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RESEARCH ARTICLE

A COMPARATIVE STUDY TO EVALUATE THE FRACTURE RESISTANCE EFFICIACY OF THREE DIFFERENT LUTING AGENTS USED FOR ADHESION OF POST IN ENDODONTICALLY TREATED TOOTH

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Abstract

Due to the carious process's peripheral destruction and the endodontic treatment's central destruction, the majority of endodontically treated teeth are structurally compromised and weaker. In an effort to strengthen the tooth a post was placed to hold the core material in place when there was not enough clinical crown left. Thus the main

Aim : of our study was to compare and evaluate the efficacy of three different luting cements to hold these core materials in place.

Material And Methodology: 30 freshly extracted maxillary incisors were treated endodontically and decoronated 2mm above the cementoenamel junction and divided into three experimental groups based on the type of luting cements used. In group A glass ionomer cement, group B resin modified glass ionomer cement and in group C variolink II was used for cementation of pre fabricated post. Fracture resistance of the restoration was measured by applying loads at an angle of 135°.

Results: fracture modes of all the samples were recorded and analyzed using mean and standard deviation. Inter and intragroup comparison was done using one way ANOVA test and Tukey HSD test. A statistically significant result was obtained between the three groups.

Conclusion: An effective and significant observation was obtained when three groups were compared. Much higher results were obtained in group C where etched luting cement was used.

Introduction:-

The main aim of root canal treatment is to retain the natural teeth in our oral cavity. Sometimes these teeth require additional support for long term retention in oral cavity. This additional support is post that is needed in teeth with considerable hard tissue loss resulting from cavities or trauma. Posts provide sufficient retention for the core material.[1] The prognosis of teeth with post rely on multiple factors, these include amount of residual tooth structure, ferrule height, restorative material used for core build up, design of post and core and the luting agents used for post cementation.[2] Different designs and types of posts are available nowadays. Prefabricated post comes in metallic (titanium, stainless steel) and non-metallic include zirconia and fibre posts.

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Nowadays fibre posts have gained much admiration due to its property that is modulus of elasticity which is similar to dentin (approximately 20 Gpa).[2,3] However the luting agent used for cementation of fibre post is still a big concern for clinicians due to the variable luting agents with different chemical structure and bonding to dentin available in market.[4]GIC adheres to tooth structure by chemical bonding. RMGIC also bonds chemically to tooth structure as well as post. Etch and rinse adhesives adhere to tooth structure by the hybrid layer, an intermediate zone created by impregnation, diffusion, and monomer polymerization into the dentin.[4] The factors that affect long term survival of post retained teeth and its fracture resistance include design of post, post diameter, ferrule height ,core material and cementing medium.[2] Among all the factors less literature is available on effect of luting agents on fracture resistance of endodontically treated teeth.

The purpose of our present in-vitro study is to evaluate the effect of three luting cements that include GIC, RMGIC and Etch and rinse adhesive on the fracture resistance of endodontically treated teeth.

Materials And Methodology:-

The study was conducted in the Department of Conservative and Endodontic, Pacific Dental College and Hospital Udaipur, Rajasthan. For the execution of the study thirty freshly extracted maxillary central incisors with the mean length of 22mm were obtained from the department of oral and maxillofacial surgery with intact roots. The obtained teeth were disinfected with 2% glutaraldehyde solution for the period of 48 hours followed by their placement in saline solution. Caries free teeth with no previous endodontic treatment or cracks were included in the study. Before the conduction of the study an institutional and departmental ethical justification was obtained. Being an in vitro study no informed consent was required from the patients.

Procedure:-

Model trimmer (Whipmax, USA) was used for decoronation of the selected teetth crowns by sectioning coronal portion 2mm horizontally to cement enamel junction. Endodontic treatment was done in all the teeth with crown down technique using Protaper Gold files (Dentsply, Sirona). Preparation was done till F2 and 5.25% sodium hypochlorite solution was used for lubrication and disinfection of the canals. Obturation was done using F2 gutta percha with Ah plus sealer (Dentsly,Sirona) employing warm vertical compaction technique leaving 5mm of gutta percha apically. Peso reamer #1, 2, 3 and 4 (Mani) were used for post space preparation 10mm apical from cement enamel junction followed by rinsing with distilled water and dried with protaper paper points (Dentsply Maillefer). The prepared teeth were then divided into three groups according to the type of cement used for cementation of post.

In Group A prefabricated 1.3 size fibre post (Coltene, Whaledent) was placed in canal of 10 teeth and cemented with Glass ionomer cement (GC Gold). In Group B prefabricated fibre post of similar size placed in canal was cemented using Resin Modified Glass Ionomer Cement (GC Fuji CEM). While in Group C, the prepared canal was etched and rinsed for 15 seconds followed by application of bonding agent (Excite F DSC). The prefabricated post was then cemented using Variolink II (Ivoclar Vivadent AG Schaan, Liechtienstein). The cements used in all the three groups were mixed according to the manufacturer's instruction. Excess amount of cement was removed from all the groups. The remaining coronal tooth structure was etched with Eco etch etching gel (Ivoclar Vivadent), followed by etching and rinsing and eventually application of bonding agent (Te - econom Bond, Ivoclar vivadent) was done. Finally the core build up was done with the help of Te-Econom flow (Ivoclar Vivadent) composite completing with finishing and polishing to the desired shape and contour.

Fracture Resistance Testing:

All the specimens were subjected to a compressive load using universal testing machine (Universal Testing Machine, Model No. WDW-5, Taiwan). Load application was done at an angle of 135 degrees in the middle of lingual surfaces of the teeth just 2 mm below the incisal edge. The cross head speed was 0.2 mm / min and specimens were loaded to fracture. The maximum force needed to complete crown fracture was recorded in Newtons (N) and the data was recorded for each teeth.

Statistical Analysis:

The recorded data was then transferred to Microsoft excel sheet where analysis of the obtained data was done using SPSS software version 20.0. The statistical data of the fracture load was evaluated using mean, standard deviation and standard error. While intergroup and intragroup comparison was done using one was ANOVA test and post hoc Tukey test. The p values of less than 0.05 were supposed to be statistically significant.

Results:-

On evaluating the results of the study a mean and standard deviation of 31.916±0.828, 43.088±0.985 and 56.339±1.593 was obtained in respective three groups (table 1). According to one way ANOVA analysis a significant difference was obtained between the mean fracture resistances among three groups with F=1069.336 and p=0.000 (table 2). A much smaller value than 0.05 was obtained when three groups were compared with each other (table 3).

Table 1:- Representing The Statistical Data Of Fracture Loads In Three Groups.

Groups	Mean	SD	Error	C.I (95%) of mean	Lower range	Upper range
A	31.916	0.828	0.262	± 0.593	31.323	32.509
B	43.088	0.985	0.311	± 0.705	42.383	43.793
C	56.339	1.593	0.504	± 1.139	55.200	57.478

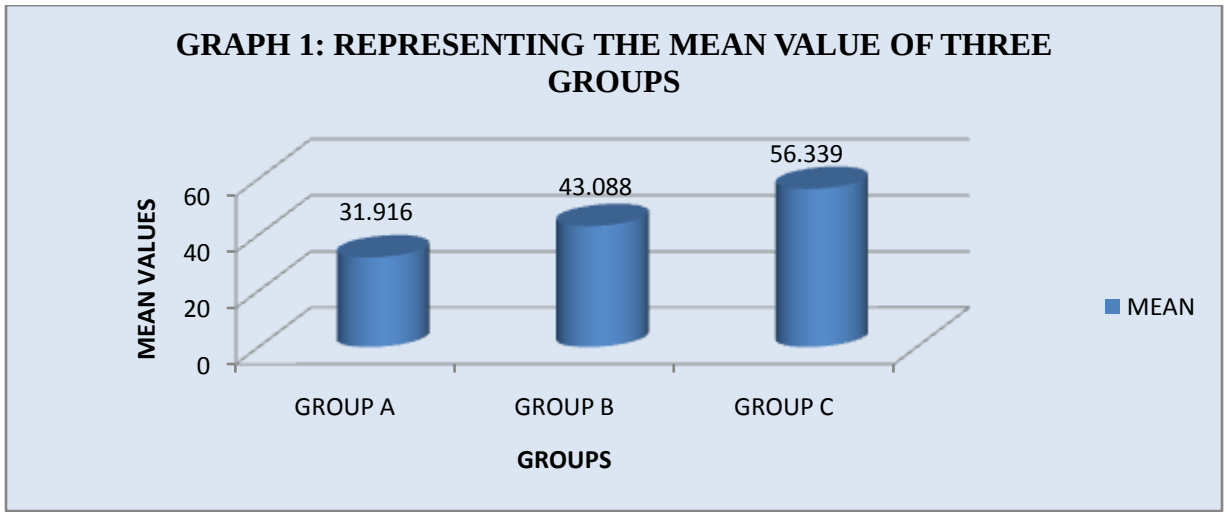

Table 2:- Representing The Values Of One Way Anova Test, Using Right Tailed F Distribution.

Source	DF	Sum of Squares	Mean Square	F-statistics	p-value
Groups (between groups)	2	2989.618	1494.809	1069.336	0.000*
Error (within groups)	27	37.742	1.397		
total	29	3027.361	104.391		
*p-value equals to 0 [p(x<F) =1], means that the chance of type 1 error is small. The smaller the p-value the stronger it supports H_1					

Table 3:- Representing The Mean Difference Between The Three Groups Using Tukey Hsd Test.

Groups	Difference	Error	Lower CI	Upper CI	Critical Mean	P-Value
Group A-group B	11.172	0.3739	9.861	12.483	1.311	2.456e-12*
Group A-Group C	24.423		23.112	25.734	1.311	
Group B-Group C	13.251		11.94	14.562	1.311	
*In this case, the p-value of 2.456e-12 is much smaller than 0.05, which suggests that the results are highly statistically significant and provide strong evidence against the null hypothesis.						

Discussion:-

In vitro testing of post-restoration conditions has typically been carried out using human teeth. Ottl et al. produced dimensionally standardized roots using composite filling material with a modulus of elasticity similar to that of dentin.[5] However, the results could not be compared to clinical situations because a bond like that between the post and natural tooth could not be achieved. Even though human teeth exhibit relatively large variation in size and mechanical properties, extracted human teeth were utilized for the preparation of the test specimens in this study. The maxillary central incisors were chosen for this study because of its position and susceptibility to trauma following requirement of the most post-core restoration. Post diameter of 1.5 mm, not exceeding one third of the mesiodistal root width of maxillary central incisor, was used in the study, and standardized Te-Econom flow composite resin core foundations were fabricated over the posts. This was done because 1.5–2 mm of remaining coronal tooth structure has been shown to significantly enhance fracture resistance of endodontically treated teeth, which have been restored with posts and cores and/or complete crowns.[6, 7] A wedging effect on the root have seen when forces are applied directly to the core.[8] However, if the core is completely covered by a crown, the wedging effect disappears due to transfer of stress to the CEJ. The post's characteristics were marginalized because the crown altered the distribution of forces to the root, post, and core complex. It was viewed as that by dispensing with such boundaries like material construction, shape, length, and thickness, by crown reclamations, the primary uprightness and crack opposition of a post and centre establishment could be tried all the more unequivocally.

In the current study the fracture resistance of endodontically restored maxillary central incisors was evaluated with pre-fabricated post system using three different luting cements i.e. GIC, RMGIC and Variolink II. Cementation of a post with a dentin-bonding system could theoretically provide internal bracing of the root and preserve the critical interface between dentin and post.[9] In addition to providing flexibility and cushioning effect of the cement layer, resin cements might contribute to uniform stress distribution between the post and the dentinal walls and absorb micro-movements of an artificial crown as a result of occlusal forces more effectively than standard brittle cements. Adhesive composite resin luting systems (group C) are generally recommended, as a result, damage to the root, post, and core dentin and the cement seal of the artificial crown could be avoided. Compared to cemented restorations, the mechanical stability of teeth with adhesively cemented internal restorations was superior. When compared to resin-based materials, glass ionomer powder is found to be weak and brittle.[10] Additionally, glass ionomers have unfavorable in vitro cyclic fatigue characteristics and low compressive strengths when compared to resin-based luting cements. Glass-ionomer cements are not suitable for use as cement for posts because they are known to take several days or even weeks to reach their maximum strength. Comparing the fracture modes of direct core builds using the different cements did not yield any conclusive results.[9]

A universal testing machine was used to apply a compressive load to the specimens at a 135-degree angle to the middle of lingual surfaces of the teeth just 2 mm below the incisal edge. The post-restoration loading angle of teeth can have a significant impact on their fracture resistance.[11, 12] According to Guzy and Nicholls, a loading angle of 135 degrees was chosen for the incisor teeth to mimic the contact angle between the mandibular and maxillary anterior teeth in class 1 occlusions.[13] This angle was also found to be the most clinically comparable angle of loading in the anterior teeth by several other authors.[14] During testing, the lingual side was picked for the utilization of stacking powers to reproduce oral circumstances.[15]

The speed of the cross head was set at 0.2 mm/min. It has been reported in the literature to range from 0.5 to 76.2 mm/min.[14] This speed of 0.2mm/min was picked in light of the fact that the low cross head speed looks like the sluggish stacking powers acting during typical mastication, while high cross head speed looks like the higher stacking powers acting during awful wounds. This study uses a speed of 0.2 mm/min, which is not too fast and allows for the best analysis of the experimental setup's responses.[15] All of the post systems tested in this study could only support endodontically treated teeth at a longer post length. At 10mm post length, pre-fabricated posts showed the most noteworthy fracture resistance since this was the only parallel post bunch utilized in this study. As Goldman et al. point out, Mendoza and Eakle found that parallel-sized posts that were passively cemented were the most retentive.[17, 18] Cementing parallel-sized posts with resin cement can also improve their retention and thus their fracture resistance.

Limitations:-

According to the current study and the most recent literature, post, core, and restoration strength are given a lot of weight and importance. However, the literature indicates that the load at which teeth, posts, or cores fracture is

significantly greater than that experienced during mastication. Therefore, the tooth structure loss and the occlusion it will be subjected to should guide the selection of the post and core. Thus more longitudinal studies with a higher sample size should be conducted to overcome the cons observed in this study.

Conclusion:-

Within the limitations of the study it can be concluded that, though a higher fracture resistance was observed when a pre fabricated posts were luted using etched adhesive resin cement. The results culminated a significant difference between the three luting cements with statistically remarkable results.

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