Impression and registration for full-arch implant dentures

Prof. Gregor-Georg Zafiropoulos

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 reconstitution of the final 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, adjustments, 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, Heraeus, 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. 1d), using the casts of the original denture. Afterwards, the DentDu was placed in an articulator and a controlling of the occlusion was made (Fig. 1a) with the bite records. A pickup transfer system consisting of a titanium impression post and a plastic impression sleeve was employed (Dentegris, Germany, Fig. 2a). 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, 3M ESPE, USA). During this process, the DentDu was kept in centric occlusion using the bite records (Fig. 1a).

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. 1b). A master cast was then fabricated and articulated with the help of the bite records (Fig. 1c, Figs. 2a & 2b).

The customizable abutments (Dentegris) were then fabricated to fabricate the implant abutments. Paralleling, angulation, position and shape of the implant abutments were determined using a silicon key fabricated from a matrix of EAST-cast (Zetalabor, Zhermack, Spa, Radia Polesine, Italy, Fig. 2). 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, an 89.50 per cent, Wieland, Germany, Fig. 4a) or
2) platinum-iridium customizable abutments (PTIR, Dentegris) for casting with a chromium cobalt (CrCo) alloy (for example, Ankatail, Anka Guss, Germany, Fig. 4b).

After casting, the customized implant abutments were grinded, polished and served as the basis for the fabrication of electroformed pure-gold copings with a thickness of 0.25 mm (AGC Galvanoquik, Au > 99.9 per cent, Wieland, Fig. 5a). 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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Fig. 1a: Trial of the DentDu in the articulator. — Fig. 1b: Pick-up impression system on the left. Titanium impression post (placed on the implants). — On the right: plastic impression sleeve (will be left in the impression). — Fig. 1c: Taking the impression with the DentDu. The bite records were used to determine the exact position of the implants in the master cast. — Fig. 2a: Placement of the cast onto the articulator using the bite registrations. — Fig. 2b: The master cast is placed into the articulator. — Fig. 2c: The customized implant abutments are fabricated using a matrix of EAST-cast (Zetalabor, Zhermack, Spa, Radia Polesine, Italy, Fig. 2). The dentist and the dental technician relied on two alternatives for customized abutments selection:

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The abutments were transferred, positioned on the implants and torqued to 55 Nm using a resin periodontal key, glazed and used as abutments. In these cases, the customized abutments remained in function in order to avoid any possible inaccuracies. The electroformed copings were placed on the implant abutments (Fig. 7a). The mock-up was placed over the electroformed copings and the occlusion was checked with the site records (Figs. 7a & b). A final impression was made using a polyether impression material (Impregum, 5M ESPE) taken with electroformed copings. The mock-up was further set up and used for the fabrication of a new (final) master cast. After the impression was taken, the TFD was fixed on the implant abutments using temporary cement (TempBond, Kerr, Orange, CA). It was then left in place until the delivery of the final restoration (Fig. 8a).

The new master cast was articulated with the help of the gold copings and the mock-up. The metal framework was milled (here: Titanium Zenotec Ti, Wieland, Fig. 9a). The veneering of the superstructure was made using a light-cured indirect ceramic polymer (CeramOne, Shofu, USA, Figs. 9a–d). The electroformed gold copings were fixed in the metal framework using a self-curing composite cement (AGC Cem, Wieland, Fig. 10).

The above-described procedures can be also performed in cases in which a fixed denture was planned for the rehabilitations of the full arch (Figs. 11a & b, Figs. 12c–e) and in cases where part of the natural dentition is preserved and can be applied as abutments. In these cases, the immediate full denture can be fixed as a cover denture. From this cover denture, a dentulous could be fabricated and further used as described above (Figs. 11a–e).

Porcelain is a possible material for the veneerings of the 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, frameworks can be fabricated into the DentuFl (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.10 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 implant 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.11,12 Furthermore, the angulation or proximity of the implants may inhibit proper seating of the impression copings and/or caps, which may also have a detrimental effect on the registration of the implant positions.13

The precise recording of the interocclusal relationship, e.g. interocclusal, relationship is a prerequisite for achieving proper occlusion and a successful treatment outcome.13,14 The initially delivered denture allowed for the correction of the interocclusal relationship, tooth shape and color and any variations during the entire healing period. In this way, the patient was able to acclimatize to the functional and esthetic characteristics 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 expose the patient to any risk involved in surgery. The immediate full denture was usually needed for recording the interocclusal relationship, e.g. was-up, etc., at the time of the fabrication of the final restoration.

If an open-tray impression is preferred, only minor changes to the procedure are necessary. This method is based on a previously published method.15 In cases such as this, it is advisable to fabricate two DentusFls. The impression can be taken by the first DentuFl; the second DentuFl is used for the remaining steps. Customized abutments are applied instead of a bar. Galvalume copings allow a precise transfer coping, and secondary superstructures as well as different technologies are employed for the transfer of the implant positions and for the construction of the superstructure.

Customized implant abutments allow for better angulation and shape, and improved occlusal force transmission from the crown to the implant and the bone, and also for facilitating the fabrication of an esthetically pleasing implant-supported dentures. Ways in which abutment design contributes to improved esthetics include changes in the location of the crown and changes in the dimension and/or form of the restorative platform.

With the help of the milling 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 positions. The vertical height and interocclusal relationship were recorded. The delivery of a milled temporary restoration permitted a slow and non-progressive loading of the implants, which then leads to bone remodeling.16 Abutments were left in place after mounting. Combined with the fabrication of a new cast, this further decreased the risk of inaccuracies during the transfer process.

Conclusion

The method described here can be used for full-arch restorations with both fixed and removable implant supported dentures. Accurate impressions can be accomplished and occlusion, vertical dimensions, as well as implant positions can be transferred while facilitating the full-arch restoration process. In addition, this technique resulted in a reduction of the required chair time.

Disadvantages of this technique lie in the fact that the quality of laboratory technician’s work meets higher demands than usual, and that the clinician also needs to acquire some additional skills. Further disadvantages of this method include the need for a highly qualified technical lab and higher technical costs relative to those associated with prefabricated titanium 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.18

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

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Figs. 9a–d: Final telescopic crown retained implant denture, palatal (a), anterior teeth (b), right side (c), left side (d). A case of fixed implant retained denture for the maxilla full arch rehabilitation: trial of the mock-up (a) and the milled temporary fixed denture placed on the abutments (b).– Figs. 11a & b: A case of fixed implant retained denture for the maxilla full arch rehabilitation, right side (a) and left side (b).– Figs. 12c–e: A case of implant supported dentures. The mock-up almost “splinted” the galvano-forming process and electroforming process yielding a precisely-fitted second copings for the implant abutments 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.

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