Digital Production of a Zirconia, Implant-Supported Removable Prosthesis with an Individual Bar Attachment Milled from Polyether Ether Ketone: A Case History Report

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Several attachment systems for implant-supported removable dental prostheses (ISRDPs) are currently available. The bar attachment option includes cast or milled alloyed male and female parts. Replaceable slide attachments made from elastic materials can be inserted into the female part of the bar to counter loss of friction that develops due to wear. Another approach involves milling the female part from organic thermoplastic polymers. In the present case history report, an edentulous maxilla was restored with a digitally fabricated ISRDP with the female part of the bar milled from polyether ether ketone (PEEK) polymerized into a zirconia framework. Int J Prosthodont 2018;31:471–474. doi: 10.11607/ijp.5866

In 2016, a German publication reported that 12.4% of the German younger elderly in 2014 were completely edentulous.¹ At least four implants per arch are widely considered as mandatory to support a fixed restoration, while two to four implants are required for an overdenture.² A within-subject comparison of maxillary fixed and removable implant-supported/retained prostheses reported higher patient satisfaction in elderly edentulous patients wearing removable bar overdentures, especially due to the cleaning and articulation benefits.³ However, this positive outcome might change if loss of retention occurs. Replaceable slide attachments made from elastic materials to be inserted in the female component can be used for readjusting the friction of a bar attachment, but a significant amount of space is needed for both the superstructure and the inserts. Individually milled female components from polyether ether ketone (PEEK) blanks polymerized into the framework might present an alternative. Digital production allows the PEEK female components to be easily reproduced and exchanged if the desired friction-related retention decreases over time.

Case History Report

A 76-year-old man was diagnosed with two remaining but hopeless teeth and one remaining implant supporting an overdenture in the maxilla and an insufficient fixed prosthesis supported by four implants in the mandible (Figs 1a to 1c). To restore the maxilla with a removable prosthesis and the mandible with a new fixed restoration, three more implants (SIC invent AG) were placed in the maxilla. After impression-taking with an open tray 12 weeks postsurgery (Impregum; 3M Espe; Figs 1d and 1e) and subsequent maxillomandibular registration, the produced master casts were mounted onto an articulator and digitized mounted and individually (S600 ARTI scanner; Zirkonzahn; Figs 1f to 1j). Pairwise registration allowed for cross-mounting the master casts with the models of the former prostheses produced by pick-up impressions. The position of the former prostheses/teeth served as reference for setting up the new teeth in the computer-aided

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Fig 1  (a, b) Clinical and (c) radiographic situation prior to treatment. After impression-taking in the (d) maxilla and (e) mandible, models were mounted on the (f) articulator. (g) Scanmarkers were used for (h) digitization of the implant position. (i) The registration was digitized by scanning the mounted casts.

Fig 2  (a) After setting up the artificial teeth and (b) designing the first prototype in the CAD software, the prototype was (c) milled from PMMA, colored, and (d) connected to titanium abutments/bases. The screw-retained prototype was (e, f) mounted intraorally for esthetic, phonetic, and functional analyses.
design (CAD) software (Figs 2a and 2b). Prototypes of the preliminary designed prostheses were milled from polymethyl methacrylate (PMMA, Temp Basic, Zirkonzahn) and mounted intraorally (Figs 2c to 2f) for verification of phonetics, esthetics, function, and for final occlusal adjustments. Thereafter, this prototype was removed, digitized, and superimposed with the first version in the CAD software (Zirkonzahn. Modellier). After the final design was set, two separate bars and the female superstructure were designed and milled from titanium (Titan, titanium grade 5, Zirkonzahn) and PEEK (Tecno Med, Zirkonzahn), respectively (Figs 3a to 3e). Another prototype was produced from PMMA, and the PEEK superstructure was polymerized to the corresponding openings (Fig 3f). The patient wore this prototype for 3 months. Subsequently, pick-up impressions of the worn prototype were scanned to implement traces of wear to the final zirconia prosthesis. A cutback of the buccal faces of the anterior teeth, except for the incisal edges, was done in both the maxilla and mandible. Both prostheses were milled from zirconia blanks (Prettau Zirconia, Zirkonzahn), colored, sintered, and finally veneered (ICE Zircon Ceramics, Zirkonzahn; Figs 4a to 4d). The PEEK superstructures and anodized titanium abutments were polymerized into the openings of the corresponding zirconia frameworks (Figs 4e and 4f). At final prosthetic delivery (Figs 4g to 4l), the screw access holes of the mandibular prosthesis were sealed with composite (Fig 4h).

**Discussion**

Production of two prototypes presented a cost-intensive procedure but successfully avoided the need for adjustments of the final zirconia prosthesis. Since attachments made from PEEK are not documented in the literature, it was decided to evaluate the patient’s satisfaction with this system before finalizing the zirconia restoration. One appointment to reduce friction by slightly milling visible traces on the inner surface of the PEEK superstructure was needed. A major limitation of the final zirconia prosthesis is represented by the susceptibility to veneer fracture in case of dropping the prosthesis during removal. This might be a problem for the elderly. As a next step, removable prostheses made from zirconia might be produced monolithically without any veneering.

**Conclusions**

The patient expressed satisfaction with the prescribed attachment system, resulting functional retention, and esthetic result after 6 months. However, likely vulnerability to veneer fractures was recognized, and the time-dependent merits of the frictional efficacy of the employed method clearly need to be evaluated if the proposed technique is to be regarded as both efficacious and effective.
Digital Production of PEEK Framework: A Case History Report

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References


Fig 4. (a) Maxillary and mandibular prostheses after (a) milling, (b) coloring, (c) sintering, and (d) veneering. (e) PEEK female components and (f) anodized titanium abutments were polymerized into the corresponding openings before (g to l) final prosthetic delivery.