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Practice Limited to Implant Surgery & Prosthodontics



Implant-supported Cantilever Fixed Partial Dentures

To provide optimal implant-based clinical care for partially edentulous patients missing 2 to 3 teeth, the practitioners must consider implant location and design of the restoration prior to implant surgery. Restrictions imposed by mesial-distal space, esthetics, ideal pontic form, soft and hard tissue maintenance, bone volume, and the desire to limit grafting procedures can often be overcome by using fewer implants and a cantilever prosthesis design. This issue of Prosthodontics Newsletter discusses this treatment planning and design concept, along with clinical outcomes.

Cantilever Restorations in the Anterior Region

Studies have shown that, in situations where placing 2 implants to replace 2 adjacent teeth is impractical, a cantilever fixed dental prosthesis can be a viable treatment alternative. However, nearly all published research has analyzed restorations in the posterior dentition; very little research has been published on cantilever prostheses in the esthetic zone. Rues et al from the University of Heidelberg, Germany, designed an in vitro study to test the fracture load of a single implant-supported cantilever zirconia crown in the anterior region.

A model missing the maxillary right central and lateral incisors was created. An experienced surgeon placed a 4.1-mm-diameter, 10-mm-long titanium

implant in the region of the central incisor. Half the implants received a cemented 2-unit crown on top of a screw-retained abutment; the remaining implants received a unified, screw-retained restoration. All of the crowns were veneered manually on the facial side. Half of each group underwent artificial aging. The implants in each of the resultant 4 groups were then tested using a universal testing device under 1 of 2 loading conditions:

- **axial loading on the pontic:** eccentric load application with the load parallel to the implant axis
- **oblique loading on the pontic:** eccentric load appli-

cation with the load tilted 45° to the implant axis

Neither noticeable screw loosening nor visible damage to the ceramic structures occurred after exposure to artificial aging. Fracture resistance for the entire assembly was >2× greater under axial loading than under oblique loading. In all cases, minimum frac-

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Cantilever Restorations in the Anterior Region

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ture resistances easily exceeded the recommended clinical thresholds. A second test measuring the fracture resistance of the cantilever restorations found that the solely screw-retained crowns significantly outperformed the cemented crowns.

Comment

The authors concluded that, within the limitations of an in vitro study, cantilever fixed dental prostheses can be a viable treatment option in the esthetic zone.

Rues S, Kappel S, Ruckes D, et al. Resistance to fracture in fixed dental prostheses over cemented and screw-retained implant-supported zirconia cantilevers in the anterior region: an in vitro study. Int J Oral Maxillofac Implants 2020;35:521-529.

10-year Results Of Cantilever Restorations

While the use of implant-supported single-unit crowns with a cantilever extension could solve certain difficulties faced in restoring the dentition, several potential complications from their use have been suggested. Among these are that the mesio-distal length of the cantilever extension and the type of opposing dentition might increase implant and prosthesis failure. But evidence proving or disproving these hypotheses has been lacking. In its review of single-unit crowns with cantilever extensions, the fifth Consensus Conference of the European

Table 1. Mechanical and technical complications.

Mechanical/technical complication	Patient-based events
Implant fracture	0 (0%)
Abutment fracture	0 (0%)
Framework fracture	0 (0%)
Ceramic chipping	2 (9.5%)
Loss of retention	3 (14.3%)
Abutment screw loosening	2 (9.5%)

Association of Osseointegration reported in 2018 that “no valid information regarding the occurrence of complications could be gathered from the literature.”

To address this information gap, Schmid et al from the University of Bern, Switzerland, published the results of a retrospective study that looked at the survival and success rates of implant-supported single-unit crowns with cantilever extensions after 10 years in service. Patients treated in a university setting who received a solid-screw implant in the premolar or molar areas restored with a cemented single-unit crown with a cantilever extension were recalled after the crowns had been in function ≥10 years. A comprehensive clinical examination included medical history; dental, periodontal and endodontic evaluations; pocket probing depth; and bleeding on probing. Radiographs revealed changes in bone at the implant site.

All implants in the 21 patients survived. None of the patients showed signs of peri-implantitis; 11 were diagnosed with peri-implant mucositis. Mechanical and technical complications were few and minor; no implant, abutment or framework fractures occurred (Table 1). Marginal bone levels did not change significantly, nor did pocket probing depth or bleeding on probing.

Comment

Although small, this study suggested that cantilever extensions with a mean length of 5.5 mm can be a reliable treatment option to restore implant-supported single crowns in posterior areas. The authors noted that all implants had a diameter of ≥4.1 mm; implants with a smaller diameter may not be able to support these restorations.

Schmid E, Rocuzzo A, Morandini M, et al. Clinical and radiographic evaluation of implant-supported single-unit crowns with a cantilever extension in posterior years: a retrospective study with a follow-up of at least 10 years. Clin Implant Dent Relat Res 2021;23:189-196.

Cantilevered Fixed Partial Dentures

Cantilevered restorations can take several forms. In addition to their use in situations where 1 implant supports a crown replacing 2 teeth, cantilevered prostheses can be used in anatomically compromised locations for fixed partial dentures in partially edentulous patients and full arch prostheses in fully edentulous patients. Storelli et al from the University of Milan, Italy, systematically reviewed the literature to evaluate

which clinical situations can be successfully treated with a cantilever fixed implant-supported restoration and what complications have been reported.

A literature search identified 9 reported studies of fixed partial dentures and 2 reported studies of single implants supporting 2 restorations with ≥10 rehabilitations each and ≥5 years of follow-up. (Studies reporting results for cantilevered restorations for fully edentulous patients were reviewed separately.) Of the 739 implants placed to support 376 fixed partial dentures, 13 failed, causing 10 failed rehabilitations, to create an estimated 5- to 10-year survival rate of 99% for the implants and 98% for the rehabilitations. Mechanical complications occurred in <2% of cases, veneer fractures in 14%, retention loss in 5% and screw loosening in 5%; peri-implantitis was reported in 4% of implants and 6% of prostheses. Estimated marginal bone loss was 0.68 mm at 5 years.

The 2 studies of single implants supporting 2 crowns included 44 restorations supported by 44 implants. Two implants were lost to peri-implantitis and 1 to implant fracture; 2 prostheses failed due to screw fracture and 2 to abutment fracture. Estimated 5- to 10-year survival rate was 98% for implants and 97% for prostheses. Marginal bone loss ranged from 0.1 mm to 2.5 mm.

Comment

This systematic review demonstrated a high success rate for cantilevered rehabilitations in partially edentulous patients. The authors felt that there was insufficient evidence at the time the review was undertaken (2018) to reach a definitive conclusion for their use to restore 2 adjacent edentulous sites.

Storelli S, Del Fabbro M, Scanferla M, et al. Implant supported cantilevered fixed dental rehabilitations in partially edentulous patients: systematic review of the literature. Part 1. Clin Oral Impl Res 2018;29(suppl. 18):253-274.

Two-unit Cantilever FPDs

In patients with 2 missing teeth in the posterior maxilla or mandible, the ideal solution would be to place 2 single-tooth implant-supported crowns. Unfortunately, some patients present with a too-narrow diastema or without enough bone volume to support 2 implants. A possible solution to this problem involves placing 1 implant with a crown extended by a mesial or distal cantilever. Such crowns, however, risk overloading the implant and superstructure, which could lead to biological and technical complications.

To evaluate this treatment option, Jensen-Louwerse et al from the University of Groningen, the Netherlands, conducted a retrospective analysis of patients treated at a single practice who received a single implant-supported 2-unit cantilever

fixed partial denture (FPD) in the posterior region. A standardized surgical protocol was used to place a 4-mm-diameter implant with a height ranging from 8 mm to 13 mm, depending on the height of the bone. Twelve weeks after implant placement, a healing abutment was placed. Four weeks later, the implant was restored with either

- a titanium individual abutment and a cemented metal- or zirconia-based porcelain FPD with cantilever or
- a metal- or zirconia-based porcelain FPD with cantilever screw retained directly to the implant.

Measured outcomes included implant survival rate, marginal bone level, plaque level, bleeding, probing depth, gingival health, biological and technical complications, and patient satisfaction.

Follow-up ranged from 1 year to 14 years, with a mean of 6.5 years. All 28 implants survived, and all FPDs were in function through the final follow-up. Marginal bone loss was small, with tooth location and cantilever direction having no significant influence. Plaque, calculus and gingiva scores, along with bleeding index, were low. While technical complications were few, the rate of peri-implant mucositis was high (Table 2).

Table 2. Biological and technical complications of single implant-supported 2-unit cantilever FPDs.

Biological complications	
Implant failure	0%
Peri-implant mucositis	89.3%
Peri-implantitis	17.9%
Technical complications	
Restoration failure	0%
Cement loosening	3.6%
Screw loosening	3.6%
Fracture of veneering ceramics	7.1%



The type of restoration had no effect on any of the outcomes.

Comment

This report showed that single implant-supported FPDs with a mesial or distal cantilever can be an effective treatment option in the posterior region with only minor technical complications. Patients reported a high level of satisfaction with their treatment.

Jensen-Louwerson C, Sikma H, Cune MS, et al. Single implant-supported two-unit cantilever fixed partial dentures in the posterior region: a retrospective case series with a mean follow-up of 6.5 years. Int J Implant Dent 2021;doi:10.1186/s40729-201-00361-8.

Two Short Implants vs One with a Cantilever

Limited available vertical bone height in the posterior area, often caused by the maxillary sinus or the inferior alveolar nerve, creates challenges for implant placement. This difficulty is compounded when the patient lacks 2 adjacent teeth. The treatment of choice has been to place 2 adjacent short, single-tooth implants.

However, when confronted with an unfavorable anatomy at the alveolar ridge—limited mesio-distal space, preexisting bone deficiency, proximity of the maxillary sinus or alveolar nerve—the use of a single implant with a cantilever may be a better solution. Yet questions remain as to whether a short implant with a cantilever provides results similar as the use of 2 adjacent short implants.

To gain better insight into this situation, Thoma et al from the University of Zurich, Switzerland, designed a prospective, randomized control study comparing 5-year results of the alternative treatments. They enrolled 36 consecutive patients with 2 adjacent missing teeth in either jaw from the first premolar to the second molar who had enough vertical bone height to allow the placement of two 6-mm-long implants.

The patients were then randomized to receive either 1 or 2 short implants using a standard protocol including, when necessary, guided bone regeneration. Using a conventional loading protocol, the implants were restored with either 2 nonsplinted single crowns or a single crown with cantilever.

Following insertion of a screw-retained porcelain-fused-to-metal prosthesis, patients were examined at 1 to 3 weeks (baseline), 6 months, 1 year, 3 years and 5 years. In the cantilever group, 1 implant failed soon after crown delivery, and another, failed 6 months after baseline; in the 2-implant group, 2 implants failed after the 3-year follow-up. At 5 years, implant survival rate was 84% in the cantilever group and 80% in the 2-implant group.

Clinical outcomes did not differ significantly between the groups, nor did rates of technical complications (primarily screw loosening and chipping) or incidence of peri-implant mucositis. No cases of peri-implantitis were reported.

Comment

While this study had several limitations, the results showed that short implants with a cantilever restoration had outcomes similar to those

achieved with 2 single-crown short implants. The fact that failures occurred earlier in implants with the cantilever restoration, however, could suggest an overload of the implants.

Thoma DS, Wolleb K, Schellenberg R, et al. Two short implants versus one short implant with a cantilever: 5-year results of a randomized clinical trial. J Clin Periodontol 2021;48:1480-1490.

In the Next Issue

Implant-tooth supported fixed dental prostheses

Our next report features a discussion of this issue 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.

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