Oct 30th, 12:00 AM - 12:00 AM

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Introduction: Secondary caries of abutment teeth is an unwanted complication during prosthodontics treatment and the main reason for the replacement of FPD restorations. Marginal gap space in fixed restorations is responsible for micro-leakage and cement decomposition with caries appearance due to specific demineralization process by bacteria colonization. The aim of the study was to evaluate caries lesions in correlation to the crown marginal gap.

Material and methods: Marginal gap between the abutment tooth and the crown was measured using a light-body silicone for evaluating of absolute discrepancy with replica technique (RT). Twenty porcelain fused to metal crowns were fabricated on ten premolars casts. Light body polyvinylsiloxane addition silicone impression material was used to fill the discrepancies between crown and tooth. After setting, impression material was removed from the die, and the thickness of the layer was measured and evaluated by electron microscopy.

Results: The measurements of marginal fit were with mean marginal discrepancies in a range between 61.5 and 75.0 microns, mean marginal gaps in a range from 40.9 - 45.3 microns, mean vertical discrepancies in a range from 22.9 - 46.0 micron, and mean horizontal discrepancies in the range of 42.0 to 58.8 micron. Statistical data analysis was performed using a non-parametric test of Kruskal-Wallis and Mann-Whitney.

Conclusion: Based on the selection of 100 microns as a limit of clinical acceptability, restoration margins were presented with increased risk for caries occurrence, even when the prostheses have an acceptable fit. However, in patients with proper oral hygiene and maintenance with regular follow-ups crown margin gap was not critical.

Keywords: Secondary caries, abutment, marginal gap

Introduction

The main goal of every prosthodontist is to create dental restorations with both esthetical and functional clinical performance. The restorations must fit both internally and marginally, and withstand masticatory forces for a long time. Accurate and precise layering between the abutment teeth and dental prostheses is highly required in the manufacturing process of dental prosthesis[1].

Imperfect marginal adaptation can lead to unpleasant and unwanted side effects such as plaque accumulation, marginal discoloration, microleakage, carious and endodontic lesions, and periodontal disease[2]. The marginal fit of the restorations is considerably affected by the materials and techniques used when making dental crowns. If the fit of the restoration and the thickness of the cement is well designed, the cement is not dissolved and the abutment tooth is prevented from secondary caries[3].

Caries formation requires host substrate, presence of biofilm, fermentable carbohydrates, and time. For caries to be initiated, dental plaque usually has a high proportion of Streptococcus mutans present[4]. The patient's behavioral and dietary modification also play a key role in reducing carries risks.

Prosthesis failure may be defined as any condition that leads to their replacement. A systematic review on ceramic-based FDPs reported that more than 15% were removed or were in need of replacement at 10 years. Complications are technical or biological, and dental caries was most common[5]. Secondary caries of the abutment teeth is an unwanted complication during prosthodontics treatment and the main reason for the replacement of FPD restorations. With single crowns, one of the 3 most common complications was a need for endodontic treatment in 3%, while in fixed partial denture (dental bridges) studies reported complications like caries in 18% of abutments[6]. Carious lesions at an early stage cause pathological reactions of the pulpal tissues, and further development of deep lesions leads to the destruction of hard tissues of the abutment tooth causing pain and loosening of the restoration[7].

The most important element for the long-term success of a cast restoration is probably the fit of the crown margin and the so-called "marginal gap". Today we still do not have a common agreement on a clinically accepted value on marginal fit, but some expert studies accepted 32 µm to 230 µm gap in the gingival margin region[8]. Some differences in rating the gap value are correlated to the vertical position of the gap, supragingival or infragingival location. Margins should ideally be placed supra-gingival, but this is not always clinically feasible.[9]

The silicone replica technique (SRT) has been frequently used for evaluating the marginal and internal fitting because of its ability to measure the condition of a dental prosthesis without causing any damage. However, due to morphological variations such as rounded margins, it is sometimes necessary to predetermine the location and number of the measurement points.

The aim of the in-vitro study was to evaluate the development of the secondary caries lesions on the abutment teeth in correlation to crown marginal gap.

Material and methods

The marginal gap between the abutment tooth and the crown was measured using a light-body silicone for evaluating of absolute discrepancy with the silicone replica technique (SRT). The replica technique is one of the common methods used to evaluate the width of the marginal gap between the dental crown and the abutment[10]. It evaluates the impression material thickness, which is a result of the cementation of the crowns over copings[11].

Ten anatomical premolar abutments (dies) with dimensions 6.5 mm of height, axial walls 6º tapered and chamfer finish line was made of type IV dental stone as master models (Figure 1). Die spacing was not used. The models were then sent to the dental laboratory. Twenty porcelain fused to metal crowns (Co-Cr alloy) were fabricated on the premolars casts. They were fabricated conventionally with wax technique, invested and cast. The investment was removed from the framework and cleaned by 110 µm aluminum oxide sandblasting. Finally, the veneering porcelain was manually layered on the frameworks and sintered according to the manufacturer's recommendations.

Fig.1 Premolar abutment as a master model

Afterward, the light body polyvinylsiloxane addition silicone impression material (base and catalizator) was mixed with activator according to manufacturer's recommendations and used to fill the discrepancies or the space between the crowns and abutment teeth (Figure 2).

Fig. 2 Light body addition silicone immersion material

The film from the silicone impression material was used to simulate the position and thickness of the cement layer for evaluation of the width of the existing "marginal gap" (Figure 3).

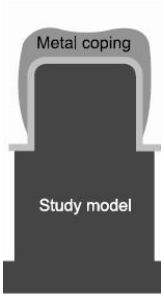

Fig. 3 SRT – Porcelain fused to metal crowns on the stone abutment over light body silicone

After setting the impression material, it was removed (Figure 4.) from the die and the thickness of the layer was measured and then evaluated by electron microscopy. The fitting of the marginal surface was measured as the distance between the finish surface angle of the prepared tooth and the cervical margin of the 20 crowns. Internal adaptation or the film thickness was measured as the distance between the inner surface of the crown and the outer surface of the prepared tooth at three location points (marginal, occlusal, and axial).

Fig.4 Silicone impression film after setting and removing from the coping

Results

Statistical analysis was performed using SPSS 11.0 software for Windows. Kruskal-Wallis one-way analysis of variance (H-test) and Mann-Whitney U-test were used to compare the differences between measured values. The results from the measurements of the marginal fit in the marginal point in 10 crowns showed mean marginal discrepancies in a range between 61.5 and 75.0 µm. The results from the

measurements in the occlusal points showed mean marginal gaps in a range from 40.9 - 45.3 µm. The results from the measurements in the axial points mean vertical discrepancies in a range from 22.9 - 46.0 µm. The measurements in the occlusal points showed mean horizontal discrepancies in the range of 42.0 to 58.8 µm.

Discussion

The gap space is a determining factor for the long-term integration of a restoration. The gap space can be detected clinically at the margin of a crown. Usually, it is the result of multiple errors encountered throughout the crown fabrication step. The impression method (conventional or digital) and fabrication techniques affect the accuracy of fit of complete-coverage fixed restorations[12].

Cementation technique and cement thickness play a major role in the creation of the final clinical gap space. Studies aimed at decreasing gap space have been done. In some instances authors tried to measure the gap space without the presence of any cement, thus, eliminating the possible error that can result from the cementation procedure. Others measured the space after cementation and sectioning of samples.

Cementation and marginal integrity play important roles in the long-term prognosis of the treatment. The focus of prosthodontics restorations is to obtain the smallest or acceptable marginal gap value from 25 to 120 µm. According to some authors, the maximal opening should not exceed 100 µm. The quantitative evaluation of the marginal adaptation is not yet standardized and can be misleading. According to Guess et al., 100 µm is the clinically acceptable marginal gap for ceramics, while McLean and von Frauenhofer reported a gap of fewer than 120 µm.44 Another previous study reported that 100 - 200 µm is the clinically acceptable range for long-term preserved dental prostheses.

Conclusion

Within the limitations of this study, it can be concluded that the porcelain fused to metal crowns demonstrated a comparable and acceptable marginal, axial, and occlusal fit all being within the range of clinically accepted values.

Within the limitations of this study it can be concluded that the SRT is an accurate and reliable technique that can simulate crown gap space after the cementation. The RT is reliable for evaluating cement thickness at the marginal and internal gaps.

REFERENCES

Young Park J, S Bae, J Lee, Kim J, Kim H, Kim H. Evaluation of the marginal and internal gaps of three different dental prostheses: comparison of the silicone replica technique and three dimensional superimposition analysis. J Adv Prosthodont 2017; 9: 159-69.

Zeynep A, Bicer Y, Unver S. Etiology of Secondary Caries in Prosthodontic Treatments. Dental Caries - Diagnosis, Prevention and Management. IntechOpen, September 2018

Rosen H. Dissolution of cement, root caries, fracture, and retrofit of post and cores. J Prosthet Dent. 1998; 80 (4): 511-3.

Paes Leme AF, Koo H, Bellato CM, Bedi G, Cury JA. The role of sucrose in cariogenic dental biofilm formation--new insight. J Dent Res. 2006; 85(10):878-887.

K. J. Anusavice, Kunjan Kakar, N. Ferree. Which mechanical and physical testing methods are relevant for predicting the clinical performance of ceramic-based dental prostheses? Clinical oral implant research. 2007; 18 (3): 218-231.

Goodacre CJ, Bernal G, Rungcharassaeng K, Kan JY. Clinical complications in fixed prosthodontics. J Prosthet Dent. 2003; 90(1):31-41.

Zoellner A, Heuermann M,Weber HP, Gaengler P: Secondary caries in crowned teeth: correlation of clinical and radiographic findings. J Prosthet Dent 2002; 88:314–319.

Dedmon HW: Disparity in expert opinions on size of acceptable margin openings. Oper Dent 1982; 7: 97-101

Holmes JR, Bayne SC, Holland GA, et al. Considerations in measurement of marginal fit. J Prosthet Dent 1989; 62: 405- 408.

Bronson MR, Lindquist TJ, Dawson DV. Clinical acceptability of crown margins versus marginal gaps as determined by pre-doctoral students and prosthodontists. J Prosthodont. 2005; 14(4): 226-32.

Rahme HY, Tehini GE, Adib SM, Ardo AS, Rifai KT. In vitro evaluation of the "replica technique" in the measurement of the fit of Procera crowns. J Contemp Dent Pract. 2008 1; 9 (2):25-32.

Freifrau von Maltzahn N, Bernhard F, Kohorst P. Fitting accuracy of ceramic veneered Co-Cr crowns produced by different manufacturing processes. J Adv Prosthodont. 2020; 12(2): 100-106.

Molin M, Karlsson S. The fit of gold inlays and three ceramic inlay systems. A clinical and in vitro study. Acta Odontol Scand. 1993; 51(4):201-6.

Beuer F, Aggstaller H, Edelhoff D, Gernet W, Sorensen J. Marginal and internal fits of fixed dental prostheses zirconia retainers. Dent Mater. 2009; 25: 94–102.

Haddadi Y, Bahrami G, Isidor F. Accuracy of crowns based on digital intraoral scanning compared to conventional impression-a split-mouth randomised clinical study. Clin Oral Investig. 2019; 23(11): 4043-4050.

Hasanzade M, Aminikhah M, Afrashtehfar KI, Alikhasi M. Marginal and internal adaptation of single crowns and fixed dental prostheses by using digital and conventional workflows: A systematic review and meta-analysis. J Prosthet Dent. 2021; 126(3):360-368.