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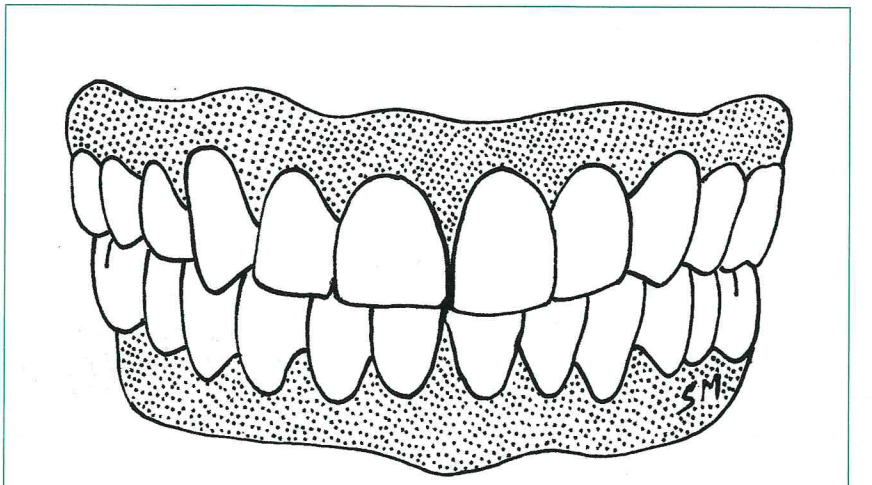


A study of immediately loaded, complete-arch, fixed, implant-supported complete dentures, supported by 4 implants, evaluated risk factors that may be associated with higher potential for implant failure. When the maxillary and mandibular arches were restored simultaneously, there was less risk for failure compared with placing a prosthesis that occluded with a mandibular natural dentition. See *FOUR-IMPLANT, IMMEDIATELY LOADED MAXILLARY PROSTHESES* inside.

Outcome of Prosthodontic Care

Many advances over the last few decades in materials and techniques have been made in treating patients with damaged or missing teeth. Evidence from clinical studies on the outcomes of these contemporary approaches can assist the dentist when recommending treatment and determining a prognosis. This issue of *Prosthodontics Newsletter* reviews a series of clinical studies devoted to the results of prosthodontic treatment of patients with missing or damaged teeth.

Prognosis for Zirconia-based Fixed Dental Prostheses

Metal-ceramic restorations have a long history of success, but many patients prefer a more esthetic restoration without a metal substructure. Currently, there are several ceramic materials that can be used to fabricate all-ceramic fixed dental prostheses (FDPs). One of these, zirconia, is a polycrystalline ceramic that can be used as a substructure for the FDP that is then veneered with an esthetic ceramic material. However, there are several problems with zirconia-based FDPs:

(continued on next page)

Inside this Issue

Prognosis for Zirconia-based Fixed Dental Prostheses

(continued from front page)

- chipping of the ceramic veneer
- strength degradation of the zirconia after long-term exposure to moisture
- abutment tooth failures
- fracture of zirconia substructure

Raigrodski et al from the University of Washington conducted a systematic review of the literature on the survival and complications reported for zirconia-based FDPs. Mean follow-up time was relatively short for the 12 clinical studies included in the review (range, 25–60 months).

Chipping of the veneering ceramics was reported in the vast majority of the studies, although 1 study that used pressable veneering ceramics reported no incidences of chipping. Complete failures of the FDPs occurred in <10% of the restorations in the 12 studies.

Comment

Chipping of the veneering porcelain appears to be the major problem reported with zirconia-based FDPs. However, these studies were conducted a number of years ago when manufacturers and dental laboratory technicians were unsure of the best approach when applying the veneering ceramics. The profession's understanding of the thermal behavior of the veneering ceramics and the underlying zirconia has improved, and it appears that with currently recommended veneer firing cycles, chipping could be less of a problem in the future.

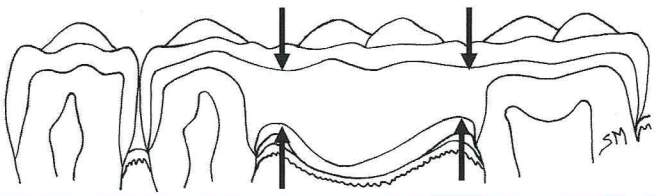
No chipping was reported in the study that used a press-on technique for the veneering ceramics. Perhaps hand layering the veneering ceramics is more likely to produce minor voids and defects in the veneer that could later lead to chipping. Pressing on the veneer is less likely to result in voids and defects.

In the reported studies, fracture of the zirconia substructures was rare. In most of the studies, the dimensions of the connectors of the zirconia substructures ranged from 9 mm^2 to 16 mm^2 (Figure 1). This range is commonly recommended by manufacturers and appears to be sound advice.

Also, the infrequent occurrence of fracture of the zirconia frameworks suggests that degradation of the zirconia may not be a problem, at least from a short-term perspective. The authors concluded that this type of restoration is a viable option that can be used as an alternative to conventional metal-ceramic FDPs.

Raigrodski AJ, Hillstead MB, Meng GK, Chung K-H. Survival and complications of zirconia-based fixed dental prostheses: a systematic review. J Prosthet Dent *2012;107:170-177.*

Figure 1. A connector's strength depends on its bulk (arrows). Manufacturers recommend dimensions from 9 mm^2 to 16 mm^2 for FDP connectors with a zirconia substructure. Bulk fracture of the zirconia substructure was rare in the 12 studies reviewed, probably because of a mechanically favorable connector design.



Four-implant, Immediately Loaded Maxillary Prostheses

Placement of 4 implants to restore a complete arch with an immediately loaded implant-supported fixed prosthesis has been advocated. The 2 anterior implants are vertically placed, and the 2 most posterior implants are inclined distally to increase the antero-posterior spread of the implant platforms and improve stability and support for the prosthesis. This approach can be used in the maxilla or the mandible, but failure rates of implants in the maxillary arch have been reported to be 5 to 6× greater than failure rates in the mandibular arch.

Parel and Phillips, private dental practitioners from Texas, conducted an evaluation of potential risk factors for implant failures in the maxilla when the 4-implant design was used. Only patients who experienced maxillary implant failures were included in the study; patients who required maxillary bone grafting were excluded.

A number of factors appeared to influence the potential for implant

resin occlusal guards for bruxist patients to protect the veneers from occlusal overload.

Beier US, Kapferer I, Burtscher D, Dumfahrt H. Clinical performance of porcelain laminate veneers for up to 20 years. Int J Prosthodont *2012;25:79-85.*

Longevity and Failure of All-ceramic Restorations

Although all-ceramic restorations are esthetically pleasing, they exhibit mechanical shortcomings, including brittleness, the potential for crack propagation and low tensile strength. There are various types of single-tooth all-ceramic restorations, such as crowns, laminate veneers, inlays and onlays.

Beier et al from Innsbruck Medical University, Austria, conducted a retrospective study of 302 patients (120 men, 182 women) to evaluate the long-term survival and failure characteristics of various single-tooth all-ceramic restorations. The participants had been examined during regularly scheduled appointments at the dental school between March and July 2010. The study sample included 470 single crowns, 318 porcelain laminate veneers, 213 onlays and 334 inlays.

Mean follow-up time for the restorations was 102 ± 60 months. Variables observed included esthetic match, porcelain surface characteristics, marginal discoloration and marginal integrity. The number of failed restorations, along with the reasons for failure, were recorded, and success rates were calculated using Kaplan-Meier survival analysis.

A total of 95 failures were recorded, the most common (33.68% of all failures) being bulk fracture of the ceramics. Pulpless teeth exhibited a significantly higher incidence of failure compared with teeth with vital pulps. Patients with bruxism habits were 2.3× more likely to experience failure compared with patients who did not exhibit parafunctional habits. No significant difference in survival was noted when the restoration type or location in the mouth was considered.

Fifty-seven (4.1%) patients rated their satisfaction with their restorations as good, and 1280 (95.9%) patients rated it as excellent. All patients, even those whose restorations failed, said they would bear the costs and time of the all-ceramic procedure again.

As for the brand of cement used, fewer failures were observed with high-viscosity Variolink cement (Ivoclar Vivadent, Amherst, NY) than with Optec Cement (Jeneric/Pentron, Wallingford, CT) and Dual Cement (Ivoclar Vivadent), both low-viscosity cements. Estimated survival rates were 97.3%, 93.5% and 78.5% at 5, 10 and 20 years, respectively.

Comment

The authors concluded that all-ceramic restorations are highly predictable and offer a favorable long-term prognosis. Although this study is not a randomized, controlled clinical trial, it offers important insight concerning factors that can influence the success and failure of all-ceramic restorations, including

- the type of cement used (high viscosity vs low viscosity)
- the existence of bruxism habits
- the pulpal vitality of the restored tooth

The large number of restorations evaluated and the long mean follow-up time also help to enhance the strength of the evidence.

Beier US, Kapferer I, Dumfahrt H. Clinical long-term evaluation and failure characteristics of 1,335 all-ceramic restorations. Int J Prosthodont *2012;25:70-78.*

In the Next Issue

- Clinical performance of removable partial dentures
- Masticatory performance with complete dentures
- Properties of denture materials

Our next report features a discussion of these issues and the studies that analyze them, as well as other articles exploring topics of vital interest to you as a practitioner.

Do you or your staff have any questions or comments about **Prosthodontics Newsletter**? Please write or call our office. We would be happy to hear from you.

Table 1. Occurrence rate of either primary or secondary contributors to implant failure (n = 41) in 20 patients

Factor	Occurrence
Opposing natural dentition	16 of 20
Opposing implant-supported complete arch restoration	4 of 20
Poor bone density	17 of 20
Male gender	15 of 20
Posterior implant	32 of 41
Bruxism	9 of 20
Smoker	4 of 20

failure (Table 1). Variables that had the highest association with implant failure and were considered to be the "highest risk" factors were male gender, opposing natural dentition and poor bone density.

The implants that failed tended to have lower insertion torque values compared with the ones that osseointegrated. Also, the vast majority of failed implants (32 of 41) were posterior implants, and failures were more commonly associated with patients with bruxism habits.

The authors suggested that patients identified as high risk for failures should be treated differently by placing additional implants to improve the support and stability of the prosthesis or eliminating the immediately loaded protocol entirely and placing a conventional removable complete denture as an interim prosthesis.

Comment

When the maxillary and mandibular arches are to be restored simultaneously with complete-arch, implant-supported prostheses, the dentist has complete control of the occlusion (see cover illustration) and can ensure the development of a favorable, biomechanically sound occlusal scheme. When existing natural teeth are present in the mandibular arch, controlling the occlusion becomes more difficult, and unfavorable forces on the maxillary implants can occur. The implant most susceptible to these unfavorable forces is the most posterior implant (because of its location and angulation), which can explain the high proportion of failed posterior implants in this study population.

Parel SM, Phillips WR. A risk assessment treatment planning protocol for the four implant immediately loaded maxilla: preliminary findings. J Prosthet Dent *2011;106:359-366.*

Clinical Performance Of Porcelain Laminate Veneers

Porcelain laminate veneers (PLVs) have been used to restore and improve the esthetic appearance of anterior teeth. First introduced in 1938 as a method to improve the appearance of an actor's teeth, the modern application of the technique with tooth preparation and resin bonding dates back to the early 1980s.

While some clinical studies on the outcome of PLVs have been conducted, long-term evaluations are relatively rare. Beier et al from Innsbruck Medical University, Austria, conducted a retrospective clinical study of silicate ceramic veneers placed by 2 associate professors at the dental school from November 1987 to December 2009. They evaluated the clinical quality, success rate, estimated survival rate and failure rate of anterior PLVs made of silicate ceramics. Eighty-four patients (38 men, 46 women) were included in the study; 318 veneers were placed, and the restorations were followed for 118 ± 63 months.

Twenty-nine failures were recorded. The predominant cause of failure was fracture of the ceramics.

Statistical analysis showed an estimated survival rate of 94.4%, 93.5% and 82.93% at 5, 10 and 20 years, respectively. The following reasons for failure were found:

- Pulpless teeth had a higher incidence of failure compared with teeth with vital pulps.
- Smokers had a significantly higher incidence of marginal discoloration.
- Bruxism habits had a major impact on the outcome of treatment, with bruxists experiencing 7.7× greater risk of failure.

Comment

The survival rates reported in this study are very encouraging. It appears that the primary variable that influenced the survival of the veneers was bruxism. The authors strongly recommended hard acrylic