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Effect of Immediate Dentin Sealing on the Fracture Resistance of Lithium Disilicate Onlay Restoration

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ABSTRACT

Background: Immediate Dentin Sealing (IDS) is sealing the dentin using nano-hybrid composite after the cavity preparation and before taking the impression. The clinical advantages of the IDS are superior bond strength, less gap formation and bacterial leakage, and decreased dentin sensitivity.

Materials and methods: Twenty-eight human extracted first lower molar teeth were divided randomly into two groups. Teeth received root canal treatment. The control group (n=14), the orifices were closed by nano-hybrid composite and teeth were prepared. 2nd group (n=14), immediate dentin sealing was applied by nano-hybrid composite, onlay preparation. Teeth were sent to the laboratory to study the fracture resistance and the mode of fracture under a static force.

Results: Independent t-test was done to compare between IDS and non-IDS onlays. The difference between two groups was not statistically significant (p-value: 0.851), whereas the mean difference is -.288 and standard error difference is 1.515.

Conclusion: The use of IDS has no additional effect on the fracture resistance in teeth restored by lithium disilicate onlays.

Key words: Immediate dentin sealing, Lithium disilicate onlays, Fracture resistance

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INTRODUCTION

Full coverage restorations are used very commonly in clinical practice. However, the usage of onlay and inlay indirect restorations started to increase in the daily clinical practice [1]. The reason behind this can be the lesser tooth reduction, when compared to the full coverage crown. Moreover, they have better esthetic and fracture resistance when compared to resin composite [2].

In 1998, Ivoclar Vivadent introduced lithium disilicate reinforced glass ceramic as IPS impress II, which was discontinued by the manufacturer and redeveloped into IPS e.max, and is available in both press able (IPS Press) and machinable (IPS E.Max CAD) forms [3]. The flexural strength is 360 MPa and 400 MPa for IPS E.Max CAD and IPS E.Max press respectively, with no significant difference in term of fracture resistance [4].

Several studies in the literature showed an excellent survival rate of lithium disilicate crown. A study reported 98.83% survival rate of lithium disilicate crowns over 24 months [5]. Another study revealed the survival rate of lithium disilicate ranged from 91-100% during 2-5 years [1]. Sulaiman, et al. evaluated the fracture resistance and the failure rate of lithium disilicate over a period of 7.5 years. The authors reported failure rate 0.96% of single monolithic crowns and 1.26% of layered single crown [6]. Several onlay preparation designs have been mentioned by several studies [7]. However, the preparation design is determined by the restorative material of the final indirect restorations. Conventional onlay preparation requires an aggressive tooth preparation by reducing 1.5 mm of the occlusal surface while conserving the cusp slopes with an occlusal box 1mm deep and a flat surface finish line [2]. Traditional principles of tooth preparation can be overlooked, allowing more conservative tooth preparation [8]. Immediate Dentin Sealing (IDS) is sealing the dentin using nano-hybrid composite after the cavity preparation and before taking the impression. It was first introduced by Paul and Schärer, et al. as well as by Dieteschi, et al. and Spreafico, et al. as dual bonding [9,10]. It was renamed by Pascal Magne to immediate dentin sealing [11]. The clinical advantages of the IDS are superior bond strength, less gap formation and bacterial leakage, and decreased dentin sensitivity [12]. IDS can help enhance retention for short clinical crowns and immoderate tapered preparations. Provided that superior adhesion is additionally achieved at the restorations intaglio surface, including the utilization of techniques like porcelain etching and salinization for inlays, onlays, and veneers.

With regards to the fracture resistance of indirect onlay restoration combined with immediate dentin sealing in comparison to indirect onlay restoration bonded to the dentin, no studies were found by authors. The purpose of this study was to investigate if the immediate dentin sealing improved the fracture resistance of the lithium disilicate indirect onlay restoration.

Null hypothesis

There is no significant difference in fracture resistance of lithium disilicate onlay when bonded to immediate dentin sealing and when bonded directly to the dentin.

MATERIALS AND METHODS

Twenty-eight human extracted first lower molar teeth were divided randomly into two groups. Teeth received root canal treatment. The control group (n=14), the orifices were closed by nano-hybrid composite and teeth were prepared. 2nd group (n=14), immediate dentin sealing was applied by nano-hybrid composite, onlay preparation.

After the preparation was done, the teeth were scanned using extra-oral scanner. The onlay restoration was designed and milled using computer aided design-computer aided manufacture. Try in for the onlay restoration with corresponding teeth was done. For the control group, a 36% phosphoric acid etch on the enamel and universal adhesive bonding agent were placed on the dentin. While for the second group, sandblasting was applied to the enamel and IDS, application of 36% phosphoric acid etch on the enamel and universal adhesive bonding agent were placed on the composite. As for the lithium disilicate, 9% of hydrofluoric acid was placed for 20 seconds on the intaglio surface. After the silane coupling agent was placed for 1 minute. Next, cementation of the lithium disilicate indirect onlay restoration using self-adhesive resin cement under a 5 KG constant force was taken place. Finally, teeth were sent to the laboratory to study the fracture resistance and the mode of fracture under a static force.

RESULTS

A total of 28 teeth were tested being grouped equally into either with immediate dentine sealing or without immediate dentine sealing. SPSS version 22 was used in order to analyze the data, which included the descriptive as well as inferential analysis. Table 1 shows the descriptive analysis of maximum load with and without immediate dentin sealing (IDS), which revealed a mean load of 2126.07 N in the case of IDS and 2326.36 N in the case of without IDS. Table 2 shows the descriptive analysis of fracture resistance in both case and control groups. Findings revealed that the mean fracture resistance in IDS group was 20.44, whereas 20.73 in non-IDS group.

Moreover, Table 3 shows the inferential statistics where independent t-test was conducted in order to compare the means of fracture resistance between two groups. It can be noted from the findings that the difference between two groups was not statistically significant (p-value: .851), whereas the mean difference is -0.288 and standard error difference is 1.515. Figure 1 shows the fracture Resistance at Max Load [MPa] in green group. Table 4 shows fracture resistance at MPa with Standard deviation in green group. Figure 2 shows the fracture Resistance at Max Load [MPa] in black group. Table 5 shows fracture resistance at MPa with Standard deviation in black group.

DISCUSSION

This study aimed to determine the effect of immediate dentine sealing on the fracture resistance of Lithium

Table 1: Descriptive analysis of Maximum load with and without IDS.

	Range	Minimum	Maximum	Mean	Std. Deviation
Max Load with IDS	2048.52	1304.08	3352.6	2126.07	604.49
Max load without IDS	1497.85	1528.34	3026.19	2326.36	384.35

Table 2: Descriptive analysis of fracture resistance with and without IDS.

	Range	Minimum	Maximum	Mean	Std. Deviation
Fracture resistance with IDS	16.1	14.44	30.54	20.44	5.07
Fracture resistance without IDS	8.49	15.21	23.7	20.73	2.53

Table 3: Comparing the means of fracture resistance with and without IDS using independent t-test.

			t-test for Equality of Means				
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Equal variance assumed	-0.19	26	0.851	-0.288	1.515	-3.404	2.827

Table 4: Fracture Resistance at Max Load [MPa] with Standard deviation in green group.

	Maximum Load [N]	Fracture Resistance at Max Load [MPa]
1	1,736.42	15.73025
2	1,685.79	15.9443
3	2,745.77	25.81368
4	1,304.08	20.61521
5	1,874.85	16.73174
6	2,539.27	25.2297
7	2,563.96	23.35969
8	2,224.30	20.26516
9	1,683.18	15.65545
10	2,598.72	24.89124
11	3,352.60	30.54481
12	1,378.37	14.63617
13	1,585.18	14.44227
14	2,492.51	22.33027
Mean	2,126.07	20.44214
Standard deviation	604.49698	5.07324

Table 5: Fracture resistance at Max load [MPa] with standard deviation in black group.

	Maximum Load [N]	Fracture Resistance at Max Load [MPa]
1	2,176.67	19.83114
2	2,203.92	20.02896
3	2,214.75	19.24107
4	3,026.19	23.70006
5	1,850.96	15.21074
6	2,326.90	21.12289
7	2,554.78	23.27605
8	2,751.93	22.60424
9	2,191.66	21.4907
10	2,466.97	24.2516
11	2,780.87	23.42378
12	1,528.34	16.81013
13	2,121.52	19.13581
14	2,289.22	24.58887
15	2,406.52	22.78668
16	2,434.09	21.56642
Mean	2,332.83	21.19182
Standard deviation	359.7162	2.67707

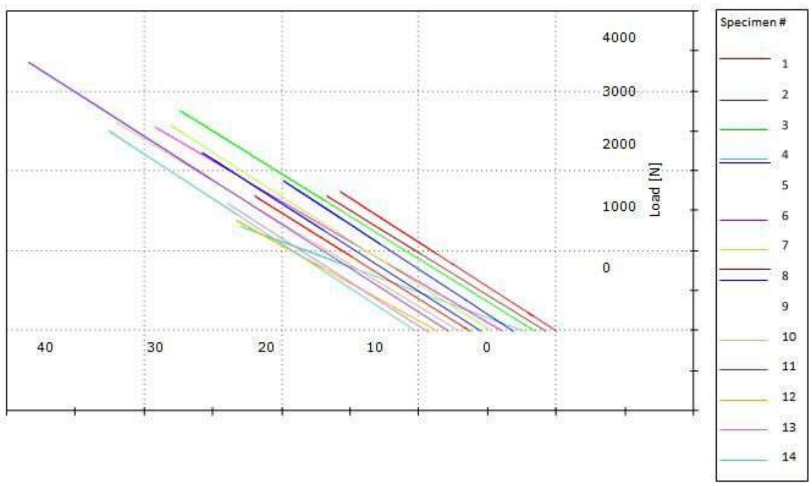

Figure 1: Fracture Resistance at Max Load [MPa] in green group.

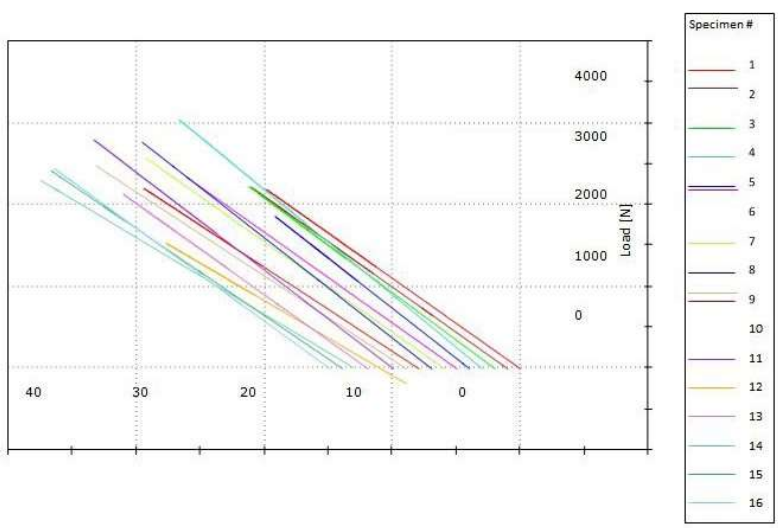

Figure 2: Fracture resistance at max load [MPa] in black group.

disilicate onlay restoration. While minimally invasive occlusal onlays do not yet have consistent long-term clinical facts available in the scientific literature, all-ceramic restorations, mostly circumferential crowns, usually show positive results. In single tooth restorations, lithium disilicate crowns (IPS E.Max Press, Ivoclar Vivadent, Schaan. Liechtenstein) exhibit dependable long term clinical performance with survival rates of 92% after 5 years and 85.5% after 10 years [13].

This study involved the use of IDS in order to determine any change in the fracture resistance of Lithium disilicate onlay restorations. The IDS method rests upon four essential ideologies. First, only fresh-cut, contaminant-free dentin delivers the ideal substrate for bonding. In any other case, the bond strength is substandard. Second, if the dentin bonding agent (DBA) and overlaying composite are light-cured together, the hybrid layer may breakdown due to the compression from the composite or restoration placement. Thus, pre-curing the DBA results in a better bond strength. Third, IDS and delayed restoration placement allow development of the dentin bond in an atmosphere free of occlusal forces and overlaying composite shrinkage. Fourth, IDS decreases fluid and bacterial penetration [14].

Using of IDS obviously has an edge over not being used due to the reasons mentioned above. Therefore, we determined its ability to resist fracture when used in lithium disilicate onlay restoration. Our findings suggest that there was no statistically significant difference between the two groups, namely one using IDS and the other not using IDS. Similar findings were observed by Hofsteenge, et al. [15] where they did not find any statistically significant difference between the groups using and not using IDS when fabricating lithium disilicate inlays and onlays. Although they discovered a statistically significant difference in the maximum loads applied on teeth with and without IDS. However, this was not measured in our study as our focus lied upon the fracture resistance merely.

Another relevant study by Elbishari, et al. [16] revealed significant in-vitro evidence endorsing the IDS benefits such as improved bond strength, decreased dentin permeability, enhanced restorations' adaptation, and improved fracture strength of the restorations. However, these findings are not supporting our results as there was no statistically significant improvement of the fracture resistance when using IDS.

CONCLUSION

There is no statistically significant difference between the fracture resistance showed by restorations done with or without IDS. Therefore, the use of IDS has no additional effect on the fracture resistance in teeth restored by lithium disilicate onlays. This study was done under laboratory conditions; therefore, the findings may not be representable when tested in clinical situations of the patient.

REFERENCES

1. Abduo J, Sambrook RJ. Longevity of ceramic onlays: A systematic review. J Esthet Restor Dent 2018; 30:193-215.
2. Vianna AL, Prado CJ, Bicalho AA, et al. Effect of cavity preparation design and ceramic type on the stress distribution, strain and fracture resistance of CAD/CAM onlays in molars. J Appl Oral Sci 2018; 26.
3. Pieger S, Salman A, Bidra AS. Clinical outcomes of lithium disilicate single crowns and partial fixed dental prostheses: A systematic review. J Prosthet Dent 2014; 112:22-30.
4. Dolev E, Bitterman Y, Meirowitz A. Comparison of marginal fit between CAD-CAM and hot-press lithium disilicate crowns. J Prosthet Dent 2019; 121:124-128.
5. Schmitz JH, Beani M. Effect of different cement types on monolithic lithium disilicate complete crowns with feather-edge preparation design in the posterior region. J Prosthet Dent 2016; 115:678-83.
6. Sulaiman TA, Abdulmajeed AA, Delgado A, et al. Fracture rate of 188695 lithium disilicate and zirconia ceramic restorations after up to 7.5 years of clinical service: A dental laboratory survey. J Prosthet Dent 2020; 123:807-810.
7. Oyar PE, Durkan R. Effect of cavity design on the fracture resistance of zirconia onlay ceramics. Nigerian J Clin Pract 2018; 21:687-691.
8. Magne P, Kim TH, Cascione D, et al. Immediate dentin sealing improves bond strength of indirect restorations. J Prosthet Dent 2005; 94:511-519.
9. Paul SJ, Schärer P. The dual bonding technique: A modified method to improve adhesive luting procedures. Int J Periodont Restorative Dent 1997; 17:536-545.
10. Dietschi D, Spreafico R. Current clinical concepts for adhesive cementation of tooth-colored posterior restorations. Pract Periodont Aesthet Dent 1998; 10:47-54.
11. Dietschi D, Spreafico R. Evidence-based concepts and procedures for bonded inlays and onlays. Part I. Historical perspectives and clinical rationale for a biosubstitutive approach. Int J Esthet Dent 2015; 10:210-227.
12. Magne P. Immediate dentin sealing: A fundamental procedure for indirect bonded restorations. J Esthet Restor Dent 2005; 17:144-154.
13. Edelhoff D, Güth JF, Erdelt K, et al. Clinical performance of occlusal onlays made of lithium disilicate ceramic in patients with severe tooth wear up to 11 years. Dent Materials 2019; 35:1319-1330.
14. Samartzi TK, Papalexopoulos D, Sarafianou A, et al. Immediate dentin sealing: A literature review. Clin Cosmet Investig Dent 2021; 13:233.
15. Hofsteenge JW, Hogeveen F, Cune MS, et al. Effect of immediate dentine sealing on the aging and fracture strength of lithium disilicate inlays and overlays. J Mech Behav Biomed Materials 2020; 110:103906.
16. Elbishari H, Elsubeihi ES, Alkhoujah T, et al. Substantial *in-vitro* and emerging clinical evidence supporting immediate dentin sealing. Japanese Dent Sci Rev 2021; 57:101-110.