A Combination of CAD/CAM–Fabricated Zirconia Milled Bars and a Gold-Electroplated Superstructure Framework for an Implant-Supported Overdenture: A Case Report

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A 54-year-old woman presented with severe maxillary resorption, which resulted in an unstable maxillary removable denture. Due to poor anatomical conditions, the prosthodontic solution posed for the patient was an implant-supported maxillary overdenture based on four implants. This report presents the detailed workflow for CAD/CAM–fabricated, individually milled zirconia bars and an electroplated superstructure framework for an implant-supported removable overdenture, which enabled good retention and an optimal esthetic result. A critical element in the present case was the production of electroplated secondary elements, which are highly precise, with a homogenous layer of gold. No retention loss was observed after 12 months in use. Int J Prosthodont 2020;33:572–575. doi: 10.11607/ijp.6928

Implant-supported milled-bar overdentures show similar stability and retention in comparison to fixed prostheses.¹ ² Telescopic crowns also provide effective retention of removable dentures.³ Electroplating or galvanoforming techniques can be used to manufacture secondary telescopic crowns. Since the retention system is not based on friction between the primary and secondary elements, a decrease in retentive force over a long period is not observed.⁴ Zirconia primary crowns can be manufactured precisely with CAD/CAM technology. This case report presents a zirconia milled-bar primary structure in combination with a gold-electroplated secondary structure.

CASE REPORT

A 54-year-old woman presented with severe maxillary alveolar ridge atrophy—Type III according to classification by the American College of Prosthodontists. The treatment plan included four implants, two milled lateral zirconia bars, and an overdenture with an electroplated secondary structure. In the mandible, a new fixed metal-ceramic partial denture was planned to support a mandibular metal-frame removable partial denture.

Four Straumann Bone-Level NC implants (10 mm) were inserted based on a CBCT radiograph in the regions of the maxillary canines and first premolars (according to a radiographic template based on the existing complete denture). After a 3-month osseointegration period, an individual open-tray impression using polyether (Impregum Penta, 3M ESPE) was taken. Four prefabricated abutments were chosen (NC Screw-Retained Abutments 0°, Straumann) (Fig 1). The bars were designed in auto-polymerizing acrylic resin (Pattern Resin, GC) over Straumann titanium copings for...
screw-retained abutments. The bar height was 3 mm, and the bars were positioned 1 mm above the gingiva. Both the gold-electroplated secondary and tertiary structures required 0.3 mm of space, and at least 8 mm of space from the tertiary structure to the incisal edge was required. After scanning, definitive bars were milled from zirconia (IPS e.max ZirCAD, Ivoclar Vivadent) on a five-axis computer numeric control (CNC) machine (Arrow Mill Beluga, Dentas) (Fig 1). After polishing, the copings were cemented to the zirconia bars on the master cast using an adhesive luting system (Multilink Automix, Ivoclar Vivadent) (Fig 2). Try-in of the finished bars was made before processing the secondary structures from 24-carat gold using a fully automated dental electroforming system (GAMMAT optimo2, Gramm Technik).

A horseshoe-shaped overdenture base, designed with an open palate and reinforced with a metal framework (Remanium GM 380+, Dentaurum), was fabricated. The secondary structure was cemented to the metal framework using an adhesive luting system (Fig 2). The subsequent procedures were: maxillomandibular jaw registration with a maxillary occlusal rim; tooth shade and shape selection; a try-in procedure with set-up of teeth (VITA PHYSIODENS, VITA Zahnfabrik), and, finally, flasking and packing of the acrylic resin.

Figure 3 shows the completed overdenture before delivery. After 12 months in use, radiographs showed stable crestal bone levels around the implants, the bar showed no technical complications, and no retention loss was evident (Fig 4). A black mark was noticed on
**Fig 3**  The completed implant-supported maxillary overdenture (a and b) at delivery and (c and d) in situ.

**Fig 4**  (a) Photograph and (b) orthopantomogram of the clinical status 1 year after delivery.
the left zirconia bar, probably due to the metal part of the crown touching the opposing teeth. Some debris collected in the access holes on the zirconia bars, so they were sealed with Teflon tape and composite (Tetric EvoCeram, Ivoclar Vivadent).

**DISCUSSION**

Zirconia bars were selected due to biocompatibility, anatomical, and esthetic reasons. An implant-supported overdenture based on Locator attachments can also be used as a therapeutic option, especially in cases with reduced interarch distance. For a bar-retained implant-supported overdenture, at least 15 to 17 mm of interarch distance is needed. The bar design with adequate space between the gingiva and the zirconia allows for easy cleaning with interproximal brushes or dental floss. A critical factor in this case was the production of electroplated secondary elements with an exact and homogenous layer of gold. An extraoral scanner could have been used to achieve a more digital workflow from implant planning to definitive restoration.

One year after delivery, the soft and hard tissues showed no significant bone loss, irritation, infection, or injury to the soft tissues surrounding the zirconia bars, and patient satisfaction was high.

**CONCLUSIONS**

A maxillary implant-supported overdenture based on individual milled zirconia bars with high-precision elements (electroplated secondary structures) allowed for suitable retention and esthetic results over the first 12 months in use and should be considered in cases of severe maxillary resorption. Long-term clinical validation is necessary.

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**REFERENCES**


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**Bond Strength of Denture Teeth to Heat-Cured, CAD/CAM and 3D Printed Denture Acrylics**

To compare the fracture toughness (K1C) and flexural bond strength of commercially available denture teeth to heat-cured, CAD/CAM, and 3D-printed denture-base resins (DBRs). Three types of DBRs (heat-cured, CAD milled, and 3D printed) and four different types of commercial denture teeth (unfilled PMMA, double cross-linked PMMA, PMMA with nanofillers, and 3D-printed resin teeth) were investigated. DBR and epoxy-embedded denture teeth (n = 30 per group) specimen beams (25 x 4 x 3 mm) were fabricated. The testing ends of all the specimens were surface treated, bonded, and processed according to the manufacturer’s instructions. Twenty specimens were thermocycled to simulate intraoral wear of 6 and 12 months. A 4-point bend test using the chevron-notched beam method was done, and K1C (MPa·m$^{1/2}$) and flexural bond strength (MPa) were calculated. All specimens were analyzed for the mode of failure under the light microscope, and selected specimens under an SEM microscope. Results were statistically analyzed using ANOVA (SPSS ver 24). The mean K1C was the highest for the teeth bonded to the heat-cured DBR group (1.09 ± 0.24), followed by the CAD/CAM (0.43 ± 0.05) and 3D-printed groups (0.17 ± 0.01). Differences were statistically significant ($P < .01$). Within each group, aging showed statistically significantly lower values, but no statistical significance between the mean K1C and flexural bond strength ($P = .36$). The dominant mode of failure was cohesive in the CAD/CAM groups and adhesive in the heat-cured and 3D-printed groups. Teeth bonded to heat-cured DBRs produced the highest K1C. The bond strength decreased significantly with aging. Teeth bonded to CAD/CAM and 3D-printed DBRs showed significantly lower bond strength, with no significant influence of aging.