Original Article

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EVALUATE THE MARGINAL MICROLEAKAGE IN CLASS II COMPOSITE RESTORATIONS BY FOUR DIFFERENT PLACEMENT TECHNIQUES

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ABSTRACT:

Objective: This study was undertaken to evaluate the Marginal Microleakage in class II composite restorations by four different placement techniques.

Materials and Methods: In 60 sound extracted human molars, standardized class-II cavities were prepared at mesial and distal surfaces with cervical margin at the level of CEJ using high speed burs.All cavities were Etched with N ETCH (35% phosphoric acid) for 15 seconds and rinsed for 30 seconds with water and blot dried. Bonding agent (Tetric N Bond) was applied and light cured for 40 seconds. Palodent sectional matrix was placed and adapted to cavosurface margins. All preparations were restored with a nanofilled composite Tetric N Ceram (A2 shade) according to assigned groups.

GROUP 1- Bulk Technique
GROUP 2- Oblique Incremental Technique
GROUP 3- Centripetal Technique
GROUP 4- Split Horizontal Incremental Technique

After restoration, Palodent sectional matrix was removed and samples were stored in distilled water at 37^0C for 24 hours. For evaluation of microleakage, the samples were isolated with two layers of nail varnish except 2.0mm around the restoration. Specimens were later thermocycled for 1000 cycles at 5°C ± 1°C and 55°C ± 1°C with 30 seconds dwell time. After thermocycling, the samples were immediately immersed in methylene blue dye for 24 hours.

Later the samples were sectioned longitudinally in the mesiodistal direction with diamond discs. The sections were analysed by an independent examiner using a stereomicroscope at 10x magnification who was blinded by the groups and scored for the degree of dye penentration along the occlusal and cervical walls using the scores described below-

0 = no dye penetration
1= dye penetration into enamel; dye penetration extending to one-third of cervical wall
2= dye penetration into dentino enamel junction; dye penetration extending to half of the cervical wall
3= dye penetration into axial wall; dye penetration into cervical wall
4= dye penetration into the cervical wall and axial wall toward the pulp

Results: Kruskal wallis test was done for proportionality within the groups for microleakage. Mann-Whitney test was done to find significant difference between each group. Microleakage scores indicated that incremental techniques were better than bulk techniqueand among all incremental techniques, Split incremental techniques fared best results.

Conclusion: Among all the incremental techniques, split horizontal incremental technique showed least microleakage followed by centripetal incremental technique and oblique placement technique, at the occlusal margins of the restorations. Further in vivo and in vitro studies should be conducted to derive at definite conclusions.

Key words: Marginal Microleakage, Bulk Technique, Oblique Incremental Technique, Centripetal Technique, Split Horizontal Incremental Technique.

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INTRODUCTION

Composite restoration has become an essential part of dental practice with the improvement in dental adhesive systems, increase in patient's demand for esthetics and more emphasis on preservation of tooth structure.[1]

Despite advances that have been made many clinical and material limitations have restricted the use of resin composites as posterior restorative materials. Polymerization shrinkage and microleakage remains the great challenge in direct resin based composite. Microleakage at the tooth restoration interface is considered a major factor influencing the longevity of dental restoration.[2]

FEILZER et al. in 1987 postulated that the geometric configuration plays an important role in the adaptation of resin composite restoration. The cavity configuration (C-factor) is defined as the ratio of bonded to unbonded surfaces. A high ratio denotes high polymerisation stresses, which are accompanied by increased shrinkage stresses. Among many of the factors contributing to the shrinkage stresses, C-factor is an important one.[3]

The use of beta-quartz glass ceramic inserts in the mass of restorative material are other methods proposed to minimize polymerisation shrinkage of light cure composites. Several techniques have been suggested to improve marginal adaptation of high C-factor preparation, including adhesive system that potentially resist composite shrinkage placement techniques for resin composites, protocols for polymerisation and different cavity preparation.[2]

Various techniques have been recommended to reduce the size and incidence of polymerization gaps formed following placement of composite restorations. When visible light cured(VLC) resin is utilized, increment placement is recommended to decrease the overall setting contraction by reducing the bulk of composite cured at one time. As a result, polymerisation shrinkage is directed away from the gingival margin of the preparation. An alternative technique that utilizes a clear matrix has also been recommended. This matrix allows the use of a transparent reflecting wedge which can more favourably direct polymerisation shrinkage toward the gingival margin. However, because the clear matrix is not as pliable as metal matrix, it is more difficult to place and obtain an interproximal contact. During polymerization the conversion of monomer molecules into a polymer network results in a closer packing of the molecules leading to bulk contraction, but their success depends on the access of high-intensity light to cure the matrix material. Light-curing can be accomplished with quartz-tungsten-halogen (QTH) curing units, plasma arc curing (PAC) units, laser curing units, and light-emitting diode (LED) curing units. [4]

It has been reported that placing composite resins in increments reduces shrinkage stresses.[5]

The idea of oblique technique as proposed by Lutz et al was to increase adhesive free surface, allowing better flow of resin, hence reduction of polymerization shrinkage.[6]

Bichacho demonstrated centripetal incremental technique, which involved construction of a thin composite proximal wall before filling the entire preparation with increments ensuring better adaptation of composite to cavity walls.[7]

Recently a new technique, the split horizontal incremental technique, has been proposed as modification of centripetal incremental technique, in which after building the proximal wall, the horizontal increments placed to fill the class I cavity so formed, are split to further reduce the C-factor, hence microleakge.[5]

Thus, the aim of this study was to evaluate and compare the marginal microleakage at occlusal and gingival margins in posterior class II restorations placed with Bulk, Oblique, Centripetal and Split horizontal incremental techniques.

MATERIALS AND METHODS

This in vitro study was conducted in the Department of Conservative Dentistry and Endodontics and Department of Oral pathology and Microbiology, KLE's V.K. Institute of Dental Sciences, Belgaum-590010.

Selection of teeth:

Inclusion criteria:

- Extracted molar teeth.
- Non carious teeth.

Exclusion criteria:

- Teeth with fracture or a restoration.
- Teeth with developmental anomalies.
- Teeth with preparation depths below CEJ.

All teeth are then placed in 3% NaOCl for 24 hours for surface disinfection and then stored in distilled water at room temperature until use.

ARMAMENTARIUM

- High Speed Contraangled Hand Piece (Nsk)
- No 245 Carbide Bur(S S White)
- Straight Hand Piece (Nsk)
- Mandrell
- Diamond Discs
- Palodent Sectional Matrix System (Dentsply)
- Applicator Tips
- Light Curing Unit (Monitex)
- Thermocycler
- Stereomicroscope

MATERIALS USED

- Etchant -N-Etch (37% Phosphoric Acid)
- Bonding Agent-Tetric N-Bond **Ivoclar Vivadent**
- Composite-Tetric N-Ceram(A2 Shade)
- Cold Cure Acrylic Resin (Dpi-Rr)
- Nail Varnish
- Methylene Blue Dye

- Distilled Water

METHODOLOGY

60 sound collected human molars were cleaned of calculus, soft tissue and debris and stored in distilled water .Standardized class-II preparations are made on the mesial and distal surfaces of each tooth leading to 120 cavities. Each cavity was prepared with a carbide bur 245. The final preparation has the following dimensions,

2.0mm- Occlusal extension

3.0mm- Buccolingual extension

5.0mm-Occlusocervical extension.

A sectional metallic matrix (Palodent) was placed and adapted to cavosurface margins. This sectional matrix band allowed proximal wall reconstruction and reduced the chance of composite overhangs.

Bonding Procedure

The cavities were etched with N-ETCH Etchant (35% PHOSPHORIC ACID) for 15 seconds and washed with water for 15 seconds and blot dried .The dentin was kept moist. A self-etching primer, TETRIC-N-BOND was applied with an applicator tip and light cured for 20secs.Light curing (Monitex) was done with a blue light having wavelength ranging from 400-500nm. During curing of samples, light intensity was checked using a radiometer. TETRIC N-CERAM (A2 SHADE), a nano filled composite was used. Prior to restoration, a metallic Palodent sectional matrix was placed and adapted to cavosurface margins of the preparations.

Later all specimens were randomly divided into four groups, each containing 15 teeth.

GROUP I- Bulk Technique
GROUP II- Oblique Incremental Technique
GROUP III- Centripetal Technique
GROUP IV- Split Horizontal Incremental Technique.

RESTORATIVE PROCEDURE

Group I:

Samples were restored with bulk placement technique. A single layer of composite was applied to fill the preparation up to the cavosurface margin. The increment was cured for 120 seconds.

Group II:

Samples were restored with oblique placement technique .The first increment was horizontally placed at cervical wall and light cured for 40 seconds. The second increment was obliquely placed contacting the buccal and axial walls was cured for 40 seconds. The third increment was obliquely placed, filling the preparation and light cured for 40 seconds.

Group III:

Samples were restored with centripetal placement technique .A thin layer of composite, 0.5mm thick, was applied toward the metallic matrix contacting the cavosurface of the proximal box upto half of occlusal -cervical extension. A second layer was applied over the previous increment contacting cavosurface margin of the proximal box and forming marginal ridge. Both the composite increments were cured for 40 seconds .The resulting class one cavity was restored in 2 horizontal increments, each increment being cured for 40 seconds.

Group IV:

Samples were stored using split horizontal incremental technique. The marginal ridge was formed as in centripetal technique to form a class 1 cavity .Later first 2mm horizontal increment is placed. One diagonal cut was made in increment in order to split it into two triangular-shaped flat portions with the help of OPTRASCUPLT instrument, which were cured for 40 seconds. In this way, each portion of the split-increment contacted half of the gingival wall and only two of the surrounding cavity walls during curing instead of opposing each other. The diagonal cut was filled completely with composite and light cured for 40 seconds from the occlusal direction. Similarly second horizontal increment was placed upto cavosurface margin and lightcured .

Preparation For Microleakage Test

For each specimen, after the restoration was complete the metallic matrices were removed and specimens were stored in distilled water at 37˚ C for 24 hours. The restorations were finished and polished.

To evaluate microleakage, the teeth surfaces were isolated with 2 layers of finger nail varnish, except for 2mm around the restoration. The specimens were thermocycled for 1,000 cycles at 5° ± 1°C and 55° ± 1°C with 30 seconds dwell time. Then the specimens were immediately immersed in methylene blue dye for 24 hours.

After that nail polish was removed and specimens were sectioned along the long axis in the mesiodistal direction of the restoration with a diamond disc and analyzed using a stereomicroscope at 10x magnification by an independent examiner who was blinded by the groups. And scored for the degree of dye penetration along the occlusal and cervical walls using the scores described below-

0= no dye penetration

1= dye penetration into enamel; dye penetration extending to one-third of cervical wall

2= dye penetration into dentino enamel junction; dye penetration extending tohalf of the cervical wall

3= dye penetration into axial wall; dye penetration into cervical wall

4= dye penetration into the cervical wall and axial wall toward the pulp.[26]

EXPERIMENTAL DESIGN

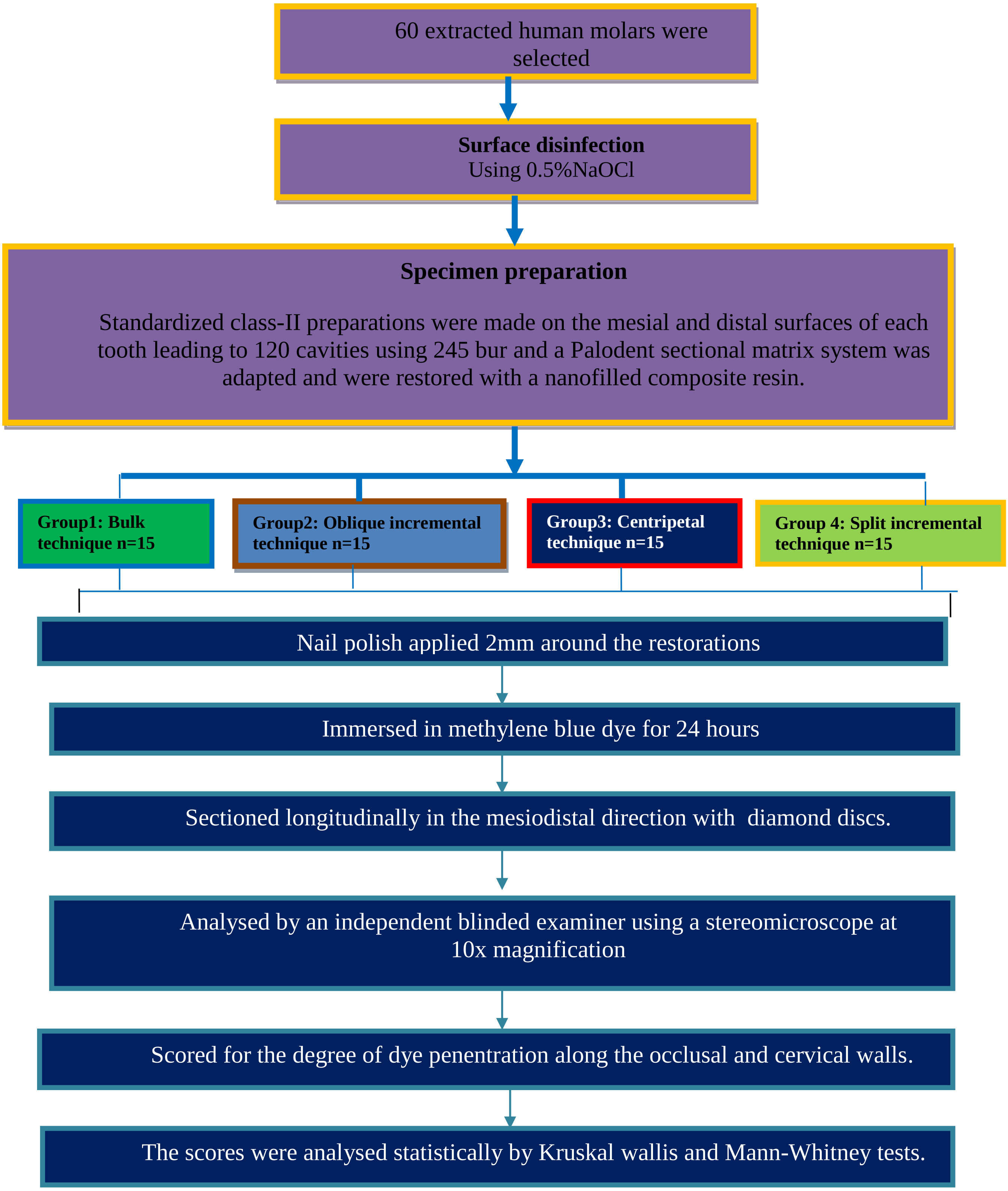


Fig 1 –Extracted Human Molars

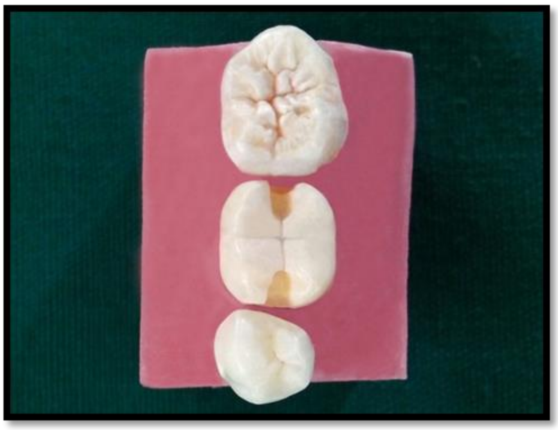


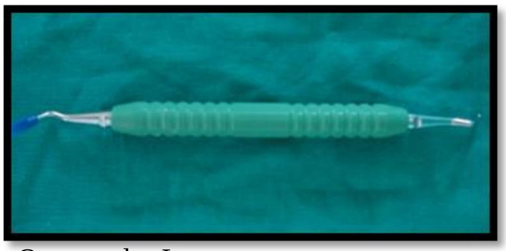
Fig-2 - Standardized Class Ii Prepared Cavities

Fig 3- Adaptation Of Palodent Sectional Matrix System

Fig 4- Bulk Technique
(Clinical Representation)

Fig 5- Oblique Incremental Technique
(Clinical Presentation)

Fig 6- Centripetal Technique
(Clinical Presentation)



Optrasculpt Instrument

Diagonal Cut

Spatula Shaped Tip

Fig7 Split Horizontal Incremental Technique
(Clinical Representation)

Fig8 Grouping Of Samples

Fig 9-Stereomicroscope Microscopic View Of Sectioned Specimens

Fig 10-- Group 1- Bulk Technique

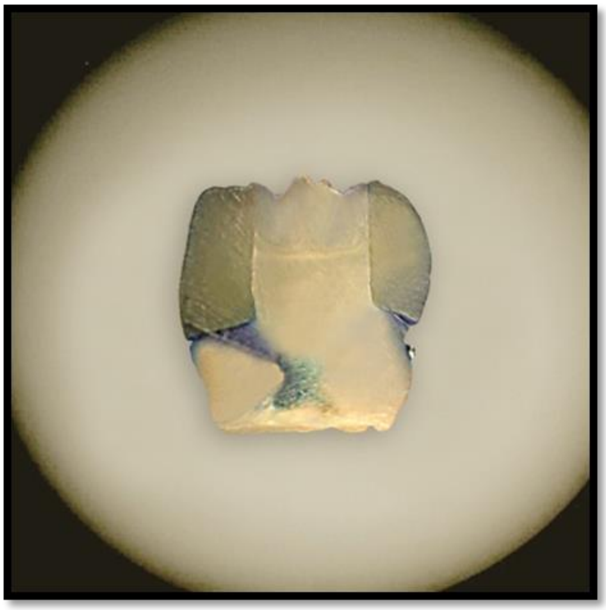


Fig 12- Group III- Centripetal Technique

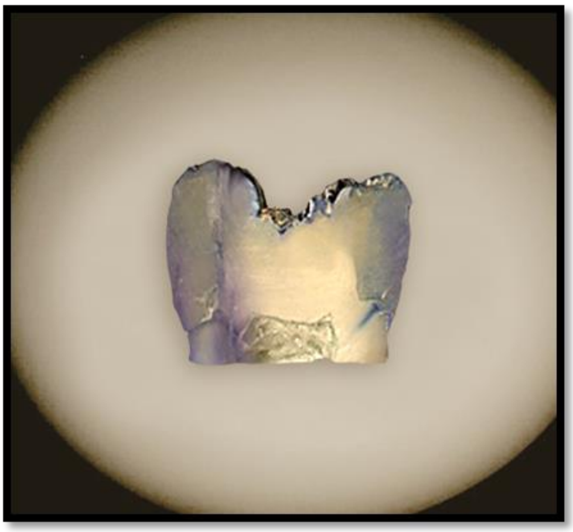


Fig 11 --Group II- Oblique Technique

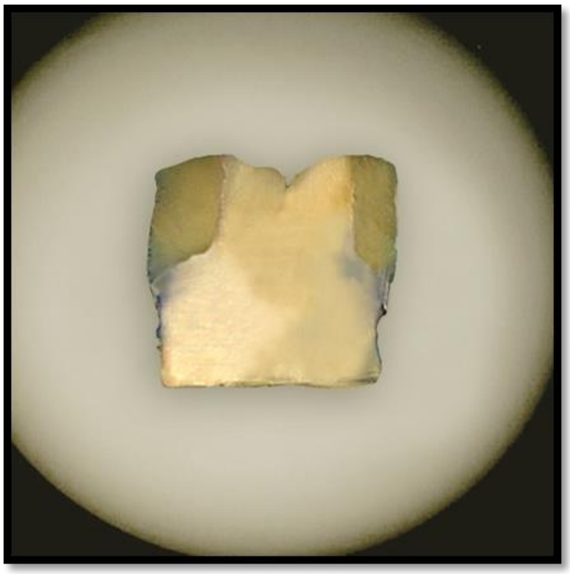


Fig13-Group IV- Split Horizontal Incremental Technique

RESULTS:

TABLE- 1: Microleakage scores at occlusal margins

Groups	Score 0	%	Score 1	%	Score 2	%	Score 3	%	Score 4	%	Total
Group I	1	6.67	1	6.67	2	13.33	5	33.33	6	40.00	15
Group II	1	6.67	4	26.67	4	26.67	3	20.00	3	20.00	15
Group III	3	20.00	7	46.67	3	20.00	1	6.67	1	6.67	15
Group IV	5	33.33	8	53.33	2	13.33	0	0.00	0	0.00	15

TABLE -2: Microleakage scores at gingival margins

Groups	Score 0	%	Score 1	%	Score 2	%	Score 3	%	Score 4	%	Total
Group I	0	0.00	1	6.67	2	13.33	6	40.00	6	40.00	15
Group II	1	6.67	2	13.33	4	26.67	6	40.00	2	13.33	15
Group III	2	13.33	5	33.33	5	33.33	2	13.33	1	6.67	15
Group IV	4	26.67	6	40.00	2	13.33	2	13.33	1	6.67	15

COMPUTATIONS:

Micro-leakage analysis at occlusal margin:

Comparison of four groups with micro leakage scores at occlusal margins by Kruskal Wallis ANOVA

TABLE -3

Group	Mean	SD	Median	Sum of ranks
Group I	2.93	1.22	3.00	661.00
Group II	2.20	1.26	2.00	536.00
Group III	1.33	1.11	1.00	369.50
Group IV	0.80	0.68	1.00	263.50
H-value	21.5134			
P-value	0.0001*			

It is observed that there is a significant difference between the groups with respect to micro-leakage (P<0.001).

Higher mean micro-leakage is found to be in Group I (bulk) followed by Group II (oblique) and Group III (centripetal) respectively. Group IV(split horizontal) recorded the lowest mean micro-leakage.

In order to find out among which pair of groups there exist a significant difference, Mann-Whitney test was done and the results are given below:

TABLE -4: Pair wise comparison of four groups with micro leakage scores at occlusal margins by Mann-Whitney U test

Group	Mean	SD	Median	Sum of ranks	U-value	Z-value	P-value
Group I	2.93	1.22	3.00	271.00	74.00	-1.5969	0.1103
Group II	2.20	1.26	2.00	194.00			
Group I	2.93	1.22	3.00	305.50	39.50	-3.0279	0.0025*
Group III	1.33	1.11	1.00	159.50			
Group I	2.93	1.22	3.00	324.50	20.50	-3.8160	0.0001*
Group IV	0.80	0.68	1.00	140.50			
Group II	2.20	1.26	2.00	277.50	67.50	-1.8665	0.0620
Group III	1.33	1.11	1.00	187.50			
Group II	2.20	1.26	2.00	304.50	40.50	-2.9864	0.0028*
Group IV	0.80	0.68	1.00	160.50			
Group III	1.33	1.11	1.00	262.50	82.50	-1.2443	0.2134
Group IV	0.80	0.68	1.00	202.50			

*p<0.05

*denotes significant difference

Micro-leakage analysis at gingival margin:

TABLE -5: Comparison of four groups with micro leakage scores at gingival margins by Kruskal Wallis ANOVA

Group	Mean	SD	Median	Sum of ranks
Group I	3.13	0.92	3.00	658.50

Group II	2.40	1.12	3.00	511.00
Group III	1.67	1.11	2.00	361.00
Group IV	1.33	1.23	1.00	299.50
H-value	17.7991			
P-value	0.0005*			

*p<0.05

The result showed significant difference between the groups with respect to micro-leakage (P<0.0005).

Higher mean micro-leakage is found to be in Group I (Bulk) followed by Group II (Oblique) and Group III (Centripetal) respectively. Group IV (Split horizontal) recorded the lowest mean micro-leakage at gingival margins.

In order to find out among which pair of groups there exist a significant difference, Mann-Whitney test was carried out and the results are given below:

TABLE-6

Group	Mean	SD	Median	Sum of ranks	U-value	Z-value	P-value
Group I	3.13	0.92	3.00	276.00			
Group II	2.40	1.12	3.00	189.00	69.00	-1.8043	0.0712*
Group I	3.13	0.92	3.00	308.50			
Group III	1.67	1.11	2.00	156.50	36.50	-3.1523	0.0016*
Group I	3.13	0.92	3.00	314.00			
Group IV	1.33	1.23	1.00	151.00	31.00	-3.3805	0.0007*
Group II	2.40	1.12	3.00	275.00			
Group III	1.67	1.11	2.00	190.00	70.00	-1.7628	0.0779
Group II	2.40	1.12	3.00	287.00			
Group IV	1.33	1.23	1.00	178.00	58.00	-2.2606	0.0238*
Group III	1.67	1.11	2.00	254.50			
Group IV	1.33	1.23	1.00	210.50	90.50	-0.9125	0.3615

*denotes significant difference

Significant difference is observed between Group I & Group II (P<0.05), Group I & Group III (P<0.01) and also between Group I & Group IV (P<0.0005) with respect to micro-leakage.

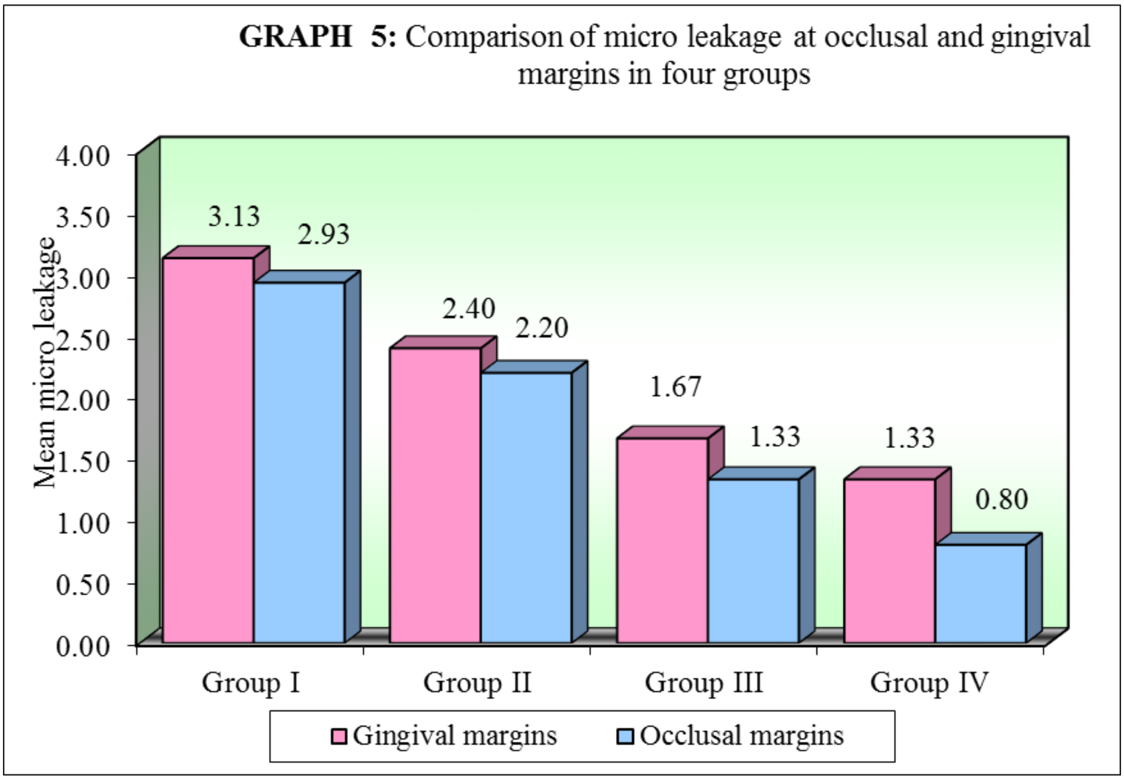
The difference between Group II & Group III with respect to micro-leakage is not found to be statistically significant (P>0.05) but the difference between Group II & Group IV is found to be statistically significant (P<0.01).

Between Group III & Group IV, statistically significant difference is observed with respect to micro-leakage (P<0.05).

So it can be concluded that at the gingival margin, bulk technique showed greatest microleakage followed by oblique and centripetal placement techniques ,which had almost similar microleakage scores .Least microleakage was shown in groups restored with split horizontal incremental technique.

TABLE-7: Comparison of micro leakage at occlusal and gingival margins in four groups by Mann-Whitney U test

Group	Margins	Mean	SD	Median	Sum of ranks	U-value	Z-value	P-value
Group I	Occlusal	2.93	1.22	3.00	226.50			
	Gingival	3.13	0.92	3.00	238.50	106.50	0.2489	0.8035
Group II	Occlusal	2.20	1.26	2.00	220.50			
	Gingival	2.40	1.12	3.00	244.50	100.50	0.4977	0.6187
Group III	Occlusal	1.33	1.11	1.00	210.50			
	Gingival	1.67	1.11	2.00	254.50	90.50	0.9125	0.3615
Group IV	Occlusal	0.80	0.68	1.00	208.00			
	Gingival	1.33	1.23	1.00	257.00	88.00	1.0162	0.3095



We observe that there is a significant difference between Group I & Group II (P<0.05), Group I & Group III (P<0.001) and also between Group I & Group IV (P<0.001) with respect to micro-leakage.

The difference between Group II & Group III with respect to micro-leakage was not found to be statistically significant (P>0.05) but the difference between Group II & Group IV was found to be statistically significant (P<0.001).

Between Group III & Group IV, statistically significant difference is observed with respect to micro-leakage (P<0.01).

So it can be stated that bulk technique showed highest microleakage scores. Centripetal and oblique technique showed no significant difference among themselves, but showed a significant lower microleakage scores when compared to bulk. Split horizontal technique showed least microleakage among all groups.

DISCUSSION :

The ability to achieve a complete and long lasting seal is perhaps one of the major challenges in dentistry.[22] However, the polymerization shrinkage and its associated stress still remains a major drawback of dental composite materials, and numerous studies have been performed to assess and reduce the polymerization shrinkage stress. [1]

The cavity configuration(C factor) is defined as the ratio of bonded to unbounded surfaces. A high ratio denotes high polymerization stresses. Extensive efforts have been made to minimize these stresses. All of them were directed at improving composite resins formulation, curing methods and restorative placement techniques.[5]

Polymerization shrinkage causes stress at the interface between a tooth and a restoration as the elastic modulus of the composite increases during curing. This stress manifests as bond failure, cuspal flexure, enamel micro cracking, pulpal irritation and secondary caries due to bacterial infiltration, and post-operative sensitivity, which in turn can lead to restoration failure requiring re-restoration.[1]

Many methods have been advocated for the detection and evaluation of microleakage around the margins of the restorations such as chemical tracers, dye penetration, radioactive tracers, SEM. Among all the methods, use of dyes as tracers is found to be most common method of detecting microleakage in invitro circumstances as it is inexpensive, nontoxic and leakage is easily detected in dilute concentrations.

In the present study the magnitude of microleakage was assessed by sectioning the samples along the long axis in the mesiodistal direction. The severity of microleakage was delineated as linear leakage length.

. The dye penetration among the specimens were analysed with stereomicroscope at 10X magnification. The restoration were thermocyled before evaluating microleakage scores. Thermocycling is a in vitro process of subjecting a restoration and tooth to temperature extremes that conform to those found in oral environment.

Factors that can affect the shrinkage are inorganic filler content, molecular weight of monomer system, degree of conversion ,method of cure ,placement techniques and using various liners below composite resin.[34] All these techniques have been followed with variable results, yet none of them was able to completely eliminate microleakage . Hence we opted to check microleakage by four various placement techniques in a standardized class II preparations.

At the gingival margin (Table 2 and Graph 4) it was seen that bulk placement technique showed greatest microleakage when compared to those groups which where restored by incremental placement techniques.

In our study, results showed lower microleakage scores at occlusal margins when compared to gingival margins in all four groups. Because of different bonding characteristics and different dental tissues at occlusal and gingival margins, in our study marginal microleakage was evaluated and comparison was made at the occlusal (Table 1and Graph 1) and gingival margins (Table 2 and Graph 2) in all the four groups.

As the occlusal walls are located at enamel margins , more resistance to microleakage was expected as observed in our study .One factor that led to this outcome is higher inorganic content in enamel , which upon acid etching creates microporosities , allowing better penetration of adhesive system thus forming strong micromechanical bond with composite resin. Gingival margin are frequently placed apical to cementoenamel junction. Dentin bonding is more difficult because heterogeneous nature of tissue requires the bonding to accommodate simultaneously the properties of hydroxyapatite, collagen, dentinal tubules etc. Consequently the ability to achieve an effective seal at gingival margin is more important and difficult in terms of longevity of restoration.[26]

Our findings of greater microleakage at gingival margin when compared to occlusal margins in class II composite restoration were confirmed by the Studies done by Sillias Duarte, Lawrence W. Stockhon ,Sussan T Tang.

Precontoured sectional matrix bands are available in various shapes, thickness and sizes depending on the manufacturer. Overall benefits with the sectional matrices and contact rings include ease of use and good visibility, anatomic contour of the bands ensures optimal contact areas and embrasures, smaller tension on the teeth and greater comfort, and adequate gingival adaptation to the restoration.[27] Considering all these advantages, we opted Palodent sectional matrix system in our study.

Various placement techniques have been introduced such as oblique incremental, centripetal increment, and recently split horizontal incremental to reduce C-factor.[26]

In the current study the above mentioned incremental techniques have been carried out and the microleakage scores were compared with the bulk placement technique . The results demonstrated that all incremental techniques showed a significant reduction in microleakage when compared to bulk. As placing composite in increments reduces the overall volume of composite and reduces polymerization shrinkage .

While comparing marginal microleakage at occlusal margin (Table no1), it was observed that all the techniques showed reduction in microleakage when compared to bulk technique but the Split horizontal incremental technique showed the least scores . In split horizontal incremental technique, each horizontal increment was split into two triangular shaped increments by giving a diagonal cut using Optrasculpt instrument (Spatula tip). Thus minimizing stresses by reducing the C-factor from the ratio of 5.0 before splitting to approximately 0.5 as each triangular-shaped split increment is allowed to contact only two non-opposing cavity surfaces during light curing. This can be substantiated by a study by Hassan et.al, which stated that split horizontal placement technique helps in relieving the polymerization shrinkage stresses generated at the adhesive interface, resulting in an improved marginal seal.[36]

It was also observed from the values obtained with oblique and centripetal techniques showed significant reduction in microleakage when compared to bulk technique. On comparing oblique layering technique with centripetal technique, the latter proved to be better in terms of microleakage reduction at occlusal margin(Table 1 and Graph 1).

Oblique layering technique showed significant microleakage despite reduction in C factor. The reason being stated as, during restorative procedures cusp tend to move due to polymerization shrinkage, and these cuspal movements can be in same direction, opposite or nonexistent. Thus flexure of cusps reduces the ratio V/A(V-preparation volume ,A-area of cavity wall) thus reducing the amount of composite to be inserted into preparation. The increase in polymerization stress might produce a marginal gap if the polymerization stress surpasses the bond strengths. Also Sillias Duarte has stated that in centripetal technique there is better adaptation of composite resin to margins ,which further leads to reduction of microleakage when compared to oblique layering technique.[5]

Layering resin composites has been shown to reduce stresses generated on cavity walls. The reason for lesser microleakage with incremental techniques in our present study may be result of the low configuration factor, consequently minimal shrinkage occurs within each increment .Incremental restoration techniques actually lowers C factor to less than 1.0, because there is usually almost as much free surface as bonded surface in any single increment. E Ozel also stated that incremental placement is the preferred restorative technique for posterior composite restorations as it results in better marginal adaptation.[36]

With Incremental technique, there is possibility of incorporation of air bubbles in the restorations . Alster et. Al, have shown that the stress relief in thin resin increments is proportional to the amount of resin porosity. The oxygen present in air void contributes to stress reduction. Authors have also pointed out that incremental technique has advantages over bulk on account of improved marginal adaptation and wetting, enhanced control of overhangs at lateral margins, more effective and uniform cure. [36]

Current study showed significantly lower microleakage in incremental techniques when compared to bulk technique. This can be supported by a study conducted by Bhuyan et al. The oblique technique, proposed by Lutz et al in 1986, was modified in the present study by the use of a metallic matrix instead of a transparent one.[32] The idea of the oblique technique relies on placing small amounts of composite, which increases the adhesive free surfaces, allows a better flow of the resin, and reduces the shrinkage to a small volume. This procedure reduces the configuration factor (C-factor) of the preparation, assisting in the adaptation of the composite to the bonded surfaces.[36]

Even though, controlled thickness of the increments was maintained, polymerization stress occurred at the bonded surfaces. At the cervical wall, the first increment contacted the axial, buccal, lingual, and cervical walls simultaneously. Thus, there are more adhesive surfaces than free ones, the polymerization shrinkage tends to pull the increment toward the axial wall, resulting in an interfacial gap at the cervical margin.[36] Due to above said reason, oblique technique fared worst among incremental techniques in reducing microleakage.

In group III, teeth were restored with centripetal technique . The main purpose of the centripetal incremental technique is to transform a Class 2 into a Class 1 preparation. In this placement technique, first a proximal wall is built adjacent to the matrix band converting class II into class I and later is restored with horizontal increments. Because the amount of composite required to build up the proximal wall is minimal compared to that for the oblique technique, it is supposed to achieve a better marginal adaptation. Besides, it is possible to check the proximal contacts clinically before completing the placement of the increments and correct the proximal contact if necessary.[23]

With the use of centripetal technique, the V/A ratio could be reduced .This differs from oblique technique , in that the apical area of cavity will be filled completely with first layer of composite resin material. On the contrary, first layer of centripetal technique has no contact with the pulpoaxial walls and thus has less tendency to contract towards this wall and away from cervical floor during polymerization.[14] In the proximal box, the polymerization shrinkage tends to pull this first increment away from cervical margin. The second layer in oblique, which is a diagonal layer, will not be able to cover the first increment in cervical area , which can occur with the second layer of the centripetal build up technique. It is possible that above said explanation could be partly responsible for reduced microleakage scores of centripetal technique as compared to oblique technique as seen in our study .However the results were not statistically significant among both the groups (Table 6). Similar results were found in studies by Susanne et al, supporting the findings in our study.

The Split horizontal incremental technique is a simplified technique of composite placement advocated to reduce C factor, hence polymerization shrinkage and marginal gap formation .In this technique the proximal wall was constructed first, along with the marginal ridge, by adapting the first increment of composite on the inner surface of the sectional matrix band. Later the class I cavity formed was filled with horizontal increments. In the proximal box, each composite horizontal increment was further split diagonally into two portions before light curing. In this way, each portion of the split-increment contacted half of the gingival wall and only two of the surrounding cavity walls during curing instead of opposing each other. The two increments were cured and later the diagonal cut was filled and cured. With this technique, polymerization shrinkage stress was relieved by splitting the continuous large horizontal increment in the proximal and occlusal cavities into smaller triangular flat portions prior to light curing. This split would reduce the C-factor from a ratio of 5 to a ratio of 1 for proximal portions. The smaller increment size, along with the lower C-factor, would relieve most of the shrinkage stresses by means of flow of the free surfaces, rather than at the bonded interfaces, which otherwise would increase cuspal deformation.[5]

The above reasoning justifies the results we got in our study. In the present study split incremental technique exhibited least marginal microleakage scores among all the four groups in both occlusal and gingival margins.

Along with the placement techniques, even the restorative material used also affects the polymerization shrinkage in the restorations. In our study we used universal Nano composite TETRIC N CERAM for restoration, which Tetric N-Ceram is a light-curing, radiopaque nano-hybrid composite based on nano-optimized technology for direct restorative procedures. It can be universally applied to restore teeth in the anterior and posterior region. Its nano-optimized filler technology is responsible for the material's unique chameleon effect and natural esthetic results. As the filler particle diameter in Nano composite was only 5 µm i.e. about half the wavelength of the activating light and the light scattering was increased, thereby decreasing the degree of conversion and consequently polymerization shrinkage.

TETRIC N BOND is a light-curing, nano-filled single-component adhesive which is used in conjunction with the total etch technique. Best partner for Tetric N-Bond is the phosphoric acid gel N-Etch same was followed in our study. Tetric N-Bond is used in the placement of direct composite and compomer restorations as well as in the adhesive luting of indirect restorations made of all-ceramic and composite materials involving light-curing. A reduced microleakage score has been reported when using filled adhesives in studies by Deliperi S et al.

CONCLUSIONS:

Finally we could infer from the results of our study that placing composite in increments reduced microleakage as compared to bulk technique and amongst various incremental techniques used in this study, Split horizontal Incremental Placement technique revealed an adequate marginal adaptation, especially at the gingival margin. In addition, it may relieve the polymerization shrinkage stresses generated at the cavity walls and adhesive interfaces.

In vitro experiments for Marginal integrity and microleakage are currently being performed to evaluate the effects of the different placement techniques on the quality of the margins in composite restorations.

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