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CLINICAL REPORT

Fabrication of an implant-retained overdenture with ceramic crowns cemented on a polyetherketoneketone framework: A clinical report

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ABSTRACT

This clinical report describes the treatment of a complex intraoral situation by fabricating a maxillary implant-retained overdenture with a high-performance polymer (polyetherketoneketone) framework and lithium disilicate crowns and mandibular tooth- and implant-supported ceramic restorations. No complications were noted in 2 years, and the patient was satisfied with function and esthetics. (J Prosthet Dent 2021;■:■-■)

In complex situations, proper treatment planning and prosthetic material choice is essential to ensure the predictability and longevity of implant-supported restorations.[1,2] Metal-ceramic and metal-resin combinations have been commonly used for fixed and removable implant-supported prostheses.[3-5] However, because these material combinations have been prone to technical complications,[6] alternatives have been proposed.[7,8] Computer-aided design and computer-aided manufacturing technologies have enabled the use ofmonolithic zirconia, carbon fiber, and high-performance polymers[9-14] such as polyetherketoneketone (PEKK). Its use in dentistry has increased because of its biocompatibility.[15-19] PEKK has high fracture strength,[16] and its elastic modulus is comparable with that of dentin (4 GPa versus 18 GPa), which may be biomechanically advantageous.[16,20-24] The use of PEKK as a framework material for implant-supported fixed prostheses has been described in clinical reports[22,25] and one case series in complete-arch treatments.[20] However, the authors are unaware of reports describing the combination of a PEKK framework and lithium disilicate crowns for implant-retained overdentures. Clinicians may benefit from information on how PEKK can be used as an overdenture framework combined with lithium disilicate crowns in a complex situation.[26] This clinical report describes the rehabilitation of a patient by using a maxillary implant-retained overdenture with lithium disilicate crowns on a PEKK framework. The mandible was restored with ceramic restorations and implant-supported crowns.

CLINICAL REPORT

A 69-year-old man presented complaining of his inability to masticate properly and sought esthetic improvement. He wanted "a solution with dental implants (fixed or removable) in a short time and without many surgeries." He had worn a 15-year-old ill-fitting removable partial denture and presented with extensive dental caries on some abutment teeth, localized bleeding on probing, and

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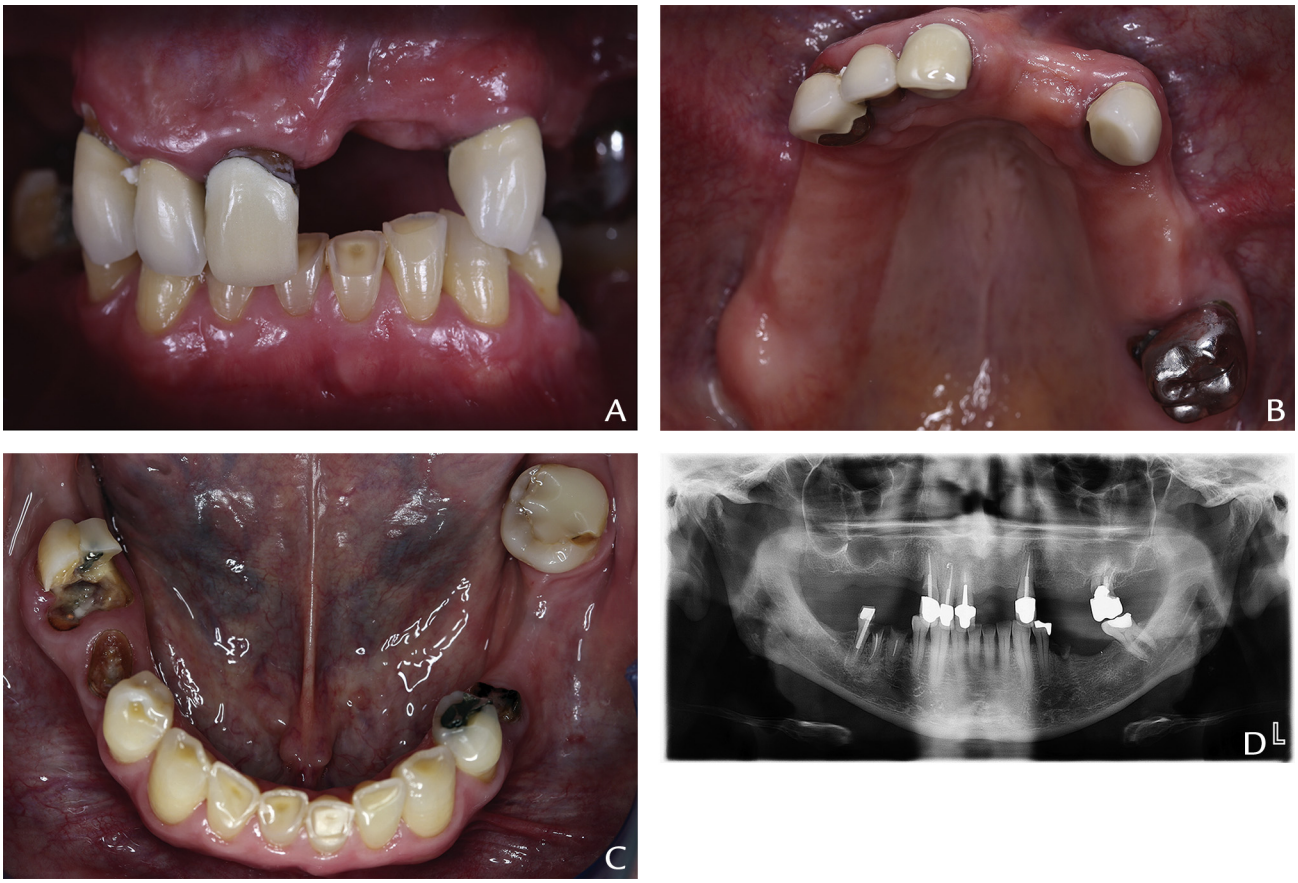

Figure 1. Before treatment. A, Frontal view. B, Maxillary occlusal view. C, Mandibular occlusal view. D, Panoramic radiograph.

deep pocket depths in the maxilla. Tooth wear and caries were observed on the mandibular posterior teeth (Fig. 1). Fixed and removable options were discussed, and he elected to receive a 4-implant-retained maxillary overdenture and mandibular anterior veneers and posterior implant-supported crowns to replace the missing teeth.

The maxillary teeth and the mandibular second premolars and right first molar were deemed nonrestorable because of caries and periodontal disease and were extracted. An interim maxillary complete denture was delivered. After scaling and root planning, he complied with the hygiene maintenance and proceeded with the implant placement. A computed tomography scan was made with a barium sulfate template to evaluate the suitability of both arches for implants, and a software program (CoDiagnostiX; Dental Wings GmbH) was used for virtual implant planning. Eight weeks after the extractions, 4 implants were placed in the maxilla (Standard Regular Neck Tissue Level; Institut Straumann AG) at the maxillary right (4.1×10 mm) and left lateral (4.1×12 mm) and the maxillary right (4.1×12 mm) and left first premolar sites (4.1×12 mm) with a static computer-aided implant surgery protocol, In the mandible, 4.1×10-mm dental implants (Standard Regular Neck Tissue Level; Institut Straumann AG) were placed at the right first and second premolar and the left first molar sites.

After a healing period of 8 weeks, a second-stage surgery in the maxilla was performed, and the implant stability quotient values of all implants were greater than 75. Definitive, fixture-level, open-tray impressions on both arches were made with an elastomeric impression material (Identium medium/light; Kettenbach GmbH & Co) in a custom tray. The interarch relationship records were made with a maxillary base plate and a wax occlusion rim (Megatray; Megadenta Dental products GmbH) and a facebow transfer. Both impressions were poured in Type IV dental stone (Elite Stone; Zhermack GmbH), and the definitive casts were mounted in a semiadjustable articulator (Condylator; Gerber Condylator GmbH). A diagnostic tooth arrangement (SR Phonares II; Ivoclar Vivadent AG) was evaluated clinically to verify vertical dimension, phonetics, function, and esthetics. The definitive casts and diagnostic prostheses were sent to a dental laboratory technician. The diagnostic tooth arrangement was used in designing the maxillary framework and to evaluate the space for the implant attachments (Fig. 2). The definitive PEKK (PEKKTON-Ivory; Cendres+Métaux SA) framework and

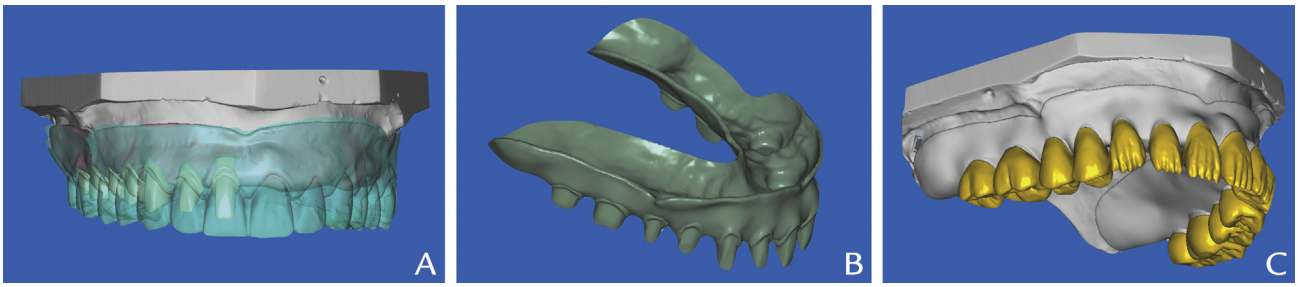

Figure 2. Computer-aided design of maxillary overdenture. A, Virtual tooth arrangement. B, PEKK framework. C, Single crowns on virtual PEKK framework. PEKK, polyetherketoneketone.

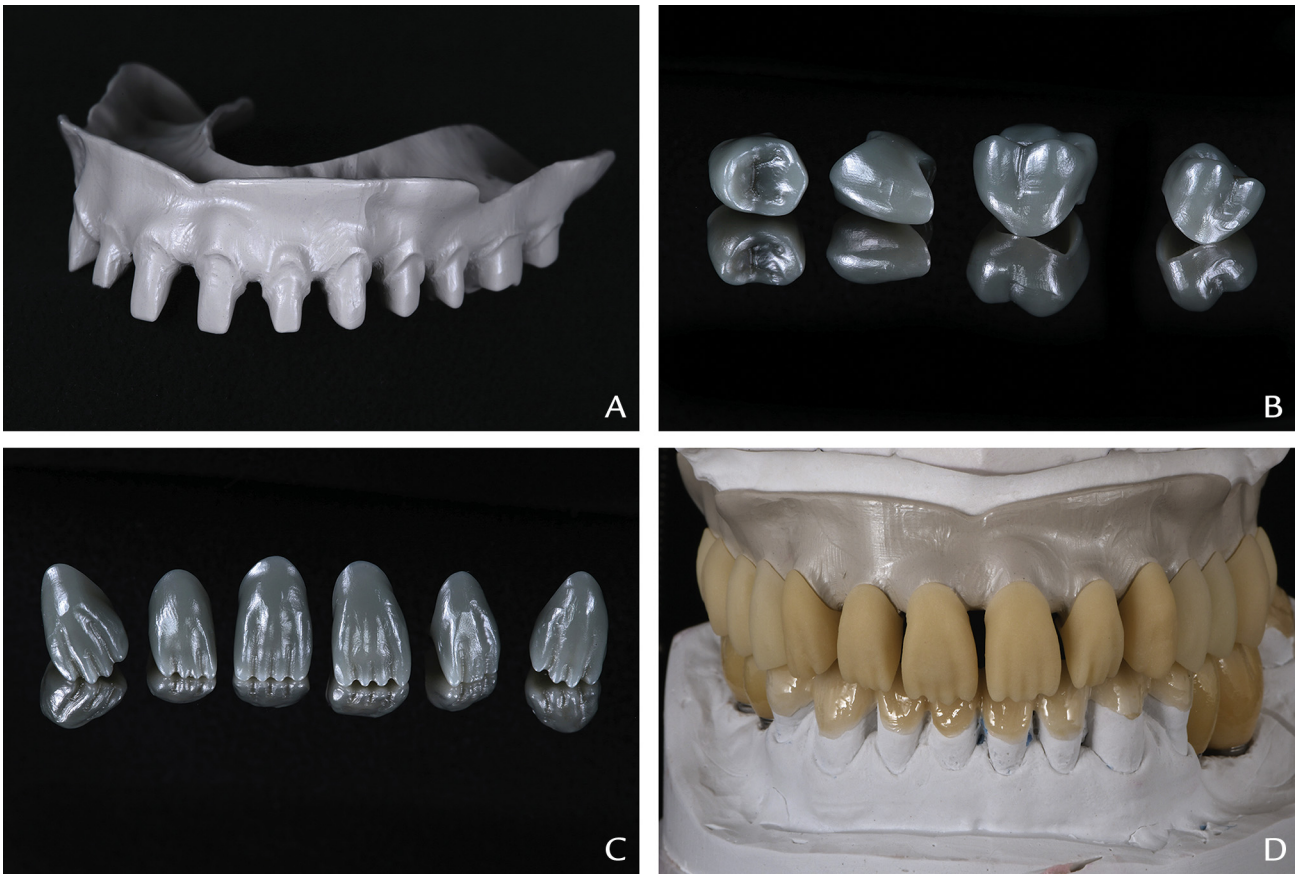

Figure 3. A, Milled PEKK framework. B, C, Milled wax crowns. D, Maxillary crowns pressed in lithium disilicate ceramic. PEKK, polyetherketoneketone.

the wax maxillary crowns were fabricated in a 5-axis milling machine (S2 milling machine; vhf Camfacture AG) and evaluated intraorally (Fig. 3). The fit of the framework was evaluated by using the 1-screw test,[27] and wax crowns were evaluated for occlusion and esthetics. The crowns were pressed in lithium disilicate (Livento press; Cendres+Métaux SA), and the anterior crowns were veneered (Soprano; Cendres+Métaux SA). After glazing and polishing, the crowns and the overdenture attachment housings (CM-LOC; Cendres+Métaux SA) were cemented to the framework with an autopolymerizing composite resin cement (Multilink Hybrid Abutment; Ivoclar Vivadent AG) (Fig. 4). The gingiva was reproduced by layering a light-polymerizing composite resin (SR Nexco; Ivoclar Vivadent AG). The mandibular anterior veneers, the onlay on the left second molar, and the screw-retained posterior crowns were pressed in lithium disilicate (Livento press; Cendres+Métaux SA) (Fig. 4).

The overdenture attachments (CM-LOC; Cendres+Métaux SA) and mandibular screw-retained crowns were tightened to 35 Ncm with a torque wrench, and the screw access holes were plugged with polytetrafluoroethylene tape and light-polymerizing composite resin (Tetric

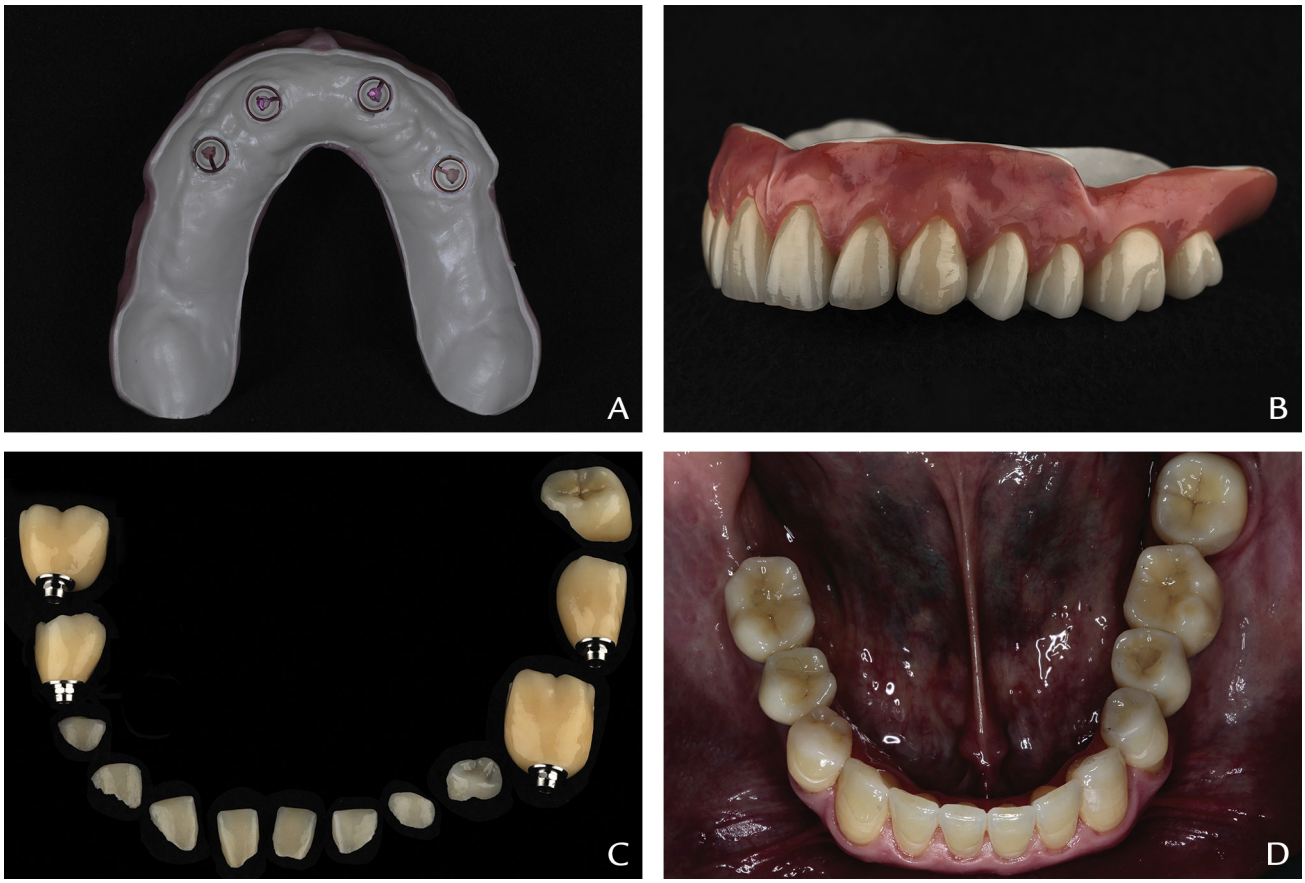

Figure 4. A, Definitive maxillary implant-overdenture with PEKK framework. B, Single ceramic crowns. C, Mandibular implant crowns and ceramic restorations, D, Intraoral view. PEKK, polyetherketoneketone.

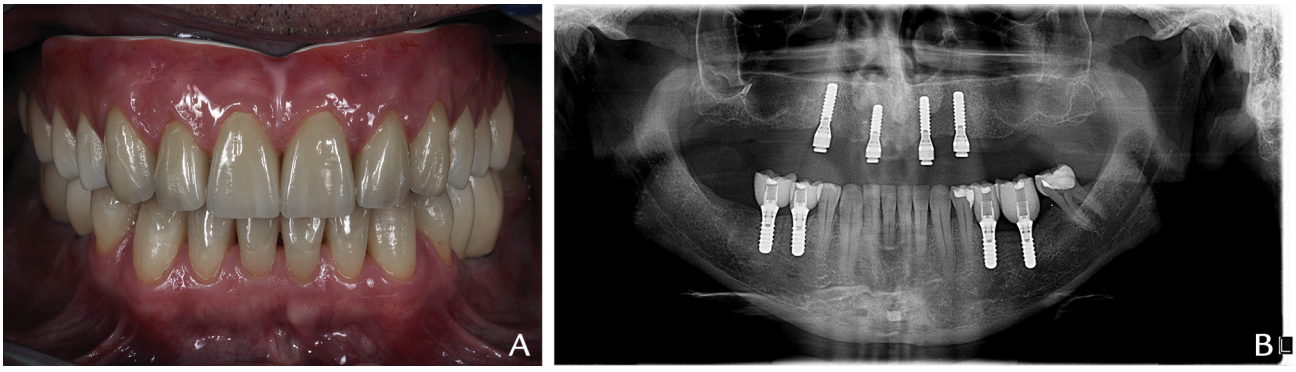

Figure 5. After delivery of restorations. A, Frontal view. B, Panoramic radiograph at 2-year follow-up.

Evoceram; Ivoclar Vivadent AG). The mandibular ceramic restorations were cemented with resin cement (Variolink Esthetic DC; Ivoclar Vivadent AG) (Figs. 4, 5). The occlusion was adjusted, and the adjusted surfaces were polished by using a ceramic polishing kit (Kit 1440; Jota AG). He was satisfied with the function and esthetics at the 2-year follow-up. No biologic or technical complications were identified (Fig. 5B).

DISCUSSION

The use of a shock-absorbing material such as acrylic resin has been recommended for implant superstructures.[23] However, replacement of the resin because of wear has been necessary periodically,[28] and clinical evidence to support the theory that mechanical overload of implants may lead to crestal bone loss is scarce.[24]

Implant overdenture bases have been commonly fabricated in acrylic resin supported with a cobalt-chromium framework; however, debonding, chipping, and wear have been reported, which may be extensive in patients with parafunctional habits.[13,23] Lithium disilicate crowns luted to a polymer framework veneered with pink acrylic or composite resin avoid the complications with acrylic resin denture base and denture teeth. Chipping and occlusal wear of the lithium disilicate crowns may have been minimized in the presented patient, as they were used in opposing arches; acrylic resin denture teeth could have debonded or worn.[23,26] When a reline is needed, the PEKK intaglio surface can be relined with conventional acrylic resin.[29] In addition, advances in bonding agents and techniques have improved the bond strength between the veneering resin and PEKK.[18,19] PEKK is a suitable option when treating patients with metal or acrylic resin allergy.[13,17] However, long-term studies are needed before recommending PEKK for patients with parafunctional habits.

Stud attachments are commonly used to retain implant overdentures; however, they are susceptible to wear, with increased implant angulation and cyclic dislodgement.[5] To minimize wear, polyetheretherkethone or PEKK retention inserts have been introduced[4] that are resistant to abrasion.[8,14] The attachments used in the presented report had PEKK inserts.

The short-term outcomes with complete-arch implant-retained-acrylic resin prostheses have been evaluated, and 100% implant and 98% prosthetic survival rates were reported.[13] Loss of veneer adhesion, chipping, and screw loosening were reported, but the authors concluded that this material combination may be a valid option; however, long-term validation is required.[13] The use of high-performance polymers for fixed implant prostheses requires the use of titanium bases, as some complications were noted when titanium bases were not used.[20]

In the present report, a favorable outcome was achieved with a high-performance polymer framework and lithium disilicate ceramic restorations. However, results may vary depending on the situation of the treated patient, and clinical studies that evaluate the long-term outcomes in multiple situations are needed. The use of PEKK may require a learning curve, but a skilled dental laboratory technician can improve the esthetic outcomes dramatically when it is combined with recently developed materials which enable shading and surface characterization. Nevertheless, proper layering of the gingiva may require experience. After 2 years of service, no biologic or technical complications were observed, and he reported an improvement in his quality of life. Although the combined materials are more expensive than acrylic resin overdentures because the prosthetic design files are stored electronically, prostheses can be remilled if remakes are required.

SUMMARY

A maxillary implant-retained PEKK overdenture framework with lithium disilicate crowns and mandibular tooth- or implant-supported ceramic restorations was used to treat a complex intraoral situation. This treatment enabled favorable outcomes in 2 years, and the material combinations used for the overdenture may be alternatives to conventional materials. Although the outcomes after 2 years were satisfactory, clinical trials are needed to evaluate the long-term performance of the combinations of materials used.

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