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Comparative evaluation of fracture strength of super bond, rely XM and composite z 350 using different techniques on permanent central incisors- A case control study

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Light-activated resin composite restorative material has revolutionized clinical dentistry. Before the development of photo-cured materials, composite material was self- or chemical-cured. Sixty-second exposure durations are recommended to provide uniform cure and compensate for a decrease in source intensity. Increments of composite should be no greater than 2mm in order to obtain uniform and maximal cure, although a 1mm thickness is ideal. If the source intensity decreases to 233 mW/cm², it is recommended that a new bulb be used. A minimum intensity of 400 mW/cm² is recommended for routine polymerization of light-activated dental resin composites. Dental composites continue to evolve with the development of smaller average particle sizes, better bonding systems, curing refinements and sealing systems, plus increasing focus on maintenance of existing restorations. Although composites are now well-accepted in general practice, the complex steps involved have hindered their full success. The aims and objective of this in vitro study were to evaluate and compare the bond strength of super bond, rely xm, and filtek z 350 maxillary permanent central incisor using different techniques are Simple re-attachment ,chamfer, Over contouring, Internal dentinal groove.

Materials

1. Super bond (Fig.1)

- 2. Dual cure resin cement 3M Rely x (Fig,2)
- 3. Composite Z 350 [supreme XT] (Fig.3)

Following materials were used: **1**. **Etchan**t 2. Single Bond Universal Adhesive 3. Filtek Z 35047 the resin system is slightly modified from original Filtek Z 250 universal restorative and filtektm supreme universal restorative resin. The resin contains BIS-GMA, UDMA, TEGDMA, BIS-EMA resins, to moderate the shrinkage, PEGDMA has been substituted for a portion of the TEGDMA resin in filtek supreme XT restorative. Rely xtm u 200⁴⁶ composition Bis-GMA, Triethylene Glycol, DimethacrylateDimethacrylate, PolymerAmines and photoinitiatorsFillers: zirconia, silica

Composition of Catalyst S of Super Bond1] TBB 2] Acetone Composition of L- type Radiopaque 1] PMMA 2] radio opaque pigments.

Methodology-A total of 70 extracted permanent human maxillary central incisors were used for the present study. The teeth were thoroughly cleaned with slurry of pumice. The steps involved in the study are as follows:- Step i-sectioning of sound teeth Experimental specimens were sectioned at the mesialincisal proximal edge 3 mm from the incisal edge in a labio-lingual direction at 25° inclination apically using a diamond disk. Fragments were matched and stored at room temperatures in sterile water. Step ii preparations of the sectioned teeth and fragments the specimens were divided into five groups, with the control group having 10 samples and other 4 groups having 15 samples each. The groups formed were: -

- **Group I:** Control group consisted of intact sound teeth which were not subjected to sectioning.
- **Group II:** Simple re-attachment no additional preparation was made. The sectioned fragments were re-attached.
- **Group III:** chamfer In this group a 1mm depth chamfer were placed circumferential of fracture line
- **Group IV:** Over contouring Following re-attachment the teeth were prepared on the buccal surface by means of cylindrical diamond finishing burextending 2.5mm coronally and apically from fracture line at a depth of 0.3mm.

Group V:Internal dentinal groove - Internal groove of 1 mm deep and wide were placed within the fragment and tooth by means of # 2 round carbide bur with a high- speed hand piece.

Step iii restoration of fractured teeth: - In group II to group V teeth, those which were bond by filtek z 350 and rely X U 200 additional step of etching was done by 37% phosphoric acid for 20 sec on sectioned teeth and fragments and rinsing for 10 sec. Then bonding agent was applied on cut and prepared surfaces of both sectioned teeth and fragments and later extra bonding agent was removed by air blow followed by light cure of the surfaces. Then the composite material was applied on cut and prepared surface and the fragment was attached on it. The light cure was done. The teeth were finished and polished with the flexible polishing disk. Stored in sterile water at room temperature..While group II to group V teeth those who attached by super bond were treated by green activator both on prepared surfaces of sectioned teeth and fragments for 10 sec then rinsed with water. The surfaces were dried, then 4 drops of monomer and 1 drop of catalyst were mixed and applied on prepared surfaces, then 1 scoop of L-type radioopaque polymer was added on mixture of monomer and catalyst and

BULK MIX technique is used for application of material on prepared surface step iv fracture strength of restored teeth

The specimens were mounted on custom made fixture for determination of shear bond strength using Universal Testing Machine. A knife-edge chisel (0.5mm in cross section) was used to deliver the force so that contact was achieved 2 mm from the incisal edge. The shearing load was applied at a cross head speed of 5 mm per minute. The shearing force was noted and shear bond strength was calculated and recorded in kilogram force units (Kgf).Step v stastical analysis-The data was collected and statically analyzed. The shear force will be summarized for all group in terms of mean as central tendency measure and standard deviation as the measure of dispersion. Then the variance among the groups will be determined by ANOVA if it follows the normal distribution or by K-W test in case of non-parametric distribution. Another measurement will be related to unit change in the dimensions (shearing strains) in reference with shearing force. This incremental/detrimental value will be plotted and compared through a regression method. The maximum permissible type-i error in all these analyses will be set on 0.5 and type ii error at . 20. K-W Test-Kruskal–Wallis test by ranks, Kruskal–Wallis H test (named after William Kruskal and W. Allen Wallis), or one-way ANOVA on ranksis a nonparametric method for testing whether samples originate from the same distribution. It is used for comparing two or more independent samples of equal or different sample sizes.. The parametric equivalent of the Kruskal-Wallis test is the one-way analysis of variance (ANOVA). A significant Kruskal-Wallis test indicates that at least one sample stochastically dominates one other sample. Since it is a nonparametric method, the Kruskal-Wallis test does not assume a normal distribution of the residuals, unlike the analogous one-way analysis of variance. If the researcher can make the less stringent assumptions of an identically shaped and scaled distribution for all groups, except for any difference in medians, then the null hypothesis is that the medians of all groups are equal, and the alternative hypothesis is that at least one population median of one group is different from the population median of at least one other group.



Review of literature- Theodore P. Croll et al. $(1988)^{30}$ according to the author micromechanical bonding of composite resin to acid etched enamel surfaces has greatly simplified and improved treatment of traumatically fractured teeth. With the advent to various enamel-dentin bonding agents, the overall quality of the attachment mechanism can be augmented by chemically adhesive bonding of resin to dentin. F M Andreasen et al. (1991)³¹ described a method by which porcelain laminate veneers are used to reinforce crown-fractured incisors which have been restored by re-attachment of enamel-dentin fragments using enamel etching and a dentin bonding system. In an experimental model using sheep incisors, it was found that fracture strength equal to that of intact incisors could be achieved by employing this method. This is in contrast to fracture strengths of re-attached enamel-dentin tooth fragments without porcelain laminates which were only 50% of intact incisors. It is suggested that porcelain laminate veneers may be used to supplement fragment bonding thereby enhancing dental esthetics and function. F M Andreasen et al. (1993) according to author previous experimental studies into the dentin bonding agents for reattachment of enamel-dentin crown fragments have demonstrated fracture strength about 50-60% of that of intact teeth. Recently newer bonding agents have been developed which can bond equally well with enamel and dentin. Employing the same experimental model, these bonding agents (All-Bond 2, Scotchbond MP) were used to re-attach crown fragments to the remaining portion of sheep incisors. It is concluded on basis of previous and present results that re-attachment with a bonding resin of the enamel dentin crown fragment after crown fracture is a realistic alternative

to composite resin build-up although only half the strength of intact teeth is achieved. F A Rueggeberg et al. (1994)³⁷ according to author light-activated resin composite restorative material has revolutionized clinical dentistry. Before the development of photocured materials, composite material was self- or chemical-cured. Sixty-second exposure durations are recommended to provide uniform cure and compensate for a decrease in source intensity. Increments of composite should be no greater than 2mm in order to obtain uniform and maximal cure. although a 1mm thickness is ideal. If the source intensity decreases to 233 mW/cm², it is recommended that a new bulb be used. A minimum intensity of 400 mW/cm² is recommended for routine polymerization of light-activated dental resin composites. Luiz Narciso Baratieri et al. (1994)³⁸ presented a case of fractured maxillary central incisor, invading the biologic width. The biologic width was surgically restored, and in the same session the fragment was reattached to the tooth remnant with a "new" dentinal adhesive system. Short-term results indicate that esthetics, function, and oral health have been maintained. ResultsThis study used 70 anterior teeth in the study out of which 10 teeth were sound while 60 teeth were sectioned by diamond disk. The teeth included in the study as were essentially non carious, non attrited and were only with periodontal involvement in order to avoid any structural confounders .The Graph-1 shown is a box-plot matrix which gives the visual description of distribution of maximum loads associated with various techniques in a matrix. It gives information about the median value, 25 percentile, 75 percentile and minimum/maximum value attained through the respective technique.



The mean value of Maximal load was highest for over contour technique and minimal for simple attachment. The null hypothesis states that the point estimates for these groups are all equal and if there are any differences, they are because of random variations. Because the p-value is more than the significance level of 0.05, we cannot reject the null hypothesis. Thus for Rely X U 200 materials all the four techniques may perform equally on maximal load.The mean value of Maximal load was highest for overcountour technique and minimal for simple attachment. The null hypothesis states that the point estimates for these groups are all equal and if there are any difference they are because of random variations. Because the pvalue is more than the significance level of 0.05, cannot reject the null hypothesis. Thus for superbond material all the four techniques may perform equally on maximal load The mean value and standard deviation of maximal load for various techniques on FiltekZ-350

Techniques	RelyX	Super bond	Z350	Summary Ranking
Chamfer	3	3	4	3.33
Internal Groove	2	2	1	1.66
Over contour	1	1	3	1.66
Simple reattachment	4	4	2	3.33

	Chamfer	Internal Groove	Over contour	Simple reattachment	Control			
Mean	22.642	28.82	23.812	26.69	32.468			
Std deviation	4.86832	2.48553	6.94771	10.3957	4.67966			
KW satistic=8.41(df=4,n=25),p=0.077								

Table 5 the mean value of Maximal load was highest for internal grove technique and minimal for overcountour technique. The null hypothesis states that the point estimates for these groups are all equal and if there are any differences, they are because of random variations. Because the p-value is more than the significance level of 0.05, we cannot reject the null hypothesis. Thus for z350 material, all the four techniques may perform equally on maxim Table5-Summary measures for techniques under study. As we were dealing with non-parametric data this table gives a relative ranking followed by overall ranking for all the four techniques in reference with materials under inquiry. As a whole internal groove and over contour techniques seem more consistent in general as compared to Chamfer and simple reattachment technique on the parameter of maximum load. Discussion-The present study was conducted to evaluate and compare various reattachment materials and techniques on 60 sectioned teeth and 10 sound teeth used as control. The salient findings of this study showed non superiority of any technique when the reattachment material was same, however internal groove and over contour technique were more sturdy and dependable. On the other hand, RelyX U200 material and z350 dental adhesive material were found to have stronger attachment. RelyX U200 is claimed as self-adhesive resin cement having acidic and hydrophilic property, on application which is claimed to become neutral and hydrophobic after setting. This fact may assign a resistance to water uptake and more stability over time. This product is claimed to bear the thermo cycling stress test compared to its counterpart. Filtek Z350 is a nano-composite dental restorative material discovered to meet the functional needs of posterior class I and class II restoration as well as to satisfy the aesthetic requirements for anterior restoration. Nano-composites by default have an improved mechanical property in terms of better

compressive strengths, diametrical tensile strength and fracture/bear resistance. This enhanced strength may be attributed to its manipulative ability in nascent structure for providing improvement in mechanical property. Superbond on the other hand is a self-cured adhesive resin containing 4-META, MMA. It claims to formulate a hybrid layer in both enamel and dentine which reinforces the tooth surface against carries and prevents the post-operative hypersensitivity. This solution acts on smear layer and demineralise the dentine thus exposing the collagen. It impregnates with exposed collagen fibrils and after polymerization, creates the hybrid layer giving significantly high tensile strength.Conclusions-The present study was to evaluate and compare various conducted reattachement materials and techniques on 60 sectioned teeth and 10 sound teeth. The salient findings of this study showed non superiority of any technique when the reattachment material was same, however internal groove and over contour technique were more study and dependable. On the other hand, RelyX U200 material and Filtek Z-350 dental adhesive material were found to have stronger attachment.

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