EGYPTIAN DENTAL JOURNAL
www.eda-egypt.org
VOL. 70, 563:566, JANUARY, 2024
PRINT ISSN 0070-9484 • ONLINE ISSN 2090-2360
FIXED PROSTHODONTICS AND DENTAL MATERIALS
Submit Date : 04-12-2023 • Accept Date : 25-12-2023 • Available online: 10-01-2024 • DOI : 10.21608/EDJ.2023.251584.2807

EFFECT OF DIVERGENCE ANGLE AND INTRA-PULPAL DEPTH ON MARGINAL ADAPTATION OF ENDO-CROWNS (IN VITRO STUDY)

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ABSTRACT

Objectives: The aim of the study was to evaluate effect of divergence angle. (12º , 6º) and intra-pulpal Depth. (3mm, 5mm) on marginal adaptation and internal fit of premolar endo-crowns using intraoral scanner: 3Shape "Trios 4".

Materials & Methods: The preparation was done on a Four extracted endotreated premolars, preparations were done using Carbide Carburundom diamond Endmil. Premolars was divided into four groups, each group has different angel and different intra-pulpal depth. All the preparations were scanned with trios 4 intraoral scanner 7 times (n=7). All the samples were designed with Exo-cad software and milled using VHF Milling Machine. Marginal adaptation measurements were done using Dino-lite digital microscope.

Results: regarding divergence angle 6° had a significantly higher value than 12°, regarding intrapulpal depth 5 mm depth had a significantly higher value than 3 mm depth.

Conclusion: 12 degree divergence angle shows better marginal adaptation than 6 degree and 3 mm depth shows better marginal adaptation than 5 mm.

KEYWORDS: Retention, Cement Gap, Preparation Design , Replica Technique

INTRODUCTION

With the advancement of the digital dentistry over the last years, it becomes so important to evaluate all the computer aided design/computer aided manufacturing (CAD/CAM) devices. There have been a lot of intra-oral scanners launched to the market, and ever since, a large number of intraoral scanners have emerged with various scanning technologies in an effort to capture scans

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with a high degree of accuracy and resolution. The creation of a quicker and more accurate prosthetic solution became crucial due to the quickening speed of life, increasing awareness, rising aesthetic and functional demands, and high expectations from patients and dentists.

Endocrowns in natural premolars is considered a new alternative treatment for fully coverage crowns, Premolars has deeper pulpal depth than molars, So studying how intraoral scanners deal with this depth is challengeable. Premolars are smaller than molars mesiodistally & buccolingually considered to be a more conservative alternative to the traditional Crown that requires a greater amount of tooth preparation.

Fractures are more common in pulpless teeth than teeth with vital pulp, as endodontically treated teeth are more brittle due to loss of structural integrity associated with access preparation or caries, or due to decrease moisture content, planning to restore this teeth will be associated to remaining tooth structure and functional demands[1]. Several studies have indicated that the strength of the tooth is directly related to the remaining bulk of dentin[2].

The Endocrown firmly follow this rational: the preparation consists of a circular butt-joint margin and central retention cavity inside the pulp chamber and lacks intraradicular anchorage constructing both the crown and core as a single unit, i.e., a monoblock[3] .

MATERIALS AND METHODS

Four Natural Freshly Extracted premolars were Endodotically treated and prepared with two different Divergence angles (6 degrees, 12 degrees) and two different Intra pulpal Depths (3mm, 5mm by CNC Machine 3 axis working, Design done on master cram program and scanned on thunk3d digital laser beam scanner, Carbide Carburundom diamond Endmil.

Samples were divided into four groups according to the divergence angle and Intra-pulpal Depth:

- Group "6-3": Six Degrees Angle with 3 mm Depth.
- Group "6-5: Six Degrees Angle with 5 mm Depth.
- Group "12-3": Twelve Degrees Angle with 3 mm Depth.
- Group "12-5": Twelve Degrees Angle with 5 mm Depth.

Trios 4 was used, software version (v4.4.0.41651), The T12A variant supplied with a cart and built in PC. The cart was placed on a stable floor away from any sharp objects.

The 3D model file was imported into Exocad Alternatively, using exocad's built-in tools to create a virtual tooth model by selecting the appropriate tooth type, dimensions, and morphology.

Then S5 milling machine Was used to fabricate endocrowns.

Vertical marginal adaptation of all Endocrowns was evaluated using digital microscope (Figure 1)

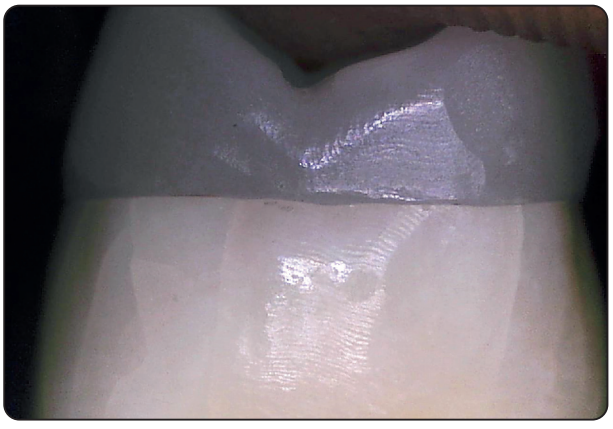

Fig. (1): Stereomicrograph.

Shots of the margins were taken for each endocrown using hand held digital microscope with a built in camera fitted on a precision microscopic stand connected to IBM compatible personal computer using a fixed magnification of 50X .

RESULTS

Statistical analysis

1- Effect of divergence angle on Marginal Adaptation 6° (68.65±19.68) had a significantly higher value than 12° (50.22±15.20) (p<0.001).

TABLE (1) Mean, Standard deviation (SD) values of marginal fit (μm) for different divergence angles.

Marginal fit (µm) (mean±SD)		p-value
6°	12°	
68.65±19.68	50.22±15.20	**<0.001***

**** : significant (p ≤ 0.05); ns: non-significant (p>0.05)***

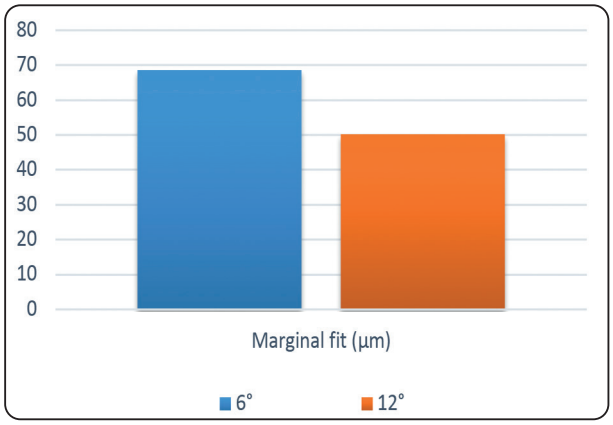

Fig. (2) Bar chart showing average marginal fit (μm) for different divergence angles.

Effect of intra-pulpal depth on Marginal Adaptation:

Samples with 5 mm depth (66.25±19.34) had a significantly higher value than 3 mm depth (52.62±18.00) (p<0.001).

TABLE (2) Mean, Standard deviation (SD) values of marginal fit (μm) for different intra-pulpal depths.

Marginal fit (µm) (mean±SD)		p-value
3 mm	5 mm	
52.62±18.00	66.25±19.34	**<0.001***

**** : significant (p ≤ 0.05); ns: non-significant (p>0.05)***

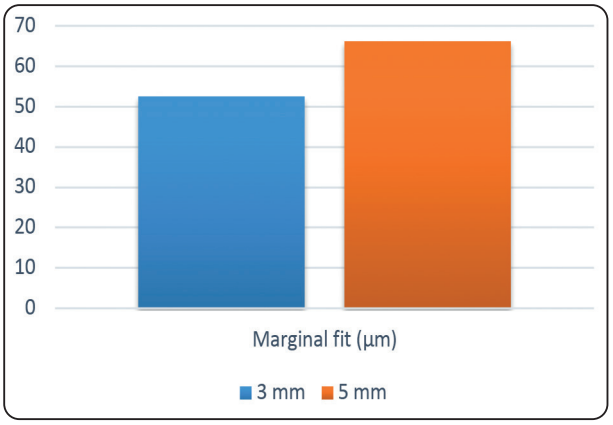

Fig. (3) Bar chart showing average marginal fit (μm) for different intra-pulpal depths.

DISCUSSION

Digitization in diagnosis and treatment has emerged as a significant trend in prosthodontics as a result of the application of electronic technology, digital technology, and advanced manufacturing technology in the field of dentistry[4].

Regarding the effect of Divergence angles and intra-pulpal depth on the marginal adaptation, the results showed significant difference in the marginal adaptation as a result of the change of the divergence angle and intra-pulpal depth. This might be due to the fact that though the more divergence angle the easier for seating and fitting of the restoration, the shallower in depth the easier for seating and fitting of restoration[5] .

This was opposite to Ji-Man Park et al in 2019[6]. Since they reported that intra-coronal preparation depth had no significant effect on the accuracy of the intra-oral scanners.

This was in agreement with Hegazi et al., [7]. Whose results showed that post preparation depth had significant effect on the accuracy of the intraoral scanners.

This was in partially agreement with Mohammadreza Hajimahmoudi, in (2023)[8]. Since they reported that there was statistically significant difference was shown among the tested groups

at 10 degrees of taper. At 5 degrees of taper, the difference was insignificant. This may be due to these experiment was made on Molars with large and wide cavity chamber counter to premolars with have narrow pulp chamber[9], So any tapering will be effective.

CONCLUSION

Within the limitation of our study the following conclusion should be drawn: 12 degree shows better marginal adap. than 6 degree, 3 mm depth shows better marginal adaptation than 5 mm.

REFERENCES

1. A. Alharbi, F.Nathanson, D.Morgano, Baba N. Fracture resistance and failure mode of fatigued endodontically treated teeth restored with fiber-reinforced resin posts and metallic posts in vitro. Dental Traumatology 2015; 30: 317-325.
2. Faria A, Rodrigue R, de Almeida Antunes R, de Mattos M, Ribeiro R. Endodontically treated teeth characteristics and considerations to restore them. J of prosthodontics 2011; 55: 69-74.
3. Bindl, A. and Mormann, W.H. Clinical evaluation of adhesively placed Cerec endo-crowns after 2 years-preliminary results. J of Adhesive Dentistry 1999; 1: 255-266.
4. Güth JF, Edelhoff D, Schweiger J, et al. A new method for the evaluation of the accuracy of full-arch digital impressions in vitro. Clin Oral Investig 2016;20:1487–94. https://doi.org/10.1007/s00784-015-1626-x.
5. Mostafavi AS, Allahyari S, Niakan S, Atri F. Effect of Preparation Design on Marginal Integrity and Fracture Resistance of Endocrowns: A Systematic Review. Front Dent. 2022 Nov 27;19:37. doi: 10.18502/fid.v19i37.11250. PMID: 36873612; PMCID: PMC9975774.
6. Park JM, Kim RJY, Lee KW. Comparative reproducibility analysis of 6 intraoral scanners used on complex intracoronal preparations. J Prosthet Dent 2020;123:113–20. https://doi.org/10.1016/j.prosdent.2018.10.025.
7. Ahmed A. Hegazi, Maged M. Zohdy, Tarek S. Morsi. Effect of Two Post Space Depths on the Accuracy of the Scan. Mansoura Journal of Dentistry, 2022; 9(1): 27-31. doi: 10.21608/mjd.2022.226774.
8. Hajimahmoudi M, Raseipour S, Mroue M, Ghodsi S. Evaluation of Marginal and Internal Fit of CAD/CAM Endocrowns with Different Cavity Tapers. Int J Prosthodont. 2023 May;36(2):189-193. doi: 10.11607/ijp.6877. Epub 2023 May 24. PMID: 33625391.
9. Pissis P. Fabrication of a metalfree ceramic restoration utilizing the monobloc technique. Pract Periodontics Aesthet Dent, 1995; 7: 83-94.
10. Bindl A, Mormann WH. Clinical evaluation of adhesively placed Cere endocrowns after 2 years-preliminary results. J Adhes Dent, 1999; 1: 255-62.
11. Lise, D. P., Van Ende, A., De Munck, J., Suzuki, T. Y. U., Vieira, L. C. C., Van Meerbeek, B. Biomechanical behavior of endodontically treated premolars using different preparation designs and CAD/CAM materials. J Dent. 2017; 59: 54-61.
12. Chaudhary S, Rathod AA, Yadav P, Talwar S, Verma M. Restorative management of grossly mutilated molar teeth using endocrown: A novel concept. J Res Dent 2016; 4: 97-100. 13.
13. Valentina V, Aleksandar T, Dejan L, Vojkan L. Restoring endodontically treated teeth with all-ceramic endo-crowns-case report. Serbian Dent J, 2008; 5: 54-64.
14. Lander E and Dietschi D: Endocrowns: a clinical report. Quintessence Int 2008; 39: 99106.
15. Magne P, Carvalho AO, Bruzi G: Influence of no-ferrule and no-post buildup design on the fatigue resistance of endodontically treated molars restored with resin nanoceramic CAD/CAM crowns. Oper Dent 2014; 39: 595-602.
16. Forberger N, G¨ohring TN: Influence of the type of post and core on in vitro marginal continuity, fracture resistance, and fracture mode of lithia disilicate-based all-ceramic crowns. J Prosthet Dent 2008; 100: 264-73.
17. Shin Y, Park S,Park JW, Kim KM,Park YB and Roh BD. Evaluation of the marginal and internal discrepancies of CADCAM endocrowns with different cavity depths: An in vitro study. J Prosthet Dent 2017; 117: 109-15.
18. Gaintantzopoulou M D and ElDamanhoury HM. Effect of Preparation Depth on the Marginal and Internal Adaptation of Computer-aided Design/Computer-assisted Manufacture Endocrowns. Oper Dent 2016; 41: 607-16.
19. Dalloul R, Abou Nassar J and AlHouri N. A Comparative Study of Marginal Fit between IPS e.max Press Crown and Endocrown after Cementation (In Vitro). Clin Med Diagn J 2016; 6: 122-25.