doi:10.5368/aedj.2012.4.1.1.6

CLINICAL EVALUATION OF FLEXURAL EFFECTS ON THE RETENTION OF THREE DIFFERENT CERVICAL RESTORATIVE MATERIALS

[1] Saritha Vallabhaneni [1] Professor
[2] Radhakrishna G [2] Professor

[1]Department of Conservative Dentistry and Endodontics, P.M.N.M Dental College and Hospital, Bagalkot, Karnataka.
[2]Department of Orthodontics, P.M.N.M Dental College and Hospital, Bagalkot, Karnataka.

ABSTRACT:

Aim: The aim of the study was to clinically evaluate the best material for restoring non carious cervical lesions, in terms of retention and sensitivity, among Glass Ionomer Cement (GC Fuji II), composite(Filtek Z350 Universal Hybrid) and compomer (Dyract-AP): In patients with normal occlusion and with traumatic occlusion. **Materials and Methods** : Patients with non-carious cervical lesions were selected on a random basis. No restrictions were placed on the size or position of the lesion.A total of 66 restorations were placed in 20 patients. Teeth were divided into two groups: Group 1 : teeth in normal occlusion.(no of restorations = 33) ,Group 2 : teeth in traumatic occlusion.(no of restorations = 33). Teeth in the respective groups were restored with Glass Ionomer Cement (n = 11), Composite (n = 11) and Compomer (n = 11). The patients were recalled at intervals of 2,4 and 6 months for assessment of restorations in terms of retention and tooth sensitivity for both the groups. **Results:** In terms of retention and sensitivity, when comparison was made between normal and trauma group, there was statistical significance only for glass ionomer cement.

KEY WORDS : Cervical Defects, Glass Ionomer, Compomers, Flexural Stress, Hypersensitivity

INTRODUCTION

Non carious loss of hard tissue at the cemento-enamel junction of a tooth is a condition commonly encountered in clinical practice. Dental erosion has been defined as chemically induced loss of hard tissue by processes not involving bacteria. Erosion is generally brought about by acid dissolution of tissues and involves both endogenous and dietary factors. Abrasion is the wearing away of tooth substance by extrinsic mechanical factors. Tooth brushing is the primary cause of abrasion [1]

Abfraction is a stress induced lesion that result from hyperfunction and parafunction and can be further exacerbated by erosion, corrosion and tooth brush/ dentifrice abrasion. Abfraction lesions develop overtime as wedge shaped hard tissue defects in the cervical region and more rarely as oval or crescent shapes within enamel. Horizontal loading of teeth results in tension, compression and torsion stresses at the cervical region. These stresses cause a physical or physico- chemical loss of cervical tooth structure and results in dentin hypersensitivity in these regions due to the progressive exposure of dentinal tubules. Because of the location of cervical lesions and their proximity to the pulp, achieving sufficient macro mechanical retention is difficult. The retention of cervical restorations is largely dependent on bonding to dentin, which is frequently sclerotic. Bond strength and hybrid layer formation have been found to be less favourable on sclerotic dentin than on sound dentin. Tooth flexure resulting from occlusal loading causes deterioration of bond between tooth and restorative material, leading to restorative failure [2,3].

Aim of the study

The present study was done to determine the best material among glass ionomer (Fuji II), composite resin (Filtek Z350 Universal Hybrid) and polyacid modified composite resins (Dyract AP), for restoration of non-carious cervical lesions in terms of retention and sensitivity, in patients with and without traumatic occlusion.

Materials and methods:

Restorative materials used for the study:

1. Conventional glass ionomer cement- *Fuji II (GC Corp)*
2. Composite resin- *Filtek Z350 Universal Hybrid*
3. Polyacid modified composite resin- *Dyract –AP (DeTrey, Dentsply)*

Methodology:

Patients with non-carious cervical lesions were selected on a random basis. No restrictions were placed on the size or position of the lesion.

Teeth were divided into two groups:

1. **Group 1** : Teeth in normal occlusion
2. **Group 2** : Teeth in traumatic occlusion

Diagnosis of teeth in traumatic occlusion was done on presence or absence of the following conditions / symptoms.

- **Medical history**
  - Arthritis
  - Frequent headaches
  - Psychological stress
- **Dental history**
  - Bruxism
  - Orthodontic treatment
- **Personal history**
  - Habits
- Missing teeth
- Mobility
- Wear facets
- Tooth migration
- Temporomandibular joint dysfunction
- Periodontal pockets
- Fremitus
- Pain on percussion
- Occlusal bite analysis using indicator wax

If the patient/ teeth had three or more of these symptoms they were grouped under traumatic occlusion. A total of 66 class v restorations were placed in 20 patients. No cavity preparations were done for any of the lesions and were cleansed thoroughly with pumice and water slurry. Each patient received at least two of the restorative materials**.**

Lesions restored with GIC were first treated with 10% poly acrylic acid for 10 seconds, rinsed, dried, leaving tooth surface moist. GIC was mixed according to manufacturer's directions and applied over the lesion. After 5 minutes, gross excess was removed and after 15 minutes final polishing was completed with Soflex discs (3M, USA). Following this a coating of varnish was applied. **(Fig.1)**

For lesion restored with composite, etchant (37% phosphoric acid) was applied for 15 seconds, rinsed and dried. Bonding agent was applied as per manufacturer's recommendations and cured for 20 seconds. Composite was placed incrementally and cured for 20 seconds. Finishing and polishing was completed with *Soflex discs* (3M, USA)**.(Fig.2.)**

For lesions restored with compomer, Prime and Bond was applied using an applicator tip and left on the surface, undisturbed for 20 seconds. Solvent was removed by blowing air for 5 seconds and light cured for 10 seconds. Compomer was placed incrementally and cured for 30 seconds. **(Fig.3.)**

Patients were recalled at 2 months, 4 months and 6 months post operatively. Tooth sensitivity was recorded at every appointment, as per :

0 – No discomfort
1 – Mild discomfort
2 – Moderate discomfort
3 – Severe discomfort

Restoration retention was recorded at every appointment, as per :

0 Restoration is completely missing.
1 Restoration is partially retained, with major portion of the restoration still intact.
2 Restoration is intact & fully retained

Results

Data were expressed as the mean +/- SD for each group. The results were analyzed with Student's t-test. Differences were considered significant at $P < 0.05$.
(Table I- Table X). Total number of restorations done in each groups were tabulated **(Table I).** Retention rates in patients with normal occlusion showed that at 2 months all three types of restorative treatments have 100% retention rate. At 4 months GIC (91%) was better when compared to compomer (82%) or composite (82%). At 6 months GIC still maintained better retention (91%), compared to compomer (82%) or composite (82%). There was no statistical significance found between any of these 3 groups at 3 different time intervals **(Table-II, Graph-I).** Retention rates in patients with truamatic oclusion showed at 2 months, composite and compomer had retention rate of 91% followed by GIC (82%). At 4 months, composite and compomer had retention rate of 82% followed by GIC (64%). At 6 months interval, composite had better retention rate (73%) followed by compomer (64%) and GIC (55%). (**Table-III, Graph-II).**

Table I. Total Number of restorations done in each group of normal/Traumatic Occlusion

Group-description		No. of restorations in patients with normal occlusion (Total-33)	No of restorations in patients with traumatic occlusion (Total-33)
Group I	Composite	11	11
Group II	Glass ionomer cement	11	11
Group III	Compomer	11	11

Sensitivity scores in patients with normal occlusion revealed that there was no statistical significance between any of these three groups at 5 different time intervals**(Table-IV, Graph-III). D**ecreased sensitivity at different time intervals in Normal Group is shown(**Table.V).**

Sensitivity scores for teeth in traumatic occlusion restored with composite, glass ionomer and compomer at five different time intervals i. e pre operative,immediate

Table.2 Retention Rates In Patients With Normal Occlusion

Time of assessment	Retention	Composite	GIC	Compomer	Difference between materials
2 months	Missing	-	-	-	No difference
	Partially retained	-	-	-	
	Intact	11 (100%)	11 (100%)	11 (100%)	
4 months	Missing	2 (18%)	-	2 (18%)	X^2 = 2.46 NS
	Partially retained	-	1 (9 %)	-	
	Intact	9 (82%)	10 (91 %)	9 (82%)	
6 months	Missing	2 (18%)	-	2 (18%)	X^2 = 2.46 NS
	Partially retained	-	1 (9%)	-	
	Intact	9 (82%)	10 (91%)	9 (82%)	

Table.3. Retention Rates In Patients With Traumatic Occlusion

Time of assessment	Retention	Composite	GIC	Compomer	Difference between materials
2 months	Missing	1 (9%)	1 (9%)	1 (9%)	No difference
	Partially retained	-	1 (9%)	-	
	Intact	10 (91%)	9 (82%)	10 (91%)	
4 months	Missing	2 (18%)	2 (18%)	2 (18%)	X^2 = 1.47NS
	Partially retained	-	2 (18%)	-	
	Intact	9 (82%)	7 (64%)	9 (82%)	
6 months	Missing	3(27%)	3 (27%)	4 (36%)	X^2 = 0.74 NS
	Partially retained	-	2 (18%)	-	
	Intact	8 (73%)	6 (55%)	7 (64%)	

postoperative, at 2 months, 4 months and 6 months. **(Table.VI, Graph-IV).** There was no statistical significance found between any of these three groups at five different time intervals. **D**ecreased sensitivity at different time intervals in Traumatic occlusion is shown(**Table-VII)**

Comparison of retention and sensitivity values of composite, glass ionomer and compomer at 6 months post-operative in normal and traumatic occlusion**.(Table-VIII)**

Discussion

The ultimate success of any material is indicated by its longevity in the oral cavity. The retention rate for glass ionomer cement in the normal occlusion in present study was 91%. **Tyas** and **Beech**[4] restored 42 cervical abrasion lesions with Fuji Type II Glass ionomer cement and reported a retention rate of 92% and another study reported a retention rate of 91 %.[5] In a similar study **Sonia Glady's et al** [6] and **Powell et al** [7] reported a retention rate of 97% .

Composites have good aesthetic properties and high wear resistance. The retention rate of composite in the present study was 82% for teeth in normal occlusion.

The retention rate for compomer, for teeth in normal occlusion in the present study was 82%. This study confirms the findings of similar studies done by **Sonia Glady's et al**[6] who observed a retention rate of 89%. However, higher retention rates were observed by **Abdalla** and **Alhadainy** [8] who reported a retention rate of 100% and **Tyas M.J**[9] who reported a retention rate of 97%. This variation may have occurred due to moisture contamination because many of the compomer restorations were done in the mandibular arch without rubber dam isolation. Glass ionomer restorations had

Table.4.sensitivity Scores In Patients With Normal Occlusion

Time of assessment	Sensitivity score					Mean score ± SD	Difference . between Groups
	Group	0	1	2	3		
Pre-operative	Composite	3 (27.3%)	5 (45.4%)	2 (18.2%)	1(9.1%)	1.09 ± 0.9	
	GIC	2 (18.2%)	5 (45.4%)	3(27.3%)	1(9.1%)	1.27 ± 0.9	X^2 = 0.27 NS
	Compomer	3 (27.3%)	6 (54.5%)	1 (9.1%)	1(9.1%)	1.00 ± 0.9	
Immediate post operative	Composite	6 (54.5%)	4 (36.4%)	1 (9.1%)	-	0.54 ± 0.7	
	GIC	7 (63.6%)	3 (27.3%)	1(9.1%)	-	0.45 ± 0.7	X^2 =0-79 NS
	Compomer	8 (72.7%)	1 (9.1%)	2(18.2%)	-	0.45 ± 0.8	
2 Months	Composite	10 (90.9%)	1 (9.1%)		-	0.1 ± 0.3	
	GIC	11 (100%)	-		-	0.0 ± 0.0	X^2 = 4.20 NS
	Compomer	8 (72.7%)	1 (9.1%)	2(18.2%)	-	0.5 ± 0.8	
4 Months	Composite	9 (81.8%)	1 (9.1%)	1(9.1%)	-	0.3 ± 0.6	
	GIC	10 (90.9%)	1 (9.1%)	- 1	-	0.1 ± 0.3	X^2 = 1.58 NS
	Compomer	8 (72.7%)	1 (9.1%)	2(18.2%)	-	0.5 ± 0.8	
6 Months	Composite	9 (81.8%)	1 (9.1%)	1(9.1%)	-	0.3 ± 0.6	
	GIC	10 (90.9%)	1 (9.1%)	-	•	0.1 ± 0.3	X^2 = 1.22 NS
	Compomer	8 (72.7%)	1 (9.1%)	2(18.2%)		0.5 ± 0.8	

Table.5. Decreased Sensitivity At Different Time Intervals – Normal Group

Time of assessment	Composite (n = 11)		GIC (n = 11)		Compomer (n = 11)	
	Sensitivity (%)	Decreased sensitivity*	Sensitivity (%)	Decreased sensitivity*	Sensitivity (%)	Decreased sensitivity*
Pre-operative	73%	-	82%	-	73%)	-
Immediate post operative	45%	28%	36%	46%	27%	46%
2 Months	9%	64%	0%	82%	27%	46%
4 Months	18%	55%	9%	73%	27%	46%
6 Months	18%	55%	9%	73%	27%	46%

comparatively better retention than composite or compomer restorations because of their:

- Ability to bond with extra calcium ions available in cervical areas of sclerosed dentin
- Ability to tolerate the presence of moisture
- Decreased dependence on dentin etching

In the present study, teeth in traumatic occlusion restored with composite had a restoration retention rate of 73%, those restored with compomer had 64% and with Glass ionomer had a retention rate of 54%. Comparatively, lower retention rates of all the three restorative materials in traumatic occlusion as compared to normal occlusion is explained by **Heymann** et al [10] who postulated that eccentric forces applied to the occlusal surfaces of teeth generate cervical flexural forces resulting in increased concentrations in cervical area. The two primary mechanisms for cervical flexure are:

1. Lateral deformation of tooth caused by eccentric occlusal forces, resulting in tensile stresses on restoration.
2. Vertical deformation of the tooth caused by heavy eccentric forces leading to compressive stresses on restoration.

Table.6.sensitivity Scores In Patients With Traumatic Occlusion

Time of assessment	Sensitivity score					Mean score ± SD	Difference between Groups
	Group	0	1	2	3		
Pre-operative	Composite	1 (9.1%)	1 (9.1%)	3 (27.3%)	6(54.5%)	2.3 ±1.0	X^2 =0.64 NS
	GIC	2(18.2%)	2 (18.2%)	2(18.2%)	5(45.4%)	1.9 ± 1.2	
	Compomer	1 (9.1%)	2 (18.2%)	4 (36.4%)	4(36.4%)	2.00± 1.0	
Immediate post operative	Composite	6 (54.5%)	4 (36.4%)	1 (9.1)	-	0.5± 0.7	X^2 =0.73 NS
	GIC	7 (63.6%)	3 (27.3%)	1 (9.1%)	-	0.4 ± 0.7	
	Compomer	5 (45.4%)	4 (36.4%)	2 (18.2%)	-	0.7 ± 0.8	
2 Months	Composite	5 (45.4%)	4 (36.4%)	2 (18.2%)	-	0.7 ± 0.8	X^2 = 1.70 NS
	GIC	4 (36.4%)	5 (45.4%).	1 (9.1%)	1(9.1%)	0.9 ± 0. 9	
	Compomer	7 (63.6%)	1 (9.1%)	2 (18.2%)	1 (9.1%)	0.7± 1.1	
4 Months	Composite	6 (54.5%)	3 (27.3%)	1 (9.1%)	1 (9.1%)	0.7± 1.0	X^2 = 0.32 NS
	GIC	5 (63.6%)	2 (18.2%)	2 18.2%)	2(18.2%)	1.1±1.2	
	Compomer	5 (63.6%)	3 (27.3%)	2(18.2%)	1(9.1%)	0.9± 1.0	
6 Months	Composite	6 (54.5%)	2 (18.2%)	2 18.2%)	1(9.1%)	0.8± 1.1	X^2 = 0.27NS
	GIC	5 (63.6%)	1 (9.1%)	3 (27.3%)	2(18.2%)	1.2 ± 1.2	
	Compomer	6 (54.3%)	1 (9.1%)	2 (18.2%)	2(18.2%)	1.0 ± 1.3	

Table.7 Decreased Sensitivity At Different Time Intervals – Traumatic occlusion Group

Time of assessment	Composite (n = 11)		GIC (n = 11)		Compomer (n = 11)	
	Sensitivity (%)	Decreased sensitivity*	Sensitivity (%)	Decreased sensitivity*	Sensitivity (%)	Decreased sensitivity*
Pre-operative	91%	-	82%	-	82%	- -
Immediate post operative	45%	46%	36%	46%	54%	28%
2 Months	54%	37%	64%	18%	36%	46%
4 Months	54%	37%	54%	28%	54%	28%
6 Months	46%	45%	54%	28%	46%	36%

Table.8. Retention And Sensitivity Values At 6 Months Postoperative In Normal And Traumatic Occlusion

Material	Retention		Difference between groups	Sensitivity		Difference Between groups
	Normal	Trauma		Normal	Trauma	
Composite	9	8	z =: 0.5087 NS p<0.05	2	5	z = 1.3732 NS p<0.05
Glass Ionomer	10	6	z = 2.5887 N S p<0.0l	1	6	z = 2.5887 NS p<0.01
Compomer	9	7	z = 0.9574 NS p<0.05	3	5	z = 0.8864 NS p<0.05

Fig.1A. Preoperative-GIC filling

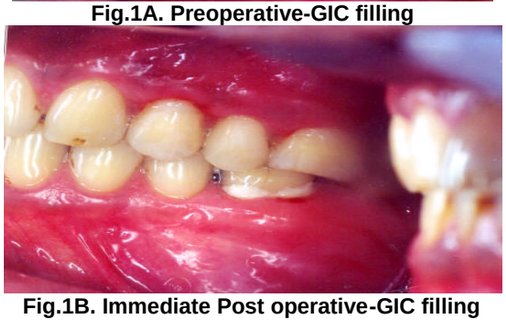


Fig.1B. Immediate Post operative-GIC filling

Fig.1C. After 2-months follow up-GIC filling

Fig.1D. After 4-months follow up-GIC filling

Fig.1E. After 6-months follow up-GIC filling

These flexural forces debond cervical restorations, especially those lacking macro mechanical retention. Patients with traumatic occlusion generally impose greater stress on their teeth. Increased flexure in the cervical region resulting from greater occlusal stress could result in restoration debonding either partially or in toto. Comparatively, less retention rates of composite and compomer in traumatic occlusion when compared to normal occlusion can be explained by the fact that, as a response to trauma, dentin in the cervical area of the tooth becomes increasingly calcified, and the arrangement of the dentinal tubules becomes increasingly irregular. The increase in calcification leads to smaller dentinal tubules and to less collagen available for creation of a strong bond to dentin, one that is based on both penetration of resin into tubules and the creation of an interdiffusion zone [11]. Lower retention rate of glass ionomer in teeth in traumatic occlusion can be explained as conventional Glass ionomers are brittle, and have low fracture strength and break under tensile stress.[6]

All the three different restorations in traumatic occlusion had increased loss of restorations with time. Increased loss of restoration with time could be explained by the fact that while adequate retention existed at base line, continuing flexure caused degradation of the dentinal bond until debonding occurred[12] . However, statistical significance was found only in case of glass ionomer for retention; when comparison was made between normal and trauma group.

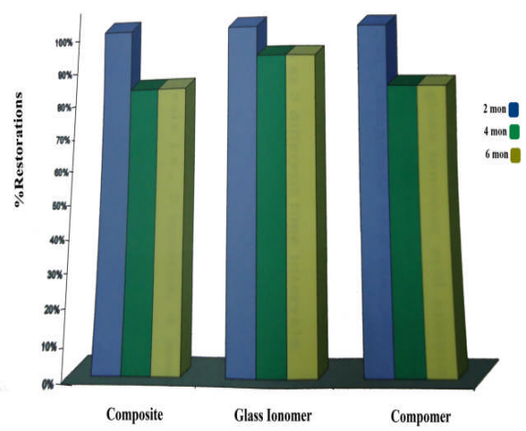
Fig.2A.Preoperative -Composite

Fig.2B. Immediate postoperative -Composite

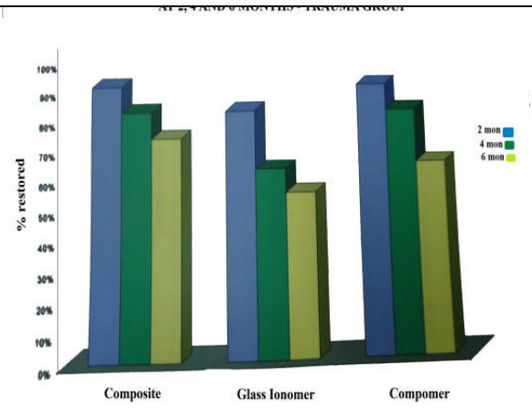
Clinicians are frequently confronted with the problem of hypersensitivity. Cervical dentin hypersensitivity is a dentino pulpal response to air, cold, acid exposure, tactile stimulation or any combination of these external stimuli. In the present study, teeth under normal occlusion exhibited decreased sensitivity of 91 % after six months for Glass ionomer restorations. In a study by **Powell** et al[7] recorded 80% decrease in sensitivity. This difference may be due to the higher preoperative sensitivity scores in the present study (82%). In the present study, teeth restored with composite recorded decreased sensitivity of *82%* and those restored with compomer recorded a decreased sensitivity of 73%.

Powell et al[7] observed a decreased sensitivity of 78% for teeth restored with composite. The difference in decreased hypersensitivity between the restorations may be explained by the fact that in normal occlusion glass ionomers had a comparatively better retention rate than composite or compomer. The difference in hypersensitivity may be due to the fact that glass ionomer restorations undergo less stress and gap formation resulting from polymerization shrinkage and from thermal expansion and contraction [7]. Thermal stimuli particularly cold can lead to marginal gaps at tooth-resin interface. These gaps are generally larger at the cervical margin where enamel etching and bonding cannot be done. Cold stimulus created a larger gap because of thermal contraction by the resin and causes a contraction of the fluid within the gap. These events cause a rapid outward flow resulting in a sharp pain within the tooth. In the present study, teeth in traumatic occlusion restored with Glass ionomer cement had 46% decreased sensitivity after six months and teeth restored with composite and compomer had exhibited a decreased sensitivity of 54%.

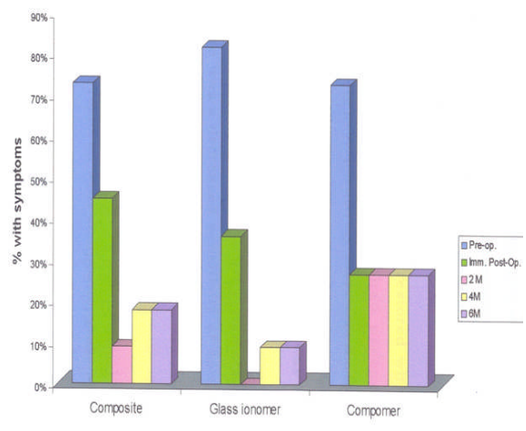
The difference in the sensitivity ratings could be explained by the fact that in traumatic occlusion, glass ionomer had less retention rate (54%) when compared to composite (73%) or compomer (64%). However statistical significance was present only for glass ionomer for sensitivity when normal and trauma group were compared.



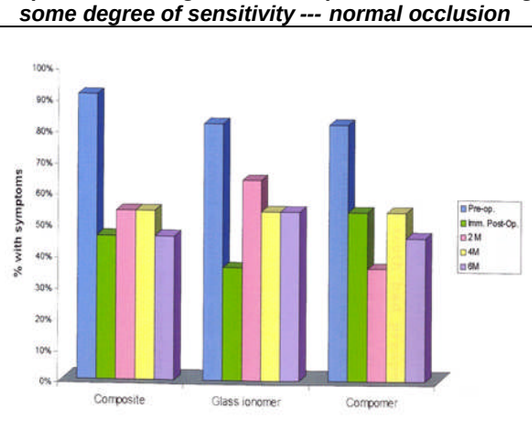
Graph.1. Percentage of retained restorations at 2,4, and 6 months --- normal occlusion



Graph.2 .Percentage of retained restorations at 2,4, and 6 months --- Trauma Group



Graph.3. Percentage of Teeth reported as exhibiting some degree of sensitivity --- normal occlusion



Graph.4. Teeth reported as exhibiting some degree of sensitivity --- Trauma Group

Fig.3A. Preoperative -Compomer

Fig.3B. Immediate postoperative – Compomer.

Increased flexure in the cervical region due to greater occlusal stress results in debonding of the restoration. In the present study, in patients with normal occlusion, the retention was stabilized for four months. But in case of patients with traumatic occlusion, there was decrease in retention with time. In terms of retention and sensitivity only glass ionomer was found to be statistically significant.

CONCLUSION

Under the conditions of the present study, the following Conclusions were drawn :

1. GIC Fuji II, Filtek Z350 Universal Hybrid and Dyract AP are effective materials for restoring non carious cervical lesions in patients with normal occlusion, in terms of retention and sensitivity.
2. However, no statistically significant difference was found between GIC Fuji II, Filtek Z350 Universal Hybrid and Dyract AP.
3. GIC Fuji II, Filtek Z350 Universal Hybrid and Dyract AP showed comparative results when non carious cervical lesions were restored in patients with traumatic occlusion when retention and sensitivity were considered, with no statistical significance between the materials.
4. The number of retained restorations showed reduction even at 6 months follow up in patients with traumatic occlusion. Hence, studies on larger sample with longer follow up period need to be conducted for better assessment.

References:

1. Bader JD et al. Case control study of non-carious cervical lesions. Commun Dent Oral Epidemiol 1996;24:286-91. http://dx.doi.org/10.1111/j.1600-0528.1996.tb00861.x
2. Thomas A, Coleman, John O Grippo, Keith E Kinderknecht. Cervical dentin hyper sensitivity Part II: associations with abfractive lesions. Quint Int 2000;31:446-73.
3. Kuroe Toshifumi et al. Biomechanics of cervical tooth structure lesions and their restoration. Quint Int 2000;31:267-74.
4. Tyas MJ. Clinical studies related to glass ionomers. Oper Dent Supplement; 5: 191-98.
5. Vandewalle KS, G Vigil. Guidelines for the restoration of class V lesions. Gen Dent 1997;45:254-60.
6. Sonia Gladys et al.Marginal adaptation and retention of a glass ionomer, resin-modified glass ionomers and a polyacid modified resin composite in cervical class V lesions. Dent Mater 1998;14:294-306. http://dx.doi.org/10.1016/S0109-5641(98)00043-8
7. Powell LV, Jhonson GE. Factors associated with clinical success of cervical abrasion erosion restorations. Oper Dent 1995;20:7-13
8. Abdalla AI, Alhadiny HA. Clinical evaluation of hybrid ionomer restoratives in class V abrasion lesions: two year results. Quint Int 1997;28:255-58.
9. Tyas MJ. Three year clinical evaluation of a poly acid-modified resin composite (Dyract). Oper Dent 2000;25:152-54.
10. Heymann et al . examining tooth flexure effects on cervical restorations: a two year clinical study. JADA 1991; 122:41-47.
11. Browning WD, WW Brackett, RO Gilpatrick. Two year clinical comparison of a microfilled and a hybrid resin based composite in non-carious class V lesion. Oper Dent 2000;25:46-50.
12. Richard B, McCoy et al. Clinical success of class V composite resin restorations without mechanical retention. JADA 1998;129:593-99.

Corresponding Author

Saritha Vallabhaneni
Professor
Department of Conservative Dentistry and Endodontics,
P.M.N.M Dental College and Hospital,
Bagalkot, Karnataka- 587101
Phone no: 09866148164
E-mail : sarithavallabhaneni@yahoo.com