ORIGINAL PAPER

The influence of cervical finish line and type of cement on microleakage

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Abstract
The appropriate marginal fit of the fixed dentures is required in all the cases, but the appearance of marginal deficiencies is inevitable at the tooth-restoration interface. Besides the improvement of the technological processes, different cements with adequate sealing capacity had been developed in order to minimalize the marginal discrepancies. The most important features of an ideal cement are biocompatibility, sealing capability and caries prevention. Microbial infiltration may be the most critical factor influencing the long-term success of a fixed prosthetic restoration. The aim of this study was to measure the rate of microleakage between tooth and restoration according to the type of finish line and luting agent. Sixty healthy premolars, extracted for orthodontic reason were prepared with chamfer and knife-edge finish line. Full metal crowns were manufactured in a dental laboratory. The luting of dental restorations was done with glass ionomer, zinc phosphate and dual-cured glass fiber reinforced resin. In order to monitor the marginal infiltration rate, methylene blue (1%) was used. The result showed that dual-cured glass fiber reinforced resin has the highest sealing capacity preventing microleakage.
Keywords: microleakage, luting agent, finish line

Introduction

The fixed dentures are commonly used in the daily practice to restore and preserve the hard dental tissues. The appropriate marginal fit of these restorations is required in all the cases, but the appearance of marginal deficiencies is inevitable at the tooth-restoration interface. The different luting agents used at the cementation of the fixed restorations pretended to seal the gap at the restoration margins and avoid the infiltration of the fluids from the oral cavity followed by microbial invasion into the dental structures. [1]

The inappropriate use of these luting agents in vital teeth results inflammation and necrosis of the pulp, which affects the longevity of the restorations. [1, 2] The microleakage is detected by clinical signs of the chronic dental hypersensitivity and color changes of the abutment at the restoration margins. [3 The water-based cements with a high degree of solubility in the oral cavity, used in the past, served only to "fill" the space between the restoration and the abutment. The two-component, powder-liquid systems, were traditionally used to fill the gaps between the tooth and restoration. However, due to their high solubility in the oral fluids, the sealing capacity of these cements depends on the precision of the marginal fit. [4] Numerous studies demonstrated that 100-500 μm is the acceptable gap at the tooth-restoration interface regarding the protection against microleakage. [5-7]

Besides the improvement of the technological processes, different cements with adequate sealing capacity had been developed in order to minimalize the marginal discrepancies. The glass ionomer cements are effective, due to their ability to continuously release fluoride ions and also the resin cements through their ability to establish chemical bonds with dental tissues. [4, 8]

The most important features of an ideal cement are biocompatibility, sealing capability and caries prevention. Microbial infiltration may be the most critical factor influencing the long-term success of a fixed prosthetic restoration. [3]

The aim of this study was to measure the rate of microleakage between tooth and restoration according to the type of finish line and luting agent.

Material and method

For this study were used sixty healthy premolars, extracted for orthodontic reason.

Prior to tooth preparation, the teeth were immersed in artificial saliva for ninety days. After preparation, the teeth were separated into two groups: thirty teeth with knife edge finish line and another thirty with chamfer finish line. Full metal crowns were manufactured in a dental laboratory. In order to monitor the marginal infiltration rate, methylene blue (1%) was used. To avoid the infiltration of the root surface with methylene blue spacing varnish was applied before crown cementation. For cementation were selected three materials, frequently used in daily practice: glass ionomer, zinc phosphate, and dual-cured glass fiber reinforced resin. Six groups resulted. The cementation was performed in accordance with the manufacturers' indications. For cementation with dual-cured resin were applied tribochemical technic which involves microblasting with silica AlO_3 followed by silanization. After five days the teeth were embedded in transparent autopolymerizing acrylic resin. Each tooth was vertically sectioned mesiodistally with a water-cooled diamond disc. After sections 12 teeth were compromised so in the final, we achieved six samples with eight teeth each.

All the pieces obtained were photographed with Canon Sx40 HS IS - 12 MPx, optical zoom 35x. All photos were taken at the same ambient light intensity at the same distance using a tripod, and they were placed in the same position. For all photos, the camera was set with the macro option.

In order to evaluate the resistance of the cement to the liquids of the oral cavity, irrespective to the marginal adaptation of the restorations, all the specimens were included in this study, even those with dehiscences bigger than 0.05 mm between the restoration and the tooth.

To measure the infiltration rate, the Digimizer Image Analysis Software® was used. For this purpose, a ruler was used to calibrate the unit of measure (pixels/mm) during shooting. Measurements were made on both halves of the pieces taking into account the highest values obtained. Each measurement was performed three times using their arithmetic mean (Figure 1).

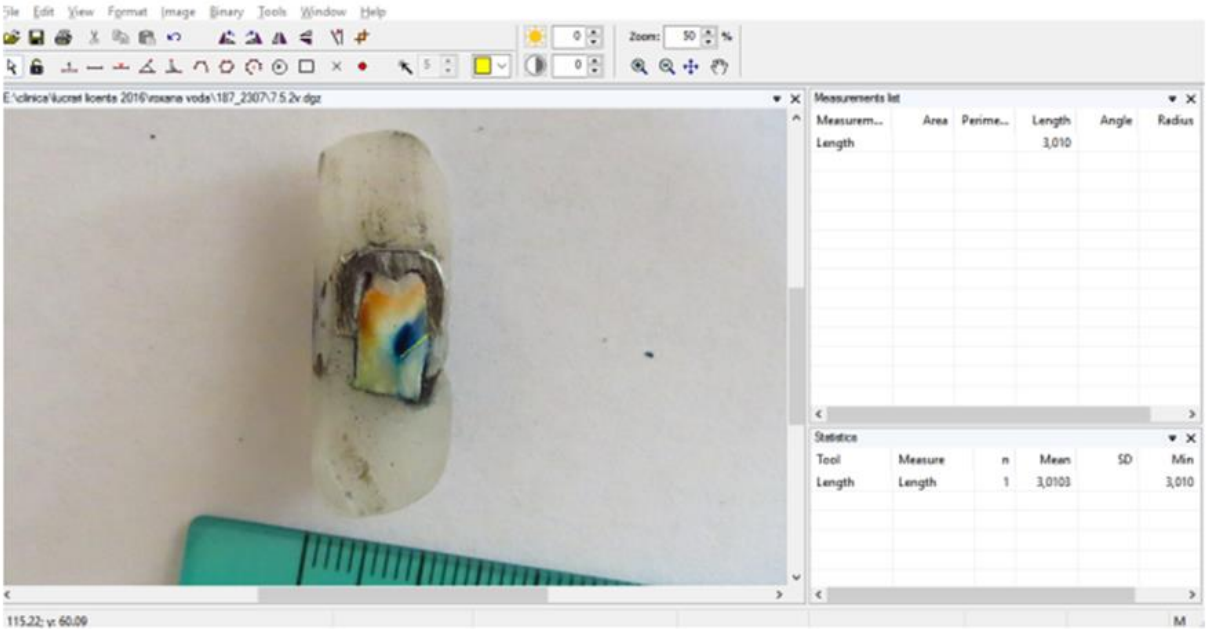

Figure 1. The Digimizer Image Analysis Software®

Statistical analysis: The GraphPad InStat® and NCSS Dowson Edition® software were used. The statistical significance was set at $p<0,05$. The mean (M) and standard deviation (SD/±) were calculated. The used test was Mann-Whitney.

Results

The value obtained after measurements are represented in Table 1.

Table 1. The degree of infiltration (mm)

Cementing material				
Type of finish line		Glass ionomer	Dual-cured glass fiber reinforced resin	Zinc phosphate
	Knife edge	2,1887	1,4742	2,9915
		2,1046	1,1678	2,3657
		2,1976	1,005	2,6155
		2,2653	1,2098	2,7896
		2,1807	1,4035	3,0005
		2,1246	1,1773	2,3743
		2,1771	1,3705	2,7153
		2,1633	1,2098	2,8842
	M (SD)	2,173 (±0.052)	1,252 (±0.152)	2,717 (±0.251)
	Chamfer	0,2742	0	0,718
		0,2052	0	0,6792
		0,3742	0	0,5473
		0,2652	0	0,62
		0,2742	0,1024	0,5176
		0,2052	0,0987	0,5792
		0,3742	0,2093	0,7042
		0,2652	0	0,7324
	M	0,280 (±0,07)	0,051 (±0,078)	0,637 (±0,082)

As is showed in Table 2 was found a statistical difference between teeth with knife edge finish line based on the cement used for fixation.

Table 2. Difference between teeth with knife edge finish line based on the cement used for fixation.

	p-value
Glass ionomer vs. Dual-cured glass fiber reinforced resin	0,0015
Glass ionomer vs. Zinc phosphate	0,0003
Dual-cured glass fiber reinforced resin vs. Zinc phosphate	0.0009

Statistical difference was also obtained in case of teeth with chamfer finish line (table 3).

TableI 3. Difference between teeth with chamfer finish line based on the cement used for fixation

	p-value
Glass ionomer vs. Dual-cured glass fiber reinforced resin	0,0026
Glass ionomer vs. Zinc phosphate	0,0014
Dual-cured glass fiber reinforced resin vs. Zinc phosphate	0.0008

The results obtained comparing the degree of infiltration according to the type of finish line and cement used for fixation is represented in Table 4.

Table 4. Degree of infiltration according to the type of finish line

Finish line/Cementing material	p-value
Knife edge vs. Chamfer/Glass ionomer	0,0021
Knife edge vs. Chamfer/Dual-cured glass fiber reinforced resin	0,0008
Knife edge vs. Chamfer/Zinc phosphate	0.0002

Discussion

In our study, we have shown that dual-cured glass fiber reinforced resin has the highest sealing capacity preventing microfiltration.

Studies have shown that resin-modified cement exhibit adhesion to the tooth, so it provides a superior sealing capacity relative to conventional cement (e.g., zinc phosphate cement). [1,4,9,10] Numerous studies have assessed the sealing capacity of different types of cement in different types of restorations, on different types of teeth prepared with different convergence angles. [11]

Similar results were also obtained in the 2011 year in a study in which was assessed the influence of marginal adaptation and the type of cement used in all ceramic systems on microleakage. In this study, a self-adhesive composite and glass ionomer cement was used as a luting material. The results showed that composite cement showed lower levels of microleakage. [7]

In the study by Reza Eftekhar Ashtiani et al., in which four types of cementing materials have been tested, zinc phosphate cement has been shown to have the lowest resistance in a wet environment, favoring marginal

microleakage, as it was demonstrated in our study. [8]

Similar to our results, in a study comparing the degree of infiltration correlated with the type of restoration and the cement used in the fixation, it was demonstrated that, regardless of the type of restoration, all ceramic or metal-ceramic, the adhesive cementation showed the lowest degree of infiltration compared to zinc phosphate and glass ionomer cement [9]. Another study that used noble alloy crown restoration has shown that the best marginal sealing provides self-adhesive cement compared to glass ionomer and dual composite cement, although no statistically significant differences have been found. [10]

In the in-vivo study, where local changes induced by zinc phosphate and self-adhesive cement were observed in the batch of patients over 38 months, no significant differences were found at the level of the observed parameters (bleeding gingival index, plate index, pulp vitality, etc.). [11]

In a study that considered as parameters the retention, the finish line and the sealing effect of the luting material for all metallic restorations, it was demonstrated that the shoulder and shoulder with bevel provide higher retention than the chamfer, but the finish line and luting material did not affect marginal sealing. [12]

In our study, we have shown that there are significant differences between the marginal preparation, the cement used and the degree of infiltration. Boftino et al. demonstrated that the best adaptation at the cervical level was obtained in the case of a chamfer finishing line compared to the 135^0 angle and rounded shoulder. From the point of view of the influence on the marginal adaptation of the best cement was the zinc phosphate cement followed by the glass ionomer and the resin-based cement. [13]

Conclusions

1. Microleakage is directly influenced by the type of cementing material used.
2. Large-scale use of glass ionomer cement for fixation of the dental crown with metallic infrastructure can result in microleakage by solubilizing it in saliva.
3. Most practitioners only use composite cement only in case of cementation of the all-ceramic crown, but it has been shown that they perform a good marginal sealing when are used to cement crown with metallic infrastructure.

Conflict of interest: None to declare.

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