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Prosthetic Complications in Implant Restorations

The ability to provide tooth replacement therapy based on implant support has substantially changed dentistry over the past 40 years. While the bulk of the literature is focused on the surgical aspect of care, the reality that patients live with is the prosthetic phase. A prosthesis—be it a crown, a fixed prosthesis, or an implant-retained overdenture—will be the primary measure a patient uses to assess the outcomes of care (and the monetary investment they have therein). Patients depend on accurate diagnostics, care planning, and prosthodontic restorative care, especially due to the high level of resources—in terms of both time and money—that they invest. To this end, the appropriate measures of outcomes of care are prosthetic, not surgical.

In the reviews in this issue, the comprehensive review on prosthetic failures by Sailer et al is enlightening. The authors identified technical and mechanical risks that influenced patient perceptions of care. Technical issues concerned chipping and wear, while mechanical issues related to component fracture. As outlined, the specific complication and rate of incidence depended on the size of the restoration and if it was a fixed or removable option. For single-tooth restorations (STIs), this was chipping and loss of veneering materials over the first 10 years, while abutment screw loosening and fracture were also identified as areas of concern (up to 9% in some studies). For STIs, the potential risk of fracture for ceramic abutments has been noted. Sailer et al noted similar patterns with implant-supported fixed partial dentures (FPDs). Overdentures continue to have higher maintenance issues than other options, separate from complications. Patients need to be counseled

that overdentures have many advantages but also have higher expected maintenance costs that do not qualify as complications of care. Zhang et al reported occlusal wear on all-ceramic crowns, which agreed with Sailer et al's observations, and the authors emphasized the need for close monitoring of a changing occlusion.

Another potential complication of implant prosthetics is the patient perception of esthetics. Tavelli et al emphasized the 3D assessment of the potential area for tooth replacement to predetermine the need for hard and soft tissue grafting to develop a more predictable 3D prosthetic anatomy. In a short-term study of full-arch reconstructions, Nikellis et al indicated that acrylic prosthetic reconstructions had a high rate of initial wear, especially when using a canine-guided design. Saleh et al then extrapolated the impact of prosthetic contours on implant biologic outcomes. In this review, they underscore the critical need for prosthetic contours that allow for routine hygiene. While this would appear obvious, the data reported indicated there is still room for improvement.

In a study in Japan, Kihara et al described an ongoing issue where full-arch misfitting led to screw loosening and fracture. The concern here is that this appears to be an ongoing issue that was first raised in the literature many years ago. To follow up with a slightly older study that underscores this observation, Papaspyridakos et al evaluated the cumulative rates for a "prosthesis free of minor complications" at 5 and 10 years, finding results of 60.5% (95% CI: 47.2% to 71.3%) and 8.9% (95% CI: 2.9% to 18.0%), respectively. The cumulative rates for a "prosthesis free of major technical complications" at 5 and 10 years were 85.5% (95% CI: 73.0% to 92.5%)

and 30.1% (95% CI: 12.0% to 50.6%), respectively. They identified bruxism and lack of nightguard use as being associated with chipping.

Regarding the current state of the prosthetic reconstruction of implants, it is apparent that although implants provide invaluable stability for a prosthesis, it is key to ensure that patients are aware of the maintenance and replacement of the prosthesis required over a lifetime.

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Sailer I, Karasa D, Todorovic A, Ligoutsikou M, Pjetursson BE. Prosthetic failures in dental implant therapy. *Periodontol* 2000 2022;88:130–144.

Both fixed and removable implant-supported prostheses are well-established methods for replacing missing teeth in partially or fully edentulous patients. Numerous systematic reviews have been performed in recent years to evaluate the survival and complication rates of implant-retained fixed dental prostheses and implant-retained overdentures, displaying high 5-year survival rates ranging from 97.1% for fixed dental prostheses to 95% to 100% for implant-retained overdentures. However, the survival rates only represent the prostheses remaining in use for a defined follow-up time, and do not account for the potential prosthetic complications that may have arisen and influenced the general success of the implant treatment. The most common technical complications of fixed implant-retained single crowns are crown fracture, fractures of ceramic implant abutments, and esthetic problems. The predominant technical complication at multiple-unit, implant-retained fixed dental prostheses is fracture/chipping of the veneering ceramic. Reported technical complications for implant-retained overdentures are overdenture fracture or chipping of the veneer materials, whereas mechanical complications include implant fracture, attachment failure, and attachment housing or insert complications. To reduce the risk of such failures, a comprehensive pretreatment diagnostic work-up is essential, including defining the prosthetic goal with the aid of a wax-up or set-up and the associated ideal prosthetically oriented three-dimensional implant position. Furthermore, selection of the ideal type of prosthesis, including the respective implant components and materials, is important for clinical long-term treatment success. **Correspondence to:** irena.sailer@me.com

Zhang Y, Wei D, Tian J, Zhao Y, Lin Y, Di P. Clinical evaluation and quantitative occlusal change analysis of posterior implant-supported all-ceramic crowns: A 3-year randomized controlled clinical trial. *Clin Oral Implants Res* 2023;34:1188–1197.

The purpose of this study was to compare the survival and complication rates of posterior screw-retained monolithic lithium disilicate (LS₂) and veneered zirconia (ZrO₂) implant crowns (SICs), as well as analyze the occlusal changes observed during a 3-year follow-up period. Thirty-three patients were included and randomly divided into two groups. The test group consisted of 17 patients who received monolithic LS₂ SICs, while the control group consisted of 16 patients who received veneered ZrO₂ SICs. Implant/prosthesis survival rates, technical complications, peri-implant soft tissue conditions, and quantitative occlusal changes of SIC (obtained by the intraoral scanner and analyzed in reverse software Geomagic Control 2015) were assessed at 1- and 3-year follow-ups. Bone loss and functional implant prosthodontic score (FIPS) were evaluated at a 3-year follow-up. After a 3-year follow-up period, 1 patient dropped out of the follow-up. No implant loss was observed. One crown was fractured, resulting in prosthesis survival rates of 93.75% for the monolithic group and 100% for the veneered group. A technical complication rate of 25% (4/16) was observed in the veneered group ($P = .333$). No significant differences in the marginal bone loss were observed at the 3-year follow-up (0.00 [–0.22, 0.17] mm vs 0.00 [–0.12, 0.12] mm, $P = .956$). The total FIPS scores for the test group were 9.0 (9.0, 9.0), while the control group received scores of 9.0 (8.0, 10.0) ($P = .953$). The changes in mean occlusal clearance were 0.022 ± 0.083 mm for the test group and 0.034 ± 0.077 mm for the control group at 3 years ($P = .497$). The changes in occlusal contact area were 1.075 ± 2.575 mm² for the test group and 1.676 ± 2.551 mm² for the control group at 3 years ($P = .873$). After a 3-year follow-up, screw-retained monolithic LS₂ and veneered ZrO₂ SICs demonstrated similar survival rates. The occlusal performance of implant prostheses needs to be closely examined during follow-up, and appropriate occlusal adjustments need to be considered.

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Tavelli L, Heck T, De Souza AB, Stefanini M, Zucchelli G, Barootchi S. Implant esthetic complications: Anatomical, prosthetic, and patient-centered considerations for treatment. *Int J Periodontics Restorative Dent* 2023;43:281–288.

Implant esthetic complications can negatively affect a patient's perception of implant therapy and their quality of life. This article discusses the etiology, prevalence, and strategies for the treatment of peri-implant soft tissue dehiscences/deficiencies (PSTDs). Three common scenarios of implant esthetic complications were identified and described, where PSTDs could be managed without removing the crown (scenario I), with the

surgical-prosthetic approach (crown removal; scenario II), and/or with the horizontal and vertical soft tissue augmentation and submerged healing (scenario III).

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Nikellis T, Lampraki E, Romeo D, et al. Survival rates, patient satisfaction, and prosthetic complications of implant fixed complete dental prostheses: A 12-month prospective study. J Prosthodont 2023;32:214–220.

The purpose of this study was to determine the survival rate, incidence of prosthetic complications, and patient satisfaction of implant fixed complete dental prostheses (IFCDPs) after a mean observation period of 1.4 years. A total of 28 eligible participants were recruited according to specific inclusion and exclusion criteria. The definitive metal-acrylic resin IFCDPs consisted of titanium bars veneered with acrylic resin and acrylic denture teeth. Prosthodontic complications, divided into major and minor, were monitored. Parameters such as sex, jaw location, bruxism, and occlusal scheme were evaluated. Moreover, a questionnaire was administered throughout the study to assess patient satisfaction. Poisson regression as well as repeated measures ANOVA were used for statistical analysis. A total of 14 males and 14 females were enrolled and followed-up at 3, 6, and 12 months. All IFCDPs survived (100% survival rate). The most frequent minor complication was the loss of material used to close the screw access hole (20% out of total complications). The most frequent major complication was chipping of the acrylic denture teeth (77.14% out of total complications). Sex ($P = .008$) and bruxism ($P = .030$) were significant predictors for the total major complications (major wear and major chipping), while occlusal scheme was a significant predictor for major chipping events ($P = .030$). While IFCDPs demonstrated high prosthetic survival rates, they also exhibited a high number of chipping events of the acrylic veneering material, especially in men, bruxers, and individuals with canine guidance occlusion. However, the occurrence of these prosthetic complications did not negatively affect patient satisfaction.

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Saleh MH, Galli M, Siqueira R, Vera M, Wang HL, Ravidà A. The prosthetic-biologic connection and its influence on peri-implant health: An overview of the current evidence. Int J Oral Maxillofac Implants 2022;37:690–699.

Prosthetic design is a critical step in implant treatment planning that must synchronize with implant positioning to promote a state of peri-implant health. Improperly designed prostheses may not only hinder patient (or professional) hygiene measures, but also impact the ability of clinicians to examine the peri-implant supporting tissues for diagnostic purposes. The purpose of this review was to discuss the current state of the evidence surrounding prosthetic factors associated with

peri-implant diseases. Following the chronologic order of implant treatment, key prosthetic variables were discussed in relation to peri-implant disease pathogenesis. Specific concepts including the impact of implant spatial positioning, abutment height, residual cement, and implant splinting were found to be associated with peri-implant disease pathogenesis. Excessive occlusal forces were found to play a role in susceptibility to prosthetic complications, with limited evidence to suggest a role in peri-implant disease progression. An intimate prosthetic-biologic connection exists, which must be respected to promote an environment for long-term peri-implant stability and health.

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Kihara H, Hatakeyama W, Kondo H, Yamamori T, Baba K. Current complications and issues of implant superstructure. J Oral Sci 2022;64:257–262.

The purpose of this review is to search for dental implant superstructure complications and consider the issues involved. This narrative review was performed by searching through PubMed databases and reviewing articles that were published after 1990. Misfitting of the superstructure can result in loosening of screws, reduced preload, and in some cases, significant stress around the implant. External connection modalities and single implant prostheses have been reported to have more loose or broken abutment screws. In addition, when zirconia abutment was used for platform shifting, the rate of fracture of the abutment was considered to be high. Additionally, it was reported that men were at a significantly increased risk of abutment fracture. As for the retention mechanism of implant overdenture, stud attachments (Locator type) should receive more attention to wear and damage of retention parts than other attachments. The causes of the complications of implant superstructures have not been clarified in some cases, and further verification is required. Verification of complications is considered important to obtain a long-term prognosis for superstructures of implants. It will be necessary to further verify complications of implants in the future.

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Papaspyridakos P, Bordin TB, Kim YJ, et al. Technical complications and prosthesis survival rates with implant-supported fixed complete dental prostheses: A retrospective study with 1- to 12-year follow-up. J Prosthodont 2020;29:3–11.

The purpose of this study was to report the rate of technical complications and prosthesis survival in a cohort of edentulous patients treated with implant-supported fixed complete dental prostheses (IFCDPs) after a mean observation period of at least 1 year. The single-visit examination included clinical and radiographic assessment, occlusal analysis, photographs, and a questionnaire assessing patient satisfaction in a cohort

of 52 patients rehabilitated with 71 IFCDPs (supported by 457 implants). The IFCDPs were assessed for technical complications, number of implants and cantilever extension, retention type, and prosthetic material type. A comparison was made between ceramic IFCDPs (group 1) and metal-resin IFCDPs (group 2). Kaplan-Meier survival curve analysis was carried out for assessment of prosthesis survival and was done for both groups 1 and 2 separately. The Cox proportional hazard model was used for survival analysis—adjusting for a number of potential confounders—to evaluate the association between prosthesis survival and several risk factors such as type of opposing occlusion, nightguard use, and presence of bruxism. Responses to patient satisfaction questions were compared with Fisher exact test. Out of 71 edentulous arches (52 patients) restored with IFCDPs, 6 IFCDPs had failed, yielding a cumulative prosthesis survival rate of 91.6 % after a mean observation period of 5.2 years (range: 1 to 12 years) after definitive prosthesis insertion. Three IFCDPs were lost due to implant failures after 5.8 to 11 years of functional loading. Additionally, 3 metal-resin IFCDPs failed due to technical complications. Minor complications were the most frequent complications observed, namely wear of the prosthetic material (9.8% annual rate) being the most common, followed by decementation of cement-retained IFCDPs (2.9%), and loss of the screw access filing

material of the screw-retained IFCDPs (2.7%). The most frequently observed major complication was fracture of the prosthetic material (1.9% annual rate), followed by fracture of occlusal screw (0.3%), and fracture of framework (0.3%). The annual rate of wear of prosthetic material was 7.3% for porcelain IFCDPs (n = 19/55) and 19.4% for metal-resin IFCDPs (n = 13/16), yielding a statistically significant difference between the 2 groups ($P = .01$). After a mean exposure time of 5.2 years, 91.6% prosthesis survival rates were achieved (65 out of 71 IFCDPs). The most frequent minor technical complication was wear of the prosthetic material, with an estimated 5-year rate of 49.0%, while the most frequent major complication was fracture of the prosthetic material, with an estimated 5-year dental unit-based rate of 9.5%. The cumulative rates for “prosthesis free of minor complications” at 5 and 10 years were 60.5% (95% CI: 47.2% to 71.3%) and 8.9% (95% CI: 2.9% to 18.0%), respectively. The cumulative rates for “prosthesis free of major technical complications” at 5 and 10 years were 85.5% (95% CI: 73.0% to 92.5%) and 30.1% (95% CI: 12.0% to 50.6%), respectively. Presence of bruxism and absence of a nightguard were associated with increased risk for chipping of the prosthetic material of the IFCDPs.

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