

Trends in Restorative Materials for Full Crown Coverage

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Abstract

The trends in numbers of full coverage restorations fabricated over the 6-year period of 2015 to 2020 are presented. The data indicate that not only are CAD/CAM fabricated zirconia restorations the treatment of choice in preference to PFMs and all metal (gold) crowns but also to Emax restorations. Further, the data show that the numbers of patients receiving permanent zirconia restorations steadily increased on the period of 2015 to 2020, but that the numbers of these restorations greatly exceeded the numbers of other types of full contour restorations, and the decrease in the number of these restorations that were fabricated, over the same period.

Keywords: CAD/CAM; Restorative Materials; Full Crown Coverage

Introduction and Methodology

Full coverage crowns ideally satisfy many criteria (Table 1).

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| <ul style="list-style-type: none"> • Restoration of function • Conservation of hard tissue • Strength • Chemical resistance • Satisfactory esthetics • Ability to match existing dentition • Ease of processing • Economical cost • Resistance to stains and plaque build-up • Accuracy of fit • Biocompatibility • Clinical durability and longevity |
|---|

Table 1: Criteria for a successful full contour crown restoration.

However, despite the valiant efforts of the dental profession, dental technicians, biomaterials scientists and dental manufacturing companies over the past century or so, every practicing dentist knows that there is no ideal restorative material [1,2].

High gold alloys have many advantages including the fact that gold crowns can be annealed (softened) to facilitate marginal adaptation and fit, and then can be hardened by heat treatment to improve strength and performance. However, these crowns must be cast, lack esthetics in the anterior region of the mouth, and are costly in terms of laboratory processing and materials cost. Gold crowns, however, can be relatively thin and conserve hard tissue in tooth preparation.

All-porcelain crowns possess adequate strength, are clinically satisfactory and can be customized to satisfy the need for esthetic anterior restorations [1-3], but they are unsuitable for posterior restorations based on strength considerations. Further, all-porcelain restorations tend to be bulky and require more hard tissue removal to provide sufficient space to accommodate thicker restorations to ensure adequate crown strength. Further, achieving an esthetic result and satisfactory clinical fit is challenging for both dental technician and dentist. Material costs *per se* are moderate but laboratory processing fees can be expensive, and their clinical survival rate is reported to be significantly lower than that of metal crowns [4]. In contrast, all-ceramic restorations and notably those fabricated from zirconia have a markedly superior clinical performance. In particular, zirconia with a compressive strength of ca. 1200 - 1400 MPa is significantly stronger than porcelain and aluminous porcelain (with compressive strengths of ca. 350 and 170 MPa respectively) and, therefore, can be used in the posterior region [1,2]. Further, because of their significantly greater strength and superior mechanical properties compared to the majority of esthetic restorative materials, preparation designs can be far more conservative, requiring only a minimum crown thickness of 0.7 mm of zirconia to be satisfactory in clinical service. The other major advantages of zirconia are that restorations can be fabricated using CAD/CAM technology and that restorations can be tailored to match the existing dentition.

The metallo-ceramic or porcelain-fused-to-metal (PFM) crown has been around since the early 1960s [5]. These prostheses are strong, esthetically satisfactory and reasonably economical in cost. Although they satisfy many of the criteria in table 1, they are reported to have a lower clinical survival rate than all-metal restorations [6]. In fact, the most common reason for the replacement of crowns, notably porcelain jacket crowns, was crown fracture [6]. Other studies indicate that some 12% of PFM prostheses were found to have various defects, notably bubbles (31%), fractures and cracks in the porcelain (25%), chipping (13%), porosity (13%), shade defects (13%) and fractures in the metal framework (6%) [7]. However, failures of PFMs do not appear to be caused by fatigue, an accelerating factor for all-ceramic systems [8]. On the other hand, other workers indicate very high survival rates for PFMs, particularly those fabricated with precious metal substrates [9]. Despite the many advantages of the PFM crown, patients often complain about the subgingival "blue line" with anterior restorations. Further, the technical demands of fabricating PFMs, notably casting and porcelain bonding issues, especially with non-precious (base metal) substrates, and the esthetic requirements for the porcelain veneer can present problems for both the dentist and, particularly, the dental technician. It should be noted, however, that there have been efforts to fabricate metal copings for PFMs using CAD/CAM technology [10].

All-ceramic restorations have been steadily growing in popularity since early in the 21st Century, this trend being accelerated by the marked improvements in materials properties, esthetics and the convenience and efficiency of utilizing CAD/CAM technology to fabricate restorations [11-14].

The present study was undertaken to quantify the change in the restoration prescribing patterns of dentists over the period of 2015 to 2020. The data for the study were supplied by a very busy dental laboratory¹ that serves over 200 dentists in the greater San Antonio region of Texas in the United States.

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Results

The raw data for the numbers of PFM crowns, all metal and ceramic crowns are shown in table 2.

	2015	2016	2017	2018	2019	2020
Zirconia full contour	4378	6956	7925	8075	10573	11663
Emax full contour	2591	1739	2216	1867	2217	2017
PFM (non-precious)	1175	1152	849	1319	670	374
PFM (semi-precious)	694	449	575	284	246	113
PFM (precious)	41	9	0	11	12	34
Full gold crown (yellow)	142	192	166	226	229	0
Full gold crown (white)	15	3	11	13	13	14

Table 2: Numbers of full coverage restorations fabricated by art and technology dental studio over the period 2015 - 2020.

In order to present the data more clearly, the PFM data were condensed into a single category “PFMs” as were the gold crowns, table 3.

	2015	2016	2017	2018	2019	2020
Zirconia full contour	4378	6956	7925	8075	10573	11663
Emax full contour	2591	1739	2216	1867	2217	2017
PFMs	1910	1610	1424	1614	928	521
Gold crowns	157	195	177	239	242	14

Table 3: Consolidated crown fabrication data.

The data clearly indicate a marked change in the relative numbers of different full contour restorations, figure 1, whereas the trends in numbers of fabricated crowns are shown in figure 2.

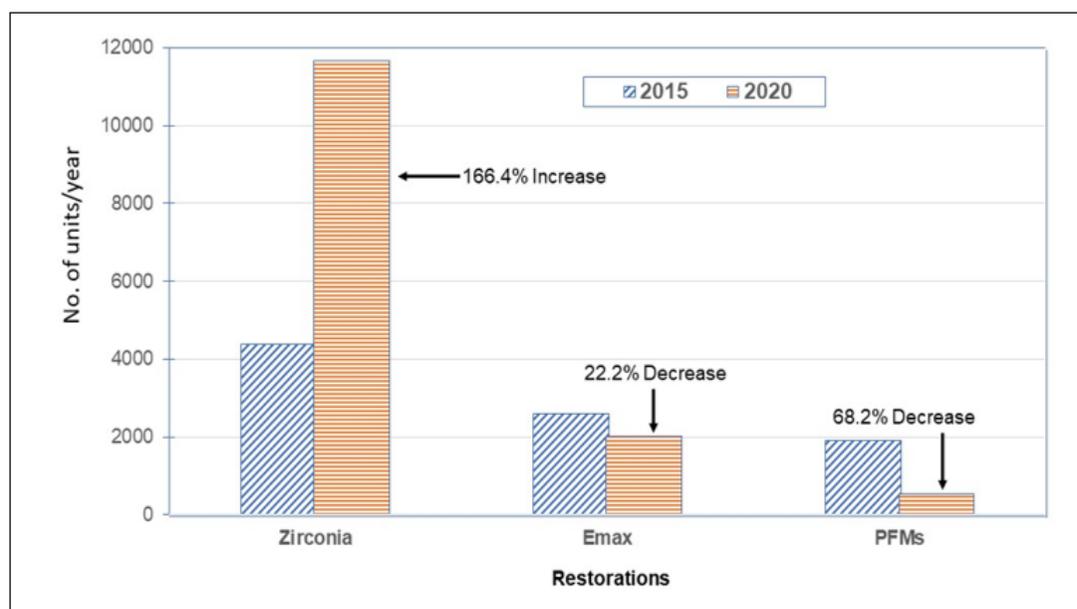


Figure 1: Change in number of full contour restorations from 2015 to 2020.

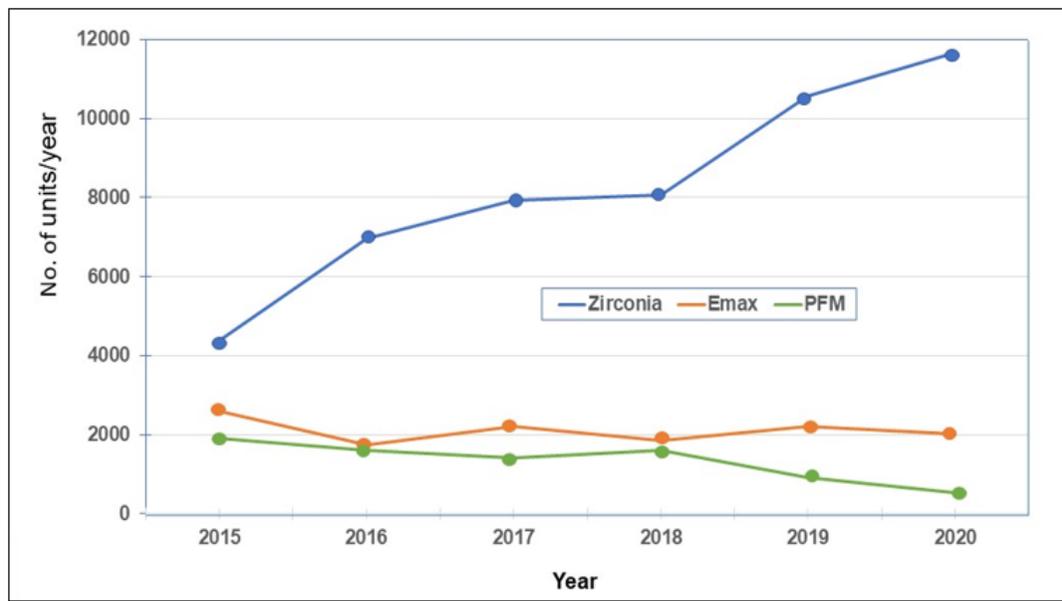


Figure 2: Trends in number of full contour restorations from 2015 to 2020.

Discussion

The laboratory data clearly indicate that there was a quasi-linear increase in the numbers of zirconia restorations over the six-year period 2015 to 2020, the overall increase being slightly over 166%. In contrast, there was a small but steady decline of 22% in the number of Emax restorations but a drop of 68% in the number of PFM restorations. Interestingly, the numbers of gold crowns fluctuated from 2015 to 2019 and then dropped dramatically in 2020.

The decrease in the number of PFMs restorations is dramatic and, like the variability in the numbers of gold crowns was likely due to such factors as restoration cost and esthetic demands of patients. The small but continuous drop in dentist prescriptions for Emax crowns is less clear but may reflect the attitudes of dentists using the laboratory services.

What is significant is that the increase in numbers of zirconia crowns on an annual basis appear to be markedly greater than the combined decrease in the numbers of other full contour restorations. This indicates that the progressive overall patient (and dentist) satisfaction with the convenience, esthetics and numerous advantages of zirconia crowns. Part of this satisfaction may undoubtedly be ascribed to the fact that CAD/CAM technology enables the dentist to provide patients with permanent restorations considerably faster, more efficiently and with superior esthetics than is possible with PFM and all metal restorations.

Conclusion

CAD/CAM technology and the strength, durability and esthetics of zirconia restorations appear to have appeal to patients and dentists. Further, the data clearly show that not only are PFMs and all metal restorations no longer the treatment of choice for patients but, in fact, greater numbers of patients seek zirconia restorations in preference to other treatment modalities.

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