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RESEARCH ARTICLE

CLINICAL EVALUATION OF CERAMIC INDIRECT RESTORATIONS A 5 – YEAR FOLLOW-UP

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ABSTRACT

Restorations of the posterior teeth with similar characteristics to those of the dental structures, such as color, brightness, and superficial texture, associated to high durability are often the patient's desire. The restorative technique with contemporary dental ceramics has also been enhanced significantly and had its acceptance increased due to the advancement of adhesive systems. The selection of adhesive system is of utmost importance for long-lasting and sustainability of cemented ceramic restorations.

INTRODUCTION

For many years, dentistry was limited to full gold or porcelain-fused-to-metal indirect restorations. Ceramic inlays have been used in dentistry for well over 100 years [Banks, 1990; Qualtrough, 1990]. Problems with early ceramic inlays included porcelain weakness, microleakage, cement failure, and poor fit [Banks, 1990].

In the past three decades, some new materials have entered that provide more esthetic options. The most common indirect restoration is the single unit posterior tooth. In today's dental practice there are many materials and options available to restore a tooth that has been compromised from disease or trauma. In clinical practice we are continuing to see posterior teeth that have old direct restorations that need to be replaced with a stronger indirect restoration.

The last material of recent interest is the lithium disilicate material, and E.Max (IvoclarVivadent AG) is currently the only one available. This material presented esthetic properties approaching or equaling the Lucite-reinforced glass materials, but has significantly better strength properties, and provides a high level of esthetic restoration for posterior restorations.

There have been numerous laboratory studies examining various aspects of ceramic inlays, mainly focusing on those areas which led to failures in early attempts at these restorations, such as fit, marginal accuracy, gap location, cement thickness [Geppert, 1986; O'Neal, 1993; Sjögren, 1995], microleakage [Alavi and Kianimanesh, 2002; Beznos, 2001], nanoleakage, fracture resistance [Dietschi, 1990] and effects of various luting agents [de la Macorra and Pradíes 2002; Dérand, 1991; Sjögren, 1995]. During resin cement polymerization, high internal stresses can be developed causing disruption between the restoration and cavity walls that also can lead to marginal leakage, especially when margins are located in dentin. In the case of inlay/onlay preparations, the presence of peripheral enamel is critical to successful bonding [Heintze, 2005].

The clinical success of indirect restorations has been evaluated by measuring marginal fit and leakage, and correlating these parameters with loss of integrity of the bond to peripheral tooth structure [Peumans, 2007]. Loss of this integrity has been associated with formation of secondary caries, post-operative-sensitivity and staining of the tooth/restoration interface [Kidd and Beighton, 1996; Mjor, 2005]. In spite of this, there is no restoration/luting material combination capable of achieving a complete marginal seal [Piwowarczyk, 2005]. The purpose of this clinical study was to evaluate the fracture strength and marginal adaptation and integrity of teeth restored with bonded ceramic inlays and onlaysfor a period of 5 years.

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MATERIALS AND METHODS

Eighty six indirect restorations (n=86) E.Max (IvoclarVivadent AG) were placed in 22 patients. There were 12 women and 10 men, ranging in age from 20 to 65 years (Table 1).The distribution of the restorations is shown in Table 2. The restorations were luted with a composite system – Variolink II (IvoclarVivadent AG) using an enamel-dentin bonding system – Syntac Classic by isolation with rubber dam. All of the steps recommended by the manufacturer in bonding procedure were strictly followed. The restorations were assessed 5 years after placement. All procedures were performed by one investigator. A sharp probe and dental loupe (x 4.5) was used to assess marginal integrity.

Table 1 Distribution by age and gender of patients receiving indirect ceramic restorations

20 - 30	1	2	3
31 - 40	5	6	11
41 - 50	2	1	3
51 - 65	2	3	5
Total	10	12	22

Fracture rate, esthetics, including caries, staining of the luting cement, gingival tolerance and patient acceptance were also recorded. Esthetics performance was assessed clinically at chair side in terms of color match and surface roughness. Indirect ceramic restorations were rated as perfect, clinically acceptable or clinically unacceptable in each assessment category. Intraoral color photographs were taken.

Figure 1 The second clinical stage – cementation of indirect restorations.

Table 2 Distribution of teeth receiving indirect ceramic restorations

Tooth	Maxilla	Mandible	Total
First premolar	8	3	11
Second premolar	6	10	16
First molar	18	17	35
Second molar	9	15	24
Total	41	45	86

RESULTS

The results after clinical evaluation of five years are shown in Table 3. Four of the 86 investigated restorations had to be replaced because of a fracture (failure rate 4.65%; Kaplan-Maier) (Fig.4). There are not restorations with cohesive bulk fractures.

Figure 2a/ Dental rehabilitation with ceramic onlaysand overlays - intraoral view (2009).

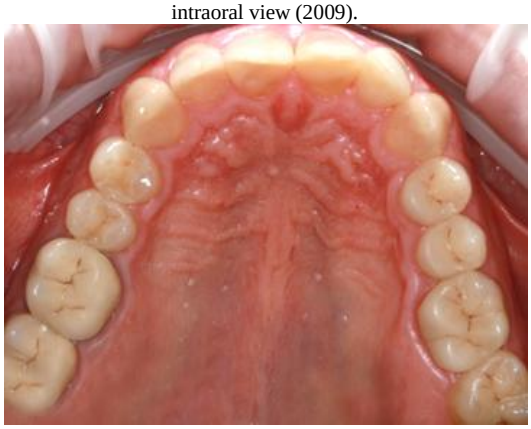

Figure 2.b/ Intraoral view after 5 years (2014)

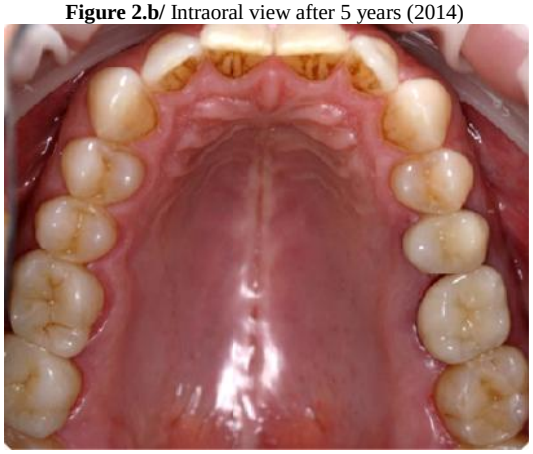

Figure 3a/Dental rehabilitation with ceramic onlays and overlays - intraoral view (2009)

Table 3 Clinical ratings for indirect posterior ceramic restorations after 5 years (*n=86*)

	Color match		Surface roughness		Marginal adaptation		Fracture rate		Patient acceptance		Caries		Marginal discoloration	
Rating	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Perfect	86	100	81	93.83	80	92.5	82	95.12	86	100	84	97.62	85	96.47
Clinically acceptable	0	0	5	6.17	6	7,5	0	0	0	0	2	2.38	3	3.53
Clinically unacceptable	0	0	0	0	0	0	4	4.88	0	0	0	0	0	0

After 5-years clinical service significant deterioration (Friedman 2-way ANOVA; $p<0.05$) was found for marginal adaptation for two of the restorations (2.32%). 97.68% of the surviving restorations exhibited satisfactory marginal adaptation with enamel structure.

Figure 3b/ Magnification of tooth 27 after 3 years

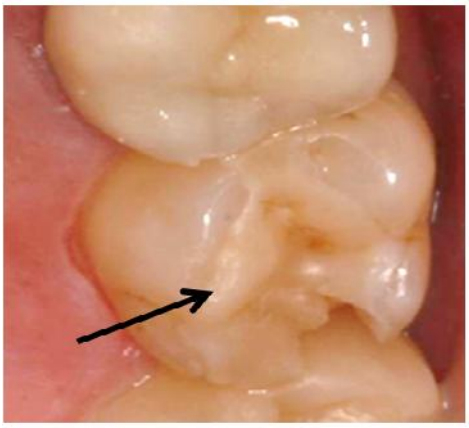

Figure 4 Magnification of tooth 27 after 4 years

DISCUSSION

Choosing a restoration methodand a restorative material comes down to evaluating several different parameters. These include the condition of the existing tooth, the color of the existing tooth, the position of the tooth in the mouth (anterior vs. posterior), the esthetic desires of the patient, and the skills and preferences of the dental technician doing the restoration.The use of resin cement provided a better integration between tooth and restoration, transferring the external forces to the dentin. Therefore, an increase in ceramic resistance occurred, probably resulting in enhanced clinical durability of these restorations [Rosentritt, 2004]. The failed cases might be caused by insufficient bonding to enamel or degradation of the luting agent caused by fatigue. Therefore, it is necessary the adaptationwiththe dental structure as good as possible for these restorations, including edges and cavosurface margins [Rosentritt, 2004, Yancheva and Vasileva, 2013].

The results of this study clearly demonstrate that the major problem is the margin between the restoration and the dental structure. Kramer and Franken berger [Piwowarczyk, 2005] reported that every clinical trial assessing ceramic inlays revealed a certain deterioration of marginal quality. This might be caused by insufficient bonding to enamel or degradation of the luting agent caused by fatigue. The negative results observed for marginal adaptation occurred in the first months. This fact clearly demonstrates that the main concern with this type of restoration must be the initial adaptation and the friability of ceramic material at the cementation moment and the first months of use, as well as for the material and technique used to cement these restorations [Thordrup, 2001]. Scientific studies and clinical experience have validated use of bonded tooth-colored restorations, and we may have entered the so-called "postamalgam era" [Magne, 2006].

With regard to the preparations for posterior ceramic restorations, some authors have demonstrated that occlusal reduction results in a reduced chance of restoration failure, thus increasing the longevity of the restoration [Banks, 1990; Fuzzi , 1989; Garber and Goldstein, 1994]. Fracture resistance tests have been used to determine the forces that may induce fracture of such restorations, and thus enabling a preparation design to be suggested could provide the greatest resistance to fracture [Bremer and Geurtsen, 2001; Dietschi, 1990; Soares, 2004].

Coelho Santos (2004) in a controlled clinical trial evaluated the clinical performance of ceramic inlays and onlays made with two systems: sintered (Duceram, Dentsply-Degussa = D) and pressable (IPS Empress, Ivoclar-Vivadent = IPS) after two years. Eighty-six restorations, 44 IPS and 42 D, were cemented into the mouths of 35 patients.

Twenty-seven premolars and 59 molars received Class II preparations totaling 33 onlays and 53 inlays.The author's conclusion is that these two types of ceramic materials demonstrated excellent clinical performance after two years [Coelho Santos, 2004].

In 2005, Hayashi M, evaluated the quality of fired feldspathic ceramic inlay after eight years in vivo. Longevity was observed in 80% of the fired ceramic inlay restorations at eight years (Kaplan-Meier method), although it was 92% at the six-year observation. Marginal fracture was detected in 11 restorations (22%), including bulk fracture in five (11%), which had first occurred during the last two years. Recurrent caries was observed in three (7%) cases and marginal discoloration in 14 (31%). SEM evaluation disclosed marginal micro fractures in 77% of the restorations, wear in 36% and wear of the resin cement along the margin in 74% at eight years. No significant difference was observed between molarsand premolars. This longitudinal eight-year clinical observation suggested that feldspathicceramic inlay restorations are clinicallyacceptable. However, critical failure as bulk fracture may become a future problem because of marginal disintegration from microscopic and macroscopic perspectives [Hayashi, 2000].

The results of this study clearly demonstrate that the major problem of the failure is the destruction at the marginal adhesion between the restoration and dental structures. Ceramic restorations perform well after 5 years in function and provide a good treatment alternative that can be successfully managed in general dental practice [Arnelund, 2004; Yanakieva, 1997; Yanakieva, 1997]. The formation of a hybrid layer is one of the key factors in long-lasting of ceramic restorations.Gateva

and Kabaktchieva (2012) present that the application of the same adhesive system with the same clinical protocol leads to formation of adhesive andhybrid layer with different characteristics [Gateva and Kabaktchieva, 2012]. Considering the analysis of the hybrid layer, we can suppose that some of the failures in the indirect ceramic restorations importance there is also a hybrid layer [Gateva and Kabaktchieva, 2012; Van Meerbeek, 2003; Walshaw, 2003]. Tagtekin. found that fractures in ceramic restorations usually occur during the first 6 or 8 months [Tagtekin ., 2009].

CONCLUSIONS

In this clinical study it was observed that the use of indirect ceramic units from eMax for posterior restorations had a low failure rate 4.65% and exhibited satisfactory marginal adaptation and stability in 95.35%.

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