Original Article

Comparative evaluation of microleakage of paracore, multicore and luxacore - an in vitro study

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Abstract

Aims:
This in- vitro study aimed to compare the microleakage in three different core materials (Para core, Multicore and Luxacore).

Materials and methods:
30 samples of first mandibular premolar were selected and divided into three groups, each group consisting of 10 samples. Standardized class V cavities were prepared on buccal surface and were restored with assigned core materials .After thermocycling for 500 cycles (5^{O}-55^{O}c), the specimen were then coated with two layer of nail varnish leaving an area of 1mm around the filling material uncovered .The samples were then immersed in 0.5% in methyl blue dye for 24 hours. The teeth were sectioned longitudinally and greatest depth of dye penetration was recorded in coronal and cervical surface under stereomicroscope (15X).

Results:
The result revealed that at Occlusal and gingival surface Paracore showed less microleakage as compared to other materials in the study.

Conclusion:
Paracore (at occlusal & gingival) core build up material showed significantly more effective seal than the Luxacore and Multi core.

Keywords: Dye penetration, luxacore, microleakage, multi core, para core.

Introduction:

The prognosis of final coronal restoration depends on the type of core reconstruction and the material used. A variety of composite resin materials with variable physical properties and different modes of polymerization (light activated, self activated or dual activated) are used for core build up. Core materials differ in terms of strength, stiffness, elasticity and other properties[1] that may influence the structural integrity as well as the durability of the final restoration. The tooth/restoration interface must resist dimensional changes to prevent developing leakage and possible further deterioration of the adhesive restoration. The permeability of dentinal tubules in adhesive-bonded restorations depends not only on the sealing ability of the adhesive, but also on bonding of the restorative material to the adhesive, as shrinkage of resin tags from the tubular walls during composite polymerization may result in incomplete dentinal sealing [2-3]

During polymerization shrinkage, stresses are generated within the restoration and at the margins, and if these stresses exceed the bond strength gap formation; microleakage may occur at the tooth restoration interface [4]. Microleakage is the passage of fluids, bacteria, molecules or ions and even air between a restorative materials and prepared cavity wall of a tooth. Different methods are available to evaluate

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the microleakage out of which one of the established methods is dye penetration. Jensen and Chan (1985)[5] stated that the evaluation of microleakage in a restoration must include thermocycling the restoration.

Inspite of great deal of developments in

Table 1: Composition of the core materials used in this study as per manufacturer

Core Material	Composition	Filler content/ Particle size
PARACORE	A-Para Post Para core contains: Methacrylate, Fluoride Barium Glass -Amorphous Silica B- Para Bond None rinse conditioner contains: Water, Acrylamidosulphonic acid, Methacrylate Para Bond Adhesive A- -Methacrylates,Meleic Acid,Benzoyl peroxide Para Bond Adhesive B- -Ethanol,Water,Initiators	68 wt% 0.1μm
LUXACORE	-Barium glass, Pyrogenic Silica acid,Nano Fillers and Zirconium oxide in a Bis-GMA based dendel resin matrix, Total filler volume 71 weight% and 50 vol%	71 wt% 0.01μm
MULTICORE	Bis-GMA,Urithane dimethacrylate and Triethylene glycol dimethacrylate (29 wt%) -barium glass, Ytterbiumtride,Ba-Al-Fluorosilicate glass and highly dispersed silicon dioxide (70 wt%) - catalysts,stabilizers and pigments .	70 wt% 0.04 μm

Fig 1: Core Materials used in the study

Fig 2: Samples used in the study

Fig 3: Class V tooth preparation

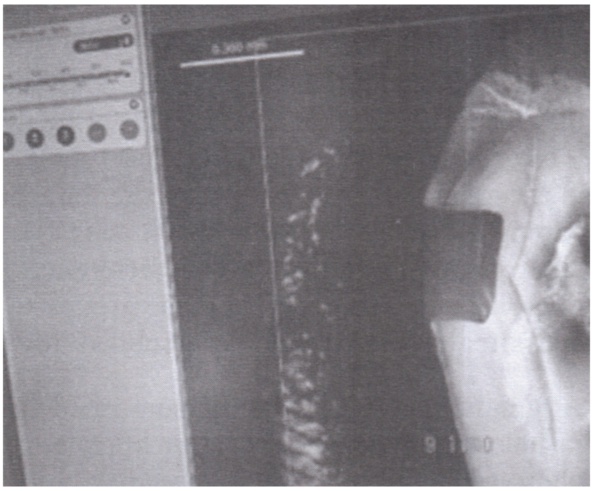

Fig 4: Stereomicroscopic image showing dye leakage

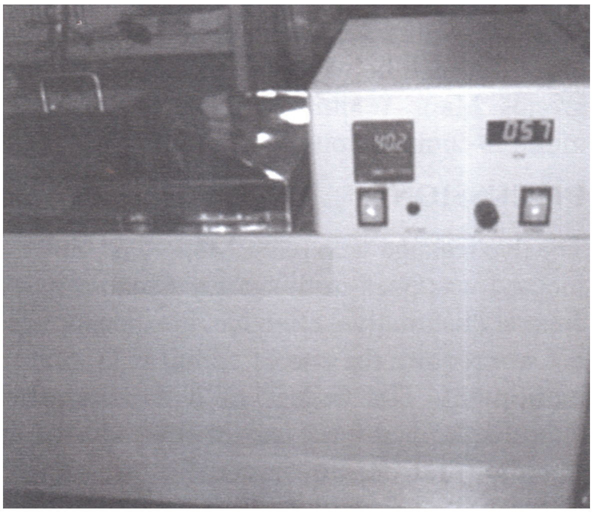

Fig 6: Picture of thermocycling unit

technology and technique none of the material could perfectly seal the gap between material and tooth structure. Achieving a perfect seal is still problematic with commercially available simplified etch and rinse adhesives. The present in vitro study aimed to compare the microleakage of the following four recently introduced core build up material Paracore (Coltene/ Whalendent) ,Luxacore (DMG America)and Multicore (Viva dent) with dye penetration.

MATERIALS AND METHODS

Thirty extracted non carious premolars were selected for this study. Previously restored teeth, teeth with visible cracks and those with non carious cervical lesions were excluded. After cavity preparations, Group I was restored with Para core; Group II was restored with Multicore and Group III was restored with luxa core according to the manufacturer's instructions. Following restorations, the teeth were stored in distilled water at room temperature for 24 hours before being subjected to 500 thermal cycles between 5-55°C water baths with a 30 second dwell time and a 15-second transfer time. The root apices were sealed with utility wax, and all the surfaces, except for the restorations and lmm from the margins, were coated with two layers of nail varnish. The teeth were then immersed in a 0.5% methylene blue dye solution for 24 hours. They were then rinsed in running water, blot-dried and sectioned longitudinally through the center of the restorations in a buccolingual direction using diamond disk in slow speed handpiece. The sections were assessed for dye penetration using a stereomicroscope (Wild Heerbrugg) with software (Leica application suit) at 15x magnification. Dye penetration at the core/ tooth interface was scored for both the occlusal and gingival margins on a non-parametric scale from 0 to 3.The scoring criteria followed was

A statistical analysis was performed using the

Table 2: Scoring Criteria

SCORE	
0	No dye Penetration
1	Dye penetration of less than half of the cavity depth.
2	Dye penetration more than half of the cavity depth
3	Dye penetration spreading along the axial wall

Table 3: Comparison of Microleakage at occlusal and gingival level in different groups

SN	Group	No. of samples	Occlusal		Gingival	
			Mean	SD	Mean	SD
1.	Group I(PARACORE)	10	9.950	6.247	8.770	1.407
2.	Group III(LUXACORE)	10	10.964	4.411	13.730	2.465
3.	Group II(MULTICORE)	10	12.670	3.795	11.670	5.722

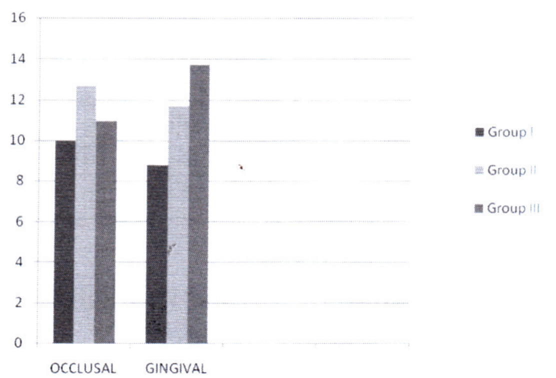

Fig. 5: Graphic representation of microleakage values.

Table 4: Group I: Summary Statistics

Statistic	Occlusal	Gingival	Middle
Min	0	0	0
Max	76.2	29.6	29.9
Mean	18.475	12.860	12.620
SD	23.332	11.748	11.878
Median	11.750	15.850	15.150
KS test for normalcy	0.148	0.048	0.062

Table 5: Group II: Summary Statistics

Statistic	Occlusal	Gingival	Middle
Min	0.9	0	0
Max	31.5	22.3	23.7
Mean	10.964	5.880	9.880
SD	8.193	9.567	7.982
Median	9.200	0	11.700
KS test for normalcy	0.025	<0.001	0.200

Table 6: Group III: Summary Statistics

S. No.	Comparison	Occlusal	
		"z"	"p"
1.	Group I vs Group II	0.454	0.684
2.	Group I vs Group III	2.688	0.015
3.	Group II vs Group III	3.330	0.001

Table 7: Multiple Comparisons

S. No.	Comparison	Occlusal		Gingival		Middle	
		"z"	"p"	"z"	"p"	"z"	"p"
1.	Group I vs Group II	0.454	0.684	1.324	0.247	0.734	0.481
2.	Group I vs Group III	2.688	0.015	2.218	0.052	0.808	0.481
3.	Group II vs Group III	3.330	0.001	0.795	0.579	0.713	0.529

Kolmogorov-Smimov test and Kruskall Wallis Test and Mann Whitney "U" test

RESULT

At the occlusal level the Paracore demonstrated the least microleakage as compared to the, Luxacore and Multi core. Microleakage observed in ascending order in the groups are Paracore (Group I), followed by Luxacore (Group III) and Multi core (Group II) . The difference in microleakage score among these groups was statistically significant at occlusal level. At gingival level Paracore demonstrated least microleakage as compared to other. Microleakage observed in gingival level in ascending order is Para core (group I) followed by Multi core(Group II) and Luxacore (Group III) in Table III. The Kruskall Wallis Test was applied to determine the difference between microleakage in three groups. Mann-Whitney U test was applied for multiple comparison.

DISCUSSION

The dye leakage with 0.5% Methylene blue dye method was used in this study because it was simple, quantitative, effective, inexpensive, and did not require the use of complex laboratory equipment. The degree of dye penetration indicates the inert space between the tooth margin (enamel and dentin or cementum) and the restorative material interface that could allow the ingress of bacterial endotoxins and their inflammatory products. In dye penetration testing, which is one of the main methods of assessing microleakage, the sample is subjected to a dye marker such as methylene blue, which was previously used by the Ernst[6].

Recently, Heitze and others reported that there is no significant difference in tracer penetration between fuchsin, silver nitrate and methylene blue[7]. Methylene blue is one of the most common tracers and can be used in different concentrations, from 0.5% up to 5%[8]. It was pointed out that, because of the small surface area of the particles (approximately 0.52nm^2), methylene blue may lead to an over estimation of leakage at the tooth-restoration interface, particularly with self-etch adhesive in relation to their increased hydrophilicity[6].

In the present study steremicroscopic observations were done for the microleakage in the interfaces which is an established method and gives a clear in depth image with the help of recent image processors and softwares.

Extreme differences of linear co-efficient of thermal expansion between tooth and restorations causes percolation and subsequent microleakage. As core materials possess different thermal conductivity and co-efficient of thermal expansion from tooth structure, these properties are important in controlling and minimizing microleakage[9]. Because the cavities were only 1.5 mm in depth, the bulk technique was used to restore them with the respective composite resin[10]. It aims at thermally stressing the junction at the tooth-restoration interface by subjecting the restored tooth to extreme temperature changes compatible with temperature changes encountered intraorally[11].

Para core composites exhibited least microleakage at both the enamel and the dentin margins as compared to other core materials. These results can be attributed to higher filler loading with smaller particle size of Multicore and Luxacore in comparison with comparatively larger-sized filler particles and lesser filler loading in the Para core composition. High filler loading results in a high degree of stiffness, which can lead to high shrinkage stress[12]. The low-molecular weight UDMA and resultant high number of double bonds per unit weight create a high degree of cross linking, creating a rigid resin with a relatively high shrinkage.

At gingival level Luxacore demonstrated maximum microleakage which may be explained on the basis of application of total etch bonding as recommended by its manufactures, as there is comparatively weak bond in absence of enamel at gingival margin.

The class V cavity design was chosen because it had a high C-factor value. It was relatively easy to restore and therefore exhibited minimized interoperator variability. It had both enamel and dentinal margins and did not offer any inherent macro-mechanical retention[13]. They involve both the enamel and the dentin margins and therefore the nature of adaptation of core material could be compared at both the margins. The enamel margins were beveled in order to-increase the surface area for core material to bond to enamel.

The samples were subjected to the thermocycling in order to replicate the intraoral environment, because there was a difference in the coefficient of thermal expansion of the restoration and the tooth interface. The resulting mismatch in its value was said to cause fatigue of the bond between the restoration and the tooth, leading to a gap formation, which could lead to microleakage[12]. In the current study all specimens were subject to 500 cycles between 5°C and 55°C which is considered an appropriate artificial aging test according to ISO TR standard 11405:1994[14].The dye penetration method used in the current study is a gross assessment of the quality of the interface. Other methods of dye penetration are Fluid filtration method, Electrochemical method, Neutron activation method and Bacterial method.

At present there is lack of literature regarding evaluation of microleakage using the dye penetration method when studying three different core materials (Paracore, Multicore and Luxacore).This research will add to the body of knowledge already present on core materials. This research also questions the benefit of materials with low volumetric polymerization shrinkage,which should be not be considered as the only parameter for decreasing stress,and other factor such as modulus of elasticity much also be kept in mind.

In summary, the result of our study indicated that.-

At occlusion- Paracore< Luxacore< Multicore.

At gingival-Paracore < Multicore < Luxacore

CONCLUSION

According to the methodology proposed and within the limitation of this study (in vitro experimental design and sample size) the following conclusions can be drawn: Paracore (at occlusal & gingival) produced significantly more effective seal than the Luxacore and Multicore and neither of these core materials was able to fully prevent microleakage.

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