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Predicting the Final Result in Implant-Supported Fixed Restorations for Completely Edentulous Patients

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ABSTRACT

Predicting the final result is a very important factor in implant restorations. When a fixed implant-supported restoration is planned for the restoration of completely edentulous patients, it is important to recognize the esthetic performance of the prosthesis in the initial stages. Bone resorbtion may result in an unfavorable interarch relationship, and soft tissue support may be needed. A detailed presurgical evaluation (including tooth setup, construction of radiological and surgical guide) is needed to ensure the placement of implants in prosthetically favored positions. In this paper, a technique is presented where a detailed wax-up of the restoration is accomplished on provisional implant abutments and tried on the patient after implant placement. This setup may offer valuable information on the expected lip support and the need of gingiva-colored ceramic. In this way, the esthetic result can be evaluated at early stages before any irreversible laboratory stages are performed and needed corrections can be done accordingly.

CLINICAL SIGNIFICANCE

In extended implant-supported fixed restorations, it is very important to predict the final esthetic result at an early stage. The presented technique allows a safe and accurate evaluation of the expected esthetic result before any construction stage.

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INTRODUCTION

Partially or completely edentulous patients often consider the loss of teeth as a handicap. The use of dental implants for the prosthetic restoration of these patients is an established and well-documented treatment procedure for more than three decades. Long-term clinical research has shown that restoration by the dental implants is a predictable treatment option.[1–9]

Implants can be used for the restoration of a single-tooth in partially edentulous patients or a fully edentulous arch. When a single tooth is missing, adjacent teeth and anatomical structures can guide the clinician through the initial and final design of the prosthesis.

On the other side, when planning the restoration of completely edentulous patients, great attention should be given to the expected final result. The procedure is more complicated because all teeth have been lost and additional resorbtion has occurred to the hard and soft supporting tissues. Various clinical parameters such as the quality and quantity of the bone substrate, the pattern of resorbtion and the interarch available space

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should be taken under consideration during the treatment planning, as they may be important factors for the selection of the restoration.

Anatomical structures such as the sinus, the nasal fossae, and the mandibular canal restrict the available space for implants.[10] The resorbtion of the alveolar crest in the maxilla and the mandible are different and may affect the interarch relationship.

Regarding the esthetic performance of the planned restoration, the smile line and the support of the lips should be evaluated carefully prior to prosthetic treatment. Resorbtion of the alveolar crest may impose greater tissue support from the restoration. If severe bone resorbtion has occurred on the labial side of the alveolar crest and a fixed prosthesis is planned as the definite restoration, the teeth in the restoration may appear extremely long. The needed support for the lips will indicate whether a buccal flange should be used to compensate for the resorbed soft and hard tissue, and a removable prosthesis should be the treatment option. This is in several cases indicated especially in patients with nonfavorable interarch relationship.[10–13]

At the initial stages of treatment, before establishing a definite treatment plan, the prosthetic options should be evaluated, and the most appropriate solution should be selected for each specific patient. With minimal to medium resorbtion, a fixed prosthesis is the ideal solution because esthetics, phonetics, and hygiene can be achieved.

In cases of severe ridge resorbtion, an implant-supported or an implant-and-tissue-supported overdenture may offer a better final result concerning esthetics, lip support, and access for oral hygiene.[9,14,15]

Implants should always be placed according to the demands of the planned prosthesis following a detailed and determined treatment plan. In some cases, however, the positions and inclination of the implants may differ from the initial plan because of unpredictable anatomical or surgical factors. For these reasons, the type of the planned restoration should be re-evaluated after implant placement.[15]

At this stage, the diagnostic wax-up and a try-in to the patient offer precious information before the fabrication of the final restoration. The use of a detailed diagnostic setup on provisional abutments may guide the clinician and the laboratory during the stages of fabrication of an extended fixed implant-supported prosthesis.

AIM

The aim of this paper is to present a new technique for a full diagnostic tooth setup that can be tried intraorally allowing a more precise prediction of the esthetic result after implant placement and before initiation of the prosthetic restoration. In this technique, the diagnostic setup is performed on provisional abutments directly on the implants instead of a base plate. The setup can be tried on the patient, and a more precise evaluation can be accomplished before any fabrication step.

CASE PRESENTATION

A 63-year-old male Caucasian patient presented for prosthetic restoration of the edentulous maxilla. The patient demanded a more stable prosthesis than the existing complete denture. Presurgical examination with a full tooth setup, a radiographic guide and a computerized tomography (CT) dental scan had shown that there was adequate bone substrate for implants, but it remained questionable if a fixed restoration would ensure proper support for the lips.

Six implants (Xive implants, Densply/Friadent, Mannheim, Germany) were inserted in regions of teeth #16, 14, 12, 22, 24, and 26 in the predetermined positions to support a full arch restoration (Figures 1 and 2). The patient had expressed his preference for a fixed restoration but was also concerned for the esthetic result and the lip support. At the end of osseointegration period, an impression was taken with addition-type silicon material, and a working cast was fabricated from extra-hard dental stone (Figure 3). The vertical dimension of occlusion and the soft tissue support were initially determined using a base plate (constructed on the working cast) and with wax rims.

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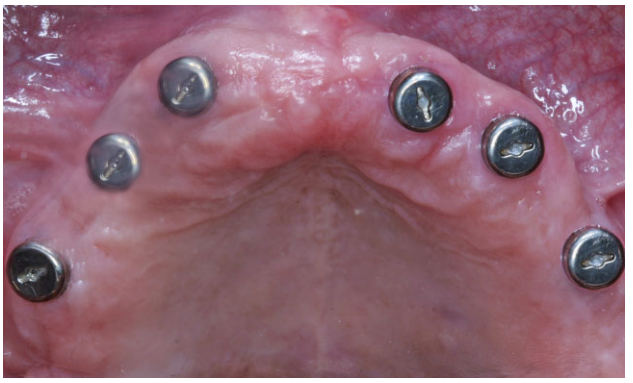

FIGURE 1. Initial clinical situation.

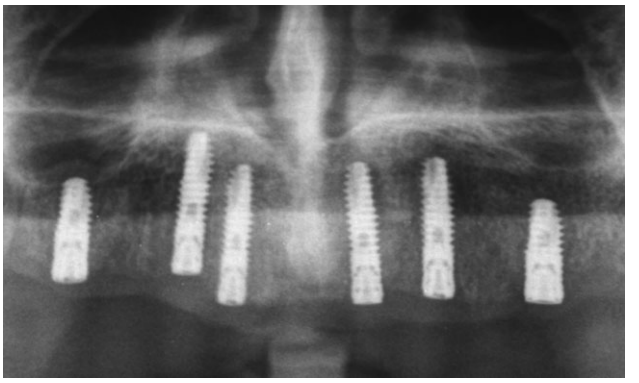

FIGURE 2. Initial radiographic situation after implant placement.

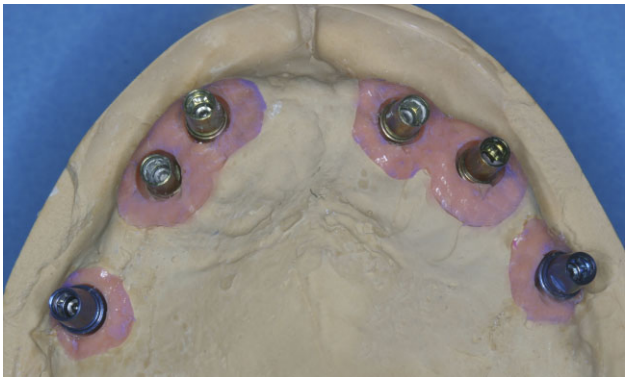

FIGURE 3. The working cast with the provisional abutments.

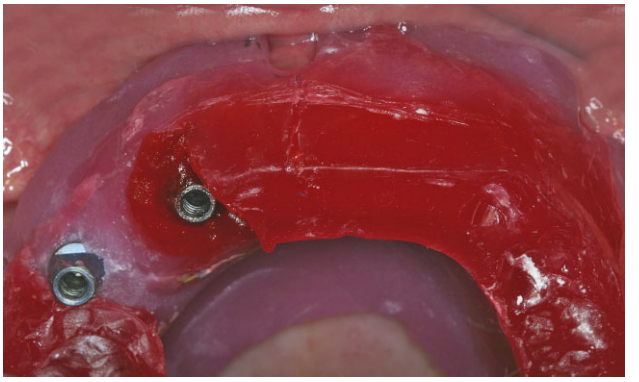

FIGURE 4. The base plate retained on two implants.

The base plate is fixed on an implant (usually the one with the easiest access) by a provisional abutment or an impression post (Figure 4). The base plate was used for face bow transfer and the registration of the interarch relation. As the patient was satisfied with the soft tissue support from the existing denture, it was used as a reference point for further stages.

The working cast was mounted on a semi-adjustable articulator with the use of the face bow, and the opposing arch cast was mounted accordingly. The interarch relation was found favorable at the anterior-posterior and the vertical level (Figure 5).

FIGURE 5. The interarch relation on the mounted casts.

According to the treatment plan and the patient's wish, an implant-supported fixed restoration was planned. In the presented case, the patient was extremely concerned about the esthetic performance and the natural appearance of the teeth in the restoration. He also insisted on the soft tissue support so that no significant change in the facial area could be detected by his social environment.

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The clinical dilemmas in this case were if a fixed restoration would ensure proper lip support (to avoid a removable restoration with a labial flange) and whether pink porcelain would be needed. In many cases, the use of pink porcelain is necessary to compensate the increased length of the teeth on the restoration because of bone resorbtion.

It was considered mandatory to clear the previously mentioned clinical questions before proceeding to any construction step.

As a first step, an acrylic base was fabricated from autopolymerizing acrylic resin (Pattern resin, GC Co, Tokyo, Japan). The acrylic base was fixed on two provisional metal abutments (Temp-base abutments, Xive implants, Densply/Friadent) on the implants in the premolar area and was covered with hard base plate wax. At the distal parts, the acrylic base was extended with cantilevers up to the second premolar area. Prefabricated acrylic denture teeth were setup on the base plate at the labial surface of the wax. The acrylic teeth were selected in shape and size taking under consideration the patient's remarks regarding the teeth in the existing denture that were acceptable from an esthetic point of view. The position of the acrylic teeth allowed access to the fixing screws of the abutment from the palatal side (Figures 6–9).

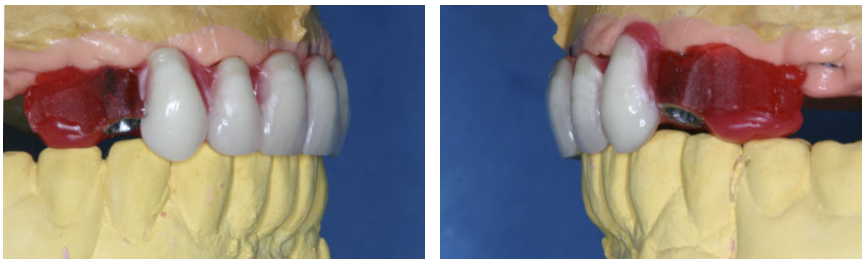
The tooth setup was fixed on the implants and was tried on the patient (Figure 10). At this stage, the shape, size, and position of the teeth were checked intraorally and also the occlusal relation (Figures 11 and 12). Additionally, the planned emergence profile of the restoration on the cervical areas could be evaluated.

Extraorally, the vertical dimension of occlusion, the smile line, the lip support, and the midline of the maxillary teeth as related to the midline of the face were checked (Figures 13 and 14). The need for pink porcelain was also evaluated as the emergence profile and the lip support were concerned. As an acceptable result could be achieved with the planned shape and position of the teeth, it was decided not to use any additional gingival-colored ceramic material at the cervical area.

The patient could also visualize the esthetic result of the planned restoration already from the initial stages and evaluate the final esthetic result. In the presented case, only minor corrections regarding the shape of anterior teeth and the position of the canines were necessary.

Following the esthetic check-up, a new bite registration was taken using the acrylic base of the setup as anterior guidance. In this way, the centric relation could be registered with more accuracy compared to a base plate.

FIGURE 6. Diagnostic setup of the maxillary anterior teeth.



FIGURES 7 AND 8. The base plate is extended distally as a cantilever up to the second premolar area.

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FIGURE 9. The setup is retained on two provisional abutments.

FIGURE 10. Try-in of the setup on the patient (anterior view).

FIGURES 11 AND 12. Try-in of the set up on the patient (lateral views).

From this stage on, the construction of the restoration could proceed in the dental laboratory based on the predicted final result. From the tooth setup, silicone partial impressions (silicone keys) were obtained in the laboratory and the implant abutments were selected and modified according to the outer contour of the planned restoration. The metal framework was cast in the proper dimensions, allowing proper support and even thickness for the veneering ceramic material. The veneering process was also significantly simplified by the use of the previously mentioned partial impressions as the final result had already been designed and checked from all aspects (Figures 15 and 16). The final restoration for the patient was a cement-retained implant-supported fixed partial denture (FPD). The emergence profile was shaped according to the diagnostic setup (Figure 17). The patient was completely satisfied from the final result, which could be achieved with reduced clinical sessions in a predictable way.

DISCUSSION

The prosthetically driven implant placement is a clinically established concept for implant restorations. Presurgical evaluation including tooth setup and a radiographic guide is needed to establish a detailed treatment plan. The implants should be placed in predetermined positions according to the planned restorations. In some cases, however, even if the implants are in a prosthetically favorable position, there are clinical dilemmas for the final restoration. Predicting in details the final result before any fabrication steps of the restoration is essential to avoid any time and cost-increasing corrections.

The detailed wax-up or tooth setup has been advocated for the presurgical evaluation of patients with implant restoration.[12] Predicting the final result in implant restoration has also been reported for single tooth implants and implant-supported FPDs in partially

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FIGURE 13. Check of the middle line of the teeth in relation to the face of the patient.

FIGURE 14. Evaluation of the lip support by the planned restoration.

FIGURE 15. The final metal ceramic restoration.

FIGURE 16. The restoration on the working cast.

FIGURE 17. The final restoration after cementation.

edentulous patients.[16,17] In completely edentulous patients, however, prediction of the final result is complicated as most orientation points are lost and resorbtion has occurred both in hard and soft tissues.

A detailed treatment plan before implant placement is a prerequisite for a successful restoration. On the other hand, the presented technique can offer precious help to evaluate the final result of the prosthetic restoration after implant placement and should not be considered

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as a substitute for presurgical planning. The main goal of this technique is to define the amount of lip support and the need for gingiva-colored ceramic in full-arch implant restorations. If the implants are not in prosthetically favorable positions, it is difficult—if not impossible—to compensate resulting esthetic problems.

The presented technique offers certain advantages compared with other similar methods. When planning a fixed restoration, it is essential both for the patient and the dentist to visualize the final result at the initial stages. By using this technique, esthetic aspects as the lip support can be evaluated in an accurate and predictable way. When a fixed prosthesis is planned, there is no buccal flange that could compensate for the resorbtion of the residual ridge. The wax-up try-in plays a significant role in order to verify if the patient's requirements as far as esthetics and lip support are fulfilled. This technique reveals the degree of needed tissue support in each residual alveolar ridge and its effect on the interarch relationship. The occlusal relation and the vertical dimension of occlusion can be determined, especially in cases where a non-favorable interarch relationship has occurred because of the different resorbtion patterns of the maxilla and the mandible. Bone resorbtion is the most significant factor in order to determine the length and contour of the teeth in the prosthesis. When significant resorbtion has occurred, the prosthetic teeth will probably appear extremely long with extended dark spaces on the proximal areas. Such a result is usually unacceptable to patients with smile line and is often a cause for phonetic difficulties.

Gingiva-colored ceramic materials have been used on the labial side of fixed restoration to compensate for increased tooth length and offer tissue support. Its use however is a technique-sensitive procedure, and the esthetic performance is not always the expected. It is advantageous to recognize the need for pink porcelain before any laboratory procedure in order to fabricate the metal framework adequately.

On the other side, a full wax-up offers an orientation point for the construction at the restoration. The partial impression from the wax-up (silicone key) can be used for the shaping and the control of the framework dimensions before and after casting. The veneering process is also significantly simplified to reach the preplanned esthetic result, and an even thickness of the ceramic material can be easily achieved. Even the selection and modification at the implant abutments can be accomplished based on the expected final contour of the restoration.[16,17]

Regarding the phonetic ability, it is essential to form an adequate lingual anatomy on the anterior maxillary teeth. The contour of the cingulum should therefore be correct as the contact of the tongue to the palatal side of the maxillary anterior teeth is important for the "t" and "d" sounds. Excessive air escape through the interproximal areas of a fixed prosthesis could cause speech problems.[12]

The intraoral try-in of the esthetic result has already been reported with the use of a tooth setup on a base plate fixed on one or two implants.[9,14] Although it is a simpler procedure, the thickness of the base plate does not allow a precise evaluation of the functional and esthetic outcome of the restoration. The denture teeth on a base plate may not represent the final length of the teeth as on a fixed restoration and the need for pink ceramic material may not be estimated properly. Without the use of the base plate for the diagnostic setup, the smile line and the tissue support can be estimated more precisely. It must also be mentioned that the base plate is not so stable as the wax-up in the presented technique and does not usually have bilateral stability, if it is not supported by two implants. Particularly in the mandible, increased space is needed for the tongue, and thus the base plate does not represent the true dimensions of the prosthesis.

On the other hand, it must be noted that this technique is more time-consuming and requires a greater number of modifications whenever either the patient or the clinician estimate that a correction is needed. Moreover, the acrylic material (Pattern Resin) is more difficult to handle than the wax on the base plate and the diagnostic setup but offers increased stability during the intraoral try-in.

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A similar technique of full diagnostic setup has been described in the early years of the use of implants, but it concerned the construction of a framework of a hybrid restoration.[18] As mentioned earlier, an alternative method could be the use of base plate and wax-up or diagnostic setup, bearing, of course, the disadvantages already described.

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