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THE EFFECT OF RESTORATION OF ENDODONTICALLY TREATED TEETH WITH DIFFERENT RESTORATIONS IN BOTH MODERN AND TRADITIONAL ACCESS CAVITY PREPARATIONS

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ABSTRACT

Restoration of endodontically treated teeth represents a great challenge to the dentist due to several limiting and undermining factors that affect the quality of the final restoration.

Aim: This study aimed to compare two different endodontic access preparations concepts– traditional vs modern caries driven access cavity preparation- and their effect on the final restoration of the endodontically treated teeth taking in consideration the material of final restoration, regarding the effect of the access design and the afterwards restoration design and material effect on the fracture resistance of the restoration.

Methodology: a total number of 120 human permanent molars were used in this study (in-vitro), all were divided into 2 main groups –60 molar each- classified according to the design of the endodontic access cavity performed in the molars of the first group which were accessed through traditional design of access cavity with subsequent root canal treatment for the teeth. While the second group was accessed through a modern access cavity design called caries/restoration driven access cavity, in which the access was guided by caries where less natural tooth structure is removed. Each group was then restored with a different type of restoration, and all were subject to testing for fracture resistance.

Results: Less invasive endodontic therapy seeks to improve traditional endodontic treatment by establishing a highly accurate access cavity (AC) that will subsequently results in increased strength of the endodontically treated tooth through preserving more natural tooth structure and less restoration margins exposed to the occlusal stresses.

Conclusion: The involvement in functional activity could be kept promoting fracture resistance. Endodontic new ACs were recently created to decrease tooth structure loss. With the introduction of microscopes and enhanced root canal equipment, the preparation of the conservative access opening has evolved to a new level. The conservation of the cervical dentin is a particularly significant element in sustaining the normal function and durability of the restored tooth. So, this study has shown that minimally invasive endodontics can be considered a challenge to the standard approach.

KEYWORDS: Conventional access cavity, modern access cavity, root canal treatment, fracture resistance, Lithium Disilicate Endo-Crown, 3D printed resin restorations, milled resin restorations.

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INTRODUCTION

The loss of tooth structure is one of the most prevalent causes of fractures in endodontically treated teeth. The second most common cause of tooth structure loss was observed to be the preparation of the endodontic access cavity according to traditional endodontic cavity principles. As a result, an optimal and limited endodontic access design may improve the prognosis of root canal treated teeth. [1]

Trials utilizing more conservative designs for access cavity, such as the caries driven AC, have shown the ability to increase the fracture resistance of endodontically treated teeth and reduce the need for complex, higher-priced post endodontic restorations. [2]

The caries driven AC technique is a type of Conservative Endodontic Access Cavity (CEC)). Its purpose is to save the maximum possible amount of natural tooth structure without compromising the quality of endodontic treatment. [3]

In conservative access cavity with a caries-driven access, all residual dental structures are retained while caries is eliminated. This includes the soft structure, which could be characterized as the base of an architectural feature. [4]

Conservative access maintains tooth structure while enabling a quick and safe procedure, making it a viable choice for root canal therapy. [5]

Endodontically treated teeth have a lower long-term survival percentage than non-endodontically treated teeth, which leads to reduced breakage resistance. [6]

Several clinical studies have therefore brought attention to the fact that root canal therapy is an identifiable cause for tooth fracture brought on by a decrease or loss in natural tooth structure. [7]

By employing simulated functional stresses until fracture occurs, the universal testing machine was used to assess the resistance of teeth to fracture. The load at fracture, the loading point, the force, and the direction were all adjusted. [8]

Teeth that have had endodontic treatment usually need a final restoration to maintain appearance and functionality, safeguard remaining tooth structure, and prohibit microleakage. [9]

Due to quick advancements in adhesive technology along with more powerful adhesive materials, it is now possible to fabricate Conservative, very aesthetic restorations that are bonded precisely to the dental structure and reinforce it. [10]

Modern therapeutic concepts encourage a minimally prepared technique for endodontic treatment that preserves as much of the tooth structure as is possible yet preserves the quality of the endodontic treatment to increase the fracture resistance of endodontically treated teeth. [11]

But compared to other access methods, conventional access has been demonstrated to have a higher percentage of irreparable tooth fractures, that appear to be connected to more coronal tooth structural loss. [12]

Endodontic therapy aims to completely remove any diseased tissue from the root canal and clean it out to shape and prepare the canal space for filling with an inactive material, lowering or preventing the risk of a second infection. [13] Accidents happen when endodontic therapy comes short of traditional clinical guidelines. It has been established that several factors contribute to endodontic treatment failures, So the quality of the endodontic therapy is unnegotiable. [14]

Since the modern caries driven access cavity may provide limited access, however, instruments that are cracked could be the result of failing to follow the instructions for using rotary instruments or the AC preparation guidelines. [15]

The outcome of endodontic therapy is affected by several variables, and microbial infection is one of the most frequent causes of endodontic failure.[16] So, the final restoration of the endodontically treated

teeth is crucial as coronal ACs can permit leaking to the root canal system. Therefore, how properly a tooth has been sealed on the coronal side is as crucial as the caliber of the endodontic therapy. [17]

To avoid coronal leakage following root canal therapy, teeth that have had endodontic treatment should be repaired as soon as possible. [18]

Multiple restorative options are available, and they can be direct or indirect restorations and can be fabricated from various materials with specific properties that can reinforce the endodontically treated teeth for different extents.

However, when it comes to restoring an endodontically treated teeth, the choice of restoration should be made wisely to ensure the desired outcome of the restoration and achieve patient satisfaction. [19]

MATERIALS AND METHODS

This study was conducted as an in- vitro study in which a total number of 120 extracted human molars were compared regarding the fracture resistance of the final restoration according to two different factors.

The first is the design of access cavity made for the root canal treatment procedures, the used designs were traditional endodontic cavity (TEC) and the second is conservative endodontic cavity (CEC) called caries driven access cavity.

The second is the restoration type where three different restorations used lithium Disilicate 3D printed composite mild the composite.

First the 120 teeth were divided into two groups of 60 each.

Group I: was prepared using traditional access cavity preparation,

Group II: was prepared using caries driven endodontic access where teeth selected contain medium sized carious lesions involving only one or two walls.

After the access cavity was done conventional root canal treatment of the teeth was done with conventional steps of cleaning and shaping and obturation using gutta percha.

After root canal treatment, each group of teeth were restored with a coronal final restoration, and the teeth were further subdivided into 3 sub-groups.

Sub-Group I A: teeth were restored with lithium disilicate Endo-crown.(Emax : Ivoclar Vivadent)

Sub-Group I B: teeth were restored with indirect 3D printed Endo-crown restoration.(Savoy Resin for # d printing using Bredent # D printer)

Sub-Group I C: teeth restored with milled Endo-crown restoration. (BreCAM HIPC Disks- Bredent)

The second main group which consisted of 60 molars accessed through caries driven access cavity and furtherly divided into 3 subgroups.

Sub-Group II A: teeth were restored with lithium disilicate Inlay restoration. .(Emax : Ivoclar Vivadent)

Sub-Group II B: teeth were restored with indirect 3D printed Composite Inlay restoration. (Savoy Resin for # d printing using Bredent # D printer)

Sub-Group II C: teeth restored with milled Composite Inlay restoration. (BreCAM HIPC Disks- Bredent)

Each group were then tested for fracture resistance using controlled equal loading force, direction, and magnitude on all the study groups.

The data were analyzed using regression analysis to analyze more than two groups with unequal variances at a 5% significance level.

Group I A was considered the gold standard for this study (with traditional access cavity restored with Lithium Disilicate Endo-crown statistical analysis was done using excel regression analysis with more than two groups with unequal variance. The comparison was done on two levels level one intergroup analysis where we compared the gold

standard group 1A traditional and Endodontic access and the Endo-Crown preparation restored with lithium disilicate compared with group II with modern Endodontic Caries driven access restored with three different restorations. Another level of comparison was intra-group analysis where within each group cavity design the different materials were tested.

RESULTS

Inter-Group Comparison

The highest value recorded was Group IIA with mean 1604 ± 42.5 followed by Group I A with mean 1594 C 68.8 followed by Group II C 1577±34.2 followed by Group II B 1567±21.8. There was no statistically significant difference among tested groups.

Intra-Group II Comparison

The highest value recorded was Group IIA with mean 1604 ± 42.5 followed by Group II C 1577± 34.2 while the lowest value recorded by Group II B 1567 ± 21.8. There was no statistically significant difference among tested groups

Intra-Group I Comparison

The highest value recorded was Group I A with mean 1594 C 68.8 followed by Group I C 785.9± 19.4 with the lowest value was Group I B 550.1 ± 11.7. There was statistically significant difference between Group I A and both groups while there was no statistically significant difference between group II b and C .

ANOVA

	df	*5S*	*MS*	*F*	*Siqnificance F*
Regression	3	16267.58025	5422.527	2.78E+30	8.18565 E -91
Residual	8	4.68905E-26	5.86E-27		
Total	11	16267.58025			

Coefficients		*Standard Error*	*t Stat*	*P-value*	*Lower* 95%	*Upper 95%ower 95.0"} lpper 95.0%*		
Intercept	-10.5007	9.63648E-13	-1.1E+13	5.6E-l02	-10.5007	-10.5007	-10.5007	-10.5007
Group II C	0	0	65535	#NUM!		0 0	0	0
Group II A	1	6.00255E-16	1.67E+15	#NUM!		1 1	1	1
Group II B	0	0	65535	#NUM!		0 0	0	0

NOVA

dj		*55*	*MS*	*F*	*Significance F*
tegression	2	16267.58025	8133.79	2.78E+30	2.2287E-105
tesidual	81	4.67506E-26	5.84E-27		
"otal	10	16267.58025			

	Coefficients	*Standard Error*	t *Stat*	*P-value*	*Lower* 95%	*Upper 95%ower 95.0~/pper 95.0%*		
Intercept	28.13352	9.45353E-13	2.98E+13	1.8E-l05	28.13352	28.13352	28.13352	28.13352
Group II C	a	a	65535	#NUM!	a	a	a	a
Group II B	1	5.99359E-16	1.67E+15	#NUM!	1	1	1	1

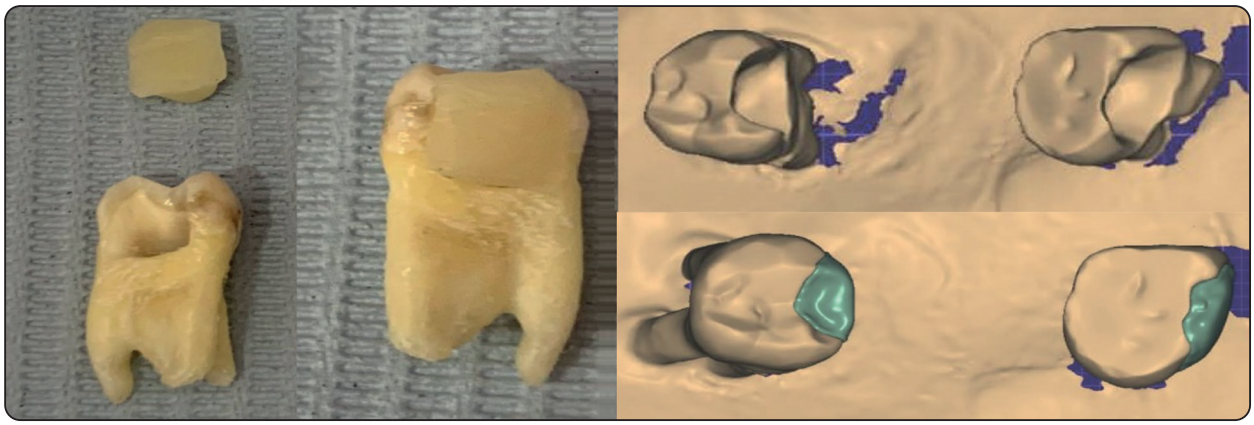

Fig. (1) Group II Caries Driven Acess

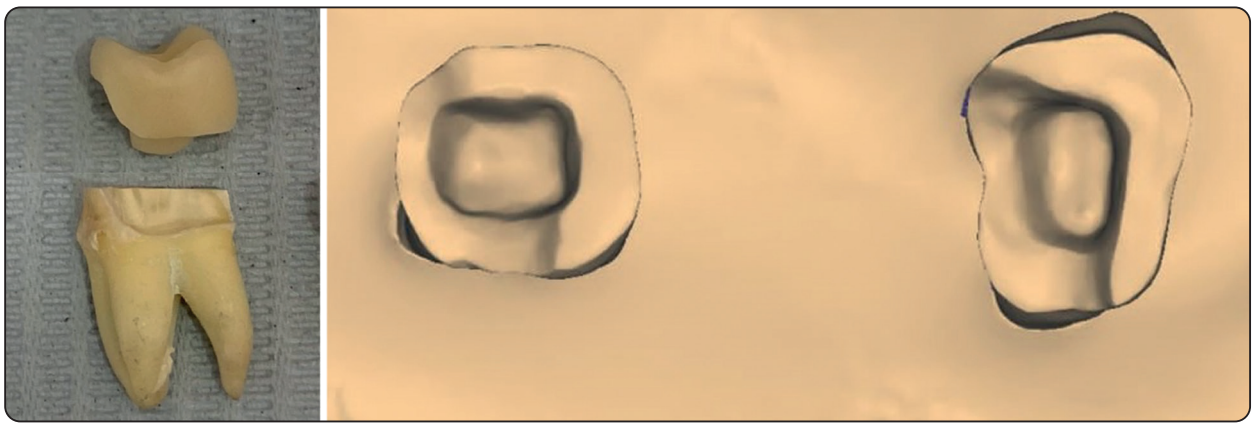

Fig. (2) Group I Traditional Access and Endo-Crown Preparation

Fig. (3) Fracture Resistance testing using

DISCUSSION

Traditional access cavity was always representing the most suitable design of access to achieve the proper access to all the canals. [20, 21]

However, with recent technologies it becomes easier to access the canals with minimized amount of lost tooth structure. [22]

The conservative access cavities represent better cavities for restorations either direct or indirect due to less exposed margins to the occlusal stresses and smaller surface area. Restorations used for the conservative access showed better fracture resistance. Conservative access cavity proved to be less invasive for the remaining tooth structure but required proper and careful access to the canals to avoid any possible mishaps. [23, 24]

The amount of remaining hard tooth structure appeared to be directly related to the fracture resistance of the endodontically treated teeth, where the higher the amount of remaining tooth structure the greater the fracture resistance. The fracture resistance of a tooth and the way the restoration must be preserved depend on how much of the original tooth remains. Therefore, the likelihood of a positive outcome will be improved by preserving as much tooth tissue as feasible. [25]

In the intergroup comparison, the highest value was shown in the conservative access restored with lithium disilicate group IIA followed by traditional access restored with lithium disilicate followed by conservative access restored milled composite and finally conservative access restored by 3D printed composite. This proves that the conservation of endodontic access cavity preparation has increased the fracture resistance of the weaker materials to be non-statistically significant than the higher strength materials by preservation of the material of the tooth structure.

This can also be seen in intra group II comparison, where there was no statistically significant difference between tested groups as most of the tested specimen was composed of tooth structure. Therefore, the effect of material strength was not statistically significant between groups and the fracture resistance main role was played by the remaining tooth structure. These findings were consistent with previous studies that proved that dentin protection is achieved by reducing the cavity size which consequently increases tooth break resistance. [26, 27]

On the other hand, in intra Group I comparison, the effect of material strengths was significantly shown due to significant amount of loss of tooth structure by the traditional access cavity preparation and traditional Endo-Crown preparation which showed that lithium disilicate is almost double the strength of composite milled and triple the strengths of 3D printed composite. The result coincides with other studies that show lower fracture resistance of endodontically treated teeth following traditional access cavity preparation regardless the type of restoration material used. [28]

CONCLUSION

The conservative access cavities can be used to increase the amount of the remaining tooth structure thus increasing the fracture resistance of the restored endodontically treated teeth.

Traditional access shows less fracture resistance because of the increased removal of the remaining tooth structure that causes more weakening of the endodontically treated teeth.

The strength of teeth is significantly reduced because of endodontic procedures, particularly during the extensive preparation of endodontic access cavities.

Furthermore, the amount of residual cavity walls affects the strength to fracture, and the removal of hard tissue enhances cusp flexure under occlusal force.

Consequently, a precise and minimal endodontic access design could enhance the prognosis for a tooth that has had endodontic treatment.

Recommendations

In modern endodontic access the indirect composite showed superior result and proved to be a practical economic restoration for endodontically treated teeth, but more testing is needed to be done on those specimens on other mechanical properties such as marginal adaptation.

REFERENCES

1. Özyürek T, Ülker Ö, Demiryürek EÖ, Yılmaz F. The effects of endodontic access cavity preparation design on the fracture strength of endodontically treated teeth: traditional versus conservative preparation. Journal of endodontics. 2018 May 1;44(5):800-5.
2. Mandil OA, Ghoulah KT, Hazzam BM, Alhijji HS, Al Abbas AH, Rehan AK, Doumani M, Mandil AA. Modern

versus traditional endodontic access cavity designs. Journal of Pharmacy & Bioallied Sciences. 2022 Jul;14 (Suppl 1):S24.

3. Vats S, Mishra P, Nikhil V. Modern access cavity concept: a review. International Journal of Research and Review. 2021;8(2):450-3.
4. Morgano SM, Rodrigues AH, Sabrosa CE. Restoration of endodontically treated teeth. Dental Clinics. 2004 Apr 1;48(2):397-416.
5. Robbins JW. Guidelines for the restoration of endodontically treated teeth. The Journal of the American Dental Association. 1990 May 1;120(5):558-66.
6. Dimitriu B. Current opinions concerning the restoration of endodontically treated teeth: basic principles. Journal of medicine and life. 2009 Apr;2(2):165-72.
7. Assif D, Gorfil C. Biomechanical considerations in restoring endodontically treated teeth. The Journal of prosthetic dentistry. 1994 ;71(6):565-7.
8. Sengun A, Cobankara FK, Orucoglu H. Effect of a new restoration technique on fracture resistance of endodontically treated teeth. Dental Traumatology. 2008 Apr;24(2):214-9.
9. Borén DL, Jonasson P, Kvist T. Long-term survival of endodontically treated teeth at a public dental specialist clinic. Journal of endodontics. 2015 Feb 1;41(2):176-81.
10. Aquilino SA, Caplan DJ. Relationship between crown placement and the survival of endodontically treated teeth. The Journal of prosthetic dentistry. 2002 Mar 1;87(3):256-63.
11. Tang W, Wu Y, Smales RJ. Identifying and reducing risks for potential fractures in endodontically treated teeth. Journal of endodontics. 2010 Apr 1;36(4):609-17.
12. Trope M, Maltz DO, Tronstad L. Resistance to fracture of restored endodontically treated teeth. Dental Traumatology. 1985 Jun;1(3):108-11.
13. Corsentino G, Pedullà E, Castelli L, Liguori M, Spicciarelli V, Martignoni M, Ferrari M, Grandini S. Influence of access cavity preparation and remaining tooth substance on fracture strength of endodontically treated teeth. Journal of endodontics. 2018 Sep 1;44(9):1416-21.
14. Tribst JP, Dal Piva AM, Madruga CF, Valera MC, Borges AL, Bresciani E, de Melo RM. Endocrown restorations: Influence of dental remnant and restorative material on stress distribution. Dental Materials. 2018 Oct 1;34(10):1466-73.
15. Kanat-Ertürk B, Saridağ S, Köseler E, Helvacioğlu-Yiğit D, Avcu E, Yildiran-Avcu Y. Fracture strengths of endocrown restorations fabricated with different preparation depths and CAD/CAM materials. Dental materials journal. 2018 Mar 26;37(2):256-65.
16. Biacchi GR, Mello B, Basting RT. The endocrown: an alternative approach for restoring extensively damaged molars. Journal of Esthetic and Restorative Dentistry. 2013 Dec;25(6):383-90.
17. Scotti CK, Velo MM, Rizzante FA, de Lima Nascimento TR, Mondelli RF, Bombonatti JF. Physical and surface properties of a 3D-printed composite resin for a digital workflow. The Journal of Prosthetic Dentistry. 2020 Nov 1;124(5):614-e1.
18. Beuer F, Schweiger J, Edelhoff D. Digital dentistry: an overview of recent developments for CAD/CAM generated restorations. British dental journal. 2008 May 10;204(9):505-11.
19. Awada A, Nathanson D. Mechanical properties of resin-ceramic CAD/CAM restorative materials. The Journal of prosthetic dentistry. 2015 Oct 1;114(4):587-93.
20. Sarvaiya UP, Rudagi K, Joseph J. A comparative evaluation of the effect of different access cavity designs on root canal instrumentation efficacy and resistance to fracture assessed on maxillary central incisors: An in vitro study. J Conserv Dent. 2020;23:609–14.
21. 12. Patel S, Rhodes J. A practical guide to endodontic access cavity preparation in molar teeth. Br Dent J. 2007;203:133–40.
22. 8. Saeed M, Al-Obadi M, Salim A, Alsawaf AY, Hadi K. Impact of access cavity design on fracture resistance of endodontically treated molars: A systematic review. Clin Cosmet Investig Dent. 2021;13:1–10
23. 12. Modern molar endodontic access and directed dentin conservation. Clark D, Khademi J. Dent Clin North Am. 2010;54:249–273.
24. 13. Case studies in modern molar endodontic access and directed dentin conservation. Clark D, Khademi JA. Dent Clin North Am. 2010;54:275–289.
25. The effects of endodontic access cavity preparation design on the fracture strength of endodontically treated teeth: traditional versus conservative preparation. [Nov; 2021];Özyürek T, Ülker Ö, Demiryürek EÖ, et al. J Endod. 2018 44:800–805.

26. An ex vivo study of the effects of retained coronal dentine on the strength of teeth restored with composite core and different post and core systems. Al-Omiri MK, Al-Wahadni AM. Int Endod J. 2006;39:890–899.

27. Patil, P., Newase, P., Pawar, S., Gosai, H., Shah, D., & Parhad, S. M. Comparison of fracture resistance of endodontically treated teeth with traditional endodontic access cavity, conservative endodontic access cavity, truss endodontic access cavity, and ninja endodontic access cavity designs: An in vitro study. 2022 Aug; 14(8).

28. l incisors restored with different posts and cores. Rezaei Dastjerdi M, Amirian Chaijan K, Tavanafar S. Restor Dent Endod. 2015;40:229–235.