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CLINICAL REPORT

Channel retention for fixed implant superstructures: A clinical report

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ABSTRACT

This clinical report describes the treatment of a patient with anatomic and biomechanical problems that made retrievability of an implant-supported prosthesis a design priority. During treatment, the patient was found to be intolerant of local anesthesia, prompting an alternative retrievable design from the screw-retained interim restoration. A channel retention technique for fixed implant superstructures is presented. (J Prosthet Dent 2015;114:323-327)

The *Glossary of Prosthodontic Terms*, 8th edition, defines a superstructure as "the superior part of a fixed or removable dental prosthesis that includes the replacement teeth and associated gingival/alveolar structures."[1] Implant-supported, fixed superstructures are categorized as cement- or screw-retained.[2] Screw retention permits retrievability of the prosthesis but requires access channels that typically exit through the occlusal surface and are restored with composite resin, diminishing porcelain strength and esthetics. Alternatively, a prosthetic screw can be used on the lingual side, but this can enlarge the crown contour. Also, inserting small screws presents an ingestion hazard, especially in molar areas. Cement-retained superstructures preserve porcelain integrity, correct implant malalignment, and are easily modified if an implant is lost.[3,4] Definitive cement increases superstructure retention but dictates the need to drill an access channel if an abutment screw needs to be retightened or replaced. Cementation must be done carefully to prevent subgingival excess and periimplantitis. Interim cementation allows the prosthesis to be removed but may not provide long-term retention and may alter occlusal contacts because of increased film thickness.[5]

It is clinically desirable to have ideal superstructure contour, strength, esthetics, retrievability, and retention without the disadvantages of retention from cement or screws. Channel retention of fixed implant superstructures fulfills these goals by polymerizing composite resin within aligned 2-mm-diameter channels in the implant abutment and superstructure (Fig. 1). The composite resin is easily drilled out to remove the superstructure and treat mechanical or periimplant problems. This clinical report describes the prosthetic treatment of missing maxillary posterior teeth and a severely atrophic residual ridge with a fixed implant-supported prosthesis with channel retention.

CLINICAL REPORT

A 70-year-old woman presented for the replacement of her missing left maxillary posterior teeth. Her medical history was noncontributory. Clinical examination revealed a significant left maxillary defect from bone and tooth loss related to periodontal disease. The mandibular left first premolar had overerupted and distorted the mandibular occlusal plane. Sinus augmentation had been completed during the previous year, anticipating implant placement. A cone beam computed tomogram (CBCT) showed 14 mm of grafted bone height with a cranially elevated bone crest and excessive soft tissue thickness (Fig. 2). Clinical mobility and CBCT views of the maxillary left canine revealed a radicular fracture adjacent to a post and core, indicating the need for an implant-supported restoration. Additionally, keratinized tissue was absent on the crest and buccal aspect of the maxillary left premolar and first molar implant sites.

Decision making for implant-supported restorations is facilitated by establishing priorities for each site and

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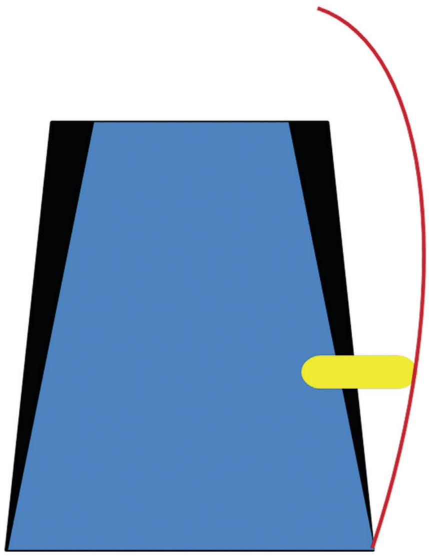

Figure 1. Diagram showing channel retention. Blue, implant abutment; black, superstructure framework; white, superstructure porcelain; red, external porcelain contour; and yellow, composite resin in channels.

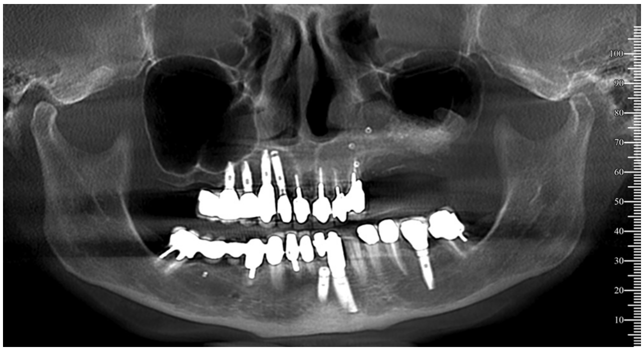

Figure 2. Cone-beam computed tomogram reconstructed panoramic view with left sinus augmentation, resultant bone crest position, and excessive gingival thickness.

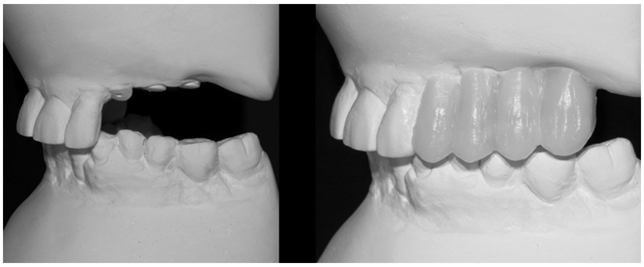

Figure 3. Diagnostic casts showing amplified restorative space (gingival margin to opposing occlusal surface). Diagnostically waxed teeth are long, indicating increased crown to implant ratios.

Figure 4. Splinted, composite resin screw-retained interim restoration demonstrating increased crown to implant ratio and normal gingival embrasures.

then coordinating these into a cohesive plan that includes each item on the patient's problems/solutions list.[6] A diagnostic waxing and trial equilibration of duplicate diagnostic casts, verified in centric relation by an anterior deprogrammer and bimanual guidance, accurately assessed the planned post-treatment contours and occlusion (Fig. 3).[7] The patient's low lip line masked the length of the maxillary left canine, premolar, and first molar prosthetic teeth. However, the length of the diagnostically waxed teeth demonstrated an increased crown-to- implant (C:I) ratio on the maxillary left premolar and first molar sites, even with 9- or 11-mm-long implants. Also, greater buccal cusp vertical overlap was needed to maintain the maxillary occlusal plane for proper esthetics at the maxillary left premolar sites. This required sufficient inclination for lateral excursion guidance on the maxillary left canine crown to avoid working-side interferences and adverse torque on the prosthesis and implants.

Diagnostic waxing demonstrated the horizontal component and vertical component of bone loss due to preferential loss of buccal bone. Both of these dimensions created a cantilever that increased the bending moment on the implants, stressing crestal bone.[8] Short implant length and large restorative space increased the C:I ratio and stress on crestal bone. However, short implants have success rates similar to those of implants >10 mm long, and high C:I ratio does not correlate with increased marginal bone loss.[9-14] High C:I ratio may contribute to component fractures and screw loosening, but this has not been found in all studies.[12,14] Creating an occlusion without excursive contact interferences and splinting the crowns were essential to reduce stress on the implants for this patient.[15,16]

The initial plan was a single crown on the maxillary left canine implant and a screw-retained, splinted fixed prosthesis on the maxillary left premolar and first molar implants. Metal ceramic restorations were

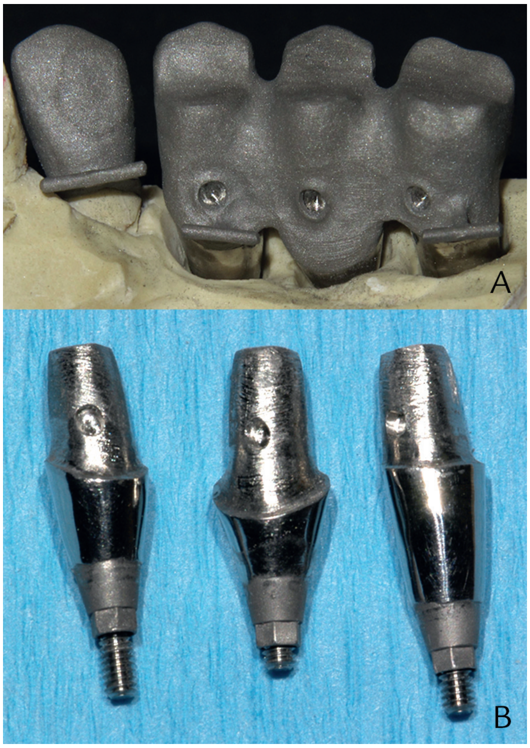

Figure 5. A, Superstructure frameworks showing aligned channel-retention features. B, Custom abutments showing channels for composite resin retention.

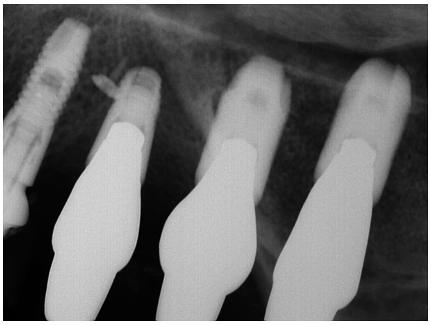

Figure 6. Parallel implants with stock abutment at the maxillary left canine site and custom, milled abutments with gingival crest margins at the premolar and molar sites.

Figure 7. Palatal view of seated superstructure before placement of composite resin into the aligned retention channels. Palatal contour of prosthesis is anatomic.

chosen to match the existing metal ceramic restorations. Priorities for the maxillary left canine site were anterior guidance contact and access for hygiene. A single crown permitted normal hygiene measurements and decreased the number of teeth splinted in the event of mechanical complications. Priorities for the maxillary left posterior sites were retrievability if complications occurred, management of adverse force from the amplified C:I ratio, and normalization of the gingival embrasures to minimize food accumulation. An interim restoration of the same design would test all factors before placing the definitive prosthesis.

A CBCT-derived stereolithographic guide (Simplant SAFE guide; Materialise) was used to place a slanted platform bone-level implant (Astra Osseospeed TX Profile; Dentsply Implants) 4.5×13 mm in the maxillary left canine site to match the buccal bone contour. Bone-level implants (Astra Osseospeed TX; Dentsply Implants) were placed in the posterior sites: maxillary left first premolar, 4.5×9 mm; and second premolar and first molar, 5×11 mm with a submerged protocol. Type III bone was noted at all sites. A vacuum-formed interim restoration (Essix ACE Plastic; Raintree Essix) incorporating the maxillary left canine original porcelain crown was provided. Five months later, palatal tissue was mobilized and shifted laterally to provide adequate keratinized gingiva. The tissue thickness was not reduced because the restorative space was already enlarged and creating ideal 3-mm sulci would incur dramatic loss of tissue with concave architecture.

Six weeks after soft tissue surgery, the implants were provisionally restored. A single cemented crown over a stock abutment was placed on the maxillary left canine implant and splinted, and screw-retained crowns were placed on the premolar and first molar implants (Fig. 4). Two months later, a maxillary, complete arch, polyvinyl siloxane definitive impression (Take 1 Advanced; Kerr Corp) was obtained with an open customized tray and impression posts (Astra Tech Abutment Pickups; Dentsply Implants). Excessive gingival dimension (8-mm maxillary left first premolar, 9-mm second premolar, and 10-mm first molar) caused tissue collapse and pain on reseating the interim restoration. Topical anesthetic and slow, buccal infiltration of local anesthetic (Articaine with 1:100 000 epinephrine; Septodont) allowed replacement of the interim restoration but resulted in several days of postoperative pain. This unusual response may have been from scar tissue formation after multiple surgeries and was significant enough to change the treatment plan so that retrieval of the definitive prosthesis would not result in the same problem. A superstructure supported by custom abutments with margins at the gingival crest

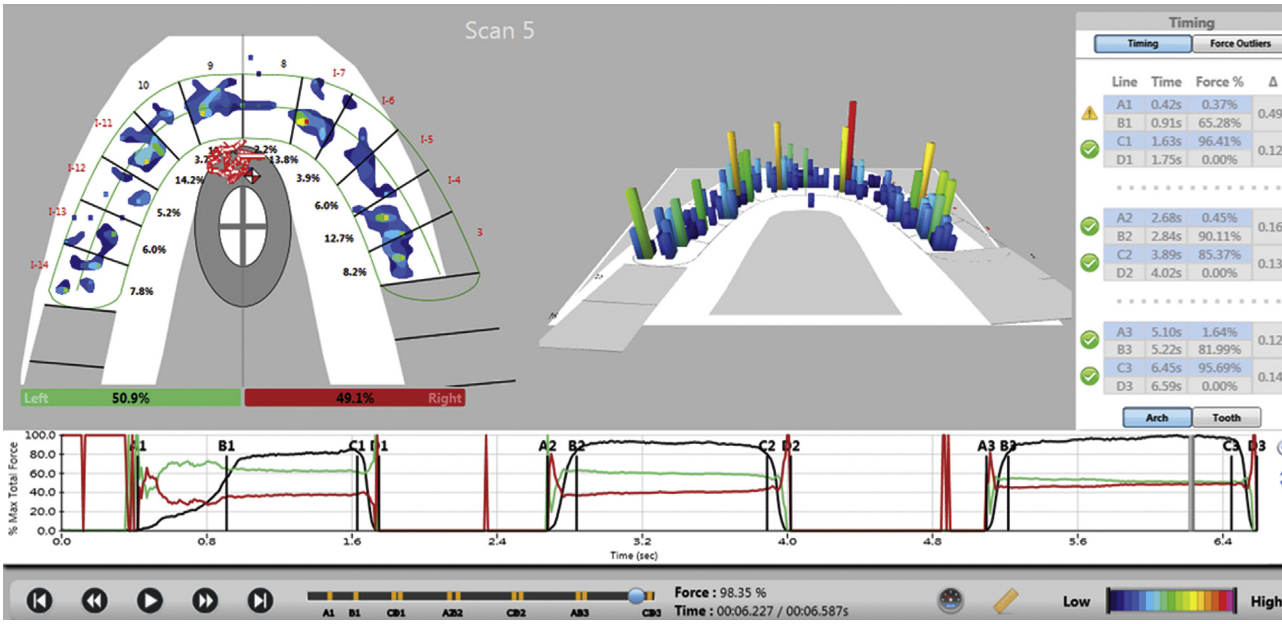

Figure 8. Computerized occlusal analysis of maxillary left channel-retained implant-supported prosthesis. Similar column heights and color of posterior sites indicate even contact on bilateral implant-supported restorations.

would avoid soft tissue trauma if the prosthesis was retrieved (Fig. 5).

Custom abutments were fabricated (AstraTech CastDesign; Dentsply Implants) with silver-palladium alloy (Pulse N3; Jensen), and complete seating was verified before tightening to 25 Ncm (Figs. 5, 6). Prosthetic frameworks were seated intraorally, and the 3-unit framework was sectioned and indexed (Pattern Resin LS; GC America), and a pickup impression was made. A second interim restoration was fabricated with the definitive superstructure design but with internal relief for interim cement retention. The framework was laser-welded (iWeld 980; Laserstar Technologies) and the porcelain completed to replicate the contours of the interim restoration. The maxillary left canine crown was cemented with zinc phosphate cement (Flecks; Mizzy Inc). Complete seating of the first premolar to the first molar superstructure was visually confirmed at the palatal margins, and the intaglio was adjusted (Fit Checker Advanced; GC America) to refine the stable, passive fit (Fig. 7). Microhybrid composite resin (Renamel; Cosmedent) was placed incrementally into the channels and light-polymerized while the superstructure was held in complete seating. Complete mouth equilibration developed multiple, even, bilateral contacts in closure and bilateral, immediate disclusion of the posterior implant-supported restorations by the canines. Traumatic occlusal interferences were avoided on the implants that had a mean C:I ratio of 2.2. The intended occlusal scheme was verified by computerized occlusal analysis (T-Scan III; Tekscan) (Fig. 8).[17] Six months after delivery, examination revealed no change in superstructure retention or porcelain contour.

SUMMARY

This clinical report presents a technique for retaining an implant-supported fixed prosthesis by connecting matching channels in the superstructure and abutments with composite resin. The prosthesis was retrievable without disturbing the soft tissue over deeply placed implants.

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Noteworthy Abstracts of the Current Literature

All-ceramic or metal-ceramic tooth-supported fixed dental prostheses (FDPs)? A systematic review of the survival and complication rates. Part I: Single crowns (SCs)

Irena Sailer, Nikolay Alexandrovich Makarov, Daniel Stefan Thoma, Marcel Zwahlen, Bjarni Elvar Pjetursson

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Objective. To assess the 5-year survival of metal-ceramic and all-ceramic tooth-supported single crowns (SCs) and to describe the incidence of biological, technical and esthetic complications.

Methods. Medline (PubMed), Embase, Cochrane Central Register of Controlled Trials (CENTRAL) searches (2006-2013) were performed for clinical studies focusing on tooth-supported fixed dental prostheses (FDPs) with a mean follow-up of at least 3 years. This was complimented by an additional hand search and the inclusion of 34 studies from a previous systematic review [1,2]. Survival and complication rates were analyzed using robust Poisson's regression models to obtain summary estimates of 5-year proportions.

Results. Sixty-seven studies reporting on 4663 metal-ceramic and 9434 all-ceramic SCs fulfilled the inclusion criteria. Seventeen studies reported on metal-ceramic crowns, and 54 studies reported on all-ceramic crowns. Meta-analysis of the included studies indicated an estimated survival rate of metal-ceramic SCs of 94.7% (95% CI: 94.1-96.9%) after 5 years. This was similar to the estimated 5-year survival rate of leucit or lithium-disilicate reinforced glass ceramic SCs (96.6%; 95% CI: 94.9-96.7%), of glass infiltrated alumina SCs (94.6%; 95% CI: 92.7-96%) and densely sintered alumina and zirconia SCs (96%; 95% CI: 93.8-97.5%; 92.1%; 95% CI: 82.8-95.6%). In contrast, the 5-year survival rates of feldspathic/silica-based ceramic crowns were lower ($p<0.001$). When the outcomes in anterior and posterior regions were compared feldspathic/silica-based ceramic and zirconia crowns exhibited significantly lower survival rates in the posterior region ($p<0.0001$), the other crown types performed similarly. Densely sintered zirconia SCs were more frequently lost due to veneering ceramic fractures than metal-ceramic SCs ($p<0.001$), and had significantly more loss of retention ($p<0.001$). In total higher 5 year rates of framework fracture were reported for the all-ceramic SCs than for metal-ceramic SCs.

Conclusions. Survival rates of most types of all-ceramic SCs were similar to those reported for metal-ceramic SCs, both in anterior and posterior regions. Weaker feldspathic/silica-based ceramics should be limited to applications in the anterior region. Zirconia-based SCs should not be considered as primary option due to their high incidence of technical problems.

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