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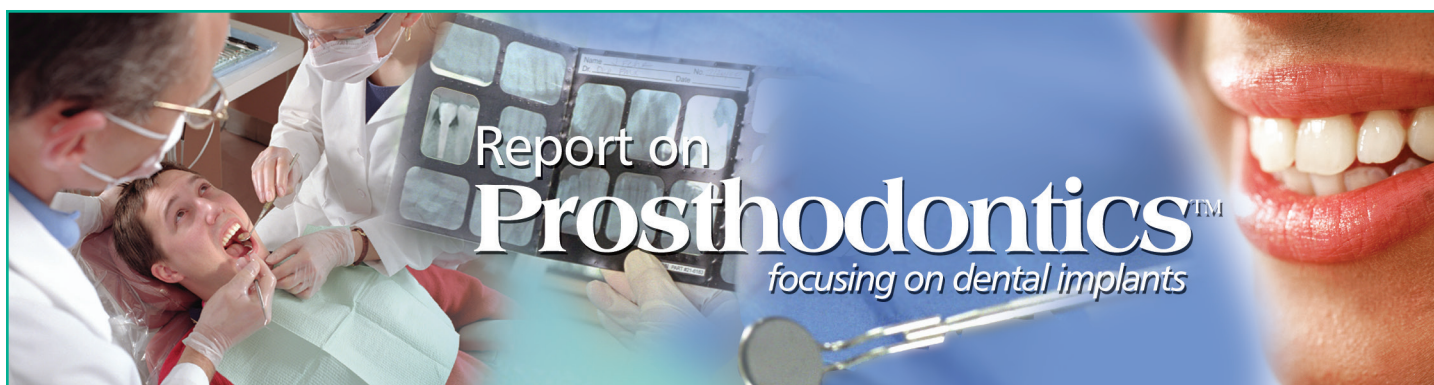
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Finding a Reliable All-ceramic Overdenture

While all-ceramic reconstructions for fixed dental prostheses on implants have become a sought-after alternative to conventional metal-ceramic restorations, long-term prosthesis success remains a question worthy of investigation. This issue of Report on Prosthodontics reviews the literature to examine prosthetic complications and the long-term survival of these types of prostheses.

Outcomes with CAD/CAM Cross-arch Zirconia Fixed Dental Prostheses

Due to its high biocompatibility, low plaque affinity, high flexural strength and esthetic appearance, zirconium oxide has gained popularity as a restorative material. Most clinical studies evaluating this material have examined single crown and fixed dental prostheses supported by teeth. However, there is a gap in the literature of medium- to long-term data about the complications and survival rates of zirconium oxide's use for reconstructions on dental implants.

Pozzi et al from the University of Rome Tor Vergata, Italy, retrospectively investigated the implant survival, prosthetic success and survival rates of implant-supported, screw-retained cross-arch zirconia-based restorations in function up to 5 years. They examined data collected from 22 consecutive patients (mean age, 68.3 years;

≥1 edentulous arches) who had received 26 restorations fabricated by computer-aided design/computer-assisted manufacturing (CAD/CAM) technology and a zirconia-based framework supported by 4 to 10 implants each.

Patients ≥18 years of age were included in the study if they had had ≥36 months' follow-up, a plaque index of ≤25%, a residual ridge that could support a dental implant 10 mm long and 3.5 mm wide, and a stable occlusion. Patients were excluded for medical or psychiatric indications, radiation therapy to the head or neck within the previous 5 years, pregnancy or nursing, smoking >10 cigarettes/day, a history of steroid or bisphosphonate therapy, alcohol or drug abuse,

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high and moderate parafunctional activity, unrelated periodontitis, poor oral hygiene, no opposing dentition or prosthesis, and cantilever lengths >10 mm.

Among the 22 patients, 4 received prostheses in both jaws, for a total of 348 fixed units (26 zirconia bridges) on 170 dental implants. The cumulative plaque score was 1%. Nine implants exhibited bleeding on probing; all 9 had been placed in 2 patients who were light smokers, which may have contributed to this result. The reported gingival index was 93% normal, 2% with mild inflammation and 5% with moderate inflammation.

No implants were lost, and all prostheses were in situ at the time of the investigation; thus, the cumulative implant and prosthesis survival rate was 100% at up to 5 years after insertion. While no prostheses required replacement, 3 of the 26 restorations had a veneering porcelain chip, resulting in a prosthesis success of 89%. This chipping occurred on 5 of the 348 units; 2 fractures were within the veneering ceramic (cohesive), while 3 fractures exposed the core ceramic material (adhesive). All areas of chipping could be managed by either recontouring the porcelain or adding a porcelain laminate veneer.

Patients were asked to rate their perception of the function and esthetics of their prosthesis on a 100-mm visual analog scale. The average score for function was 99.2; for esthetics, 98.1. Patient responses indicated that the low number of complications (chipping of veneering porcelain) had little to no impact on patient satisfaction.

The major limitation of this study was the low number of patients and prostheses examined. However, given the lack of long-term data, this report should be considered as a partial answer to the question of the long-term success of these types of prostheses. From this investigation, it does appear that this material may be a long-term option.

Clinical Implications

For rehabilitating edentulous patients, CAD/CAM-manufactured, screw-retained full-arch zirconium oxide implant restorations provide a viable alternative.

Pozzi A, Holst S, Fabbri G, Tallarico M. Clinical reliability of CAD/CAM cross-arch zirconia bridges on immediately loaded implants placed with computer-assisted/template-guided surgery: a retrospective study with a follow-up between 3 and 5 years. Clin Implant Dent Relat Res 2015;17(suppl 1):e86-e96.

Zirconia Full-arch Prostheses Used with Different Opposing Dentitions

The limited number of reports in the literature about clinical outcomes of zirconia fixed dental prostheses have often had small sample sizes with short-term follow-ups. Chipping of the veneering porcelain has been the most commonly reported complication. To investigate the possible role of the opposing dentition in causing this complication, Gonzalez and Triplett from Texas A&M College of Dentistry examined the performance of implant-retained zirconia complete-arch prostheses with various opposing dentitions.

Included in the study were 40 patients (21 women; mean age, 60 years) who needed an implant-retained complete-arch prosthesis. All had a history of recurrent tooth fracture in an existing conventional implant-retained (hybrid) denture; they received an implant-retained zirconia prosthesis produced using the manufacturer's fabrication protocols. For improved esthetics, frameworks were made using a veneer-layering technique.

Among the patients, 24 were edentulous in 1 arch, 16 in both arches. All patients received maxillary implant-retained zirconia complete-arch prostheses and were examined 3, 6 and 12 months after prosthesis placement; mean observation time was 33 months. According to dentition, patients were classified into 3 groups:

- **Group 1** (4 patients) had maxillary and/or mandibular implant-retained zirconia complete-arch prostheses; 1 had minor porcelain chipping, and 1 had a debonded metal insert.
- **Group 2** (12 patients) had maxillary implant-retained zirconia complete-arch prostheses opposing mandibular conventional hybrid prostheses. No complications were associated with the zirconia prostheses, but 16 denture teeth on the opposing prostheses fractured (Figure 1).
- **Group 3** (24 patients) had maxillary implant-retained zirconia complete-arch prostheses opposing natural dentition; 5 had minor porcelain chipping, and 1 had a debonded metal insert.



Figure 1. Examples of denture tooth fractures found on veneered acrylic teeth of mandibular conventional hybrid prosthesis opposing zirconia complete-arch prosthesis. (Reprinted with permission from Quintessence Publishing Company, Inc.; Int J Oral Maxillofac Implants 2017;32:868.)

Chipping of veneering porcelain appeared to be the most common complication in this study, regardless of whether the opposing arch had natural dentition or a prosthesis made of similar material. However, when the opposing arch had a conventional hybrid denture, the strength of the zirconia prosthesis appeared to win out, and the denture tooth appeared to be the stress breaker protecting the porcelain from chipping.

The authors noted that the debonding of the metal inserts may have resulted from the use of off-brand materials due to an inability to obtain the manufacturer's recommended metal

insert. Thus, this finding should be viewed with caution.

Clinical Implications

For completely edentulous patients, implant-retained zirconia complete-arch prostheses may be an acceptable alternative to titanium-framework acrylic-veneer prostheses.

Gonzalez J, Triplett RG. Complications and clinical considerations of the implant-retained zirconia complete-arch prosthesis with various opposing dentitions. Int J Oral Maxillofac Implants 2017;32:864-869.

Patient Outcomes for Monolithic Zirconia Fixed Dental Prostheses

Fracture of the acrylic veneer, wear or debonding of resin denture teeth, and abutment/screw loosening or fracture were common complications of the metal-acrylic fixed complete (hybrid) denture, while porcelain chipping or fracture have been noted with zirconia-based materials used for full-arch frameworks. The use of monolithic zirconia rather than a veneering 2-layer technique has been suggested as a means to overcome this chipping of the veneering material. Because few

longitudinal clinical studies of full-arch zirconia (layered or monolithic) exist, Limmer et al from the University of North Carolina School of Dentistry prospectively investigated complications of full-arch monolithic zirconia fixed dental prostheses (FDPs) supported by 4 implants.

Included in the study were 17 patients (11 men; mean age, 57.9 years; age range, 30–78 years) who were completely edentulous or who required extractions making them edentulous in both jaws. Patients were excluded if they had a history of radiation therapy to the head and neck; uncontrolled diabetes; known alcohol or drug abuse; medication use that might interfere with coagulation and/or bleeding disorders; unrealistic esthetic expectations or psychological problems that prevented the acceptance of a removable prosthesis; vertical bone height of <10 mm; smoked >10 cigarettes/day; were pregnant; or were American Society of Anesthesiology class III or IV.

New conventional dentures were initially constructed to establish functional and esthetic parameters. Four mandibular implants were placed, and a prosthesis made from monolithic zirconia was fabricated. Implant survival, prosthesis survival and complications were observed at 6 and 12 months. An oral health quality-of-life (OHQoL) questionnaire (the 49-item Oral Health Impact Profile) was administered at time of enrollment, prior to implant surgery, and at 6 and 12 months after prosthesis insertion.

One implant failed to integrate, for a 99% implant survival rate. The number of complications by type are summarized in Table 1. Chipping complications occurred only in the opposing prosthesis, not in the zirconia prosthesis. Where the zirconia cantilevers fractured, the length ratio was 1.7:1, greater than the 1.5:1 length commonly accepted as the standard, which may have created an unfavorable mechanical property leading to fracture. The vertical height of the segment in the fractured prosthesis was approximately 9 mm, smaller than the 13.2-mm mean height for the other prostheses. It has been suggested that a minimum of 12 mm is needed for vertical height of full-arch prostheses. The prosthesis that fractured did not meet this minimum.

Significant OHQoL changes indicated an improvement between enrollment and implant surgery, and at 6 months after zirconia prosthesis placement. The differences between 6 and 12 months were not significant but indicated a continued sense of improvement from baseline. While



Table 1. Number of complications by type

Type of complication	Number of occurrences
Implant failure	1
Chipped denture tooth	6
Fractured abutment	2
Loose abutment	1
Debonded FDP component	1
Fractured FDP	1
No complications	7

this article comprised data over a short term, it was one of the first publications to look at complications associated with monolithic zirconia-implant FDPs.

Clinical Implications

Monolithic zirconia FDPs represent a viable option for the edentulous mandible and warrant further study.

Limmer B, Sanders AE, Reside G, Cooper LF. Complications and patient-centered outcomes with an implant-supported monolithic zirconia fixed dental prosthesis: 1 year results. J Prosthodont 2014;23:267-275.

Monolithic Zirconia Full-arch Restorations: Pluses and Minuses

To reduce chipping complications, computer-aided design/computer-assisted manufacturing (CAD/CAM) 1-block milled zirconia has been suggested as an alternative to porcelain layering. Because little has been published to support this hypothesis, Carames et al from University of Lisbon, Portugal, conducted a retrospective case series to evaluate monolithic zirconia restorations and determine advantages and limitations of full-arch restorations.

Fourteen consecutive patients (mean age, 56 years; age range, 37–67 years) received 4 to 9 dental implants and monolithic zirconia full-arch prostheses: 12 received both maxillary and mandibular restorations; the others received only a maxillary zirconia prosthesis opposed with either natural dentition and a fixed prosthesis or a complete denture. A total of 26 edentulous arches were restored:

- 9 restorations received no veneering porcelain

- 17 restorations received veneering porcelain on the buccal surfaces of the anterior area

Recall appointments, performed after 2 weeks, 3 months (follow-up range, 3–24 months) and annually after prosthesis insertion found the following:

- no implant failures
- porcelain chipping on the buccal surface of the anterior veneered porcelain in 1 prosthesis (96% success rate) that had received anterior layering, not in the milled monolithic portion of the prosthesis
- no fractures in the monolithic zirconia portion of the frameworks
- no other mechanical complications, such as screw loosening or fracture

Clinical Implications

Monolithic zirconia CAD/CAM-milled framework restorations present a treatment option for full-arch restorations over implants.

Carames J, Tovar Suinaga L, Yu YCP, et al. Clinical advantages and limitations of monolithic zirconia restorations full arch implant supported reconstruction: case series. Int J Dent 2015;doi:10.1155/2015/392496.

Overall Conclusion

While these studies were conducted over a short term and with small sample sizes, they suggest that monolithic frameworks may hold promise. Additional data are needed to evaluate these prostheses over a longer time period.

In the Next Issue:

Loading of dental implants in augmented bone

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