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Esthetics and the Anterior Single Implant Restoration

In many ways, esthetic potential drives modern restorative dentistry as much as does functional improvement, especially in the anterior dentition. Successful practitioners require a broad understanding of diagnostic factors that will affect esthetic outcomes and must account for these factors early in patient management, well before therapeutic interventions have taken place. This issue of Prosthodontics Newsletter focuses on factors influencing the esthetics of anterior single-implant restorations and the need for practitioners to appreciate the multiple esthetic factors affecting outcomes.

Individualized CAD/CAM Abutments

Although single-tooth implants have excellent survival rates, their survival is frequently accompanied by a loss of peri-implant marginal bone. Immediate implantation accompanied by restoration in the extraction socket may reduce soft and hard tissue recession of the alveolar ridge, thereby minimizing initial bone remodeling. While depth of bone support and peri-implant soft tissue are key factors in the health and function of implants, integrating peri-implant soft tissue is essential for restorations in the esthetic zone.

To assess whether individualized healing abutments lead to better clinical, radiographical and esthetic outcomes, Wang et al from Tongji University, China, compared outcomes using pre-

fabricated abutments and abutments created using individualized computer-aided design and manufacturing (CAD/CAM).

Patients requiring a dental implant to replace a lost maxillary incisor were randomly allocated to 1 of 2 groups. After the same sized implant was inserted into the socket, one group received an individualized healing abutment created using a CAD/CAM program immediately after dental implantation; the other group received a submerged prefabricated healing abutment. Six months later, members of the first group entered the restoration stage; after 6 months,

the healing abutments of the second group were removed and, 4 weeks later, these patients entered the restoration stage. All patients were seen for follow-up at 1, 6 and 12 months after crown insertion.

Comment

Marginal bone levels varied significantly between groups at all time points. Probing depths were

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Individualized CAD/CAM Abutments

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significantly less, while mesial and distal papilla height were significantly higher for the individualized abutment group. That group also showed a significantly greater improvement in the pink esthetic score (Table 1). Patient satisfaction was slightly greater in the individualized abutment group, but the difference did not reach statistical significance.

When treatment was used with an immediate protocol, both abutment groups showed a high survival rate and few complications, along with a shortened treatment duration and the elimination of the need for additional stage-2 surgery. The use of a personalized CAD/CAM healing abutment at the time of implant placement supports the papilla, protects the bone and bone substitutes after guided bone regeneration, and inhibits bacterial penetration, allowing soft tissue remodeling and osseointegration. The use of these abutments better guided soft tissue to form a natural-looking gingival profile and limit bone loss.

Wang L, Wang T, Lu Y, Zhen F. *Comparing the clinical outcome of peri-implant hard and soft tissue treated with immediate indi-*

vidualized CAD/CAM healing abutments and conventional healing abutments for single-tooth implants in esthetic areas over 12 months: a randomized clinical trial. Int J Oral Maxillofac Implants 2021;36:977-984.

Color Changes With Zirconia And Titanium Abutments

Prefabricated titanium abutments have several advantages, especially ease of use, but they come with several disadvantages, among them overcontouring and a deeper cementation line, which can contribute to ineffective removal of excess cement. Some reports suggest that titanium abutments cause a “graying effect,” a discoloration in the peri-implant mucosa, in patients with thin gingival biotypes. The white coloration of zirconia abutments may be a solution to the graying effect.

de Moura Costa et al from the Federal University of Goiás, Brazil, conducted a systematic review and meta-analysis to evaluate the influence of titanium and zirconia abutments on peri-implant soft tissue color. Of randomized clinical trials and controlled clinical trials that

directly compared zirconia and titanium abutments for color outcomes, 8 randomized clinical trials were published between 2009 and 2018 that were suitable for quantitative analysis and used spectrophotometric evaluation to analyze color changes in soft tissue after the crown had been placed.

All studies found discoloration in restorations using zirconia and titanium abutments compared with contralateral teeth. The meta-analysis found no significant difference in soft tissue discoloration between zirconia and titanium abutments as measured by spectrophotometry. However, in 3 of the 8 studies, the zirconia abutments showed a better color match with the soft tissue of natural teeth than did the titanium abutments. In 2 studies, zirconia abutments in the anterior region were a better choice where the gingival thickness was <2 mm, promoting less color change.

Comment

These results suggest that, when an implant is placed in a location with a gingival thickness of 3 mm, neither titanium nor zirconia abutments cause a noticeable change in color, but a less-than-perfect esthetic outcome may result with either type of abutment in gingival biotypes <2 mm thick. Perhaps a soft tissue augmentation procedure

Table 1. Mean values for peri-implant soft tissue parameters for patients receiving individualized healing abutments (test group) and prefabricated healing abutments (control group).

	6 months after implant placement		Loading		1 year after loading	
	Test	Control	Test	Control	Test	Control
Probing depth	1.36	3.09	1.14	2.14	0.93	1.32
Mesial papilla height	4.00	2.50	3.93	2.59	4.06	2.64
Distal papilla height	3.56	2.27	3.50	2.22	3.56	2.09
Pink esthetic score	11.44	9.18	12.50	9.91	11.67	10.82

All values statistically significant between test and control groups.

might be considered in the treatment planning of these situations.

de Moura Costa PV, Ferreira MS, Veríssimo C, et al. Is zirconia better than titanium abutments for soft tissue color? A systematic review and meta-analysis of spectrophotometric evaluation. Int J Oral Maxillofac Implants 2021;36:875-884.

Esthetics of Anterior Single-Tooth Implants

Single-tooth implant therapy frequently replaces nonrestorable maxillary anterior teeth. For the patient, the esthetic outcome is the important consideration. Although practitioners tend to critically evaluate implant esthetics, the measures they use tend to correlate with patient perceptions, with the papillae and facial gingival margins key parameters. There are 4 risk factors that can affect peri-implant facial mucosal stability:

- improper facial implant position
- thin soft tissue biotype
- thin buccal bone plate
- smoking

Any of these factors may warn of the potential of facial peri-implant mucosa instability and suggest the need for extra therapies to enhance esthetic outcomes.

While a relationship between peri-implant mucosal changes and peri-implant bone changes is assumed, few data support this thesis. To address this, Cooper et al from the University of Illinois at Chicago undertook a 5-year prospective randomized clinical trial to compare peri-implant tissue stability

Table 2. Mean marginal bone level changes after implant placement (in mm).

	Conical interface	Flat-to-flat interface	Platform-switched interface
Crown placed	-0.19	-1.20	-1.12
At 6 months	-0.17	-1.13	-1.24
At 1 year	-0.22	-1.20	-1.32
At 2 years	-0.09	-0.88	-1.10
At 3 years	-0.12	-1.02	-1.04
At 4 years	-0.19	-0.80	-0.91
At 5 years	-0.16	-0.92	-0.81

and marginal bone response with 3 different implant-abutment systems.

Trial participants were treated for a single missing anterior tooth using an immediate provisionalization protocol using 1 of 3 implant systems:

- conical interface system
- flat-to-flat interface system
- platform-switched system

They received zirconia implants and pressed lithium disilicate crowns cemented using a resin-based cement. At 6, 12, 36 and 60 months, patients returned for clinical and periapical radiographic evaluations. The primary outcome measure was peri-implant mucosal change from baseline that includes implant survival, marginal bone level alterations at the mesial and distal aspects of the implant, soft tissue changes, plaque index, bleeding on probing, and probing depths.

Of the study's 141 implants, 14 (8 flat-to-flat, 6 platform-switched) were lost during the first year from a failure to osseointegrate. At the 5-year follow-up, conical interface implants experienced significantly less mean marginal bone loss, as well as fewer implants with >1 mm marginal bone loss (Table 2). No peri-implant mucosal recession

was seen; changes in peri-implant mucosal levels were small and without clinical relevance, with the 3 groups showing similar results. All soft tissue parameters were similar for the different implant systems.

Comment

The results of this study indicate that marginal bone loss, which was significantly greater in the flat-to-flat interface and the platform-switched systems, does not correlate with peri-implant mucosal loss. After 6 months, peri-implant tissues stabilized and there were minimal changes over the ensuing 5 years.

Cooper LF, Reside G, DeKok I, et al. A 5-year esthetic RCT assessment of anterior maxillary single-tooth implants with different abutment interfaces. Int J Oral Maxillofac Implants 2021;36:165-176.

Mucosal Color Changes with Implants

Successfully used for several decades for both implants and abutments, titanium can create a grayish discoloration in thin peri-implant mucosa. This color shift can



be prevented by using zirconia abutments, whose color is similar to that of natural teeth. Gehrke et al from Johann Wolfgang Goethe University, Germany, conducted an in vitro study to assess the extent of mucosal discoloration caused by different abutment materials and determine the influence of mucosal thickness on the resulting color.

The researchers created 6 sets of 5 × 5 mm disks made up of the following materials: titanium alloy, titanium alloy covered with veneering ceramic, titanium nitride, titanium nitride covered with veneering ceramic, zirconia and zirconia covered with veneering ceramic.

Disks with a ceramic veneer were 2 mm thick; those without were 1 mm thick. Soft tissue grafts with 1.5, 2.0 and 3.0 mm thicknesses were harvested from a porcine maxilla. The researchers conducted a colorimetric analysis of all combinations of disk and tissue graft, with a control value based on an analysis of a tissue graft without an accompanying disk.

At tissue thickness of 1.5 mm, both titanium nitride and zirconia disks showed a value significantly below the reference threshold—color changes perceptible to the human eye—while the titanium alloy showed a mucosa discoloration significantly above the reference threshold. Despite significant differences in the colorimetric analysis at other tissue thicknesses, all values fell below the reference threshold, as did values for all veneered disks in all combinations.

Comment

These results show that the titanium nitrite-coated abutments combine the strength of titanium alloy abutments, and the absence of soft tissue color shift found in zirconia abutments and

the procedures used to create porcelain veneers on the abutment may alter the precision of the implant–abutment connection. Because of the limitations of a spectrophotometric in vitro study, larger investigations performed under controlled and standardized conditions are needed.

Gehrke P, Zimmermann K-P, Weinhold O, et al. Optical efficacy of titanium nitride-coated abutment material on soft tissue discoloration: a spectrophotometric in vitro analysis. Int J Oral Maxillofac Implants 2021;36:e91-e96.

Implant- vs Tooth-supported Crowns

Wittneben et al from University of Bern, Switzerland, conducted a systematic review and meta-analysis to compare patients' esthetic outcomes for implant- and tooth-supported single crowns in the esthetic zone, along with how the choice of crown material, implant type and provisional crown delivery influences patient-reported outcome measures.

After an electronic and hand search of the available literature, the authors found 22 studies covering 29 patient cohort results from 1270 implant- and 486 tooth-supported crowns. For the implant-supported crowns, the type of implant, method of crown retention, type of abutment and composition of the crowns varied from study to study. Tooth-supported crowns were made either of veneered zirconia or of lithium disilicate.

Patients reported a 94.3% level of esthetic approval with tooth-supported crowns vs a 90.1% approval with

implant-supported crowns. The difference approached but did not reach statistical significance. A meta-analysis revealed that the type of restorative material, the type of implant and the presence of a provisional crown, as well as the crown composition on the tooth-supported restorations, had no statistically significant effect on patient restoration.

Comment

This systematic review showed that patients are highly satisfied with the esthetics of both implant- and tooth-supported crowns as well as the mucosa around the implants. Despite a tendency toward patient preference for tooth-supported crowns, that tendency did not reach statistical significance.

Wittneben J-G, Yilmaz B, Wismeijer D, et al. Patient-reported outcome measures focusing on the esthetics of implant-compared to tooth-supported single crowns—a systematic review and meta-analysis. J Esthet Restor Dent 2023;35:632-645.

In the Next Issue

Esthetics and full-arch implant restorations

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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