ORIGINAL ARTICLE

MIND THE CROWN MARGINS

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ABSTRACT

Metal free ceramic restorations have increased in demand due to their superior esthetics and more resemblance to the natural teeth, more so now that metal-free biocompatible options are preferred.

Although porcelain fused to metal crowns are also used owing to less tooth structure loss in their preparation, the metal portion shows through the marginal area giving a blue-gray, cyanotic appearance to the tissue.

Margins are one of the most important components in the success of a ceramic restoration. Essential prerequisites for the clinical success of an all-ceramic restoration includes good esthetics, a high resistance to fracture and perfect marginal fit. A poor marginal design or one that is not prepared well may be a source of plaque accumulation, other than being esthetically unpleasing.

Different marginal designs have been proposed and the most acceptable ones for all-ceramic restorations are either the rounded shoulder or the large chamfer margin. A major part of the current literature and research done on this subject falls into two broad categories that are affected by the type of marginal finish line – marginal fit and fracture resistance.

Key Words: *Finish Lines, Shoulder Margins, Chamfer Margins.*

INTRODUCTION

Better looking smiles have always had a growing importance for patients all over the world. This makes fabricating esthetic restorations the main objective for every dentist in any kind of treatment he performs.[1] Multiple options are suggested when it comes to restoring teeth with crowns, ceramic being the foremost. Ceramics are a favorable option as regards to biocompatibility and unchangeable color over time, as well as their resistance to corrosion or wear.[2]

Ceramic restorations have increased in demand due to their superior esthetics[3] and more resemblance to the natural teeth, more so now that metal-free biocompatible options are preferred.[4] Although porcelain fused to metal crowns are also used owing to less tooth structure loss in their preparation, the metal portion shows through the marginal area giving a blue-gray, cyanotic appearance to the tissue.[5,6]

Margins are one of the most important components in the success of a ceramic restoration.[7,8] Essential prerequisites for the clinical success of an all-ceramic restoration includes good esthetics, a high resistance to fracture and perfect marginal fit.[9] A poor marginal design or one that is not prepared well may be a source of plaque accumulation[10], other than being esthetically unpleasing.

Different marginal designs have been proposed and the most acceptable ones for all-ceramic restorations are either the rounded shoulder or the large chamfer margin.[11] A major part of the current literature and

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research done on this subject falls into two broad categories that are affected by the type of marginal finish line – marginal fit and fracture resistance.

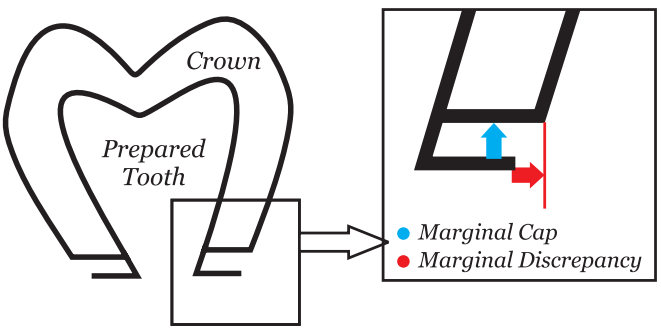
LITERATURE REVIEW

Marginal and internal fit plays an essential role in clinically evaluating the long term success of a ceramic restoration in the oral cavity.[12,13,14] Marginal fit has been shown to be clinically significant to the periodontal health and the development of secondary caries in the marginal area.[15] A poor marginal adaptation may lead to marginal discoloration, exposure of the luting agent, dissolution of the cement, more gingival sulcular fluid flow, micro leakage, plaque accumulation, secondary decay, and eventually to bone loss and periodontal disease.[16]

Multiple in-vitro studies and clinical trials have been conducted to measure the marginal and internal gap sizes. However, there are no particular specifications in relation to the clinically acceptable marginal discrepancy.[4] May et al[18] evaluated that a marginal gap at the crown and die interface of an all ceramic crown in the posterior dentition was less than 70 micrometers. In one study[19], the mean value was 28+/- 3.13 micrometers, while in another study[20], it was 160 +/- 45.98 micrometers. According to Schaefer et al[14], most acceptable marginal discrepancies have been reported in the range of 50-150 micrometers. A five year study conducted by McLean and Fraunhaufer[21] on more than 1000 restorations revealed that 120 micrometers is the maximum tolerable marginal gap size. This value has been suggested in the current literature, to represent the maximum clinically acceptable gap size.[13,17]

Holmes et al[22] defined the measurements of the misfit of crowns at different locations as internal gap, marginal gap, vertical marginal discrepancy, over-extended margin, under extended margin, absolute marginal discrepancy and seating discrepancy. The recommended instrument for evaluation of absolute marginal discrepancy is the Profilometer, which provides a highly accurate and nondestructive method of measurement.[23]

Researchers have also evaluated changes in the marginal fit that may occur during various stages of fabrication.[24] Euán et al[25] found that during different stages of fabrication, differences in marginal fit were observed in the chamfer group (p=0.0042) but there were no differences in the crowns with shoulder margins (p=0.4335). Balkaya et al[26] reported similar findings and also concluded that the marginal fit of the all ceramic crowns is affected by porcelain firing cycles. Miura et al[24], as well as Vigolo and Fonzi[27] differed in their results and found no such changes between the different marginal designs in the different CAD/CAM systems. These results were consistent with those found by Komine et al.[28]



A study concluded that the marginal discrepancy in the rounded shoulder group was significantly lower than that in the large chamfer and tilted chamfer groups, whereas the rounded shoulder had the greatest internal discrepancy and large chamfer group had the least values (p=0.0014).[29]

METHODOLOGY

Electronic literature search of Medical Database, Pubmed and Google Scholar was carried out on a campus network by one author using specific search strategies which included combination of MeSH terms and keywords. Keywords used were “crown margin”, “finish line”, “margin design”, “shoulder margin”, “chamfer margin”, “marginal discrepancy”, “marginal fit” and “fracture resistance”. A single author did the initial selection of studies and sent copies of each study to the other three authors for validation of the inclusion criteria. The titles and abstracts were filtered by one author according to the following inclusion and exclusion criteria.

Inclusion Criteria

In vitro and In vivo studies were chosen. At least one of the materials was chosen to be all ceramic and/or metal ceramic. Only studies published in English language were included. Articles published between the last 20 years (1994 to 2014) were included.

Exclusion Criteria

Studies evaluating intracoronal restorations or implant supported restorations were excluded. Materials other than all ceramic or metal ceramic were excluded.

DISCUSSION

Majority of the researchers have agreed to the importance of fracture resistance and marginal fit in the longevity and success of all-ceramic restorations.[47] Several different marginal configurations have been used to resolve problems related to esthetics but it has been difficult to devise a design that provides excellent esthetics, maintains good marginal seal, and promotes periodontal health.[5] The marginal fit of crowns is a

References	Sample Size	Material	Margins evaluated	Results	P Value
Demir N et al (2014)	60	All Ceramics	Shoulder, Chamfer	MG: Buccally, Shoulder > Chamfer	N/A
Miura S et al (2014)	15	All-Ceramic	Shoulder	MD: Lingually Chamfer > Shoulder	N/A
Yucel MT et al (2013)	80	All Ceramics (Cerec 3, IPS Empress 2, In Ceram Alumina, Celay)	Shoulder	No significant difference in MG before and after glazing	p < 0.01
Euán R et al (2012)	20	All Ceramic	Shoulder, Chamfer	MG: In Ceram>Cerec 3> IPS Empress 2>Celay	N/A
Souza RO et al (2012)	30	All Ceramic	Tilted Chamfer, Large Chamfer, Rounded Shoulder	MG at different stages of fabrication: Chamfer (Significant) > Shoulder (Non-Significant)	P < 0.05
Jalalian E et al (2011)	20	All Ceramic	Shoulder, Chamfer	MG: Tilted Chamfer > Large Chamfer > Rounded Shoulder	P = 0.012
Jalalian E et al (2011)	20	All Ceramic	Shoulder, Chamfer	FR: Chamfer > Shoulder	P = 0.001
Polansky R et al (2010)	60	4 All Ceramic systems, 2 Metal ceramic systems	Shoulder	FR: Chamfer > Shoulder	N/A
Baig MR et al (2010)	30	All Ceramics (Cercon, IPS Empress 2), Full Metal	Shoulder, Chamfer	MG: Vita Mark II > Empress > InCeram > Metal Ceramic > Galvano Ceramic > Procera	N/A
Giannetopoulos S et al (2010)	30	All Ceramic	Shoulder, 30° bevel, 60° bevel	MG: Shoulder = Chamfer	P < 0.05
Michalakis KX et al (2009)	24	Metal Ceramics	Shoulder, Chamfer	FR: Shoulder > 30o bevel > 60o bevel	P < 0.001
Limkangwalmongkol P et al (2009)	16	All Ceramics	Shoulder, Feather edge	FR: Chamfer > Shoulder	p = 0.065
Beuer F et al (2008)	50	All Ceramic	Shoulderless, slight chamfer, pronounced deep chamfer, beveled shoulder, shoulder	MG: Shoulder = Feather edge	P < 0.01
Di lorio D et al (2008)	20	All Ceramic	Shoulder, Chamfer	FR: Shoulder > Shoulderless > Bevelled shoulder > Pronounced deep chamfer > Slight chamfer	P < 0.05
Limkangwalmongkol P et al (2007)	32	Metal-Ceramic	Shoulder, Feather edge	FR: Shoulder > Chamfer	p = 0.0045
Kokubo Y et al (2005)	90	All Ceramics	Chamfer	MG: Feather edge > Shoulder	N/A
Yeo IS et al (2003)	120	All Ceramic: (Celay InCeram, Conventional InCeram, IPS Empress 2) Metal-Ceramic	Shoulder	MG: At rounded slope of chamfer> Margin MG: Conventional InCeram > Celay InCeram > IPS Empress 2; Metal-ceramic > IPS Empress 2	P < 0.05

huge concern for clinicians and there is no conclusive evidence of any one margin configuration that brings out better results than others in terms of marginal fit.[12] The crown adaptation and the film thickness of the cement can influence dissolution of luting agent[8,24] and hence marginal leakage.[48] Therefore a good marginal fit is consistently emphasized during fabrication of all ceramic crowns.[4-10]

An excessive marginal gap leads to periodontal problems, plaque retention, recurrent caries and pulp lesions eventually leading to bone resorption.[29] In addition, an excessive internal discrepancy leads to decreased fracture strength of an all ceramic restoration.[49] However, it cannot be concluded that good marginal fit will influence the fracture resistance of an all ceramic restoration and the two properties may be interlinked. Foncesca et al[50] conducted a study to identify a correlation between marginal fit and fracture resistance but did not get any statistically significant results.

Donovan T and Prince J[5] suggested that the all ceramic margin should be close to a 90-degree angle so that the porcelain will be primarily under compressive forces, as the compressive strength of porcelain is much higher than its tensile strength.[51] It was theoretically evaluated that the stress induced during seating of a restoration which has a porcelain margin angle of 33 degrees or less would result in fracture. Also, it was found that as the porcelain crown margin angle decreases in width, the angle of the margin, which is required to prevent failure of the restoration, increases.[52] In another study,[53] it was concluded that introducing a marginal angle increases the likelihood for marginal chipping of the all ceramic restoration.

Where the large chamfer produced micro cracks, Souza et al[29] suggested that it may be because the chamfer finish line is more complicated to produce owing to the concave and convex areas in the tilted surfaces of this finish line. A study in support of chamfer margin, however suggested that there was a better marginal fitness due to the curve in the chamfer finishing line and that causes a better spread in the load.[32]

This is not the case in a 90 degree shoulder preparation. In addition, in the chamfer finishing line, there is an angled cut of enamel that brings a greater width of enamel in exposure to etch and bonding so there is a stronger bonding and unity between the restoration and teeth. This is in contrast to the shoulder margin that has a lesser width of enamel for exposure to etching and bonding.[54]

It was suggested that future researches should involve multiple evaluators to eliminate any examiner bias and increase the reliability of the research. There is no agreement on the number and location of measuring sites that should be evaluated during measuring of marginal accuracy, although, this is one very important parameter because the marginal gap values can fluctuate greatly within the same sample.[56]

The profile meter is an accurate instrument for measurement of marginal gap but other more accurate methods should be discovered to evaluate marginal accuracy.[13] X-ray micro tomography is a relatively more accurate and nondestructive method for measurement of marginal gaps as it allows easier recognition and measurement of critical distances but is not used by most researchers.[56,57] It is recommended that future researches be conducted on the subject with the help of this instrument.

CONCLUSION

Shoulder or chamfer finishing lines can be selected for all ceramic crowns bonded to prepared teeth. There is no conclusive evidence about which marginal design is preferred over the other as both the margins have displayed different results in the studies and more research is suggested to evaluate their viability. The accuracy in measurements of the marginal fit depends on two factors.

1 The angle of the surface of the crown margin.

2 The profile readings during evaluation by the evaluator.

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