ESTHETIC EVALUATION OF MATERIALS USED TO FILL ACCESS HOLES OF SCREW-RETAINED IMPLANT CROWNS

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The access hole of screw-retained dental implant crowns presents an esthetic obstacle for the restorative dentist. Few if any studies have compared the different materials used for access hole restoration. Our objective was to investigate the esthetic value and acceptability of both commonly used and innovative access hole filling materials from the perspectives of both the patient and the dentist. One cement-retained crown and 5 screw-retained crowns were prepared on maxillary models. Access hole filling materials included dentin composite, resilient composite (F), enamel composite, dentin composite with opaquer, and resilient composite with opaquer (FO). Subjects for this study were recruited from a convenience sample of laypersons (n = 50) and dentists (n = 25). All subjects evaluated the 6 restorations on a visual analog scale (VAS) and determined the acceptability of each. Dentists yielded equal or higher mean acceptability ratings compared to laypersons for all casts; dentist ratings were an average of 18% more acceptable. Dentists also yielded higher mean VAS esthetic values on all casts, with an average value that was 7.5 points higher than that of laypersons. Resilient composite coupled with opaquer, compared to resilient composite alone, yielded improved values. Visual analog scale esthetic values increased from 13.8 and 24.6 (F) to 63.5 and 65.6 (FO) between laypersons and dentists, respectively. Acceptability improved from 12% and 36% (F) to 76% and 88% (FO) between laypersons and dentists, respectively. Both laypersons and dentists are able to detect significant esthetic differences in the materials used to fill the access holes of screw-retained dental implants. The data showed that using a small amount of opaquer in combination with filling materials makes a significant esthetic improvement in the implant restoration.

Key Words: dental implant esthetics, access hole, restorative materials, opaquer

INTRODUCTION

The access holes of screw-retained dental implant crowns present an esthetic obstacle for restorative dentists (Figure 1). The technique of filling the access holes has been investigated, but little research has focused on comparing the esthetics of the different filling materials. If screw retention is used, the access hole must be filled to help insures the success of the implant restoration; however, many times the esthetics of the restoration are compromised in order
to maintain its functionality.\textsuperscript{2} Many commonly used dental restorative materials are relatively translucent and are unable to completely mask the dark, underlying metal oxide layer lining the access hole.\textsuperscript{3} These materials include a variety of composites, such as dentin, enamel, and resilient composites. Maintaining the function and retrievability of the implant crowns is important, but attention also needs to be given to providing a crown that is esthetically acceptable to the patient. Therefore, it seems valuable to know if patients and dentists are able to detect a significant difference between these composite filling materials, and if so, it would be worthwhile to determine which materials are viewed as esthetically acceptable by each group.

This study aimed to investigate different materials and layering strategies that can be used to fill the screw access holes of screw-retained implant crowns, with the goal of bridging the gap between esthetics and retrievability.\textsuperscript{4–6} Specifically tested was the use of an opaquer to decrease the translucency of restorative materials. A second aim of this study was to determine if laypersons and dentists can detect significant differences between materials and if there were significant differences between the layperson and dentist perspectives. Specifically evaluated were 5 filled screw access holes, each of which used a different material, and 1 cement-retained crown. The primary hypothesis tested states that both laypersons and dentists are able to detect differences among the various materials; the secondary hypothesis states that patient and dentist perspectives also differ.

**Materials and Methods**

Two groups of subjects were tested in this study: convenience samples of 50 laypersons and 25 dentists. Institutional review board approval was requested and granted. All layperson subjects were over the age of 18 years, and all dentist subjects were either general practitioners or prosthodontists. Each subject was presented with 6 maxillary casts, with a single tooth implant at position 5. Each of these implants was restored with nearly identical implant crowns, and each of the screw access holes was filled with a different material.

**Access hole filling procedure**

The access holes of each of the 5 screw-retained crowns were filled with one of the materials tested, including dentin composite (DC), enamel composite (EC), resilient composite (F), dentin composite with opaquer (DO), and resilient composite with opaquer (FO). A small cotton pellet was placed at the bottom of the access hole to protect the top of the retention screw. A thin layer of F (Fermi, Ivoclar Vivadent, Schaan, Liechtenstein) was then placed on top of the cotton to seal the access hole. In the case of EC and DC, the DC (Herculite A2 dentin, Kerr, Orange, Calif) or EC (Herculite A2 enamel, Kerr) was then placed on top of the layer of the F. In the case of F, the access hole was completely filled with F. In the case of DO and FO, a thin layer of opaquer (OP1, Pulpdent, Watertown, Mass) was painted around the access hole on top of the resilient layer and then the F or DC was added to the top. Minimal to no finishing and polishing were completed in order to more closely simulate the actual clinical situation. Figure 2 shows a diagram of the filling strategies and Figure 3 shows the occlusal perspective of the finished restorations.

**Subject surveys**

Subjects were asked to evaluate each of the 6 casts, focusing only on the occlusal esthetics of the position 5 implant restorations. All subjects evaluated the restorations on a visual analog scale (VAS) according to esthetic value only, and subjects also stated whether each of the 6 restorations was acceptable or unacceptable.

The 100-mm VAS, pictured in Figure 4, was used to obtain esthetic value data for each of the 6 casts. Laypersons and dentists alike were asked to view the 6 different casts as a group and to give each cast an esthetic value by placing a mark on the VAS. They were informed that an 0 would correspond to an unfilled access hole and a value of 10 would correspond to an undetectable hole. The distance from the far left end of the VAS to the subject’s mark was measured to establish the specific esthetic value, equating to the length (in millimeters) from the left end of the scale to the mark. Subjects were also asked to indicate whether each restoration was acceptable or unacceptable. Layperson subjects were asked to consider acceptability based on having the restoration in their own mouth, and dentist subjects were asked to base acceptability on providing the restoration to one of their patients.

To assess reliability, all subjects were then asked to evaluate the same group of 6 casts a second time; they were not told that they were evaluating the same 6 casts. The 6 casts were randomly assorted between the first and second evaluations.

**Statistics**

Intrarater reliability for both subject groups was calculated using an intraclass correlation coefficient for the VAS data and a simple kappa statistic for acceptability data.
A factorial analysis of variance and the Tukey-Kramer procedure were used to compare the VAS data. Between-cast percent acceptability data were analyzed using multiple McNemar tests, with P-values adjusted using the step-down Bonferroni method of Holm. Results were considered significant if P < .05.

**RESULTS**

Reliability for the VAS scale was excellent for lay dental subjects, with intraclass correlation coefficients of 0.91 and 0.93, respectively, for all casts. For the acceptability scale, overall kappa values were again excellent, with values of 0.81 and 0.92 for the lay and dental subjects, respectively.

Figure 5 shows the mean esthetic values (VAS data) for both layperson and dentist subject groups. The layperson subject group yielded significant differences (P < .05) in VAS esthetic values when comparing all casts, except between DO and FO. With regard to the dentist subject group, significant differences (P < .05) in VAS esthetic values were found between all casts, except between DO and FO and DC and FO.

Figure 6 shows the mean acceptability data for the layperson and dentist subject groups. For the lay group, significant differences in acceptability were found between all groups, except the following: DC and FO, DO and cement-retained (CR), DO and FO, and F and EC. The dentist group showed significant acceptability differences for only 4 comparisons: DC and FO, DO and cement-retained (CR), DO and FO, and F and EC.
and F, DO and F, F and CR, and F and FO. The Table shows the $P$-values of the cast comparisons. Both the esthetic value and the acceptability scores improved with the use of the opaquer. For the laypersons, DC went from 44.8 to 65.9 when coupled with the opaquer (DO). The dentists' esthetics scores improved from 56.1 (DC) to 71.7 (DO). Acceptability improved from 54% and 80% (DC) to 88% and 88% (DO) between laypersons and dentists, respectively.

The evaluation of the F also improved when used with the opaquer. Layperson esthetic values increased from 13.8 (F) to 63.5 (FO), and dentist esthetic values increased from 24.6 (F) to 65.6 (FO). Acceptability improved from 12% and 36% (F) to 76% and 88% (FO) between laypersons and dentists, respectively.

**DISCUSSION**

The results of this study support the hypothesis that both laypersons and dentists are able to detect differences among filling materials. Figures 5 and 6 and Table 1 contain the VAS and acceptability data for both laypersons and dentists. The layperson subject group yielded significant differences ($P < .05$) in esthetic values (VAS) of all but one of the material comparisons, and all but 4 acceptability comparisons showed significant differences. Dentists showed significant differences in all but 2 esthetic value (VAS) comparisons and found significant differences in 4 of the 15 acceptability comparisons.

The secondary hypothesis that patient and dentist perspectives show significant differences is also supported by the data from this study. The fact that dentists deemed the restorations to be overall more acceptable than did laypersons is likely the reason that dentists found fewer significant differences among materials. On average, dentists are more familiar with materials and are more likely to look at the practicality of the restoration, despite the esthetics. Laypersons, on the other hand, tend to be more critical of the esthetics of the materials, a fact that is supported by the many significant differences in esthetic values and acceptability among the layperson subject group. The increased layperson scrutiny is also supported by the fact that, on average, dentists rated casts 7.5 points higher and 18% more acceptable than did laypersons.

So once again we pose the question: How do we begin to bridge the gap between esthetics and retrievability? One possibility that was investigated in this study involved using a layering strategy (involving an opaquer underneath the composites) to help

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**TABLE**

List of the $P$-values obtained by comparing the mean esthetic and acceptability scores from each of the casts. Significant adjusted $P$-values ($P < .05$) indicated by bold type.

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*VAS indicates visual analog scale.
diminish the translucency of the composites. The opaquer was coupled with both the DC and the F in this study. In both opaquer cases, there was remarkable improvement in both esthetic value and acceptability when compared to the DC and F used without the opaquer. The DO offered improvement over DC of 21 VAS esthetic points among laypersons and of 16 points among dentists when coupled with the opaquer. The DO was also 14% more acceptable according to laypersons and 8% more acceptable according to dentists when compared to DC.

Possibly the most significant findings of this study are associated with the scores of the F compared with the FO. Because the F has the best retrievability of access hole filling materials, it seemed important to investigate possible ways to improve this material’s relatively poor esthetics. The results show, however, that a very sizable improvement was noticed by subjects when using the FO.

Mean VAS esthetic values between F and FO increased 44 points (F = 19, FO = 63) among laypersons and 41 points (F = 25, FO = 66) among dentists. The acceptability of FO also improved dramatically when compared to F. Laypersons noted a 64% (F = 12%, FO = 76%) improvement and dentists a 52% (F = 36%, FO = 88%) increase in acceptability. These large improvements could prove to be very important to the way access holes are filled. If dentists are able to retain the ease of retrievability that the F provides while facilitating the simple and practical addition of an opaquer to drastically improve esthetics, restoring dentists might be able to provide an even better restoration to their patients.

Conclusions

The finding of this study supported the idea that the general public is able to detect esthetic differences in the materials used to fill the access holes of screw-retained dental implants. The results help to support the notion that dentists view implant restorations as having greater esthetic value and greater acceptability than do the layperson subjects. The results also support the notion that using a small amount of opaquer along with a standard access hole filling material provides drastically improved esthetics.

References

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