected when the junctional epithelium is not detached and injured; however, this has to be proven in animal experiments and clinical studies.

Observed from the economic standpoint, the concept offers clear advantages for dentists and patients. On one hand, the concept saves treatment time, yet the healing period does not have to be abbreviated. On the other hand, the MIC concept offers saving potential regarding additional implant parts, as there is no need for transfer posts and healing abutments.

A screw-retained full contour crown from lithium disilicate on a Ti insert seems to be the best restorative approach for the presented concept based on today’s knowledge. Even in cases where the soft-tissue level might heal more apically from the planned level, there will be no esthetic or functional disadvantages due to the continuous color and form of the restoration.
Conclusion
The Munich Implant Concept offers economical and biological advantages for practitioners and patients, and the ongoing integration of the digital workflow offers the potential for further enhancements and simplifications.

References