

Evaluation of Cusp Deflection in Teeth Restored with Various Manipulation Techniques and Types of Composite Restorations

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Abstract

This study aim to evaluate and compare the deflection of premolar teeth cusps that filled incrementally with conventional composite (Universal Ceram X One Sphere TEC TM) and various types of bulk fill composite materials (Kerr SonicFillTM3, 3M FiltekTM Bulk Fill and Shofu Beautifil Bulk Fill). In this study 40 human, healthy maxillary first premolars were collected and large MOD cavity were prepared in them. According to restorative materials, the teeth were haphazardly categorized in 4 groups (n=10 per group). Group I : The teeth were filled with SonicFillTM3 Kerr composite, Group II : The teeth were filled with Filtek Bulk Fill, Group III : The teeth filled with Shofu Beautifil Bulk Fill composite, and Group IV : The Teeth were filled with Dentsply Ceram X One Sphere TECTM. By the aid of digital microscope intercusp distance on the tips of the cusps between two index reference points was measured pre preparation of the cavity, post preparation, after 15 minutes of completion of fillings. The cuspal deflection was calculated by determination of the changes in measurements. Inward cuspal deflection was occurred in all teeth after filling, minimal cuspal deflection reported in all study groups that filled with bulk fill filling in comparison with group IV that filled in layering technique with conventional composite. Greater cuspal deflection produced by Beautifil Bulk Fill restorative in comparison with other groups. As a conclusion of this study that using of new bulk filling restorative materials could dramatically minimize cuspal deflection.

Keywords: Deflection in the cusp, Ceram X One Sphere TECTM, SonicFillTM3

Introduction

The demands for tooth color restore are increased nowadays so Commonly composite filling materials is used for direct restoration for posterior teeth⁽¹⁾. However, the polymerization shrinkage when using direct composite resins is considered a major drawback which is prompted by curing of the composite resin matrix⁽¹⁾.

Two clinical problems (cuspal deflection and microleakage) are associated with the polymerization

shrinkage stress Depends on the microleakage; bonding strength results from the polymerization shrinkage stress is higher than the bonding strength of the adhesive material, which may lead to marginal Gap creation and failure of the composite-tooth interface. Thus Can lead to sensitivity after restoration and development of secondary caries, while when adhesion bonding strength is sufficient to withstand the stress of polymerization; cuspal deflection occurs and can cause tooth fracture, cracks in the enamel, this described by the patient clinically as pain and sensitivity postoperatively⁽²⁾. Two major biomechanical factors are influencing the type and the amount of deflection of the cusp, the previous geometrical factors (involve cavity wall thickness post preparation and dimension of the cavity) and the properties of the material "(polymerization shrinkage, elastic modulus, the flow of the material

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and hygroscopic expansion)", this representing the first factors group; whereas the second factors group is clinical one; including the techniques of restoration placement, indirect or direct technique of restoration, low modulus of elasticity liners as layers to absorb stress, and the system of light curing and the protocol of usage^(3,4).

In large cavities, the golden standard technique for resin composite placement is Incremental layering technique since it is capable of minimizing the effects of stress related to shrinkage and enable an acceptable conversion level⁽⁵⁾.

The introduction of New kinds of restoration materials (Bulk fill composites restoration) which minimize the needed Placement time. The layer thickness could be 4-5mm of these materials with adequate polymerization and low polymerization shrinkage stress⁽⁶⁾. Indeed, the data which is available about these restoration materials influence of on cuspal deflection is little. The aim of this study was to evaluate the deflection of the cusp by restoration of maxillary first premolars with advanced new kinds of bulk Fill restoration materials and make a comparison between their results with incremental layering technique by using conventional composite material.

Materials and Methods

In this study forty non carious ,healthy human max. first premolar teeth were gathered. The aim of teeth extraction was for orthodontic cause, they stored instantly in special container with distilled water. Any calculus deposits were carefully removed from the teeth with air sonic scaler, washed and polished by using pumice. cracks examination was done for all selected teeth through visual examination with the aid of magnifying lens and using transillumination from light cure unit. The roots of each tooth have been mounted by the use of dental surveyor vertically into custom made silicon mold. 3M single bond universal used to bond two heads of pins as a reference points into indentation prepared by small round bur on the Buccal and palatal cusps tips of each tooth. After that high speed hand piece with water coolant used to prepare each tooth to large MOD cavity by the use of flat ended fissure bur . To confirm standardization of cavity a modified dental surveyor was used to control the motion of hand piece

in all preparation, to ensure high quality of cutting burs were discarded every five preparations . The preparation of each cavity was 3 mm depth and 3 mm width at gingival seats of the boxes and at the pulpal floor. The cavo surface cavity margins were created at 90 ° with cavity rounded internal line angle.

Three M universal single bond was used in etch and rinse technique In each prepared toot. Next, according to kind of restoration, the teeth divided into 4 groups; Group I: The teeth were filled with Kerr SonicFill™3 composite.

One bulk increment used for filling the entire cavity with 20 second curing time with 800 mw/cm² light cure unit (LED).

Group II : The teeth were filled with 3M Filtek Bulk Fill composite In the same manner of Group I. Group III : Teeth were filled with Beautifil Bulk Fill in one bulk increment same to Groups I and II. Group IV: the teeth were filled in multiple increments of with Universal Ceram X One Sphere TEC™ in 2 mm of each layer thickness. Following the manufactural instructions, The curing time of each increment was twenty seconds. The measurement the intercusp distance of each sample was done with th aid of Dino lite digital microscope.

Intercusp distance was calculated at three different times : for intact tooth, after finishing the preparation of each tooth , and the last record was done in 15 minutes after tooth restoration . Cuspal deflection after the preparation of cavities (CD1) was determined by intercusp distance subtraction after the cavity preparation from the intercusp distance for unchanged teeth. Initial distance was recorded from the inter cuspal distance post preparation, whereas the final distance was recorded from inter cuspal distance after 15 minutes⁽⁷⁾ . after that, subtraction of final distance from initial distance was done to measure the cuspal deflection that happened as a consequence of polymerization shrinkage stress (CD2) .

Results

Inward cuspal deflection (CD1) and (CD2) measured in (mm) micrometer units (descriptive statistics) are shown in the table no. 1.

Table 1. Inward cuspal deflection (CD1) and (CD2) measured in mm (descriptive statistics)

Groups	n	Mean	±SD	Mean	±SD
		CD 1		CD 2	
I	10	4.5982	1.210515	5.8315	0.53325
II	10	4.4121	1.313454	5.7827	1.218534
III	10	3.9671	0.954385	7.2637	1.264121
IV	10	3.4285	1.18428	9.5743	1.543291
P value		0.469		0.000	

All groups post cavity preparation showed no significant differences in CD1 using one way ANOVA with P value > 0.01). Although, after 15 minutes of complete the filling, Significant difference was reported among all study groups (P = 0.000).

Discussion

The common problem of composite restoration is cuspal deflection due to the resin-based composite stress on the surface of the tooth, which could serve as a preload encouraging tensile fractions of the tooth and could be the key cause of failure during the curing of the composite (8,9).

The deflection of the cusp was assessed by using of extracted teeth since the problem of supporting structures and the testing system compliance have been eliminated (10). In this study, Maxillary first premolar teeth were used because they are evenly sized and shaped (11).

Then, large MOD cavity was prepared to get high C factor, the remaining tooth structure weaken, and cause 63% of the cusp strength loss; As a result, possibility of the deflection of cusp is increased (12,13). When comparing MO or DO against MOD fillings, the shrinkage strength of the composite polymerization can cause lower negative deflection in cusps because minimum amounts of restorative material are required (14-17).

The cuspal deflection was estimated after 15 minutes of finishing restoration by measuring the distance between both reference points which was longer and slower than other composites in the polymerization shrinkage, through this time the largest degree of

inward displacement was happened as reported by many previous studies (18-20).

This is due to the remaining free radicals. There have continued to react double bonds in composite restoration. Therefore, after complete polymerization, For several minutes the deformation continued (21,22).

These finding was consistent with other studies that conclude that after polymerization, an inner cuspal deflection occurred because of polymerization shrinking stress development (7,23-26).

The results of this study is deflection in the cusps deflection when compared with conventional type (6,25-30). The addition of stress relievers to the bulk fill composite alter the dynamics of shrinking, decreasing resin matrix with Increased loading of the filler, and thus minimize polymerization shrinkage stress and decrease in cuspal deflection (26,28,30).

On the other hand, this disagree with other studies, which has shown that there is no difference between bulk resin composites and conventional composites in shrinkage stress composites and cuspal deflection (31).

After restoration, minimal mean value of cuspal deflection had been reported in teeth filled with Filtek™ Bulk Fill (group II), removal of TEGDMA monomer from its resin compartment might be the cause for that.

In this study, there is no statistical significant difference between teeth filled with SonicFill™3 (group I) and teeth filled with Filtek™ Bulk Fill (group II). Filtek™ Bulk Fill and SonicFill™3 composites in order to minimize shrinkage stress because their manufacturers have revolutionized their manufacturing mechanism and their monomers composition respectively ⁽³⁰⁾ . In this study, greater cuspal deflection reported in teeth filled by Beautiful Bulk Fill (group III) than other groups of bulk fill kinds used, because of the presence of high molecular weight polymerization modulators which minimize polymerization shrinkage in the remaining groups of bulk fill composite material that had been used in this study ⁽³²⁾ .

Conclusion

Bulk fill resins-based material resulted in lesser cuspal deflection in comparison with conventional incremental composite. In Bulk fill composite material the cuspal deflection magnitu is related and affected by the kind of composite restoration materials.

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Conflict of Interest : Nil

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