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INFLUENCE OF TWO DIFFERENT INTRAPULPAL DEPTHS ON FRACTURE RESISTANCE OF ENDOCROWNS RESTORING MAXILLARY PREMOLAR TEETH USING VITA ENAMIC (IN VITRO STUDY)

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ABSTRACT

Purpose: This study was conducted to evaluate the effect of two different preparation extensions(4mm,6mm) On fracture resistance of endo-crowns restoring Maxillary premolar teeth under loading using Vita Enamic.

Methods & Materials: 14 non-carious, human premolar teeth without obvious crack lines, were removed for orthodontic treatment were all randomly assigned to two groups of 7 teeth, where a dental-surveyor was used to ensure upright positioning of teeth in epoxy-resin molds, placing the margin below the cemento-enamel junction by 1mm and parallel to it. Then the crown portion of all premolars were removed to within 3 mm above the CEJ Mesio-Distally. Specimens were divided into two groups according to the type of preparation extensions done, **Group A**(4 mm extension into the pulp chamber),**Group B**(6 mm extension into the pulp chamber). After Cementation fracture resistance test was performed and failure modes were observed

Results: There was a significant difference between samples regarding different depths of preparation extension were the highest value of fracture resistance was found in samples with 6 mm extension depth (1617.43±733.46) followed by samples with 4 mm depth (1422.21±659.89).

Conclusion: From the results obtained from this study, it could be concluded that endodontically treated premolars can be restored with endocrowns, moreover, the increase of the preparation depth of the endocrowns showed a massive increase in fracture resistance

KEYWORDS: Endocrowns, Premolars, Enamic.

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INTRODUCTION

Restoring root canaled treated teeth with severely and extensively coronal loss has always had an extremely tight protocol, with the manufacture of crowns supported on metal and/or glass fiber posts and core.[1–4] Firstly, it was thought that this process would provide the best possible solution for reinforcement of the remaining dental structure[5]. However, it has been seen clinically that the usage of intraradicular posts only helped the retention of the prosthetic crown. As a result of removing healthy dentinal structure to enable the placement of stiff materials which lack mechanical behaviors similar to those of the tooth [6–9], the remaining tooth could be weakened extensively.

With the development of adhesive dentistry, the urge for applying the usage of posts and cores became much more less. In addition to, the manufacturing of ceramic materials that has high mechanical properties and were capable of being acid etched (such as those reinforced with leucite or lithium disilicate), partnered with the adhesive capacity of adhesive systems and resin cements, made it possible to restore posterior teeth, specifically molars, without cores and intraradicular posts which was proved recently that it lead to the weakening of the remaining tooth structure.[10]

Therefore, it is possible now to fully restore posterior teeth with massive coronal damage by onlay and/or overlay restoration and recently, with endocrowns without the use of intraradicular posts and while using the whole extension of the pulp chamber "to increase the surface area of adhesion" as a retentive resource.[10–12]

These dental-crowns would be adhered to the intrapulpal space and on the cavity margins, therefore gaining macro-mechanical retention given by the pulpal walls, and micro-retention would be acquired with the usage of new adhesive cementation. It is a way specifically suggested in cases in which there is extreme loss of hard tissues of the crown, interproximal space is limited, and traditional rehabilitation with post and crown is not applicable because of inadequate ceramic thickness.[13]

Moreover, because of the lack of enough information about the biomechanical properties of endocrowns and the expectation that this type of restorative material would act equally or superiorly to conventional crowns (because of the potential to be retained in the pulp chamber by micromechanical retention given by the adhesive system and resin cement).

This recent study took place to evaluate the fracture resistance of endodontically treated premolars with extensive coronal loss, restored by two different preparation extensions into the pulp chamber using Vita Enamic material as endocrown restorations.

MATERIALS AND METHODS

Fourteen sound premolars without any seen cracks, were removed for orthodontic reasons, cleaned and stored in saline. Premolars were randomly assigned to two groups of 7 teeth each. Teeth of similar size and shape were selected by root length where it was 14 mm ±3mm and crown dimensions after the bucco-lingual and mesio-distal widths were measured at the cement-enamel junction (CEJ) in millimeters where the average width of the Buccolingual dimension was 8.5mm and the Mesio-Distal dimension was 6mm, and allowing a maximum deviation of 10% from the mean. All premolars were treated endodontically by the same operator using the same sequence for the purpose of standardization. The pulp chamber of each tooth was opened following its pulp chamber morphology using a round carbide high speed bur Then endodontically treated with Pro-Taper nickel-titanium according to the manufacturer's instructions and were obturated with gutta-percha by a vertical compaction technique.

A dental-surveyor was used to ensure upright positioning of the teeth in molds which were filled with non-shrink epoxy resin material placing the margin below the cemento-enamel junction by 1mm and parallel to the epoxy resin. The crown portion of all premolars were removed to within 3 mm above the CEJ Mesio-Distally. Before the Two different preparation extensions of the endodontically treated premolars were done all the cavities resulting from the endodontic treatment were filled with composite material to ensure the standardization of the two preparation extensions done where they were executed by a Boxford 300VMCi (3D Vertical Machining Centre) using an endmill of 3 mm diameter to ensure that all depths and preparations were standardized Specimens were divided into three groups according to the type of preparation extensions done,**Group A** (4 mm extension into the pulp chamber), **Group B** (6 mm extension into the pulp chamber)

All prepared samples were scanned using a primescan desktop scanner. The endo-crowns were designed by a CAD software cerec 5.0.1 with different extensions according to the group category but with the same crown design for all the specimens. The final restorations were milled out of CAD CAM blocks (Enamic)

All samples were finished and polished according to manufacturer's instructions. The endo-crowns were first treated with Hydrophloric acid then Silane agent was added for 60 seconds Then finally cemented to the corresponding samples using dual cured resin cement using a loading machine to ensure the escape of all excess material. Finally all samples were subjected to static loading test using universal testing machine with speed 1mm/min to evaluate the fracture resistance.

RESULTS

There was a significant difference between samples regarding different depths of preparation extension ($p<0.001$). The highest value of fracture resistance was found in samples with 6 mm extension depth (1617.43±733.46) followed by samples with 4 mm depth (1422.21±659.89)

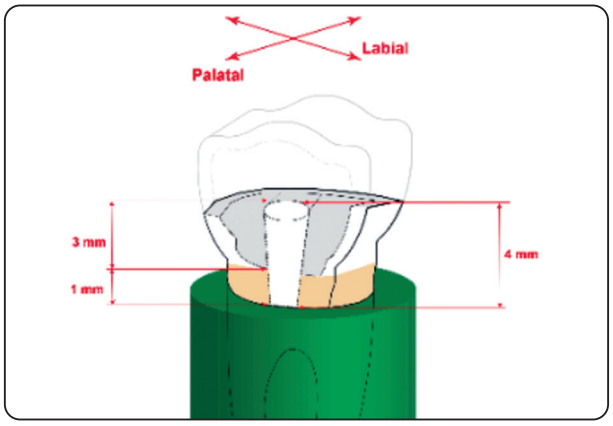

Fig. (1): Diagram showing 4 mm extension inside the pulp chamber

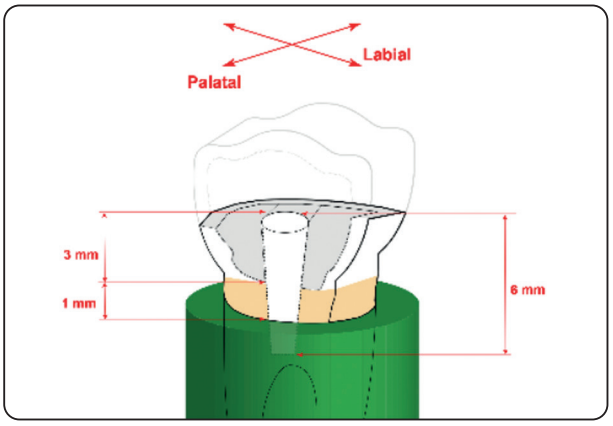

Fig. (2): Diagram showing 6 mm extension inside the pulp chamber

TABLE (1) Descriptive statistics for fracture resistance (N) for different groups

Material	Preparation extension	Mean	Std. Deviation	Median	Range
Vita Enamic	**4 mm**	595.71	26.84	600.00	80.00
	6 mm	815.71	26.37	820.00	70.00

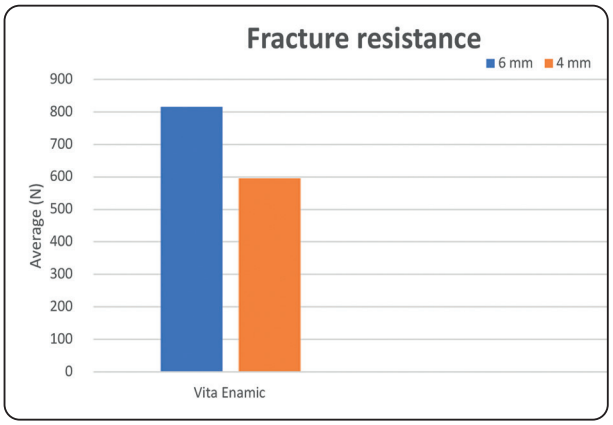

Fig. (3) Bar chart showing average fracture resistance (N) preparation extensions (A)

DISCUSSION

To use endocrowns in Premolars or not to use this is the dilemma that needs to be answered. The initial outcome of the experiment done by **Bindl et al.**[10] suggested endocrowns as a favorable and efficient method of treatment for crown rebuilding of molars and premolars.

Thus, the bases of our study was to investigate the biomechanical behavior of endodontically treated premolars restored with endocrowns with two different depths (2mm,6mm) and two different materials (Vita Suprinity, Vita Enamic).

Several studies reported dissimilar biomechanical behavior of different endocrown designs regarding altering pulpal extension depth[14-16] Posterior premolar-teeth were used on experiments that took place before[10,17] conducted poor performance of premolar-endocrowns when compared to molar-endocrowns in action of forces affecting occlusal areas and bond strength. This may have occurred due to the less surface area of the pulp chamber and using restoration material with weak bonding to the teeth.

Therefore, comparison of two different designs was one main concern in our study in addition to testing two different materials. There was a significant difference between samples with different depths of preparation extension were the highest value of fracture resistance regardless of the material used was found in samples with 6 mm extension depth while the lowest value was found in samples prepared with 2 mm extension depth regardless the type of the material.

This is explained because the main problem regarding the usage of endocrowns in premolars was the lack of enough surface area for bonding plus the concentration of forces on a small surface area in the pulp chamber, so when we increase the surface area of bonding and the contact between the endocrown and the tooth structure the fracture resistance increases which also means that there are more distribution of forces on the whole length of the tooth which eventually increases the fracture resistance of the restoration and the tooth.

Recently, Zirconia-reinforced lithium silicate (ZLS) glass ceramic blocks for CAD/CAM use have been launched aiming to improve optical and mechanical properties relative to previous glass-ceramics systems[18-21] Vita Suprinity showed a highly significant results regarding fracture resistance under centric loading than Vita Enamic in the two different depths (2mm,6mm) a zirconia reinforced lithium silicate glass ceramic (Vita Suprinity) for dental CAD/CAM usage for the construction of inlays, onlays, partial crowns, veneers, anterior and posterior crowns and anterior and posterior single tooth restorations on implant abutments has been introduced to the dental market.

Although Vita Suprinity showed significantly higher results than Vita Enamic but this doesn't mean that Vita Enamic can't be used as an endocrown material in premolars because simply Vita Enamic has a modulus of elasticity less than Vita Suprinity which mimics normal dentin therefore when the fracture occurred during the experiment Vita Enamic endocrowns were fractured saving the tooth, while the specimens restored with Vita Suprinity the tooth was fractured.[22]

Thus the dilemma that needs to be solved is the suitability of endocrowns to restore endotreated premolars .The primary results of a clinical trial conducted by Bindl et al.[10] suggested endocrowns as a promising and efficient treatment method for crown reconstruction of molars and premolars.

It seems reasonable to hypothesize that the deeper the pulp-cavity preparation for an endocrown and the deeper the resultant intra-radicular extension, the greater the surface area for adhesive retention and the better the transmission of masticatory forces to the root [23]

CONCLUSION

Bearing in mind the limitations of this study, the following conclusions were drawn:

- Endocrown is an appropriate treatment approach for restoration of endodontically treated premolar teeth, and premolar teeth properly restored with endocrowns aren't prone to fracture under normal masticatory forces.
- The endocrown pulpal extension influenced the stress distribution in endodontically treated premolars. Where extending the pulpal extension to 6 mm gave better results than 2mm
- Vita Enamic showed better mode of fracture where the tooth can be still restorable after the endocrown fracture due to similarity of modulus of elasticity between Vita Enamic and dentin.

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