Impression and registration for full-arch implant dentures

Prof. Gregor-Georg Zafiropoulos, Germany

Usually, a full denture is delivered following tooth extraction or implant insertion of a fully edentulous arch. A denture is usually used until the final restoration is performed. A well-designed full denture should fulfill the following criteria:

1) correct vertical height and maxilla-mandibular relationship;
2) accurate occlusion;
3) appropriate choice of teeth with regard to shape, length, width and position;
4) adequate lip support; and
5) proper function and aesthetics to meet the patient’s expectations. The final restoration should fulfill or surpass these requirements. Obtaining a correct impression and accurately evaluating the interocclusal relationship (e.g., interocclusal distance, occlusal recording and determination of the exact position of the placed implants) are often challenging and time-consuming tasks.

The aim of the current report is to present an impression and registration technique that allows the transfer of the interocclusal relationship, occlusal recording and esthetics that were initially applied to produce a full denture as a template for the reconstruction of the full-arch implant.

Materials and Methods

Following multiple extraction of a non-salvageable rest dentition and the placement of six dental implants in positions #4, #5, #6, #11, #12, #13, a full denture was fabricated. After the extraction sites had healed and denture sores were eliminated, the function and esthetics of the denture was optimized. If necessary, amalgamations, shape and color of the denture teeth and the shape of the denture base were corrected (Fig. 1a).

The resulting denture was used by the patient until the final restoration was delivered. For the final restoration of the maxilla, an implant-retained denture with telescopic crowns as attachments was planned. After the implant was uncovered, the denture was modified to allow sufficient space for the healing abutments. A duplicate of the denture (DentDu) was made out of clear resin (Paladur, Wieland, Germany, Fig. 1b). A trial of the DentDu was performed and minor occlusal discrepancies were corrected (Fig. 1c). Bite records were taken in centric occlusion with modeling resin (pattern resin®, GC, USA; Fig. 1c), using the casts of the original denture. Afterwards, the DentDu was placed in an articulator and a controlling of the occlusion was made (Fig. 2a) with the bite records. A pickup transfer system consisting of a titanium impression post and a plastic impression sleeve was employed (Dentegris, Germany, Fig. 2b, DentDu). The DentDu was carefully modified by creating internal clearance in the area of the implants so that it could be applied as an individualized custom tray. This permitted it to be fully seated when the impression posts were in place. Impressions were generated by a polyether material (Impregum, 5M ESPE, USA). During this process, the DentDu was kept in centric occlusion using the bite records (Fig. 3a).

The titanium impression posts were connected with the implant analogues and with the plastic impression sleeves (Dentegris), which were embedded in the impression material (Fig. 3b). A master cast was then fabricate and articulated with the help of the bite records (Fig. 3c, Figs. 4a & 4b).

The customizable abutments (Dentegris) were to be fabricated using a silicon key fabricated from a matrix of G-silicone (Zetalabor, Zhermann, SpA, Radia Polesine, Italy, Fig. 5). The dentist and the dental technician relied on two alternatives for customized abutments selection:

1) UCLA customizable abutments (UCLA, Dentegris) for casting with a gold alloy (for example, Portadur P4, Au 99.9 per cent, Wieland, Germany, Fig. 6a) or 2) platinum-iridium customizable abutments (PTIR, Dentegris) for casting with a chromium cobalt (CrCo) alloy (for example, Ainkali, Anka Guss, Germany, Fig. 6b).

After casting, the customized implant abutments were ground, polished and served as the basis for the fabrication of electroformed pure-gold copings with a thickness of 0.25 mm (AGC Galvanopall, Au > 99.9 per cent, Wieland, Fig. 7a). The framework was then constructed via CAD/CAM. To ensure proper functioning of the framework, a plastic mock-up and a temporary fixed denture (TFD) were milled (ZENO-PMMA, Wieland). The customized implant abutments, the electroformed copings, the mock-up and the TFD were delivered by the dental laboratory for the next clinical session.
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The abutments were transferred, positioned onto the implants and torqued to 55 Nm using a resin periodontal key, plasters and were applied as abutments. In these cases, the immediate full denture can be applied as a cover denture. From this cover denture, a denture could be fabricated and further used as described above (Figs. 13a–c). Porcelain is a possible material for the fabrication of fixed-denture frameworks. If the angulation of the implants does not allow for taking impressions in the above-described way and an open-tray impression is preferable, fernestrations can be fabricated into the DentDu (Fig. 14).

Discussion

The reconstruction of the fully edentulous arch with implant-retained dentures necessitates thorough planning and a precise and passive fit of the superstructure. A previous study demonstrated that a passive fit between the implant superstructure and the underlying abutments is essential for the long-term success of the implant prosthesis.5 To achieve a passive fit, an accurate positioning of the implant replicas in the master cast must be assured. The impression technique and the splitting of the impression copings are factors which may contribute to errors in the final positioning of the implant analogs, thus leading to inaccuracies in the fit of the final superstructure.6,7 Furthermore, the angulation or proximity of the implants may inhibit proper seating of the impression copings and/or cap, which may also have a detrimental effect on the registration of the implant position.8

The precise recording of the masticatory, e.g. interocclusal, relationship is a prerequisite for achieving proper occlusion and a successful treatment outcome.9,10 The initially delivered denture allowed for the correction of the interocclusal relationship, tooth shape and color and angulations during the entire healing period. In this way, the patient was able to acclimatize to the functional and esthetic properties of the denture. In the method described in this report, an accurate impression and recording of the full denture was achieved by using a duplicate as a custom tray for the impression. Therefore, it was not necessary to record the implant superstructure and the underlying abutment. A previous study stated that the introduction of the UCLA abutment served as primary template for the fabrication of the occlusal splint.11 Accurate impressions can be achieved in cases where a removable implant-supported denture has to be fabricated using a self-curing composite material.12 In cases such as this, it is advisable to fabricate two DentDus. The impression can be taken by the first DentDu; the second DentDu is used for the remaining steps. Customized abutments are applied instead of a bar. Galvano-forming and electroforming process yielded a precisely-fitted secondary coping for the implant abutment with a gap of only 12 to 50 µm. The gold electroformed coping saves space and is made of high-quality material.14 Using gold copings for the impression allows for the exact transfer of the form, angulations and position of the inserted customized implant abutments.

With the help of the milled mock-up, the future fit of the CAD/CAM fabricated framework can be evaluated and necessary changes in the shape of the restoration and occlusion can be made. Making these changes on the mock-up was easier and less time consuming than making them on the metal framework itself, and it was then possible to transfer them directly to the final framework. Furthermore, the mock-up almost “simplified” the electroformed gold copings during the impression, allowing for the exact transfer of the abutment angulations while facilitating the full-arch restoration process. In addition, this technique resulted in a reduction of the required chair time.

Disadvantages of this technique include the need for a highly qualified technical lab and higher technical costs relative to those associated with prefabricated titan implant abutments.

To date, this method has not been applied in conjunction with immediate implant loading. However, dentists and patients have come to expect this level of rehabilitative accuracy, precision, long-term success and aesthetics.

Editorial note: A complete list of references is available from the publisher.